

DIGITALIZATION AND E-GOVERNMENT INDEX: OVER VIEW OF CURRENT TENDENCIES

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Abstract

The study explores how readiness to adopt digital services translates into actual citizen usage, examining the disparities and challenges associated with the "digital divide". Conceptual approaches linking supply-side government efforts with demand-side citizen activity are summarized, justifying the importance of developing mature digital ecosystems to support complex online transactions. Using Spearman correlation over 96 countries (N=96), this study has tested the empirical relationship between e-government maturity (measured by the E-Government Development Index; EGDI) as well as its 3 main subcomponents (OSI, HCI, TII) and a number of different digitalization metrics. The results show that the EGDI and its three subcomponents all correlated positively and very highly with a variety of digital sophistication and high transactional use metrics in the conditions of rapid technological advancement. The study found positive correlations between service maturity (OSI), human capacity (HCI), and high-value digital transactions like online purchases and bill payments. Furthermore, it was determined that e-government success is closely associated with higher desktop-based web traffic and lower relative technology costs for citizens. The determination of empirical links between supply-side indices and demand-side usage variables provides a new perspective on national digital maturity beyond mere readiness. Taking into account the resource potential and technological trends across 96 nations, conceptual approaches to a mature digital model have been provided, and practical directions for policymakers to implement targeted strategies have been determined.

Keywords: *digitalization, E-Government Index, share of Android web traffic, share of iOS web traffic, mobile money.*

RƏQƏMSALLAŞMA VƏ ELEKTRON HÖKUMƏT İNDEKSİ: MÖVCUD TENDENSİYALARIN ÜMUMİLƏŞDİRİLMƏSİ

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Xülasə

Tədqiqat rəqəmsal xidmətlərin tətbiqi vəziyyətinin vətəndaşların real istifadə vərdişlərinə transformasiyasını və bu prosesdə "rəqəmsal uçurum"la bağlı yaranan çətinlikləri araşdırır. Dövlətin təklif etdiyi rəqəmsal imkanlar ilə vətəndaşların tələbi arasındakı əlaqəni təmin edən konseptual yanaşmalar ümumiləşdirilmiş, mürəkkəb onlayn əməliyyatları dəstəkləyən yetkin rəqəmsal ekosistemlərin yaradılmasının vacibliyi əsaslandırılmışdır. Bu tədqiqat 96 ölkədən toplanmış statistik məlumatlar əsasında Spearman korrelyasiya analizindən istifadə edərək elektron hökumətin yetkinliyi (Elektron Hökumətin İnkişafı İndeksi - EGDI), eləcə də onun 3 əsas komponenti (Online Service Index, Human Capital Index, Telecommunication Infrastructure Index) ilə bir sıra rəqəmsallaşma göstəriciləri arasındakı empirik əlaqəni müəyyən etməyə yönəlmişdir. Tədqiqatın nəticələri göstərir ki, Elektron Hökumətin İnkişafı İndeksi və onun üç komponenti ilə müxtəlif rəqəmsallaşma dəyişənləri arasında statistik əhəmiyyətli müsbət istiqamətli, orta və ya yüksək gücə malik əlaqə var. Xüsusilə Onlayn Xidmət İndeksi (OSI) ilə "Mobil telefon/internetdən istifadə edərək alışı-verişi etmək" və İnsan Kapitalı İndeksi (HCI) ilə "Hesabları ödəmək üçün mobil telefon/internetdən istifadə edərək ödəmək" arasında demək olar ki, yüksək müsbət korrelyasiya mövcuddur. Həmçinin, elektron hökumətin uğuru yüksək səviyyəli kompüter veb trafikini və smartfonların əldə edilməsi üçün tələb olunan aşağı nisbi xərclərlə birbaşa əlaqəlidir. Tədqiqatın orijinallığı və elmi yeniliyi ondan ibarətdir ki, təklif tərəfini əks etdirən indekslər ilə tələb tərəfini əks etdirən istifadə dəyişənləri arasındakı empirik əlaqələr müəyyən edilmişdir. Bu, milli rəqəmsal yetkinliyə sadəcə "hazırlıq" səviyyəsindən deyil, həm də real istifadə kontekstindən yanaşmağa imkan verir. 96 ölkənin resurs potensialı və texnoloji trendləri nəzərə alınmaqla, müasir və yetkin rəqəmsal hökumət modelinə konseptual yanaşmalar təmin olunmuş və dövlət siyasəti üçün hədəfəyönlü strategiyalar müəyyən edilmişdir.

Açar sözlər: rəqəmsallaşma, Elektron Hökumətin İnkişafı İndeksi, Android telefonların mobil trafikdə payı, iOS telefonların mobil trafikdə payı, mobil (elektron) pul.

