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From Presence to Performance: Mapping the Digital Maturity of Romanian Municipalities

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Abstract: In recent years, technological advancements have significantly transformed the public sector, with many institutions embracing digital solutions to enhance service delivery. Romanian city halls are actively incorporating digitalization into their sustainable development strategies, aiming to improve service efficiency and accessibility. This study examines the adaptability of Romanian city halls in the face of technological changes. By evaluating the official web portals of all 103 municipalities in Romania using 23 indicators, the research provides a comprehensive analysis of the current state (mid 2024) of e-services delivered via the web portals of the respective municipality. Even though the study findings are indicating a certain degree of maturity in digitalization, with most municipalities offering online services such as property tax payments, public transportation information, and civil status documents, it also reveals significant disparities in the quality and availability of these services across the country, underscoring the need for more standardized digitalization efforts. This research contributes valuable insights for policymakers and public institutions aiming to enhance service delivery through digital means and highlights the crucial role of technology in public sector transformation. The conclusions emphasize the importance of the adaptability of public institutions to ensure continuity and efficiency in service delivery.

Keywords: city portals; online services; digitalization; urban governance; smart cities

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1. Introduction

The rapid advancement of technology has profoundly impacted various sectors, including public administration. Digitalization, characterized by the adoption of web-based platforms for electronic public services, has become a pivotal component in the strategies of public institutions worldwide. Romanian city halls are no exception, as they seek to improve the efficiency and accessibility of their services through digital transformation. The COVID-19 pandemic has accelerated this trend, necessitating a swift transition from traditional, on-site activities to remote solutions (Anthony & Andreas, 2023; Zamfir et al., 2021; Matthias et al., 2020).

Smart cities are the ones that use technology and data to enhance the quality of life for citizens while promoting sustainable development, and they have shown significant potential in transforming public service delivery (Zuhdy & Fauzi, 2021; Bharule et al., n.d.). The adaptability of public institutions to technological changes is crucial for the success of smart city initiatives. However, the extent to which these changes have been implemented and their effectiveness remains under-explored, particularly in the context of Romanian municipalities to whom the present study refers (Schachtner, 2021; Muller-Torok & Prosser, 2021; WHO, 2023).

This study aims to fill this gap by evaluating the adaptability of Romanian city halls in the digital era. By examining the official web portals of all 103 municipalities using 23 specific indicators, this research assesses the current state of e-services and identifies both the progress and disparities in digital service delivery. Key findings indicate significant strides in digitalization but also highlight considerable variations in service quality and availability across municipalities.

The significance of this study lies in its comprehensive analysis of the digital transformation of public services in Romania, offering valuable insights for policymakers and public institutions. By identifying the best practices and areas needing improvement, this research contributes to the ongoing discourse on smart city development and digital governance. It underscores the importance of standardized approaches to digitalization to ensure equitable access to high-quality public services for all citizens. The conclusion emphasizes the need for adaptable public institutions to maintain efficient service delivery (Budd et al., 2020; Nature, 2022; Xu & Tang, 2020).

Based on the scope of the study, the following research questions (RQs) are proposed:

- RQ1: To what extent have Romanian municipalities implemented digital services on their official websites as of mid-2024?
- RQ2: What patterns of digital maturity can be observed across different classes of analysis (e.g., transparency, e-documents, and communication)?
- RQ3: How do the results align with existing e-government maturity models, particularly in distinguishing municipalities at the transactional (e-Gov 2.0) and integrated service (e-Gov 3.0) stages?

These questions guide the design of the analytical framework and provide a structured lens for interpreting the findings presented in this study.

2. Context

Many scholars propose that the various stages of digitalization, or its maturity level, can be observed through the delivery of electronic public services via the web, ranging from the static display of information to a fully integrated platform for services provided (Pardo, 2000; Baltac, 2011; Vrabie, 2009b). The last stage is defined by the continuous and effortless dissemination of information within the administrative web space.

The primary objective of this article is not just to advocate for personalized digital services as an essential progression but instead to examine these services as a model for the diffusion of web technologies, focusing specifically on the most offered services on Romanian city halls' web portals. To achieve a thorough understanding, we analyzed the prevalence of internet-based electronic services across all 103 municipalities in Romania.

Romania is a decentralized state, meaning that municipalities have considerable autonomy from the central public administration, including the design and management of electronic services (Baltac, 2011; Vrabie, 2009a). At the national level, digitalization initiatives are coordinated by the Ministry of Research, Innovation, and Digitalization, in conjunction with the Ministry of Development, Public Works, and Administration. Unlike other European countries such as Estonia and Denmark, Romania does not have a chief information officer (CIO) at either the central or local levels to oversee digitalization efforts aimed at achieving inter- and intra-institutional collaboration. The absence of a CIO in Romanian's public institutions may result in a lack of coherent strategies, inefficient resource utilization, and slower progress in digitalization efforts (United Nation, 2020; Ojo et al., 2007; Obi, 2007).

The country is the twelfth largest in Europe, as it is in the center-east of the continent (Figure 1 left) and is also the sixth most populous in the European Union. It is divided

into 41 counties (see Figure 1 right), with each of them having a different number of municipalities (103 in total), cities (216), and towns (2862).

Figure 1. (**left**) Location of Romania in Europe; (**right**) the counties and municipalities of Romania. Source: authors' own work.

Municipalities are the richest administrative units, which is why this article only focuses on them, and they have the widest range of self-government tasks among all. They are responsible for delivering the services that their local community needs. Based on the above, municipalities are directly influencing the digitalization level.

3. Literature Review

E-government initially involved publishing information on public institution websites. This first phase was followed by enabling citizens to communicate with these institutions via email, leading to more sophisticated websites with integrated intranet platforms for streamlined electronic document management (Vrabie, 2016). The subsequent phase allowed for online payments and greater citizen interaction through social media, webcams, and virtual meeting applications, effectively making citizens active participants in the governance process (Vrabie & Dumitrascu, 2018; Timan et al., 2021; Vrabie, 2023). The development of the rather new concept of e-government 3.0 has seen the incorporation of artificial intelligence (AI) tools in administrative tasks, enhancing public servants' analytical and decision-making capabilities and strengthening citizen–institution relationships (Vrabie, 2022).

Theoretical approaches from researchers such as Orlikowski (Orlikowski, 2000) and Cziarniawska and Sevon (Czarniawska & Sevón, 2005) in the early 2000s highlight environmental pressures as the impetus for developing web platforms and electronic services. Orlikowski and Barley (Orlikowski & Barley, 2001) further illuminate the process of technology development and organizational change by advocating for the implementation of electronic services.

