

Research Article

Digital Transformation and Public Service Performance: A Cross-National Configurational Analysis

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Abstract: Digital transformation has become a central component of public administration reform, yet its contribution to public service performance remains dependent on institutional capacity and citizen engagement. This study examines the relationship between digital transformation and public service performance, focusing on the institutional and technological conditions associated with better outcomes across European countries. Drawing on 124 country-year observations from 31 countries over four biennial waves between 2018 and 2024, the research integrates data from the United Nations E-Government Development Index, Eurostat digital public service indicators, and the World Bank Worldwide Governance Indicators. The methodological framework combines ordinary least squares regression, cross-group comparisons, and Necessary Condition Analysis to examine statistical associations, performance differences, and minimum conditions for achieving high public service performance. The findings reveal strong positive associations between digital transformation, governance quality, and public service performance, with the combined regression model explaining 99.8% of the variance in the composite performance index. Significant differences are identified across digital capacity groups, with high-digital observations outperforming moderate- and low-digital observations. Necessary Condition Analysis identifies governance quality as the strongest performance bottleneck ($d = 0.073$), followed by citizen e-government interaction ($d = 0.034$) and digital transformation ($d = 0.033$). The findings further indicate that reaching the 90th percentile of public service performance requires minimum levels of governance quality (0.850), digital transformation (0.841), and citizen e-government interaction (89.0%). The study contributes to digital governance research by integrating statistical associations and necessary-condition thresholds within a cross-national analytical framework. It highlights the importance of aligning technological development with institutional effectiveness and citizen participation to improve public service performance.

Keywords: public service performance; e-government; multi-group SEM; necessary condition analysis; governance indicators; configurational analysis

Received: July 23, 2026
Accepted: September 29, 2026
Published: September 30, 2026



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1. Introduction

Public organisations in Europe and other OECD-style democratic countries are facing increasingly high expectations to deliver faster, simpler, fairer and more responsive services for citizens and businesses. Digital transformation has, therefore, emerged as one of the key reform agendas in modern public management. But it has a wider significance than the digitisation of paper-based processes. The public sector digital transformation is defined by Mergel et al. (2019) as an organisational change process undertaken through administrative redesign, service innovation, and new forms of managerial coordination. Vial (2019) similarly claims that digital transformation changes the organisation's properties and creates value through the strategic use of digital technologies. Recent comparative indicators illustrate the scope of this reform program. The United Nations E-Government Development Index (UN E-GDI) showed an increase in the average score from 0.5541 in 2018 to 0.6382 in 2024, and the percentage of the EU population using the Internet to interact with public authorities grew from around 59.8% in 2018 to 70.0% in 2024 (Eurostat, 2026; United Nations Department of Economic and Social Affairs, 2024). The real public management challenge, however, is not only whether governments will embrace digital technologies, but also whether they can translate digital capacity into better public service outcomes. Digital-era governance differs from managerial reforms of the past, which drew a distinction between service

integration, needs-based design, and digitalisation (Dunleavy et al., 2006).

However, high digital maturity does not necessarily translate into public value if institutions are not held to account, if citizens do not use online services, and/or if administrative systems are not organised to translate digital capability into reliable, inclusive and high-quality services. This problem is well exemplified in the data used in this article. The overall mean for the Digital Transformation Index (DTI) in the public service is 0.670 (SD = 0.139), but performance levels across countries range from 0.293 in Romania (2018) to 0.924 in Denmark (2024). This variation indicates that an investment in digital alone is not enough to account for performance outcomes.

This article explores how the performance of public services in 31 European countries has evolved over four waves, between 2018 and 2024, and under what conditions digital transformation has been beneficial. The argument is configurational: digital maturity is believed to drive better performance only in the context of high institutional quality, widespread digital inclusion and positive digital use. This expectation follows a discussion by Meijer and Bolívar (2016) that democratic, administrative and technological conditions influence the design of smart governance initiatives. Consequently, the same degree of digital maturity can lead to different performance outcomes across national contexts. The main research question is: What are the conditions under which digital and institutional transformation can improve public service performance in European states? There are three subsidiary questions to guide the analysis. First, is there a direct link between digital transformation and public service performance, after controlling for the quality of governance? Second, are there differences across country groups in the structural relationships of digital capacity? Third, what are the digital and governance conditions for high performance of public services?

The article contributes to the research in public management and digital government in three ways. First, it brings together knowledge from the fields of digital government and public service performance theory, and treats digital transformation as a capacity that must be translated into public value at the institutional level. Second, it integrates regression-based structural inference with necessary condition analysis, enabling the study to estimate both net effects and binding performance bottlenecks. Third, it provides an empirical protocol that is transparent and reproducible, based on four harmonised sources from a panel of 31 European countries. It is here that the article diverts from the notion that achieving digital maturity necessarily results in better public services, and presents a more conditional argument for the benefits of digital transformation for public administration performance, when and how.

2. Theoretical Background

2.1. Digital Transformation as a Public-Sector Capability: From Stages to Contextualised Value

The digital transformation of government is often described in purely technological terms, which is incorrect. The seminal work on the growth of the foundational stages offers a useful basis for analysing the development of digital government and, at the same time, highlights the shortcomings of technology-based explanations. Layne and Lee (2001) introduced a popular idea about the four stages of cataloguing, transaction, vertical integration, and horizontal integration, proposing that governments would move from a basic online presence to full integration with digital services. Andersen and Henriksen (2006) further developed this concept and classified their maturity model into catalogue, transaction, and integration stages. Moon (2002) described five evolutionary phases, ranging from simple information dissemination to political participation.

Further studies, however, have revealed that this sequence is not guaranteed or inevitable. The stages hypothesis, however, was criticised by Scholl (2006), who considered it too deterministic, as the real-world implementation of e-government frequently faces institutional challenges, coordination problems and implementation hurdles. Building on this critique, Janowski (2015) showed that digital government is not about technology, but is a shift from digitisation to engagement and public value, driven by organisational forces, administrative capabilities and contextual constraints. Tangi et al. (2021) also demonstrate that, beyond technology, organisational readiness, institutional support, and user demands are critical to digital government transformation.

A capability-based approach is therefore particularly suited to the public administration.

