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Citizen Satisfaction with eGovernment in the EU

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Table of Contents

1. Introduction	4
Research Question (RQ ₁).....	5
2. Literature Review / Theoretical Framework.....	6
2.1 - Digital Transformation in Public Governance	6
2.2 - Civil Registries as Foundational Digital Infrastructure	7
2.3 - Information Capacity & State Legibility Theory	8
2.4 - Key Enablers of Civil Registry Comprehensiveness.....	9
2.5 - Successful Digital Public Service Delivery	12
2.6 - Gaps and the Need for Configurational Analysis (fsQCA)	13
3. Methodology	14
3.1 - Qualitative Comparative Analysis (QCA)	14
3.2 - Variations and selected method.....	15
3.3 - Research Design	16
3.4 - Case Selection.....	17
Secondary Data	18
3.5 - eGovernment Benchmark 2024.....	18
3.6 - Special Eurobarometer 551 – The Digital Decade.....	24
4. Empirical Findings and Analysis	29
4.1 - Descriptive Patterns.....	29
4.2 - Outcome variable	30
4.3 - Condition variables.....	33
Analysis	40
4.4 - Necessity Analysis.....	41
4.5 - Truth Table, Sufficiency & Solution terms	41
4.6 - Robustness.....	44
5. Conclusion and Discussion	45
References:.....	48
Appendices	52

ABSTRACT

The digital transformation of public administration has reshaped how governments deliver services, yet citizen satisfaction with digital public services varies across the European Union (EU). This study investigates how the comprehensiveness of national civil registries, a key component of state information capacity and a central concept in James C. Scott's State Legibility Theory, affects public perceptions of digital service success. Using data from the 2024 eGovernment Benchmark and Special Eurobarometer 551 – The Digital Decade, this research applies fuzzy-set Qualitative Comparative Analysis (fsQCA) to the 27 EU member states. Six causal conditions representing civil registry comprehensiveness are analyzed: online availability, user support, electronic identification (eID), transparency, pre-filled forms, and eDocuments. The outcome is citizen satisfaction, measured as the proportion of respondents who report that digitalization makes their lives easier. The analysis identifies multiple, equifinal pathways to high satisfaction, showing that no single condition is sufficient on its own. Instead, successful outcomes consistently arise from configurations that combine strong interoperability, secure digital identification, and high transparency. Robustness tests confirm that these solutions remain stable across different calibration thresholds. By integrating State Legibility Theory with contemporary digital governance research, this thesis highlights the critical role of comprehensive and interoperable civil registries in enabling citizen-centric and effective eGovernment. The findings provide theoretical insight into how state information capacity translates into public value and offer practical guidance for policymakers aiming to enhance digital public service delivery across the EU.

Keywords: eGovernment, civil registries, state legibility, information capacity, digital public services, fuzzy-set Qualitative Comparative Analysis (fsQCA), European Union

1. Introduction

Public sector modernization, driven by ICTs (Hood & Margetts, 2007) and the internet (United Nations, 2024), has transformed citizen-government relationships. The transformative effect of modern technology on public administration is well documented (Fountain, 2004), and global institutions like the United Nations (2024), the OECD (Terlizzi, 2021), and the European Commission (2024) all have shared commitments to help facilitate the digital transformation into “Electronic Government (eGovernment)”. While some scholars have expressed concern that such a transformation will result in unintended consequences (Bovens & Zouridis, 2002; Hood & Margetts, 2007), there is a broad consensus among the fields of Public Administration (Torfing et al., 2021), Political Science (Mello & Ostermann, 2023), Sociology (Oana et al., 2021), and Psychology (Moynihan et al., 2015) that the fundamental nature of how we are governed has changed with digitalization. Thus, it has become necessary to determine which components of eGovernment are associated with higher proportions of citizen satisfaction as an outcome.

Much of contemporary public administration scholarship largely reflects the core message that modern governance should be more efficient, transparent, and user-friendly, all underpinned by digital innovation (Fountain, 2004; Peeters et al., 2023). The Covid-19 pandemic further accelerated this shift toward eGovernment, raising the expectation that public agencies should be able to provide agile and responsive services using digital tools in the face of such crises (European Commission, 2024; Peeters et al., 2023). International organizations specifically call on nations to leverage eGovernment to become more resilient and efficient in the face of shocks like those experienced in the early 2020s decade (European Commission, 2024c; United Nations, 2024). This sentiment is echoed in contemporary reviews of existing digital initiatives (Latupeirissa et al., 2024; Terlizzi, 2021), which emphasize that investing in digital infrastructure can significantly enhance public service delivery and promote inclusivity through its online accessibility (Tan & Crompvoets, 2022; United Nations, 2024).

While all regions are advancing in the development of eGovernment as of the most recent UN report (United Nations, 2024), the pace of progress is uneven, and disparities exist between regions persist to a significant degree. This transition from in-person interaction with the government to one mediated through digital tools has been conceptualized and defined in many different normative frameworks (Latupeirissa et al., 2024), reflecting the diverse ways scholars and policymakers have understood the role of technology in delivering public services (European Commission, 2024, 2024a, 2024b, 2024c; Scott, 2020). At the center of eGovernment is the state’s capacity to collect, process, and utilize information (European Commission, 2024c; Fountain, 2004; Peeters et al., 2023); a capacity that ultimately determines whether digitalization can effectively translate into satisfactory levels of service delivery to citizens (Scott, 2020). This concept is often referred to as the information capacity of a state, which encompasses the institutional, technical, and procedural capabilities to generate accurate and actionable population data (Peeters et al., 2023; Scott, 2020; Widlak & Peeters, 2023).

Information is crucial for governance (Hood & Margetts, 2007), enabling activities like taxation, policy implementation, and public service delivery (Peeters, 2023; Scott, 2020). Civil registries, which standardize population, resource, and territory information, are essential for legibility and effective governance (Peeters et al., 2023). With eGovernment already prevalent (European Commission, 2024; United Nations, 2024),

necessitating a shift in research focus towards institutional and infrastructural factors contributing to its success. Central to this focus are civil registration systems, critical information databases that, when digitally enhanced, provide the foundation for carrying out the core functions of eGovernment. In the context of information capacity, these systems determine how “comprehensive” a state’s ability is to standardize and manage information about its population, resources, and territory (Peeters et al., 2023; Scott, 2020). Examining how different levels of data integration and interoperability within national civil registries influence digital service outcomes, as measured by citizen satisfaction, contributes to a broader understanding of the conditions that support successful public service delivery in the digital era.

Drawing on prior literature and scholarship on eGovernment, this study seeks to identify specific conditions under which public services through eGovernment is most successful, according to citizen perception. To address the research question, fuzzy-set Qualitative Comparative Analysis (QCA) will be utilized to capture the interactive effects of multiple causal conditions. These conditions represent comprehensive infrastructural components of civil registry systems; the outcome of their interactions will be analyzed to determine which combinations are necessary to achieve successful levels of citizen satisfaction. To give meaningful measurement to the these conditions, this study draws on the European Commission’s, eGovernment Benchmark which tracks the digitalization progress across the EU27 (European Commission, 2024b). By using the standardized indicators, the analysis can meaningfully extract conditions needed to conduct QCA analysis. To evaluate the outcome variable of satisfactory delivery of digital public services, the 2024 Eurobarometer survey will be used. This survey captures EU citizens perceptions of whether the digitalization of services has made their lives easier or more difficult. In this study, positive responses in each member state are interpreted as indicators of successful public service delivery in that case example, reflecting the degree to which digital transformation improves citizens’ experiences. The different configurations of conditions produced by QCA will be investigated to determine which conditions are necessary to produce successful delivery outcomes using the 27 European Union member states as case examples.

Problem statement:

Despite comprehensive civil registration systems in the EU, disparities persist in digital public service delivery, as highlighted by UN and EU assessments (European Commission, 2024c; United Nations, 2024). Existing scholarship has not fully explained how the comprehensiveness of civil registration systems shapes these outcomes. These gaps risk exacerbating inequalities and undermining equitable access to services if not corrected. Addressing the gap in knowledge, this study seeks to correct the insufficient understanding of how civil registry infrastructure, key components of state information capacity, shapes citizen satisfaction with digital services, measured by indicators present in the EU eGovernment Benchmark, and the perceived ease of use reported in the 2024 Eurobarometer survey (European Commission, 2024a).

Research Question (RQ₁)

“Which configurations of causal conditions reflecting civil registry comprehensiveness are associated with higher public satisfaction in the 27 EU member states?”

2. Literature Review / Theoretical Framework

2.1 - Digital Transformation in Public Governance

The origins of the shift to digital government can be traced back to the 1980s, with early initiatives and scholarship aimed at framing and integrating technology into administrative functions (Terlizzi, 2021; United Nations, 2024). A major milestone for this topic came in 2001, when the United Nations Department of Economic and Social Affairs (2024) released its first edition of the biennial project, *Benchmarking E-Government: A Global Perspective – Assessing the Progress of the UN Member States*. This pioneering survey developed an index for assessing the emerging concept of electronic government amongst member states. It also introduced a policy planning framework to help evaluate national approaches and levels of commitment toward digital reform. By establishing this benchmark, the UN helped set global expectations for the digital modernization needed to meet the demands of 21st-century governance.

The digital transformation of public services represents one of the most significant shifts in the history of public administration (Fountain, 2004; Latupeirissa et al., 2024; United Nations, 2024). Moving beyond traditional, hierarchical bureaucracies, governments are increasingly relying on digital technologies to modernize their services for citizens (Bovens & Zouridis, 2002; Hood & Margetts, 2007). This evolution is characterized by the gradual replacement of in-person interactions with bureaucrats to platform-based engagements that fundamentally reshape the “public encounter (Bovens & Zouridis, 2002; Lindgren et al., 2019). Classic public administration relied on the concept of street-level bureaucrats, a term coined by political scientist Michael Lipsky in his 1980 book *Street-Level Bureaucracy: Dilemmas of the Individual in Public Services* (Lindgren et al., 2019). It refers to public service workers who had interacted directly with citizens and used substantial discretion while implementing public policy (Bovens & Zouridis, 2002; Terlizzi, 2021). Contemporary governance theories shift the model to system-level bureaucracy, where digital automation leaves very little human interaction in the public encounter (Lindgren et al., 2019). Citizens are no longer passive recipients of services but active participants in multi-level governance systems (Terlizzi, 2021).

While this shift can reduce administrative burdens and enable standardized services, scholars caution that it also raises questions about equity, discretion, and the quality of public services (Moynihan et al., 2015; Widlak & Peeters, 2023). Information and Communication Technologies (ICTs) have been the driving force behind this transformation, not only digitizing services but reshaping administrative processes, organizational design, and citizen–state relationships (Bretschneider & Mergel, 2011; Hood & Margetts, 2007). As Tan and Crompvoets (2022) observe, this evolution has occurred in three broad phases:

- **E-Government (1990s–2000s):** Focused on the efficiency gains of moving services online.
- **Digital Government (2000s–2010s):** Introduced integrated, data-driven service delivery.
- **New Digital Era Governance (NDEG, 2010s–present):** Emphasizes automation and the strategic role of data infrastructures in decision-making.

Crucially, scholars stress that digital government is not solely a technological phenomenon but also an institutional and organizational one (Fountain, 2004; Torfing et

al., 2021). Technologies create public value only when embedded within governance systems that can leverage data (Luna et al., 2024; Torfing et al., 2021), coordinate across agencies (Peeters et al., 2023), and respond to citizen needs. The European Commission (2024) underscores that effective digitalization requires robust infrastructures, reliable population data, and interoperability across public institutions. Building on this understanding, Hood and Margetts (2007) modernize the traditional “tools of government” framework to categorize government activity into four primary tools: nodality, authority, treasure, and organization. A key insight provided by their research is that tools of government are rarely used in isolation. A similar conclusion is reached by Fountain (2004) in her foundational work *Building the Virtual State: Information Technology and Institutional Change*. For governments to deliver effective eGovernment services, they require not only sophisticated databases but also reliable conduits for delivering these services digitally (European Commission, 2024c; Fountain, 2004; Torfing et al., 2021).

In this regard, civil registration systems emerge as a foundational element of eGovernment. Civil registries ensure that citizens are “visible” to the state (Scott, 2020), providing the backbone for identity verification, eligibility assessment, and service integration. Without complete and interoperable registries, digital initiatives risk failure, undermining the very goals of modernization and rationalization that underpin public sector digitalization (Latupeirissa et al., 2024; Peeters et al., 2023).

2.2 - Civil Registries as Foundational Digital Infrastructure

Registration in a national civil registry is essential for administrative tasks in the digital era, as registration is fundamentally linked to service delivery (Luna et al., 2024; Peeters et al., 2023; Scott, 2020). Inscription in these registries has often served as the initial point of contact between citizen and state and is what enables the provision of services (Scott, 2020). Reviewing Public Administration scholarship, the theory that best captures this concept is known as State Legibility Theory, as presented by James C. Scott (2020).

In *Seeing like a State*, Scott (2020) highlights that civil registries are vital to "making populations legible" to the state. In this seminal book, Scott (2020) explains how state institutions have historically depended on mechanisms like registries and censuses to "render society legible": allowing governments to transform complex social realities into standardized, manageable information. The distinction between the two is that civil registration systems typically focus on recording vital life events (European Commission, 2024b), while a census aims to count the entire population of a territory, often including demographic and socioeconomic information (Scott, 2020). Both are crucial for understanding population dynamics and informing public policy (Widlak & Peeters, 2023), yet recent research highlights that the comprehensiveness of civil registries is directly linked to equitable and effective digital public service delivery (Peeters et al., 2023; Widlak & Peeters, 2023). Modern digital registries, enhanced by ICTs, underpin citizenship rights (electoral participation to social benefits) by enabling legal identity-based identification as the foundation of eGovernment (Fountain, 2004; Peeters et al., 2023; Tan & Crompvoets, 2022).

Incomplete or fragmented civil registries create administrative burdens and inefficiencies, disproportionately affecting vulnerable populations (Peeters et al., 2023; Ranchordas, 2024). Administrative burdens - defined as the learning, compliance, and

psychological costs of interacting with the state (Moynihan et al., 2015) - persist even with digitalization (Peeters, 2023), as early ICT initiatives often failed to deliver expected efficiency gains without institutional readiness (Bretschneider & Mergel, 2011.; Moynihan et al., 2015). While the advent of ICTs has enabled the accessibility of government services online, its successful implementation hinges on various institutional factors. Reducing administrative burden is central to improving citizen access to services and enhancing the effectiveness of digital governance (European Commission, 2024c), being fully “legible” can minimize these barriers (Scott, 2020).

National civil registration systems are critical tools for reducing administrative inefficiencies, integrating government information on citizens between different public agencies, and effectively enhance the provision of digital services. By providing a reliable foundation for identity verification and data integration, it has been demonstrated in the literature that high information capacity make it possible for governments to deliver such digital services efficiently and effectively (Torfing et al., 2021; Widlak & Peeters, 2023).

