



Self-reinforcing barriers to municipal digital government: A system dynamics perspective

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ABSTRACT

Municipal governments have invested substantially in digital government endeavors, yet progress in public sector digital transformation remains surprisingly slow. Although research has repeatedly identified, categorized and reclassified barriers while also proposing numerous strategies to address them, the same obstacles continue to reappear across ongoing digitalization efforts. This persistence suggests that existing knowledge about barriers and their remedies remains insufficient. To address this gap, this study adopts a systemic perspective to explain why the barriers to municipal digital government persist, even after being repeatedly identified and targeted. We conducted 56 semi-structured interviews with 67 municipal employees and employees of GovTech providers in Germany and analyzed them through an inductive multi-stage coding process. Using system dynamics principles, we reconstruct the shared mental model through which actors perceive, explain and interlink barriers into a causal map. The resulting model reveals a dense web of interdependencies among barriers that form extended causal chains and self-reinforcing feedback loops. This perspective provides a dynamic and system-level explanation of persistence that reconceptualizes barriers not as discrete factors, but as generative mechanisms that sustain digital stagnation through their mutual reinforcement.

1. Introduction

Over the last decade, national and municipal governments have launched strategies, reformed legal frameworks and invested in digital infrastructure to modernize public services and improve administrative performance (UNDPEPA, 2001). Digital technologies have been positioned as enablers of transparency, efficiency and citizen-centric service delivery (Dunleavy et al., 2006). Although early studies reported high expectations among public employees (West, 2005), the digital transformation in public administration has progressed slowly since the beginning (Meijer, 2015) and continues to do so (Kempeneer & Heylen, 2023).

This persistent gap between ambitions and actual progress has given rise to a large and growing body of literature that identifies extensive lists of barriers to digital government and clusters them into typologies that group individual obstacles under higher-level categories (Ashaye & Irani, 2019; Jakob & Krcmar, 2018; Lam, 2005; Meijer, 2015; Schedler et al., 2019; van Veenstra et al., 2011; Wilson & Mergel, 2022). Most commonly, these typologies distinguish between structural factors such as legal constraints, limited financial and human resources on the one hand and cultural factors such as resistance to change, risk aversion or deeply embedded bureaucratic norms, on the other (Meijer, 2015; Tangi et al., 2020; Wilson & Mergel, 2022). The corresponding barriers

are well documented, have been recategorized multiple times and are frequently accompanied by strategic recommendations for overcoming them (Eynon & Dutton, 2007; Gil-García & Pardo, 2005; Meijer, 2015; Tangi et al., 2020; Wilson & Mergel, 2022).

However, with each new digital government endeavor, similar barriers and recommended strategies tend to resurface (Kempeneer & Heylen, 2023). Combined with the considerable gap between high public-sector investments and modest adoption rates, also known as the e-government paradox (Savoldelli et al., 2014), this suggests that existing knowledge about the barriers to digital government remains insufficient to explain their persistence. In 2011, van Veenstra et al. (2011) demonstrated that barriers are interrelated and emphasized the need for a holistic approach, arguing that overcoming one barrier may be a precondition for addressing another. Subsequent studies have focused on where to intervene so that addressing one barrier also helps overcome others, but this literature remains at times contradictory. For example, some studies argue that addressing structural conditions will naturally enable cultural change (Borman & Janssen, 2013; Tangi et al., 2020), while others claim that cultural transformation must precede any meaningful structural reform (Ashaye & Irani, 2019; Meijer, 2015; Weerakkody et al., 2021). This indicates the complexity of the underlying causal barrier structure, and reflects the uncertainty about where to

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intervene, and why barriers persist despite being repeatedly identified and targeted.

Taken together, the literature provides extensive knowledge about what barriers to digital government exist, but it remains insufficiently clear how these barriers are interrelated, how they may reinforce one another, and how these interdependencies contribute to their persistence. This lack of understanding creates a risk that existing strategies primarily address observable symptoms rather than the underlying mechanisms that contribute to the persistence of barriers.

While the most recent United Nations E-Government Survey reports a general upward trend in digital government development worldwide, it also highlights that progress at the municipal level consistently lags behind that of national governments (United Nations, 2024). This makes the municipal level a particularly relevant context for examining the persistence of barriers to digital government. This leads us to the following research question:

RQ: Why do identified barriers to municipal digital government persist?

To answer this question, we analyze how barriers are explained and grounded in empirical cause-and-effect beliefs. We adopt the core assumption of system dynamics that systemic problems are rarely solved by isolated interventions and that understanding the causal complexity of challenges is key to breaking persistent patterns of failure (Stermann, 2002). Addressing the observable symptoms of a systemic problem may offer short-term relief, but might even exacerbate the underlying causes over time, ultimately reinforcing the barriers they were meant to resolve and making future change increasingly difficult (Stroh, 2015). This perspective allows us to understand how organizational, cognitive, and institutional components interact to entangle barriers.

We conducted 56 semi-structured interviews with 67 employees working in and with the public sector, focusing on municipal administration across Germany. Rather than relying on predefined barrier typologies, we intentionally used an inductive approach to trace how interviewees themselves reason about barriers, articulate explanations, and narrate their believed causal relations that explain the barriers. We find chains of explanation in which barriers mutually reinforce one another and form perceived self-reinforcing cycles.

These results contribute to the digital government literature by reconceptualizing barriers as generative mechanisms rather than discrete factors. This perspective offers a dynamic explanation for the persistence of well-known barriers. It shifts the focus from isolated obstacles to the underlying dynamics that sustain stagnation. We move beyond the debate over structural versus cultural change by showing that both domains continuously influence and amplify one another. Practically, our model helps practitioners trace a specific barrier back to its likely antecedents within these reinforcing dynamics and to position their particular municipality within a causal map of barrier relationships. This offers a more accurate basis for understanding why digitalization efforts stall, and where future strategies might target underlying systemic interdependencies rather than focusing only on visible symptoms.

The remainder of this paper is structured as follows. The next section reviews the literature on digital government and research on barriers to digital government. We then present our qualitative research design, outlining the data collection and analytical process. The findings section reconstructs the identified chains and cycles of explanation derived from the interview data. We then introduce a causal-loop model that explains the persistence of transformation barriers before we conclude by discussing implications for theory, practice and future research.

2. Related work

We divide our review of related work into two broader themes: The general efforts to digitalize government and the barriers that have emerged in this process.

2.1. Towards a digital government

Over the past decades, the modernization of public administration through digital technologies has been pursued under a shifting landscape of conceptual labels. Terms such as digitization, digitalization and digital transformation, borrowed from the private sector discourse (Mergel et al., 2019), have entered the public domain, with the latter progressively reinterpreted and relabeled many times, including as e-government (West, 2005), the virtual state (Fountain, 2001), digital-era governance (Dunleavy et al., 2006), t-government (Weerakkody & Dhillon, 2008) and smart government (Schedler et al., 2019). We follow recent scholarly usage (Wilson & Mergel, 2022) and adopt the umbrella term digital government to collectively describe the digital transformation of the public sector (Janowski, 2015). While digitization describes the shift from analog to digital by replicating services through digital channels, digitalization refers to changes in processes enabled by technology, and digital transformation captures the broader cultural organizational and relational changes that emerge from digital change (Mergel et al., 2019). For the private sector, digital transformation means restructuring business models in response to market competition and customer needs through the use of new technologies and the development of new markets and opportunities (Berman, 2012). In contrast, digital government must align such efforts with legal mandates, political accountability, and institutional norms (Fountain, 2001). It aims to enhance service efficiency and address citizen needs by providing a more efficient, citizen-oriented, and responsive public sector (West, 2005). Within the scope of this overarching vision, numerous thematic and operational initiatives have emerged over time. Foundational ideas were articulated as early as the 1990s and 2000s, including integrated one-stop portals for public services and governmental information, the principle of “ask once” for administrative data reuse, proactive service delivery based on predictive data, transparency around the use of personal data, citizen co-production in policymaking, and agile organizational structures to enhance responsiveness (Dunleavy et al., 2006). These initiatives were met with high expectations from the beginning. A 2004 national survey of U.S. public employees showed that 83 percent anticipated a positive impact from their implementation (West, 2005).

Despite the considerable passage of time, many foundational ambitions remain unfulfilled and continue to shape both research and ongoing practical efforts (Kempeneer & Heylen, 2023). Even with technological advancements, digital government initiatives and scholarly debates often remain anchored in earlier reform paradigms, with recent contributions refining long-standing concepts rather than superseding them: intelligent one-stop portals enhanced with conversational agents (Larsen & Følstad, 2024), algorithmic decision-making systems (Souza et al., 2019), government technology (GovTech) ecosystems linking public organizations to external innovators (Bharosa, 2022) and the increasing institutionalization of data-driven governance and performance measurement (van Donge et al., 2022), to name a few.

2.2. Barriers to the envisioned digital government

Many empirical studies have examined the barriers that hinder the further and faster advancement of digital government (Kempeneer & Heylen, 2023). Although definitions vary, a frequently cited characterization describes barriers as “characteristics, either real or perceived, of legal, social, technological or institutional contexts which work against developing e-governance” (Eynon & Dutton, 2007, p. 39). Barrier research has evolved into a dedicated subfield, drawing on various theoretical innovation traditions including innovation resistance theory (Ram & Sheth, 1989) and diffusion of innovation (Rogers, 2010). Unlike success-oriented models such as the Technology Acceptance Model (Davis, 1989) or Government Adoption Models (Shareef et al., 2011), which emphasize enabling conditions and predictors of technology

uptake, this literature stream focuses on understanding why and how innovations fail and what kinds of barriers exist.

To cope with the complexity and breadth of findings, scholars have proposed various typologies to classify the large number of barriers identified. For example, an early empirical interview study in this field grouped 17 empirically derived barriers into four dimensions: “Strategy”, “Technology”, “Policy”, and “Organization” (Lam, 2005). Another study conducted a review of the literature and classified 20 barriers into five categories: “Information and data”, “Information technology”, “Organizational and managerial”, “Legal and regulatory”, and “Institutional and environmental” (Gil-García & Pardo, 2005). Eynon and Dutton (2007) selected 30 barriers and conducted a survey to assess which barriers were perceived as most relevant, clustering them into nine factors: “Resistance”, “Technical”, “Take-up”, “Administrative”, “Privacy”, “Design”, “Legal”, “Cost”, and “Accessibility”. Barriers have also been classified according to where they occur, for example, within the administration or among citizens (Meijer, 2015), according to the different phases involved in the adoption of an innovation (Meijer, 2015), or other self-developed topologies (Schedler et al., 2019; van Veenstra et al., 2011). More recently, barriers have been categorized according to macro-, meso-, and micro-level barriers (Kempeneer & Heylen, 2023). A widely used high-level classification, however, distinguishes between structural and cultural barriers (Meijer, 2015; Tangi et al., 2021; Wilson & Mergel, 2022).

Structural barriers refer to institutionalized constraints arising from formal rules, limited capacities, scarce resources, or rigid business processes that restrict an organization's ability to initiate and sustain digital change (Wilson & Mergel, 2022). Common examples include legal constraints (Meijer, 2015), absence of clear legal frameworks (Xu et al., 2025), constraints in data handling (Schedler et al., 2019), lack of organization readiness (van Veenstra et al., 2011), bureaucratic work (Weerakkody et al., 2019), lack of financial resources (Schwester, 2009), shortage of experts and staff in general (Schwester, 2009), missing top management and political support (Ashaye & Irani, 2019), weak coordination within administrations and across different levels (Weerakkody et al., 2019), insufficient IT governance (van Veenstra et al., 2011), outdated or fragmented IT infrastructures (Irani et al., 2023), lack of system interoperability (Weerakkody et al., 2019), poor technical design (Eynon & Margetts, 2007) and a poor cost-benefit relationship (Schedler et al., 2019).

Cultural barriers, by contrast, refer to deeply embedded belief systems, norms, perceptions, and expectations that shape how digital reforms are interpreted (Wilson & Mergel, 2022). Common examples include a general resistance to change (Meijer, 2015), bureaucratic risk aversion (Schedler et al., 2019), fear of being replaced (Oschinsky et al., 2021), fear of losing control or power (Al-Emadi & Anouze, 2018), lack of willingness to cooperate (Schedler et al., 2019), a lack of legitimacy to the public (Schedler et al., 2019), and general concerns about a digital divide (Eynon & Dutton, 2007).

The identification of a barrier does not necessarily imply that it occurs or is perceived as important under all circumstances. Rather, identified barriers represent potential obstacles that frequently occur and may be perceived in practice (Eynon & Dutton, 2007; Schedler et al., 2019; van Veenstra et al., 2011). Barriers to digital government can also be examined at different levels of government, with municipalities often serving as a unit of analysis (Ashaye & Irani, 2019; Jakob & Krcmar, 2018; Kempeneer & Heylen, 2023; Schedler et al., 2019; Schwester, 2009; Tangi et al., 2020; van Veenstra et al., 2011; Wilson & Mergel, 2022). In addition to the actual barriers, strategies for overcoming them are also often included (Eynon & Dutton, 2007; Gil-García & Pardo, 2005; Meijer, 2015; Tangi et al., 2020; Wilson & Mergel, 2022). However, many of the barriers identified in early digital government research continue to appear in contemporary digital government initiatives (Kempeneer & Heylen, 2023). Examples include a hindering organizational culture and a lack of resources for social media use in government (Criado & Villodre, 2022), the absence of

appropriate regulatory frameworks for the metaverse (Kshetri et al., 2024), incompatible legacy systems and unclear benefits for quantum-safe information sharing (Kong et al., 2024), and innovation silos, a lack of leadership support, privacy concerns and limited data quality and availability for the adoption of artificial intelligence (Rjab et al., 2023; Selten & Klievink, 2024).

This persistence suggests not merely the recurrence of individual obstacles but the stabilization of deeper systemic patterns that endure across administrations, technologies, and reform cycles. Although some studies recognize that barriers are interrelated (Ashaye & Irani, 2019; Meijer, 2013; Tangi et al., 2020; van Veenstra et al., 2011; Weerakkody et al., 2021), the literature has paid less attention to empirically reconstructing these relationships as part of a broader system of mutually influencing factors. As a result, much of the current discourse risks addressing symptoms rather than underlying causes. To examine such underlying causal structures, system dynamics has been applied in public administration research. Mellon et al. (2025) use formal simulation to examine how digital inequality propagates through online civic participation into policy outcomes, while Luna-Reyes et al. (2021) apply participatory group model building to identify the feedback dynamics sustaining collective sensemaking in large digital government integration projects. Drawing on this tradition, we conducted an extensive set of interviews with municipal governments and related stakeholders to reconstruct the causal reasoning and explanatory logic through which actors themselves understand the emergence, interaction, and persistence of digitalization barriers.

