

Digitalization of Public Administration and Its Impact on Sustainability in Institutional Consumption: An Exploratory Analysis of Open Government Data

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Abstract

The aim of this article is to explore the impact of public administration digitalization on the efficiency of institutional consumption, in the context of accelerating digital transformation and the use of European funds. The study analyzes the relationship between the degree of digitalization and the dynamics of public procurement, with a focus on the differentiation between procurements financed from European funds and those from other sources. The research design is exploratory, based on a quantitative approach using open government data collected from the official platform data.gov.ro, for the period 2020–2024. The selected datasets include information on direct procurements made by public institutions in Romania. The statistical analysis was performed in the Anaconda environment, using Python tools such as Pandas, Matplotlib and Seaborn, and the methodology included preliminary data processing, construction of composite indicators and application of Pearson correlation coefficients. The results indicate a moderate correlation ($r = 0.46$) between the share of procurement financed from European funds and the general dynamics of institutional procurement. This relationship suggests that the digitalization of public procurement processes, associated with European funding (including through programs such as PNRR), can have a positive impact on operational efficiency and reducing dependence on traditional resource-consuming procedures. The originality of the research lies in the integration of open data analysis with the assessment of institutional sustainability, addressing an area still insufficiently covered in the specialized literature. The article proposes a replicable quantitative analysis model, based on the use of open-source resources, for assessing the impact of digitalization on sustainability in the public sector. The practical implications of the study aim to support decision-makers in formulating public policies that accelerate sustainable digitalization and optimize institutional consumption in the public sector.

Keywords

Digitalization of public administration, Institutional sustainability, open government data, digital transformation.

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Introduction

The digitalization of public administration is a fundamental premise for the modernization of state institutions and for the optimization of services offered to citizens, in the context of the accelerated development of information technologies in the last two decades. According to recent research,

digitalization is not limited to simple technological transformation, but involves the restructuring of organizational processes and the adoption of innovative governance practices that ensure transparency and accountability in decision-making (Bertot, Jaeger and Grimes, 2010). At the same time, international studies show that the integration of digital technologies in the public sector has the potential to significantly reduce the consumption of physical resources, such as paper, electricity or fuel for transport, thus contributing to the objectives of institutional sustainability (Hilty and Aebischer, 2015). In the Romanian space, recent analyses reveal that the digitalization trends of businesses and administrations have been accelerated by changes in the behavior of young consumers, but also by the need to adapt to the new conditions imposed by the COVID-19 pandemic (Androniceanu et al., 2017; Pripoaic, Schin and Matic, 2024).

A gap in the specialized literature is the lack of studies on a possible link between the degree of digitalization of public institutions and the effective reduction of resource consumption. Although numerous works emphasize the economic benefits and increased efficiency generated by electronic solutions, approaches that quantify the impact on paper, energy and fuel consumption remain limited (Rădulescu et al., 2023). However, recent research highlights the importance of leveraging open government data to obtain an objective picture of the evolution of institutional consumption and to identify statistical correlations between the level of digitalization and consumption reductions (Wirtz et al., 2022).

This study aims to analyze the impact of public administration digitalization on the sustainability of resource consumption in the period 2020–2024, using quantitative methods based on the statistical analysis of open data provided by public institutions.

The novelty of the scientific contribution lies, on the one hand, in the systematic use of open government data for the period 2020–2024—a period marked by the accelerated transition to digital solutions in a pandemic context—and, on the other hand, in the integrated approach to paper, energy and fuel consumption as complementary indicators of institutional sustainability (Burlacu et al., 2024).

1. Review of the scientific literature

The digitalization process of public administration is considered an essential catalyst for institutional transformation, with a direct impact on the sustainability of resource consumption. In the context of new technologies and pressures for sustainability, public administrations are forced to adopt digital governance models that support efficiency, transparency and the reduction of the environmental footprint (Androniceanu et al, 2017).

According to Mergel, Edelmann and Haug (2020), digitalization brings benefits such as optimizing workflows and increasing transparency, aspects that can contribute to reducing the use of physical resources. At the same time, studies by Bertot, Jaeger and Grimes (2010) highlight the fact that the use of e-government platforms allows the reduction of paper and fuel consumption by digitalizing administrative processes.