2.3 - Information Capacity & State Legibility Theory

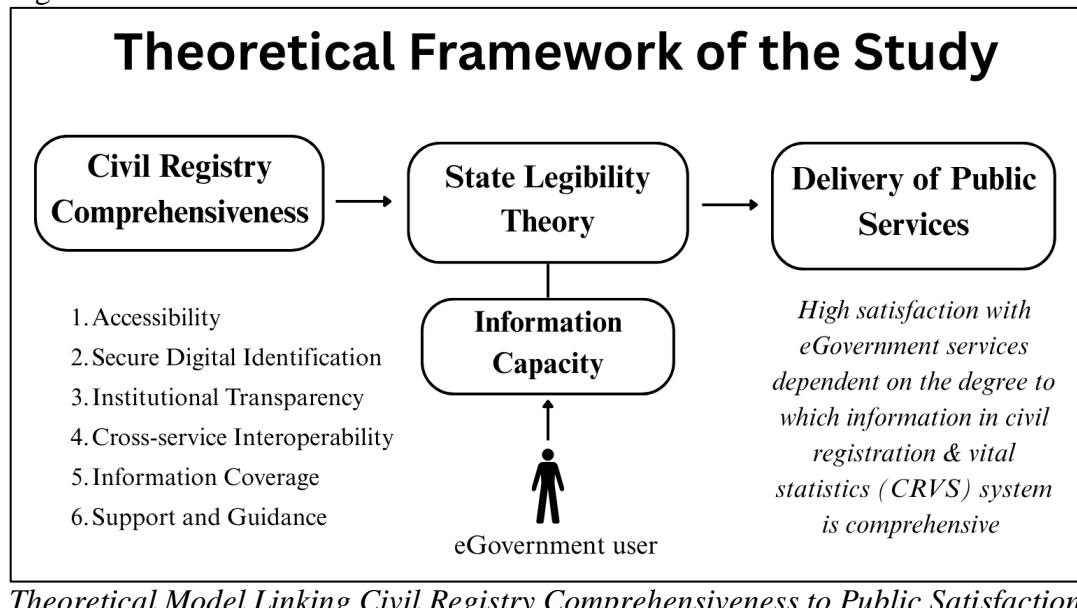
James C. Scott's State Legibility Theory provides a theoretical framework for comprehending information capacity and its effect on service delivery. According to SLT, effective governance hinges on the state's ability to process information on its population, businesses, and territory to improve decision-making and service delivery (Scott, 2020). This theoretical perspective goes beyond simply viewing digitalization as a technological advancement; it emphasizes the institutional and infrastructural transformations necessary to translate data into actionable governance capabilities.

Civil registration and vital statistics (CRVS) systems operationalize this legibility by recording life events (births, deaths, and marriages, etc.) and providing every individual with a legal identity (United Nations, 2023; *Civil Registration and Vital Statistics*, 2024). Such identity is established with the issuance of legal identification (i.e. birth certificates, passports) or inclusion in a population census. High comprehensiveness and interoperability ensure that all citizens, including marginalized groups, are visible in official data and able to access public services, while fragmented or incomplete registries limit both information capacity and service equity (Peeters et al., 2023; Ranchordas, 2024).

This study's focus on civil registry comprehensiveness aligns with SLT's emphasis on foundational data infrastructures. Civil registries serve as the bedrock of legibility, enabling governments to identify, authenticate, and serve their citizens. However, when registries are fragmented or incomplete, state legibility, and consequently information capacity, is hindered, limiting the potential for effective digital public service delivery. This study conceptualizes civil registry comprehensiveness as comprising six essential dimensions - data automation, secure digital identification, institutional transparency, cross-agency interoperability, information coverage, and user support - which collectively determine the degree of state legibility and, consequently, information capacity. The aim of the study is to analyze their interactions and determine whether these conditions enhance digital public service delivery through perceptions of high citizen satisfaction. As illustrated in Figure X, SLT and the operational mechanism of information capacity provide the theoretical bridge between registry comprehensiveness

and the outcome of public satisfaction with eGovernment services, forming the basis for the configurational analysis conducted in this research.

Figure 1



2.4 - Key Enablers of Civil Registry Comprehensiveness

Building on State Legibility Theory (SLT) and the concept of information capacity, civil registries can be understood as core infrastructure for modern digital governance. A comprehensive civil registry enhances the state's ability to render its population "legible" by reliably documenting legal identities, facilitating data integration, and supporting inter-agency coordination (Scott, 2020; Peeters et al., 2023). When registry systems achieve this degree of completeness and interoperability, they increase the state's information capacity, reduce administrative burdens, and improve the delivery of citizen-centric digital services (Ranchordas, 2024; Widlak & Peeters, 2023).

To give clarity to the public encounter in the digital era, Luna et al. (2024) defines it as "a sequence of digital interactions" between a service provider (the state) and service receiver (the citizen) which add some value to the receiver (Terlizzi, 2021). These interactions encompass a wide array of applications that facilitate citizen-state interaction (Luna et al., 2024; Ranchordas, 2024). These digital tools are the product of ICT integration with public administration (Hood & Margetts, 2007), and they include: informational websites, open data portals, platforms for official correspondence, and electronic procedures for accessing social benefits (European Commision., 2024a; Fountain, 2004; Latupeirissa et al., 2024). Recognizing the growing importance of digital public services, international organizations such as the European Commission have substantially upgraded their monitoring frameworks in recent years. Central to this effort is the eGovernment Benchmark, which evaluates the maturity, accessibility, and interoperability of digital public services across the EU27 and associated states (European Commission, 2024c). The Benchmark forms part of the EU's broader Digital Decade 2030 Policy Programme (European Commission, 2024), which sets explicit

targets for fully online, accessible, and interoperable public services for all EU citizens by 2030.

By focusing on key dimensions of the report such as User Centricity, Transparency, and Key Enablers, the eGovernment Benchmark provides an empirical framework to measure the extent to which member states have built the information capacity and digital infrastructure necessary for successful delivery of public services.

As noted by Peeters (Peeters, 2023; Peeters et al., 2023; Widlak & Peeters, 2023), a comprehensive civil registry allows services to be highly accessible, interoperable across government agencies, and automated where possible. In this study, Civil Registry Comprehensiveness (CRC) refers to the extent to which a country's civil registration and vital statistics (CRVS) system functions as a core digital infrastructure for public service delivery in EU member states. Conceptually, CRC is treated as a latent construct: a theoretical representation of the overall functionality of a civil registration system in the digital era. It does not refer solely to the breadth of demographic data recorded, but to the institutional, technical, and procedural integration of registries within a country's broader digital government framework.

In this framing, civil registries are not isolated databases but foundational infrastructure components that enable seamless, user-centric service delivery (Terlizzi, 2021). By integrating user data, legal identification, and inter-agency coordination, CRC strengthens the state's information capacity, which is critical for realizing the full potential of digital public services. Drawing on the literature, the six identified key conceptual dimensions of civil registry comprehensiveness are derived from the intersection of theory (Hood & Margetts, 2007), EU monitoring frameworks (European Commission, 2024a, 2024c, 2024d), and practical considerations of state information capacity (Scott, 2020; Widlak & Peeters, 2023).

The six indicator (IV) conditions derived from this framework - Pre-filled forms, Transparency, Online availability, Electronic identification (eID), User support, and eDocuments - measure the performance of 27 European countries in 2022-2023 (European Commission, 2024d). Each condition is measured on a 0–100 scale in the eGovernment Benchmark and subsequently calibrated to fuzzy-set membership scores (0–1) for qualitative comparative analysis (fsQCA). From the literature and the eGovernment Benchmark, six conceptual dimensions of CRC have been identified as critical enablers of digital service delivery:

Availability - Evaluates the extent to which information about public service and the services themselves are accessible online via a portal. Higher scores indicate that citizens can complete more processes digitally without needing to visit an office. This variable condition will be a composite measure of both the Online Availability and Mobile Friendliness indicators, which are measured separately by the report (European Commission, 2024d).

User Support - The Benchmarks' definition of this essential component notes that before the mass adoption of digital solutions (Bovens & Zouridis, 2002; Hood & Margetts, 2007), users could ask for assistance at their local government office (European Commission, 2024d). Therefore, the User Support indicator assesses the availability of online support, help features and feedback mechanisms

to assist users when they encounter problems or questions Seven features related to User Support were assessed for each government portal. This includes FAQs, live chat and call-back services (European Commission, 2024d).

Electronic Identification (eID) - Measures how widely electronic identification credentials – through applications or verified usernames/passwords – are accepted for online service transactions. Authenticating online is a foundational enabler for other condition indicators, and the concept captures the readiness of government portals to authenticate users digitally, without having to reauthenticate for services provided by other agencies (European Commission, 2024, 2024d).

Transparency of service delivery, design and personal data - A composite score assessing how transparent service processes. The Benchmarks' definition for this composite variable is: "About showing users what steps (still) need to be taken when accessing a service, showing how personal data is being used by the government, and enabling users to participate in the design of services they want to use." (European Commission, 2024d). The indicator aggregates several elements, including the proportion of services that provide completion notices or progress tracking, as well portals that allow users to access personal data.

Transparency is a fundamental concept in Public Administration literature, as it builds trust among citizens, and lowers psychological barriers to digital adoption (European Commission, 2024; Moynihan et al., 2015).

Pre-Filled Forms - Measures the share of administrative steps where data already known to public administrations are pre-filled in online forms, summarizing "the number of services requesting data through a form which present already available data to the user" (European Commission, 2024d). This indicator represents an essential component of civil registry comprehensive because it conceptualizes the interoperability aspect of "base registries used by governments to automatically validate or retrieve data relating to citizens and businesses" (European Commission, 2024b).

Electronic Documents - This indicator of the Benchmark indicates the extent to which electronic documents can be uploaded or downloaded as part of a public service transaction. It considers whether users can submit required documents digitally and receive official outputs (certificates, licenses) in digital form (European Commission, 2024d). This indicator condition evaluates an essential capacity of the state, to issue and receive official documents entirely in digital form, enabling end-to-end digital service delivery and reducing reliance on paper or in-person processes (Peeters et al., 2023; Scott, 2020).

These definitions help clarify what each condition measures in the fsQCA model. Table X below presents the official definitions of these six indicators, their method of quantification, the key eGovernment Benchmark dimension from which each is derived, and a brief description of the conceptual focus each variable represents within the study's framework for fuzzy-set Qualitative Comparative Analysis (fsQCA). These indicators are

derived from the User Centricity, Transparency, and Key Enablers dimensions of the eGovernment Benchmark, ensuring consistent cross-national measurement for all EU27 countries.

<u>Condition Label</u>	<u>Conceptual Focus</u>	<u>Type</u>	<u>Key Dimension</u>	<u>Justification</u>
AVAIL	Accessibility	Quantitative (0–100)	User Centricity (Online Availability + Mobile Friendliness)	Reflects digital accessibility of public services on any platform
USER SUPPORT	Support and Guidance	Quantitative (0–100)	User Centricity (User Support)	Measures extent of guidance, help, and feedback support available to users
eID	Secure digital identification	Quantitative (0–100)	Key Enablers (eID)	Indicates secure digital authentication infrastructure
TRANS	Institutional Transparency	Quantitative (0–100)	Transparency dimension	Reflects trust, control, and openness in digital public service delivery
PREFILL	Cross-service Interoperability	Quantitative (0–100)	Key Enablers (Pre-Filled Forms)	Captures registry integration and administrative intelligence
eDOCU	Information Coverage	Quantitative (0–100)	Key Enablers (eDocuments)	Enables fully digital issuance and exchange of official documents

2.5 - Successful Digital Public Service Delivery

The European Union's commitment to universal digital inclusion is formulized in the European Declaration on Digital Rights, which affirms that "everyone should have access to key public services in the EU" (European Commission, 2024b). Yet, as of the 2024 State of the Digital Decade report, it is confirmed that progress towards full eGovernment is uneven across the EU (European Commission, 2024d). Despite these extensive frameworks, several member states are still behind in areas such as eID, Transparency, and Pre-filled forms. The Eurobarometer survey provides the fundamental basis for data collection in the study of the success of the delivery of public services through digital platforms.

To measure citizens' experiences and perceptions of digital service delivery, this study draws on Special Eurobarometer 551, commissioned by the European Commission (DG CNECT) and coordinated by DG COMM (European Commission, 2024a). Conducted from 6 March to 8 April 2024, the survey gauges public attitudes toward the digitalization of public and private services, supporting the EU's Digital Decade 2030 Policy Programme. The instrument explores how digitalization affects daily life, the importance of various digital technologies, and public support for EU initiatives such as the Digital Services Act (European Commission, 2024a; European Commission, 2024e).

The Special Eurobarometer 551 survey is organized into several thematic sections designed to capture citizens' experiences with digital technologies and public services. QC1 asks respondents to assess the importance of digital technologies by 2030 across

various areas of life, providing context for how the public views the role of digitalization in society. QC2 focuses on the perceived impact of digitalization on daily public and private services, asking whether these changes make life easier or more difficult—this serves as the key outcome variable for the study. QC3 examines factors that could facilitate improvements in digital services, such as digital literacy, personalization, and cybersecurity measures. QC4 through QC7 address public priorities and rights, including support for government initiatives, awareness of the Digital Services Act, and perceptions of online rights and protections. Finally, QC8 collects demographic and contextual information, including views on digital rights, political engagement, and socio-economic characteristics, enabling richer analysis of citizen experiences with eGovernment.

For this research, QC2 - “Would you consider that the digitalization of daily public and private services is making your life easier or more difficult?” - serves as the outcome variable in the fsQCA. Respondents who report that digitalization makes life “easier” or “much easier” are treated as expressing positive satisfaction with digital public services, a widely accepted proxy for successful service delivery (Bretschneider & Mergel, 2011; Luna et al., 2024). This approach aligns with literature emphasizing that citizen perception is a core measure of public value creation, as individuals evaluate digital services based on tangible benefits such as time and cost savings (Luna et al., 2024). This citizen-centered survey complements the eGovernment Benchmark by capturing the user-perceived outcomes of digital transformation across the EU27. In doing so, it links state information capacity, civil registry comprehensiveness, and the delivery of quality, user-centric public services through eGovernment.

2.6 - Gaps and the Need for Configurational Analysis (fsQCA)

According to the World Bank (2023), approximately 850 million people currently lack the ability to prove their identity, leaving them without access to vital services typically expected from the government. As seen in the literature, comprehensive information capacity facilitates access to health, education, and social welfare, as well as formal employment (European Commission, 2024; United Nations, 2024). Conversely, the absence of comprehensive registries results in fragmented information systems, duplicative data collection, and higher compliance costs for citizens (Peeters et al., 2023). During the COVID-19 pandemic, countries with robust registry infrastructures, such as the Netherlands, were able to organize automated service delivery and vaccination scheduling with minimal burden on citizens (Peeters et al., 2023). Peeters et al. (2023) demonstrates that strong information capacity enables governments to implement policies more effectively by reducing administrative burdens, improving targeting, and facilitating citizen access to services. Countries with fragmented or ad hoc registries, by contrast, shifted administrative burdens to frontline workers and the public (Peeters et al., 2023; Ranchordas, 2024).

Despite growing interest in eGovernment from both academic and official sources, there is limited understanding of the specific conditions that produce high public satisfaction with digital services. Most prior studies examine individual factors in isolation, but eGovernment success likely depends on combinations of conditions, including data automation, secure identification, inter-agency interoperability, transparency, and user support. These conditions are all collectively enhanced by information capacity to produce.

This thesis addresses this gap through a fuzzy-set Qualitative Comparative Analysis (fsQCA) approach, which captures configurational causality. Rather than seeking a single determinant of success, fsQCA identifies multiple pathways of conditions that can lead to high public satisfaction with eGovernment services. By linking civil registry comprehensiveness, state legibility, and information capacity, this study contributes to both the theoretical understanding and practical assessment of digital public service delivery.

3. Methodology

3.1 - Qualitative Comparative Analysis (QCA)

This study employs Qualitative Comparative Analysis (QCA), developed by Charles C. Ragin (2008), to systematically investigate causal complexity in social phenomena. QCA is a set-theoretic method that bridges the strengths of qualitative and quantitative approaches: it preserves the contextual richness of case-based research while enabling cross-case comparison and pattern identification across a moderate number of cases (Oana et al., 2021; Pappas & Woodside, 2021). Its growing adoption in the social sciences reflects its unique capacity to address causal complexity, making it particularly suitable for governance and policy research (Mello & Ostermann, 2023). Modern software environments such as R and Python have further enhanced QCA's analytical reach and accessibility for academic research.

QCA is grounded in set theory, which frames social science phenomena as relationships between sets rather than as linear correlations between variables. Ragin (2008) argues that social science theories are fundamentally about sets and their relationships, yet social scientists often translate these set-relational statements into "hypotheses framed as correlations between variables" (Ragin, 2008). Rather than emphasizing correlations between variables and their predict linear relationships, Ragin argues that theories focused on subset and superset relationships should be evaluated directly in terms of their relations. This perspective makes QCA particularly compelling for research questions that seek to identify the configurations of conditions leading to a desired outcome.