3. Research design

Barriers to digital government are constructed socially through processes of sensemaking (Weick, 1995) rather than objectively, emerging from how actors perceive, interpret and legitimize them in everyday practice. We therefore adopt an interpretive research philosophy. This interpretive stance acknowledges that social reality is constructed through meaning-making in context (Klein & Myers, 1999). To capture such meaning-making holistically, we draw on techniques from the system dynamics tradition.

System dynamics, originally developed by Jay Forrester in the 1950s (Forrester, 1961), provides a conceptual tool for modeling and simulating the underlying causal structure of complex social systems. It aligns with General Systems Theory, which highlights holistic perspectives, interdependencies among system components and reciprocal, temporally extended causal relationships (Von Bertalanffy, 1972). System dynamics offers two complementary modeling approaches. First, causal loop diagrams, which depict causal relationships and feedback structures, and second, stock-and-flow models, which allow for quantitative simulation of dynamic system behavior over time (Stermann, 2002). We base our methodological approach on (Luna-Reyes & Gil-García, 2014) in relying on the underlying grammar of system dynamics as a template for theory building (Kim & Andersen, 2012), rather than developing quantitative simulation models. Specifically, we rely on causal diagrams to reconstruct the shared mental models through which actors explain and link barriers. This does not imply that we necessarily make a claim of exclusive causal relationships between the identified system elements. Rather, we identify relationships that may be complemented by other factors. The analytical techniques for developing such diagrams are rooted in principles of grounded theory (Kim & Andersen, 2012), which itself represents a suitable interpretive methodology (Starks & Trinidad, 2007). Grounded theory aims to develop explanatory theories of social processes by studying them directly in the environments where they unfold (Glaser & Strauss, 1967). Our system dynamics approach builds on this foundation and formulates dynamic hypotheses that articulate how actors collectively perceive causal structures and how recursive feedback mechanisms give rise to persistent patterns and stabilization (Stermann, 2002). Research in system dynamics highlights that actors in complex systems may feel powerless and therefore shift blame onto

others, which creates chains or cycles of blame and inaction that further reinforce the perception of individual incapacity (Stermann, 2002). Our results show that this is highly relevant in the context of barriers to digital government initiatives.

The conceptual orientation of system dynamics is well suited to our objective. We use its techniques to elicit how actors reason about barriers, how they explain them and how these explanations create causal chains. Consistent with our interpretive stance, we do not claim to model an objective system. Rather, we make actors' mental models explicit in the form of causal maps that function as dynamic hypotheses about the transformation processes of municipal government. This enables us to understand the socially constructed environment in which actors locate themselves and their perceived constraints.

3.1. Research context: Municipal digital government in Germany

Our empirical context is the implementation of digital government in Germany with a focus on the municipal level. Being a federal republic, the federal government formulates the legal framework, while the task of concrete implementation lies within the purview of municipal government (Ogonek & Becker, 2018). Germany's constitutional right of municipal self-determination (Article 28: Autonomy of municipalities) further strengthens local autonomy, allowing municipalities to self-determine and implement their digital agenda. Therefore, many municipal governments employ dedicated staff to advance local initiatives. On the commercial side, this creates a fragmented technology market in which private companies compete to provide digital services. Given the approximately 11,000 municipalities, digital government in Germany is highly decentralized and progress is fragmented and heterogeneous.

Efforts to advance the digital transformation of public authorities are also driven at the European level: In 2018, the European Union adopted an ambitious regulation establishing a single digital gateway (European Union, 2018). In Germany, the corresponding obligations are reflected in the Online Access Act (OZG), which requires federal, state and municipal governments to make a catalogue of public services available online by the end of 2022 (BMJ, 2017). The institutional anchoring of this agenda has since been strengthened repeatedly, for example through the appointment of a Federal Government Commissioner for Digitalization, the establishment of the Federal IT Cooperation (FITKO), and most recently, in 2025, the creation of a dedicated federal digital ministry (Kropp, 2026). Germany's cumulative efforts have yielded measurable progress: since 2024, the country has been classified in the very high EGDI group, indicating comparatively strong digital government capacity in international terms (United Nations, 2024). However, progress remains uneven across levels of government, with more than three quarters of the services still to be digitalized falling within the responsibility of the states and municipalities (European Commission, 2026). The European Commission's 2026 country report on Germany accordingly points to persistent coordination and implementation challenges, particularly where services must be rolled out at municipalities (European Commission, 2026). For example, the OZG deadline of 2022 was missed by a wide margin, and even in 2026 many of the mandated services have not yet been implemented (European Commission, 2026).

Given this environment, the German case is suitable to represent a broad perspective on barriers to digital government because while the objective of digitalization is centrally set, the paths towards this objective are chosen decentrally and enacted through various means with different levels of success.

3.2. Data collection

We conducted qualitative semi-structured in-depth expert interviews to collect primary data. Interviews are particularly well-suited to investigate complex socio-technical phenomena such as barriers to

digital government, as they allow for uncovering diverse perspectives and comprehensive practical insights (Creswell & Creswell, 2018). In the context of system dynamics, interviews are an effective tool for eliciting the mental models of participants, which contain perceived dynamics and perceived cause-and-effect relationships (Andersen et al., 2012). Interviews with experts are especially appropriate in this regard, as they provide access to context-specific and informed knowledge as well as interpretations derived from daily practice (Bogner et al., 2009).

3.2.1. Sampling strategy

To develop a differentiated and practice-oriented understanding of barriers to digital government, we conducted 56 semi-structured expert interviews with two relevant stakeholder groups:

1. Municipal government representatives responsible for digital government initiatives (40 interviews with 51 employees)
2. Employees of GovTech companies providing digital solutions to the public sector (16 interviews with 16 employees)

This dual perspective enables us to capture both demand- and supply-side views on digital government, thereby enhancing the credibility of our findings through triangulation (Carter et al., 2014).

Recruitment of interviewees took place through multiple channels, including direct email outreach, professional networks and personal contacts at the university. Through this approach, we ensured the inclusion of municipalities of different sizes and from various federal states. Thus, our sampling followed a purposive strategy, emphasizing diversity of actors and information-rich perspectives rather than statistical representativeness (Palinkas et al., 2015).

We conducted 40 interviews (M1–M40) with employees from the municipal level, who are directly responsible for or closely involved in municipal digital government initiatives (Table 1). Our final sample covered 13 out of 16 federal states and included municipalities of varying sizes: eleven with fewer than 20,000 inhabitants, fifteen between 20,000 and 100,000 and fifteen with more than 100,000 inhabitants. Interviewees represented a range of diverse roles such as digitalization officers, IT managers, smart city officers, mayors and organizational specialists, thereby covering a broad spectrum of perspectives on municipal digital government projects.

To complement this demand-side perspective, we conducted 16 interviews (G1–G16) with representatives of GovTech companies (Table 2). Inclusion criteria required that companies have been on the market for less than ten years, offer innovative digital products or services that integrate with public sector systems and data (Bharosa, 2022) rather than the line-of-business applications provided by traditional IT vendors, and derive a significant share of their revenue from public sector projects. This sample provided insights into how private providers perceive barriers when collaborating with municipal governments on digital initiatives.

3.2.2. Interview process

We followed the river-and-channel technique, in which a semi-structured guide provides the thematic "river" for orientation while allowing interviewees' narratives to follow their area of expertise, i.e. their "channel" (Rubin & Rubin, 2012). This design balances structure with openness and ensures that key themes are addressed while giving participants the freedom to articulate their own priorities and experiences of reaching a barrier. In doing so, it yields rich insights into individually perceived barriers and their explanations. To prevent the omission of relevant issues that interviewees might not spontaneously recall, we developed two semi-structured interview guides, one tailored for municipal governments and one for GovTech providers. As our understanding of the phenomenon deepened throughout the study, the interview guides underwent three stages of iterative refinement to ensure that emerging themes and causal relationships could be explored in greater depth. The interview guides were initially informed

Table 1

Overview of the interviews with municipal government representatives, including the focal role discussed, number of interviewees, municipality size, interview date and duration.

ID	Focal role (Interviewees)	Size	Date	Length
<i>Broad coverage of barriers</i>				
M1	E-government (2)	S	2023-12-08	00:34:51
M2	Digitalization (1)	M	2023-12-08	00:47:16
M3	Organization (1)	M	2023-12-20	00:53:33
M4	IT (2)	L	2024-01-24	01:11:27
M5	Data (2)	L	2023-01-30	00:35:03
M6	Digitalization (1)	L	2024-01-31	00:57:13
M7	Digitalization (1)	L	2024-02-02	00:38:34
M8	Statistics (1)	L	2024-02-14	01:02:34
M9	Geographic IS (3)	L	2024-02-16	01:05:05
M10	Geographic IS (3)	M	2024-02-20	01:01:28
<i>Focus on personal experiences and projects</i>				
M11	Mayor (1)	S	2024-03-07	00:48:05
M12	Digitalization (1)	M	2024-03-20	00:58:34
M13	Mayor (1)	S	2024-03-26	00:54:24
M14	IT (1)	L	2024-03-27	00:55:43
M15	Digitalization (1)	L	2024-03-28	00:52:10
M16	Finance (2)	M	2024-04-10	00:53:54
M17	Process management (1)	S	2024-04-22	00:58:29
M18	Open data (1)	L	2024-04-26	00:53:45
M19	Data governance (2)	L	2024-04-30	00:49:19
M20	Human resources (1)	L	2024-05-21	00:55:19
M21	Smart city (1)	L	2024-05-24	00:53:21
<i>Focus on probing and rationales</i>				
M22	Organization (2)	M	2024-07-24	00:54:48
M23	Digitalization (1)	M	2024-07-25	00:57:50
M24	Digitalization (1)	L	2024-07-26	01:00:36
M25	Digitalization (1)	M	2024-07-31	00:51:46
M26	Smart City (1)	L	2024-08-01	00:55:22
M27	Digitalization (1)	M	2024-08-14	01:11:11
M28	Organization (1)	M	2024-09-17	01:13:23
M29	Internal services (1)	S	2024-09-17	00:59:50
M30	Digitalization (1)	S	2024-10-22	00:48:21
M31	Mayor (1)	M	2024-10-25	01:01:22
M32	Main office (1)	S	2024-11-05	00:43:47
M33	Smart city (1)	L	2024-11-06	01:01:46
M34	Digitalization (1)	M	2024-12-16	00:51:43
M35	E-government (2)	M	2024-12-18	00:52:20
M36	Digitalization (1)	M	2024-12-19	00:50:17
M37	Digitalization (1)	S	2025-01-24	01:30:03
M38	Digitalization (1)	S	2025-02-12	01:02:30
M39	Main office (1)	S	2025-02-18	01:01:12
M40	IT (1)	M	2025-02-28	00:53:50

Size based on citizen: L > 100,000 citizens; M > 20,000; S < 20,000.

by prior research on digital government (Wilson & Mergel, 2022) and therefore included questions about whether technical, organizational, governance, political, legal or cultural challenges had been encountered. From interview 11 onward, we shifted the focus from systematically re-eliciting every type of barrier in every interview toward encouraging interviewees to narrate their concrete experiences with previous, ongoing or planned digitalization, data-driven and smart-city projects, as well as general data-handling practices and collaboration with external partners. While the broad types of barriers remained consistent across interviews, we adapted individual questions to each interviewee's role and context (Rubin & Rubin, 2012). This narrative approach allowed barriers to emerge organically within their real-world context rather than being elicited as abstract categories, while also giving interviewees the opportunity to speak in greater depth within their own area of expertise. Since our objective was not only to identify barriers but also their explanations, we paid particular attention to causal reasoning, which is often articulated implicitly (Kim & Andersen, 2012). From interview 29 onward, the guide was further refined with a set of prompts for probing questions (Rubin & Rubin, 2012), such as "Why is that the case?" or "Why does this barrier still persist?", to validate emerging interpretations and to further and explicitly uncover the

Table 2

Overview of the interviews with GovTech representatives, including the focal role discussed, number of interviewees, number of employees, interview date and duration.

ID	Focal role (Interviewees)	Empl.	Date	Length
<i>Focus on personal experiences and projects</i>				
G1	CEO (1)	5	2024-03-06	00:31:16
G2	CEO (1)	6	2024-04-15	00:43:55
G3	CEO (1)	7	2024-04-18	01:09:57
G4	CEO (1)	6	2024-04-24	00:44:55
G5	CEO (1)	3	2024-04-25	00:36:00
G6	CEO (1)	4	2024-04-25	00:41:28
G7	CEO (1)	3	2024-04-26	00:56:18
G8	CEO (1)	2	2024-05-07	00:32:35
<i>Focus on probing and rationales</i>				
G9	CTO (1)	4	2024-06-13	00:53:45
G10	CEO (1)	7	2024-06-21	00:34:12
G11	CEO (1)	12	2024-06-26	00:56:55
G12	CRO (1)	20	2024-12-16	00:32:19
G13	CEO (1)	4	2024-12-19	00:53:24
G14	CEO (1)	4	2025-01-06	00:34:41
G15	Business Development (1)	150	2025-02-10	00:39:56
G16	Business Development (1)	103	2025-02-13	00:30:37

CEO: Chief Executive Officer; CTO: Chief Technology Officer; CRO: Chief Revenue Officer.

cause-and-effect relationships underlying interviewees' mental models. These iterative refinements did not introduce new assumptions but expanded the scope of probing to allow interviewees to articulate parts of the system, additional connections, nuances and underlying reasoning in their own terms.

All interviews were conducted in German between December 2023 and February 2025. To ensure contextual familiarity and domain expertise, two researchers and two domain experts conducted the interviews based on the agreed-upon interview guidelines. The two researchers conducted the municipal interviews and the two domain experts conducted the GovTech interviews. A total of 54 interviews were held via video conferencing systems (Microsoft Teams or BigBlueButton). The interviews were audio-recorded with the prior consent of the interviewees, then fully transcribed and anonymized. The remaining two interviews were conducted by phone because video communication was not technically feasible due to the municipal governments' digital infrastructure. For the two phone interviews, detailed notes were taken during the conversations. To reduce social desirability bias, participants were explicitly assured that no sensitive information would be published and that they would remain anonymous. Selected quotations in this article were translated from German into English using DeepL, followed by a manual linguistic check to ensure accuracy and the appropriate rendering of idiomatic expressions. Across all 56 interviews, the conversations lasted between 30 and 90 min, with an average duration of 52 min and 24 s. In total, the interviews yielded 48 h and 54 min of material, providing a rich and diverse dataset for subsequent analysis.