ЦИФРОВИЗАЦИЯ И ИНДЕКС ЭЛЕКТРОННОГО ПРАВИТЕЛЬСТВА: ОБЗОР ТЕКУЩИХ ТЕНДЕНЦИЙ

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Резюме

В работе исследуется, как готовность к внедрению цифровых услуг трансформируется в их реальное использование гражданами, а также анализируются диспропорции и проблемы, связанные с «цифровым разрывом». Обобщены концептуальные подходы, связывающие усилия государства в области предложения с активностью граждан со стороны спроса, что обосновывает важность формирования зрелых цифровых экосистем для поддержки сложных онлайн-транзакций. В данном исследовании была проверена эмпирическая зависимость между зрелостью электронного правительства (измеряемой Индексом развития электронного правительства — EGDI), его тремя основными субиндексами (Online Service Index, Human Capital Index, Telecommunication Infrastructure Index) и рядом различных показателей цифровизации с использованием коэффициента корреляции Спирмена по выборке из 96 стран (N=96). в условиях стремительного технологического прогресса выявлена почти идеальная положительная корреляция между зрелостью услуг (OSI), человеческим потенциалом (HCI) и осуществлением сложных цифровых операций, таких как онлайн-покупки и оплата счетов. Кроме того, установлено, что успех электронного правительства тесно связан с преобладанием веб-трафика через персональные компьютеры и более низкими относительными затратами граждан на приобретение технологий. Оригинальность и научная новизна исследования заключается в определении эмпирических связей между индексами предложения и переменными использования со стороны спроса, что дает новый взгляд на национальную цифровую зрелость за пределами простой оценки готовности. С учетом ресурсного потенциала и технологических тенденций в 96 странах предложены концептуальные подходы к модели зрелого цифрового правительства, определены практические направления для разработки государственными деятелями адресных стратегий.

Ключевые слова: цифровизация, индекс развития электронного правительства, доля Android в веб-трафике, доля iOS в веб-трафике, мобильные платежи.

Introduction

During the course of the twenty-first century, public administration has undergone a profound evolution due to the increasing application of Information and Communication Technologies (ICTs) across virtually all governmental functions. Often referred to as e-government, it refers to the utilization of digital technology to enhance the effectiveness, transparency, and accessibility of public services, thereby supporting the emergence of effective, accountable, and inclusive institutions [United Nations, 2024]. The transition of e-government from solely optimizing bureaucratic processes toward becoming a foundation for achieving national development goals and institutional objectives — such as the Sustainable Development Goals (SDGs), which include those related to governance and innovation — is indicative of e-government's role as a core element of political economies around the world. As such, creating robust digital platforms and the ability to deliver effective digital public services are increasingly being regarded as major policy objectives by governments globally.

In order to monitor and compare the global movement toward digital public services, the United Nations Department of Economic and Social Affairs (UN DESA) created the E-Government Development Index (EGDI). EGDI is used as the standard composite index to assess the level of development of each national digital government in terms of three equal-weighted dimensions: the capacity to provide digital services (i.e., Online Service Index - OSI); telecommunications infrastructure (i.e., Telecommunications Infrastructure Index - TII); and the human capital (i.e., Human Capital Index - HCI) needed to utilize digital services [United Nations, 2022]. However, although UN DESA uses a broad-based approach to measure a nation's level of e-government development, the EGDI and its underlying component indices represent primarily the supply side capacity or readiness of a nation to provide digital services and do not directly assess how well citizens utilize digital services [United Nations, 2016].

Despite the continuing upward trend in global EGDI values, there continues to be considerable disparity in national levels of e-government development. This has resulted in the continued existence of a significant “digital divide.” Research continually indicates that the benefits derived from e-government are largely experienced by wealthier nations possessing greater resources and better quality infrastructure and human capital than poorer nations, resulting in inequities in access, capacity, and resource investment [Dias, 2020; United Nations, 2024]. In addition to the basic gap in access, a “second-level digital divide” exists in terms of the type of digital utilization, with respect to how reliance upon mobile devices versus desktop computers impacts the delivery of more complex e-government services [Jamalova, Constantinovits, 2020b].

Considering the continued disparities identified above and the current rapid pace of technological advancements in mobile technologies and use cases, further analysis is required. Therefore, this investigation will attempt to go beyond simply assessing a

nation's readiness to adopt e-government through the empirical examination of the relationships between the E-Government Development Index (EGDI) and its three main component indices (OSI, HCI, TII) and a number of digitalization variables that represent actual usage by citizens, economic feasibility, and preferred device types.

This study seeks to achieve a principal research goal by empirically examining the degree and direction of monotonic correlation between the E-Government Development Index (EGDI) and its three main component indices (OSI, HCI, TII) and a number of digitalization variables across a sample of 96 countries. Through this analysis, the research study hopes to provide empirical evidence connecting the government supply side (indices) to citizen demand (digitalization variables) and ultimately assist policymakers in bridging the digital divide using targeted and effective strategies.

Literature review

The E-Government Development Index (EGDI) — a UN publication issued every two years — has become the global benchmark for evaluating and measuring the degree of advancement in digital government services within all UN member states. The EGDI consists of a total of three dimensions of equal weight, i.e., the Online Service Index (OSI), which evaluates the breadth and depth of services provided by governments through electronic platforms; the Telecommunication Infrastructure Index (TII), which assesses the development level and condition of the basic infrastructure required for a country's telecommunications system; and the Human Capital Index (HCI), which measures the inherent capacity — specifically literacy and education — needed for citizens to effectively use digital services. The index is mathematically calculated as an arithmetic mean of the normalized scores of the above-mentioned three dimensions; therefore, the contribution of each dimension to the overall EGDI score is equalized, and the index provides a reliable indicator of national trends over time [United Nations, 2022; United Nations, 2024]. In addition to ranking the development of countries in this area, the EGDI also serves to evaluate how countries strategically apply Information and Communication Technology (ICTs) to increase citizen access to government services and promote social inclusion.