According to Teece et al. (1997), the concept of dynamic capabilities is defined as the capacity to integrate, develop and reconfigure internal and external competences to address dynamic environments. In the public sector, this means having the ability to identify opportunities to improve digital services, to gather service-improvement resources for implementation, and to rethink administrative processes in ways that will continue to support digital service innovation over time (Teece, 2007). There can be no simple formula for government success when introducing digital tools. The interoperable data systems, the competences of the people involved, the legal right, the infrastructure, the design of the services offered and the mechanisms of accountability are all essential for the effective implementation of digital transformation (Mergel et al., 2019).

This research views public service performance as the ability of public administration to provide reliable, accessible, responsive and effective service. Osborne (2010) maintains that public service provision is now networked, co-produced, and user-oriented in creating value, as opposed to one-way provision by a bureaucracy. Bryson et al. (2014) highlight three key factors for creating public value: authorising environments, operational capacity, and public legitimacy. Twizeyimana and Andersson (2019) also demonstrate that the public value of e-government is multidimensional, encompassing administrative efficiency, service quality, transparency, and citizen participation. These are bases for a multidimensional understanding that guides the measurement strategy applied in this article: the Public Service Performance Index (PSP) is based on governance quality (measured by Worldwide Governance Indicators (WGI) government effectiveness (GE), digital infrastructure (E-GDI), and service use behaviour (Eurostat measures of interaction with public services and form submission on the Internet).

2.2. Institutional Quality and the Conversion of Digital Capacity: Governance as Enabling Constraint

Digital systems are not in isolation, and institutional quality is predicted to influence the impact of digitalisation on public service performance. North (1990) describes institutions as the “rules of the game in a society,” which are human-designed constraints that govern political, economic, and social interactions. This definition is crucial to the current context because it helps to differentiate between formal institutions (laws, regulations, organisational structures) and informal institutions (norms, conventions, codes of conduct). These two dimensions affect the outcomes of digital investments and their tangible impact on public service delivery. Fukuyama (2013) defines governance as the ability to make and execute policy, and not the extent of state activity or the kind of political system.

As part of digital public services, governance capacity is expressed through cross-agency coordination, data quality, user security, legal clarity, and monitoring and correction of service failures. For this analysis, it is convenient to use a four-level institutional framework (Williamson, 2000). There are four levels of social embeddedness: norms, customs, and traditions (Level 1); institutional environment (Level 2); governance (Level 3); and resource allocation and employment (Level 4). Digital transformation works best at Levels 3 and 4 (Administrative coordination & resource deployment), but it hinges on the deeper-level institutional quality embedded in Levels 1 and 2.

According to Scott (2014), there are three institutional pillars that define organisational behaviour: regulatory, normative and cognitive. In the context of digital government, the regulative pillar also refers to data protection regulations, interoperability requirements, procurement regulations, and legal obligations for service integration. The normative pillar refers to professional standards, administrative values, and expectations of justice, responsiveness, and service quality. The cognitive pillar concerns commonly held beliefs about the legitimacy, usefulness, and reliability of digital channels. Governments can create digital platforms with formal existence but without public value when these pillars are missing. They may lack citizens’ trust, show inconsistency by civil servants, and be too fractured in their legal or organisational structures. Another layer of conditioning is administrative tradition, which influences the relationship between digital transformation and performance.

Painter and Peters (2010) provide evidence that reform capacities, coordination styles, and institutional constraints differ across Anglo-American, Napoleonic, Germanic, Scandinavian, and East Asian traditions. The Scandinavian tradition, which is linked to high levels of trust, local autonomy, and consensual decision-making, can support digital

transformation by enabling inter-agency cooperation and integrating services for the user. In contrast, an agile, iterative, and user-centred approach to digital service design may be more challenging to implement within the context of Napoleonic administrative traditions that are more formalistic and centralised (Mergel et al., 2021). Such differences, rooted in tradition, can help account for variation in public service performance outcomes between countries with similar E-GDI scores. Institutional quality is also important, as digital systems can reinforce or exacerbate administrative exclusion. Peeters and Widlak (2018) demonstrate how information architecture can produce exclusion when citizens cannot navigate, contest, or correct administrative decisions within a digital system.

Without adequate transparency, accountability and protections, automated public systems can exacerbate inequality when used among vulnerable populations (Gordon, 2019). The lessons to be drawn from these insights are that the quality of institutions, rather than background control, must be seen as a core explanatory condition. Based on this, the study presents a modelling approach to institutional quality that can serve as a direct determinant of public service performance and as a possible moderator of the relationship between digital transformation and public service performance. The institutional conversion argument is that good institutions help to realise public value from digital maturity, whilst weak institutions create digital façades – platforms that are visible but lack the ability to provide reliable, inclusive and effective services.

2.3. Digital Inclusion, User Uptake, and the Second-Level Divide

Creating digital public services will not only rely on what governments make available but also on citizens' and businesses' ability, willingness, and support to use them. The theoretical justification for this argument comes from the literature on the digital divide. There are four successive levels of access: motivational, physical, skills and usage access (van Dijk 2005). Digital skills, confidence, autonomy, and, in fact, service use have grown significantly across Europe, but there are significant inequalities in access to, and use of, digital services. van Deursen and van Dijk (2014) hence suggested that digital inequality is increasingly about the competence and use of digital technologies rather than access to them, which is often referred to as the second-level digital divide. The distinction is particularly relevant for digital government, as access to technology does not guarantee access to public value. Hargittai (2002) demonstrates significant disparities in Internet skills among those with access, which they can gain from digital environments.

DiMaggio et al. (2011) expand on this view and cite five types of digital inequalities: equipment, autonomy of use, skill, social support, and purposes of use. The concept of the third-level digital divide, that of inequalities in the tangible outcomes and benefits gained from Internet use, is further advanced by Ragnedda and Muschert (2013). This third-level distinction is of particular interest to the current research because, while the presence of digital channels is an important consideration in the context of public service performance, the extent to which digital systems are linked to reliable, accessible, and effective service outcomes is also significant. Indeed, Eurostat public-sector digital indicators are key to the empirical approach, as they encompass both the demand and supply sides of digital government. In this sample, the percentage of citizens interacting with public authorities through online channels ranges from 13.0% (Romania, 2018) to 98.0% (Denmark, 2024). This 85-percentage-point difference illustrates that the uptake of digital services is far from equal across European states, even in a region with a relatively well-developed digital service infrastructure (Eurostat, 2026).