3.3. Data analysis

To translate the raw qualitative material into an integrative representation of the dynamic relationships among barriers, we conducted four rounds of coding (Table 3). We followed established approaches to qualitative system dynamics modeling (Eker & Zimmermann, 2016). Each round built upon the previous one, progressing from the identification of basic concepts to the construction of causal maps. The first author led the coding process in each stage. By having one author lead the coding, we achieved consistency across the dataset and avoided the challenges of inter-coder reliability (Turner et al., 2014). In our coding process, we also acknowledged potential drawbacks of relying on a single coder who had not conducted all interviews. To prevent interpretive

Table 3
Summary of the coding approach; based on the approach by Eker and Zimmermann (2016).

Round of coding	Description of the coding process	Output
1. Open coding	Text-close coding of barriers in interview data	List of codes with text segments
2. Axial coding (hierarchical)	Aggregation of codes into categories and assigning to stakeholder groups	Matrix with categories and stakeholder groups
3. Axial coding (causal links)	Identification of causal relationships between categories and stakeholder groups	List of causal relationships
4. Causal maps	Integration of causal relationships into a causal map	The final causal map

bias, the first author held regular meetings with the data collectors to reflect on and validate whether the emerging interpretations were consistent with their insights into the collected data. These meetings ensured that interpretations were not limited to the first author's perspective but reflected collective discussion of emergent categories and causal connections. To achieve rigor and remain as objective as possible, the interpretive process was systematically documented and coding decisions were iteratively justified and compared with the empirical material (Corbin & Strauss, 2015). Any disagreements were resolved by returning to the underlying data and discussing them until a consensus was reached.

3.3.1. First round of coding: Identifying the overall barriers of the system

In the first round, we applied grounded theory open coding (Corbin & Strauss, 2015) to the raw interview transcripts using MAXQDA (Version 24). Every aspect mentioned as being detrimental to the implementation of digital government was coded as a type of barrier. We generated individual, independent codes, either as short analytic terms or as in-vivo codes, directly reflecting the interviewees' language (Corbin & Strauss, 2015). This preserved linguistic nuances and contextual meanings that, while not yet analytically central, were valuable for later phases (Eker & Zimmermann, 2016). Through iterative engagement with the data, we produced more than 2000 initial codes. These codes were highly provisional and changed frequently, with many being split, merged or discarded during the process, particularly those derived from in-vivo expressions (Saldaña, 2013). Rather than coding sentence-by-sentence or paragraph-by-paragraph, we coded each distinct thought, so a single sentence could carry multiple codes if it expressed several ideas (Saldaña, 2013). The process was deliberately exploratory and we remained open to whatever perceived barriers the data revealed. While the primary focus of this step was identifying general perceived barriers, early interpretations of potential causal relationships inevitably emerged. Following Eker and Zimmermann (2016), these preliminary insights were not formalized but carefully logged in analytical memos for later use.

3.3.2. Second round of coding: Focus on hierarchical relationships

For the second round, two contrasting strategies are common in system dynamics research. One involves coding every causal link mentioned by interviewees and later generalizing them (Kim & Andersen, 2012). The other relies on merging interview data into higher-level categories and constructing causal links at a higher level of abstraction. Following Turner et al. (2014), we adopted the latter strategy, which we found to be more efficient. It avoids redundantly coding each cause-and-effect relationship while still preserving rigor and transparency. Accordingly, this step focuses on axial coding (Corbin & Strauss, 2015). Although axial coding in its original form examines various types of relationships, including hierarchical and causal ones (Corbin & Strauss, 2015), in this step, we restricted its use to organizing codes hierarchically. In doing so, we considered existing theoretical lenses for classification but ultimately chose a purely grounded approach, since the existing typologies were too generic to provide meaningful guidance and offered little help in identifying the specific mechanisms through which causes were constructed in practice.

Following the two-dimensional strategy of Eker and Zimmermann (2016), we assigned each coded segment simultaneously to a higher-level category of barriers and to the domain in which the barrier manifests. For example, the code "Lack of technical skills of employees" is assigned to the higher-level category "Lack of skills" and the domain "Administrative operations", while the code "Lack of data literacy among the local council" is also assigned to the higher-level category "Lack of skills" but to the domain "Political governance & public". We developed both dimensions inductively through constant comparison, grouping codes by similarity and progressively clustering, merging, splitting, and reassigning them until the categories were internally consistent and conceptually distinct (Corbin & Strauss, 2015). The central challenge was to remain abstract enough to capture general patterns while staying sufficiently concrete to maintain analytical precision. To ensure consistent assignment, we formulated explicit inclusion rules for each category (Saldaña, 2013). For instance, the rule for "Lack of skills" read: "The interviewee describes a situation in which an individual or group lacks the necessary knowledge, expertise, or competencies to effectively perform a specific task."

3.3.3. Third round of coding: Focus on causal relationships

In the third step, we moved beyond contained relationships and sought to uncover causal links between categories. On the coding tree, such causal links may appear either vertically or horizontally (Eker & Zimmermann, 2016). While interviewees often articulate causal reasoning in more nuanced and detailed ways than can be represented in a causal model (Eker & Zimmermann, 2016), we aim to systematically extract the core mechanisms that connect categories to build a coherent and tractable representation. This ensures that the final model captures the dynamics of barriers to digital government without being overwhelmed by idiosyncratic detail. Causal arguments can be identified at the level of single statements by the interviewees and are often supported by rationales and examples (Kim & Andersen, 2012). Therefore, it is good practice to pay attention to language indicative of causal reasoning, such as "because of ...", "if ... then" or "I'd like to, but ..." (Eker & Zimmermann, 2016). We used a list to track the causal relationships of categories based on such explicit statements (e.g., $A \rightarrow B$, based on M10, Line 25). Arguments often point to underlying causal structures that are not made fully explicit and may be communicated in different ways (Kim & Andersen, 2012), for example, through alternative labels, illustrative practical examples or by omitting variables that seem obvious to interviewees. In these cases, when the context suggested the presence of implicit variables, we decomposed causal relationships into intermediate steps, marking them with a question mark (e.g., $A \rightarrow B? \rightarrow C$ instead of $A \rightarrow C$). We carefully examined the context of ambiguous statements, cross-referenced them with earlier or later arguments and documented interpretive decisions in analytical memos. After establishing an increasing number of causal links, we noticed that the interviewees tended to complement each other rather than contradict one another and that suspected implied causal links were confirmed by other interviewees' mental models. This meant that the question marks surrounding the intermediate variables became progressively fewer over time.

Table 4

Inductively identified barriers to municipal digital government, organized by the domain in which they manifest.

Administrative operations	IT & service providers	Political governance & public
<i>Mentioned by both municipal government and GovTech representatives</i>		
1. Low prioritization	18. Low integration maturity (e.g., legacy IT)	1. Low prioritization
2. Lack of resources (e.g., financial and human, vacant positions, no time and capacity)	19. Low agreement on standards (e.g., lack of technical regulation and standardization)	9. Lack of skills (e.g., data literacy, technical, financial)
3. Lack of local strategies and guidelines (e.g., digitalization, organizational structure, silo departments, data governance)	20. Fragmented IT landscape	12. Cultural resistance (e.g., fear of change and mistakes)
4. Municipal heterogeneity	21. Low usability	14. Unclear benefits
5. Diverse tasks	23. Lack of testbeds	15. Low activation for action
7. Shifting requirements		26. Legal framework (e.g., restrictions, legal uncertainties, unclear framework conditions, complex requirements)
9. Lack of skills (e.g., data literacy, technical, project management)		27. Local self-government
10. Implementation deficit		28. Low superior governance (e.g., strategy, interoperability guidelines)
11. Unattractive for innovators		
12. Cultural resistance (e.g., fear of change and mistakes)		
14. Unclear benefits		
15. Low activation for action		
17. Low workforce cooperation		
<i>Mentioned only by municipal government representatives</i>		
6. Complex structures	22. Lack of functionality	13. Low effects (e.g., low demand and low usage by citizens)
8. Resource-intensive implementation		24. Low political capital
13. Low effects (e.g., poor cost-benefit ratio, no workload relief)		25. Low local political support
16. Low management support		29. Low bargaining power

3.3.4. Fourth round of coding: Building the causal map

In the final round, we integrated all identified causal relationships into a consolidated model (Eker & Zimmermann, 2016), ensuring that only links supported by empirical evidence from at least two different interviews were included. For visualization, we employed the system modeling software VensimPLE (Version 10.3), a widely adopted choice for developing causal models (Zanker & Bureš, 2022). In this step, we moved from initially fragmented causal links toward a coherent representation of the interconnectedness of multiple barriers. The resulting causal map is deliberately abstract, condensing a large body of qualitative evidence into a system-level perspective that reflects the collective mental model of the interviewees. Within this representation, extended causal chains become visible that span across different categories. Causal chains describe sequences in which one barrier gives rise to another, thereby creating longer trajectories of cause and effect (Sterman, 2002). When such chains close back in upon themselves, they form feedback loops, that is, circular structures in which outcomes influence their initial causes (Kim & Andersen, 2012). System dynamics distinguishes between reinforcing and balancing loops (Yearworth & White, 2013). In our context, barriers were consistently explained by reference to other barriers. That implies that the strengthening of one barrier invariably leads to further strengthening of subsequent barriers. As a result, the loops we identified were exclusively reinforcing. These loops do not exist in isolation but are tightly interconnected. Some directly interacted and strengthened each other, while others are linked more indirectly by influencing barriers that, in turn, activate or intensify additional loops. The outcome is a dense web of interdependencies in which each barrier contributes to the overall dynamics of the system.

Given the density of the final causal map, countless loops can be identified in theory. One may start at any barrier and follow any branching path at each fork, ultimately arriving back at the starting barrier. To reduce the complexity, we selected, for each domain, two barriers that interviewees raised particularly frequently, and pursued a sensemaking approach (Weick, 1995) tracing the most plausible cycle grounded in our empirical material for why each barrier persists, ultimately arriving back at the initial barrier. The six self-reinforcing mechanisms presented in the following sections thus serve as illustrative examples of the reinforcing dynamics we identified, rather than an exhaustive representation of the underlying cycle structure of the causal map.

4. Results

The analysis reveals a rich set of barriers and numerous interconnections among them, reflecting how interviewees experience and explain the dynamics of digitalizing municipal government. It is important to note that the causal links described in this section represent a reconstructed shared mental model of perceived relationships, rather than objectively verified causal effects. The latter would be subject to numerous interpretations and therefore difficult to achieve. Interviewees discussed both internal challenges within their own organizations and external frictions at the interface between municipalities, service providers and political actors. To structure the findings, we organized barriers into three analytical domains reflecting distinct but interacting subsystems of municipal government digitalization.

The first domain, *Administrative operations*, encompasses the operational core within the organizations of municipal governments. It includes actors such as staff who execute and adapt processes, use digital systems and act as domain experts in areas like IT, data protection and information security as well as digitalization managers and department heads who translate political goals into concrete actions, define priorities within their area and allocate personnel and budgets.

The second domain, *IT & service providers*, captures the technological and inter-organizational interface through which municipalities interact with their IT environments and external vendors. Key actors include municipal service providers that operate shared IT infrastructures and provide cross-municipal services and tech support, alongside GovTech companies and IT vendors that design, develop and maintain digital services and line-of-business applications.

The third domain, *Political governance & public*, reflects the political and societal layer of municipal digitalization. It includes mayors and local councils who set strategic goals and priorities, represent the municipality externally and mediate the interests of citizens. It further comprises higher hierarchical levels of government, with federal authorities defining overarching legal frameworks and state governments adapting and translating these into regional contexts. The domain also encompasses the public itself, comprising citizens and local businesses that utilize municipal services, express their interests and participate in the election of mayors and councils.

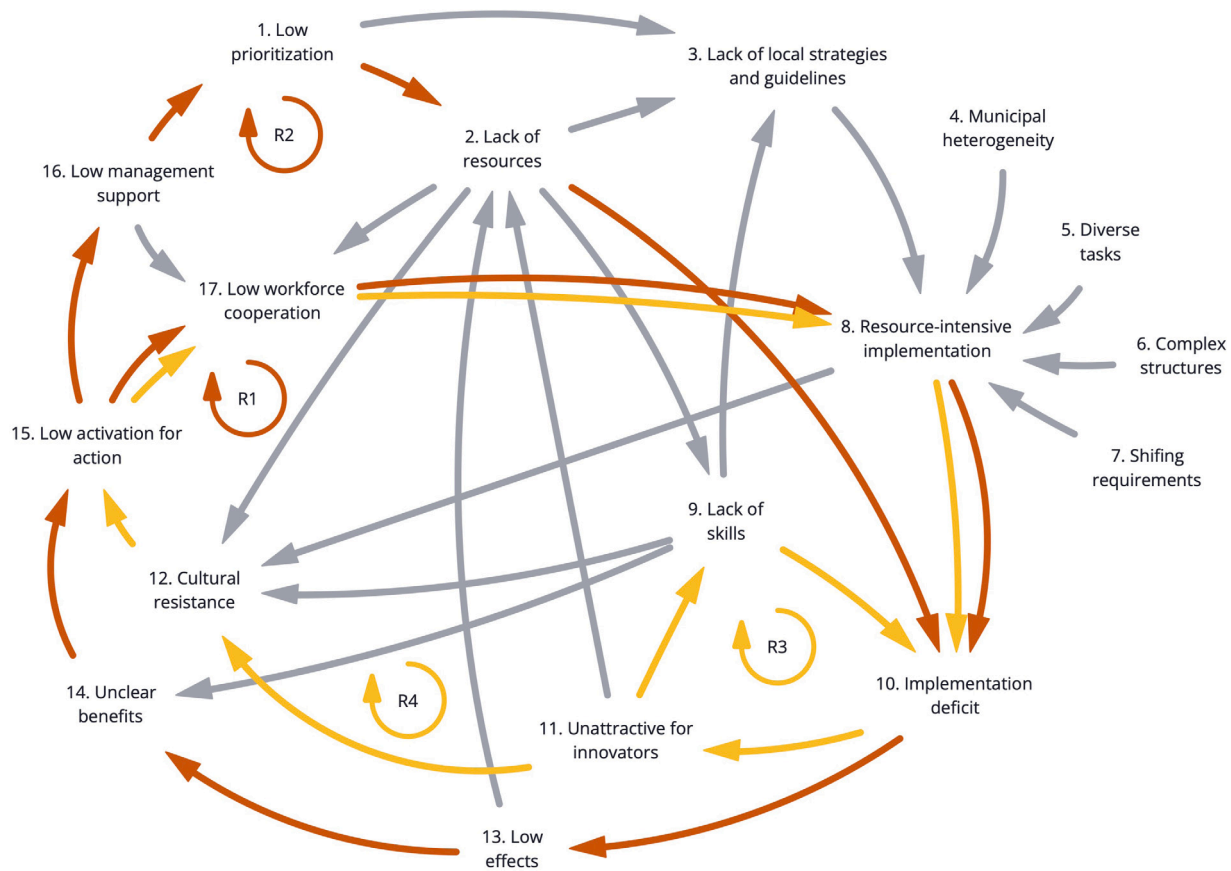


Fig. 1. Subsystem 1 – Administrative operations, with the mechanisms self-reinforcing perception of ineffectiveness (R1 and R2; orange arrows) and self-reinforcing absence of innovators (R3 and R4; yellow arrows).