The E-Government Development Index (EGDI), released every other year by the United Nations, is the global standard for quantitatively comparing the extent of digital government development among its Member States. The EGDI was developed as a composite and comprehensive measure to distill e-government development down to three essential dimensions with equal weights: the Online Service Index (OSI), which measures the breadth and quality of government services delivered electronically; the Telecommunication Infrastructure Index (TII), which measures the development stage and condition of a country's underlying telecommunications infrastructure; and the Human Capital Index (HCI), which measures the inherent human capability - particularly education and literacy - required for individuals to make effective use of digital services. Each of these three

dimensions is used to calculate the EGDI using a mathematical formula where the normalized scores of each dimension are averaged to create an arithmetic mean. This method ensures that each of the three dimensions contributes equally to the final EGDI score and allows for a consistent, comparable way of measuring the progression of individual countries over time [United Nations, 2024]. While it can be used to provide a ranking of countries' levels of development, it also serves as a tool to identify how nations are strategically utilizing information and communication technology to support greater access to government services and to enhance social inclusion.

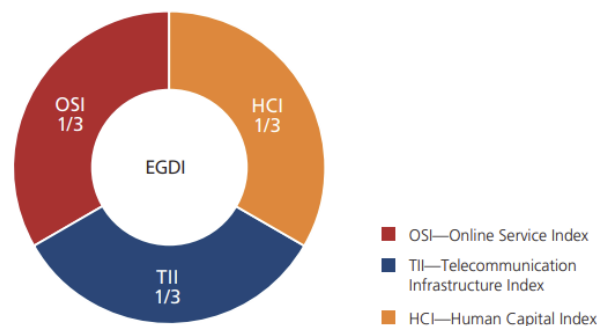


Figure 1. The three components of the E-Government Development Index

Source: [United Nations, 2016]

The Relationship Between EGDI and Digitalization Enablers

Consistently, innumerable studies have explored and confirmed an extensive connection between a nation's EGDI and many other socio-economic and digitalization factors. These studies, conducted in numerous geographic locations during varying timeframes, consistently demonstrated that nations possessing high EGDI ratings are directly related to their high digital preparedness levels, which are primarily dependent on two of the key areas of support for service delivery: human capital and physical infrastructure.

Highly developed digital infrastructure is viewed as a required precondition for achieving successful e-government [Ali, Hoque, Alam, 2018; Weerakkody и др., 2012]. The EGDI itself includes TII (core connectivity) in the form of indicators such as internet user penetration, fixed broadband, and mobile subscription data, therefore creating a relationship to e-government within the structural components of the EGDI. Studies outside of the EGDI literature often find a strong correlation between the EGDI and national internet penetration and mobile connectivity rates [Dias, 2020; Lloyd, Lee, 2018]. Conversely, there is a wealth of evidence indicating that the degree of influence of e-government can be highly contextual, based upon the presence of good governance and favorable economic conditions supporting the existing digital infrastructure [Ngome, Yeom, 2024]. The cost of technology to consumers and its availability relative to the average income of citizens play critical

roles in determining the level of e-government, with lower costs typically associated with higher levels of e-government [United Nations, 2024].

As the Human Capital Index (HCI) measures the capacity of a country's population to use e-government service offerings, literature confirms that a very close correlation between education level, digital literacy, and the successful utilization of e-government service exists [Holzer, Kim, 2006]. Ultimately, the success of e-government is limited by how willing or able citizens are to utilize the digital services made available by the government [Machova, Lnenicka, 2016; Siau, Long, 2009]. Therefore, countries with higher HCI scores will have engaged their populations at higher rates with respect to complex digital activity such as digital commerce and digital financial transactions, thereby supporting the idea that quality digital services (Open Service Infrastructure- OSI), and skilled users (Human Capital Index-HCI) must exist simultaneously for meaningful digital transformation to occur.

E-Government and the Persistence of the Digital Divide

Although the average EGDI worldwide has continued to increase over time, the literature emphasizes the persistent nature of the digital divide, these calls for an analysis of variables related to digitalization. Consistently, UN DESA surveys have shown that the EGDI tends to be higher for the highest-income countries than for all other countries, and that EGDI values for developing regions and for LDCs/SIDS are at least 25% lower than the worldwide average [United Nations, 2022; United Nations, 2024]. The disparity in EGDI values is due to the differences in access to resources and capacity to invest in digital development.

Further studies of the ways people use the Internet also show that there exists a second level of the digital divide - a difference in the quality and types of online interactions. For example, numerous studies on the use of mobile phones for accessing the Internet in developing economies show an increasing trend in mobile phone ownership; however, there remains a significant divide based upon the individual's or household's income level, and by geographic area [GSMA, 2025]. Research indicates that while government can provide citizens with mobile-based e-government (e.g., SMS-based services), providing citizens with more complex, transactional e-government services may require the use of more robust devices with greater stability, and personal computer (laptop/desktop) features [UNDP, 2024]. Thus, comparing device-specific website traffic (mobile vs. laptop/desktop) to e-government maturity provides valuable insight into whether a country has been able to bridge the gap between mere availability/accessibility of the internet, and the ability to engage in advanced, high-quality, full-spectrum online interactions.