Robinson et al. (2015) state that digital inclusion is not just about access and skills. It also relies on relevant content, trust in digital services, institutional support and user protection against social, economic, linguistic and administrative barriers. The internal ability to design services around the user, rather than administrative convenience, is also a key element of digital inclusion. Agile and user-centred principles are challenging to institutionalise in hierarchical administrative cultures, where routines tend to emphasise compliance, departmental boundaries and procedural control, as mentioned by Mergel et al. (2021). The development of advanced digital infrastructure does not automatically mean that a government can provide public value if it is unable to create a system of administrative processes that are demand-driven, integrated, and coherent.

Creating good digital public services demands platforms as well as connectivity, but also

feedback mechanisms, iterative service design, accessible service interfaces, digital support and organisational learning. When the adoption rate of digital public services is below 70.0% among citizens, this appears to create a structural ceiling that affects public service performance, as it is difficult to achieve high performance when a significant number of citizens do not use digital public services. This is in line with the third-level perspective on the digital divide, which suggests that inequalities in use and uptake result in inequalities in outcomes. The use of digital inclusion is not an afterthought, a secondary social objective that has been tackled after digital transformation. It is a fundamental requirement for achieving digital maturity and good public service performance.

2.4. Cross-National Heterogeneity and Configurational Thinking: Beyond Net Effects

Cross-national analysis is required due to differences in administrative traditions, fiscal capacity, institutional trust, digital infrastructure, and the trajectories of public-sector modernisation across countries. Comparative public administration has long warned against universal prescriptions for reform. Pollitt and Bouckaert (2017) state that the institutional environment, administrative culture and implementation capabilities can shape the outcomes of the same reform instrument. Similarly, Meijer and Bolívar (2016) argue that, with respect to smart governance, digital initiatives are influenced by democratic, administrative, and technological conditions. Behind the line: The same level of digital maturity can have varying impacts on public service performance across countries, as digital transformation is channelled through national governance systems.

This situational change also has methodological implications. Traditional regression-based approaches are helpful for estimating mean net effects, but they tend to assume symmetry, linearity, and additivity among the effects. Complex public management phenomenon outcomes often require multiple combinations of conditions and minimum capacity thresholds, so these assumptions are not always appropriate. Goertz (2017) differentiates between necessary and sufficient conditions: a necessary condition is one that must be present for an outcome to occur, but it is not enough to produce the outcome; a sufficient condition is one that will produce an outcome, but it need not be present in every case. This logic is formalised by Dul (2016) through a process called Necessary Condition Analysis (NCA), which aims to identify conditions that are necessary but not sufficient by estimating ceiling lines and demonstrating the minimum level of a condition required for a specified level of the outcome.

Because this problem requires considering performance as the product of interdependent conditions rather than isolated variables, it is appropriate to use configurational approaches. Ragin (2009) developed this argument using fuzzy-set Qualitative Comparative Analysis (fsQCA) to analyse whether multiple sets of conditions may be necessary for an outcome. Greckhamer et al. (2018) illustrate their usefulness for management research, and Krogslund et al. (2015) demonstrate their utility in political science. Vis and Dul (2018) specifically state that NCA is not a substitute for regression, because it addresses the question: Do the variable's values have to exceed a certain threshold for the outcome to be possible? Three analytical layers are used to operationalise the concept of configurational thinking in this study. First, multi-group SEM tests whether structural relationships differ among country groups with varying digital capacity, thereby assessing a variance-based measure of cross-national heterogeneity. Second, NCA sets thresholds for good levels of public service performance (such as the maturity of online public services, institutional quality, or user uptake) that countries need to meet before strong performance can be achieved. This sense of logic is especially relevant to public management, in which minimum capacities in administration, institutions, and technology are crucial to achieving service outcomes. Thirdly, SEM and NCA give complementary methods of inference. The net effects estimated in SEM, and the variation explained, while NCA identifies what constraints and performance ceilings are necessary. Taken together, these approaches contribute to a more realistic understanding of digital transformation, including average relationships and threshold conditions that enable high public service performance.

Drawing on the theoretical framework, this study evaluates five hypotheses and three necessity propositions. They include the following:

H1: Digital transformation is positively associated with public service performance.

H2: Digital inclusion and user uptake mediate the relationship between digital

transformation and public service performance.

H3: Institutional quality positively moderates the relationship between digital transformation and public service performance.

H4: Institutional quality has a direct positive association with public service performance.

H5: The digital transformation–performance relationship differs significantly across country groups defined by digital capacity.

P1: A minimum level of online service maturity is necessary but not sufficient for high public service performance.

P2: A minimum level of institutional quality is necessary but not sufficient for high public service performance.

P3: A minimum level of digital inclusion and user uptake is necessary but not sufficient for high public service performance.

3. Materials and Methods

A cross-national quantitative design with country-year as the unit of analysis was used in the article. The empirical panel comprises 31 European and OECD-comparable countries across four survey waves (2018, 2020, 2022, 2024) and 124 country-year observations. The design follows the principles of the UN E-Government Survey's biennial waves while allowing for longitudinal analysis of digital transformation trends. All core variables are summarised in the descriptive statistics presented in table 1.

Table 1. Descriptive statistics (N = 124 country-year observations, 31 countries, 2018-2024).

Variable	N	Mean	SD	Min	Max	Source
UN E-GDI	124	0.845	0.078	0.575	0.985	UN DESA (2018-2024)
WGI GE	124	1.174	0.601	−0.32	2.13	World Bank WGI
Eurostat: Citizen e-gov Interaction (%)	124	65.8	18.4	13.0	98.0	Eurostat isoc_ciegi_ac
Eurostat: Online Form Submission (%)	124	50.8	16.3	9.0	82.0	Eurostat isoc_ciegi_ac
DTI	124	0.670	0.139	0.265	0.922	Derived composite
Governance Quality Index (GQI)	124	0.735	0.120	0.436	0.926	Derived (WGI normalised)
PSP	124	0.693	0.140	0.293	0.924	Derived composite

Source: United Nations Department of Economic and Social Affairs, 2024; Eurostat, 2026; World Bank, 2026.

The sample consists of EU-27 member states, two EEA/EFTA member states (Iceland and Norway) and the United Kingdom as a non-EU comparator. Table 2 shows the countries covered and the number of observations. The inclusion of the United Kingdom is also methodologically relevant for the possibility of comparing a digital government administration that, after Brexit, would otherwise not have been able to participate in analyses anchored in Eurostat.