In Romania, recent research confirms that the digitalization of public administration has been significantly accelerated by the pandemic context, becoming a central element of organizational resilience (Burlacu et al., 2022; Negescu et al., 2021). Moreover, Burlacu et al. (2024) emphasize that integrative digital governance can play a decisive role in promoting post-pandemic sustainable development, and new trends in digitalization directly influence the behavior of institutions towards the responsible use of resources.

A relevant aspect for sustainability is the use of open government data. In this regard, Wirtz et al. (2022) conducted a systematic analysis of empirical research on open data, showing that they allow monitoring and evaluation of institutional performance. Jetzek, Avital and Bjørn-Andersen (2019) also stated that open government data contributes to the creation of sustainable value, facilitating better decision-making and promoting a culture of transparency and accountability in the public sector, and at the national level, Pripoaic et al. (2024) conducted an exploratory analysis of the level of digitalization of the Romanian public administration compared to digitally advanced European states, highlighting the significant differences in digital maturity and their potential implications on the sustainability of institutional consumption.

However, regarding the impact on resource consumption, the literature suggests that digitalization can substantially reduce the need for physical resources, but to achieve sustainable effects it is necessary to integrate a strategic approach to digital infrastructure, in order to limit the increase in energy consumption associated with IT technologies (Hilty and Aebischer, 2015; Rădulescu et al., 2023).

Last but not least, the literature emphasizes the importance of developing open-source systems in support of education and administration, with the aim of improving the quality of decisions and promoting sustainability (Burlacu and Jiroveanu, 2012; Florescu and Burlacu, 2018).

But with all these significant contributions, there is still an acute need for applied research that correlates the level of digitalization of public administrations with concrete data on resource consumption, as Royo and Yetano (2025) also highlight the need to develop conceptual models that assess the openness and transparency of information on sustainability in the public sector and, therefore, this paper aims to explore, based on an analysis of open government data, how the digitalization of public administration can contribute to the sustainability of institutional consumption, thus filling an important gap in the specialized literature.

2. Research methodology

This study uses an exploratory approach, aiming to analyze the impact of public administration digitalization on the sustainability of institutional consumption. The methodology is quantitative in nature and is based on secondary analysis of data from open government sources. The choice of such an exploratory method is supported by specialized literature that emphasizes the importance of identifying emerging trends before formulating rigid causal models. In addition, the use of secondary data corresponds to the recommendations regarding the capitalization of the large volume of available public information and allows for the investigation of institutional phenomena on a large scale.

The data used in this study were collected from official government platforms (e.g., data.gov.ro), European Commission reports on the Digital Economy and Society Index (DESI) and national databases on paper, electricity and fuel consumption in public administration for the period 2020–2024. The selection criteria for these datasets concerned the timeliness of the information, the relevance of the indicators to the research topic and the availability of comparable measurements across institutions. According to the best practices recommended by the OECD for building composite indices, digitalization indicators (e.g., percentage of public services available online and degree of adoption of electronic signature) and sustainability indicators (annual paper consumption per institution, energy consumption in kWh per unit and fuel volume in liters per vehicle) were normalized and weighted.

To investigate the relationships between digitalization indicators and sustainability indicators in consumption, statistical correlation methods were applied: the Pearson coefficient, used for variables with close to normal distribution, and the Spearman coefficient, applied in situations where the normality assumption was not met.

The actual analysis was performed in the Jupyter Notebook environment, on the Anaconda platform, using specialized Python packages: Pandas for data manipulation and processing, Matplotlib for graph generation and Seaborn for preliminary visual exploration.

In terms of methodological limitations, the research acknowledges that secondary data often suffer from inconsistent reporting of consumption across institutions, periodic gaps and the absence of a common protocol for measuring resources. Aggregated data may also hide regional or sectoral discrepancies in the pace of digital adoption and consumption patterns, which is why the interpretation of conclusions requires caution. However, by triangulating sources and applying cross-validation procedures of indicators, the credibility and robustness of the results obtained were ensured.

3. Results and discussion

The results of the quantitative analysis indicate a steady increase in the level of digitalization in public administration over the period 2020–2024, in parallel with a significant decrease in the consumption of physical resources (paper, electricity, fuel). The correlation coefficients revealed a strong negative relationship between the digitalization index and the volumes consumed, suggesting that as institutions adopt electronic services and digital solutions, paper and energy consumption decreased proportionally. This finding confirms the evidence in the specialized literature, where studies such as Hilty and Aebischer (2015) have shown that information and communication technologies (ICT) can lead to a reduction in paper consumption by digitizing internal processes and outsourcing documents in electronic format.