Classical statistical approaches typically focus on the average net effect of single variables, which risks obscuring how outcomes emerge from interacting conditions (Mello & Ostermann, 2023). QCA, by contrast, was constructed with the acknowledgement that we can rarely understand social and political phenomena by focusing on the role of a single factor in isolation (Mello & Ostermann, 2023; Oana et al., 2021; Ragin, 2008). The methodology relies on the logic that multiple conditions often interact to produce an outcome that can be achieved through various combinations of these conditions, collectively known as configurations (Mello & Ostermann, 2023). Additionally, the technique emphasizes that the presence of conditions that produce an outcome does not automatically explain its absence. Indeed, Mello and Ostermann (2023)

highlight that the most distinct strength of QCA is its ability to account for causal complexity - an overarching concept that entails three components: conjunctural causation, equifinality, and causal asymmetry.

The term conjunctural causation means that two or more conditions may jointly bring about an outcome but may not do so individually in the absence of the other condition (Mello & Ostermann, 2023). Using the example that just as a destination can be reached through multiple different routes, Pappas & Woodside (2021) define equifinality as “achieving the same outcome through multiple different combinations of conditions”. Asymmetry, in the context of QCA, refers to the principle that the presence of a causal condition in the outcome does not imply that its absence will have the opposite effect (Mello & Ostermann, 2023; Pappas & Woodside, 2021).

This non-reciprocal logic is central to how QCA conceptualizes and tests relationships. Using Boolean algebra and Boolean minimization algorithms (Pappas & Woodside, 2021), complex data structures are simplified in a holistic manner and patterns of multiple-conjunctural causation are captured. The resulting relationships are framed and presented in the language of necessary and sufficient conditions (Ragin, 2008). This rigorous process of analysis of conditions is what enables the method to explain why change (or variation) may occur in some cases, but not in others. The use of Boolean algebra means that QCA has binary data (0 or 1) as its input, and will use logical operations for the procedure (Oana et al., 2021; Pappas & Woodside, 2021).

Figure 2

$$\mathbf{A * B} \quad \mathbf{A + B} \quad \mathbf{\sim A}$$

* denotes AND
(conjunction of
conditions)

+ denotes OR
(alternative
pathways)

\sim denotes the
absence of a
condition

Notation for Logical Operators in Fuzzy-Set Qualitative Comparative Analysis (fsQCA)

In professional settings, QCA is used in different fields such as e-business and information systems (Pappas & Woodside, 2021). Olana et al. (2021) note that “QCA is used prominently in four fields: political science and international relations, sociology, environment and sustainability, and particularly business and management”. To summarize, quoting Oana, Schneider, and Thomann (2021), QCA is to be used for “when research questions ask for causes of a given effect, when we are interested in the prevalence of set relations, and when we assume that empirical relations are complex”.

3.2 - Variations and selected method

QCA has three main variations: crisp-set, multi-value, and fuzzy-set (Mello & Ostermann, 2023; Pappas & Woodside, 2021). Crisp-set QCA classifies cases strictly as

members (1) or non-members (0) of a set, without accounting for partial membership (Oana et al., 2021) for example, an EU country either has adopted the euro or it has not. Multi-value QCA extends this logic to categorical variables with more than two values, enabling greater nuance. This study employs fuzzy-set QCA (fsQCA), which allows for varying degrees of membership and is therefore most suitable for analyzing complex, gradational social phenomena.

In *Redesigning Social Inquiry: Fuzzy Sets and Beyond*, Ragin (2008) introduces fuzzy-set QCA (fsQCA) as a method that assesses how strongly individual cases belong to sets defined by causal conditions and outcomes. This approach enables researchers to capture causal complexity by identifying combinations of conditions that are necessary or sufficient for an outcome. Unlike crisp-set QCA, fsQCA allows partial membership scores, accommodating real-world scenarios where cases may satisfy conditions to varying degrees—an essential feature for analyzing complex social and institutional phenomena (Mello & Ostermann, 2023; Pappas & Woodside, 2021).

The use of fsQCA in this study is grounded in its proven effectiveness for analyzing complex, multi-causal public service outcomes. Marienfeldt (2021), for example, employed fsQCA to identify combinations of institutional and organizational factors that drive high e-service availability in EU member states. Similarly, the EnergyPROSPECTS project (2023) applied fsQCA to uncover which configurations of institutional and social conditions were necessary for high citizen engagement in energy initiatives across Europe. Mello and Ostermann (2023) further illustrate its versatility in political research, using fsQCA to explain why some democratic coalition partners withdrew from the Iraq War while others remained committed, revealing multiple causal pathways involving the conditions: leadership change, partisanship, electoral timing, casualties, and military commitments.

FsQCA is particularly well suited for determining which configurations of conditions are necessary or sufficient for successful outcomes while preserving the distinctiveness of each case. This capability makes it valuable for policy-oriented research, where each state represents a context-dependent system with unique institutional and social dynamics. By enabling the systematic comparison of diverse cases without losing their complexity, fsQCA produces insights that help identify the critical conditions for achieving high public service performance.

3.3 - Research Design

Prior applications of fsQCA in academic research closely align with the approach adopted in this study, which uses a configurational, case-based research design to determine which components of Civil Registry Comprehensiveness (CRC) are associated with citizen satisfaction with eGovernment services. Because digital transformation involves complex interactions among institutional, technical, and user-centered factors, fsQCA is well suited to capture causal complexity, including situations where multiple conditions jointly produce an outcome and where several alternative pathways

(equifinality) can lead to the same result (Mello & Ostermann, 2023; Pappas & Woodside, 2021; Ragin, 2008).

Before conducting fsQCA, several research design decisions are required (Oana et al., 2021). First, cases must be clearly defined because QCA is case-oriented rather than variable-oriented. Second, membership scores for each case are assigned through calibration, translating raw data into fuzzy-set values between 0 (full non-membership) and 1 (full membership) (Ragin, 2008). Third, model specification involves identifying the most theoretically and empirically relevant causal conditions for explaining the outcome; QCA studies typically include between three and seven conditions to avoid over-complication (Oana et al., 2021).

In this study, the outcome of interest is the successful delivery of public services through eGovernment, operationalized as high public satisfaction. The selected conditions (representing dimensions of CRC) reflect the various institutional, technical, and user-oriented enablers highlighted in the literature. By analyzing how different configurations of these conditions correspond to variations in satisfaction, this design identifies causal pathways that explain cross-national disparities in digital governance within the EU. According to Oana et al. (2021), QCA is appropriate only when the phenomenon of interest meets two conditions: it can be conceptualized in terms of set relationships, and it exhibits causal complexity. This study applies that logic to identify configurations of conditions that explain cross-national disparities in digital governance within the European Union. The resulting analytical framework can inform other comparative eGovernment research in non-EU contexts, offering a generalizable model for studying digital public service success in other regions.

3.4 - Case Selection

As in the reviewed literature International Relations and Foreign Policy Analysis (Mello & Ostermann, 2023; Oana et al., 2021), this QCA study is conducted at the country level, comparing a medium-N of cases. The 27 member states of the European Union (EU27) are selected for four key reasons:

First, QCA requires a small to medium number of cases, ideally between 10 and 50 to meaningfully identify causal configurations while avoiding the limitations of conventional statistical methods like linear regression (Oana et al., 2021; Ragin, 2008). The number of EU member states (27) also falls squarely within the recommended medium-N range of 10 to 50 cases, allowing for meaningful cross-national analysis without losing contextual depth (Ragin, 2008). A complete list of cases is provided in the appendix. Second, the EU27 are highly comparable, sharing a common legal and regulatory environment, including harmonized digital governance initiatives such as the Digital Decade 2030 program (European Commission, 2024).

Third, despite this shared framework, the EU27 display meaningful diversity in economic development, administrative traditions, and digital governance capacity an essential condition for QCA's set-theoretic approach, which relies on comparing

configurations across similar yet non-identical cases (Ragin, 2008; Mello & Ostermann, 2023). Fourth, data availability is exceptionally complete. The two primary secondary sources the European eGovernment Benchmark (European Commission, 2024b) and Special Eurobarometer 551: The Digital Decade (European Commission, 2024d) provide standardized, cross-national measures for all member states, minimizing the risk of missing data, a common challenge in cross-national QCA (Marienfeldt, 2021). Both reports were commissioned by the executive branch of the EU, the European Commission. For these methodological and substantive reasons, the European Union is an optimal case selection for conducting Qualitative Comparative Analysis (QCA) in this study.

The European Union as case examples:

The European Union (EU) presents a uniquely compelling set of cases for Qualitative Comparative Analysis (QCA) due to its combination of institutional uniqueness, internal diversity, an optimal number of cases, and rich data availability. Europe (EU27+) consistently ranks as the highest-performing region in the UN eGovernment Survey (United Nations, 2024). All EU27 member states fall into the survey's "Very High E-Government Development" category among the 194 countries assessed. Additionally, the WHO's European region reports that 98% of all births and deaths are officially registered in civil registration and vital statistics (CRVS) systems (Civil Registration and Vital Statistics, 2024). This high degree of citizen legibility ensures reliable legal identification and access to public services, an essential precondition for analyzing eGovernment outcomes (Scott, 2020). As a distinct geopolitical and institutional entity, the EU integrates 27 sovereign nations under a shared economic, legal, and regulatory framework, including harmonized policies on digital transformation and data protection such as the GDPR (European Commission, 2024d). This alignment provides a strong basis for comparability across member states.

At the same time, the EU27 displays substantial variation in economic development, political traditions, welfare models, and digital governance capacity. This diversity is ideal for QCA, which is designed to identify configurations of conditions across similar yet non-identical cases that lead to a common outcome (Ragin, 2008; Mello & Ostermann, 2023). Furthermore, the EU provides exceptionally comprehensive and standardized secondary data, including the eGovernment Benchmark and the Eurobarometer "Digital Decade" survey (European Commission, 2024a, 2024d), which supply both cross-national metrics and country-level reports. This robust data infrastructure mitigates a common limitation in QCA research, where incomplete or non-comparable data can undermine analysis.

Secondary Data

3.5 - eGovernment Benchmark 2024

The EU eGovernment Benchmark is the European Commission's primary instrument for systematically evaluating the maturity of digital public services across Europe. Since 2014, member states' digital progress has been monitored through the Digital Economy and Society Index (DESI), now integrated into the State of the Digital Decade Report as part of the Digital Decade Policy Programme 2030, adopted in the aftermath of the COVID-19 pandemic (European Commission, 2024). This integration reflects the EU's strategic emphasis on achieving comprehensive digital transformation.

The Benchmark assesses 27 EU Member States, alongside EFTA and candidate countries, providing a standardized and comparable overview of government digitalization across 37 cases. It evaluates 95 public services structured around nine "life events", which represent typical interactions citizens and businesses have with public administration. These life events are assessed biennially, with one set measured in even years and another in odd years:

Assessed in 2023: Regular Business Operations, Health, Moving, Transport, and Starting a Small Claims Procedure

Assessed in 2022: Business Start-Up, Career, Studying, and Family

In total, the Benchmark examines 3,077 public administrations (1,370 central, 495 regionals, and 1,212 local), offering a multi-level perspective on eGovernment performance. Biennial averages are used to ensure all nine life events are included in each country's score.

Data collection for the eGovernment Benchmark relies on trained Mystery Shoppers, who are citizens of each evaluated country and hold a national eID. These participants visit and test government websites to provide real-life user experience assessments, capturing both the availability and usability of public services (European Commission, 2024d). Typically, each country is evaluated by two Mystery Shoppers, and any discrepancies between their findings are reviewed by the research team to ensure reliability. To minimize subjectivity, Mystery Shoppers are recruited through the consortium's research network, receive detailed briefings, and evaluate services using standardized personas that simulate common citizen or business scenarios. Their observations are recorded in a structured, formatted Excel questionnaire, which is subsequently validated by national representatives at the start and conclusion of the evaluation process. This collaborative, multi-stage validation ensures that the resulting data are accurate and comparable across all participating countries.

In 2022-2023 data collection period, 14,742 websites were evaluated, including 8,680 domestic websites, 841 national portals, and 5,221 cross-border sites and portals from other European countries. These Mystery Shoppers assess not only whether services are online and completable digitally, but also usability, mobile-friendliness, and transparency of processes and personal data management. Their evaluations are

supported by automated tools that measure technical performance, such as mobile responsiveness, accessibility (European Commission, 2024d).

The Benchmark measures performance across four key dimensions:

1. **User Centricity** – How accessible, user-friendly, and mobile-adaptive services are, and whether support and feedback mechanisms are provided.
2. **Transparency** – How openly public administrations communicate about service steps, policymaking, and the handling of personal data.
3. **Key Enablers** – The presence of essential digital infrastructures like eID, eDocuments, and Pre-filled Forms to enable secure and efficient online interactions.
4. **Cross-Border Services** – The ease with which citizens and businesses from other EU countries can access and complete services online.

Overview of EU27 Digital Maturity

The 2024 eGovernment Benchmark (assessing 2022/2023 data) reports an average EU27 score of 76 points out of 100, reflecting steady growth across all dimensions of digital public service maturity. Top performers include (in descending order): Malta (97), Estonia (92), and Luxembourg (90), followed closely by Finland (88), Lithuania (86), and Denmark (85). By contrast, Romania (50), Cyprus (61), and Italy (62) remain at the lower end of the spectrum, indicating substantial cross-national disparities.

Significant improvements were observed in countries such as Greece (+8 points), Bulgaria (+7), and Poland (+7), reflecting upward trends in digital transformation. These results illustrate the EU27's combination of overall high performance with meaningful internal variation, confirming its suitability for configurational comparative analysis. In terms of the key dimensions, with User Centricity (93) as the top-performing dimension, while Transparency (67) and Cross-Border Services (66) remain weaker. Key Enablers score 78, with eID available for 76% of services, eDocuments for 83%, and pre-filled forms for 72%. Progress is evident, with Greece, Poland, and Cyprus showing the largest improvements, and the performance gap between top and bottom member states narrowing to 23 points. Despite steady growth, persistent disparities in cross-border interoperability, transparency, and local digital services continue to challenge the EU's goal of a fully integrated Single Digital Gateway by 2030.

All eGovernment research data is openly available and provided in a machine-readable format on the Commission's webpage, in addition to data collected in previous measurements. A full description of the methodology and a list of all evaluated services is found in the accompanying eGovernment Benchmark methodology paper.

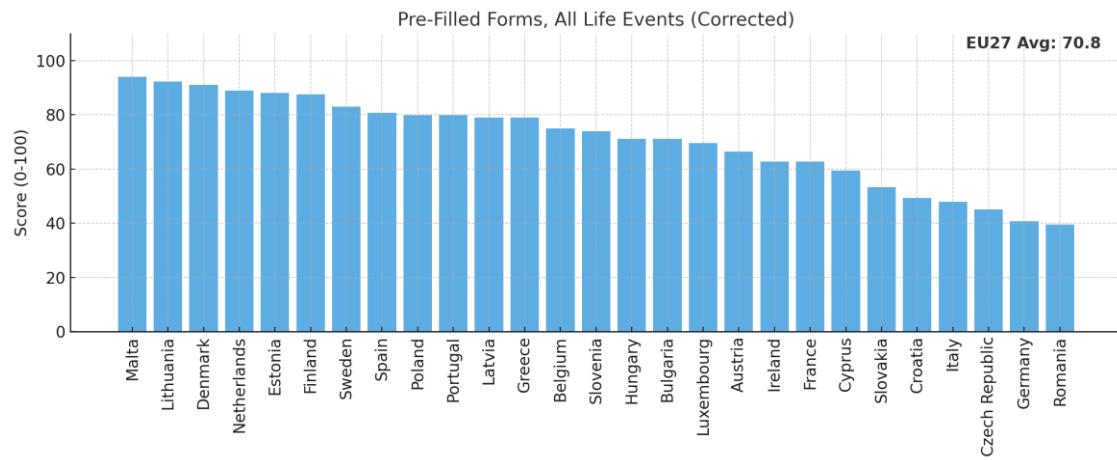
Data for the six causal conditions are derived from three out of the four eGovernment Benchmark's key dimensions - User Centricity, Transparency, and Key Enablers - each subdivided into indicators that directly operationalize aspects of digital civil registry comprehensiveness. The Cross-Border Services dimension of the eGovernment Benchmark was excluded because it does not align with this study's focus.

on domestic service delivery, equity, and efficiency, as it primarily reflects EU-specific mobility and internal market integration rather than the quality of national eGovernment systems. Including these indicators would make the analysis overly EU-centric and introduce confounding variance unrelated to domestic digital infrastructure, such as the effects of bilateral agreements or multilingual service provision. By concentrating solely on User Centricity, Transparency, and Key Enablers, the study maintains clear alignment with its objective of evaluating how civil registry comprehensiveness supports effective national digital public service delivery.

