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Article

# The impact of digital infrastructure expenditure on accounting information in the Public Sector

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This study analyzed the relationship between digital infrastructure expenditures and the quality of accounting information in municipalities of the state of São Paulo, Brazil. The research adopted a quantitative approach, applying linear regression models to data from 644 municipalities over the period 2019-2023. Variables representing information technology (ICT) expenditure were employed, alongside indicators of accounting information quality from the ranking of the Brazilian National Treasury Secretariat (STN) and transparency indicators based on the index produced by the Federal Council of Administration (CFA). The findings indicate a positive association between higher investment in digital infrastructure and improved quality and transparency in accounting information, suggesting that technological modernization contributes to strengthening public governance. The conclusions reinforce the need for strategic planning in ICT investments and recommend that entities such as the National Treasury, the Federal Accounting Council (CFC), and the Courts of Accounts should consider both the costs and adequacy of digital infrastructure in standard-setting, oversight, and management processes.

**Keywords:** digital infrastructure; quality of accounting information; transparency; information technology; integrated financial management systems.

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**O impacto dos gastos com infraestrutura digital na qualidade e transparência da informação contábil no setor público**

Este estudo analisou a relação entre os gastos com infraestrutura digital, a qualidade e a transparência da informação contábil em municípios paulistas. A pesquisa adotou uma abordagem quantitativa com aplicação de modelos de regressão linear, utilizando dados de 644 municípios do estado de São Paulo no período de 2019 a 2023. Foram utilizadas variáveis representativas dos gastos com Tecnologia da Informação (TI), bem como indicadores de qualidade da informação contábil, extraídos do ranking da Secretaria do Tesouro Nacional (STN), e de transparência, com base no índice do Conselho Federal de Administração (CFA). Os resultados indicam uma relação positiva entre maiores investimentos em infraestrutura digital e melhores níveis de qualidade e transparência das informações contábeis, sugerindo que a modernização tecnológica contribui para o fortalecimento da governança pública. As conclusões reforçam a necessidade de planejamento estratégico nos investimentos em TI e implicam recomendações para que órgãos como a STN, o CFC e os Tribunais de Contas considerem os custos e a adequação da infraestrutura digital nos processos de normatização, fiscalização e gestão.
**Palavras-chave:** infraestrutura digital; qualidade da informação contábil; transparência; tecnologia da informação; sistemas integrados de gestão financeira.

**El impacto de los gastos en infraestructura digital sobre la calidad y transparencia de la información contable del sector público**

Este estudio analizó la relación entre el gasto en infraestructura digital y la calidad transparencia de la información contable en los municipios del estado de São Paulo, Brasil. La investigación adoptó un enfoque cuantitativo, aplicando modelos de regresión lineal a datos de 644 municipios durante el período 2019-2023. Se emplearon variables representativas del gasto en tecnología de la información (TI), junto con indicadores de calidad de la información contable obtenidos del ranking de la Secretaría del Tesoro Nacional, e indicadores de transparencia basados en el índice elaborado por el Consejo Federal de Administración. Los resultados evidencian una asociación positiva entre mayores inversiones en infraestructura digital y mejores niveles de calidad y transparencia de la información contable, lo que sugiere que la modernización tecnológica contribuye al fortalecimiento de la gobernanza pública. Las conclusiones refuerzan la necesidad de una planificación estratégica en las inversiones en TI y conllevan recomendaciones para que organismos como la Secretaría del Tesoro Nacional, el Consejo Federal de Contabilidad y los tribunales de cuentas consideren tanto los costos como la adecuación de la infraestructura digital en los procesos de normalización, fiscalización y gestión.
**Palabras clave:** infraestructura digital; calidad de la información contable; transparencia; tecnología de la información; sistemas integrados de gestión financiera.

## 1. INTRODUCTION

The Brazilian public administration has experienced multiple independent reforms aimed at increasing transparency, strengthening accountability, enhancing public accounting, and transitioning toward results-oriented budgeting. A common feature of these reforms is the growing reliance on integrated financial management systems to gather and process information, due to the complexity and large volume of data involved in public management processes (Azevedo et al., 2020a; Lima & Lima, 2019). The literature generally views digital infrastructure positively, highlighting its benefits and assuming that it plays a necessary and important role in the modernization of public financial management (Cuadrado-Ballesteros et al., 2021; Uña & Pimenta, 2016).

However, technological advances also generate challenges. Among the most prominent are accountability overload, which arises from the continuous expansion of accountability requirements imposed by external stakeholders such as the National Treasury and the courts of accounts (Aquino & Batley, 2022; Aquino et al., 2022b; Lino et al., 2022), and symbolic transparency, whereby data are widely disclosed but offer limited practical utility for social accountability (Michener, 2015). Both phenomena directly affect the accounting function and increase the costs associated with system maintenance, updates, and staff training. Estimates from the National Treasury indicate that, in the

2023 fiscal year alone, municipalities in the state of São Paulo allocated more than BRL 900 million to digital infrastructure expenditures, an amount that competes with essential preventive health and sanitation programs (Secretaria do Tesouro Nacional [STN], 2023).

