

E-GOVERNMENT AS A CATALYST FOR EFFICIENT GOVERNANCE AND PUBLIC SERVICE DELIVERY: EVIDENCE FROM THE BALTIC STATES

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ABSTRACT

This paper investigates the trajectory of e-government development in the Baltic states (Estonia, Latvia, and Lithuania) over the period 2010–2024, addressing two research questions: (RQ1) How have the three Baltic states differed in their e-government development trajectories, as measured by the EGDI and its sub-indices? (RQ2) What factors explain the observed divergences between Estonia, Latvia, and Lithuania? The study relies on secondary data from the UN E-Government Knowledgebase and applies a longitudinal comparative analysis of the E-Government Development Index (EGDI) and its three components—the Online Service Index (OSI), the Telecommunication Infrastructure Index (TII), and the Human Capital Index (HCI). The findings reveal that all three countries have progressed to the "very high" EGDI tier by 2024, yet their trajectories differ markedly: Estonia advanced from rank 20 in 2010 to rank 2 in 2024 (EGDI: 0.6965–0.9727), driven by its early institutional investment in digital identity and data-exchange infrastructure; Lithuania rose from rank 28 to rank 21 (EGDI: 0.6295–0.9110) through sustained online service expansion and broadband penetration; and Latvia, after stagnating in the "high" tier until 2018, accelerated to rank 29 in 2024 (EGDI: 0.5826–0.8852) following significant infrastructure investment. The results suggest that institutional commitment and policy continuity, rather than initial resource endowments, are the primary drivers of e-government advancement in this region.

Keywords: e-Government, Public Services, Public Administration, Development, ICT, Baltic states.

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INTRODUCTION

Digital transformation is more important than ever, as modernizing the public sector and aligning the private sector with global trends have made digitalization in all areas of society a necessity rather than a choice. This shift is being accelerated by recent advancements in connectivity, the development of digital skills, and increasing societal demands, especially with the rapid evolution of new technologies. Therefore, to meet citizens' expectations for efficiency, transparency, and accessibility, public administration reform must be a top priority in every country, including the Baltic states. The implementation of electronic services and the digital transformation of public administration are essential components of reform initiatives. Digital transformation refers to reorganizing and improving operational procedures by using all available digital tools and technologies, including online service delivery. A strong legal framework is crucial for these advancements: regulations that validate electronic documents, signatures, identity, delivery, and trust services are necessary to encourage wider e-commerce adoption and increase public trust in the exchange of digital data.

The strategic integration of ICT into public administration is essential for modern governance. E-government supports democratic participation, improves public service quality, and enhances administrative efficiency. By increasing accessibility, transparency, and effectiveness in government–citizen interactions, it contributes to economic and social development. It also reduces opportunities for corruption through more transparent and auditable processes, enabling faster government responses via digital services and communication channels. However, its success depends on overcoming challenges such as the digital divide, cybersecurity risks, and resistance to change.

E-government refers to the delivery of public services through digital technologies such as computers and the Internet. It improves citizens' access to services and enhances government efficiency. Successful implementation depends on adequate digital infrastructure, including telecommunications networks, internet connectivity, and digital skills among citizens and public employees. Many people are unable to use e-services effectively, while many public employees lack the skills or resources needed to implement them properly. Insufficient infrastructure, limited digital literacy, and shortcomings in human resources can hinder or slow the successful implementation of e-government initiatives. Comparative analyses of e-government practices across countries provide valuable insights into the strengths and weaknesses of existing information technologies, helping to identify strategies for improving and maximizing the efficiency of public administration [1].

Since 2001, the United Nations has published an E-Government Survey every two years to assess the level of digitalization in public administration among its member states. The survey includes the E-Government Development Index (EGDI), which comprises three equally weighted components: the Online Service Index, the Telecommunication Infrastructure Index, and the Human Capital Index. As the only comprehensive global assessment of e-government development, the survey serves as an important resource for policymakers, digital governance experts, public administration professionals, and stakeholders involved in information and communications technologies.

Against this backdrop, the present paper is guided by two explicit research questions: (RQ1) How have Estonia, Latvia, and Lithuania differed in their e-government development trajectories over the period 2010–2024, as reflected in the EGDI and its three sub-indices? (RQ2) What structural factors—related to digital infrastructure, human capital, and online service provision—explain the observed divergences among the three countries? Answering these questions contributes to the comparative e-government literature by offering an evidence-based account of why nominally similar post-Soviet EU states have achieved different levels of digital governance maturity. The remainder of the paper is organized as follows. Section 2 reviews the relevant theoretical and empirical literature. Section 3 describes the research methodology and data. Section 4 presents and interprets the results. Section 5 draws conclusions, discusses theoretical implications, and offers policy recommendations.

THEORETICAL BACKGROUND AND LITERATURE OVERVIEW

The potential and actual benefits of e-government, along with its drawbacks, have attracted significant interest from academics and professionals [2]. The e-government system is a crucial part of modern governance. With the e-government system, government services are now faster, more reliable, and free from the bureaucratic problems that typically affected the old system [3]. The term "e-government," which refers to the state's use of information and communication technology to deliver public services to its stakeholders, has a global connotation today. It refers to the public sector providing services online or through technology [4], [5]. One of the leading trends in the modernization of public administration in the EU is e-government. Due to the importance of e-government as a tool for advancing the modernization of public administration, Ardielli and Halásková [6] examine the evaluation of the state of e-government in their research.

The existing literature on e-government can be organized around three broad thematic clusters that are directly relevant to the present study. The first cluster concerns the conceptual and definitional foundations of e-government and its relationship to public administration efficiency. The second addresses the role of technological infrastructure, human capital, and institutional factors as enablers or inhibitors of e-government uptake. The third examines country-specific and comparative evidence, including the Baltic context.