Table 1: Descriptive Statistics of E-Government and Digitalization Variables (\$N=96\$)

Variable	N	Min.	Max.	Mean	Std. Dev.
E-Government Index (Mean)	96	1.35	23.19	9.01	5.56

Online Service Index (Mean)	96	0.33	28.57	10.72	8.29
Human Capital Index (Mean)	96	0.44	29.55	10.77	8.35
Telecommunication Infrastructure Index (Mean)	96	0.18	0.99	0.72	0.2
Mobile Money Account % (Mean)	96	0	52.77	8.62	13.41
Made a purchase using mobile phone/internet (past year)	96	0	83.73	30.76	24.58
Used mobile phone/internet to pay bills (past year)	96	0	86.77	30.78	24.79
Share of web traffic - Android (Mean)	96	32.01	95.49	73.48	16.16
Share of web traffic - Apple (Mean)	96	3.52	67.61	25.56	16.46
Price of cheapest smartphone vs income % (Mean)	96	0	145	17.12	23.06
Share of web traffic - Mobile phone (Mean)	96	28.84	85.13	56.92	13.94
Share of web traffic - Laptop/Computer (Mean)	96	12.67	70.45	41.5	13.63
Valid N (listwise)	96				

Source: own editing.

The Distinct Case of E-Participation

The E-Participation Index (EPI) represents the only component of the EGDI that has been developed to measure the degree of citizen engagement with governments through consultations and decision-making. There is much less academic consensus about the EPI than the three foundational components of the EGDI. Panel data analysis has shown a consistent and very positive correlation between the EPI and the economic and technological development of countries in general. Other studies have suggested that the EPI may be driven by factors that differ from those that drive the OSI, HCI, and TII [Siau, Long, 2009]. For example, the widespread use of mobile money and other forms of alternative digital financial services in many developing economies indicates that high levels of e-participation can be achieved through means that do not require high levels of digital infrastructure; therefore, indicating that the EPI could be measuring digital maturity along a potentially independent axis. All of these complexities support continued research on how each of the various types of digitalization impacts the EPI relative to the OSI, HCI, and TII.

Research Methodology

This study aimed to provide an answer to the research question regarding how the level of development of e-government is related to the whole range of digital infrastructure and usage indicators. The correlations of the indices with digitalization

factors were checked by Spearman's correlation analyses in order to check both the direction and the degree of monotonic relationships of the variables.

The formally stated hypotheses for Spearman's correlation tests are given below for each pair of variables X and Y (for example, EGDI and Share of web traffic - Android (Mean)).

- Null Hypothesis (H_0): There is no relationship between the two variables. The population Spearman's correlation coefficient (ρ) is zero ($H_0: \rho = 0$).
- Alternative Hypothesis (H_a): There is a relationship (either positive or negative) between the two variables. The population Spearman's rank correlation coefficient (ρ) is not equal to zero ($H_a: \rho \neq 0$).

All correlations were tested at a significance level of $\alpha = 0.05$. Results were interpreted based on a 2-tailed significance test (See Table 1).

Data Collection and Variables

Two main sets of data were collected. The first set comprised the five core indices from the United Nations E-Government Survey: E-Government Development Index (EGDI), Online Service Index (OSI), Human Capital Index (HCI), Telecommunication Infrastructure Index (TII), and E-Participation Index (EPI). The second set consisted of a broad range of digitalization variables collected from country reports presented by DATAREPORTAL. These variables are:

- Device Traffic: *Share of web traffic by device - Mobile phone* and *Share of web traffic by device - Laptop and Computer*.
- Operating Systems: *Share of web traffic by Mobile OS - Android* and *Share of web traffic by Mobile OS - Apple*.
- Economic Accessibility: *Price of the cheapest smartphone in USD vs average income %*.
- Mobile Commerce/Usage: *Mobile Money Account %*, *Made a purchase using mobile phone/ internet (past year)*, and *Used mobile phone or internet to pay bills (past year)*.

Data Processing

There is an obvious limitation on how many countries will be included in the final analysis, as we require all countries to have available complete data over the three-year time frame for the variables that are selected. The final analysis, therefore, includes 96 countries ($N = 96$). In order to produce reliable time-aggregated metrics that account for potential yearly variation and seasonal variation, the average of all five e-government indexes (EGDI, OSI, HCI, TII, EPI) was calculated using the years 2020, 2022, and 2024. Likewise, the average of all digitalization variables was also calculated using the specific data collected in January 2022, 2023, and 2024. These averages resulted in one stable mean value per country per variable to be analyzed in the subsequent correlation analysis.

Results: Spearman Correlation Analysis

In addition to the use of Spearman's Rank Correlation Analysis (and since all utilized data is secondary), it was deemed unnecessary to conduct a Reliability & Validity Analysis [Hair et al., 2014]. This position can be supported through prior research that employed similar methodologies [Jamalova, 2024; Jamalova, Constantinovits, 2020b], as well as the most recent statistical literature. A Spearman's rank order correlation analysis was applied in order to assess whether or not there is a monotonic relationship between the E-Government Index (EGDI) and its three base elements (OSI, HCI, TII) with other indicators of digitalization (N = 96). As such, it has been found that the results demonstrate an extremely coherent and interdependent set of associations amongst these indices, and as such are highly consistent with the notion that high levels of e-government development have strong positive associations with both the sophistication of digital utilization and the level of economic access to digital utilization.