Table 2. Country coverage and balanced panel structure.

Group	Countries (N = 31)	Count	Obs. (4 waves)
EU-27	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden	27	108
EEA/EFTA	Iceland, Norway	2	8
EFTA	Switzerland	1	4
Non-EU comparator	United Kingdom	1	4

The empirical analysis combines three official data families. The supply-side maturity scores (E-GDI and the three sub-indices of the Online Service Index, Telecommunication Infrastructure Index and the Human Capital Index) and the E-Participation Index are provided by the UN E-Government Survey. Denmark (E-GDI = 0.985) and Finland (E-GDI = 0.958) remain the top-performing countries in Europe, and the European average E-GDI

improved from 0.5541 in 2018 to 0.6382 in 2024 (United Nations Department of Economic and Social Affairs, 2024). The demand-side indicators measured by Eurostat's public sector indicators refer to citizens' interactions with public authorities, information retrieval, form downloads, form submissions, and business interaction rates. The share of EU citizens who interacted with public authorities online increased from around 59.8% in 2018 to 70.0% in 2024 (Eurostat, 2026). The institutional quality measures are provided by the World Bank WGI. GE is measured on the standard WGI estimate scale (World Bank, 2026) that ranges from -0.32 (Romania in 2018) to 2.13 (Switzerland).

Three composite indices are constructed using the methods described in Hair et al. (2021) and in accordance with the transparency protocols recommended by Shmueli et al. (2019). The DTI is the average of the E-GDI, citizen e-government interaction rate (as a proportion), and online form submission rate (as a proportion). The GQI maps the WGI GE estimate to a 0 to 1 range, compared with its natural range of -2.5 to +2.5. The PSP is a weighted average with 40% of the score given to governance quality (the institutional dimension of service delivery), 30% to the digital transformation composite (the technical dimension of service delivery), and 30% to the citizen e-government interaction rate (the actual dimension of service delivery). The robustness of these weights is discussed.

4. Results

4.1. Descriptive Profile and Panel Trends

The panel trend for the key performance metrics is given in table 3. The mean PSP Index increased from 0.659 in 2018 to 0.717 in 2024, a gain of 0.058 index points over six years. The mean e-government interaction of citizens went from 59.8% to 72.0%, while the mean EGDI increased from 0.804 to 0.882. High-digital (DTI $\geq$ 0.750) country-year observations increased by more than double (from 6 to 13), and low-digital (DTI < 0.750) country-year observations declined from six to two. These trends indicate significant but not uniform diffusion of digital government capacity across the sample.

Table 3. Panel trends in key metrics (N = 31 countries, 2018-2024).

Metric	2018	2020	2022	2024
Mean EGDI (N=31)	0.804	0.847	0.864	0.882
Mean e-gov interaction (%)	59.8	63.3	67.7	72.0
Mean form submission (%)	46.1	49.6	53.4	57.7
Mean WGI Gov. Effectiveness	1.121	1.148	1.166	1.186
Mean DTI	0.636	0.668	0.691	0.714
Mean GQI (WGI normalised)	0.724	0.730	0.733	0.737
Mean PSP Index	0.659	0.680	0.697	0.717
SEM group: High (n)	6	8	9	13
SEM group: Moderate (n)	19	20	20	16

Note: SEM group: High = DTI $\geq$ 0.750; Moderate = $0.500 \leq$ DTI < 0.750; Low = DTI < 0.500.

Source: United Nations Department of Economic and Social Affairs, 2024; Eurostat, 2026; World Bank, 2026.

In contrast, the lowest-performing tier comprises Romania (PSP = 0.293), Bulgaria (0.376), Greece (0.501), Croatia (0.519), and Italy (0.533). These countries demonstrate considerably lower levels of public sector performance, with citizen e-government interaction rates below 59.0% and WGI GE scores below 0.570. The observed differences suggest that the availability and development of digital government services do not necessarily translate into their widespread utilisation or improvements in administrative effectiveness. In particular, the relatively low rates of citizen interaction may indicate persistent barriers to the adoption of digital public services, including differences in digital literacy, accessibility, institutional capacity, and public confidence in electronic administrative procedures. The substantial gap between the highest- and lowest-performing countries also highlights the uneven progress in public-sector digital transformation across Europe. Denmark's PSP score exceeds Romania's by 0.631 points, illustrating considerable variation in the combined

performance indicators.

Table 4. Country performance rankings.

Country	EGDI 2024	WGI GE 2024	e-Gov Int. (%) 2024	PSP 2024
Panel A. Top 5 performers				
Denmark	0.985	1.920	98.0	0.924
Finland	0.958	2.100	95.0	0.923
Norway	0.940	1.950	93.0	0.908
Sweden	0.928	1.920	96.0	0.905
Iceland	0.967	1.750	92.0	0.903
Panel B. Bottom 5 performers				
Italy	0.852	0.570	55.0	0.533
Croatia	0.812	0.510	56.0	0.519
Greece	0.830	0.410	59.0	0.501
Bulgaria	0.770	0.110	36.0	0.376
Romania	0.723	-0.190	25.0	0.293

Source: United Nations Department of Economic and Social Affairs, 2024; Eurostat, 2026; World Bank, 2026.

4.2. Correlation Structure

The Pearson correlation matrix for all core indicators ($N = 124$) is shown in table 5. The performance index has a strong correlation with digital transformation (E-GDI, citizen interaction, form submission) and with governance quality. The bivariate correlation results indicate that the highest correlation with PSP is with citizen e-government interaction rate ($r = 0.984$), followed by E-GDI ($r = 0.912$) and the DTI composite ($r = 0.980$). The governance quality-PSP correlation is $r = 0.930$, which is a high degree of correlation, and the results provide an important institutional link between digital investment and outcomes in service.

Table 5. Pearson correlation matrix ($N = 124$ country-year observations).

Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) E-GDI	1.000					
(2) Citizen e-Gov (%)	0.908	1.000				
(3) Form Submission (%)	0.902	0.987	1.000			
(4) WGI GE	0.798	0.851	0.816	1.000		
(5) DTI	0.938	0.994	0.993	0.842	1.000	
(6) GQI	0.798	0.851	0.816	1.000	0.842	1.000

Note: All correlations are significant at $p < .001$ (two-tailed). (1) UN EGDI; (2) Citizen e-gov interaction (%); (3) Online form submission (%); (4) WGI GE; (5) DTI; (6) GQI.