One key initiative that could elevate the standard of public service from traditional to contemporary is the e-government system. Its implementation is linked to public administration reform policy [7]. According to Goloshchapova et al. [8], e-government refers to the use of digital technology to create electronic channels that improve public service efficiency, promote economic growth, and increase living standards. In their research, Huang et al. [9] and Setyawan [10] examined the contribution of e-government to improving the efficacy and efficiency of contemporary public administration. The results show that e-government plays a major role in reducing the possibility of corruption and abuse of power, improving transparency, and speeding up public service procedures. Sharmin and Chowdhury [11] state that automating procedures, reducing costs, and encouraging public participation significantly increase administrative efficiency in e-governance. Their research indicates that blockchain, artificial intelligence, and big data will shape the future of digital governance. However, legal and ethical frameworks must be strengthened to ensure safe, inclusive, and citizen-centered governance models.

Increasing public awareness, managing organizational change, strengthening cybersecurity, and improving IT infrastructure can all help public administrators and legislators implement more inclusive and successful e-government programs [12]. Mensah [13] examined the relationship between e-government service usage and government performance and competence. The results showed that both factors significantly influenced how helpful consumers perceived e-government services to be. The adoption of e-government promises the efficient delivery of government services to citizens across various economic sectors. With significant investments made to establish procedures that ensure transparency in much of the nation's operations, especially in the contracting and acquisition of public properties and services, e-government processes have become a key area of development [14], [15]. The quality of online government information, services, and transactions is expected to continue improving, according to e-governance evolution models [16], [17]. However, the potential advantages of continued government investment in e-Government technology are seriously questioned [18].

Many governments worldwide are increasingly adopting information and communication technologies (ICT) to modernize their service delivery systems, aiming to improve the efficiency, effectiveness, and responsiveness of public administration. By digitalizing government processes and services, ICT enables faster service provision, reduces administrative costs and paperwork, enhances transparency and accountability, and improves citizens' access to public services. Consequently, ICT-driven modernization has become a key component of public sector reform and digital transformation strategies in both developed and developing countries [19]. With the careful and thorough application of contemporary ICT, many nations have transformed their administrative structures in the public sector. Economic progress significantly affects the development of ICT, e-government, and the quality of a country's institutional framework. Governments in many developed countries support initiatives to improve public administration, most of which are fundamentally linked to the use of ICT to provide e-government services [20], [21]. Innovations in information and communication technology have changed how people work, communicate, behave, and what information they require.

In the digital age, e-government integration is widely recognized as a transformative tool for public administration reform, enabling governments to modernize their structures, processes, and service delivery through the effective use of information and communication technologies (ICT). By digitizing administrative procedures and facilitating online interactions among governments, citizens, and businesses, e-government enhances the efficiency, transparency, accountability, and accessibility of public services [22]. Given globalization and the digital age, the question of how the digital environment is evolving is particularly relevant [23]. Governments worldwide are increasingly implementing e-government solutions as digital technology advances to enhance public services, boost public confidence, and streamline administrative procedures [24]. The authors examine how e-government can enhance transparency and accountability in public administration in the digital age. Their findings highlight the importance of digital inclusion and the need for a comprehensive strategy to ensure equitable access to e-government services for all segments of society. According to Alakash et al. [25], new organizations and contemporary laws have emerged to regulate the interaction between e-government and public administration, as well as their interactions with individuals and businesses.

Every country's social and economic development depends on the digitization of government administration. In this regard, e-government is developing and expanding its methods of application, contributing significantly to the effectiveness of public administration, transparency, and the reduction of corruption in public institutions [26]. The modernization of public administration, especially the growth of e-government, was supported by digitalization [27]. By digitizing government services and procedures, e-government plays a critical role in improving accessibility, efficiency, and transparency [28]. With the advent of e-government, digital transformation has become a key factor in improving the quality of public service delivery. Digital technologies are considered essential for technical modernization in public administration, improving government agencies' operations and stakeholder interactions [29]. Compared with countries where public service digitization is less advanced, the analysis found that higher levels of population proficiency with online services significantly amplify government performance, effectively doubling the improvement in government efficiency. This suggests that when citizens are more digitally literate and able to confidently use online public services, governments can deliver services more quickly, reduce administrative burdens, and streamline internal processes more effectively. In contrast, in countries with lower digital skills among the population, the benefits of digital transformation are less pronounced, as limited user capability restricts the full utilization of e-government systems and reduces overall efficiency gains. Doran et al. [30] examined the influence of intensifying the digitization of public services on government efficiency in EU member states. The analysis found that, compared with countries with less advanced public service digitization, the population's proficiency with online services doubles the improvement in government efficiency.

Estonia is often cited as an innovative model for its use of information and communication technology (ICT) in the public sector. It is renowned for its highly advanced digitalization of public services. Despite being a leader in e-governance, the nation's public sector digital transformation plan must be regularly evaluated because of societal challenges and the rapidly evolving technological landscape [31]. Ikromov [32] critically examines how digital platforms are transforming public administration, focusing on Estonia, a globally recognized leader in e-government. He identifies strong government commitment, a supportive regulatory environment, the innovative use of technologies such as blockchain, and a consistent emphasis on cybersecurity and public trust as key factors contributing to Estonia's success in digital governance. Sustained political leadership has ensured long-term investment in digital infrastructure and policy continuity, while enabling legislation has created a flexible, innovation-friendly framework for e-government development. The adoption of advanced technologies, including blockchain, has strengthened data integrity, security, and transparency in public services. Estonia's focus on cybersecurity has protected sensitive information and maintained system resilience, while efforts to build and sustain public trust have encouraged widespread citizen adoption of digital services and reinforced the overall effectiveness of its digital transformation strategy.

Focusing on the Estonian context, Espinosa and Pino [33] examine how e-government (EG) promotes economic development and transition. They highlight two key institutions: secure property rights and governance regulations that emphasize openness, trust, and security. Björklund [34] discusses Estonian e-government, the digitalization of public administration and governance, and how it creates moral citizens. Centralization is a defining feature of the power-knowledge regime in Estonia. A strong national e-government policy requires centralization, within which the distinctive Estonian citizenry is portrayed. The

effectiveness of public service depends not only on the proposed solutions but also on the information accessible to citizens, who are the potential users. The e-service must be simple to use, easily available, and beneficial to the user; if these qualities are considered during the development phase, the service can also achieve other goals, such as cost savings and efficiency [35]. As a leader in government-business partnerships, Estonia consistently improves its standing under the European Union's Digital Single Market project and effectively deploys these services nationwide [36].