Table 4 summarizes the barriers empirically derived within these domains, indicating whether a barrier was mentioned by both municipal government and GovTech representatives or only by municipal government representatives. Notably, no barrier was mentioned exclusively by GovTech representatives. Overall, both groups share a largely similar mental model of the barriers to municipal digital government. The only difference we identified is a small number of barriers that were raised exclusively by municipal government representatives.

Although the barriers provide a comprehensive view of perceived challenges, they do not yet explain how these interact. The following sections examine the dynamic interconnections between barriers and how they coalesce into feedback structures that stabilize the broader system of stagnation of municipal government digitalization. We begin with the subsystem of the first domain, extend the view to include the second and finally incorporate the third domain. Although numerous feedback loops were identified, we focus on two dominant reinforcing loops within each subsystem that we find to influence the overall system behavior.

4.1. Subsystem 1: Administrative operations

The first subsystem concerns the dynamics within the operational core of municipal governments. Fig. 1 illustrates the underlying causal structure of the interviewees' shared mental model, showing how resource constraints, limited competencies and administrative work culture interact with other barriers to shape the progress of digital transformation in municipal governments or lack thereof.

Many interviewees identified constrained municipal budgets and the resulting lack of resources as a key barrier to digital transformation. Limited financial resources prevent the creation of dedicated positions for digitalization and data management, both at central administrative

levels and within individual departments. Yet, building targeted human resources with expertise in data-driven work is crucial in the short to medium term to enable active engagement with new digital practices. According to the interviewees, many municipal governments lack the broad-based competencies required for data-driven and digital work. This gap encompasses both legal knowledge, particularly regarding data protection and data sharing as well as technical skills related to IT systems, process design and data handling. In smaller municipalities, the absence of dedicated experts in digitalization and data management further exacerbates the problem. Moreover, the strategic and operational value of data-driven practices is often neither apparent nor well communicated. This lack of awareness extends across administrative levels, from operational departments where most data is generated to senior management and political committees where data could inform evidence-based decision-making. Where competencies and awareness of potential benefits are missing, active participation in data-driven transformation processes remains limited.

Resistance to change and a pervasive fear of making mistakes have been cited as continuing to shape the behavior of many employees in municipal governments. Innovations related to digitalization and data-driven work can be met with skepticism and intrinsic motivation to pursue such changes proactively remains limited. The potential of new approaches, particularly data-based practices, is reported to go unnoticed. Instead, employees express concerns about long-term shifts in their tasks, loss of control, excessive workload and increased unwanted transparency. These attitudes are described to be reinforced by the traditional self-understanding of public administration, which is grounded in well-established analog routines and constrains openness to new forms of work and cross-departmental collaboration. As a result, silo thinking persists and cooperation across departments remains rare. Knowledge, data and communication largely remain confined within

organizational boundaries. Furthermore, decision-making processes are often characterized by caution and repeated verification, which can considerably slow down administrative procedures. Change initiatives tend to gain momentum only when their benefits are clearly identifiable. In the context of data sharing, employees are said to act with restraint, particularly when the immediate value of data exchange is not apparent or when additional effort and uncertainty are anticipated.

Smaller and medium-sized municipalities report a lack of structural capacity to address the diverse demands of digitalization and data management. Even when larger cities have developed effective solutions, potential adopters frequently lack the resources to evaluate and adapt them to their specific needs. Limited staff capacities and competing operational workloads leave little room for strategic innovation. The broad functional scope of municipal administrations, coupled with significant variation in political priorities, financial means and local particularities, further complicates the transfer of successful approaches. As a result, proven solutions are rarely scaled beyond individual municipalities.

4.1.1. A self-reinforcing perception of ineffectiveness

In the domain of administrative operations, low management support and low workforce cooperation emerged as two closely related, frequently raised barriers. Starting from each of these barriers, we trace two self-reinforcing cycles (R1 and R2; orange arrows in Fig. 1), in which a lack of conviction among employees and managers constitutes a reinforcing mechanism sustaining digital stagnation.

R1 captures how limited willingness to cooperate and occasional active resistance among parts of the workforce, slow down implementation processes: When employees are reluctant to adapt to new workflows or explore digital tools, implementing new solutions requires extensive coordination and additional effort, making the process slower, more complex and resource-intensive. As one interviewee explained:

“Getting people on board and persuading them to do things differently, even though they have grown up with the old ways. That’s actually a really big issue, because we can somehow use an interface here and get the budget for it, so that’s not really a problem. But getting people on board... I think that’s what I would see as the biggest challenge right now.” (M35)

R2 reflects the same underlying mechanism at the managerial level: When the potential value of digitalization or data-driven work is not recognized or taken seriously, digital initiatives receive little attention at the management level. This lack of prioritization directly affects the allocation of resources and sends weak signals of support to employees who might otherwise develop digital skills or experiment with innovative solutions.

Both cycles slow down implementation and reduce the overall effectiveness of digital initiatives. When visible improvements in daily work or among colleagues fail to materialize, concrete evidence of the benefits of digitalization remains absent. The expected gains remain unrealized, positive experiences are lacking and digitalization is increasingly perceived as ineffective. As doubts intensify, the cycle restarts and reinforces itself once again. One interviewee foresaw this loop and noted:

“The problem was that I needed examples to prove that digitalization could make things much easier. But I didn’t have the resources to come up with examples to prove it, which turned into a kind of vicious cycle.” (M38)

4.1.2. A self-reinforcing absence of innovators

Lack of skills and cultural resistance emerged as two further closely related, frequently raised barriers. Starting from each of these barriers, we trace two additional self-reinforcing cycles (R3 and R4; yellow arrows in Fig. 1), in which an unattractive labor market for innovation-oriented professionals constitutes a reinforcing mechanism that impedes digital transformation.

R3 captures how a low level of digitalization reduces the attractiveness of municipal governments for innovation-oriented professionals: As modernization remains limited, administrations struggle to attract applicants with the skills needed to advance digital transformation. The absence of such change agents restricts the inflow of new ideas and technical expertise, which in turn closes the loop and keeps the level of digitalization low.

R4 covers how the same conditions weaken internal change readiness: When administrations primarily attract individuals seeking security and predictability, the workforce tends to be more cautious toward uncertainty, change and transformation. This resistance makes implementation more effortful and resource-intensive, which in turn closes the loop and slows the digitalization process. In this regard, one interviewee explained:

“Even the young people who completed their apprenticeship with us three or four years ago didn’t necessarily come here with the idea of starting a business; they had a reason for going into administration. And that reason was precisely security.” (M29)

Both cycles slow down implementation, increase complexity and resource demands as well as limit visible progress. When tangible improvements do not materialize, credible evidence of benefits remains absent, skepticism grows and the cycle begins anew. One interviewee summarized her aspiration:

“I would simply like to see the administration become more attractive in the area of digitalization. In other words, I would like to see an understanding from the outside world and receive some cool applications or something similar, so that people can see that “Ah, it’s not all dusty in the offices, but can actually be really cool work.”” (M25)

4.2. Subsystem 2: IT & service providers

The second subsystem captures the dynamics between municipal governments and their IT and service providers. Fig. 2 illustrates the underlying causal structure of this interaction, showing how outdated IT infrastructure, limited system functionality and strong vendor dependency increase the complexity and cost of digitalization while simultaneously reducing its perceived benefits.

Many interviewees highlighted technical shortcomings of municipal government IT systems, which constrain integration possibilities, functionality and usability. Systems are typically designed around bureaucratic procedures rather than employee-oriented workflows, which limits flexibility and hampers their practical utility and versatility. Their usability is frequently criticized, as interfaces are outdated, un-intuitive and require specialized knowledge or extensive training. This problem is amplified by the fragmented landscape of digital applications for municipal digitalization, which affects both employees and citizens.

Long-term dependencies from software vendors create additional constraints. Maintenance, administration and system adjustments are resource-intensive and lock-in effects make switching providers or introducing new technologies difficult. The greatest perceived challenge lies in the historical heterogeneity of system environments, which lack interoperability and open standards. Many systems operate in isolation, with proprietary or undocumented interfaces that prevent seamless data exchange. As a result, data remains trapped within legacy systems

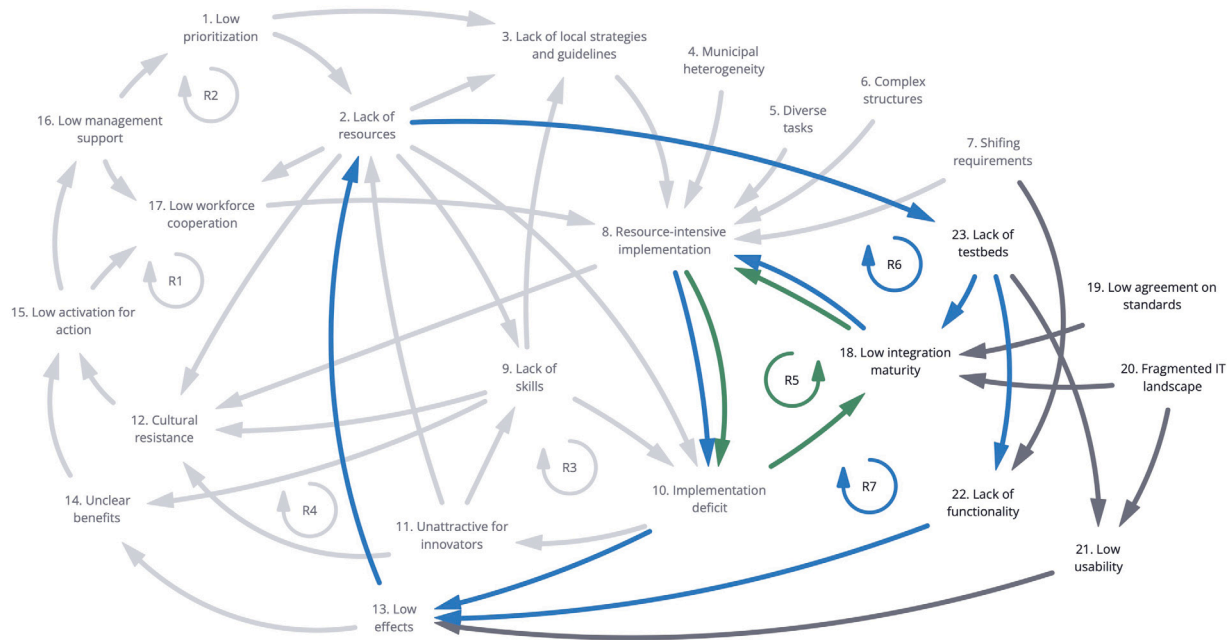


Fig. 2. Subsystem 2 – IT & service providers, with the mechanisms self-reinforcing legacy trap (R5; green arrows) and self-reinforcing lack of experimentation (R6 and R7; blue arrows).

and technical fragmentation hampers the uniform and efficient use of information.

Due to limited financial resources, most municipal governments are unable to invest extensively in modern digital infrastructure, training environments or testing facilities for new technologies. In smaller administrations, the costs of licenses, interface development and maintenance are often considered disproportionate to the expected benefits, especially in areas with low case volumes. This imbalance further discourages investment and prolongs reliance on outdated systems.

4.2.1. A self-reinforcing legacy trap

In the domain of IT & service providers, low integration maturity emerged as a particularly frequently raised barrier. Starting from this barrier, we trace a self-reinforcing cycle (R5; green arrows in Fig. 2), in which an implementation deficit constitutes a reinforcing mechanism that perpetuates dependence on outdated and poorly integrated IT infrastructures.

R5 captures how legacy IT systems create persistent structural barriers: Many municipalities must implement digital projects on top of system landscapes that have evolved over decades. These environments are technologically outdated, weak in interoperability and rarely modular. Systems are seldom aligned and allow only limited data exchange. As one GovTech representative noted:

“Technically, the biggest problem was that many interfaces [to existing software] were either non-existent or severely outdated.” (G9)

Within such settings, integrating new GovTech applications requires substantial technical organizational and financial effort. To ensure connectivity, administrations often commission costly customizations or consider complete system replacement. Both options consume resources and delay implementation and for smaller municipalities, they are frequently not economically viable:

“But that’s also a cost-benefit factor. Too few people do it [register their dogs] digitally for it to be worth paying €10,000 now to make the interface work properly.” (M12)

Because a complete replacement of the IT infrastructure is complex and risky, administrations often resort to bespoke interfaces that offer short-term relief but deepen long-term lock-in. These isolated solutions increase system complexity, hinder updates and reinforce vendor dependence. As a result, legacy IT structures persist rather than diminish, which worsens integration maturity, slowing subsequent projects and thus restarting the cycle.

4.2.2. A self-reinforcing lack of experimentation

A lack of functionality emerged as a further particularly frequently raised barrier. Starting from this barrier and low integration maturity discussed above, we trace two additional closely related self-reinforcing cycles (R6 and R7; blue arrows in Fig. 2), in which a lack of testbeds constitutes a reinforcing mechanism that impedes digital transformation. Many municipalities lack the financial and technical capacity to provide GovTech providers with secure digital spaces and representative data for experimentation. Without such environments, new systems cannot be tested under real conditions before deployment.