Previous studies have largely focused on normative aspects or implementation challenges, without systematically measuring costs and outcomes incurred (Lima & Lima, 2019). This gap is evident, for instance, in the scarcity of research comparing how variations in information technology (IT) expenditure simultaneously affect transparency indicators and the quality of accounting information. Because the adoption of digital technologies entails licensing, infrastructure, and workforce training costs, understanding the cost–benefit relationship of these investments is fiscally and managerially relevant, particularly given the budgetary constraints faced by local governments.

The pronounced heterogeneity among municipalities in São Paulo, as reflected in different levels of per capita IT expenditure, offers a useful setting for studying how institutional environments affect the ability to produce more transparent and trustworthy accounting information. The lack of strong empirical evidence about the effects of these investments creates uncertainty about their success, which makes it harder to prioritize public policies (Aquino et al., 2022a).

The ongoing development of integrated financial management systems (SIAFICS) and those used by external oversight bodies has led to a significant increase in compliance requirements, impacting both local governments and courts of accounts (Aquino et al., 2022a; Lino et al., 2022). Although expanding digital infrastructure is essential for enhancing public management, it involves high costs that must be considered in decision-making (Azevedo et al., 2020a, 2020b). However, high spending and investment do not always result in meaningful improvements in the quality of accounting information (Sousa, 2022).

Furthermore, the quality of accounting information in the public sector is crucial for economic growth and societal trust, as it allows oversight bodies, citizens, and investors to monitor the proper use of public resources. For information to be considered high quality, it must meet the criteria outlined in the Conceptual Framework of the Brazilian Accounting Standards Applied to the Public Sector (NBC TSP) (Conselho Federal de Contabilidade [CFC], 2016; Lima et al., 2024; Martins et al., 2014), and its usefulness is improved when qualitative enhancing characteristics are present (Araújo & Callado, 2020; Chen et al., 2010).

The absence of studies that measure actual costs and assess the effective impact of digital infrastructure on transparency and the quality of accounting information highlights a significant gap in both the literature and public management practice, an area that remains underexplored (Cohen et al., 2007; Lino et al., 2022; Uña & Pimenta, 2016).

In light of these considerations, this study aims to investigate whether municipal IT expenditure is associated with greater transparency and improved accounting information quality in municipal governments in the state of São Paulo. To address this question, we analyze a panel of 644 municipalities from 2019 to 2023, excluding the state capital, using descriptive statistics, k-means clustering, and ordinary least squares (OLS) regression.

This research is relevant from three distinct perspectives. From a theoretical standpoint, it contributes to understanding how coercive, normative, and mimetic institutional pressures influence IT investment decisions, thereby extending the application of institutional theory in public sector accounting. From a practical perspective, it provides evidence to municipal managers and oversight

bodies regarding the tangible effects of digitalization. From a social perspective, it reinforces the role of high-quality accounting information in promoting social accountability and preventing mismanagement.

## 2. DIGITAL INFRASTRUCTURE IN THE PUBLIC SECTOR

The literature suggests that digital transformation influences all aspects of organizations and leads to significant changes in their processes, often emphasizing the positive outcomes. Digitization and digitalization are the initial stages of this process, representing different approaches to integrating digital technology into organizational operations and strategies (Verhoef et al., 2021). These stages are essential for advancing to a third phase, where effective digital transformation takes place, moving technology beyond mere operational support to shape management and decision-making models (Lino et al., 2022).

Digital transformation is seen as a facilitator of new governance models in the digital age and operates as a dynamic process in which digital technologies alter organizational operations, prompting strategic responses (Reis et al., 2018; Vial, 2019). This transformation extends beyond the implementation of information technologies in the public sector; it also involves the interaction between processed data and human understanding of the contexts in which the data is collected and analyzed (Twizeyimana & Andersson, 2019). The emergence of digital ecosystems has caused significant changes in organizational structures, leading organizations to adopt new organizational design models to adapt to this digital reality (Hanelt et al., 2021).

The development of digital infrastructure occurs through the implementation of isolated systems and modules, each serving different public policy areas and specific laws introduced by successive governments (Irani et al., 2023). The incorporation of systems is defined when the use of an information system becomes an intrinsic part of organizational activities. This integration can be measured either by counting the number of other systems connected to one or by evaluating how deeply it is embedded in the organization's routines (Furneaux & Wade, 2011).

System integration has been identified as a key element for ensuring the quality and security of information. However, despite its importance, it is not yet a core feature in many governments (Azevedo et al., 2025). One major obstacle to implementing an integrated financial management system is the lack of a supportive regulatory and legal framework, as well as the incompatibility of many countries' institutional environments with such recommendations (Alawattage & Azure, 2021). Another recurring issue highlighted in the literature is the low maturity of systems management, manifested by a lack of long-term planning, insufficiently qualified personnel, unrealistic implementation schedules, and unclear system ownership (Cohen et al., 2007; Guarda et al., 2015).