Casual Conditions:

Pre-filled Forms

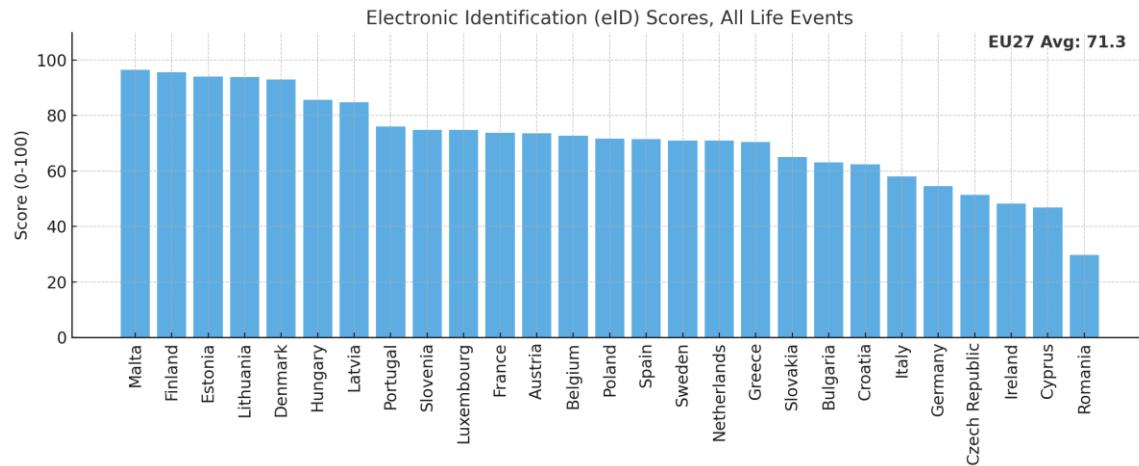
Figure 3



Pre-filled forms measure the extent to which online services automatically populate data already held by public authorities, reflecting interoperability and administrative intelligence within civil registries. The EU27 average is 71%, meaning that over seven in ten online forms now include pre-filled information from government databases. Leading countries in this area include Malta (94 points), Lithuania (92 points), and Denmark (91 points), indicating that citizens can conveniently fill in forms required for accessing services. The report notes impressive growth on this indicator from the previous benchmark, but notes “countries with low pre-filled form scores often lack integrated base registries” indicating limited information capacity (European Commission, 2024b).

Electronic Identification (eID)

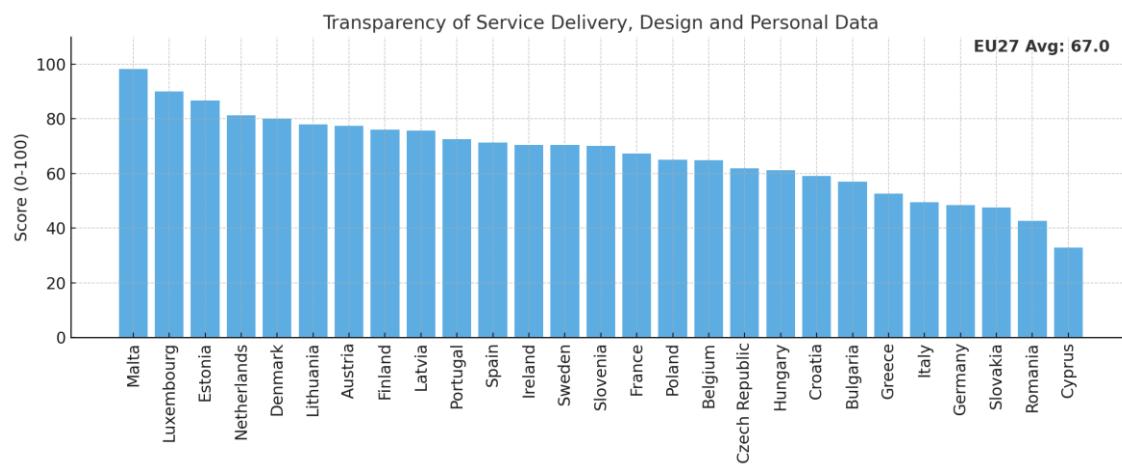
Figure 4



eID assesses the ability of citizens to authenticate securely online for public services, a foundational enabler of digital government. The EU27 average is 76%, a 6-point increase from the previous benchmark cycle. Northern and smaller EU states such as Malta (96.5), Finland (95.6), and Estonia (94.1) lead, while Romania (29.7) and Cyprus (46.8) remain low, reflecting uneven adoption and fragmented infrastructure.

Transparency

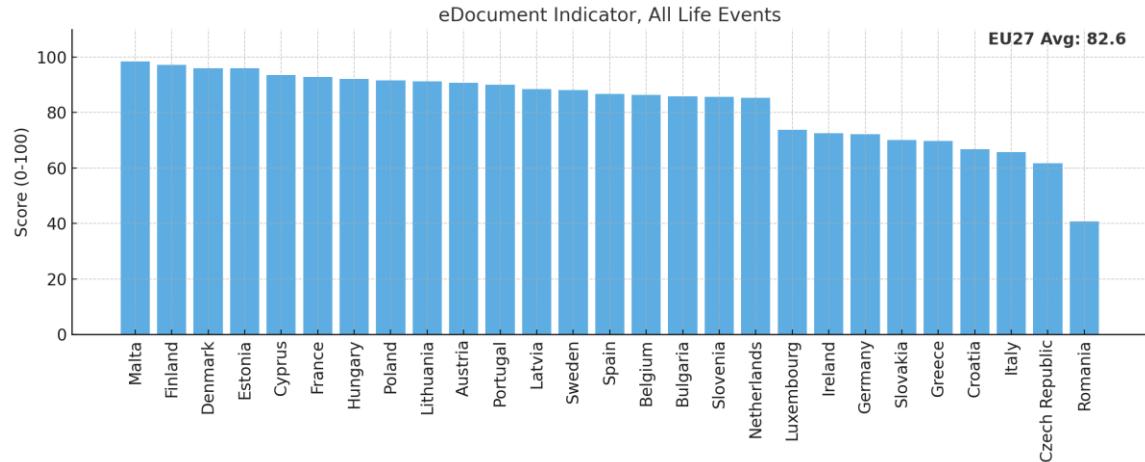
Figure 5



This composite indicator captures the openness of service delivery, design, and personal data usage, which fosters citizen trust and accountability. The EU27 average is 67 points, with Malta (98) and Luxembourg (90) at the forefront. Fourteen countries surpass the 70-point mark, while several Central and Southern states remain below this threshold, signaling gaps in procedural and data transparency.

eDocument

Figure 6

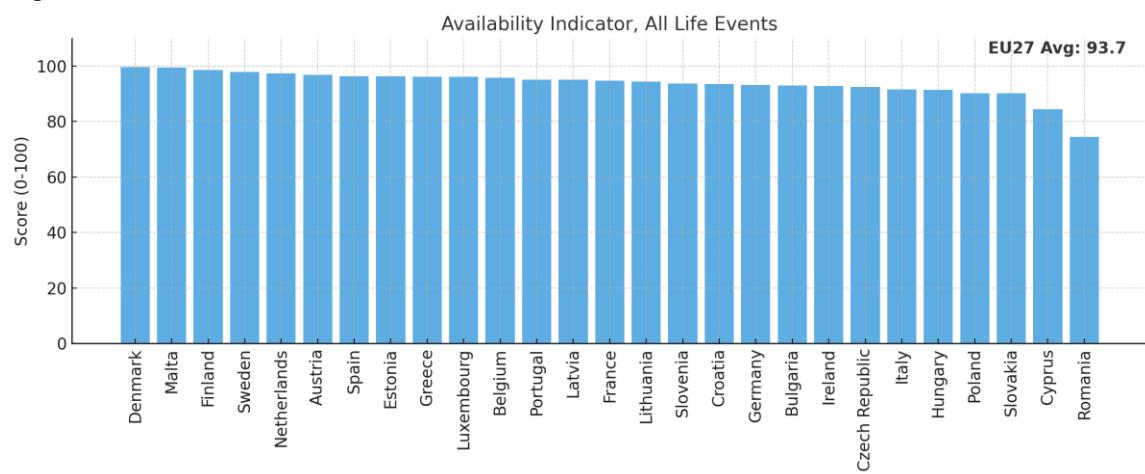


The eDocument indicator in the eGovernment Benchmark 2024 measures the extent to which citizens and businesses can submit, or download required official documents digitally when interacting with public services. Digital availability of documents significantly reduces administrative burdens, speeds up service delivery, and enhances user convenience, supporting the EU's vision for user-centric and streamlined digital services. the EU27 average for eDocuments stands at approximately 83%, indicating that most services now provide the ability to exchange documents electronically, though disparities remain across member states

Top performers such as Malta (98.41), Finland (97.13), Denmark (95.99), and Estonia (95.94) have nearly universal digital document capabilities. Conversely, Romania (40.78), Czech Republic (61.65), and Italy (65.74) sit at the lower end of the spectrum, signaling persistent gaps in digital document enablement.

Availability

Figure 7



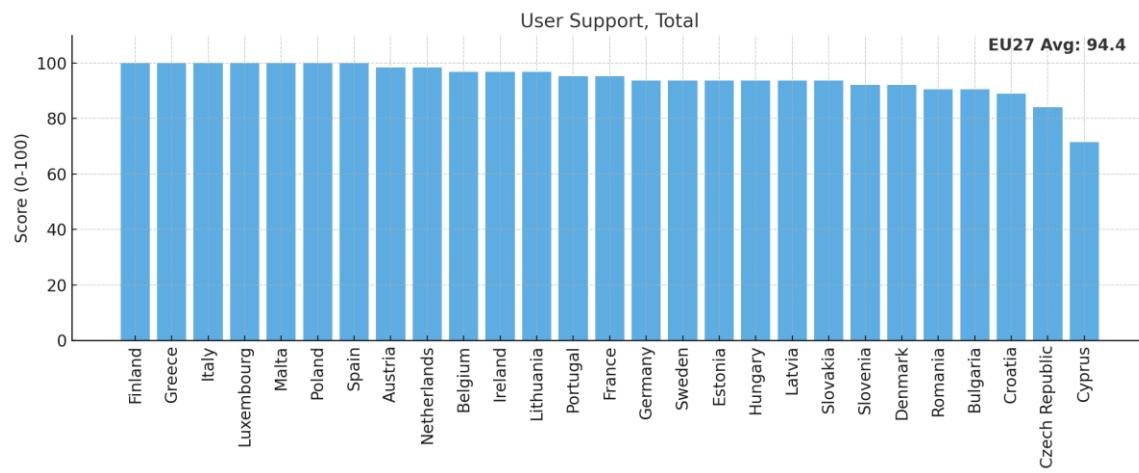
Availability evaluates the proportion of services accessible and fully completable online, combined with mobile friendliness. The EU27 average for this composite measure is 93.7%, indicating strong digital accessibility. Denmark (99.6) and Malta (98.9) lead,

while Romania (74.5) and Cyprus (84.4) fall behind, suggesting remaining barriers to universal online access.

According to the 2024 results, the EU27 average for Online Availability is approximately 89%, meaning that almost nine out of ten services can be accessed online, with 85% fully completable digitally. Mobile Friendliness performs even better, with an EU27 average of around 95%, indicating that most government websites are mobile optimized. High mobile scores are critical, as most users now engage with public services on smartphones or tablets. Creating Availability as a composite variable captures both online accessibility and mobile friendliness, providing a more realistic measure of how citizens access digital services. This combined indicator aligns with the user-centric focus of the eGovernment Benchmark and better reflects true service availability.

User Support

Figure 8



This indicator evaluates the availability of alternative contact channels, detailed contact information, Frequently Asked Questions (FAQ) sections, complaint procedures, and live support functionalities. The EU27 average for User Support in digital public services stands at 94 points, reflecting that almost all European government portals now provide comprehensive assistance to help users navigate online services. The strongest performers in User Support are Malta (100), Luxembourg (100%), and the Netherlands (98.41), achieving near-perfect scores, which reflects their commitment to user-centric service delivery and proactive digital assistance. Conversely, Romania (90.48), and Cyprus (71.43) are among the lowest scorers, highlighting gaps in comprehensive support structures and the need for further digital service enhancement.

3.6 - Special Eurobarometer 551 – The Digital Decade

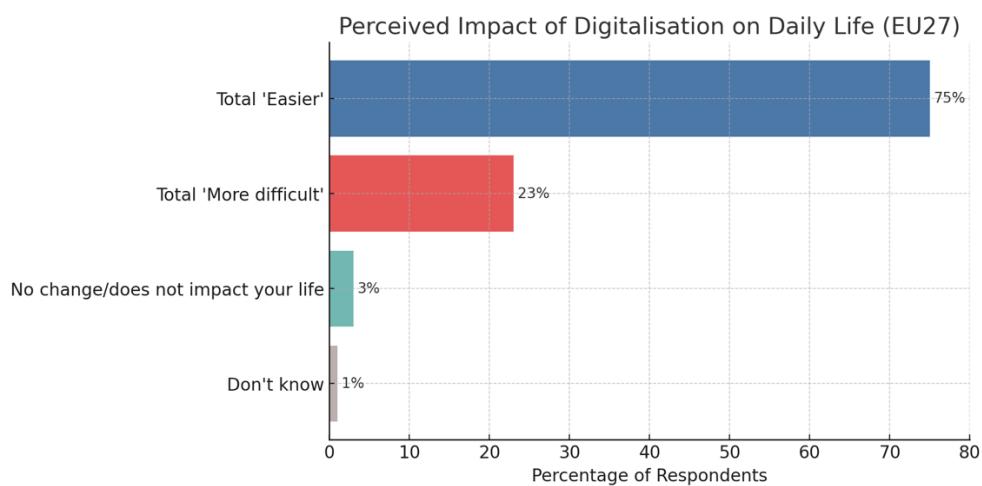
The outcome variable for this fsQCA study captures citizens' perceived success of digital public services across the EU27. Positive responses indicate effective digital service delivery, aligning with the citizen-centric perspective emphasized in public

administration literature and EU digitalization policy (Ruijer et al., 2023). This measure is derived from the Special Eurobarometer 551 – The Digital Decade 2024, the EU's flagship public opinion survey for assessing citizens' views on societal, political, and technological issues. The survey is specifically designed to monitor attitudes toward digitalization and evaluate how the Digital Decade Policy Programme 2030 meets public expectations (European Commission, 2024a).

The Eurobarometer survey includes an average of 967 respondents per country, with Germany, the EU's most populous member, having 1,516 participants, while smaller states such as Malta, Luxembourg, and Cyprus include around 500 each. This reflects Eurobarometer's stratified sampling approach, which combines minimum quotas for small countries with scaled, but not strictly proportional, samples for larger populations. Most member states (21 of 27) have approximately 1,000 respondents, ensuring both cross-national comparability and adequate national representation. All EU27 countries provide complete data for the indicators, allowing consistent calibration for fsQCA.

Respondents in the Special Eurobarometer 551 survey evaluated digital technologies across ten life domains, accessing public services, healthcare, education, online shopping, transport, democratic participation, and environmental impact, with 83% expecting digital technologies to be important for accessing public services online, reflecting perceptions of eGovernment performance (European Commission, 2024a). This perception of success was measured through survey question QC2: "Would you consider that the digitalization of daily public and private services is making your life easier or more difficult?" with response options "Much Easier," "Easier," "No Change / No Impact," "More Difficult," and "Much More Difficult." According to the 2024 results, nearly three-quarters of Europeans (73%) report that digitalization makes their life easier, including 19% who say it makes life "much easier," while 23% report that it makes life more difficult. This indicator serves as a direct proxy for public satisfaction with digital public service delivery, which is the research's core outcome variable.