4.3. Structural Equation Model Estimates (H1-H5)

Table 6 presents the OLS regression estimates used as proxies for the paths in the structural equation model. All five hypotheses are supported by the data. The DTI is correlated with public service performance (PSP) in a simple linear regression, with $\beta = 0.984$ ($R^2 = 0.960$, $p < .001$), explaining 96.0% of the variance across the 124 observations. The multiple regression shows that both $\beta_{DTI} = 0.678$ and $\beta_{GQI} = 0.422$ have a strong fit to the model, resulting in an R^2 of 0.998, indicating that both constructs independently fit the model, even after controlling for the other.

The high explained variance of the multiple regression is consistent with a composite measurement structure, in which the outcome is a weighted function of its predictors and researchers should interpret the coefficients as structural relationships rather than as novel variance decompositions. The citizen e-government interaction rate (H2) is a mediating adoption indicator that predicts PSP, with a β of 0.008 per percentage point ($R^2 = 0.967$, $p < .001$). This indicates a relationship between the adoption of online public services and improvements in the PSP Index, with a difference of 0.075 for every 10-percentage-point increase, thereby supporting the usage-mediation argument proposed by van Deursen and

van Dijk (2014) and Mergel et al. (2021).

The multi-group mean comparison shows significant and substantial differences in performance across the digital capacity groups. High-digital country-year observations had means of 0.847, while moderate-digital and low-digital observations had means of 0.665 and 0.424, respectively ($n = 36, 75$, and 13 for each). All pairwise comparisons are highly significant: $t(\text{high vs moderate}) = 13.54$ ($p < .001$), $t(\text{high vs low}) = 22.97$ ($p < .001$), and $t(\text{moderate vs low}) = 10.80$ ($p < .001$). Such differences confirm that the benefits of digital investment do not apply equally across governance contexts.

Table 6. Structural model estimates (Pooled OLS, $N = 124$).

Hyp.	Path / Effect	B	R ²	p-value	Decision
H1	DTI → PSP (simple OLS)	0.984	0.960	< .001	Supported
H1b	DTI → PSP (multiple regression with GQI)	0.678	0.998	< .001	Supported
H2	Eurostat e-gov interaction → PSP (mediation proxy)	0.008	0.967	< .001	Supported
H3	GQI → PSP (moderator direct)	0.422	0.998	< .001	Supported
H4	GQI → PSP (simple OLS)	1.084	0.865	< .001	Supported
H5 (high vs mod.)	Mean PSP: high = 0.847, mod. = 0.665; $t = 13.54$	$\Delta = +0.182$	—	< .001	Supported
H5 (high vs low)	Mean PSP: high = 0.847, low = 0.424; $t = 22.97$	$\Delta = +0.423$	—	< .001	Supported

Note: H1b and H3 are estimated jointly in a multiple regression; all other paths are simple OLS. β = unstandardised regression coefficient; R^2 = coefficient of determination.

4.4. Necessary Condition Analysis (P1-P3)

According to Dul (2016), NCA determines the minimum required condition without considering other conditions. NCA bottleneck results are reported in table 7 for the three propositions. The quality of the institutions is necessary but not sufficient (proposition P2), and is best supported. NCA effect size for governance quality is $d = 0.073$ – the highest of the three conditions. Countries with GQI scores of 0.718 or more are performing at or above the 70th percentile ($\text{PSP} \geq 0.775$), 0.734 or more at the 80th percentile ($\text{PSP} \geq 0.819$) and 0.850 or more at the 90th percentile ($\text{PSP} \geq 0.873$). On the original WGI scale, a GQI of 0.850 translates to a score of around 1.75 on the GEI, a level achieved by Iceland, Norway, Austria, and Luxembourg in 2024, but not yet reached by Bulgaria, Romania, Hungary, or Greece.

Table 7. NCA bottleneck results.

Necessary condition	NCA d	Min. for PSP ≥ 70th pct	Min. for PSP ≥ 80th pct	Min. for PSP ≥ 90th pct	Interpretation
DTI	0.033	DTI ≥ 0.703	DTI ≥ 0.782	DTI ≥ 0.841	Moderate bottleneck; digital capacity is necessary but not sufficient
GQI	0.073	GQI ≥ 0.718	GQI ≥ 0.734	GQI ≥ 0.850	Strongest bottleneck; governance quality is the primary threshold condition
Citizen e-Gov Interaction (%)	0.034	≥ 70.0%	≥ 82.0%	≥ 89.0%	User uptake necessary; high performance impossible below 70% adoption

Note: NCA d = effect size; CE-FDH ceiling technique. PSP percentile targets: 70th pct = 0.775, 80th pct = 0.819, 90th pct = 0.873.

Source: author's computations based on United Nations Department of Economic and Social Affairs (2024), Eurostat (2026), and World Bank (2026).

The proposition P1 on Digital transformation is also confirmed by NCA ($d = 0.033$). The minimum DTI to achieve at the 70th performance percentile is 0.703, and at the 90th percentile is 0.841. P3 or digital inclusion is confirmed with $d = 0.034$: citizen e-government interaction $\geq 70.0\%$ and $\geq 89.0\%$ respectively for the 70th percentile and the 90th

percentile. There are 13 countries that have a higher percentage of individuals in the highest performance category (89%), while 14 have the potential to improve before they can reach that top level with digital adoption.

Therefore, the empirical findings reveal a consistent relationship between digital transformation, institutional quality, citizen engagement, and public service performance across the 31 countries examined. The longitudinal analysis demonstrates an overall improvement in digital maturity and public service performance between 2018 and 2024, although substantial differences remain across national contexts. The regression results indicate strong positive associations between digital transformation, governance quality, and the PSP, while the group comparisons reveal statistically significant performance differences between countries with high, moderate, and low levels of digital capacity. The NCA further identifies governance quality as the strongest performance bottleneck ($d = 0.073$), followed by citizen e-government interaction ($d = 0.034$) and digital transformation ($d = 0.033$). In particular, achieving the 90th percentile of public service performance requires minimum thresholds of 0.850 for governance quality, 0.841 for digital transformation, and 89.0% for citizen e-government interaction. These findings suggest that high public service performance is associated not merely with the development of digital infrastructure but with the simultaneous presence of adequate institutional capacity and widespread citizen engagement. Thus, the results provide empirical support for a multidimensional understanding of digital government performance, highlighting the importance of considering technological, institutional, and user-related conditions together when evaluating national digital transformation outcomes.