Marc Holzer's analyses, presented in "Digital Governance in Municipalities Worldwide" (Holzer & Manoharan, 2016), offer a valuable model for studying digitalization at the local level. Complementary research from journals like the *Journal of Web Semantics* [issues 2020–2024], *Sustainability and Smart Cities* [issues 2020–2024], *Government Information Quarterly* [issues 2020–2024], and the *International Journal of Web Services Research* [issues 2020–2024] indicate a broad focus on e-government, though not always at the comprehensive scale this study aims to achieve.

Don Tapscott's seminal work "Grown Up Digital" (Tapscott, 2008), alongside studies by Homburg and Dijkshoorn on personalized e-government services (Homburg & Dijkshoorn, 2011), underscores the increasing importance of citizen interaction with public

administration. Successful examples include national initiatives like Estonia's eesti.ee (Riigi Portal eesti.ee, n.d.), Norway's Norway.no (Norwegian Ministry of Foreign Affairs, n.d.), Belgium's MyMinFin (belgium.be, n.d.), the Netherlands' MijnOverheid app (MijnOverheid, n.d.), and Denmark's borger.dk (borger.dk, n.d.).

Despite increasing demand for efficient public services, there is a global trend of declining trust in governmental bodies (Hallahan, 2017; Fombrun & van Riel, 2017; Vangelov, 2023). This dynamic underscores the need for upgraded infrastructure, enhanced services, and adaptive leadership, although limited budgets and rising demands often slow down these efforts (Iancu, 2013). The literature on public management posits that web applications can address these challenges by promoting good governance through improved service delivery, task automation, and decision support, particularly when enhanced by AI. Online platforms also boost transparency, accountability, and citizen engagement (Thakhathi & Langa, 2022; de Lange-Ros et al., 2018; Schachtner, 2021; Etscheid, 2019; Kolkman, 2020).

Research by Ibtissem et al. (Ibtissem et al., 2018), who used advanced statistical methods, highlights the challenges emerging economies face in addressing governance issues. Digital platforms, particularly those powered by AI, are heralded as revolutionary for public management, facilitating e-petitioning through automated responses (Munshi et al., 2021; Zalwert, 2021). Studies by Hreňo et al. (Hreňo et al., 2011) and Piaggesi (Piaggesi, 2021) further discuss achieving semantic interoperability and the future of connectivity, respectively. Verma's bibliometric review (Verma, 2022) suggests that smart technologies are fostering smarter governance, although this view is optimistic.

The integration of web technologies into public service delivery is now seen as a cornerstone of smart city development, enhancing efficiency, accessibility, and citizen engagement. Recent studies have explored various facets of this integration, highlighting both its potential and challenges. For instance, Latupeirissa et al. (Latupeirissa et al., 2024) conducted a comprehensive review of digital transformation projects in public service delivery, finding that such initiatives improve efficiency, increase citizen involvement, and enhance government accountability. However, they also identified challenges like the digital divide, which can exacerbate inequalities by excluding individuals lacking access to or familiarity with digital platforms. Similarly, Pislaru et al. (2024) examined the role of artificial intelligence in governance processes, focusing on AI-driven tools like chatbots that facilitate effective communication between public institutions and citizens. Their study suggests that these technologies can improve service delivery and foster greater public participation. Iqbal and Olariu (2021) explored the integration of information and communication technologies (ICTs) with citizens' lives, emphasizing the importance of tighter integration to bring new services to the public. They review known technologies that play a significant role in the transition to Society 5.0, aiming to meet the various needs of society members through ICT integration. Furthermore, Itair et al. (Itair et al., 2023) discuss the concept of smart public spaces, which involve citizens in governance and leverage smart technology for monitoring, providing real-time information and services and improving facility efficiency.

Madan and Ashok (Madan & Ashok, 2023) identify key contextual variables affecting the adoption of online services, emphasizing the importance of governance maturity in IT implementation. Ahn and Chen (Ahn & Chen, 2022) find that public employees are generally positive about the integration of technology, anticipating improvements in efficiency and service quality. Similarly, Eom and Lee (Eom & Lee, 2022; Zankova, 2021) conclude that actor-based computing models and large-scale data utilization can enhance government decision-making, leading to cost savings and improved event anticipation. The proper implementation of current web applications is expected to significantly improve citizen engagement with government services.

These studies collectively affirm the critical role of web technologies in modernizing public services, promoting sustainable development, and enhancing the quality of life in urban environments. They also highlight the necessity for inclusive digital strategies that address access disparities to ensure equitable benefits for all citizens.

The measurement of e-services in public administration has been widely studied through various models and frameworks. Some of the most influential theoretical models include Layne and Lee's E-Government Maturity Model (2001), a four-stage framework progressing from cataloging (basic online information) to transactional services (interactive e-services), vertical integration (interconnectivity between different government levels), and horizontal integration (seamless, interoperable services across agencies) (Layne & Lee, 2001).

United Nations E-Government Development Index (EGDI): this index evaluates online services, telecommunication infrastructure, and human capital, offering a global benchmark for assessing digital governance maturity (United Nations, 2025).

The digitalization of public services extends beyond administrative functions to key economic sectors such as transportation, mobility solutions, and shared services. Research by the European Central Bank (European Central Bank, 2023) highlights the transformative economic effects of digitalization in urban mobility, particularly in the integration of smart transport solutions with municipal governance.

While these frameworks provide valuable insights, they are often designed for comparative national assessments rather than detailed municipal evaluations. Therefore, the need for a localized, context-specific measurement framework remains relevant, especially in the case of Romania's municipal services.

4. Research Methodology

Despite the existence of the above theoretical models, they do not fully capture the municipal-level digitalization trends observed in Romania, specifically

- Lack of granularity: the UN EGDI and Holzer's model focus on broad national indicators, failing to assess municipal service differentiation.
- Limited citizen-centric indicators: many frameworks emphasize technological availability rather than usability, citizen interaction, and service efficiency.
- Absence of local governance autonomy considerations: Romania's decentralized governance structure allows municipalities to implement digital services independently, which is not reflected in standard global indices.

To address these gaps, this study adopts a municipality-specific evaluation framework. Unlike existing models, this classification provides a practical, municipality-centered assessment that highlights variations in digital governance implementation at the local level.