A thorough analysis of the complex effects of digitalization across various sectors of Latvian society underscores the strategic importance of fostering digital innovation and creating a supportive, transformation-friendly environment. In Latvia, ongoing digital development is closely tied to efforts to modernize public administration, enhance economic competitiveness, and reduce regional disparities in access to services and opportunities. Baskar [37] notes that cooperation among public institutions, the private sector, and research organizations, along with continuous innovation and sustained investment, are essential pillars for ensuring Latvia's long-term growth and prosperity in an increasingly digital economy. Latvia's progress particularly depends on expanding digital public services and improving digital infrastructure, especially in rural and less-developed regions where access and digital skills may still lag behind urban centers. Broader deployment of e-services and smart technologies can increase efficiency, improve social welfare delivery, and support more inclusive development at both regional and national levels. As digital competitiveness becomes an increasingly important measure of national performance, Latvia's ability to strengthen its innovation ecosystem and invest consistently in digital transformation will play a decisive role in shaping the country's future economic resilience and social well-being.

Vilkaite-Vaitone and Povilaitiene [38] studied the evolution of e-management in public sector organizations and potential solutions to e-management issues in Lithuania. They concluded that, before the COVID-19 pandemic, e-management in municipalities was used only in special circumstances due to workplace stationarity and legislation, based on interviews with managers at local public administration organizations in Lithuania. However, e-management is now seen as the only option available to municipality administrations, rather than as an alternative. Lithuania continues to face methodological, legal, and technical issues that prevent e-government from reaching its full potential. These obstacles are problematic because, as several national and international studies have shown, ineffective public administration significantly reduces a nation's ability to attract foreign investment and its appeal as a place to live [39]. Municipalities in Lithuania that already use ICT for everyday tasks are prepared to use e-leadership tools; however, they still need a clearer vision and guidelines to establish e-leadership as an organizational practice [40]. The Lithuanian case also reflects a broader regional trend in which the rapid shift toward digital governance has revealed both institutional strengths and structural weaknesses in public administration. The forced acceleration of e-management practices during and after the COVID-19 pandemic has highlighted the uneven readiness of municipalities to fully adopt digital leadership models. While some local administrations have successfully integrated ICT into daily operations, many still face fragmented digital systems, insufficient interoperability between platforms, and limited administrative capacity to manage complex e-government tools. As a result, the transition from traditional to digital governance has been inconsistent, creating disparities in service quality and organizational efficiency across municipalities. In addition, ongoing legal ambiguities and the absence of a coherent national framework for e-leadership hinder the institutionalization of digital governance practices in Lithuania. These challenges are intensified by the need for targeted training programs and clearer strategic guidance to support public sector managers in adapting to digitally driven decision-making processes. Without addressing these systemic issues, Lithuania risks limiting the full benefits of its digital transformation efforts, particularly in improving public sector performance, strengthening institutional trust, and enhancing the country's overall attractiveness for investment and skilled labor.

The EGDI, developed by the UN, is the most widely used indicator for evaluating the expansion of e-governance [41], [42], [43]. Yuliantini and Nurmandi [44] examined how the EGDI affected the Worldwide Governance Indicators (WGI) in EU Member States. Based on EGDI data from EU Member States, the results show that the implementation of e-government has no discernible impact on the six WGI indicators. Paul and Adams [45] investigate the relationship between e-government development indicators and the Corruption Perceptions Index using cross-sectional data from 2012 to 2020. According to the data, perceptions of corruption increase as OSI increases; the relationship between TII and perceptions of corruption is statistically significant but not inversely correlated; and perceptions of corruption decrease as HCI increases.

The reviewed literature reveals several tensions that motivate the present study. First, while much of the general e-government scholarship assumes a positive relationship between digital governance investment and administrative efficiency [8], [9], [10], MacLean and Titah [18] caution that empirical evidence of such benefits remains inconsistent, with many studies relying on anecdotal or single-country evidence. Second, Yuliantini and Nurmandi [44] found that EGDI improvements do not automatically translate into measurable improvements in broader governance quality indicators in the EU context, contrasting with the optimistic claims of Sharmin and Chowdhury [11]. Third, comparative Baltic literature highlights that even countries sharing similar post-Soviet institutional legacies and EU membership can diverge substantially in outcomes—as demonstrated by the gap between Estonia’s sustained leadership and Latvia’s mid-period stagnation [37], [38], [39], [40]. These contradictions underline the need for a longitudinal, sub-index-level comparative analysis that can isolate the specific dimensions driving divergence, which is the contribution of the present paper.

RESEARCH METHODOLOGY

This study is guided by two research questions: (RQ1) How have Estonia, Latvia, and Lithuania differed in their e-government development trajectories over the period 2010–2024, as measured by the EGDI and its sub-indices (OSI, TII, HCI)? (RQ2) What structural factors explain the observed divergences? Based on the literature reviewed in Section 2, two working propositions frame the analysis: (H1) Countries with earlier and more sustained institutional investment in digital identity infrastructure will exhibit higher EGDI growth rates over the observation period; (H2) Improvements in the Telecommunication Infrastructure Index will be the primary driver of EGDI gains in the Baltic states that were classified below the “very high” tier before 2020.

The study employs a longitudinal comparative case design using secondary data from the UN e-Government Knowledgebase and the biennial UN E-Government Surveys (2010–2024, eight measurement points). The analytical procedure comprises three steps: (1) descriptive profiling of EGDI scores and rankings for each Baltic state at each measurement point; (2) sub-index decomposition, comparing OSI, TII, and HCI trajectories across the three countries to identify which component drove overall EGDI change in each country and each period; and (3) comparative interpretation, explaining observed differences by cross-referencing sub-index trends with known policy developments documented in the country-specific literature (Sections 2 and 4). The Baltic states were selected because they constitute a theoretically coherent comparison group—three small post-Soviet EU members with broadly similar starting conditions in 2010—whose subsequent divergence in e-government outcomes makes them an ideal case for examining what differentiates high e-government performers from very high performers in a European context. The choice of the UN EGDI as the primary measure is justified by its unique global coverage, methodological consistency over time, and its disaggregation into three sub-indices that enable the analysis of enablers and barriers at the infrastructure, service, and human capital levels.