R6 captures how the missing testing capacity makes integration into existing system landscapes more difficult and resource-intensive: Without prior validation, interfaces and functionalities must be adjusted during implementation, which increases complexity, causes delays and prevents early positive effects that could otherwise strengthen confidence in digitalization. This additional effort, combined with the delayed materialization of positive effects, places further strain on personnel and financial resources, which in turn ties up the very capacity that would be needed to establish dedicated testing environments, reinforcing the initial lack of testbeds. As one interviewee noted:

“It would also be important for administrations to be able to experiment with these [digital solutions] without immediately interfering with productive systems. This would allow new solutions to be developed and tested in a secure environment before being put into practice.” (G8)

R7 captures how the same lack of testing capacity contributes to a disconnect between GovTech providers and administrative practice: When new tools cannot be developed and refined in collaboration

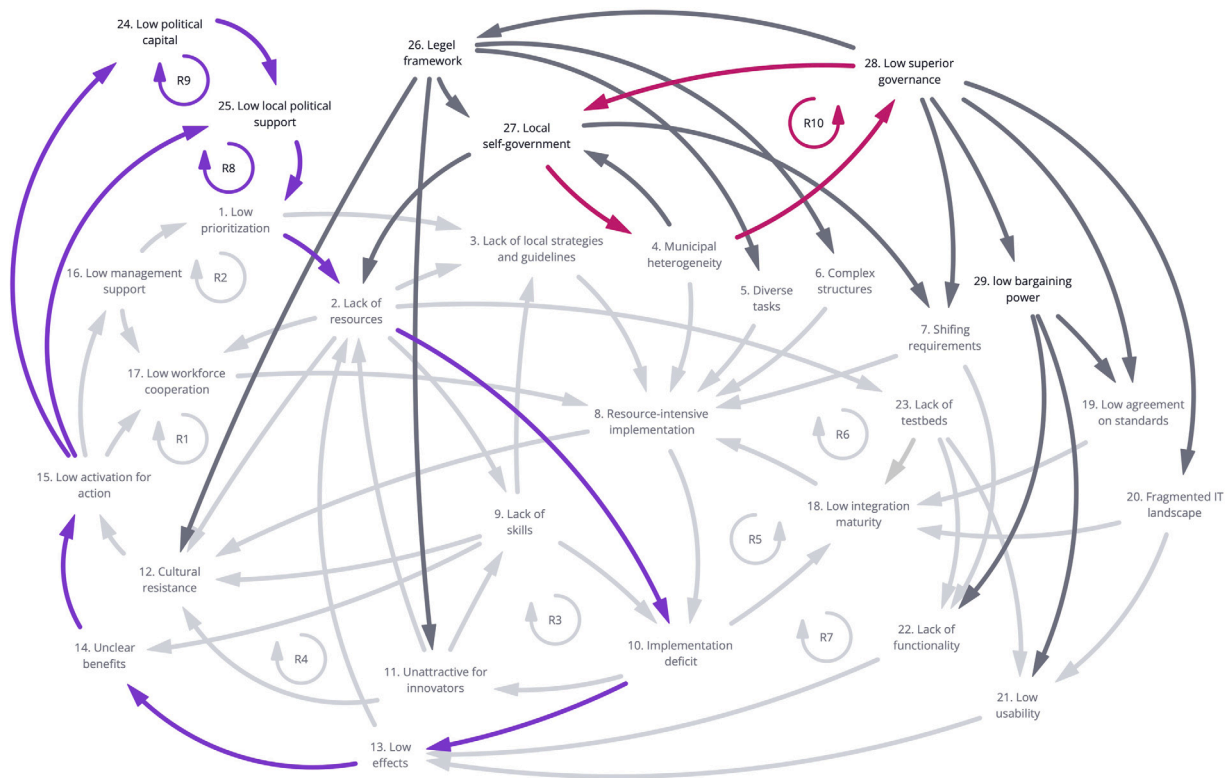


Fig. 3. Subsystem 3 – Political governance & public, with the mechanisms self-reinforcing lack of local strategic commitment (R8 and R9; purple arrows) and self-reinforcing harmonization deficit (R10; magenta arrows).

with practitioners, their functionalities often fail to match real administrative requirements. This reduces user satisfaction and weakens the benefits of digital solutions. As expected efficiency gains and cost savings fail to materialize, municipal governments have less financial possibilities for investing in dedicated testing environments, reinforcing the initial lack of testbeds. One interviewee described this challenge:

“The tools are not necessarily practical. [...] It’s always the same in our state and at the federal level: legislation is passed and suddenly we realize: now let’s try to create this tool based on the legislation, instead of first going out and saying: Dear people, let’s go back to basics and take another look at what problems are actually occurring here? [...] and suddenly you realize: That’s still missing. Then there’s this special case. What about exemptions for a building permit application? Where do I enter that? And so on and so forth. So I just find that this interaction is missing time and again.” (M13)

4.3. Subsystem 3: Political governance & public

The third subsystem captures the dynamics between the legal framework, political decision-makers and overarching governance structures at the state and federal levels. Fig. 3 illustrates the underlying causal structure, showing how these institutional conditions shape the pace and direction of digital transformation in municipal governments.

Legal and administrative rules often limit the ability of municipalities to build and maintain the necessary human resources. Rigid tariff laws, inflexible payment structures and complex job evaluation systems restrict the recruitment, retention and professional development of qualified digital specialists. As a result, municipalities struggle to replace retiring employees or to compete with salaries in the private sector. This situation reinforces dependence on cooperation with external service providers. In addition, legal uncertainties, particularly regarding the use of new technologies and data processing, create

insecurity among administrative staff and managers and contribute to a cautious culture that discourages innovation.

Changes in legal requirements and a lack of clarity about what is permissible increase the administrative burden within digital projects. Employees remain uncertain about the legality of digital procedures or the transfer of solutions developed in other regions. These uncertainties are pronounced in dynamic fields such as artificial intelligence, where clear regulatory guidance is still missing. Procurement and tendering procedures further increase complexity by making project implementation lengthy and resource-intensive. Moreover, specific legal provisions such as mandatory personal identification, handwritten signatures or manual verification steps often prevent a comprehensive process digitalization, requiring the parallel operation of analog and digital processes. Data protection plays a central role in this context. Missing or unclear legal bases for data processing can hinder digital workflows even when suitable technical solutions already exist.

Another challenge is the limited ability of municipalities to influence market-dominating IT vendors and service providers. Established companies often dominate the market for niche digital government applications and are reluctant to provide open interfaces. This dependency leads to both technical rigidity and economic disadvantages, such as opaque and possibly unfavorable pricing models.

Finally, fragmented legislation across federal, state and local levels results in divergent initiatives rather than coordinated action. The absence of harmonized standards for data models and interfaces hinders interoperability and seamless data exchange within administrations, across levels of government and with external service providers. Consequently, the overarching political and legal environment reinforces structural fragmentation and slows the progress of digitalization.

4.3.1. A self-reinforcing lack of local strategic commitment

In the domain of political governance & public, low local political support and a low political capital emerged as two closely related, frequently raised barriers. Starting from these barriers, we trace two

closely related self-reinforcing cycles (**R8** and **R9**; purple arrows in Fig. 3) that shape strategic decision-making in municipal government digitalization. Both describe how political influence steers the prioritization of projects and the allocation of resources, yet they differ in the type of expected payoff that drives attention and support.

R8 captures a dynamic of low perceived strategic advantage: When decision makers do not see convincing internal benefits from data-driven work, digital initiatives are not prioritized and receive limited resources. Implementation slows, direct effects from digitalization remain modest and the administration lacks better data and insights that could inform future strategic choices. This reinforces the initial perception that digital projects do not yield sufficient internal value. As one interviewee noted:

“We are a municipality. In the end, we are dependent on politics. We implement what (local) politicians dictate.” (M29)

R9 captures a dynamic of low perceived political capital: Where digitalization has low electoral salience and limited external visibility, leaders see little political payoff in advancing it. Projects are deprioritized and underfunded, implementation drags and visible public-facing effects remain scarce. The absence of tangible signals that could be communicated to voters further reduces incentives to invest, which restarts the cycle. As one interviewee observed:

“I think we need to get to a point where election campaigns are decided on issues like this [digitalization] and then we can talk again. [...] You only have to look at the election campaigns. We just had local elections in [state], in [another state] and look at the issues that were discussed, the issues that were on the election posters. Nowhere does it mention anything about digitalization.” (M26)

4.3.2. A self-reinforcing harmonization deficit

Low superior governance emerged as a further particularly frequently raised barrier. Starting from this barrier, we trace another self-reinforcing cycle (**R10**; magenta arrows in Fig. 3) that hinders digital transformation through political fragmentation and an overemphasis of local autonomy.

R10 captures how the decentralized structure of municipal administration creates largely autonomous units of action: Under the principle of local self-government, each municipality independently decides which topics to prioritize and how to design its processes and digitalization projects. These choices often follow local political preferences and shifting priorities. As one interviewee explained:

“It depends on who sets their priorities where. It’s not as if everyone has the same priorities, nor do they all have the same procedures and they all have different citizens and different settings in which they operate. If I’ve been badly affected by flooding, climate adaptation may be a much bigger issue than if, for example, I have a huge problem with my kindergartens and don’t know what to do with all my young people. And I only have vandalism because they’re all underutilized. So I don’t know. That means everyone has a different focus depending on what’s happening locally. And I don’t think there’s one super issue.” (M12)

As a result, differing objectives, processes and corresponding technical solutions emerge, which complicate the overarching coordination of municipal digitalization. Shared standards and joint solutions are difficult to establish, as they rarely reflect the diversity of local interests and may restrict individual decision-making authority. Harmonization efforts, therefore, often encounter resistance, as local actors seek to preserve their autonomy. As one interviewee put it:

“Why is this [centralized solutions] not the case? Yes, the states and municipalities do not want to relinquish their sovereignty or are not necessarily willing to accept certain adjustments.” (M15)

This political fragmentation affects digitalization and data-driven work in municipalities. IT landscapes remain heterogeneous, standards remain the exception and the implementation of digital solutions becomes more complex, slower and resource-intensive. At the same time, the absence of a consistent overarching strategy leads to shifting requirements, legal uncertainty and a general lack of direction. This manifests in a temporal mismatch: requirements change on a national timetable that municipalities can neither anticipate nor meaningfully influence, and the resulting expectation of anticipated obsolescence suppresses local initiative. Interviewees described cases in which a municipality had proposed, budgeted, procured and built a solution, only to see it superseded a few years later by a federal or state solution (e.g., a locally developed service portal with its own account management replaced by a federal portal with centralized federated identity). One interviewee summarized this as not knowing where a municipality should push ahead on its own and where a superordinate solution is about to arrive, which makes waiting the rational choice. Best practices can hardly be generalized or disseminated and the cycle of fragmentation continues.

5. Discussion

We set out to answer why barriers to municipal digital government persist. As a starting point, our results empirically confirm that the well-known barriers repeatedly described in prior digital government research (Ashaye & Irani, 2019; Jakob & Krcmar, 2018; Lam, 2005; Meijer, 2015; Schedler et al., 2019; van Veenstra et al., 2011; Wilson & Mergel, 2022) remain highly salient in contemporary municipal governments, despite decades of reform efforts and sustained strategic attention (Kempeneer & Heylen, 2023). Table 5 maps the empirically identified barriers together with related literature. The lack of testbeds is the only barrier for which we found no correspondence in prior research, plausibly because our inclusion of GovTech startups surfaces a perspective in which the need to try out solutions still under development is particularly salient.

5.1. Explaining persistence: barriers as a reinforcing system

Our analysis therefore supports and further extends prior research showing that barriers to digital government are not only interconnected (van Veenstra et al., 2011) but that each barrier is both a consequence and a cause of others, such that no barrier exists in isolation or can be identified as a central cause of the remaining barriers. Our causal map reveals a complex network of interdependent barriers that form self-reinforcing systems that generate stable yet undesirable dynamics. In the results section, we highlighted six such feedback mechanisms that demonstrate how barriers continuously reproduce themselves and trap municipal governments in cycles of digital stagnation. These loops are not only self-reinforcing but also mutually reinforcing, amplifying one another in ways that make them difficult to break.

In such a system, attempts to address a single barrier may fail because the underlying causal structure remains untouched and reproduces the barrier (Stermann, 2002). Thus, many observable barriers may turn out to be symptomatic. For example, a lack of financial resources is frequently cited as a key constraint both in our interviews and in the literature (Schedler et al., 2019; Schweser, 2009; Wilson & Mergel, 2022). However, our analysis suggests that even when funds are available, decision-makers, such as local politicians, are often reluctant to dedicate them specifically to digitalization projects. Available resources tend to be used for other priorities (Jakob & Krcmar, 2018), which means that an increase in funding alone would not automatically accelerate municipal government digitalization. Effective interventions need to go beyond compensating for the visible barriers, such as resource shortages, and instead address the deeper causes that shape how issues are prioritized and resources are put to use. This aligns with prior findings that local political support (Jakob & Krcmar, 2018)

Table 5
Empirically identified barriers constituting the six self-reinforcing loops, with related literature.