Public authorities promote the values of their initiatives or ongoing projects primarily by posting them on their websites (Feeney & Brown, 2017; Khudeira, n.d.; Vrabie, 2009a, 2011). As early as 1999, Jon M. Kleinberg from Cornell University (Kleinberg, 1999) examined the network structure of hyperlinked environments and developed a set of algorithmic tools to extract information from such link structures.

For data collection in this study, the authors employed the ParseHub API (ParseHub, 2023) to simultaneously gather information from all 103 official municipal websites. To mitigate data loss from websites that were temporarily down during the initial query, the process was repeated one week later. This methodology ensured more comprehensive and accurate data collection.

The selection of municipalities for this study was based on Romania's official classification of administrative territorial units. As mentioned, we included all 103 municipalities, which are defined as the highest-ranking cities in Romania's administrative hierarchy.

These are distinct from towns and communes due to their larger population, economic influence, and wider scope of administrative responsibilities. No additional demographic filters (such as population size thresholds or economic indicators) were applied, ensuring comprehensive national coverage.

The initial list of URLs was derived from official registries maintained by the Ministry of Development, Public Works, and Administration and cross-validated with public data from the Association of Romanian Municipalities. This ensured that each domain was accurately mapped to its respective administrative unit. In instances of ambiguity or missing links, manual searches were conducted using the municipality's name and verified through government portals and contact information.

To ensure data accuracy, we employed a two-stage quality assurance mechanism:

- Automated scraping using ParseHub API was used to gather structured data uniformly across all web pages.
- Manual validation was conducted on a sample to cross-check the scraper outputs against the actual website content. This included verifying the accuracy of indicator detection and the correct association between each web portal and its city hall.

This study categorized the queries into five distinct classes that are essential for evaluating municipal websites. The first class, transparency, focused on the municipality's compliance with relevant regulations. The second class, e-documents, examined various aspects related to electronic documents. The third class, communication, aimed to extract critical information on the municipality's use of new media. The fourth class assessed the availability of useful online information, such as city maps, live cameras, and newsletters. The final class evaluated the ease of website navigation and overall user-friendliness. The responses to the queries were then rated on a fixed-point scale, as outlined in the table below. These five analytical categories were not predefined but emerged from the logical grouping of indicators based on their function, as shown in Table 1.

For the analysis, 48 instruments were initially used to investigate specific websites. However, for this study, only 23 were considered based on their relevance to the research question. The remaining 25 indicators, while valuable for assessing broader aspects of good governance and local administrative performance, focused primarily on traditional governance concerns rather than digital maturity. Examples of these excluded indicators include measures such as reporting the presence of potholes in city roads; assessing whether public transportation adequately serves citizens' needs, particularly in newly developed neighborhoods; and evaluating the cleanliness of public spaces or the availability and quality of recreational facilities. Such governance-focused indicators, although important, did not directly contribute to evaluating the municipalities' digital maturity and were therefore set aside for a separate, governance-centered analysis.

The 23 instruments were grouped into the five classes mentioned above, with each containing a different number of indicators, as shown in Table 1. All 23 indicators were equally weighted to ensure fairness and methodological consistency. For binary indicators (e.g., the presence of a mayor's contact form or downloadable forms), a fixed score of 1 point was awarded for presence and 0 for absence. However, two indicators (C51—Pleasant Design and C52—Easy Browsing) required subjective evaluation. For these, a 5-point Likert scale was applied using predefined rubrics (detailed in Table 2 with very relevant references from the field), and scores were converted into normalized values (out of 5 points) to align with other categories.

Table 1. Classes of analysis used in this study.

C1 Transparency	C2 E-Documents	C3 Communication	C4 Practical Content	C5 Generalities
C11. Employee's declaration of wealth	C21. Online forms and/or off-line (.pdf, .doc, and .xls)	C31. Mayor cabinet direct contact line (by email, tel., or WhatsApp number)	C41. City map on the Google map platform (updated and maintained by the municipality)	C51. Pleasant design of the city official website [1]
C12. Organizational chart	C22. Tracking of submitted application	C32. Online suggestions of improvement	C42. In site search by keywords	C52. Easy browsing inside the website [2]
C13. Minutes of the internal/public meetings	C23. Online petitioning	C33. Social media official presence (Facebook, Instagram, Twitter, etc.)	C43. Multiple language selector	C53. Contact information regarding private companies that provide public services
C14. Employees' resumes	C24. Public announcements	C34. Sign-in/Log-in section for citizens	C44. City news section	
C15. Budget information	-	-	C45. List of live cameras and web addresses for citizens to connect	-
C16. Existence of legislation and city/county decisions	-	-	C46. Newsletter subscription	-
Maximum no. of points per class = 6	Maximum no. of points per class = 4	Maximum no. of points per class = 4	Maximum no. of points per class = 6	Maximum no. of points per class = 3
Maximum no. of points per city = 23				

[1,2] While the first four classes are easy to measure ('0' for non-existent information and '1' for existing information), the C5 subclass, generalities, needs some further explanation. Therefore, in the table below we present the C51 and C52 subclasses' criteria.

Table 2. Criteria for the C51 and C52 subclasses (Anusha, 2014; Alsaeedi, 2020; Mallon, 2014; Bigby, 2018; Craig, n.d.).

Grade	Description
1	- The portal's design is very poor, unprofessional, and probably executed in-house. - Difficult navigation: the site is built in .html; it has no dynamism, and the maximum number of clicks needed to reach the last page of a branch is more than four.
2	- The design is poor and is probably executed in-house. - Difficult navigation: the site is built in .html, and it has no dynamism.
3	- Satisfactory design, yet the page is overloaded. - Difficult navigation, bushy menus, and hard to identify exactly where the information can be found; general information about the municipality is displayed in a to "be there" manner.
4	- Pleasant contrasts, airy page/easy navigation, but with bushy menus even if they are executed in advanced programming languages (ASP, PHP, etc.). - The information about the municipality is rich and "at sight".
5	- The website is executed in a professional manner, and the pages are airy. - Navigation is completely dynamic and intuitive; the information about the municipality is very rich and easy to find.

Although multiple evaluators were not used for scoring, a standardized rubric was applied throughout to reduce potential scoring bias as addressed in the limitation sec-

tion of this article. Future work will incorporate inter-rater reliability testing to further enhance objectivity.