To compute the EGDI, each component is normalized—often using z-score standardization—so that its values range from 0 to 1, and then their arithmetic mean is calculated. The resulting score places each of the UN’s 193 member states into one of four tiers: very high, high, medium, or low levels of e-government development. Beyond ranking, the EGDI helps identify strengths and weaknesses in a country’s e-government ecosystem. For example, a country may score high in human capital but lag in infrastructure or online service delivery. The 2024 survey also noted global improvements: more states are reaching “high” or “very high” EGDI levels, and the share of the world’s population lagging in digital government development has dropped significantly.

$$EGDI = 1/3 (OSI_{\text{normalized}} + TII_{\text{normalized}} + HCI_{\text{normalized}}) \quad (1)$$

Each of these indicators can be retrieved and examined independently because they are composite measures.

The Online Service Index (OSI) is a key component of the EGDI that measures the scope, quality, and development of online government services, including portals, ministry websites, and e-participation tools. The Telecommunication Infrastructure Index (TII) is a component of the EGDI that measures a country’s ICT infrastructure readiness based on indicators such as internet usage, mobile and fixed broadband, and cellular subscriptions, standardized for international comparison. The Human Capital Index (HCI) reflects how well a country’s population is prepared, in terms of education and literacy, to engage with e-government services. The HCI is based on five equally weighted components: the adult literacy rate, the combined gross enrollment ratio across primary, secondary, and tertiary education, expected years of schooling, mean years of schooling, and “e-government literacy”.

RESEARCH RESULTS

The E-Government Development Index (EGDI) measures countries' progress in developing and implementing e-government systems. It ranges from 0 to 1, and based on their scores, nations are classified into four tiers: (a) Very High: 0.75–1.00, (b) High: 0.50–0.7499, (c) Medium: 0.25–0.4999, and (d) Low: 0.00–0.2499. These categories provide a standardized way to compare the digital maturity of governments, track progress over time, and identify where improvements are most needed in infrastructure, human capacity, or online services. The EGDI monitors public administration development in 193 countries worldwide. Denmark (0.9847), Estonia (0.9727), Singapore (0.9691), the Republic of Korea (0.9679), and New Zealand (0.9671) are the top five countries according to the 2024 index. As the analysis focuses on the Baltic states, Table 1 presents the EGDI values for these countries from 2010 to 2024.

Table 1. Baltic states - EGDI ranking

		Estonia	Latvia	Lithuania	Europe (average)	World (average)
2024	EGDI	0.9727	0.8852	0.9110	0.8493	0.6382
	Rank	2	29	21	-	-
2022	EGDI	0.9393	0.8599	0.8745	0.8308	0.6102
	Rank	8	29	24	-	-
2020	EGDI	0.9473	0.7798	0.8665	0.8170	0.5988
	Rank	3	49	20	-	-
2018	EGDI	0.8486	0.6996	0.7534	0.7727	0.5491
	Rank	16	57	40	-	-
2016	EGDI	0.8334	0.6810	0.7747	0.7241	0.4922
	Rank	13	45	23	-	-
2014	EGDI	0.8180	0.7177	0.7271	0.6936	0.4712
	Rank	15	31	29	-	-
2012	EGDI	0.7987	0.6604	0.7333	0.7188	0.4882
	Rank	20	42	29	-	-
2010	EGDI	0.6965	0.5826	0.6295	0.5937	0.4178
	Rank	20	37	28	-	-

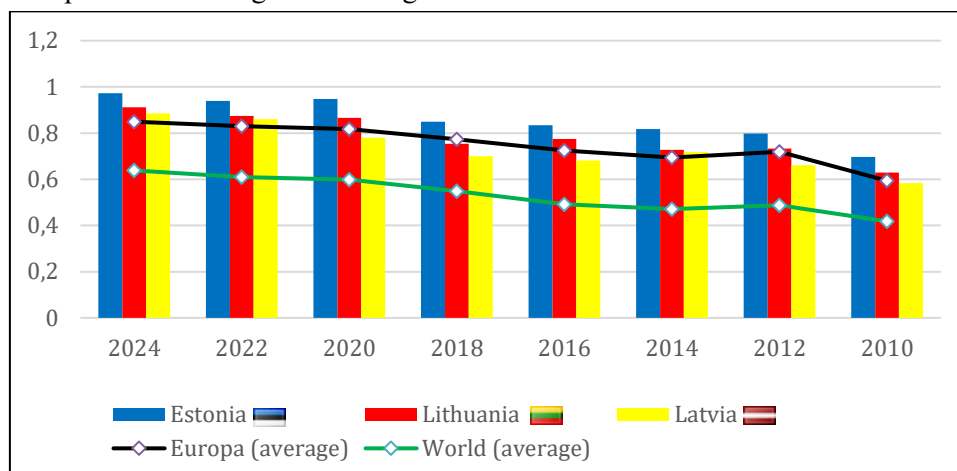
Source: UN E-Government Knowledgebase, 2025.

The Baltic states have collectively made impressive progress in e-government, with all three now exceeding the European average. Estonia is a world-class benchmark in digital governance. Lithuania is a consistent overperformer. Latvia's ranking volatility stands out, likely reflecting infrastructure or policy gaps in the late 2010s, but its recovery since 2020 has been notable. The upward trend across all three countries aligns with broader European digital transformation efforts.