Barrier	Cycles	Related literature
1. Low prioritization	R2, R8, R9	Jakob and Krcmar (2018), Wilson and Mergel (2022)
2. Lack of resources (e.g., financial and human, vacant positions, no time and capacity)	R2, R6, R7, R8, R9	Ashaye and Irani (2019), Eynon and Dutton (2007), Jakob and Krcmar (2018), Meijer (2015), Schedler et al. (2019), Wilson and Mergel (2022)
3. Lack of local strategies and guidelines (e.g., digitalization, organizational structure, silo departments, data governance)	-	Jakob and Krcmar (2018), Lam (2005), Schedler et al. (2019), Wilson and Mergel (2022)
4. Municipal heterogeneity	R10	Carstens (2021), Eynon and Dutton (2007), Schedler et al. (2019)
5. Diverse tasks	-	Jakob and Krcmar (2018)
6. Complex structures	-	Eynon and Dutton (2007), Schedler et al. (2019), van Veenstra et al. (2011)
7. Shifting requirements	-	Jakob and Krcmar (2018), Lam (2005)
8. Resource-intensive implementation	R1, R4, R5, R6	Eynon and Dutton (2007), Lam (2005), Schedler et al. (2019)
9. Lack of skills (e.g., data literacy, technical, project management)	R3	Jakob and Krcmar (2018), Kempeneer and Heylen (2023), Schedler et al. (2019), van Veenstra et al. (2011), Wilson and Mergel (2022)
10. Implementation deficit	R1, R2, R3, R4, R5, R6, R8, R9	Schedler et al. (2019), van Veenstra et al. (2011)
11. Unattractive for innovators	R3, R4	Ebrahim and Irani (2005), Wilson and Mergel (2022)
12. Cultural resistance (e.g., fear of change and mistakes)	R4	Ashaye and Irani (2019), Kempeneer and Heylen (2023), Lam (2005), Meijer (2015), Schedler et al. (2019), van Veenstra et al. (2011), Wilson and Mergel (2022)
13. Low effects (e.g., poor cost-benefit ratio, no workload relief)	R1, R2, R6, R7, R8, R9	Jakob and Krcmar (2018), Kempeneer and Heylen (2023), Savoldelli et al. (2014), Schedler et al. (2019), van Veenstra et al. (2011)
14. Unclear benefits	R1, R2, R8, R9	Kempeneer and Heylen (2023), Lam (2005), Meijer (2015), Schedler et al. (2019), Wilson and Mergel (2022)
15. Low activation for action	R1, R2, R4, R8, R9	Schedler et al. (2019), Wilson and Mergel (2022)
16. Low management support	R2	Ashaye and Irani (2019), Meijer (2015), Schedler et al. (2019), Wilson and Mergel (2022)
17. Low workforce cooperation	R1, R4	Ashaye and Irani (2019), Eynon and Dutton (2007), Wilson and Mergel (2022)
18. Low integration maturity (e.g., legacy IT)	R5, R6	Kempeneer and Heylen (2023), Lam (2005), Savoldelli et al. (2014), Schedler et al. (2019)
19. Low agreement on standards (e.g., lack of technical regulation and standardization)	-	Bharosa (2022), Ebrahim and Irani (2005), Lam (2005), Schedler et al. (2019), Xu et al. (2025)
20. Fragmented IT landscape	-	Eynon and Dutton (2007), Lam (2005), van Veenstra et al. (2011)
21. Low usability	-	Eynon and Dutton (2007), Gil-García and Pardo (2005)
22. Lack of functionality	R7	van Veenstra et al. (2011), Wilson and Mergel (2022)
23. Lack of testbeds	R6, R7	-
24. Low political capital	R9	Ashaye and Irani (2019), Wilson and Mergel (2022)
25. Low local political support	R8, R9	Eynon and Dutton (2007), Jakob and Krcmar (2018), Meijer (2015), Savoldelli et al. (2014), Schedler et al. (2019), Wilson and Mergel (2022)
26. Legal framework (e.g., restrictions, legal uncertainties, unclear framework conditions, complex requirements)	-	Ashaye and Irani (2019), Kempeneer and Heylen (2023), Meijer (2015), Schedler et al. (2019), Wilson and Mergel (2022)
27. Local self-government	R10	Carstens (2021), Schedler et al. (2019)
28. Low superior governance (e.g., strategy, interoperability guidelines)	R10	Carstens (2021), Eynon and Dutton (2007), Schedler et al. (2019)
29. Low bargaining power	-	Kempeneer and Heylen (2023), Wilson and Mergel (2022)

and top-level management buy-in are important drivers for successful digital initiatives (Ashaye & Irani, 2019) and shows that these are preconditions for success when financial means are available.

While previous literature does not describe these barriers as cycles, those studies provide indications that the mechanisms we identify are already implicitly present in prior research: Support from local politicians is considered an indispensable precondition, as they prioritize between competing issues and allocate budgets accordingly (Jakob & Krcmar, 2018). At the same time, a lack of awareness at all levels, and particularly at the leadership level, constitutes a central barrier: where the benefits remain unclear, there is little reason to support an initiative (Wilson & Mergel, 2022). Combined with the observation that prospective managers enter public service largely underprepared for governing in the digital age (Hu, 2017) and that political incentives for digitalization are scarce (Wilson & Mergel, 2022), these findings point towards our self-reinforcing lack of local strategic commitment. The same lack of awareness recurs one level down, where it affects top management support and workforce cooperation within the administration (Wilson & Mergel, 2022). Combined with insufficient cooperation,

which frequently causes projects to fail (Ashaye & Irani, 2019), this indicates our self-reinforcing perception of ineffectiveness, to which cultural factors such as the fear of losing one's job further contribute (Ashaye & Irani, 2019). Hiring the right people is emphasized as critical, while it is simultaneously noted that government struggles to convince candidates with a strong technical background to work there (Wilson & Mergel, 2022), which suggests our self-reinforcing absence of innovators. Legacy systems, in turn, are frequently incompatible with newer solutions, while replacing them is complex and may itself fail (van Veenstra et al., 2011), which points closely towards our self-reinforcing legacy trap. Finally, the pursuit of autonomy by the states and municipalities produces an increasingly heterogeneous IT landscape and considerably complicates collaboration within the public sector (Carstens, 2021), pointing towards our self-reinforcing harmonization deficit.

5.2. Mutual reinforcement across analytical levels

Our model illustrates how institutional, organizational and cognitive components interact to sustain the identified barriers. Institutional

conditions, such as low local political support, the fragmented, small-scale structure of municipal administration, or the absence of supra-local harmonization, directly shape organizational conditions. They constrain available resources, complicate implementation, and leave municipalities with a digitalization deficit, settling for compromise solutions rather than optimal ones. These organizational constraints, in turn, shape cognitive perceptions, as the resulting compromise solutions often fail to deliver unambiguous positive effects and clear benefits. These cognitive perceptions, in turn, feed back into and reinforce the institutional and organizational conditions that produced them in the first place.

We can further integrate our findings into the ongoing debate about the relationship between structural and cultural barriers in public-sector digitalization. Prior research has offered differing views on whether structural constraints must be resolved before cultural change can occur (Borman & Janssen, 2013; Tangi et al., 2020) or whether cultural transformation must precede meaningful structural reform (Ashaye & Irani, 2019; Meijer, 2015; Weerakkody et al., 2021). Empirical work has shown that effective digitalization initiatives employ strategies that address multiple types of barriers simultaneously, such as using cultural interventions that indirectly weaken structural rigidity (Wilson & Mergel, 2022). Our model provides a unifying explanation for these observations. Because structural and cultural barriers are intertwined within reinforcing feedback loops, interventions directed at one type of barrier can propagate through the system and gradually influence others. This systemic logic is consistent with evidence that cultural change can slowly induce structural change (Pittaway & Montazemi, 2020) and it clarifies why such cross-barrier effects occur. Our model uncovers that seemingly conflicting findings in prior research can coexist because they stem from the same underlying feedback structure, making both cultural and structural interventions possible leverage points. We therefore reaffirm the importance of a holistic approach when addressing barriers to municipal digital government (Mergel et al., 2019).

5.3. Contextual variation

Beyond the overall structure of barriers and their interdependencies, we also examined whether this structure held consistently across our different empirical contexts. We analyzed differences in the mental models of municipal government and GovTech representatives, municipality size, and the type of project pursued.

All actors regularly attributed responsibility for barriers to other actors or external constraints rather than to their own scope of action, a pattern consistent with the blame-shifting dynamics that usually emerge in complex systems (Sterman, 2002). GovTech representatives tended to locate the barriers in the organizational and cultural constraints of municipalities, a perception consistent with previous research documenting how external actors entering public bureaucracies frequently perceive them as innovation-hostile and bureaucratically constrained (Mergel, 2026). Municipal governments, in turn, similarly attributed responsibility to external actors and expressed criticism of available solutions and support. Rather than a contradiction, these mutual attributions of responsibility, in which one actor cannot act because of the other and vice versa, are themselves a valid circular structure in a causal loop diagram (Sterman, 2002). Notably, municipal government representatives named all the barriers raised by GovTechs and demonstrated self-critical awareness of barriers within their own organizations. The few differences we observed appear to reflect each group's respective vantage point rather than a fundamentally divergent understanding. GovTech representatives did not raise barriers related to a lack of software functionality or to municipalities' limited bargaining power relative to providers, which is unsurprising given their commercial interests. Conversely, barriers raised exclusively by municipal government representatives concern intra-organizational and political dynamics that GovTech providers, as external actors, are not directly

exposed to. Overall, municipal governments and GovTechs appear to operate with broadly similar sectoral expectations.

Interviewees indicated that not every barrier occurs in every project, which is consistent with previous research (Eynon & Dutton, 2007; Schedler et al., 2019; van Veenstra et al., 2011). In a state-funded smart city initiative, for example, resource-related barriers were less pronounced. Similarly, a chatbot project with high public visibility may alleviate the barriers surrounding low local political support. Yet even comparatively simple digitization projects, which involve limited cultural change (Mergel et al., 2019), such as the introduction of electronic file management, can still encounter cultural resistance in our data, suggesting that barriers are not confined to particularly transformative reforms or types of projects. This may be because cultural resistance depends on how directly and visibly a project intervenes in employees' established routines. An IoT-based sensor network, for instance, may operate largely in the background and leave everyday work practices comparatively untouched. Similarly, such a system may run independently of internal administrative infrastructure and therefore generate fewer integration challenges with existing legacy systems.

Larger municipalities in our sample were generally reported to possess greater structural, financial, and technical capacity than smaller ones. This does not mean, however, that specific barriers become irrelevant for larger municipalities. Rather, municipality size appears to shift the relative weight of different barriers rather than eliminating them outright. Larger municipalities, for instance, typically employ dedicated IT experts, whereas smaller municipalities are often dependent on external providers. At the same time, larger municipalities tend to have more complex administrative structures, more pronounced silo thinking, and a substantially more intricate IT landscape, which similarly complicates the implementation of digitalization projects. In such cases, the barrier of a lack of skills becomes less pronounced, while complex structures become more salient instead. This tendency is of course not universal. We encountered smaller municipalities with a comparatively strong local economy and their own IT experts that had progressed considerably in their digitalization efforts, as well as larger municipalities where a lack of political will constrained meaningful progress.

Taken together, the overall structure of barriers and their causal links remain stable across these contexts. What varies is the concrete activation and relative weight of specific barriers depending on the particular context in which transformation efforts take place. This is consistent with contingency theory, which suggests that the effectiveness of any approach depends on the specific situational context (Donaldson, 2001). Each municipality has its own specific dynamics and therefore exhibits different prevailing barriers and feedback loops, where other barriers and loops may be less relevant.

5.4. Identification of leverage points

This context-dependency makes it also difficult to identify universally effective leverage points that would work reliably across all municipalities. Interviewees repeatedly speculated that the most promising lever would be a supra-local harmonization of technical and data standards, processes as well as legal frameworks across federal states, ending the parallel efforts that individual municipalities currently undertake by focusing on local preferences often in isolation. Achieving this, however, lies largely outside the scope of what individual municipalities or even our interviewees could bring about themselves. Still, our empirical data suggest that municipal government employees are already developing approaches that noticeably weaken individual barriers within these reinforcing cycles. In the following, we provide a few examples.

Bottom-up initiatives that give employees a visible channel to pitch their own ideas and, with sufficient, if limited, resources, can already activate contributions to digitalization efforts. Such initiatives can help counteract the implementation deficit, producing visible positive effects

and clearer benefits that, in turn, can strengthen workforce cooperation, management support and even local political support, that is, precisely the conditions that sustain R1, R2 or R8. One interviewee described how their municipality's chatbot project originated from his own idea at an internal idea workshop, providing tangible evidence that employee-driven initiatives can succeed:

"I hate doing things that a machine can do, or that a machine can do better than I can. [...] And the chatbot emerged as a result of an internal ideas contest, where I submitted this idea." (M16)

Once a solution proves genuinely convincing in practice, cultural resistance may weaken over time. One interviewee described how sustained efforts to convince employees of a new digital tool's value became self-sustaining once initial resistance was overcome, suggesting that positive examples can overcome R1:

"It took a lot of persuasion and was exhausting, but now that people are actually using it, they're realizing that it works and are very pleased with it." (M38)

Some municipalities actively counteract duplicated effort by pooling resources with neighboring municipalities rather than each independently developing parallel solutions, data centers, and processes. This reduces the practical weight of resource shortages and the resulting lack of expertise, which sustain R4, and can offer more affordable shared testbeds, weakening R6 and R7 in turn:

"The three (municipalities) of us together, exchange ideas, and then we look at what we can implement going forward, whether in the coming months or the coming years. And then we coordinate our efforts, to achieve our goals as efficiently and effectively as possible." (M35)

Even within a highly heterogeneous and fragmented IT landscape, dedicated technical expertise can enable smarter architectural solutions that reduce redundant coordination effort. One interviewee described how their municipality addressed the fragmentation arising from numerous incompatible specialized IT systems by introducing a central data hub that transforms and routes data between systems. This middleware-based approach reduces municipalities' dependence on individual vendors, shields them from the resource-intensive coordination that a fragmented IT landscape otherwise requires, and weakens the influence of legacy IT and R5:

"Our software is simply linked to the data hub, and the data hub ensures that the data comes through. If something changes in the DMS now, you don't need to worry about it at all on the front end. Instead, we'll adjust what we've built in the middle [the interface between the software and the data hub] so that it works again on the back end, and then it only needs to be adjusted in one place, not in 30." (M33)

Based on these examples, we propose several hypotheses for future research. Municipalities in which low digitalization willingness across political (R8), management (R2), or workforce (R1) levels sustains a cycle of inaction may find that low-threshold bottom-up initiatives and internal ideas contests offer a viable entry point, as they can produce visible successes with limited resources and thereby gradually shift the very conditions that sustain these cycles. Where cultural resistance among the workforce is the dominant constraint (R1), the quality and practical utility of the solution itself appears to be a decisive lever. Solutions that deliver tangible and perceptible value are likely to see resistance weaken over time, while top-down mandates that introduce poorly functioning tools risk deepening resistance further. Municipalities trapped in cycles of scarce expertise and absent innovators (R4) are likely to gain more from inter-municipal cooperation than from

isolated local efforts. Shared testbeds enabled by such cooperation also offer more affordable experimentation with solutions, which is likely to improve integration outcomes (R6) and software satisfaction (R7). Where low integration maturity across multiple legacy systems is the dominant cycle (R5) but IT expertise is available, middleware-based architectural solutions are likely to offer considerable leverage by reducing coordination overhead and vendor lock-in. Beyond these context-specific interventions, our interviewees identified several overarching levers whose effectiveness cannot be directly inferred from our data but which they considered structurally important. Supra-local harmonization of technical standards, data frameworks, and legal regulations was most frequently cited as a systemic intervention capable of targeting the conditions that generate and reproduce the barrier network as a whole, though how such harmonization can be achieved given the institutional fragmentation of the German federal context (R10) remains an open question. Inter-municipal learning formats especially for local councils and senior leaders were seen as promising for building the political (R8) and managerial (R2) recognition that releasing more resources for digitalization is necessary and worthwhile. Finally, raising public awareness of the value of digital government may represent a promising but structurally difficult lever. Greater public awareness could shift electoral incentives toward candidates who prioritize digitalization (R9) and make municipalities more attractive to culturally open-minded (R3) and digitally affine (R4) individuals, gradually shifting the workforce toward greater innovation capacity. How such awareness can be built reliably and at scale, however, remains unclear and warrants further investigation.