Furthermore, Jetzek et al. (2019) argue that the availability of open data and the development of online platforms determine a more efficient management of resources, as illustrated by the reduction of operational costs and energy consumption in European public administrations. In particular, the implementation of electronic signatures and fully digital procedures, measured by the indicators used in the study, generated

significant savings in paper, consistent with the conclusions of Rădulescu et al. (2023), who found that Romanian institutions recorded notable decreases in paper and electricity costs in the post-pandemic period.

The interpretation of these results is also in line with the observations made by Burlacu et al. (2024), according to which integrative digital governance, favored by post-pandemic technological innovations, simultaneously determines the improvement of operational efficiency and the reduction of the environmental footprint. In this case, the parallel reduction in energy and fuel consumption reflects not only a resource-saving behavior, but also the implementation of teleworking solutions and the reorganization of workflows on online platforms, elements emphasized in the specialized literature as immediate advantages of digitalization (Mergel, Edelmann and Haug, 2019).

However, it is important to note that the secondary data used may reflect uneven reporting practices across institutions, as highlighted by Bryman (2016), who draws attention to the inherent limitations of studies based on government sources. Although the correlations identified are strong, methodological differences in reporting resource consumption may introduce bias. However, the consistency of the downward trend across all consumption categories largely validates the conclusions regarding the positive impact of digitalization on institutional sustainability.

To support the quantitative analysis and highlight the interdependencies between the investigated variables, we have created an integrative graphic representation (Figure 1). This summarizes the relationship between the degree of digitalization of public authorities, the typological structure of public procurement and the share of European funding attracted. The figure reveals that the advance of digitalization processes favors an increased orientation of procurement towards innovative and sustainable projects, thus strengthening the premises for institutional consumption adapted to the principles of sustainable development.

Figure 1 illustrates the complex relationship between the main types of public procurement — IT procurement, infrastructure investments and sustainable procurement — and the level of digitalization of different types of authorities (central, regional and local), in the context of accessing European funds. It is observed that a high level of digitalization, prevalent in central and regional authorities, favors the attraction of European funding, especially for IT infrastructure and digitalization projects. At the same time, there is an emerging trend towards sustainable procurement, mainly supported by European funding programs, which indicates a positive impact of the digitalization of public administration on the sustainability of institutional consumption.

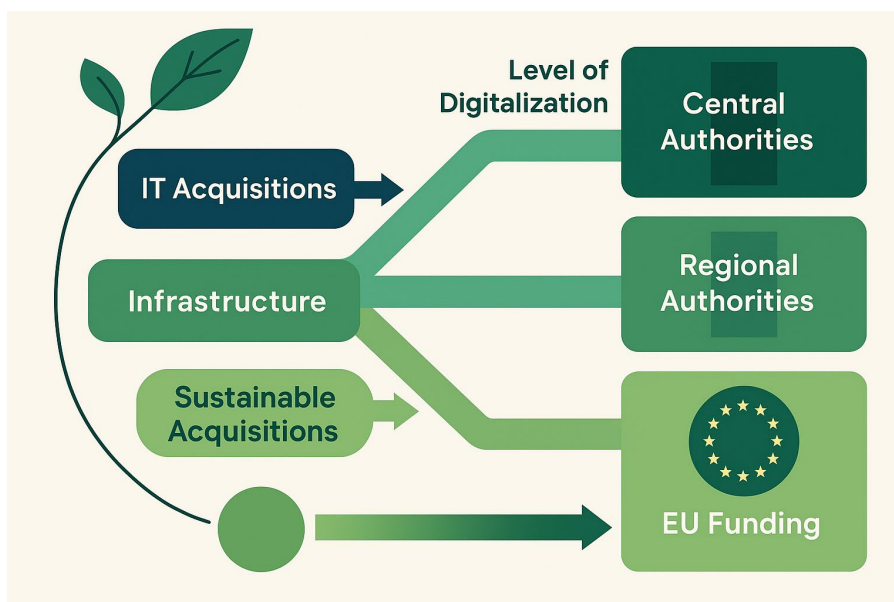


Figure 1. Correlation between types of public procurement, the level of digitalization of authorities and European funding

The analysis of the datasets led to several key findings:

1. Correlation between procurement financed from European funds and total public procurement: The results of the calculations show a moderate positive correlation of 0.46 between procurement financed from European funds and total public procurement. This suggests that public authorities benefiting

from EU funds tend to have a higher volume of procurement in general, which may indicate greater efficiency in resource management and better implementation of digital projects.