Estonia is among the global leaders in e-government development. In the 2022 UN E-Government Survey, it was classified in the "Very High" EGDI group, with a score of 0.9393. By 2024, Estonia had further improved its score to 0.9727, ranking 2nd among UN member states. Its strong performance is supported by excellent results in all three sub-indices, particularly in online services, telecommunications infrastructure, and human capital. Lithuania also shows robust progress as part of the "Very High" EGDI group. Its 2022 EGDI score was 0.8745, reflecting strong but slightly lower performance than Estonia. In 2024, Lithuania rose in the global rankings and maintained its position within the very high development tier. Improvements are especially evident in its telecommunications infrastructure and human capital indices, which helped Lithuania close the gap with the leading countries. Latvia has also performed at a high level during the 2020–2024 period, belonging to the "Very High" EGDI group. In 2022, Latvia's EGDI score was 0.8599, placing it behind Estonia and Lithuania but still among the world's leading countries. Notably, Latvia was in the "High" EGDI group during 2010–2018 and has improved significantly since then. Latvia's score reflects strong results, particularly in human capital and online service delivery, although its infrastructure score lags slightly behind those of its Baltic neighbors. In the latest 2024 survey, Latvia maintained its very high development status, demonstrating incremental improvements in its e-government systems, although not as substantial as those observed in Estonia.

The comparative performance of Estonia, Lithuania, and Latvia in the UN E-Government Development Index (EGDI) highlights both shared regional strengths and notable differences in digital

governance maturity. Estonia stands out as a global leader, driven by consistently high performance across all three EGDI pillars, which together reflect a well-integrated and highly mature digital governance ecosystem. Estonia's progress shows that sustained investment, strong institutional coordination, and a user-centered digital strategy can produce world-class e-government outcomes. Lithuania and Latvia, while also classified in the "Very High" EGDI group, demonstrate a more gradual trajectory of digital transformation with different areas of strength. These cases suggest that although all three Baltic states have achieved advanced levels of e-government development, Estonia's more balanced and accelerated progress sets it apart as both a regional and a global benchmark.



Graph 1. EGDI

Source: Authors' compilation based on the UN E-Government Knowledgebase.

Graph 1 shows the Baltic states' EGDI scores for 2010–2024, along with the averages for Europe and the world. The Baltic states ranked between 2nd and 57th among all 193 countries. However, it should be emphasized that Latvia's 57th-place ranking dates from 2018, whereas according to the latest available data for 2024, Latvia ranks a solid 29th. An analysis of the EGDI for the Baltic states shows that Estonia was the highest-ranked country throughout the observed period, with its position ranging from 20th (in 2010 and 2012) to 2nd in 2024. Over the 14-year period, the EGDI generally increased in all three Baltic states. Starting at 0.6965 in 2010, Estonia rose to about 0.80 in 2012 and 2014 and then continued to increase to 0.9727 in 2024. According to these results, the growth was relatively steady and accelerated in the later years. Lithuania started at 0.6295 in 2010, rose to about 0.74–0.77 in the middle of the decade, and reached 0.9110 by 2024. Latvia's trajectory was somewhat more erratic, rising from 0.5826 in 2010 to approximately 0.66–0.72 during the middle of the observed period before increasing to 0.8852 by 2024. After the mid-2010s, all three Baltic states generally performed at or above the European average. Relative to the world average, the Baltic states performed substantially better throughout the observed period.

The observed trends in EGDI performance among Estonia, Lithuania, and Latvia can be attributed to differences in the pace, consistency, and strategic depth of their digital transformation policies. Estonia's sustained leadership and rise to 2nd place globally in 2024 reflect a long-term, state-driven digital strategy that emphasizes the early adoption of digital identity systems, strong interoperability of public services, and a highly integrated "digital-by-default" governance model. Its steady and accelerating growth after the mid-2010s suggests the cumulative effects of sustained investment in e-government infrastructure, strong political commitment, and high levels of public trust and digital literacy, which together have enabled the efficient scaling of services across all sectors of public administration. Lithuania and Latvia demonstrate strong but more uneven development patterns, likely reflecting differences in implementation capacity, institutional coordination, and infrastructure maturity. Lithuania's relatively stable upward trajectory and significant improvement by 2024 indicate the effective strengthening of telecommunications infrastructure and human capital, both key drivers of EGDI performance. Latvia's more fluctuating progress in earlier years suggests initial structural constraints, such as weaker infrastructure and slower institutional adaptation, which limited early gains. However, its sharp improvement by 2024 indicates successful recent reforms, particularly in expanding e-services and digital skills. Across all three countries, performance above the European and global averages is largely attributable to strong regional investment in digital society development, EU integration support, and a shared emphasis on modernizing public administration systems.