5.5. Theoretical implications

Theoretically, we contribute to the digital government literature by reconceptualizing barriers not as discrete and static factors, but as generative mechanisms embedded in interdependent and self-reinforcing feedback loops. This shifts the analytical lens from typologies of barriers towards a dynamic explanation for why barriers persist, even after identified and individually targeted. Rather than persisting because of their individual severity, barriers persist because they are mutually reinforced by other barriers within the same feedback structure, such that each barrier's continuation both depends on and sustains others. This perspective moves beyond the debate about whether structural or cultural change should come first. Instead of privileging one over the other, our findings show that structural and cultural conditions continuously shape and amplify each other. What matters therefore is not whether structural or cultural barriers are addressed first, but how interventions align with the specific reinforcing mechanisms in which both are embedded. By revealing these mutual influences, our model provides a holistic foundation for understanding how change, or its absence, propagates through the system.

Yet no single actor commands more than a fragment of these feedback structures. The loops we identify span multiple actors, several of which cut across our analytical domains, leaving each actor with a limited sphere of influence (Schedler et al., 2019). Because actors habitually locate barriers upstream of themselves, what becomes visible to them is predominantly what lies beyond their own reach, and the perceived powerlessness reported across our interviews is therefore in part an artifact of this direction of attention. Representing barriers as directed relations makes the opposite direction analytically visible: each actor not only encounters constraints, but constitutes an antecedent for others within the same feedback structure. Read in this direction, digital stagnation appears as a collective action problem in which each actor must contribute without certainty about what the system returns (Hardin, 2015). Within a reinforcing loop, each actor thus has reason to await movement from those upstream, and the structure persists without any actor behaving unreasonably.

Although our analysis focuses on the German context, the barriers identified in this study closely mirror those documented in international research (Ashaye & Irani, 2019; Kempeneer & Heylen, 2023;

Lam, 2005; Meijer, 2015; Schedler et al., 2019; van Veenstra et al., 2011; Wilson & Mergel, 2022). Given this strong convergence, it is likely that similar explanation patterns and feedback structures also operate in other administrative settings.

5.6. Practical implications

Our model also offers practical value as an explanatory framework for understanding why specific barriers to digital transformation arise and endure. Although the number of perceived barriers may seem overwhelming, our systemic perspective allows practitioners encountering a particular barrier in their own organization to consult the causal structures we identify and examine whether its antecedents are present in their own context. This offers a concrete explanation for why that barrier emerged, and why it persists even though it may have already been identified and individually addressed. This shifts attention away from treating each obstacle as an isolated problem to be solved in itself, and toward recognizing how it is sustained by, and in turn sustains, other barriers within the same feedback structure. Understanding these systemic interdependencies does not by itself resolve digital stagnation, but it equips practitioners with a more accurate basis for reasoning about why previous efforts may have failed and where future interventions might plausibly need to engage with the underlying reinforcing dynamics, rather than addressing visible symptoms alone.

Rather than consulting our model only to identify further antecedents of the barriers they face, practitioners can read it in the opposite direction. Tracing outgoing rather than incoming relations allows actors to ask whom their own practices constrain, and which actors depend on their cooperation in order to make progress.

5.7. Limitations and outlook

Our study is interpretive in nature and we do not claim universal generalization or comprehensiveness of our model, which imposes several limitations that also open up promising avenues for future research.

Our model reflects perceived rather than empirically verified causality. The causal relationships depicted reconstruct a collectively shared mental model, that is, how interviewees perceive, explain, and make sense of barriers to digitalization, rather than causal effects derived from independent empirical measurement. Future research could complement our interpretive approach with methods capable of empirically testing the perceived relationships identified here. Yet, the challenge here is a lack of shared understanding of what should be measured. Therefore, the created shared mental model is a useful approximation.

Our findings are grounded in the German context, a federal state in which municipalities are constitutionally guaranteed the right to self-government and are responsible for driving their own digitalization efforts (Ogonek & Becker, 2018). This institutional context shapes both the barriers we identified and the mechanisms connecting them. As captured in Subsystem 3 (Political governance & public), Germany's decentralized governance structure gives rise to a fragmented landscape in which local rules, processes, and technical solutions are developed often independently and in parallel across municipalities and GovTechs, producing substantial divergence and persistent harmonization deficits. These dynamics, in turn, propagate through the whole system. In more centralized administrative systems, the specific configuration of barriers may differ. Harmonization deficits and their downstream effects may be less pronounced or absent, while other barriers tied to centralized bureaucratic control may become more salient instead. Transferability to such contexts may therefore be limited in terms of the specific causal structures identified. At the same time, the individual barriers documented in this study closely mirror those reported in more centralized administrative systems (Ashaye & Irani, 2019; Makki & Alqahtani, 2022; Meijer, 2015; Tangi et al., 2020; van Veenstra et al., 2011; Xu et al., 2025), suggesting that similar explanation patterns and

feedback structures may operate across other administrative settings as well. Future research could examine whether this is indeed the case, particularly in contexts with more centralized governance structures.

The resulting model remains an abstraction that simplifies complex organizational and institutional realities. Although this abstraction is necessary to identify overarching mechanisms of reinforcement, it inevitably omits contextual nuances, situational variations, and local contingencies that might trigger, alter, or weaken individual feedback loops. Relatedly, since constructing this model from qualitative data is itself an interpretive act, other researchers coding the same interview material might identify a different configuration of contextual nuances or draw different boundaries around individual feedback loops. Future research could address this limitation by conducting detailed case studies or ethnographic analyses that examine how specific organizational and institutional conditions shape or disrupt particular reinforcing dynamics.

Our consolidated causal map aggregates perspectives across interviewees, potentially obscuring differences between individual municipalities, professional roles, and stakeholder groups. While we distinguished barriers mentioned by municipal government and GovTech representatives in Table 4, the causal loops themselves represent a synthesized, collective mental model rather than distinct configurations for each municipality or stakeholder group. Not all dynamics will necessarily be present in every municipality and every municipality will be affected by some of the cycles more than by others. Future research could disaggregate this model to examine whether and how the strength, presence, or configuration of individual feedback loops varies systematically across municipalities of different sizes, administrative capacities, or stakeholder perspectives. Further, it may be worthwhile to develop analytical tools that allow municipalities to position themselves on the causal map to identify their most influential set of barriers.

Our model primarily focuses on internal municipal dynamics and therefore does not systematically incorporate external shocks, macro-level conditions or supra-local regulations. Factors such as demographic shifts, labor-market shortages, crises or EU and federal mandates likely interact with local administrative structures in ways that reshape or intensify barrier dynamics. Since these environmental factors were not explicitly modeled, future studies should investigate how exogenous pressures enter and influence feedback loops, as well as how multi-level governance conditions either constrain or enable digital transformation efforts.

Our study relies on interview data collected at a single point in time. Although the persistence of barriers to digital government is well grounded in decades of cumulative literature documenting their recurrence (Kempeneer & Heylen, 2023; Wilson & Mergel, 2022), our cross-sectional design does not allow us to directly observe whether and how these feedback loops actually unfold or evolve over time. Longitudinal data collection, revisiting the same municipalities and interviewees at multiple points in time, would allow future research to empirically validate how the reinforcing dynamics identified here sustained themselves as described, or could be overcome through targeted interventions.

Our model shows how barriers reinforce one another. However, our data does not allow us to identify which interventions would be effective in breaking reinforcing cycles. While understanding the structure of self-reinforcing mechanisms is a necessary first step, it does not by itself reveal where the relevant leverage points for intervention lie in a particular municipality. While we can hypothesize based on our results, future work may validate intervention points, explore enabling mechanisms that could counteract stagnation, and examine practical strategies for initiating and sustaining positive feedback loops in municipal digital government.

Finally, the study does not include stock-and-flow modeling or simulation, meaning that quantified temporal aspects and delays remain unexplored. As a result, the model does not reveal how interventions

evolve over time or how the system behaves under different conditions. Future research could build on the causal structure presented to develop simulation models capable of testing “what-if” scenarios, identifying bottlenecks or tipping points and assessing the long-term effects of various policy interventions, thereby providing deeper insights into the temporal behavior of barrier mechanisms and strengthening the practical applicability of the system perspective.

6. Conclusion

In this study, we examine why barriers to municipal digital government persist. While prior research has identified numerous obstacles, the underlying causes of barriers and why they persist despite repeated efforts to address them remains unclear. Our findings suggest that this persistence is not driven by the severity of individual barriers, but by their embeddedness in a network of interdependent barriers that create self-reinforcing feedback loops, reproducing and stabilizing digital stagnation over time. By reconstructing the shared mental models of 67 municipal employees and GovTech providers, we move beyond descriptive barrier typologies and offer a dynamic explanation of persistence. Rather than addressing barriers in isolation, our model allows researchers and practitioners to consider how they reinforce one another within the broader system. These contributions rest on an interpretive reconstruction: our model depicts perceived rather than independently measured causality, aggregates individual accounts into one collective map, and represents one defensible reading of the material rather than the only one. It is further bounded by its empirical scope, capturing the internal dynamics of a strongly decentralized administrative system at a single point in time, and it explains how barriers sustain one another without specifying which interventions would break them or how the system would behave over time. Future research could therefore test the perceived relationships through independent measurement, disaggregate the model across municipalities and stakeholder groups, examine whether comparable structures operate under more centralized governance and how exogenous pressures enter them, and extend the causal structure into longitudinal designs and stock-and-flow simulations capable of identifying and testing leverage points. This would further empirically strengthen the developed theoretical model and provide more understanding towards how digitalization barriers in municipal digital governments can be overcome.

CRedit authorship contribution statement

Fabian Steinert: Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Philipp Staudt:** Writing – review & editing, Methodology, Investigation, Conceptualization, Supervision.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work the authors used ChatGPT, Grammarly and DeepL for minor linguistic improvements that did not influence the intellectual content of the paper. After using these services, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

- Al-Emadi, A., & Anouze, A. L. (2018). Grounded theory analysis of successful implementation of E-government projects. *International Journal of Electronic Government Research*, 14(1), 23–52. <http://dx.doi.org/10.4018/ijegr.2018010102>.
- Andersen, D. L., Luna-Reyes, L. F., Diker, V. G., Black, L., Rich, E., & Andersen, D. F. (2012). The disconfirmatory interview as a strategy for the assessment of system dynamics models. *System Dynamics Review*, 28(3), 255–275. <http://dx.doi.org/10.1002/sdr.1479>.
- Ashaye, O. R., & Irani, Z. (2019). The role of stakeholders in the effective use of e-government resources in public services. *International Journal of Information Management*, 49, 253–270. <http://dx.doi.org/10.1016/j.ijinfomgt.2019.05.016>.
- Berman, S. J. (2012). Digital transformation: opportunities to create new business models. *Strategy & Leadership*, 40(2), 16–24. <http://dx.doi.org/10.1108/10878571211209314>.
- Bharosa, N. (2022). The rise of GovTech: Trojan horse or blessing in disguise? A research agenda. *Government Information Quarterly*, 39(3), <http://dx.doi.org/10.1016/j.giq.2022.101692>.
- BMJ (2017). Gesetz zur Verbesserung des Onlinezugangs zu Verwaltungsleistungen [Act to improve online access to administrative services]. URL <https://www.gesetze-im-internet.de/ozg/BjNR313800017.html>.
- Bogner, A., Littig, B., & Menz, W. (2009). Introduction: Expert interviews — An introduction to a new methodological debate. In *Interviewing experts* (pp. 1–13). http://dx.doi.org/10.1057/9780230244276_1.
- Borman, M., & Janssen, M. (2013). Reconciling two approaches to critical success factors: The case of shared services in the public sector. *International Journal of Information Management*, 33(2), 390–400. <http://dx.doi.org/10.1016/j.ijinfomgt.2012.05.012>.
- Carstens, N. (2021). Digitalisation labs: A new arena for policy design in German multilevel governance. *German Politics*, 32(2), 249–266. <http://dx.doi.org/10.1080/09644008.2021.1887851>.
- Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum*, 41(5), 545–547. <http://dx.doi.org/10.1188/14.ONF.545-547>, URL <https://www.ncbi.nlm.nih.gov/pubmed/25158659>.
- Corbin, J. M., & Strauss, A. L. (2015). Basics of qualitative research : techniques and procedures for developing grounded theory, In *Core textbook*, (4th ed.). Los Angeles ; London: SAGE.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: qualitative, quantitative, and mixed methods approaches*. Los Angeles London New Delhi Singapore Washington DC Melbourne: SAGE Publications.
- Criado, J. I., & Villodre, J. (2022). Revisiting social media institutionalization in government. An empirical analysis of barriers. *Government Information Quarterly*, 39(2), <http://dx.doi.org/10.1016/j.giq.2021.101643>.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), <http://dx.doi.org/10.2307/249008>.
- Donaldson, L. (2001). *The contingency theory of organizations*. <http://dx.doi.org/10.4135/9781452229249>.
- Dunleavy, P., Margetts, H., Bastow, S., & Tinkler, J. (2006). New public management is dead—long live digital-era governance. *Journal of Public Administration Research and Theory*, 16(3), 467–494. <http://dx.doi.org/10.1093/jopart/mui057>.
- Ebrahim, Z., & Irani, Z. (2005). E-government adoption: Architecture and barriers. *Business Process Management Journal*, 11(5), 589–611. <http://dx.doi.org/10.1108/14637150510619902>.
- Eker, S., & Zimmermann, N. (2016). Using textual data in system dynamics model conceptualization. *Systems*, 4(3), <http://dx.doi.org/10.3390/systems4030028>.
- European Commission (2026). 2026 Country report – Germany. Accompanying the document: Recommendation for a council recommendation on the economic, social, employment, structural and budgetary policies of Germany: Report, URL [https://ec.europa.eu/transparency/documents-register/detail?ref=SWD\(2026\)205&lang=en](https://ec.europa.eu/transparency/documents-register/detail?ref=SWD(2026)205&lang=en).
- European Union (2018). Regulation (EU) 2018/1724 of the European Parliament and of the Council. URL <https://eur-lex.europa.eu/eli/reg/2018/1724/oj>.
- Eynon, R., & Dutton, W. H. (2007). Barriers to networked governments: Evidence from Europe 1. *Prometheus*, 25(3), <http://dx.doi.org/10.1080/08109020701531361>.