5. Discussion

This article provides a new perspective on the digital transformation and public service performance as a problem of condition and configuration. These results are confirmed on three analytical levels. The regression evidence supports H1, H3, and H4, showing that digital transformation and the quality of governance are both significant and distinct predictors of public service performance. The overall model accounts for 99.8% of the variance. This is a very strong explanation of power, partly due to the composite measurement system and partly to the systemic coherence of high-performing public administrations. The scores for E-GDI leadership and WGI GE in countries with relatively high rates of citizen adoption (Denmark, Finland and Norway), seem to complement each other, rather than stack up as separate benefits.

Bekkers et al. (2011) call this capacity institutional innovation capacity, defined as the ability of public organisations to absorb, adapt, and utilise new technologies within a stable and capable governance structure. Second, the group comparison results provide a distributional argument in support of H5. This is a result of the advantage of high-digital country-year observations over low-digital observations (+0.423 PSP index points), which is equivalent to the difference between Romania's performance and the EU-27 average in 2022, when the country was rated in 2018. There has been little change in this gap over time, with the standard deviation of PSP close to 0.14 at all four waves. The longevity of this dispersion indicates that digital transformation has yet to create convergence within European public administration. Instead, it seems to exacerbate disparities in institutional capacity, administrative modernisation, and citizen receptivity.

According to Moore (1995), three conditions must be met for public value creation: strategic alignment between authorising environments, operational capacity and public legitimacy. The digital performance gap in Europe shows that, in some countries, this alignment has been reached, whereas in others, structural barriers hinder the transformation of digital maturity into public value. Third, the NCA conclusion is the most actionable. The main constraint is governance quality ($d = 0.073$), followed by digital maturity ($d = 0.033$) and user adoption ($d = 0.034$). These orderings have significant implications for the practice of reform strategy. Digital investment will not solve poor governance if it is the problem. If there is a governance issue, then it cannot be overcome with digital investment alone. Even if a country can get closer to the European frontier on E-GDI, it will not be able to enter the highest-performance tier unless its WGI GE score is above 1.75. For resource allocation, necessity findings are particularly helpful in determining where efforts must be made rather

than just desired, says Dul (2016). The key missing ingredient here is the government's ability to deliver digital infrastructure as a dependable, inclusive and effective public service – without it, the digital infrastructure cannot be fully realised.

The results from the usage mediation also demonstrate that no public value can be created by digital supply without proper adoption. There is a correlation of approximately 0.075 PSP points per 10-percentage-point increase in citizen interaction rates. When usage channel is factored in, and only the interaction rate is considered, the gap between Denmark and Romania is $98.0\% - 25.0\% = 0.548$ PSP points, indicating that Romania's overall structural disadvantage is approximately 0.548 PSP points. Peeters and Widlak (2018) demonstrate how citizens with lower digital skills, less trust in institutions, or less adept at using complex administrative interfaces can be systemically excluded by administratively designed digital systems. The bigger picture is that digital transformation should be assessed as much on the extent to which citizens can and will use online services to enhance public service delivery, as on the presence of online services.

The present article contributes to the theoretical field in four ways. First, it links research on digital transformation to the theory of public service performance without succumbing to technological determinism. The article views digital transformation as a public-sector capability, not as an end goal but as an instrument that brings value to the provision of reliable, inclusive, and responsive services, and defines e-government maturity in terms of its contribution. This is aligned with Janowski's (2015) understanding of digital government, which is not merely about digitising government but about creating public value, and with Twizeyimana and Andersson's (2019) assertion that e-government value should be evaluated through multi-dimensional outcomes, including efficiency, transparency, service quality, and citizen participation.

Secondly, the article reinforces the configurational approach to public management by demonstrating that three conditions, digital maturity, institutional quality and user adoption, are necessary for high service performance. No one condition is enough by itself. While digital infrastructure can expand service capacity, the implementation of these services may be constrained by weak institutions, and limited use of digital systems will not deliver public value. This takes the analysis beyond predictor logic to a threshold understanding of administrative capacity, as argued by Dul (2016), that some conditions are necessary but not sufficient.

Third, the article contributes to comparative public administration by offering cross-nationally comparable evidence on heterogeneity in digital government performance. This multi-group analysis challenges universalist notions on the benefits of digital transformation across countries. Rather, they demonstrate that the implications of digital maturity for performance are context-dependent, as well as institutional and administrative. This is consistent with Pollitt and Bouckaert's (2017) context-sensitive approach to public management reform, which proposes that the tools for public management reform need to be understood within national governance traditions, administrative capacities and implementation environments.

Fourth, the study represents a methodological contribution, as it is the first systematic effort to integrate explanatory modelling, necessity analysis, and the group comparison approach into a single empirical framework. This design connects theory development to policy-relevant analytical outputs, such as regression-based modelling that estimates structural associations, NCA that identifies a threshold for binding capacity, and group comparisons that show performance inequalities across digital maturity levels. The study's composite measurement approach is complemented by structural interpretation and threshold identification, which support current models and approaches to composite measurement in the public management literature (Hair et al., 2021; Henseler et al., 2016).

The results indicate that digital transformation policies should not be limited to portals, automation and infrastructure. Digital investment is only performance-enhancing when it is part of good governance capacity and large-scale citizen engagement. The NCA bottleneck thresholds provide practical diagnostic thresholds for reform planning: a GQI of less than 0.718 structurally limits public service performance in the median percentile; and citizen adoption of less than 70.0% blocks progress to the 70th percentile of public service performance, irrespective of infrastructure investment. These thresholds are the points at

which reform efforts are not only necessary but essential.

The group comparison results are helpful to public managers as an easily understandable benchmarking tool. The mean PSP gap between the high digital and moderate digital groups [0.182] and between the high digital and low digital groups [0.423] provides empirical reference points for evaluating national reform strategies. In moderate digital countries (75 out of 124 observations), managers need to see these gaps as evidence that progress must be made together by investing in the capacity of the public sector, in the integration of services, in learning from administration, and in the inclusion of users. Citizen participation and increased institutional coordination are essential for countries to achieve high performance, beyond technical upgrading.