The instruments used were chosen based on a systematic review of previous research on e-government service measurement and municipal digitalization. The selection process followed these steps:

- Literature Review: There were examined global e-government assessment frameworks, such as the United Nations E-Government Development Index (EGDI) (United Nations, 2025), Layne and Lee's E-Government Maturity Model (Layne & Lee, 2001), and Holzer's Digital Governance Model (Holzer & Manoharan, 2016). Also, the authors reviewed municipal-focused studies, including those by Feeney and Brown (2017) and Homburg and Dijkshoorn (2011), which evaluated online services at the local government level.
- Alignment with Romanian Municipal Practices: The list was refined by considering actual services provided by Romanian municipalities (as observed in a preliminary website analysis conducted between 2012 and 2024). Only indicators with a clear public service function (e.g., e-petitions, online tax payments, and transparency reports) were included. Expert Validation: a panel of digital governance specialists and municipal IT officers reviewed the list to ensure relevance and feasibility.

Below, one can see the formula needed to convert the 1-to-5 scale into points:

$$C51 = GC51 \times 0.20 \quad (1)$$

$$C52 = GC52 \times 0.20 \quad (2)$$

where

C51 and C52 — Values for the named subclasses;
GC51 and GC52 — Grades received by each subclass.

The formulas for every class and for the final result used in the present study are as follows:

$$C1\ (\text{TRANSPARENCY}) = \sum_{i=1}^{MaxC1} C1(i) \quad (3)$$

$$C2\ (E-\text{DOCUMENTS}) = \sum_{i=1}^{MaxC2} C2(i) \quad (4)$$

$$C3\ (\text{COMMUNICATION}) = \sum_{i=1}^{MaxC3} C3(i) \quad (5)$$

$$C4\ (\text{USEFUL CONTENT}) = \sum_{i=1}^{MaxC4} C4(i) \quad (6)$$

$$C5\ (\text{GENERALITIES}) = \sum_{i=1}^{MaxC5} C5(i) \quad (7)$$

$$Ms = \sum_{i=1}^{MaxC1} C1(i) + \sum_{i=1}^{MaxC2} C2(i) + \sum_{i=1}^{MaxC4} C4(i) + \sum_{i=1}^{MaxC4} C4(i) + \sum_{i=1}^{MaxC5} C5(i) \quad (8)$$

where

C1, C2, C3, C4, and C5	—	The classes of analysis, as shown in Table 1;
C1(i), C2(i), C3(i), C4(i), and C5(i)	—	Indicators used for investigating the website. To build up the result for C5, Formulas (1) and (2) were used;
MaxC(1–5)	—	The maximum number of points per class, as shown in Table 1;
Ms	—	The municipality score, that is, the final score obtained by the website.

In order to have a clear perspective on the actual stage of Romanian municipalities' official websites, we converted the absolute scores received by each class of analysis into a relative 1-to-5 scale (Likert scale, where 1 is showing the lowest score and 5 the highest) using the Excel CEILING function over the following mathematical formula:

$$Relative\ value\ of\ each\ class = \frac{Cji - minCj}{\frac{maxCj - minCj}{5}} \quad (9)$$

where
j — Takes the value from 1 to 5 according to each class of analysis;
i — Takes the value from 1 to 103 according to each municipality.

Below, one can see the Excel formulas used for the conversion of absolute values into relative ones on a 1-to-5 scale:

IF(C1 = “”,””,MIN(MAX(CEILING((C1-MIN(TSoS@C1))/((MAX(TSoS@C1)-MIN(TSoS@C1))/5),1),1),5)) (10)

IF(C2 = “”,””,MIN(MAX(CEILING((C2-MIN(TSoS@C2))/((MAX(TSoS@C2)-MIN(TSoS@C2))/5),1),1),5)) (11)

IF(C3 = “”,””,MIN(MAX(CEILING((C3-MIN(TSoS@C3))/((MAX(TSoS@C3)-MIN(TSoS@C3))/5),1),1),5)) (12)

IF(C4 = “”,””,MIN(MAX(CEILING((C4-MIN(TSoS@C4))/((MAX(TSoS@C4)-MIN(TSoS@C4))/5),1),1),5)) (13)

IF(C5 = “”,””,MIN(MAX(CEILING((C5-MIN(TSoS@C5))/((MAX(TSoS@C5)-MIN(TSoS@C5))/5),1),1),5)) (14)

IF(Ms = “”,””,MIN(MAX(CEILING((Ms-MIN(TSoS@Ms))/((MAX(TSoS@Ms)-MIN(TSoS@Ms))/5),1),1),5)) (15)

where

Ci and Ms	—	The value obtained by using Formulas (3) to (8);
TSoS@Ci	—	The total set of scores obtained at class Ci, where i takes values from 1 to 5 according to the class no.;
TSoS@Ms	—	The total set of scores obtained by the municipality (Ms).

Integration of Indicators with E-Government Maturity Models

To substantiate our analysis within established theoretical frameworks, specifically Layne and Lee's E-Government Maturity Model (2001) and the UN EGDI, we mapped our selected indicators to their corresponding maturity stages:

- Informational (web presence): basic indicators such as organizational charts (C12), budget information (C15), and public announcements (C24) align with this initial stage, representing static information dissemination.
- Interactional: indicators enabling basic two-way communication, including direct contact lines (C31), online suggestion submissions (C32), and social media presence (C33), characterize this stage, highlighting preliminary citizen–government interactions.
- Transactional (e-Gov 2.0): indicators reflecting transactional services such as online forms (C21), petitioning systems (C23), and application tracking systems (C22) align

closely with this stage, representing direct digital service interactions between citizens and institutions.

- Integrated Services (e-Gov 3.0): advanced indicators involving personalized user experiences, notably the citizen sign-in/log-in feature (C34), comprehensive city maps (C41), multilingual content (C43), and live cameras for real-time urban interactions (C45), align with this higher stage of maturity by integrating multiple services into unified, user-centric digital platforms.

5. Results

Several municipalities have exhibited exceptional performance in specific categories while underperforming in others. To address this disparity, we will present the results for each category and offer a comprehensive overview of the official web pages of Romanian municipalities as they are today (end of 2024).

It is noteworthy that we have deliberately chosen not to identify any municipality by name in this study. This decision aims to prevent any potential misuse of the findings for political purposes. As researchers, we strive to maintain an impartial stance and avoid involvement in any political controversies that may emerge following publication.

5.1. General Results

All Romanian municipalities maintain active websites as well as profiles on social media platforms such as Facebook. This indicates that Romanian municipalities are actively engaging with their citizens through social media, which replaced traditional bulletin boards and forums (Cassel, 2016; Driscoll, 2016; Holt, 2020) as a medium for public discourse and feedback on municipal activities (Tapscott, 2008).