Figure 9



QC2, Would you consider that the digitalisation of daily public and private services is making your life easier or more difficult? (EU27) (%)

Outcome Variable

The outcome variable in this study - citizen-reported satisfaction with digital public services - captures the perceived success of eGovernment and reflects the practical realization of state legibility in the digital era. According to Scott's State Legibility Theory, a government's ability to deliver efficient, user-centric, and proactive services depends on its capacity to collect, integrate, and effectively use population data (Fountain, 2004; Scott, 2020). High satisfaction levels thus signal that states are successfully transforming data capacity into tangible service delivery.

This variable is derived from the Special Eurobarometer 551 – The Digital Decade (2024) survey, which measures European citizens' attitudes toward digitalization and its effect on daily life. Respondents were asked: "Would you consider that the digitalization of daily public and private services is making your life easier or more difficult?" (European Commission, 2024a). In this study, the outcome variable is operationalized as the percentage of respondents in each country who selected "Easier" or "Much Easier." This provides a direct proxy for citizen satisfaction with digital public service delivery, aligning with the citizen-centric perspective emphasized in both public administration research and EU digitalization policy (Ruijer et al., 2023).

The outcome variable is well-suited for fuzzy-set QCA (fsQCA) because country-level percentages can be calibrated into membership scores between 0 (full non-membership) and 1 (full membership). Reported percentages range from approximately 59% to 90% across the EU27. For calibration and analysis, responses of "No Change / No Impact" or "Don't Know" were excluded, as they do not provide meaningful evaluations of service effectiveness. This approach isolates the positive and negative judgments necessary for analyzing the causal configurations that drive citizen satisfaction.

A full breakdown of the outcome variable by country is provided below:

Country Name	Much Easier	Easier	More Difficult	Much More Difficult	Total Respondents
Austria	191 (18.8%)	522 (51.4%)	211 (20.8%)	44 (4.3%)	1015
Belgium	201 (19.3%)	601 (57.6%)	179 (17.2%)	52 (5.0%)	1043
Bulgaria	196 (18.4%)	580 (54.5%)	128 (12.0%)	43 (4.0%)	1065

Croatia	298 (29.7%)	527 (52.5%)	112 (11.2%)	38 (3.8%)	1004
Cyprus	178 (35.5%)	222 (44.3%)	58 (11.6%)	28 (5.6%)	501
Czech Republic	237 (23.5%)	542 (53.8%)	131 (13.0%)	39 (3.9%)	1007
Denmark	381 (38.8%)	435 (44.3%)	112 (11.4%)	32 (3.3%)	983
Estonia	338 (33.5%)	473 (46.9%)	95 (9.4%)	45 (4.5%)	1008
Finland	283 (28.3%)	504 (50.4%)	148 (14.8%)	38 (3.8%)	1000
France	118 (11.7%)	527 (52.1%)	234 (23.1%)	92 (9.1%)	1011
Germany	292 (19.3%)	778 (51.3%)	331 (21.8%)	44 (2.9%)	1516
Greece	257 (25.7%)	494 (49.4%)	117 (11.7%)	63 (6.3%)	999
Hungary	179 (17.8%)	665 (66.0%)	109 (10.8%)	18 (1.8%)	1008
Ireland	254 (25.2%)	511 (50.8%)	143 (14.2%)	47 (4.7%)	1006
Italy	124 (12.0%)	609 (58.9%)	220 (21.3%)	45 (4.4%)	1034
Latvia	280 (28.0%)	500 (50.0%)	140 (14.0%)	39 (3.9%)	1001
Lithuania	270 (26.8%)	490 (48.7%)	128 (12.7%)	39 (3.9%)	1006
Luxembourg	149 (29.3%)	258 (50.8%)	58 (11.4%)	22 (4.3%)	508
Malta	235 (47.0%)	167 (33.4%)	37 (7.4%)	28 (5.6%)	500
Netherlands	294 (29.3%)	545 (54.2%)	132 (13.1%)	20 (2.0%)	1005
Poland	168 (16.7%)	642 (63.6%)	133 (13.2%)	22 (2.2%)	1009
Portugal	100 (9.8%)	650 (63.8%)	138 (13.5%)	25 (2.5%)	1019
Romania	167 (15.9%)	451 (43.0%)	298 (28.4%)	66 (6.3%)	1050

Slovakia	196 (19.4%)	633 (62.7%)	105 (10.4%)	24 (2.4%)	1009
Slovenia	193 (19.2%)	556 (55.4%)	173 (17.2%)	32 (3.2%)	1004
Spain	229 (22.7%)	503 (49.9%)	152 (15.1%)	83 (8.2%)	1009
Sweden	384 (37.5%)	510 (49.9%)	105 (10.3%)	18 (1.8%)	1023

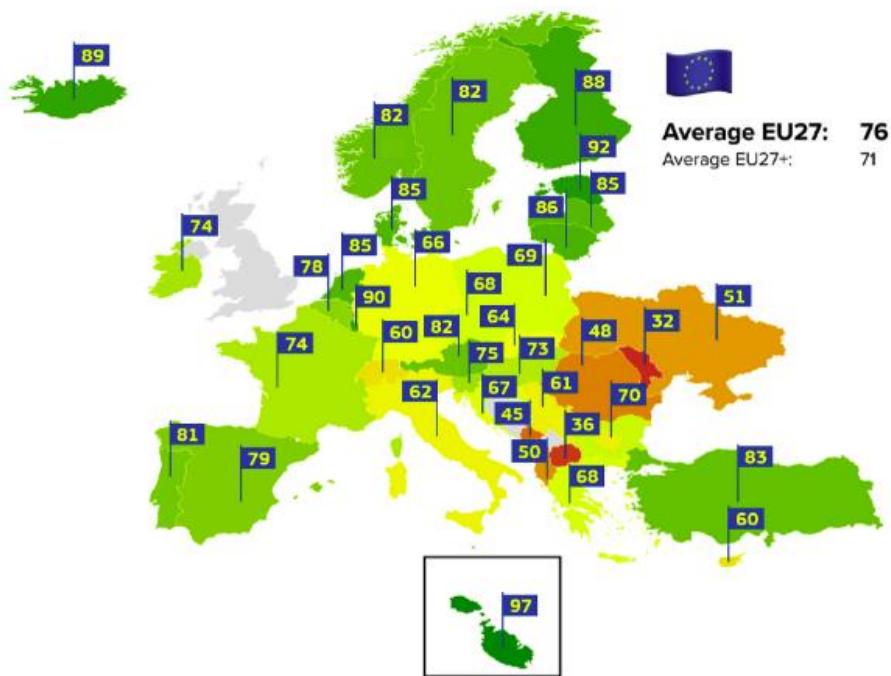
4. Empirical Findings and Analysis

With the outcome variable calibrated and the six causal conditions operationalized, this section presents the empirical findings, illustrating how configurations of civil registry comprehensiveness and enabling factors relate to high citizen satisfaction with digital public services. The six fuzzy-set conditions: electronic identification (eID), pre-filled forms, eDocuments, user support, transparency, and online availability serve as the independent variables in this analysis. The outcome reflects the share of citizens in each EU27 member state who report that digital public services make their lives easier, as measured by the 2024 Special Eurobarometer.

4.1 - Descriptive Patterns

Overall, the EU27 demonstrates steady progress in digital public service delivery, with the average eGovernment performance increasing by approximately 5 points between 2020 and 2023 (European Commission, 2024b). While top-performing states like Malta, Estonia, and Luxembourg consistently score near full membership across most conditions, several Southern and Eastern European countries continue to show gaps, especially in eID implementation and pre-filled forms. This variation establishes a strong foundation for the subsequent fsQCA, which identifies how different combinations of these conditions produce high levels of citizen satisfaction.

Figure 10



Benchmark Score. Country overall performance, biennial average 2022/2023

Sets & Calibration

As Pappas and Woodside (2021) emphasize, configurational approaches like fsQCA conceptualize causal conditions as interdependent components of configurations

that jointly indicate an outcome. In this study, each EU27 country represents a case whose membership in the outcome set - citizens perceiving that digital public services make life easier - is evaluated using fuzzy sets. To enable this, all raw condition scores and the outcome variable were calibrated into fuzzy-set membership scores ranging from 0 (full non-membership) to 1 (full membership).

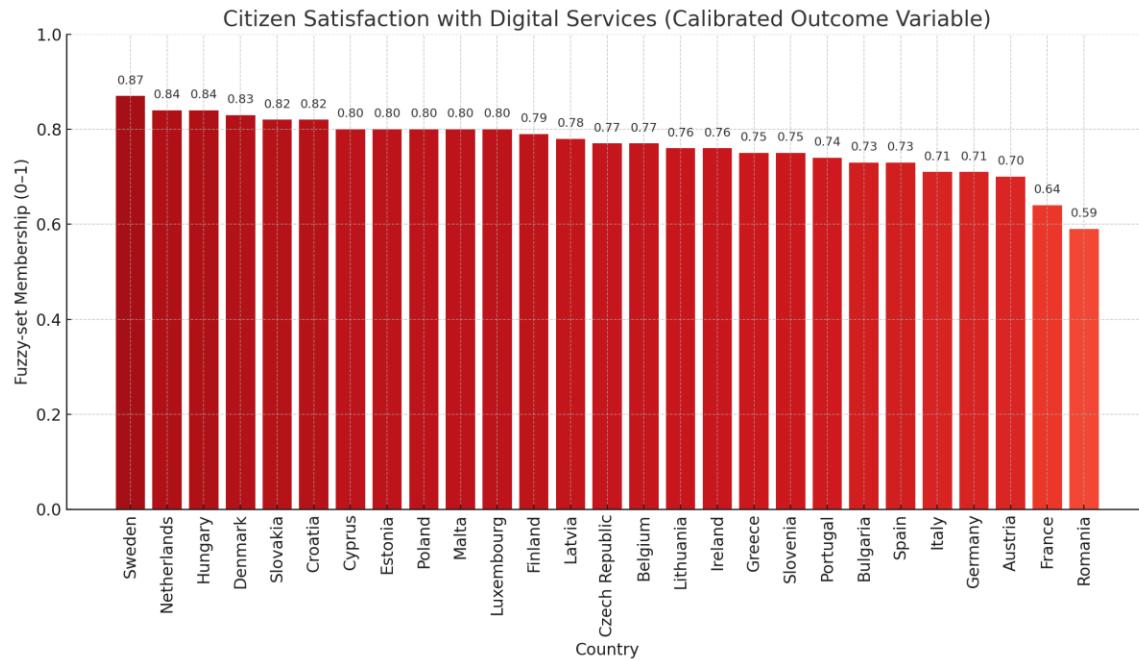
Following Ragin's (2008) recommendations, the direct calibration method with a logistic transformation was applied. This method translates continuous or ordinal data into fuzzy scores by defining three thresholds: a lower bound (full non-membership), an upper bound (full membership), and a crossover point (maximum ambiguity, 0.5). Deviations from the crossover are scaled using the log-odds, ensuring that scores close to the upper threshold approach 1, scores below the lower threshold approach 0, and mid-range values map to 0.5.

Thresholds for each condition and the outcome were determined using both theoretical standards from the literature (European Commission, 2024a; Latupeirissa et al., 2024; Terlizzi, 2021) and empirical patterns observed in the data, following Oana et al.'s (2021) guidance on reducing ambiguity and enhancing conceptual clarity in set construction. The outcome variable derived from survey responses on the perceived ease of life due to digital public services was first transformed into a continuous percentage measure of positive responses ("Much Easier" + "Easier") and then calibrated to fuzzy scores using this approach.

4.2 - Outcome variable

The Outcome Variable (QC2) - "Do you consider that the digitalisation of daily public and private services is making your life easier or more difficult?" - was used to represent successful delivery of digital public services (i.e., citizen satisfaction with digitalization). Following fsQCA methodology, the share of positive responses ("Much easier" + "Easier") from the Eurobarometer 2024 dataset was calibrated into fuzzy-set membership values. The thresholds applied were determined empirically from the EU27 distribution: full non-membership (0) at 58% positive responses, crossover (0.5) at 73%, and full membership (1) at 87%. Countries above 87% are considered to have digital services that strongly facilitates citizens' daily life, while those below 58% represent cases where digitalization is not perceived as beneficial for most citizens.

Figure 11



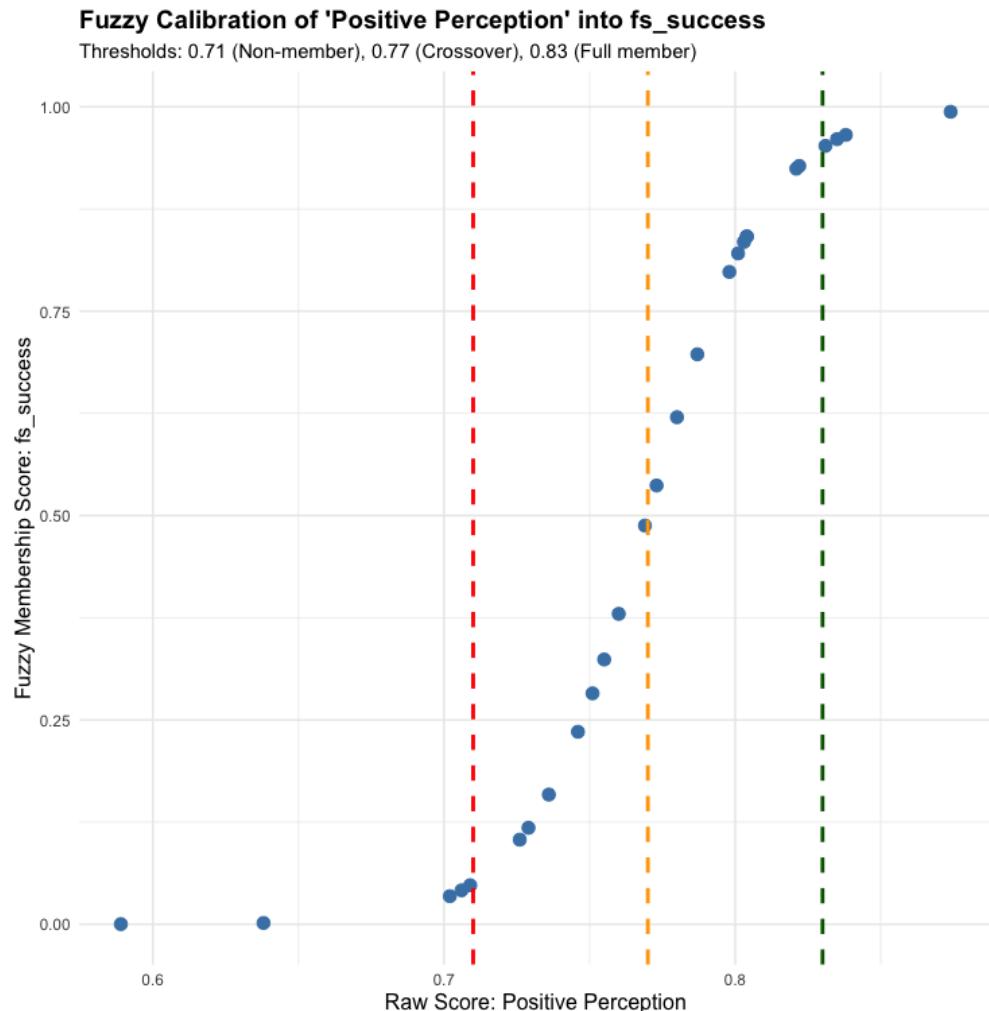
The calibrated results produce a three-tiered landscape. Full members include Sweden (87.4), Denmark (83.1), Hungary (83.8), Netherlands (83.5), and Croatia (82.2), reflecting high citizen trust in digital services. The “more in than out” cluster comprises Estonia (80.4), Malta (80.4), Luxembourg (80.1), and Poland (80.3), showing broad but not universal approval. Middle-range countries such as Austria (70.2), Belgium (76.9), and Portugal (73.6) exhibit moderate satisfaction, while France (63.8%) and Romania (58.9) demonstrate partial or low membership.