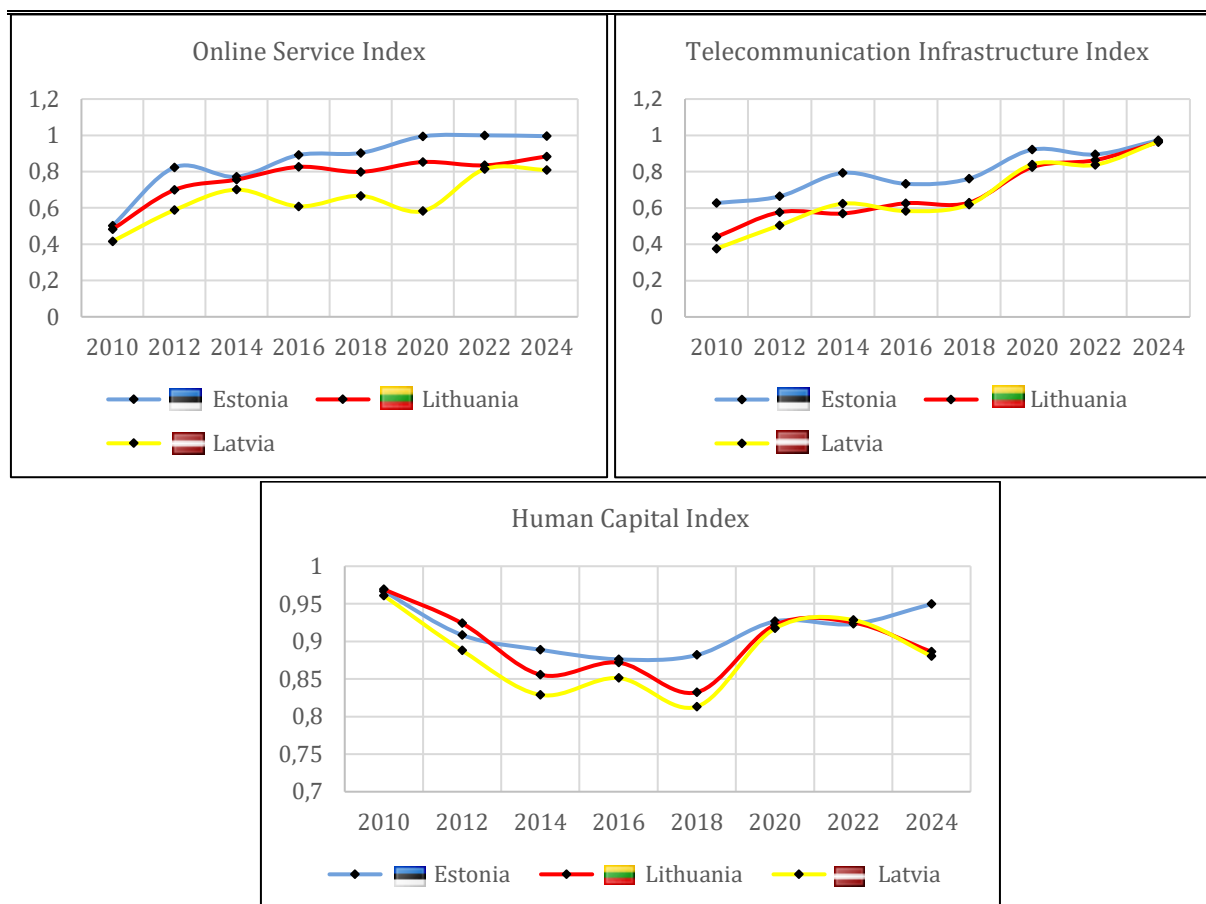
The comparative trajectories yield several analytically important observations relevant to the research questions. Estonia's near-linear growth, accelerating in 2022–2024, is consistent with H1: its early commitment to digital identity (e-ID cards introduced in 2002) and the X-Road interoperability platform created compounding returns, as each new digital service could leverage the existing infrastructure. By contrast, Latvia's relative stagnation in the "High" EGDI tier until 2018—despite broadly comparable GDP and EU membership conditions—reflects the absence of an equivalent institutional anchor; its post-2018 acceleration coincides with EU Digital Single Market investments that provided external impetus for infrastructure modernization, supporting H2 for this country. Lithuania's trajectory is intermediate: it maintained a higher baseline than Latvia throughout the period, indicating stronger early human capital and online service provision, and converged toward Estonia in the most recent period through sustained investment rather than a single policy inflection. Taken together, these patterns suggest that the Baltic divergence is better explained by the timing and coherence of national digital strategy than by differences in economic resources or EU integration status.

Estonia's EGDI score increased from 0.9393 in 2022 to 0.9727 in 2024, out of a maximum of 1.0. The average EGDI value rose from 0.6102 in 2022 to 0.6382 in 2024, indicating that while global competitiveness is increasing, most regions remain behind. Since the early 2000s, Estonia has been a leader in e-government through programs such as e-voting, digital identity cards, and the X-Road data exchange platform. Three pillars support its current ranking: (a) Digital Identity: All Estonian citizens have a digital ID, which enables digital signatures and secure online verification; (b) E-Residency: A program that allows non-Estonians to access Estonia's e-services, establishing a borderless digital nation; and (c) X-Road: A decentralized data-sharing platform that allows disparate databases from the public and private sectors to connect and operate seamlessly.

Over the past ten years, Latvia has significantly improved its EGDI score, demonstrating substantial progress in developing its e-government capabilities. In 2018, its score stood at approximately 0.6996, rising to 0.8852 in 2024 according to UN data. As a result, Latvia is firmly in the "Very High" category of e-government development. These improvements are due to a persistent emphasis on human capital, digital infrastructure, and the expansion of online public services, thereby increasing the country's global competitiveness in digital governance. High levels of human capital, a strong telecommunications infrastructure, and the strategic integration of online services have been important factors in Latvia's development.

Lithuania has progressively strengthened its position in global e-government development. With an overall EGDI score of 0.9110, Lithuania rose from 40th place six years earlier to 21st out of 193 countries in the United Nations 2024 E-Government Development Index (EGDI), placing it among the world's most developed countries in terms of e-government. This achievement highlights significant improvements in online services and digital infrastructure, ensuring that citizens benefit from some of the most advanced public services globally. These advancements place Lithuania firmly in the "Very High" development tier for e-government and result from its ongoing investments in telecommunications infrastructure and online public service delivery. Measurable improvements in several EGDI components support Lithuania's e-government advancement. Through targeted programs and funding, the government has made significant investments in expanding its online services and digital infrastructure.

The EGDI assesses how effectively countries use ICT to provide public services. Information and communication technologies are widely recognized as key drivers of successful e-government expansion. By enabling faster communication, more efficient administrative processes, and broader access to services, ICT helps governments improve transparency, reduce costs, and enhance service delivery. Consequently, countries that invest in ICT infrastructure, digital skills, and integrated online platforms are generally better positioned to develop advanced and inclusive e-government systems.



Graph 2. OSI, TII and HCI

Source: Authors' compilation based on the UN E-Government Knowledgebase.

Based on the results of a comprehensive survey assessing various aspects of the online presence of each of the 193 UN member states, key OSI estimates were developed. The five OSI sub-indices include service delivery, content delivery, portal technology, e-participation, and the institutional framework supporting e-government development. The normalized values of each sub-index are used to calculate the composite OSI score. The findings present standardized index scores on a scale from 0 to 1, where 0 indicates the lowest level of online service provision and 1 the highest.