Table 3 illustrates the most prevalent electronic public services available on Romanian municipal websites. In addition to the aforementioned information, it is evident that 68 municipalities (66.02%) feature a sign-in/log-in section, enabling customized user experiences. Furthermore, 91 municipalities (88.35%) offer electronic forms on their websites, a substantial increase from 32 in 2014 (Vrabie, 2014). Additionally, 76 municipalities (73.79%) provide online tracking for submitted applications, up from 27 in 2014. Moreover, 88 municipalities (85.44%) have implemented an e-petitioning system, compared to 43 in 2014, and 83 municipalities (80.58%) offer newsletter subscriptions.

Table 3. Electronic public services available on Romanian cites' websites.

Electronic Public Services	No. of Municipalities	%
Active website for the municipality	103	100.00%
Official social media profile of the municipality	103	100.00%
Sign-in/Log-in section for citizens	68	66.02%
The existence of electronic forms on the website	91	88.35%
Online/mobile tracking of submitted applications	76	73.79%
Online/mobile petitions	88	85.44%
The citizen's possibility to subscribe to a newsletter	83	80.58%

Data source: authors' own compiled data.

Table 4 presents the score distribution for the quality of Romanian municipal websites, with scores ranging from 0 to 23 points. Notably, 58 municipalities (56.31%) achieved scores higher than 20 points. Including those with scores between 16 and 20, approximately 90% of municipalities have well-designed, information-rich websites, indicating significant efforts to provide easy access to online public services.

Table 4. Aggregated view over Romanian cites' websites (relative scores).

Grade [1]	No. of Municipalities	%
Very good (overall relative score equal to 5)	55	53.40%
Good (overall relative score equal to 4)	25	24.27%
Satisfactory (overall relative score equal to 3)	15	14.56%
Poor (overall relative score equal to 2)	6	5.83%
Very poor (overall relative score equal to 1)	2	1.94%

[1] calculated using Formula (15).

Remarkably, one municipality achieved a perfect score of 23 points, reflecting its exceptional commitment to providing high-quality digital services and easy access to essential information. This level of dedication should serve as a benchmark for other municipalities in Romania and globally.

Overall, the high scores achieved by Romanian municipalities (Figure 2) in the website evaluations indicate significant progress in digital service provision and information accessibility. Nevertheless, there is always room for improvement, and municipalities should continue to enhance their websites to make them more user-friendly and accessible.

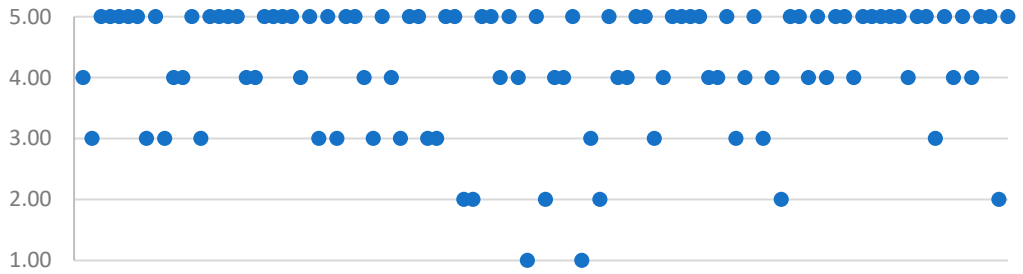

Figure 2. Distribution of scores obtained by municipalities (absolute values).

This study reveals geographical disparities in municipal digitalization, suggesting that socioeconomic factors influence digital service development:

- Larger, wealthier cities perform better. Municipalities with higher GDP per capita and larger populations tend to have more advanced e-services. These cities often receive higher IT infrastructure investment and EU funding.
- Smaller municipalities lag behind. Many smaller municipalities in northeastern Romania had lower scores in transactional e-services and usability.

This aligns with studies showing a digital divide between urban and rural regions in Eastern Europe (Homburg & Dijkshoorn, 2011).

The key insights are as follows:

- The Bucharest–Ilfov region outperforms all others, reflecting stronger government funding and IT infrastructure;
- The northeast and south regions show weaker scores, highlighting the need for targeted policy interventions.

5.2. Results on Each Classes of Analysis

Table 5 provides a detailed breakdown of the relative scores achieved by Romanian municipalities across the five analyzed categories. The majority of municipalities excelled in the transparency category, with 88 municipalities (85.44%) attaining the highest score. This is unsurprising, considering the legislative measures in place to promote transparency within public institutions. The next highest-scoring category is e-documents, with 72 municipalities (69.90%) reaching the top score, followed by communication with 63 municipalities

(61.17%), useful content with 64 municipalities (62.14%), and generalities with 55 municipalities (53.40%).

Table 5. Relative scores obtained by the cities of Romania on each class of analysis.

Score	No. of Municipalities (%)				
	C1	C2	C3	C4	C5
5	88 (85.44%)	72 (69.90%)	63 (61.17%)	64 (62.14%)	55 (53.40%)
4	7 (6.80%)	16 (15.53%)	34 (33.01%)	21 (20.39%)	25 (24.27%)
3	0 (0.00%)	0 (0.00%)	0 (0.00%)	14 (13.59%)	15 (14.56%)
2	7 (6.80%)	6 (5.83%)	5 (4.85%)	1 (0.97%)	6 (5.82%)
1	1 (0.97%)	9 (8.74%)	1 (0.97%)	3 (2.91%)	2 (1.94%)

Data source: authors' own compiled data.

The data indicate a significant interest among public officials in utilizing municipal websites and social media platforms to engage citizens. This is reflected in the high scores for the communication category, where 63 municipalities achieved the highest score, as well as in the e-documents and useful content categories. These findings suggest that public institutions are increasingly focusing on digitalization and providing relevant information to their citizens.

Overall, these results suggest that Romanian municipalities are making significant strides in providing their citizens with comprehensive and engaging online services, particularly in areas such as transparency and e-documents. However, there is still room for improvement in enhancing the online presence of municipalities to ensure a user-friendly and interactive experience that meets citizens' needs and expectations.

5.2.1. Transparency

Romanian legislation, particularly law no. 52 of 21 January 2003, emphasizes transparency in public administration (Romanian Parliament, 2013), outlining the requirements for local public authorities to engage with the community during the legislative process. This law mandates three key objectives: (1) providing advance notice to the public about matters of public interest to be discussed, (2) asking for input from citizens and legally established associations during the drafting of normative acts, and (3) encouraging active citizen participation in administrative decision-making.