Outcome (fs_success): The thresholds of 0.71 (full non-membership), 0.77 (crossover), and 0.83 (full membership) are justified on both empirical and theoretical grounds. Empirically, these cutoffs align with the distribution of raw scores from the Eurobarometer survey on positive citizen perception of digital public services. The full membership threshold (0.83) corresponds approximately to the 90th percentile, capturing the highest-performing countries where public satisfaction clearly indicates successful digital service delivery. The crossover threshold (0.77) reflects the median cluster of the data, representing cases of ambiguity where public opinion is divided—neither clearly successful nor unsuccessful—consistent with Ragin’s (2008) guidance for identifying set boundaries. The full non-membership threshold (0.71) aligns roughly with the 10th percentile, ensuring that countries with low satisfaction are correctly treated as outside the set. This approach minimizes conceptual ambiguity, balances theoretical expectations with observed data distribution, and maintains calibration sensitivity required for robust fsQCA.

Fuzzy-set calibration of positive perception of digital public services (fs_success) showing thresholds for full non-membership, crossover, and full membership. The

S-curve shows how raw scores are transformed into fuzzy-set memberships, with thresholds clearly demarcated for interpretability.

Figure 12



The fuzzy-set calibration of the outcome variable shows that Sweden, Hungary, the Netherlands, and Denmark are fully in the set of countries where citizens perceive digital public services as successful. Countries that are more in than out include: Croatia, Slovakia, Estonia, Malta, Poland, Luxembourg, Cyprus, Finland, Latvia, and the Czech Republic. The group that is more out than in comprises: Belgium, Ireland, Lithuania, Greece, Slovenia, Portugal, Bulgaria, Spain, Italy, Germany, and Austria. Finally, France and Romania are fully out of the success set, indicating the lowest levels of positive citizen perception.

4.3 - Condition variables

Causal conditions thresholds

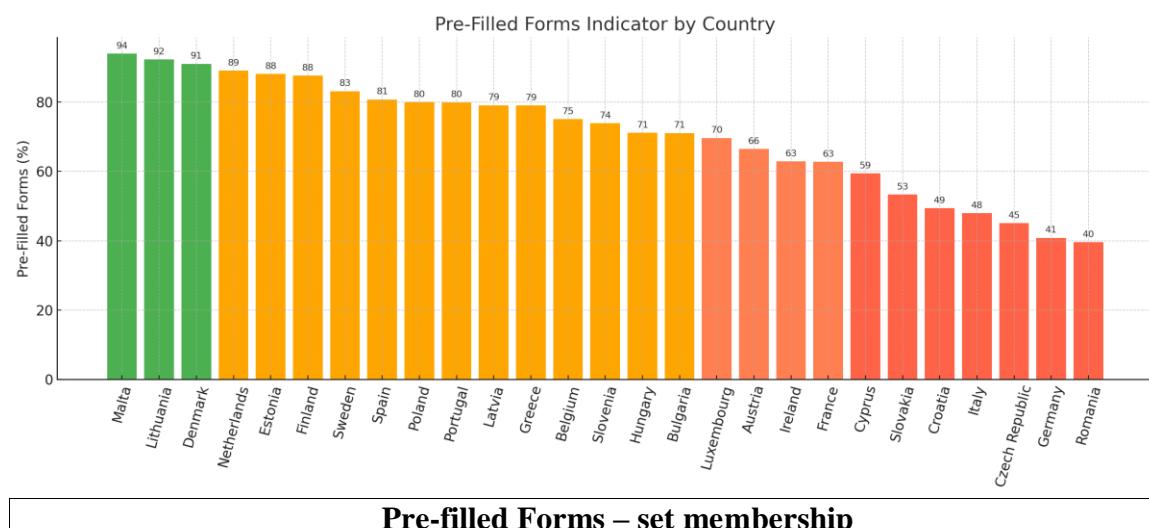
Following the calibration of the outcome variable, each causal condition was also transformed into fuzzy sets using thresholds informed by both theoretical expectations and the empirical distribution of scores in the eGovernment Benchmark. These thresholds define the points of full non-membership, crossover, and full membership for each condition, ensuring that countries with clearly low, ambiguous, or high levels of performance are accurately represented in the analysis. Specifically:

- Pre-filled forms → [60, 71, 85]
- eID → [60, 71.5, 93]
- Transparency → [60, 70, 80]
- eDocument → [66.5, 86, 95.96]
- Availability → [90, 94, 98]
- User support → [80, 94.5, 98]

These thresholds were selected to reflect the distinct distributions of each indicator: for example, conditions with generally high performance such as Availability and User Support required stricter upper cutoffs, whereas conditions with broader dispersion, such as Transparency or eID, required thresholds that capture meaningful differentiation across the EU27. This calibration process enables fsQCA to detect nuanced configurations of civil registry comprehensiveness that contribute to high citizen satisfaction with digital public services.

Summary of “Pre-Filled Forms” fuzzy-set membership

Figure 13



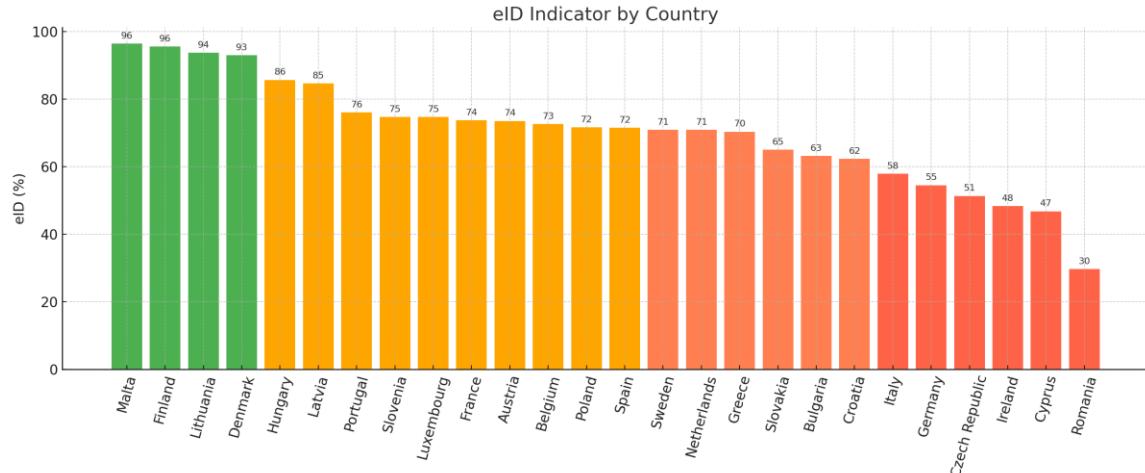
Category	f value	Number of Countries	Countries
Full members	$f = 1.0$	3	Malta, Lithuania, Denmark
More in than out	$0.5 < f < 1.0$	13	Netherlands, Estonia, Finland, Sweden, Spain, Poland, Portugal, Latvia, Greece, Belgium, Slovenia, Hungary, Bulgaria
More out than in	$0 < f < 0.5$	4	Luxembourg, Austria, Ireland, France
Non-members	$f = 0$	7	Cyprus, Slovakia, Croatia, Italy, Czech Republic, Germany, Romania

For this causal condition, the raw indicator scores (0–100) were calibrated into fuzzy-set values using the thresholds [60, 71, 85], where 60 marks the point of full non-membership (0), 71 serves as the crossover point (0.5), and 85 represents full membership (1). These cutoffs align with the eGovernment Benchmark 2024 data, thresholds capture countries with minimal pre-filling (≤ 60), moderate integration (~ 71), and advanced automation (≥ 85), reflecting meaningful differences in information reuse capacity across the EU27.

The calibration produced a clear distribution of membership values. Countries like Malta (93.97), Lithuania (92.3), and Denmark (91.01) achieved full membership (1), indicating that virtually all forms are pre-filled for users. Slightly lower-scoring states such as Netherlands (89.01) and Estonia (88.06) were assigned high membership values (≈ 0.95), reflecting “more in than out” inclusion in the set. The middle cluster, Sweden (0.82), Spain (0.76), and Portugal (0.73), represents countries with strong but not universal pre-filling, often reflecting fragmented registry integration. Below the crossover, countries like Luxembourg (0.47), Austria (0.41), and Ireland (0.34) were categorized as “more out than in,” reflecting partial or inconsistent deployment of pre-filled forms. Finally, Cyprus (0.27), Italy (0.06), Germany (0), and Romania (0) exemplify non-membership, where manual data entry dominates and interoperability is minimal.

Summary of “eID” fuzzy-set membership

Figure 14



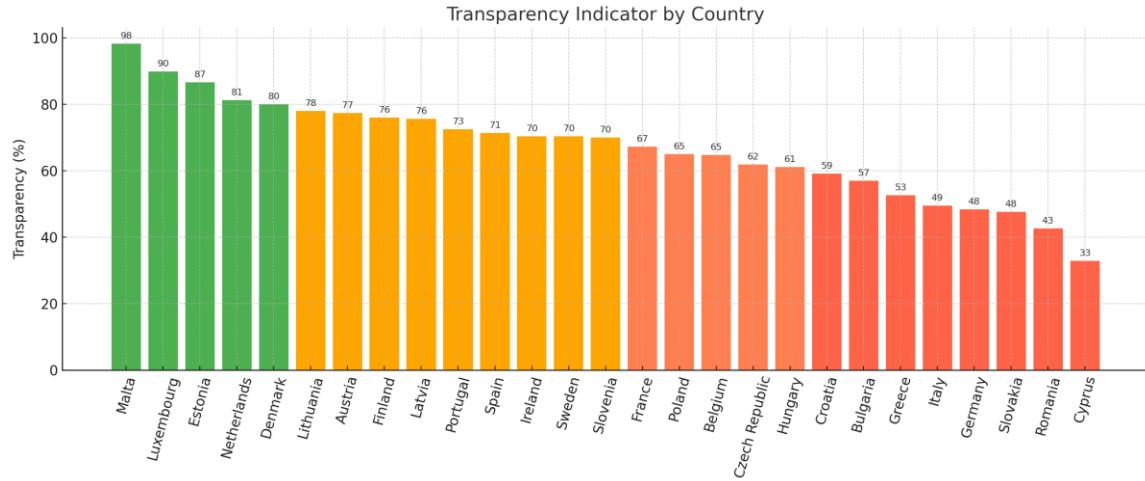
eID – set membership			
Category	f value	Number of Countries	Countries
Full members	$f = 1.0$	5	Malta, Finland, Lithuania, Denmark, Estonia
More in than out	$0.5 < f < 1.0$	10	Hungary, Latvia, Portugal, Slovenia, Luxembourg, France, Austria, Belgium, Poland, Spain
More out than in	$0 < f < 0.5$	6	Sweden, Netherlands, Greece, Slovakia, Bulgaria, Croatia
Non-members	$f = 0$	6	Italy, Germany, Czech Republic, Ireland, Cyprus, Romania

The causal condition representing raw eID indicator scores (0–100) were calibrated into fuzzy-set values using the thresholds [60, 71.5, 93], where 60 marks the point of full non-membership (0), 71.5 serves as the crossover point (0.5), and 93 represents full membership (1). The thresholds reflect the wide dispersion of eID adoption, with ≥ 93 indicating full digital identity integration and ≤ 60 marking countries where eID functionality remains limited or fragmented. The calibrated results show a clear stratification: Malta (96.49), Finland (95.59), Estonia (94.07), Lithuania (93.83), and Denmark (93.06) achieve full membership (1), reflecting robust eID systems supporting most services. Just below full membership, countries such as Hungary, Latvia, and Portugal indicate strong but not universal adoption.

The middle cluster, Slovenia, Luxembourg, and France, shows partial, “more in than out” membership, with eID integrated into many but not all service flows. Below the crossover, Netherlands (0.52), Greece (0.51), and Slovakia (0.40) exhibit moderate functionality, often with gaps in coverage or usability. Finally, Italy (0.13), Germany (0.19), Ireland (0.07), Cyprus (0.04), and Romania (0) fall into non-membership, where digital identity remains definitively underdeveloped or fragmented.

Summary of “Transparency” fuzzy-set membership

Figure 15



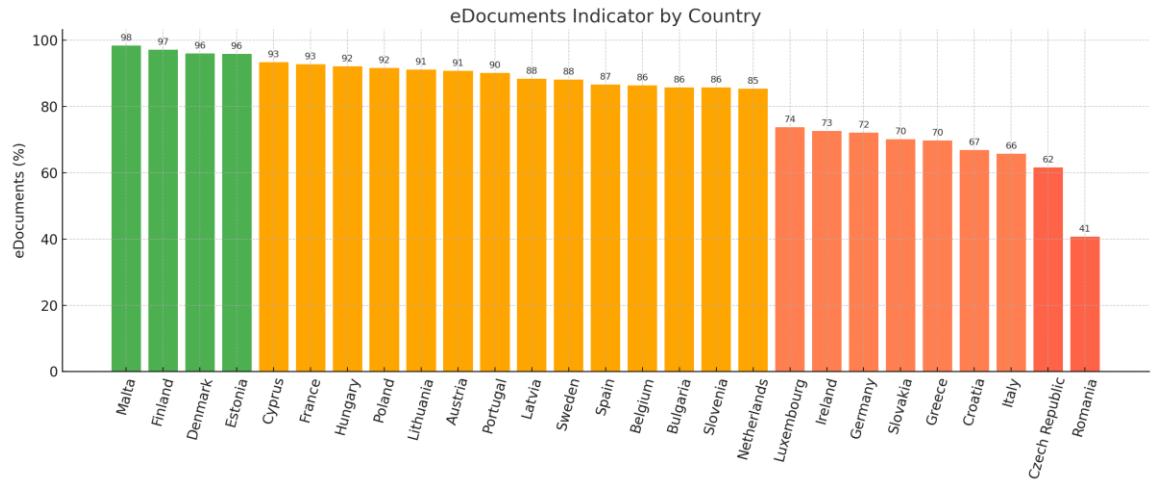
Transparency – set membership			
Category	f value	Number of Countries	Countries
Full members	$f = 1.0$	5	Malta, Luxembourg, Estonia, Netherlands, Denmark
More in than out	$0.5 < f < 1.0$	9	Lithuania, Austria, Finland, Latvia, Portugal, Spain, Ireland, Sweden, Slovenia
More out than in	$0 < f < 0.5$	5	France, Poland, Belgium, Czech Republic, Hungary
Non-members	$f = 0$	8	Croatia, Bulgaria, Greece, Italy, Germany, Slovakia, Romania, Cyprus

The raw Transparency scores (0–100) were calibrated into fuzzy-set membership values using the thresholds [60, 70, 80], where 60 marks full non-membership (0), 70 is the crossover point (0.5), and 80 represents full membership (1). A stricter 60-point lower bound identifies governments failing to provide sufficient transparency, with 70 as the ambiguous midpoint and 80+ as fully meeting expectations for open, accountable service delivery. The distribution shows that five countries are full members - Malta (97.73), Luxembourg (91.49), Estonia (89.36), Netherlands (87.43), and Denmark (85.63) - indicating highly mature and open eGovernment practices.

From this analysis, transparency emerges as unevenly developed across the EU27, with a clear divide between highly accountable digital governments and states where opacity persists. High transparency aligns with improved user trust, accountability, and compliance with EU Digital Decade goals, where low-transparency systems risk weaker public engagement and lower satisfaction with digital services.