The Baltic states' OSI and TII scores have improved significantly in recent years. Graph 2 shows that the OSI value ranged between 0.4 and 0.5 at the start of the observation period. The OSI value then generally increased until 2024, when it peaked for all three Baltic states, ranging from 0.8 to 1.0. Estonia recorded the fastest OSI growth, with consistent increases except for slight declines in 2014 and 2018. Estonia's top global ranking in 2024 indicates that its online public services are highly developed. The Local Online Service Index (LOSI) for the city of Tallinn achieved 93% of the evaluated criteria, demonstrating excellent performance in delivering digital services, including city-level e-services, accessibility, and ease of use. As a result, the OSI component is one of the strongest foundations of Estonia's overall EGDI performance. Nationally, this reflects a broad ecosystem of online services—such as tax filing, business registration, health services, and e-identification—that has been developed over decades. Lithuania's online services have also developed considerably.

In the 2023 European eGovernment Benchmark, Lithuania scored highly in the technological adoption of e-services and electronic identity, ranking among the leading EU countries in digital public services. While Latvia's overall online service usage is notable and above the EU average for some e-identification measures, its OSI still lags behind those of its Baltic neighbors in terms of infrastructure and service diversification. According to Eurostat, 73% of Latvians and 88% of Estonians accessed a public authority's website or app during the previous 12 months in 2023. This suggests that although Latvia has strong online service availability, further efforts are needed to make these services fully transactional, accessible, and mobile-friendly in order to catch up with the regional leaders.

The significant improvement in OSI and TII scores across the Baltic states reflects sustained investment in digital infrastructure and a long-term strategic focus on e-government development. Estonia's leadership is driven by a mature, highly integrated digital ecosystem, where advanced platforms such as national e-services, digital identity, and local-level solutions like Tallinn's LOSI demonstrate both the depth and usability of digital services, making online interaction with the state seamless and widespread. Lithuania shows steady progress through the strong adoption of electronic identity systems and the expansion of e-services, positioning it among the more advanced EU digital governments, although it remains slightly behind Estonia in overall sophistication. Latvia, while improving, lags somewhat due to slower diversification of services and lower user engagement, indicating that infrastructure alone is insufficient without fully transactional, user-friendly, and widely adopted digital services to match the regional leaders.

When examining the TII throughout the observation period, this index showed steady growth. In 2010, the index ranged from 0.4 to 0.6, and in the following years it improved, reaching nearly 0.97 in all three Baltic states (Graph 2). In Estonia, the development of e-government is strongly supported by its telecommunications infrastructure. With a TII score of nearly 0.9731 in 2024, Estonia outperformed its regional peers. The widespread use of mobile and broadband connections, strong fixed-mobile substitution, and a high percentage of Internet users per capita all contribute to this high score. Estonia's advanced infrastructure readiness for e-government services is further demonstrated by indicators such as mobile network coverage and reliability. Although it lagged slightly behind Estonia (its TII was 0.9631 in 2024), Lithuania demonstrated strong infrastructure performance. To strengthen the telecommunications foundation needed for online service delivery, the country has made significant investments in expanding fiber access, digital connectivity, and mobile broadband coverage. This trajectory places Lithuania in a strong position among its Baltic and European neighbors, although there is still room for improvement, particularly in fixed-line penetration and rural last-mile access. Although improving, Latvia's telecommunications infrastructure performance remains slightly below that of its Baltic neighbors (its TII was 0.9660 in 2024). The transition to modern fixed-line networks and broadband adoption are two sub-components that still lag slightly behind those of the more developed countries, although Latvia's telecommunications market remains robust overall. How quickly Latvia can catch up with the best-performing Baltic states will depend on its capacity to invest in next-generation networks, enhance digital inclusion, and expand broadband connectivity.

The steady increase in TII scores across the Baltic states reflects consistent investment in telecommunications infrastructure, a key factor enabling their strong e-government performance. Estonia's leading position is driven by near-universal broadband access, strong mobile connectivity, and highly reliable networks, providing a robust foundation for advanced digital public services and explaining its regional outperformance. Lithuania and Latvia also show strong infrastructure development, particularly through expanding fiber networks and mobile broadband coverage, but they still lag slightly behind Estonia due to gaps in rural connectivity, fixed-line development, and last-mile access. Overall, the differences in TII performance highlight that while all three countries have advanced ICT ecosystems, Estonia's earlier and more comprehensive infrastructure modernization gives it a persistent competitive advantage.

The HCI value showed a slight decline in the Baltic states over the period analyzed. In 2010, very high HCI values were recorded (Estonia: 0.9497, Lithuania: 0.98861, Latvia: 0.8805), but these gradually declined, reaching their lowest point in all three countries in 2018, after which they increased again (Graph 2). Estonia's high literacy and education levels, along with its well-developed education system, are reflected in the Human Capital Index. The UN E-Government Knowledgebase reports that Estonia's HCI in 2024 was 0.9497. Estonia has made significant progress in global human capital rankings. This positive trend supports Estonia's strong position in e-governance and other development indices by demonstrating its ability to equip citizens with the skills needed for a digital economy. Although they are slightly lower than Estonia's, Lithuania and Latvia also have strong human capital foundations (the 2024 HCI was 0.8805 for Latvia and 0.8861 for Lithuania). Despite having largely comparable levels of education, literacy, and schooling to their regional counterparts, both countries face somewhat greater challenges in effectively utilizing and leveraging their human capital.

The observed decline and subsequent recovery in HCI across the Baltic states reflect structural adjustments in education and skills development systems, as well as changing measurement dynamics in human capital indicators. Estonia's consistently high HCI, supported by strong literacy rates and a well-

developed education system, reinforces its capacity to sustain advanced e-government services by ensuring a digitally skilled population capable of effectively using complex digital platforms. Lithuania and Latvia, while maintaining solid educational foundations comparable to Estonia, show a slightly weaker translation of human capital into digital and administrative efficiency, suggesting a gap between educational attainment and the practical use of digital competencies. This suggests that the key challenge for these countries is not basic education levels, but the effective activation and application of human capital within digital governance and innovation ecosystems.

CONCLUSION

Despite the global challenges that have emerged and intensified in recent years, countries and regions around the world have continued to strengthen their commitment to digital governance initiatives. Over the past two decades, the widespread adoption of the Internet and rapid advances in information and communication technologies have facilitated communication between businesses and government agencies while also enabling citizens to interact more efficiently with the public sector.