E-Government Index (EGDI)

The Composite E-Government Index (EGDI) showed a very strong positive relationship with High Level Digital Engagement and Affinity for Higher Cost Devices. EGDI had nearly perfect positive relationships with Advanced Usage Indicators such as Made a purchase using mobile phone/internet ($\rho = 0.691$, $p < .001$) and used mobile phone or internet to pay bills ($\rho = 0.614$, $p < .001$). In addition, the EGDI had a strong positive relationship with the Share of Web Traffic by Mobile Operating System – Apple ($\rho = 1.000$, $p < 0.001$) and nearly Perfect Negative Relationships with the Share of Web Traffic by Mobile Operating System – Android ($\rho = -0.978$, $p < 0.001$). Finally, the EGDI was Negatively Related to Reliance on Mobile-Centric Traffic ($\rho = -0.578$) and Positively Related to Desktop Traffic ($\rho = 0.562$). Therefore, there is a Relationship between Overall e-Government Development and Sophisticated Multi-Device Usage when Technology Costs are Lower than Income ($\rho = -0.469$, $p < .001$).

Table 1: Spearman Correlation Coefficients (ρ) between E-Government Indices and Digitalization Variables

Index	Mobile Money Account %	Made a purchase... (past year)	Used mobile phone... (past year)	Share of web traffic - Mobile phone	Share of web traffic – Laptop / Computer	Price of cheapest smartphone vs income %	Share of web traffic - Android	Share of web traffic - Apple
EGDI	-0.479**	0.691**	0.614**	-0.578**	0.562**	-0.469**	-0.978**	1.000**
OSI	-0.525**	1.000**	0.912**	-0.655**	0.642**	-0.584**	-0.657**	0.688**
HCI	-0.431**	0.918**	0.999**	-0.652**	0.640**	-0.528**	-0.596**	0.608**
TII	-0.603**	0.832**	0.785**	-0.652**	0.638**	-0.595**	-0.709**	0.755**

Note: ** - Correlation is significant at the \$0.01\$ level (2-tailed).

*- Correlation is significant at the \$0.05\$ level (2-tailed).

Source: author's own calculations

Online Service Index (OSI)

The Online Service Index (OSI) represents the level of complex governmental services available online and has the most significant dependence on the metrics for user engagement and capacity. The OSI has the highest positive correlation with making a purchase using a mobile phone/internet ($\rho = 1.000$; $p < .001$); as well as with the Human Capital Index ($\rho = 0.917$; $p < .001$); and making a payment using a mobile phone or internet ($\rho = .912$; $p < .001$). Both OSI and the EGDI have a negative correlation with mobile share of web traffic ($\rho = - .655$) and positive correlations with laptop/computer share ($\rho = .642$) — both indicators suggest that users need a digital environment with greater capacity to use the government's complex services; and the high positive correlations with the use of laptops/computers — and the high negative correlation with the relative cost of a smartphone ($\rho = - .584$; $p < .001$) — provide additional evidence that service complexity requires a higher capacity and often a desktop-oriented digital environment.

Human Capital Index (HCI)

The alignment of the Human Capital Index (HCI) to represent the amount of available talent and capacity (skills) was nearly perfect to the activity of digital transactions; therefore the HCI had a very close positive correlation to using a mobile phone or the internet to make payments ($\rho = 0.999$, $p < 0.001$) and an extremely strong correlation to Making a purchase via mobile phone/internet ($\rho = 0.918$, $p < 0.001$). The strength of this relationship verifies that the skills measured in the HCI are critical preconditions to perform the more advanced forms of digital commercial services and citizen use of digital services. In addition to the EGDI and OSI, the HCI was shown to have significant negative correlations to Mobile Web Traffic Share ($\rho = -0.652$), as well as Significant Positive Correlations to Laptop/Computer Traffic Share ($\rho = 0.640$). These results indicate that there are significant levels of digital skills that exist within contexts that have less mobile-based Internet access and/or lower cost devices (relative to income) ($\rho = -0.528$, $p < 0.001$).

Telecommunication Infrastructure Index (TII)

The Telecommunications Infrastructure Index (TII) shows strong correlation with all previously established indices, especially the OSI ($\rho = 0.836$) and HCI ($\rho = 0.794$), indicating it is an important part of the basic infrastructure of telecommunications. The TII correlates well with digital engagement, for example, $\rho = 0.832$ for making a purchase via a mobile phone/internet and $\rho = 0.785$ for paying bills using a mobile phone/internet (all $p < 0.001$). This index follows the trends of previous studies on device use - i.e., it has a significant, negative correlation with mobile web share ($\rho = -0.652$), and a positive correlation with computer/laptop share ($\rho = 0.638$). The TII had a high, negative correlation with the cost of a smartphone compared to the cost of computers/laptops ($\rho = -0.595$, $p < 0.001$); this indicates that advanced digital

communications infrastructure develops when digital communication tools are affordable.