In terms of legislative development, authorities are required to publish a notice at least 30 days before submitting it for review, approval, and adoption. This notice must be posted on official websites, displayed in publicly accessible areas, and disseminated to the media.

To evaluate the implementation of transparency regulations on municipal websites, we used the tools outlined in class 1 (Table 1). The average score was calculated and converted to a scale from 1 to 5 (with 5 being the highest), resulting in an average score of 4.81, the highest among all classes. This high score can be attributed to legislative requirements. Conversely, in classes C4 and C5, where regulatory mandates are less stringent, the average scores were lower.

5.2.2. E-Documents

Citizens are increasingly motivated to minimize time spent waiting in queues (Baltac, 2019; Prisco, 2019), a trend amplified by the legal and social pressures stemming from the COVID-19 pandemic (U.S. Department of Health & Human Services, n.d.; Su et al., 2021). Therefore, it is imperative for public officials to enhance access to necessary forms and documents through digital platforms. Some institutions have made e-documents available in open formats (e.g., .doc, .pdf, or .xls), while others have implemented online web forms

for electronic submission. Analyzing these data provides a comprehensive view of the digitalization of public services within Romanian municipalities (Kosec & Wantchekon, 2020).

The present study focused on the availability of electronic forms required for obtaining permits, certificates, and other documents from the city halls. This category includes documents in open formats, such as .pdf and .doc, which are available for download from the municipal websites. Once completed, these forms are typically intended for submission, either online or in person, to a public institution. Among the 103 websites analyzed, 91 (88.35%) offered multiple downloadable documents as described, with some municipalities also providing electronic forms for online submission. Additionally, 76 (73.79%) municipalities had an online tracking system for submitted documents, whether submitted electronically or in person.

A total of 72 websites achieved the highest score (four points) in this category, reflecting a significant interest from officials in expanding electronic services at the municipal level.

5.2.3. Communication

Upon reviewing the research published in *Sustainable Cities and Society* (issues 2020–2024), *World Development* (issues 2020–2024), and *Information* (issues 2020–2024), it becomes clear that citizen engagement in governmental activities is a prominent area of focus within e-government studies. Modern public institutions are increasingly providing online platforms to facilitate citizen participation in decision-making processes. This engagement can occur through online polls for public decisions, though this method is infrequent and was therefore not included in our study, or via official social media profiles moderated by municipalities to involve citizens in governance (Castells, 2010). Our research specifically examines the extent of online engagement between citizens and public institutions.

While city halls can publish information of public interest on their websites, the lack of online channels for citizens to contact the institution with inquiries and suggestions can impede effective communication.

In nearly all cases, 101 out of 103 municipalities (98.06%) offered the option to send an email directly to the mayor's office and submit suggestions to the authorities (in 98 municipalities). However, only 68 municipalities (approximately 66%) have implemented dedicated sections on their websites for citizens to access personal information using a username and password.

All of the municipalities maintain an active presence on social media platforms, with profiles or pages that are regularly updated. However, the current study only assessed the presence or absence of official social media accounts, which, while informative about the municipalities' adoption of digital communication channels, does not account for the actual effectiveness of these tools. More nuanced indicators, such as frequency of updates, relevance of published content, and levels of citizen interaction (e.g., comments, shares, and reactions), would provide a more comprehensive understanding of communication quality. These indicators were excluded due to time and resource constraints but will be considered in future iterations of the study, aligning with a more performance-oriented evaluation of municipal digital maturity. As researchers noted a decade ago (Bryer & Zavattaro, 2011), social media enables citizens to actively engage in the governance process. Additionally, through social media, citizens can contribute valuable ideas and suggestions to enhance the quality of life in their cities (Song & Lee, 2016; Medium, 2020; Hood, 2018). This demonstrates the growing importance of digital communication channels in fostering a more transparent and participatory relationship between citizens and their local governments.

5.2.4. Practical Content

The quality and relevance of content are vital components of any website (Webbiquity, 2011; Martinez-Caro et al., 2018). Regardless of the sophistication of the technology used, a website will fail to achieve its objectives if the content is outdated, hard to navigate, difficult to find, or inaccurate (Gil & Artz, 2007; TomGruber, 2008; Heath & Motta, 2008).

In this study, useful content refers to the information provided on a city hall's website regarding its activities. The news section keeps citizens informed about current events in the city (Nielsen, 2002), while Google Maps offers satellite imagery, aerial photography, street maps, 360-degree panoramic street views, real-time traffic conditions, and route planning for various modes of transportation (Google, 2024). Additionally, webcams installed at strategic locations throughout the city enhance convenience and contribute to a comprehensive city-wide security strategy (Haque, 2020; Duke, 2019). Thus, 'Useful content' provides valuable information for both residents and tourists. The C4 analysis class not only evaluates the presentation of external elements related to the city hall but also assesses how easily citizens can access this information, such as through keyword searches or language options for tourists.

Unfortunately, three cities (approximately 3%) received a score of one. According to our findings and discussions with city hall representatives, the primary reason for these low scores is a lack of focus on addressing citizens' needs. This underscores the importance of ensuring that municipal websites prioritize user-friendly design and relevant content to better serve their citizens.

5.2.5. Generalities

This study also assesses the accessibility of municipal websites by evaluating their user-friendliness and ease of navigation. Various indicators commonly used in private sector web portal analyses were employed to measure these aspects. For example, we analyzed the visibility of links, the impact of color schemes on user experience, and the number of clicks required to reach the final page of the website. A detailed explanation of these indicators can be found in the methodology section (Table 2).

Table 6 illustrates a significant range in scores for the generalities class (relative values), which can be attributed to differing levels of municipal interest in maintaining an appealing online presence. A lack of attention to user experience discourages citizens and tourists from exploring the website and negatively affects the site's ranking in search engine results (Google Search Central, 2024).

Table 6. Relative scores obtained by the cities of Romania on Generalities class.

Score	No. of Municipalities (%)	
	Pleasant Design (C51)	Easy Browsing (C52)
5	8 (7.77%)	8 (7.77%)
4	27 (26.21%)	29 (28.16%)
3	19 (18.45%)	31 (30.10%)
2	33 (32.04%)	25 (24.27%)
1	16 (15.53%)	10 (9.71%)

Data source: authors' own compiled data.