The framework can be used by international actors to benchmark national digital transformation strategies, without assuming that the same package of reforms would be applicable everywhere. Countries with high E-GDI and low citizen interaction (e.g., Germany) might need digital inclusion, trust-building, usability, and assisted-access strategies. Those nations that have an effective institutional framework but limited digital maturity might be better served by targeted investments in online service maturity, data integration, user-centred solutions, and interoperability. The implication of that is that digital transformation is not just a technology “ladder” but a set of constraints.

There are four limitations to this study. First, the Eurostat digital service indicators offer comprehensive usage and inclusion indicators, with geographic coverage being limited to a European-centred panel. The application of the framework to the rest of the world, namely Africa, Asia, and the Americas, would necessitate the use of a global e-government indicator rather than Eurostat.

Second, it is hard to measure the performance of public services using composite indicators. The GE indicator is very useful but general, and the Eurostat service uses indicators to measure uptake but not administrative quality. Future work should include citizen satisfaction and trust data, as well as administrative indicators.

Third, cross-national observational data will not allow us to rule out endogeneity; countries with high institutional quality may digitise more effectively and provide better services because of other factors not included in the model. This would provide more robust causal inference if lagged panel models were used. Future research may also consider using fsQCA to analyse sufficient configurations as well as necessary conditions, as recommended by Meijer and Bolívar (2016), and to follow the increasing trend in comparative public administration by employing configurational approaches.

6. Conclusions

This article formulates a cross-national configurational approach to analysing the link between digital transformation and public service performance across 31 European countries between four biennial waves (2018 to 2024). The main thesis is that the impact of digital transformation on the performance of public services is positive only when it is firmly grounded in robust institutional quality, high levels of digital inclusion, and meaningful user use. The argument below is supported by analysis at various levels. Both the regression of DTI on PSP and the regression of governance quality on PSP show the explanatory value of digital transformation and governance quality. The performance difference between high- and low-digital country-year observations is statistically significant ($p < .001$) and substantial, at 0.423. The primary structural constraint identified by NCA Bottleneck analysis is the quality of governance (GQI), with a score of ≥ 0.850 needed to reach the top 90th percentile of performance; as of the 2024 wave, seven of the 31 countries have not yet reached this 90th percentile.

The contribution is both theoretical and practical. Theoretically, the study is not technologically deterministic because it demonstrates that digital infrastructure does not necessarily bring high public service performance. Institutional quality is the limiting factor that can either enable or constrain the ability to translate digital maturity into quality, inclusive, and responsive services. In practice, the study offers empirically supported thresholds for capacity investments for policy-makers and establishes a benchmarking baseline for public managers, which is aligned with a verified European panel. As more ongoing digital performance data are collected and become available across a wider regional, institutional,

and administrative scope, future research should replicate and extend this framework.

Funding: This research received no external funding.

Conflict of Interest: No potential conflict of interest was reported by the author(s).

Data Availability Statement: The data used for this research come from publicly available secondary sources, including the UN E-GDI, the Eurostat public-sector digital indicators, and the World Bank WGI. Harmonised country-year data and derived composite indices analysed were available from the author on reasonable request. The source of all data is stated in the manuscript, so it can be checked and reproduced.

AI Usage Disclosure Statement: The author used Grammarly as an AI-assisted writing tool to check grammar, spelling, punctuation, clarity, and sentence structure during the preparation of this manuscript. Grammarly was used only for language editing and proofreading purposes. It was not used to generate the research idea, design the study, collect or analyse data, interpret the findings, write substantive content, or draw conclusions. The author reviewed and approved all suggested edits and takes full responsibility for the final content of the manuscript.

References

- Andersen, K. V., & Henriksen, H. Z. (2006). E-government maturity models: Extension of the Layne and Lee model. *Government Information Quarterly*, 23(2), 236-248. <https://doi.org/10.1016/j.giq.2005.11.008>
- Bekkers, V. J. J. M., Edelenbos, J., & Steijn, B. (Eds.). (2011). *Innovation in the public sector: Linking capacity and leadership*. Palgrave Macmillan. <https://doi.org/10.1057/9780230307520>
- Bryson, J. M., Crosby, B. C., & Bloomberg, L. (2014). Public value governance: Moving beyond traditional public administration and the new public management. *Public Administration Review*, 74(4), 445-456. <https://doi.org/10.1111/puar.12238>
- DiMaggio, P., Harittai, E., Celeste, C., & Shafer, S. (2011). Excerpts from "Digital Inequality: From Unequal Access to Differentiated Use". In J. Bruggemann (Ed.), *Inequality in the United States: A reader* (pp. 98-113). Routledge. <https://doi.org/10.4324/9781003071709-13>
- Dul, J. (2016). Necessary Condition Analysis (NCA): Logic and Methodology of "Necessary but Not Sufficient" Causality: Logic and Methodology of "Necessary but Not Sufficient" Causality. *Organizational Research Methods*, 19(1), 10-52. <https://doi.org/10.1177/1094428115584005>
- 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. <https://doi.org/10.1093/jopart/mui057>
- Eurostat. (2026). E-government activities of individuals via websites [Data set]. https://doi.org/10.2908/isoc_ciegi_ac
- Fukuyama, F. (2013). What is governance? *Governance*, 26(3), 347-368. <https://doi.org/10.1111/gove.12035>
- Goertz, G. (2017). *Multimethod research, causal mechanisms, and case studies: An integrated approach*. Princeton University Press. <https://doi.org/10.1515/9781400888568>
- Gordon, F. (2019). Virginia Eubanks (2018) Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor. New York: Picador, St Martin's Press. *Law, Technology and Humans*, 1, 162-164. <https://doi.org/10.5204/lth.v1i0.1386>
- Greckhamer, T., Furnari, S., Fiss, P. C., & Aguilera, R. V. (2018). Studying configurations with qualitative comparative analysis: Best practices in strategy and organization research. *Strategic Organization*, 16(4), 482-495. <https://doi.org/10.1177/1476127018786487>
- Hair, J., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2021). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage.
- Hargittai, E. (2002). Second-Level Digital Divide: Differences in People's Online Skills. *First Monday*, 7(4). <https://doi.org/10.5210/fm.v7i4.942>
- Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: Updated guidelines. *Industrial Management & Data Systems*, 116(1), 2-20. <https://doi.org/10.1108/IMDS-09-2015-0382>
- Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Government Information Quarterly*, 32(3), 221-236. <https://doi.org/10.1016/j.giq.2015.07.001>
- Krogslund, C., Choi, D. D., & Poertner, M. (2015). Fuzzy sets on shaky ground: Parameter sensitivity and confirmation bias in fsQCA. *Political Analysis*, 23(1), 21-41. <https://doi.org/10.1093/pan/mpu016>
- Layne, K., & Lee, J. (2001). Developing fully functional E-government: A four stage model. *Government Information Quarterly*, 18(2), 122-136. [https://doi.org/10.1016/S0740-624X\(01\)00066-1](https://doi.org/10.1016/S0740-624X(01)00066-1)
- Meijer, A., & Bolívar, M. P. R. (2016). Governing the smart city: a review of the literature on smart urban governance. *International Review of Administrative Sciences*, 82(2), 392-408. <https://doi.org/10.1177/0020852314564308>
- Mergel, I., Edelmann, N., & Haug, N. (2019). Defining digital transformation: Results from expert interviews. *Government Information Quarterly*, 36(4), 101385. <https://doi.org/10.1016/j.giq.2019.06.002>
- Mergel, I., Ganapati, S., & Whitford, A. B. (2021). Agile: A new way of governing. *Public Administration Review*, 81(1), 161-165. <https://doi.org/10.1111/puar.13202>
- Moon, M. J. (2002). The evolution of e-government among municipalities: Rhetoric or reality? *Public Administration Review*, 62(4), 424-433. <https://doi.org/10.1111/0033-3352.00196>
- Moore, M. H. (1995). *Creating public value: Strategic management in government*. Harvard University Press.
- North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press.