With its public e-services consistently ranked among the best in the world, Estonia has established itself as a global leader in digital government, characterized by the extensive availability of online services, user-friendly platforms, and high levels of citizen adoption. Meanwhile, Latvia and Lithuania have also achieved substantial progress in the development and delivery of online public services.

Estonia's EGDI has consistently been higher than those of Latvia and Lithuania, as well as the European and world averages, throughout the 14-year observation period. In the 2024 e-government ranking, Estonia is among the top United Nations Member States, alongside Singapore and Denmark, in terms of the quality and scope of online services, the state of telecommunications infrastructure, and human capital. As one of the world's most technologically advanced countries, Estonia has long been recognized for enabling its citizens and businesses to bypass traditional bureaucracy in favor of a fully digital government. By placing second in the United Nations' 2024 E-Government Survey, the country has once again reinforced its status as a global pioneer in e-government.

Although Lithuania already has substantial human capital and widespread internet access, current reforms focus on incorporating advanced technologies, enhancing mobile access, and ensuring that public services are accessible and digitally inclusive. For this reason, other countries seeking to improve their digital government capabilities often view the Lithuanian approach as a useful model.

Latvia's rising position in the EGDI indicates that investments and policy reforms have been successful, although the country still faces challenges such as ensuring digital inclusion across all regions and addressing the remaining infrastructure gaps. Maintaining and advancing its e-government maturity will require sustained attention to digital literacy, data interoperability, and service quality.

The Baltic states—Estonia, Lithuania, and Latvia—show a clear upward trend in the development of digital public services, as reflected in their Online Service Index (OSI) performance. Governments across the region have built increasingly mature digital ecosystems that enable more transparent, efficient, and accessible service delivery, forming a key pillar of their broader e-government strategies and strong positions in international rankings. Despite this overall progress, each country faces specific challenges that will shape its future development: Estonia must sustain innovation within an already highly advanced system; Lithuania needs to strengthen integration and expand the practical use of its digital services; and Latvia must increase citizen adoption and improve mobile-friendly accessibility. The main conclusion is that infrastructure is no longer the primary constraint. Instead, long-term success will depend on continuous innovation, deeper system integration, and ensuring that digital services are fully user-centered and equally accessible to all citizens.

Strong telecommunications infrastructure promotes higher e-government preparedness, as reflected in the TII scores of the three Baltic states. The differences in TII performance across Estonia, Lithuania, and Latvia demonstrate that even in a region with generally high digital readiness, infrastructure gaps continue to exist and affect overall performance in the provision of online services and digital public administration.

All three Baltic states have a strong human capital base, supporting improvements in digital infrastructure, e-government development, and overall socioeconomic progress. However, differences in their HCI scores indicate variations in education systems, adult learning, workforce upskilling, and digital

literacy, which affect how effectively each country can translate human capital into practical outcomes in a rapidly changing technological environment. The key conclusion is that human capital is a decisive yet dynamic factor in digital development. For Estonia, Lithuania, and Latvia, long-term digital transformation and economic competitiveness will depend not only on maintaining high levels of education but also on improving lifelong learning systems, strengthening digital skills, and ensuring that the workforce can continuously adapt to technological and governance changes.

All three Baltic states already have strong digital infrastructure and well-developed e-government services. However, further progress will depend on deeper integration across public institutions through shared data platforms, unified data governance frameworks, and the consistent application of “once-only” and data reuse principles. Expanding single digital portals for accessing services will also be important to simplify interactions between citizens and the state. In addition, improving digital skills among both citizens and public sector employees will be essential, along with shifting attention from service availability to actual usage and accessibility. The inclusive co-design of services—especially for older, rural, and less digitally skilled populations—will help reduce inequalities in access. Finally, developing national AI and machine learning strategies for public administration could further enhance efficiency and innovation. The authors conclude that the Baltic states’ next stage of digital development will depend less on infrastructure expansion and more on integration, inclusivity, and the intelligent use of data and emerging technologies, enabling them to maintain their leadership in digital governance.

From a theoretical standpoint, the findings contribute to the comparative e-government literature in two ways. First, they add to the body of evidence questioning a purely resource-deterministic view of digital governance maturity: Latvia and Lithuania achieved “Very High” EGDI status with broadly similar economic endowments to Estonia, but on a delayed timeline, suggesting that institutional choices and policy continuity mediate the relationship between national wealth and e-government outcomes. This nuances the view of scholars such as Mensah [13], who emphasizes government capacity as the primary driver, by demonstrating that capacity can be built incrementally through specific program choices rather than being a fixed precondition. Second, the sub-index decomposition reveals that improvements in the TII were the primary driver of EGDI gains in Latvia after 2018 (supporting H2), whereas Estonia’s advances were driven primarily by the OSI throughout the observed period—a distinction that carries different implications for policymakers in lower- and higher-tier e-government systems.

The study acknowledges several methodological limitations. First, the analysis relies exclusively on the UN EGDI, which captures the supply side of e-government (the availability of services and infrastructure) but does not directly measure actual citizen usage or user satisfaction. Second, the biennial measurement frequency means that short-term policy effects cannot be isolated. Third, as a secondary-data study, the research cannot control for all confounding factors that may jointly influence EGDI scores, such as macroeconomic conditions, population size, or government expenditure. Future research combining EGDI data with citizen uptake surveys or administrative microdata would provide a more comprehensive understanding of e-government development.

Several avenues for further research emerge from this study. First, the present analysis is limited to the supply-side measures captured by the EGDI; future work should incorporate citizen demand-side data, such as Eurostat e-government usage statistics, to assess whether higher EGDI scores translate into meaningfully higher service uptake. Second, a mixed-methods extension combining EGDI data with expert interviews or policy document analysis could trace the specific governance decisions that explain the acceleration observed in Latvia after 2018 and in Estonia during 2022–2024. Third, the Baltic comparison could be extended to other clusters of comparable EU member states—for example, the Visegrad Group or the Nordic countries—to test whether the institutional strategy hypothesis identified in this study generalizes across regional contexts.

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