To better understand this situation, we focused on two specific indicators: 'Pleasant design' and 'Easy browsing', as shown in Table 6:

These indicators, which can be considered the online "business card" of a city (Masson, 2018) after being aggregated, reveal that many municipalities do not prioritize these aspects of their websites. According to some officials we interviewed, many municipal websites are

developed in-house using popular content management systems (CMSs) such as Joomla, WordPress, or Drupal. However, the quality of these websites is not inherently determined by the platform itself. Rather, it depends on how well the platform is customized, the design choices made, and the level of professional expertise involved in implementation. While some newer technologies offer advanced features, they can also introduce inefficiencies (e.g., bloated code or sluggish performance) if not carefully managed. Likewise, well-maintained legacy systems can still deliver highly usable and efficient user experiences. Therefore, the observed design shortcomings are more likely attributable to a lack of specialized design expertise or insufficient investment in front-end customization than to the CMS choice alone.

5.3. Discussion of Differences Between Categories

A comparative analysis of the five e-governance categories reveals notable disparities:

- Best-Performing Category: transparency. This is expected, as Romanian law mandates the publication of financial records, budgets, and public meeting minutes (Law no. 52/2003). The high scores indicate compliance with legal requirements rather than proactive digital innovation.
- Weakest Category: generalities. This category assesses user experience, accessibility, and design quality. The lower scores suggest that esthetics and navigability are not a priority for many municipalities. Possible causes: limited IT expertise among municipal staff and reliance on in-house development using basic CMS platforms (Joomla and WordPress).
- Emerging Trend: e-documents and communication. Significant growth in electronic forms and online petitions. However, tracking systems for submitted applications are still underdeveloped (only 73.79% availability). This indicates a shift toward transactional e-government (e-Gov 2.0), which has not yet reached fully integrated services (e-Gov 3.0).

To illustrate the integration of indicators with e-government maturity models, the data reveal clear examples:

- A majority (85.44%) of municipalities provide e-petitioning systems (C23) and online tracking of submitted applications (73.79%), positioning them solidly within the "Transactional" stage.
- One exemplary municipality, achieving the highest overall score of 23 points, offers advanced integrated services like personalized log-in experiences, comprehensive multilingual portals, regularly updated Google Maps integration, and live camera feeds, thus demonstrating a transition toward the "Integrated Services" stage (e-Gov 3.0).

6. Study Limitations

While this study provides valuable insights into the e-governance capabilities of Romanian municipalities, several limitations must be considered when interpreting the results:

- Nature of the data: This study's national scope makes replication difficult. Moreover, despite querying all Romanian municipalities at the same time, with the same tools and indicators, thereby controlling for potential intervening and confounding factors and reducing the risk of endogeneity, this limitation still exists;
- Temporal validity: Given the dynamic nature of online content, the data collected may not fully represent the current state of municipal websites, especially following administrative changes in June 2024 (Biroul Electoral Central [BEC], 2024). This limitation is common in digital research and reflects the inherent velocity of web-based environments;

- Inability to make international comparisons: comparing the results of this study with those from other countries may be inaccurate due to differences in economies, policies, approaches, and general conditions that influence the pace of digitalization;
- Limited indicators: This study relied on specific indicators to assess e-governance capacity, which may not capture all aspects of the local public administration's capabilities. The use of additional or alternative indicators and/or sources of data could potentially yield different results;
- Cross-sectional data: This study is based on a snapshot of data at a specific point in time, which may not reflect changes in e-governance capacity over time. Longitudinal data would provide a more precise depiction of the associations between the variables under investigation.
- Potential for measurement error: The process of collecting data for some indicators and assigning scores may be subject to human error or biases. Subjective interpretation was necessary in class C5 (generalities). However, a standardized rubric was applied to maintain scoring consistency.
- Primary focus on assessing online engagement: This focus may not capture the full spectrum of interactions and communication channels between citizens and government bodies. Additionally, the research may not account for potential barriers to online engagement, such as digital literacy, internet access, or the effectiveness of the digital tools provided by the institutions. Consequently, the findings might not fully reflect the overall engagement and interaction between citizens and their local governments.
- The study primarily focuses on the availability and structural readiness of digital services, rather than their actual usage (adoption rates) or effectiveness (e.g., reduced administrative burden or improved citizen satisfaction). While this provides a useful proxy for evaluating municipal digital maturity, it does not capture the full spectrum of digital service performance. This limitation arises largely from the absence of publicly available usage data or citizen feedback analytics on municipal platforms. Consequently, while this study can assess how well-prepared municipalities are in offering digital services, it cannot evaluate how those services are being received or utilized. We have therefore chosen to interpret "digital maturity" in this study as digital infrastructure maturity, focusing on the supply side of e-government. Future research will aim to complement this structural analysis with demand-side indicators, including platform usage metrics, citizen satisfaction surveys, and administrative efficiency improvements.
- The present analyses primarily evaluate municipal website features as a proxy for e-government maturity, focusing on the availability of online services, transparency, and digital engagement, and this study is not focusing on interoperability and citizens' usage.

By addressing these limitations in future research, a more comprehensive understanding of the relationship between city population size and e-governance capabilities can be achieved.

7. Findings

The concepts of smart cities and e-government 3.0 represent the forefront of leveraging advanced technologies to enhance urban living, governance, and public services. From the perspective of municipal web pages, these trends manifest through the implementation of various digital tools, solutions, and strategies that facilitate communication between citizens and local governments and streamline the delivery of public services.

- Enhanced user experience: municipal web pages should prioritize a user-centric design, ensuring easy navigation, engaging content, and an intuitive interface that encourages citizen participation in governance processes and access to online services.
- Integrated services: E-government 3.0 envisions the seamless integration of public services across different departments and agencies, enabling citizens to access services more efficiently. Municipal web pages can serve as one-stop portals, linking various departments and offering access to multiple services from a single platform.
- Data-driven decision-making: Smart cities use data to enhance decision-making and optimize resource allocation. Municipal web pages can incorporate data analytics tools and dashboards that provide insights into urban trends, patterns, and challenges, enabling local governments to make informed decisions and formulate targeted policies.
- Open data and transparency: E-government 3.0 emphasizes governance transparency and openness. Municipal web pages can function as platforms for sharing open data, budget information, and legislative updates, promoting accountability and encouraging citizen involvement in the decision-making process.
- Digital participation and collaboration: Municipal web pages can facilitate digital participation by offering online voting, electronic referendums, and public consultations. This enables citizens to directly influence governance and fosters a sense of ownership and responsibility within the community.
- Based on Layne and Lee's (2001) four-stage model, our findings indicate that most Romanian municipalities are in the "Transactional" stage (e-Gov 2.0), with some larger cities transitioning toward "Integrated Services" (e-Gov 3.0). However, smaller municipalities remain in earlier stages (web presence and interactional services).
- While this study frequently references the transition toward e-Gov 3.0 and the potential integration of AI into public services, we must clarify that no AI-specific indicators were included in this year's analysis. Despite actively investigating municipal websites and communications for evidence of AI deployment (e.g., chatbots, automated workflows, or decision support systems), we found only isolated and exploratory cases. These early implementations were either not operational at the time of evaluation or lacked sufficient scale or relevance to include in a structured framework. As such, their exclusion was based on empirical insufficiency rather than conceptual oversight. However, we anticipate that AI adoption at the municipal level will follow a trajectory similar to social media integration, that is, initially sparse and fragmented but increasingly normalized. Given the longitudinal nature of our research, we plan to revisit this analysis annually and will introduce AI-specific indicators when appropriate, thereby strengthening the link between Romania's digital infrastructure and the broader e-Gov 3.0 paradigm.