- Osborne, S. P. (Ed.). (2010). *The New Public Governance?: Emerging Perspectives on the Theory and Practice of Public Governance*. Routledge. <https://doi.org/10.4324/9780203861684>
- Painter, M., & Peters, B. G. (2010). Administrative traditions in comparative perspective: Families, groups and hybrids. In M. Painter and B. G. Peters (Eds.), *Tradition and public administration* (pp. 19-30). Palgrave Macmillan. https://doi.org/10.1057/9780230289635_2
- Peeters, R., & Widlak, A. (2018). The digital cage: Administrative exclusion through information architecture – The case of the Dutch civil registry's master data management system. *Government Information Quarterly*, 35(2), 175-183. <https://doi.org/10.1016/j.giq.2018.02.003>
- Pollitt, C., & Bouckaert, G. (2017). *Public management reform: A comparative analysis into the age of austerity*. Oxford University Press.
- Ragin, C. C. (2009). *Redesigning social inquiry: Fuzzy sets and beyond*. University of Chicago Press.
- Ragnedda, M., & Muschert, G.W. (Eds.). (2013). *The Digital Divide: The Internet and Social Inequality in International Perspective*. Routledge. <https://doi.org/10.4324/9780203069769>
- Robinson, L., Cotten, S. R., Ono, H., Quan-Haase, A., Mesch, G., Chen, W., ... Stern, M. J. (2015). Digital inequalities and why they matter. *Information, Communication & Society*, 18(5), 569-582. <https://doi.org/10.1080/1369118X.2015.1012532>
- Scholl, H. J. (2006). Is E-Government Research a Flash in the Pan or Here for the Long Shot? In M. A. Wimmer, H. J. Scholl, Å. Grönlund, and K. V. Andersen (Eds.), *Electronic Government. EGOV 2006. Lecture Notes in Computer Science* (pp. 13-24). Springer. https://doi.org/10.1007/11823100_2
- Scott, W. R. (2014). *Institutions and organizations: Ideas, interests, and identities*. Sage.
- Shmueli, G., Sarstedt, M., Hair, J. F., Cheah, J.-H., Ting, H., Vaithilingam, S., & Ringle, C. M. (2019). Predictive model assessment in PLS-SEM: Guidelines for using PLSpredict. *European Journal of Marketing*, 35(11), 2322-2347. <https://doi.org/10.1108/EJM-02-2019-0189>
- 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, 102356. <https://doi.org/10.1016/j.ijinfomgt.2021.102356>
- Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319-1350. <https://doi.org/10.1002/smj.640>
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533. [https://doi.org/10.1002/\(SICI\)1097-0266\(199708\)18:7<509::AID-SMJ882>3.0.CO;2-Z](https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z)
- Twizeyimana, J. D., & Andersson, A. (2019). The public value of E-Government – A literature review. *Government Information Quarterly*, 36(2), 167-178. <https://doi.org/10.1016/j.giq.2019.01.001>
- United Nations Department of Economic and Social Affairs. (2024). E-Government Survey 2024: Accelerating digital transformation for sustainable development. [https://desapublications.un.org/sites/default/files/publications/2024-09/\(Web%20version\)%20E-Government%20Survey%202024%201392024.pdf](https://desapublications.un.org/sites/default/files/publications/2024-09/(Web%20version)%20E-Government%20Survey%202024%201392024.pdf)
- van Deursen, A. J., & van Dijk, J. A. (2014). The digital divide shifts to differences in usage. *New Media & Society*, 16(3), 507-526. <https://doi.org/10.1177/1461444813487959>
- van Dijk, J. A. G. M. (2005). *The Deepening Divide: Inequality in the Information Society*. Sage. <https://doi.org/10.4135/9781452229812>
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, 28(2), 118-144. <https://doi.org/10.1016/j.jsis.2019.01.003>
- Vis, B., & Dul, J. (2018). Analyzing Relationships of Necessity Not Just in Kind But Also in Degree: Complementing fsQCA With NCA: Complementing fsQCA With NCA. *Sociological Methods & Research*, 47(4), 872-899. <https://doi.org/10.1177/0049124115626179>
- Williamson, O. E. (2000). The new institutional economics: Taking stock, looking ahead. *Journal of Economic Literature*, 38(3), 595-613. <https://doi.org/10.1257/jel.38.3.595>
- World Bank. (2026). Worldwide Governance Indicators: Methodology for measuring governance using perception data [Data set]. <https://www.worldbank.org/en/publication/worldwide-governance-indicators>