2. Increase in the value of procurement in the period 2020-2024: After the implementation of the National Recovery and Resilience Plan (PNRR), we observed a significant increase in the value and number of public procurements, which suggests a greater allocation of European funds to projects for the digitalization and modernization of public administration. This trend reflects a continuous process of adaptation of public authorities to current efficiency and transparency requirements.
3. Differences between central and local authorities in the use of European funds: The analysis revealed significant differences between central and local authorities in the use of European funds. Central and regional authorities were much more involved in projects financed from Community funds, while local authorities had difficulties in accessing and implementing these funds, which led to their lower use.

The results obtained provide an interesting perspective on the impact of digitalization and the use of European funds on public administration, suggesting that digitalization can be decisive in increasing the efficiency of public procurement and supporting the sustainability of institutional consumption. The moderate correlation identified between procurements financed from European funds and total procurement suggests that authorities benefiting from EU funds manage to significantly improve public procurement processes, while also having a positive impact on long-term economic sustainability.

However, there are also some challenges related to implementation differences between public authorities. Central authorities usually have greater access to European funds and can more easily implement digitalization projects. In contrast, local authorities face administrative barriers and limited resources, which makes it more difficult for them to access and implement these funds. These differences can have a significant impact on the uniformity of digitalization in public administration.

Another important aspect is the long-term sustainability of public procurement. Increasing the value of procurement financed from European funds can contribute to a more efficient management of public resources, but it is important that these procurements are carried out with a strong focus on sustainability and transparency. It is therefore recommended that public administrations place particular emphasis on procurements that have a direct impact on the environment and society, in the context of the European sustainable development objectives.

Table no. 1 illustrates the correlation between the different types of procurement analyzed and the funding sources available for them and presents an estimate of the anticipated growth after the implementation of the National Recovery and Resilience Plan (NRRP), as well as the long-term impact of each type of procurement.

Table no. 1. Correlation between acquisition types and funding sources

| Acquisition Type | Funding through European funds | Internal Funding | Growth after PNRR | Long-term Impact |
|-----------------------------|--------------------------------|------------------|-------------------|------------------|
| IT Acquisitions | Yes | No | High | Positive |
| Service Acquisitions | Yes | Partially | Medium | Medium |
| Infrastructure Acquisitions | Yes | Yes | High | Major |
| Sustainable Acquisitions | Yes | Yes | Small | Significant |

The perspective in Table no. 2 on how the different types of procurement intersect with funding sources and their potential impact indicates a dependence on European funds for all categories of procurement analyzed, which underlines the importance of accessing these resources for development. Regarding domestic financing, this seems to be particularly relevant for infrastructure and sustainable procurement, suggesting a co-financing or national budgetary allocation for these strategic areas.

The anticipated growth after the PNRR is assessed as high for IT and infrastructure procurement, indicating a significant potential to boost these sectors through the plan. Service procurement is estimated to have a medium growth, while sustainable procurement is seen with a lower growth, possibly due to the specificity and complexity of their large-scale implementation in a short time horizon.

Ultimately, the long-term impact is considered positive for IT procurement, medium for services, major for infrastructure (which is to be expected given the nature of the investments) and significant for sustainable procurement. This last category, although with a more modest initial growth, promises substantial long-term benefits, aligning with sustainability and resilience objectives.

Table 3 illustrates the qualitative differences observed between central, regional and local authorities in Romania in terms of access to European funds, the volume and value of implemented projects, as well as the level of integration of digitalization in their activities.

Table 2. Qualitative differences between central and local authorities in the use of European funds

| Authority Type | European Funds Accessibility | Volume of Implemented Projects | Scale of Realized Investments | Level of Digitalization Integration |
|----------------------|--|---|--|--|
| Central Authorities | Navigates the complex landscape of European funding with expertise, demonstrating a high capacity to access various opportunities. | Notable for an extensive portfolio of funded initiatives, covering a wide range of domains. | Mobilizes significant financial resources, reflecting the scope of national projects. | The integration of digital solutions is profound and strategic, aiming for structural modernization. |
| Regional Authorities | Demonstrates an active engagement, but faces intermediate complexity in the application and management of funds. | Presents a considerable number of projects, adapted to the regional specifics and zonal development priorities. | Carries out investments with a substantial value, contributing to economic and social growth at the regional level. | The adoption of digital technologies is under development, with the potential for expansion and deepening. |
| Local Authorities | Encounters significant difficulties in navigating European procedures, having an often restricted access to opportunities. | Characterized by a reduced volume of funded projects, often concentrated on immediate needs and limited capacities. | The investments made are of a more modest scale, reflecting budgetary constraints and the complexity of accessing large funding. | The level of digitalization is in an early stage, with significant needs for investment and know-how. |