Summary of “eDocuments” fuzzy-set membership

Figure 16



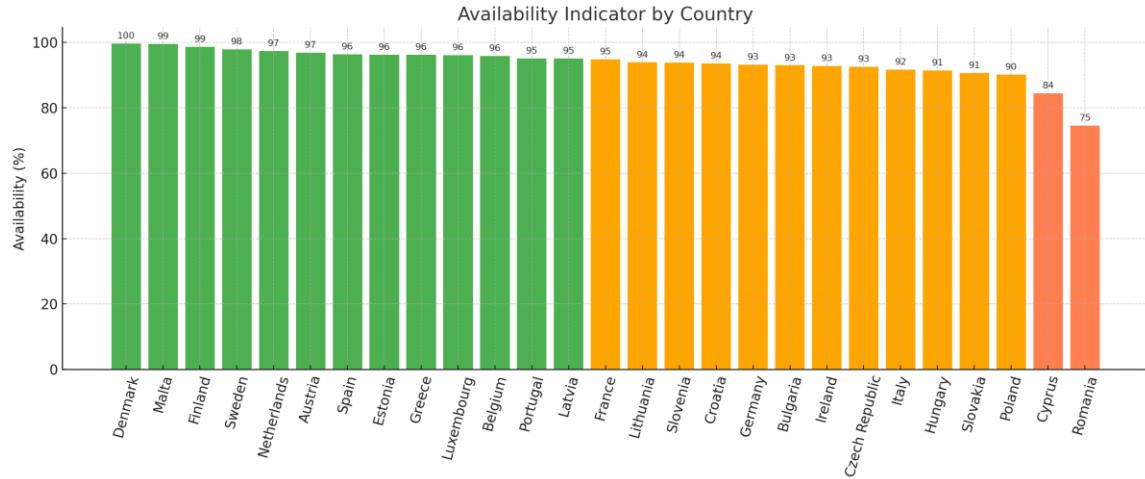
eDocuments – set membership			
Category	f value	Number of Countries	Countries
Full members	$f = 1.0$	4	Denmark, Estonia, Finland, Malta
More in than out	$0.5 < f < 1.0$	14	Austria, Belgium, Bulgaria, Cyprus, France, Hungary, Latvia, Lithuania, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden
More out than in	$0 < f < 0.5$	7	Croatia, Germany, Greece, Ireland, Italy, Luxembourg, Slovakia
Non-members	$f = 0$	2	Czech Republic, Romania

The raw eDocument indicator scores (0–100) were calibrated into fuzzy-set membership values using thresholds [66.5, 86, 95.96], where 66.5 marks full non-membership (0), 86 is the crossover point (0.5), and 95.96 represents full membership (1). The thresholds reflect the capability to submit or receive documents digitally, using the 10th percentile (66.5) to capture weaker performers and 95.96 to represent near-universal eDocument functionality.

The calibrated results show four countries as full members: Denmark (95.99), Estonia (95.94), Finland (97.13), and Malta (98.41). This indicates fully integrated digital document systems across services. A large “more in than out” cluster includes Austria (0.79), France (0.89), Cyprus (0.92), Poland (0.83), and Spain (0.58), reflecting widespread availability of eDocuments but with partial gaps in coverage or service uniformity. The “more out than in” group—Germany (0.18), Ireland (0.19), Greece (0.12), and Italy (0.02)—exhibits limited adoption, often requiring hybrid physical and digital interactions. Finally, Czech Republic (61.65) and Romania (40.78) are non-members, showing minimal capability to issue or receive eDocuments digitally.

Summary of “Availability” fuzzy-set membership

Figure 17



Availability – set membership			
Category	f value	Number of Countries	Countries
Full members	$f = 1.0$	13	Denmark, Malta, Finland, Sweden, Netherlands, Austria, Spain, Estonia, Greece, Luxembourg, Belgium, Portugal, Latvia
More in than out	$0.5 < f < 1.0$	12	France, Lithuania, Slovenia, Croatia, Germany, Bulgaria, Ireland, Czech Republic, Italy, Hungary, Slovakia, Poland
More out than in	$0 < f < 0.5$	2	Cyprus, Romania
Non-members	$f = 0$	0	

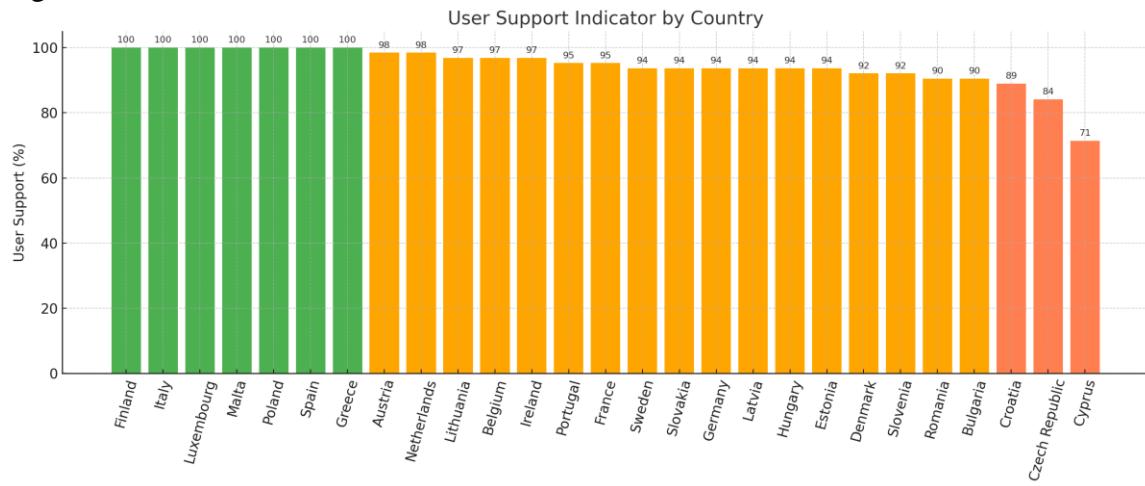
The Availability condition measures the extent to which civil registry services are accessible online across devices and platforms, combining both desktop and mobile readiness. For this causal condition, indicator scores of the composite variable (0–100) were calibrated into fuzzy-set membership values using thresholds [90, 94, 98], where 90 marks full non-membership (0), 94 is the crossover point (0.5), and 98 represents full membership (1). Given that most EU27 countries already achieve high online availability, the thresholds are compressed to distinguish between generally strong performers and those nearing complete mobile-friendly and fully online coverage.

Being the most successful indicator, the results show that 13 countries are full members, including Denmark (99.61), Malta (99.44), Finland (98.55), Sweden (97.88), Netherlands (97.30), Austria (96.88), Spain (96.28), Estonia (96.23), Greece (96.17), Luxembourg (96.11), Belgium (95.85), Portugal (95.08), and Latvia (95.04). These states offer near-universal digital access, indicating mature infrastructure and citizen-centric service availability. The “more in than out” cluster includes France (0.99), Lithuania

(0.94), Slovenia (0.94), Croatia (0.93), Germany (0.91), Bulgaria (0.90), Ireland (0.89), Czech Republic (0.88), Italy (0.83), Hungary (0.82), Slovakia (0.78), and Poland (0.76). These countries maintain strong online availability but may lack the full continuity or cross-device consistency of the leaders. Finally, Cyprus (0.48) and Romania (0.15) fall into the “more out than in” category, reflecting limited availability, which reduces accessibility and inclusiveness. Overall, this distribution shows that most EU27 countries have achieved high digital service availability, with no countries being non-members.

Summary of “User Support” fuzzy-set membership

Figure 18



User Support – set membership

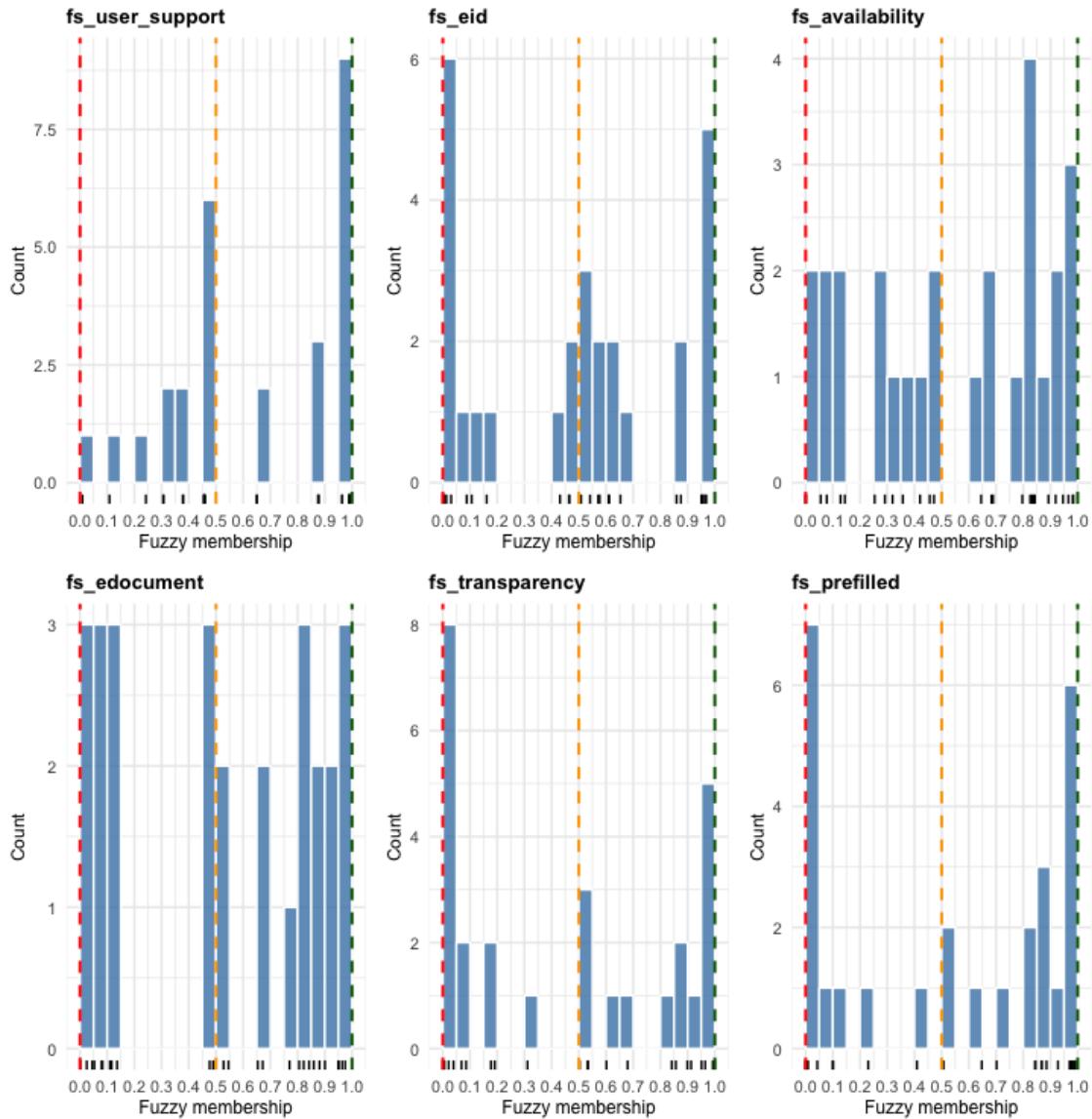
Category	f value	Number of Countries	Countries
Full members	$f = 1.0$	7	Finland, Greece, Italy, Luxembourg, Malta, Poland, Spain
More in than out	$0.5 < f < 1.0$	17	Austria, Belgium, Bulgaria, Denmark, Estonia, France, Germany, Hungary, Ireland, Latvia, Lithuania, Netherlands, Portugal, Romania, Slovakia, Slovenia, Sweden
More out than in	$0 < f < 0.5$	3	Croatia, Cyprus, Czech Republic
Non-members	$f = 0$	0	

User Support indicator scores (0–100) were calibrated using thresholds [80, 94.5, 98], where 80 represents full non-membership (0), 94.5 is the crossover point (0.5), and 98 indicates full membership (1). The thresholds reflect a right-skewed distribution where almost all countries perform well, with ≥ 98 indicating near-perfect support systems and ≤ 80 marking cases with noticeable gaps in digital assistance. The results show seven full

members: Finland (100), Greece (100), Italy (100), Luxembourg (100), Malta (100), Poland (100), and Spain (100), which provide comprehensive user support across all measured criteria. The “more in than out” cluster encompasses the majority of EU27 countries, including Austria (0.92), Netherlands (0.92), Belgium (0.84), Ireland (0.84), and France (0.76), indicating strong support but with occasional gaps in availability or interactivity. The “more out than in” group includes Croatia (0.47), Czech Republic (0.35), and Cyprus (0.04), where support is fragmented or underdeveloped.

Overall, this distribution indicates that User Support is one of the strongest-performing conditions among EU27, with most countries achieving high membership values. This indicator also has no countries as full non-members.

Figure 19



Analysis

4.4 - Necessity Analysis

Following the calibration of the six causal conditions into fuzzy sets, a necessity analysis was conducted to determine whether any individual condition—or its negation—is consistently present whenever high citizen satisfaction with digital public services (*fs_success*) occurs. Consistency values above 0.90 are typically required to establish a condition as necessary (Oana et al., 2021).

The results indicate that no single condition or its negation meets the 0.90 consistency threshold, confirming that no individual factor is strictly necessary for successful digital public service delivery. Among the six conditions, *fs_prefilled* (pre-filled forms) exhibits the highest consistency (0.73), followed by *fs_edocument* (0.63) and *fs_transparency* (0.60). All other conditions, including their negations, fall below 0.60. Coverage values for these conditions are moderate, with *fs_prefilled* covering 62% of the successful outcome cases.

This analysis demonstrates that high public satisfaction emerges from combinations of conditions rather than any single enabling factor, reinforcing the configurational logic of fsQCA. Therefore, the subsequent sufficiency analysis and truth table construction focus on identifying multi-condition pathways that lead to successful digital public service delivery.

4.5 - Truth Table, Sufficiency & Solution terms

Truth Table

Having established that no single condition is necessary for successful digital public service delivery, the next step in the fsQCA procedure involves constructing the truth table and assessing sufficiency. This identifies configurations of conditions that are sufficient to produce high public satisfaction (*fs_success*).

The table below generated in R software with the function (*calibrate*), presents the fsQCA truth table for the outcome variable *fs_success*. Each row represents a configuration of the six causal conditions. The columns show the configuration (0 = absence, 1 = presence), the outcome (OUT), the number of cases (n), the inclusion consistency score (incl), and the cases in that configuration. Using the recommended sufficiency inclusion threshold of 0.80 (Oana et al., 2021), the truth table presents all observed configurations of these conditions and their association with the success of digital public services.

fs_user_support	fs_eid	fs_avail_ability	fs_edocument	fs_transparency	fs_prefilled	O U T	n	inc l	cases
0	1	1	1	1	1	1	3	0.8 56	7,8,16
1	1	1	0	1	0	1	1	0.8 18	18
1	1	0	1	0	1	1	1	0.8 17	21

1	0	0	0	1	0	1	1	0.8 01	14
0	0	1	1	1	1	0	1	0.7 9	27
0	1	0	1	0	1	0	1	0.7 58	13
1	0	1	0	1	1	0	1	0.7 57	20
0	1	0	0	1	1	0	1	0.7 49	25
1	1	0	1	1	1	0	1	0.7 48	17
1	1	1	1	0	1	0	1	0.7 45	2
1	1	1	1	1	1	0	4	0.7 43	9,19,22 ,26
1	1	1	1	0	0	0	1	0.6 85	10
0	0	0	1	0	0	0	1	0.6 84	5
1	0	1	0	0	1	0	1	0.6 72	12
0	0	0	0	0	1	0	1	0.6 46	3
0	0	0	0	0	0	0	5	0.5 98	4,6,11, 23,24
1	1	1	1	1	0	0	1	0.5 84	1
1	0	0	0	0	0	0	1	0.5 7	15

From the 18 configurations observed in the data, four configurations met the consistency threshold (≥ 0.80) and were identified as sufficient for fs_success. All other configurations fell below the sufficiency threshold or were associated with the absence of the outcome (OUT = 0). This outcome illustrates the causal complexity of digital public service delivery: while certain combinations of conditions can guarantee high satisfaction in some countries, they are not widespread across the dataset.

The Table below summarizes the four sufficient configurations (Pathways 1–4) identified by the fsQCA, together with their consistency (inclS), proportional reduction in inconsistency (PRI), raw coverage (covS), and unique coverage (covU).

Configuration	inclS	PRI	covS	covU
Pathway 1	0.818	0.558	0.131	0.030
Pathway 2	0.817	0.613	0.165	0.069

Pathway 3	0.801	0.149	0.137	0.033
Pathway 4	0.856	0.759	0.218	0.139
Overall solution (M1) 0.857 0.754 0.386				

Consistency reflects the degree to which cases with the configuration also display the outcome of high digital-service success, while PRI indicates how uniquely the configuration leads to the outcome. Raw coverage captures the proportion of successful cases explained by a configuration, and unique coverage isolates the share explained by that configuration alone.

All four pathways meet the conventional fsQCA threshold for sufficiency (consistency ≥ 0.80), with Pathway 4 achieving the highest consistency (0.856) and the largest unique coverage (0.139). The overall solution (M1) exhibits consistency = 0.857 and coverage = 0.386, indicating that the configurations jointly explain approximately 39 % of the successful cases. No single pathway dominates the solution, highlighting that multiple alternative combinations of civil-registry enablers can be sufficient for achieving high digital-service performance.