Discussion

The correlational data provides robust empirical evidence for specific types of digitalization that are associated with the highest EGDI and its three component indexes: OSI, HCI, and TII. Consistently, the results show that achieving high levels of e-government maturity cannot occur without a corresponding level of maturity in the digital engagement practices of citizens; this includes citizens using their digital tools to engage in transactional activities at an advanced level, as well as having access to devices with sufficient capacity to support these activities and having high economic access to technology.

The Functional Nexus of Financial Service Provision and Human Capital

One of the most notable findings was the nearly perfect positive relationship between the two core indicators of e-Government and related measures of how citizens use their online transactional capabilities. The OSI (Online Service Index) has an almost perfect positive correlation with "Made a purchase using mobile phone/internet" as does HCI (Human Capital Index), which captures a nation's human capital through its citizens' education level and digital capacity, with "Used mobile phone or internet to pay bills". These findings reinforce the basic premise of e-Government theory; namely, that a country's ability to successfully provide electronic services (i.e., the OSI) is a direct result of the availability of educated and digitally capable citizens (i.e., the HCI) who can effectively utilize digital services to complete high-value transactions. Previously it was found that the convenience, enjoyment, quality of service, variety and trust experienced when using an on-line retailer, have been found to be major contributors to on-line consumer behavior [Pop-Eleches et al., 2011]. The convenience, enjoyment, quality of service, variety and trust experienced when using an on-line retailer, are therefore all-important components of the Online Service Index (OSI), which is used as a measure of the quality and availability of on-line services. The rapid growth of on-line retailers (driven by the impact of digitization) has provided customers with improved on-line shopping experiences and, subsequently, additional sales opportunities through the use of on-line platforms [Aprilia и др., 2026]. Therefore, it can be concluded that there exists a direct relationship between the OLSI (which reflects the development and quality of digital retail infrastructure) and the number of online purchases made. A study has also demonstrated that the quality of online services (including product, information and system quality) may have a significant impact upon customer satisfaction and loyalty, both of which are key drivers of on-line purchase behavior [Chen, Huang, Chen, 2011]. Furthermore, this study provides further support for the above-mentioned positive correlation between the OLSI and online purchases.

Higher human capital (e.g., better education and/or technical skills) contributes to both greater consumer adoption of e-commerce (and therefore more purchase

activity) and better use of mobile phones for economic purposes [Abdurakhmanova и др., 2021; Pourehtesham, 2022]. As such, higher levels of human capital likely lead to greater frequency and effectiveness of mobile/Internet based purchases. In addition, there is a positive relationship between human capital and technology adoption, which also positively affects economic growth [Diana и др., 2021]. Thus, as human capital increases, people are more able to utilize mobile and Internet purchasing options, further enhancing their own economic growth. The mutual reinforcement of human capital and digitalization, driven by Internet and mobile phone usage, is evidence of the "net shock" transmission effect of digitalization on human capital [Huyen и др., 2024]. Therefore, human capital and digitalization act to support one another; for example, higher human capital will support more frequent, and more effectively utilized, Internet shopping activities. As result, the author would like to conclude that countries with high EGDI scores do not simply offer services but have citizens who are digitally literate enough to perform high-value e-commerce and utility bill payment activities. This convergence highlights the importance of both designing effective services and educating citizens in order to achieve high levels of a nation's digital capability.

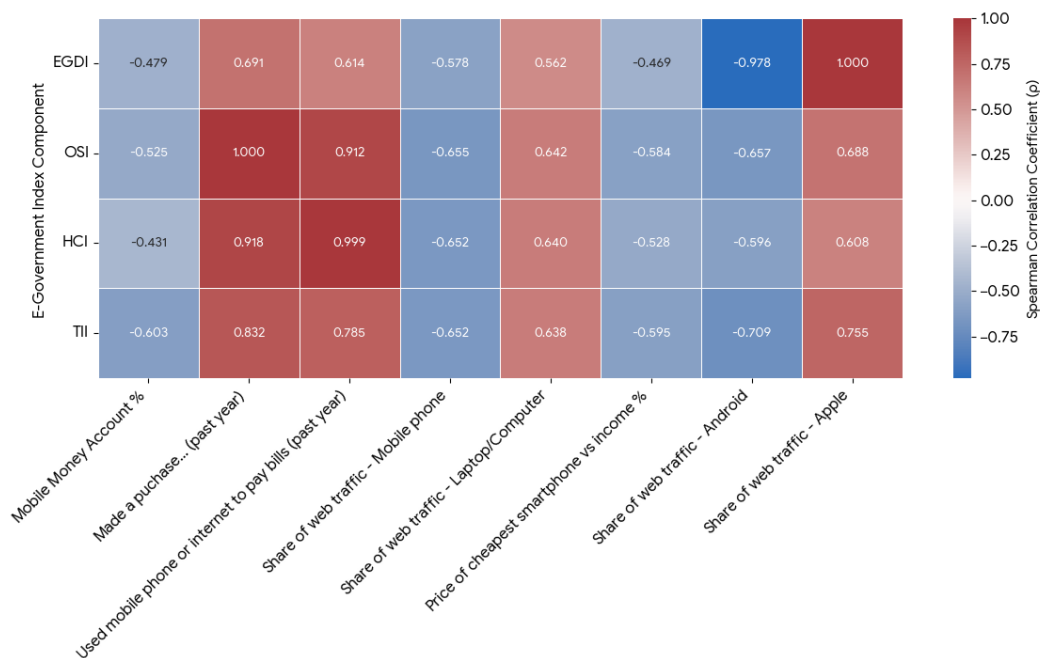


Figure 2. Heatmap of the Spearman Correlation analyses

Source: author's own editing

Digital Sophistication Divide (Device and OS)