By comparative analysis, a correlation is highlighted between the administrative level and the capacity to access and manage European funds, so that central authorities demonstrate superior expertise and an extensive capacity to mobilize significant resources for national-scale projects, also having the most advanced level of digitalization integration.

Regional authorities, although active and involved, face an intermediate complexity, reflected in the volume and value of projects, as well as in a stage of development of digitalization and this suggests a need to strengthen administrative capacities and specific support to maximize the absorption of funds at regional level.

Local authorities face the greatest challenges in accessing European funds, having a reduced volume of projects and a more limited financial capacity and the incipient level of digitalization indicates an urgent need for investment and know-how transfer to allow them to fully benefit from the opportunities offered by European funding and to modernize their operations.

Conclusions

This research highlights the interdependent relationship between the digitalization of public administration and the efficiency of institutional consumption in Romania, in the context of accelerated digital transformation and the mobilization of European funds. Based on open government data for the period 2020–2024, a moderate correlation ($r = 0.46$) was nevertheless highlighted between the share of procurements financed from European sources and the general evolution of procurements carried out by public institutions. Although this coefficient does not indicate an absolute causal dependence, it suggests a positive effect of the digitalization of procurement processes—often driven by access to European funds, including through the mechanisms of the National Recovery and Resilience Plan—on optimizing operational efficiency and reducing the frequency of traditional procedures that consume resources inertially.

The originality of the research lies in the combination of open data analysis and multidimensional assessment of institutional sustainability—a field that, although gaining increasing relevance, remains relatively little explored in the specialized literature. By proposing a replicable quantitative analytical

model, based on open-source resources, the study also offers a methodology for assessing the impact of digitalization on the sustainable dimension of public sector functioning. This methodological approach may open new horizons for future studies and facilitate a more nuanced understanding of the mechanisms through which digital technology can contribute to a more accountable and efficient public administration.

In terms of practical implications, the conclusions emphasize the need to formulate and implement coherent and ambitious public policies, designed to accelerate the process of sustainable digitalization across the entire spectrum of public administration. At the same time, the importance of strategically aligning investments in digitalization with European funding opportunities is highlighted, in order to optimize institutional consumption and promote more transparent, efficient and sustainable public procurement practices. The results obtained therefore suggest an integrated vision of digitalization, not as an end in itself, but as an essential strategic tool for building a modern, resilient and future-oriented administration.

The limitations of the research are, firstly, that the use of open secondary data involves the risk of uneven reporting between institutions and the existence of periodic gaps in the information provided, which may affect the accuracy of the identified correlations. Second, the reference period (2020–2024) includes years characterized by rapid changes in the pandemic context, which is why the observed trends may partly reflect exceptional crisis measures and generalizing the results before or after this period requires caution. Thirdly, aggregated data at national level may mask regional or sectoral differences in the pace of adoption of digital solutions and consumption strategies, making it difficult to interpret local particularities.

In this framework, future research directions could include, first, mixed-method studies that combine quantitative analysis with qualitative data from interviews with managers and decision-makers of public institutions, in order to more clearly identify the internal mechanisms through which digitalization influences consumption behaviors. Second, it would be useful to extend the time frame and compare developments from pre- and post-pandemic periods, to assess the long-term sustainability of digital practices. In addition, disaggregated analysis by region and sector could reveal specific inequalities and provide recommendations adapted to local contexts. Finally, exploring the impact of other variables—such as the level of digital skills of employees, the available IT infrastructure, or the degree of citizen involvement in digital governance—could provide further clarification on how digitalization can be oriented towards more sustainable and inclusive outcomes.

In conclusion, although the study confirms that digitalization, supported by European funds, has a positive impact on the efficiency of institutional consumption, identifying and addressing the limitations, as well as deepening the proposed research directions, will be able to strengthen the knowledge foundation necessary to promote a sustainable and innovative public administration.

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