- Eynon, R., & Margetts, H. (2007). Organisational solutions for overcoming barriers to e-government. *European Journal of EPractice*, (1).
- Forrester, J. W. (1961). *Industrial dynamics*. Cambridge, Mass.: MIT Press.
- Fountain, J. E. (2001). *Building the virtual state: Information technology and institutional change*. Brookings Institution Press.
- Gil-García, J. R., & Pardo, T. A. (2005). E-government success factors: Mapping practical tools to theoretical foundations. *Government Information Quarterly*, 22(2), 187–216. <http://dx.doi.org/10.1016/j.giq.2005.02.001>.
- Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Mill Valley, CA: Sociology Press.
- Hardin, R. (2015). *Collective action*. <http://dx.doi.org/10.4324/9781315044330>.
- Hu, Q. (2017). Preparing public managers for the digital era: incorporating information management, use, and technology into public affairs graduate curricula. *Public Management Review*, 20(5), 766–787. <http://dx.doi.org/10.1080/14719037.2017.1327180>.
- Irani, Z., Abril, R. M., Weerakkody, V., Omar, A., & Sivarajah, U. (2023). The impact of legacy systems on digital transformation in European public administration: Lesson learned from a multi case analysis. *Government Information Quarterly*, 40(1), <http://dx.doi.org/10.1016/j.giq.2022.101784>.
- Jakob, M., & Krcmar, H. (2018). Which barriers hinder a successful digital transformation in small and medium-sized municipalities in a federal system? *Central and Eastern European EDem and EGov Days*, 331, 141–150. <http://dx.doi.org/10.24989/ocg.v33i.12>.
- Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Government Information Quarterly*, 32(3), 221–236. <http://dx.doi.org/10.1016/j.giq.2015.07.001>.
- Kempeneer, S., & Heylen, F. (2023). Virtual state, where are you? A literature review, framework and agenda for failed digital transformation. *Big Data & Society*, 10(1), <http://dx.doi.org/10.1177/2053951723116052>.
- Kim, H., & Andersen, D. F. (2012). Building confidence in causal maps generated from purposive text data: mapping transcripts of the federal reserve. *System Dynamics Review*, 28(4), 311–328. <http://dx.doi.org/10.1002/sdr.1480>.
- Klein, H. K., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly*, 23(1), <http://dx.doi.org/10.2307/249410>.
- Kong, I., Janssen, M., & Bharosa, N. (2024). Realizing quantum-safe information sharing: Implementation and adoption challenges and policy recommendations for quantum-safe transitions. *Government Information Quarterly*, 41(1), <http://dx.doi.org/10.1016/j.giq.2023.101884>.
- Kropp, S. (2026). Digitalization in the german federal system: Progress at a snail's pace? In *The forum of federations handbook on digitalization in public administration of federal countries* (pp. 111–135). http://dx.doi.org/10.1007/978-3-032-03880-7_5.
- Kshetri, N., Dwivedi, Y. K., & Janssen, M. (2024). Metaverse for advancing government: Prospects, challenges and a research agenda. *Government Information Quarterly*, 41(2), <http://dx.doi.org/10.1016/j.giq.2024.101931>.
- Lam, W. (2005). Barriers to e-government integration. *Journal of Enterprise Information Management*, 18(5), 511–530. <http://dx.doi.org/10.1108/17410390510623981>.
- Larsen, A. G., & Følstad, A. (2024). The impact of chatbots on public service provision: A qualitative interview study with citizens and public service providers. *Government Information Quarterly*, 41(2), <http://dx.doi.org/10.1016/j.giq.2024.101927>, URL <https://www.sciencedirect.com/science/article/pii/S0740624X24000194?via%3Dihub>.
- Luna-Reyes, L. F., Andersen, D. F., Black, L. J., & Pardo, T. A. (2021). Sensemaking and social processes in digital government projects. *Government Information Quarterly*, 38(2), <http://dx.doi.org/10.1016/j.giq.2021.101570>.
- Luna-Reyes, L. F., & Gil-García, J. R. (2014). Digital government transformation and internet portals: The co-evolution of technology, organizations, and institutions. *Government Information Quarterly*, 31(4), 545–555. <http://dx.doi.org/10.1016/j.giq.2014.08.001>.
- Makki, A. A., & Alqahtani, A. Y. (2022). Modeling the barriers surrounding digital government implementation: Revealing prospect opportunities in Saudi Arabia. *Sustainability*, 14(23), <http://dx.doi.org/10.3390/su142315780>.
- Meijer, A. (2013). From hero-innovators to distributed heroism: An in-depth analysis of the role of individuals in public sector innovation. *Public Management Review*, 16(2), 199–216. <http://dx.doi.org/10.1080/14719037.2013.806575>.
- Meijer, A. (2015). E-governance innovation: Barriers and strategies. *Government Information Quarterly*, 32(2), 198–206. <http://dx.doi.org/10.1016/j.giq.2015.01.001>.
- Mellon, J., Sjöberg, F. M., Peixoto, T., & Lueders, J. (2025). The haves and the have nots: Civic technologies and the pathways to government responsiveness. *Government Information Quarterly*, 42(1), <http://dx.doi.org/10.1016/j.giq.2025.102007>.
- Mergel, I. (2026). Cultural humility in agile work practices. *Public Management Review*, 1–31. <http://dx.doi.org/10.1080/14719037.2026.2676775>.
- Mergel, I., Edelmann, N., & Haug, N. (2019). Defining digital transformation: Results from expert interviews. *Government Information Quarterly*, 36(4), <http://dx.doi.org/10.1016/j.giq.2019.06.002>.
- Ogonek, N., & Becker, J. (2018). Can we learn from down under how to rise up in E-government? A comparative analysis of the public sector competences in the german and Australian higher education systems. <http://dx.doi.org/10.24251/hicss.2018.283>.
- Oschinsky, F. M., Stelter, A., & Niehaves, B. (2021). Cognitive biases in the digital age – how resolving the status quo bias enables public-sector employees to overcome restraint. *Government Information Quarterly*, 38(4), <http://dx.doi.org/10.1016/j.giq.2021.101611>.
- Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm Policy Ment Health*, 42(5), 533–544. <http://dx.doi.org/10.1007/s10488-013-0528-y>, URL <https://www.ncbi.nlm.nih.gov/pubmed/24193818>.
- Pittaway, J. J., & Montazemi, A. R. (2020). Know-how to lead digital transformation: The case of local governments. *Government Information Quarterly*, 37(4), <http://dx.doi.org/10.1016/j.giq.2020.101474>.
- Ram, S., & Sheth, J. N. (1989). Consumer resistance to innovations: The marketing problem and its solutions. *Journal of Consumer Marketing*, 6(2), 5–14. <http://dx.doi.org/10.1108/eum0000000002542>.
- Rjab, A. B., Mellouli, S., & Corbett, J. (2023). Barriers to artificial intelligence adoption in smart cities: A systematic literature review and research agenda. *Government Information Quarterly*, 40(3), <http://dx.doi.org/10.1016/j.giq.2023.101814>.
- Rogers, E. M. (2010). *Diffusion of innovations* (4th ed.). New York: Free Press.
- Rubin, H. J., & Rubin, I. S. (2012). *Qualitative interviewing: The art of hearing data: vol. 3*, SAGE Publications, Inc..
- Saldaña, J. (2013). *The coding manual for qualitative researchers* (2nd ed.). Los Angeles, Calif.: SAGE.
- Savoldelli, A., Codagnone, C., & Misuraca, G. (2014). Understanding the e-government paradox: Learning from literature and practice on barriers to adoption. *Government Information Quarterly*, 31, S63–S71. <http://dx.doi.org/10.1016/j.giq.2014.01.008>.
- Schedler, K., Guenduez, A. A., & Frischknecht, R. (2019). How smart can government be? Exploring barriers to the adoption of smart government. *Information Polity*, 24(1), 3–20. <http://dx.doi.org/10.3233/ip-180095>.
- Schwester, R. (2009). Examining the barriers to e-government adoption. *Electronic Journal of E-Government*, 7, 113–122.
- Selten, F., & Klievink, B. (2024). Organizing public sector AI adoption: Navigating between separation and integration. *Government Information Quarterly*, 41(1), <http://dx.doi.org/10.1016/j.giq.2023.101885>.
- Shareef, M. A., Kumar, V., Kumar, U., & Dwivedi, Y. K. (2011). e-Government adoption model (GAM): Differing service maturity levels. *Government Information Quarterly*, 28(1), 17–35. <http://dx.doi.org/10.1016/j.giq.2010.05.006>.
- Sousa, W. G. d., Melo, E. R. P. d., Bermejo, P. H. D. S., Farias, R. A. S., & Gomes, A. O. (2019). How and where is artificial intelligence in the public sector going? A literature review and research agenda. *Government Information Quarterly*, 36(4), <http://dx.doi.org/10.1016/j.giq.2019.07.004>.
- Starks, H., & Trinidad, S. B. (2007). Choose your method: a comparison of phenomenology, discourse analysis, and grounded theory. *Qualitative Health Research*, 17(10), 1372–1380. <http://dx.doi.org/10.1177/1049732307307031>, URL <https://www.ncbi.nlm.nih.gov/pubmed/18000076>.
- Sterman, J. (2002). *Business dynamics, system thinking and modeling for a complex world: Report*, Massachusetts Institute of Technology.
- Stroh, D. P. (2015). *Systems thinking for social change: A Practical guide to solving complex problems, avoiding unintended consequences, and achieving lasting results*. Chelsea Green Publishing.
- Tangi, L., Janssen, M., Benedetti, M., & Noci, G. (2020). Barriers and drivers of digital transformation in public organizations: Results from a survey in the Netherlands. In *Lecture notes in computer science, Electronic government* (pp. 42–56). http://dx.doi.org/10.1007/978-3-030-57599-1_4.
- Tangi, L., Janssen, M., Benedetti, M., & Noci, G. (2021). Digital government transformation: A structural equation modelling analysis of driving and impeding factors. *International Journal of Information Management*, 60, <http://dx.doi.org/10.1016/j.ijinfomgt.2021.102356>.
- Turner, B. L., Kim, H., & Andersen, D. F. (2014). Improving coding procedures for purposive text data: researchable questions for qualitative system dynamics modeling. *System Dynamics Review*, 29(4), 253–263. <http://dx.doi.org/10.1002/sdr.1506>.
- UNDPEPA (2001). *Benchmarking E-government: A global perspective: Assessing the progress of the UN member states: Report*, UNDPEPA, <http://dx.doi.org/10.18356/9789210016322>, URL <https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/English.pdf>.
- United Nations (2024). *E-Government survey 2024: Accelerating digital transformation for sustainable development: Report*, United Nations Department of Economic and Social Affairs, URL <https://publicadministration.un.org/egovkb/en-us/reports/un-e-government-survey-2024>.
- van Donge, W., Bharosa, N., & Janssen, M. F. W. H. A. (2022). Data-driven government: Cross-case comparison of data stewardship in data ecosystems. *Government Information Quarterly*, 39(2), <http://dx.doi.org/10.1016/j.giq.2021.101642>.
- van Veenstra, A. F., Klievink, B., & Janssen, M. (2011). Barriers and impediments to transformational government: insights from literature and practice. *Electronic Government, an International Journal*, 8(2/3), <http://dx.doi.org/10.1504/eg.2011.039838>.
- Von Bertalanffy, L. (1972). The history and status of general systems theory. *Academy of Management Journal*, 15(4), 407–426. <http://dx.doi.org/10.2307/255139>.

- Weerakkody, V., & Dhillon, G. (2008). Moving from E-government to T-government. *International Journal of Electronic Government Research*, 4(4), 1–16. <http://dx.doi.org/10.4018/jegr.2008100101>.
- Weerakkody, V., El-Haddadeh, R., Sivarajah, U., Omar, A., & Molnar, A. (2019). A case analysis of E-government service delivery through a service chain dimension. *International Journal of Information Management*, 47, 233–238. <http://dx.doi.org/10.1016/j.ijinfomgt.2018.11.001>.
- Weerakkody, V., Janssen, M., & El-Haddadeh, R. (2021). The resurgence of business process re-engineering in public sector transformation efforts: exploring the systemic challenges and unintended consequences. *Information Systems and E-Business Management*, 19(3), 993–1014. <http://dx.doi.org/10.1007/s10257-021-00527-2>.
- Weick, K. E. (1995). Sensemaking in organizations. In *Foundations for organizational science*, Thousand Oaks, CA: Sage Publications.
- West, D. M. (2005). *Digital government: Technology and public sector performance*. Princeton: Princeton University Press, <http://dx.doi.org/10.1515/9781400835768>.
- Wilson, C., & Mergel, I. (2022). Overcoming barriers to digital government: mapping the strategies of digital champions. *Government Information Quarterly*, 39(2), <http://dx.doi.org/10.1016/j.giq.2022.101681>, URL <https://www.sciencedirect.com/science/article/pii/S0740624X22000144?via%3Dihub>.
- Xu, S., Liu, J., Li, S., & Zheng, Y. (2025). Barriers to and mechanism for open government data use by the private sectors: A grounded theory approach. *Government Information Quarterly*, 42(3), <http://dx.doi.org/10.1016/j.giq.2025.102044>.
- Yearworth, M., & White, L. (2013). The uses of qualitative data in multimethodology: Developing causal loop diagrams during the coding process. *European Journal of Operational Research*, 231(1), 151–161. <http://dx.doi.org/10.1016/j.ejor.2013.05.002>.
- Zanker, M., & Bureš, V. (2022). Knowledge management as a domain, system dynamics as a methodology. *Systems*, 10(3), <http://dx.doi.org/10.3390/systems10030082>.

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