The optimism associated with smart cities and e-government 3.0 can be seen in municipal web pages by adopting advanced technologies, user-centric designs, and innovative solutions that enhance citizen engagement, promote transparency, and streamline public services.

8. Discussions and Conclusions

This article examines the state of digitalization in Romania through an analysis of municipal websites. Viewing the evolution of e-government as a pyramidal structure over time, it can be argued that the information and communication technology (ICT) sector is progressively advancing towards maturity. This advancement sets the stage for the forthcoming e-government 3.0, which is marked by the broader integration of artificial intelligence (AI) tools in government operations. The adoption of AI is expected to streamline and enhance various processes, thereby contributing to the overall development

of the e-government landscape by reducing administrative burdens, enhance public sector transparency, and increase service personalization, thereby improving citizens' trust in institutions. The methodological contribution of this study is twofold:

- Municipality-Level Digitalization Assessment: unlike previous studies that focus on national or regional digital governance trends, this research evaluates digital services at the municipal level, providing a more granular and actionable perspective for policymakers.
- Comprehensive E-Service Evaluation: By employing a five-category framework, this study bridges the gap between theoretical e-governance maturity models and real-world municipal service evaluations (Table 7). This allows for a more precise benchmarking of Romanian municipalities and offers policy recommendations tailored to the local context.

Table 7. Comparison of measurement models for e-services.

Framework	Scope	Key Indicators	Limitations
Layne and Lee's (2001) Model	National and Theoretical	Stages: informational, transactional, and integrated	Focuses on national trends and lacks citizen interaction indicators
UN E-Government Index (EGDI)	Global and Benchmarking	Online services, infrastructure, and human capital	Aggregates national data and does not assess municipal variation
Holzer Model (2016)	Digital Governance Evaluation	Privacy, usability, content, services, and engagement	Less emphasis on automation and AI-based services
This Study's Model (2025)	Municipality-Level Evaluation	Transparency, e-documents, communication, practical content, and generalities	Tailored to Romanian municipalities and lacks AI-specific indicators

Data source: adapted from Layne and Lee's model, EGDI, and Holzer.

Research conducted in other countries often includes a broader range of indicators, such as online payments (Holzer & Manoharan, 2016; Homburg & Dijkshoorn, 2011; Gonzalez et al., 2007), citizen participation in governance through electronic voting or referendums (Tapscott, 2008; Chaieb et al., 2018), and online surveys to gather public opinions on potential city hall actions (Holzer & Manoharan, 2016; Homburg & Dijkshoorn, 2011).

A significant correlation is observed between the outcomes from each analytical category and the overall result (Table 8). However, this study aimed to identify which aspect had the most substantial impact on the final outcomes. Before applying Pearson correlation, we conducted visual inspections through scatterplots to assess the linearity of relationships between each analytical category and the final score. The data exhibited moderately linear patterns across most variables. Additionally, we verified the absence of significant outliers that could have distorted the results. These preliminary checks support the appropriateness of using Pearson correlation for this analysis. The 'Generalities' category exhibited the lowest correlation at 0.295, primarily because websites are often developed in-house by non-professionals, leading to the omission of many crucial features.

Based on the findings of this study, Romanian municipalities are progressing toward e-Gov 3.0 but remain in an early developmental stage. The widespread adoption of digital tools, such as e-petitioning, online tax payments, and social media integration, demonstrates an increasing commitment to citizen engagement. However, AI-enabled services, chatbots, and predictive analytics are still absent from most municipal platforms, indicating that Romanian municipalities are primarily operating at the advanced e-Gov 2.0 stage rather

than fully transitioning to e-Gov 3.0, which demonstrates that while Romania has made significant strides in digital governance, full integration into the e-Gov 3.0 model requires further investment in AI, data interoperability, and automation.

Table 8. Correlation between the final result and the classes of analysis.

Class Analyzed	Pearson Correlation with the Final Results (Cj and Ms)
Transparency	0.740
E-Documents	0.845
Communication	0.543
Useful content	0.842
Generalities	0.295

Data source: authors' own compiled data.

While this study primarily focuses on the technical and operational aspects of digital services, the economic and social effects of digitalization should also be acknowledged. These effects align with OECD's research on e-government's role in economic development (OECD, 2022, 2024) and are evident in three key areas:

- Local Economic Growth: digital transformation optimizes administrative processes, reducing bureaucratic burdens for businesses and residents.
- Employment and workforce implications: the transition to e-government 3.0 introduces both efficiencies and challenges in the public sector workforce.
- Digital inclusion and social equity: despite improvements in online municipal services, the digital divide remains a concern in Romania.

After reviewing the present study, one can observe the need for standardized digital service guidelines. The government should implement a national standard for municipal digital services to reduce disparities between cities, while the municipal staff should receive professional training on website development, usability, and citizen engagement strategies. Nevertheless, national and EU funds should prioritize digitization projects in weaker regions (northeast and south) to reduce the digital divide.

This study provides a foundation, but further research is needed to capture the full spectrum of e-government maturity. To complement this research, future studies will incorporate user-centered evaluation methods such as user adoption and satisfaction metrics (through sentiment analysis on citizens feedback) and impact assessments by comparing municipalities with strong vs. weak e-government maturity to see if digitalization reduces administrative burdens and higher digitalization correlates with increased public trust and participation in local governance.

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similarities in methodology, wording, or structure are due to the adherence to a specific research design and format that has been consistently applied throughout this series to maintain coherence, comparability, and/or comparison.

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