The study demonstrates that there is a long-standing relationship between EGDI rankings and the digital environment, which favors less-mobile, lower-capacity access. The three indices, OSI ($\rho = .642$), HCI ($\rho = .640$) and TII ($\rho = .638$), all show a positive correlation with the share of web-traffic generated from devices other than mobile

phones - i.e., laptops/desktops; they also demonstrate a negative correlation with the percentage of web-traffic generated from mobile phones - e.g., OSI ($\rho = -0.655$).

The majority of studies demonstrate an increase in mobile devices being utilized for web-based activity and indicate a move away from desktops/laptops for web access. This movement has been caused primarily by the proliferation of smartphones and tablets, which will be used to provide the primary means of accessing the web [Nicholas и др., 2013; Jamalova, Constantinovits, 2020b]. As mobile device utilization grows, so does the share of web traffic coming from laptops/desktops grow. The Human Capital Index (HCI) has a positive relationship with the Digital Adoption Index (DAI) when it comes to adopting new digital technologies [Abdurakhmanova и др., 2021]. Therefore, higher levels of human capital may cause increased rates of adopting mobile technologies potentially leading to decreased reliance upon desktops/laptops. Telecommunications infrastructure development and economic development are also related; better telecommunications infrastructure will support digital adoption [David, 2019]. Thus, countries with higher OSI and TII are more likely to have developed and advanced mobile networks, therefore creating a favorable environment to utilize mobile web versus desktop/laptop web. Therefore, the studies examining the trends in web traffic demonstrate that mobile web traffic is developing rapidly, and this mobile web traffic is significantly shorter, less interactive than desktop web traffic [Nicholas, Clark, 2013]. These findings reflect the observation made previously, that as mobile web traffic increases, desktop web traffic decreases.

To summarize, while there is no concrete evidence demonstrating the relationship between OSI, HCI, and TII with the share of web traffic from laptops/desktops, the study abstracts do establish a general pattern of increased mobile device utilization and digital technology adoption, which most certainly supports the decline in web traffic coming from desktop/laptop. This inference is substantiated by the shift toward utilizing mobile devices for accessing the web, and the positive correlation between human capital and digital technology adoption. These findings indicate that, despite the recent global increase in mobile connectivity, the delivery of complex public services will continue to be contingent upon the stability, screen size, and processing capabilities associated with desktop/laptop-based environments.

In addition, the strong positive correlation demonstrated among EGDI and its constituent parts with share of web-traffic generated using Mobile Operating Systems - i.e., Apple; as well as the equally strong negative correlation demonstrated with use of Android-based mobile operating systems ($\rho = -0.978$ for EGDI), reveal a fundamental socio-economic reality. There is an increasing use of mobile e-Government services and there is an obvious trend towards mobile e-Government service delivery over traditional web-based services [Sung, Lee, 2024]. Compared to their web-based equivalents mobile e-Government services have greater potential for inclusiveness, especially for those who are considered "digitally disadvantaged" [Sung, Lee, 2025]. Use of mobile e-

Government services by users can be influenced by socio-demographic factors (for example, age, level of education and geographical location) [Wongmith, 2025]. In terms of the design and usability of mobile interfaces, the design of the mobile interface will affect how widely the mobile service will be adopted [Jamalova, Constantinovits, 2020a]. Mobile devices have limited capacity to retrieve data and display data, so the mobile interface will need to be designed carefully.

Barriers to the adoption of mobile e-Government services include the physical limitations of the user (e.g., visual impairments), the user's lack of proficiency in using computers or languages or other barriers to accessing the mobile service [Winckler и др., 2009]. There can be significant differences in how well an e-Government website performs on different browsers (which can also apply to mobile operating systems) and therefore can negatively impact both the user experience and access to mobile e-Government services [Manhas, Mansotra, 2013]. To increase the likelihood of adopting mobile e-Government services, it is important to develop multi-target e-Government services that operate effectively across multiple types of device, including mobile phones [Winckler и др., 2009]. It is equally important to find a balance between providing adequate levels of information security and ensuring that the mobile e-Government service is usable [Monzón, Tupia, Bruzza, 2020].

The author might conclude that, Apple products are used by those who reside in high-income countries - i.e., those who can purchase higher-priced, premium devices, and multiple devices [Jamalova, Constantinovits, 2019]. The existence of a "digital sophistication divide" is demonstrated through this finding meaning that the most sophisticated digital governments exist in high-income countries in which citizens use premium devices and have multi-device access [Jamalova, 2024]. This creates the need to address the economic barriers to access.

Economic Accessibility as a Core Prerequisite

The results also indicate that the context of an economy is important. The correlation coefficients ranging from $\rho = -0.469$ for EGDI and $\rho = -0.595$ for TII, showing the negative relationship between all EGDI indices and the Price of the cheapest smartphone in USD divided to Average Income demonstrates that the relative technological affordability is one of the most critical requirements for achieving a high level of e-government maturity. The countries with relatively high prices of essential digital access devices compared to average incomes consistently demonstrate low levels of e-government maturity in each dimension of the EGDI. These results are consistent with the larger body of research on the Digital Divide [Dias, 2020] that suggests that economic limitations restrict the ability to develop a strong telecommunications infrastructure and reduce the potential for developing human capital and subsequently limiting the capacity of nations to deliver advanced e-government services.