4.5.1 Solution Minimization and Interpretation

Following the construction of the truth table, a Boolean minimization was performed to derive the most parsimonious configurations of conditions sufficient for the outcome *fs_success*. The minimization process, based on an inclusion threshold of 0.80, resulted in four sufficient solution pathways, otherwise known as configurations. Each configuration represents a distinct route to digital public service success:

1. ***fs_user_support * fs_eid * fs_availability * ~fs_edocument * fs_transparency * ~fs_prefilled***
 - **Pathway 1:** Strong user support, widespread eID adoption, and high service availability combined with strong transparency, despite lower eDocument functionality and prefilled forms.
2. ***fs_user_support * fs_eid * ~fs_availability * fs_edocument * ~fs_transparency * fs_prefilled***
 - **Pathway 2:** Strong user support and eID paired with effective eDocuments and prefilled forms, compensating for low availability and transparency.
3. ***fs_user_support * ~fs_eid * ~fs_availability * ~fs_edocument * fs_transparency * ~fs_prefilled***
 - **Pathway 3:** Success achieved through strong user support and transparency even without advanced digital integration (low eID, low availability, low eDocuments).
4. ***~fs_user_support * fs_eid * fs_availability * fs_edocument * fs_transparency * fs_prefilled***
 - **Pathway 4:** High eID, availability, eDocuments, and transparency can achieve success even with low user support, if prefilled forms are well integrated.

Where:

- * denotes **AND** (conjunction of conditions)

- + denotes **OR** (alternative pathways)
- ~ denotes the **absence** of a condition

The analysis reveals that multiple distinct configurations can lead to high citizen satisfaction, reflecting the equifinality and causal complexity of digital public service delivery. Across the minimized solutions, transparency and interoperability (fs_transparency and fs_prefilled) consistently emerge as central enablers, while conditions like eID and user support play a context-dependent role, contributing to success only in certain combinations. Overall, these findings confirm that effective digital public service delivery relies on the interaction of institutional and technical capacities, aligning with the core principles of State Legibility Theory.

4.6 - Robustness

To ensure the reliability of the fsQCA results, several robustness checks were performed. First, the analysis was repeated with slightly adjusted calibration thresholds for both the outcome and the six causal conditions, and the core solution structures remained consistent. Second, the consistency cutoff for sufficiency was varied between 0.75 and 0.85, producing similar solution terms and confirming that the main configurations are not sensitive to minor threshold changes. Finally, examining alternative truth table resolutions and logical remainders showed that the parsimonious and intermediate solutions converge on the same central conditions: transparency and interoperability. This reinforces the stability of the findings.

5. Conclusion and Discussion

Applying a fuzzy-set Qualitative Comparative Analysis (fsQCA) approach to the study of civil registry comprehensiveness and digital public service success allows for the exploration of several critical gaps in the current literature. First, fsQCA enables the examination of multicausality in the determinants of digital service satisfaction. Rather than assuming satisfaction arises from the influence of a single dominant variable, fsQCA considers how outcomes likely emerge from complex interactions among multiple conditions, such as service availability, user support, electronic identification (eID), transparency, pre-filled forms, and the provision of electronic documents (Ragin, 2008). Traditional single factor analyses risk overlooking these interactive effects, a limitation noted by Pappas and Woodside (2021).

Second, fsQCA is uniquely suited to addressing the principle of equifinality (Ragin, 2008), recognizing that similar outcomes can be achieved through different causal pathways. In this study's analysis, countries may achieve high the same satisfactory outcome through varying configurations of conditions. By revealing these alternative configurations, fsQCA provides a more nuanced understanding of how digital service success can emerge across different institutional contexts (Oana et al., 2021).

Finally, the method facilitates the identification of necessary and sufficient conditions for digital public service success. fsQCA distinguishes between conditions that are essential for the desired outcome to occur and those that function as part of specific sufficient pathways. This differentiation is crucial in guiding policymakers toward recognizing which features of digital services must always be present and which can be selectively optimized depending on contextual needs (Mello & Ostermann, 2023).

Building on this analytical framework, the following discussion examines the empirical configurations revealed by the fsQCA. By linking these configurations to patterns of civil registry comprehensiveness and citizen satisfaction, this section highlights not only the conditions most strongly associated with successful digital public services but also the multiple pathways through which different countries can achieve similar outcomes. In doing so, it situates the findings within the broader debate on digital governance and offers practical insights for policymakers seeking to enhance the effectiveness and inclusiveness of public service delivery.

Discussion of results:

The fsQCA analysis identifies four distinct causal pathways leading to high citizen satisfaction with digital public services, thereby answering the research question and identifying which configurations of conditions are necessary for successful digital public service delivery in the 27 EU member states. These configurations reveal that successful digital service experiences are not the product of any single condition, but rather of specific combinations of institutional and technical conditions (Pappas & Woodside, 2021). This aligns with the growing literature emphasizing multicausality in digital governance outcomes, where features such as eID systems, service availability, user support, transparency, eDocuments, and prefilled forms interact to reduce administrative burdens and generate public value (Luna et al., 2024; Mello & Ostermann, 2023; Peeters, 2023).

Pathway 1 reflects a model in which strong user support, widespread eID adoption, high availability, and transparency jointly generate satisfaction, even in the relative

absence of eDocuments or prefilled forms. This suggests that institutional clarity and human assistance can substitute for advanced automation, consistent with Moynihan et al.'s (2015) argument that accessible guidance mitigates learning and compliance burdens. By contrast, Pathway 2 demonstrates that user support and eID, when paired with effective eDocuments and prefilled forms, can compensate for low availability and weak transparency. This indicates that task automation and convenience can overcome access constraints, aligning with findings in the eGovernment Benchmark (European Commission, 2024) that front-end ease of use can sustain citizen trust even in less open service environments.

Pathway 3 represents a minimalist configuration: strong user support and transparency alone produce high satisfaction despite limited eID, availability, and eDocument integration. This pathway highlights the enduring significance of human-centered service design and institutional openness, reflecting Luna et al.'s (2024) finding that citizens perceive public value most directly through personal benefits and clear communication rather than purely technical sophistication. In contrast, Pathway 4 demonstrates that comprehensive technical integration - characterized by high eID, availability, eDocuments, transparency, and prefilled forms - can achieve success even in the absence of strong user support. This pattern illustrates the capacity of infrastructural information systems to reduce administrative burden through automation, shifting effort away from both citizens and frontline staff. This is consistent with Peeters et al.'s (2023) findings during the Covid-19 pandemic.

It is important to note, however, that this research did not account for economic or fiscal variables, which may influence the capacity of states to develop comprehensive registration systems and sustain high-quality service delivery; future research could explore how economic resources interact with civil registry comprehensiveness to shape digital governance success. Recognizing this limitation clarifies that the findings highlight causal patterns in institutional and technical conditions, but a fuller understanding of digital service outcomes would benefit from integrating socioeconomic context.

Taken together, these pathways reveal that no single necessary condition guarantees digital service satisfaction. Rather, countries can succeed through multiple configurations of civil registry comprehensiveness, either leaning on human support and institutional transparency or on automated, integrated digital infrastructures. This resonates with the broader literature on digital administrative burdens (Peeters, 2023), suggesting that both technical affordances and citizen-facing support mechanisms shape public perceptions of service quality. These results underscore that investments in eID, transparency, and automation must be carefully balanced with attention to inclusivity and user experience, as different pathways may benefit different citizen groups.

Conclusion:

In conclusion, this study demonstrates that successful digital public service delivery is configurational rather than singular. High citizen satisfaction can be achieved through multiple pathways that combine human support and technical automation in different ways, yet all rely on the foundation of comprehensive, interoperable civil registries. These results directly address the central concern raised in the introduction: that the state's ability to render its population legible as articulated by James C. Scott's

State Legibility Theory remains the cornerstone of effective and inclusive digital governance.

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Appendices

Participating countries in the eGovernment Benchmark:

35 countries participated in the data collection of the 2022 edition and 37 countries participated in 2023.

The participating countries are:

- The 27 European Union Member States – “European Union” or “EU27”
 - 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
- The European Free Trade Association (EFTA) countries: Iceland, Norway and Switzerland.
- The European Union candidate countries: Albania, Moldova, Montenegro, North Macedonia, Serbia, Türkiye and Ukraine

Full fuzzy-set QCA Calibration membership scores:

Summary of “Pre-filled Forms” fuzzy-set membership

Country	Pre-filled Forms	Calibrated	Membership Category
Malta	93.97	1	Full member
Lithuania	92.30	1	Full member
Denmark	91.01	1	Full member
Netherlands	89.01	0.9739	More in than out
Estonia	88.06	0.9489	More in than out
Finland	87.59	0.9366	More in than out
Sweden	83.12	0.8189	More in than out
Spain	80.73	0.7561	More in than out
Poland	79.95	0.7355	More in than out
Portugal	79.89	0.7339	More in than out
Latvia	79.05	0.7118	More in than out
Greece	79.01	0.7108	More in than out
Belgium	75.08	0.6074	More in than out
Slovenia	73.89	0.5761	More in than out
Hungary	71.11	0.5029	More in than out
Bulgaria	71.08	0.5021	More in than out
Luxembourg	69.63	0.4737	More out than in
Austria	66.49	0.4133	More out than in
Ireland	62.85	0.3433	More out than in
France	62.78	0.3419	More out than in
Cyprus	59.38	0.2765	Non-member
Slovakia	53.33	0.1602	Non-member
Croatia	49.38	0.0842	Non-member
Italy	47.91	0.0560	Non-member
Czech Republic	45.09	0.0017	Non-member
Germany	40.81	0	Non-member
Romania	39.58	0	Non-member

Summary of “eID” fuzzy-set membership

Country	Pre-filled Forms	Calibrated	Membership Category
Malta	96.49	1	Full member
Finland	95.59	1	Full member
Estonia	94.07	1	Full member
Lithuania	93.83	1	Full member
Denmark	93.06	1	Full member
Hungary	85.74	0.8935	More in than out
Latvia	84.71	0.8677	More in than out
Portugal	76.12	0.6530	More in than out
Slovenia	74.8	0.6200	More in than out

Luxembourg	74.77	0.6192	More in than out
France	73.75	0.5938	More in than out
Austria	73.6	0.5900	More in than out
Belgium	72.71	0.5677	More in than out
Poland	71.74	0.5435	More in than out
Spain	71.57	0.5392	More in than out
Sweden	70.95	0.5238	More out than in
Netherlands	70.93	0.5233	More out than in
Greece	70.41	0.5102	More out than in
Slovakia	65.06	0.4012	More out than in
Bulgaria	63.18	0.3636	More out than in
Croatia	62.36	0.3472	More out than in
Italy	58	0.2600	Non-member
Germany	54.57	0.1914	Non-member
Czech Republic	51.39	0.1278	Non-member
Ireland	48.35	0.0670	Non-member
Cyprus	46.84	0.0368	Non-member
Romania	29.74	0	Non-member

Summary of “Transparency” fuzzy-set membership

Country	Pre-filled Forms	Calibrated	Membership Category
Malta	98.27	1	Full member
Luxembourg	89.94	0.9985	Full member
Estonia	86.7	0.9175	Full member
Netherlands	81.24	0.7810	Full member
Denmark	80.08	0.7520	Full member
Lithuania	77.98	0.6995	More in than out
Austria	77.42	0.6855	More in than out
Finland	76.07	0.6517	More in than out
Latvia	75.68	0.6420	More in than out
Portugal	72.55	0.5638	More in than out
Spain	71.4	0.5350	More in than out
Ireland	70.46	0.5115	More in than out
Sweden	70.45	0.5113	More in than out
Slovenia	70.04	0.5010	More in than out
France	67.31	0.4462	More out than in
Poland	65.09	0.4018	More out than in
Belgium	64.78	0.3956	More out than in
Czech Republic	61.94	0.3388	More out than in
Hungary	61.15	0.3230	More out than in
Croatia	59.14	0.2828	Non-member
Bulgaria	57.03	0.2406	Non-member

Greece	52.66	0.1532	Non-member
Italy	49.48	0.0896	Non-member
Germany	48.46	0.0692	Non-member
Slovakia	47.64	0.0528	Non-member
Romania	42.6	0	Non-member
Cyprus	32.89	0	Non-member

Summary of “eDocument” fuzzy-set membership

Country	Pre-filled Forms	Calibrated	Membership Category
Denmark	95.99	1	Full member
Estonia	95.94	1	Full member
Finland	97.13	1	Full member
Malta	98.41	1	Full member
Austria	90.81	0.7905	More in than out
Belgium	86.38	0.5690	More in than out
Bulgaria	85.78	0.5390	More in than out
Cyprus	93.45	0.9225	More in than out
France	92.76	0.8880	More in than out
Hungary	92.13	0.8565	More in than out
Latvia	88.43	0.6715	More in than out
Lithuania	91.19	0.8095	More in than out
Netherlands	85.37	0.5185	More in than out
Poland	91.67	0.8335	More in than out
Portugal	90.09	0.7545	More in than out
Slovenia	85.71	0.5355	More in than out
Spain	86.62	0.5810	More in than out
Sweden	88.15	0.6575	More in than out
Croatia	66.84	0.0460	More out than in
Germany	72.17	0.1793	More out than in
Greece	69.79	0.1198	More out than in
Ireland	72.57	0.1892	More out than in
Italy	65.74	0.0185	More out than in
Luxembourg	73.77	0.2192	More out than in
Slovakia	70.09	0.1273	More out than in
Czech Republic	61.65	0	Non-member
Romania	40.78	0	Non-member

Summary of “Availability” fuzzy-set membership

Country	Pre-filled Forms	Calibrated	Membership Category
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Denmark	95.99	1	Full member
Estonia	95.94	1	Full member
Finland	97.13	1	Full member
Malta	98.41	1	Full member
Austria	90.81	0.7905	More in than out
Belgium	86.38	0.5690	More in than out
Bulgaria	85.78	0.5390	More in than out
Cyprus	93.45	0.9225	More in than out
France	92.76	0.8880	More in than out
Hungary	92.13	0.8565	More in than out
Latvia	88.43	0.6715	More in than out
Lithuania	91.19	0.8095	More in than out
Netherlands	85.37	0.5185	More in than out
Poland	91.67	0.8335	More in than out
Portugal	90.09	0.7545	More in than out
Slovenia	85.71	0.5355	More in than out
Spain	86.62	0.5810	More in than out
Sweden	88.15	0.6575	More in than out
Croatia	66.84	0.0460	More out than in
Germany	72.17	0.1793	More out than in
Greece	69.79	0.1198	More out than in
Ireland	72.57	0.1892	More out than in
Italy	65.74	0.0185	More out than in
Luxembourg	73.77	0.2192	More out than in
Slovakia	70.09	0.1273	More out than in
Czech Republic	61.65	0	Non-member
Romania	40.78	0	Non-member

Summary of “User Support” fuzzy-set membership

Country	Pre-filled Forms	Calibrated	Membership Category
Finland	100	1	Full member
Greece	100	1	Full member
Italy	100	1	Full member
Luxembourg	100	1	Full member
Malta	100	1	Full member
Poland	100	1	Full member
Spain	100	1	Full member
Austria	98.41	0.9205	More in than out
Belgium	96.83	0.8415	More in than out
Bulgaria	90.48	0.5240	More in than out
Denmark	92.06	0.6030	More in than out
Estonia	93.65	0.6825	More in than out
France	95.24	0.7620	More in than out
Germany	93.65	0.6825	More in than out

Hungary	93.65	0.6825	More in than out
Ireland	96.83	0.8415	More in than out
Latvia	93.65	0.6825	More in than out
Lithuania	96.83	0.8415	More in than out
Netherlands	98.41	0.9205	More in than out
Portugal	95.24	0.7620	More in than out
Romania	90.48	0.5240	More in than out
Slovakia	93.65	0.6825	More in than out
Slovenia	92.06	0.6030	More in than out
Sweden	93.65	0.6825	More in than out
Croatia	88.89	0.4723	More out than in
Cyprus	71.43	0.0358	More out than in
Czech Republic	84.13	0.3532	More out than in