Smartphone pricing factors include characteristics of the phone such as RAM, internal memory, etc., (brand) [Listianingrum, Jayanti, Afendi, 2021]. The prices of the different types of smartphones can vary substantially due to these characteristics. A person's income greatly affects the rate at which they adopt and diffuse smartphones; typically, the greater a person's income, the greater their likelihood of adopting a smartphone [Jamalova, Constantinovits, 2020b]. There are several factors in economics which could contribute to the cost of smart phones and the difference in how affordable these products are compared to the average person's income: for example, the differences in average incomes among different regions of a country as well as the purchasing power of people in those regions [Stephanidis, Salvendy, 2024; Jung, Lee, 2017]. The studies also show that economic development levels and the level of income inequality can both have an effect on consumers' ability to purchase technology such as a smartphone [Jamalova, 2020; Jamalova, Constantinovits, 2021]. For low-income families, the cost of the most basic smartphone is very important because it determines whether or not they will have access to mobile phone services. Studies indicate that the cost of mobile phone services is one of the primary determinants of how much low-income families use their mobile phones [Dettling, Hitz, 2016]. Low-cost mobile data can likewise make a huge difference in how often and for what purposes people use the internet [Mairaru и др., 2019]. Socioeconomic barriers keep many low-income Indians, particularly women, from purchasing even the least expensive mobile phone [Potnis, 2015].

Research into Human-Computer Interaction (HCI) stresses the importance of users' preferences and satisfaction with the usability of a product or system and will influence the consumers' willingness to spend money for the use of it and the perceived value of the product or system [Said Al, Al-Said, 2020]. Overall, based on academic literature, there is no specific information provided about the relationship between HCI and the cost of the least expensive smartphone relative to average income. However, the abstracts do indicate that HCI has an impact on the design and usability of smartphones and subsequently, may have some indirect effects on market trends and pricing strategies. Lastly, economic conditions and consumers' preferences have significant roles in defining the cost and accessibility of smartphones.

While the studies are not directly analyzing the correlation of the Telecommunications Infrastructure Index with the price of the lowest-cost Smartphone compared to average income; however, they indicate some important aspects proving the relationships. The positive effect of telecommunication infrastructure on economic development could have an indirect impact on the affordability of smartphones [David, 2019]. Policies that regulate and support the telecommunications industry will be key in establishing the cost for mobile service as well as mobile handsets.

How easily and conveniently people can utilize smartphone services influences their daily routines, especially in light of the COVID-19 pandemic [Jamalova, Bálint, 2023]. Thus, the availability and quality of online services directly affect how people use and acquire smartphones. The quality and availability of online services related to the public sector, such as health care and municipal government portals, are critical to improve service delivery and citizen engagement [Sarantis и др., 2025]. Although there was no direct reference to the OSI relating the price of the lowest priced smartphone compared to average income, the research indicated that both the quality of online services and the affordability of smartphones are influenced by socioeconomic factors. The amount of money that a person earns also significantly impacts their ability to purchase a smartphone. Furthermore, the convenience of using online services via a smartphone contributes to its acquisition and utilization.

Conclusion

The study investigates empirically the relationship between e-government maturity as measured through the E-Government Development Index (EGDI), and the EGDI's three sub-components (Open Systems Interoperability (OSI), Human-Capacity Index (HCI), Technology-Infrastructure Index (TII)), and other measures of digitalization across 96 countries. Overall, the study establishes a clear relationship between the supply side of e-government development, and the demand side of citizen engagement. Key results from this study include:

- Digital Sophistication and Engagement: There is a consistent correlation between a country's level of e-government development and how sophisticated citizens are in their digital utilization, especially when it comes to high-value transactions such as purchasing online or paying bills digitally.
- Infrastructure and Capacity: Success in implementing e-government is directly tied to the presence of mature digital ecosystems. Therefore, for there to be successful implementation of e-government, a country must have at least two aspects of digital ecosystem development simultaneously present: high-quality digital services (OSI), and a population that has the human capacity (HCI) to use these digital services.
- Device Use and Digital Divide: The results show that successful delivery of complex e-government services can depend upon the presence of more reliable, higher capacity devices. The results also showed a positive correlation with the use of desktops/laptops, and a negative correlation with those who rely exclusively on mobile devices. The study found that success in delivering e-government services was also correlated with lower relative technology costs for citizens, demonstrating an economic component of the "digital divide".

- Policy Implications: By bridging the gap between a country's national supply-side index, and the actual demand-side usage, this study presents policy makers with a more nuanced view of what constitutes digital maturity. It shows that digital transformation cannot solely be achieved by government's willingness to become digitally ready; but rather, by creating an environment that encourages citizens to want to perform digital transactions, and provides them with the technical capability to do so.

In essence, this study reinforced that achieving success in e-government requires collaboration between the infrastructure of a country (robust), the human-capital of a country (skilled), and equal access to technology for full digital participation.

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