Technological advancement also brings relevant side effects. One of the most notable is information overload, in which the excessive volume of data makes it difficult to identify and use information that is truly relevant to decision-making (Eppler & Mengis, 2004). Additionally, the phenomenon of symbolic transparency can occur, characterized by the mass availability of data in formats that are difficult to access or out of context. This creates the illusion of transparency but does not necessarily improve social accountability or the quality of public decision-making (Michener & Bersch, 2013). Therefore, simple technological expansion does not guarantee better informational quality, and active, deliberate management of the data cycle is essential.

From an institutional theory perspective, the adoption of digital infrastructure in the Brazilian public sector can be understood as the result of three types of pressures. Coercive pressures arise from legal and regulatory requirements, such as the imposition of technological standards by courts of accounts and federal legislation (for example, Decreto nº 10.540, de 5 de novembro de 2020). Normative pressures arise from professionalization and the diffusion of best practices among professionals and organizations in the field, whereas mimetic pressures arise when governments replicate models adopted by other administrations to reduce uncertainty (DiMaggio & Powell, 1983). These pressures do not always align with a consistent management strategy and may lead to significant investments in systems that do not result in proportional improvements in informational quality.

The lack of maturity in system management causes municipal agencies to lag in technology. The literature highlights that organizations with mature IT are adopting artificial intelligence (AI) in their daily routines, as AI systems enable the automation of routine tasks, thereby accelerating service delivery, increasing efficiency, and freeing personnel for more valuable tasks. Furthermore, AI algorithms assist managers in making better-informed decisions by analyzing large volumes of data and identifying patterns that facilitate early interventions. This automation improves efficiency and reduces costs by lowering the need for manual labor in repetitive tasks (Ribeiro & Segatto, 2025).

Although the literature highlights the potential benefits of digitalization, like automation of tasks, lower operational costs, and improved decision-making, there is evidence that these benefits depend on managerial capacity, data quality, and institutional alignment (Ribeiro & Segatto, 2025). Large IT investments, without proper management and systemic integration, can result in high maintenance costs, risks of technological dependence, and interoperability issues (Irani et al., 2023).

While the benefits of technological advancements are widely recognized, they also introduce challenges related to data quality, such as inaccuracy, incompleteness, and outdated information (Batini & Scannapieco, 2016), along with considerable difficulties, including legacy data migration and the need for customization (Irani et al., 2023). These issues can lead to serious failures, including technological disasters and high correction costs. If these obstacles are not managed properly, they can negatively affect the quality of accounting information (Peres, 2007).

Networked systems allow for the exchange of information between external sources and various processes (Batini & Scannapieco, 2016). Information sharing between organizations is recognized in the public sector as enhancing information quality, decision-making, productivity, and service integration. However, these attempts often fail due to limited IT capacity, as evidenced by insufficient investment in system integration and interoperability, which hinders municipalities' ability to leverage accounting and financial data to manage public services and policies.

The literature suggests that system fragmentation can bring about data inconsistencies and increase information security risks (Azevedo et al., 2025; Margariti et al., 2022). Without interoperable and integrated systems, governments still face challenges in delivering high-value digital services, such as apps to check drug availability or issuing negative debt certificates (Azevedo et al., 2025). Often, information exchange between external sources and multiple operations is uncontrolled, which can degrade data quality (Batini & Scannapieco, 2016). Without proper integration, data may be duplicated or fail to accurately reflect financial and budgetary transactions, thereby preventing governments from fully benefiting from digital transformation (Azevedo et al., 2025; Margariti et al., 2022).

Although literature focuses on various elements of digital transformation, one aspect that is often neglected is its costs. The International Monetary Fund (IMF) warns that IT projects in governments

often face planning inconsistencies, resulting in delays and unexpected additional costs (Long & Gates, 2023).

Literature suggests an explanatory framework in which costs, especially those related to negotiating, monitoring, and enforcing contracts, are no longer merely accounting details but rather central organizational and public policy issues. Based on Coase's original proposition – as revisited by Ferrando and Lock (2023) – and on developments by Williamson (1985), it is possible to say that firms (and by analogy, local governments) choose their governance structures to minimize transaction costs. These choices are conditioned by three factors: asset specificity, uncertainty, and frequency.

Highly specific assets increase the risk of opportunistic behavior and raise control and oversight costs; therefore, governments tend to favor arrangements that reduce the risk of supplier opportunism (Brown & Potoski, 2003). Uncertainty and environmental complexity increase preventive and mitigation costs, while recurring transactions tend to lower costs through learning and standardization (Ferrando & Lock, 2023). Empirical evidence supports this: a combination of high specificity, low frequency, and high uncertainty was associated with approximately 23% higher transaction costs in operations in the state of Santa Catarina (Neuenfeld et al., 2018).

In this regard, digitalization appears as an ambivalent factor: on one hand, it is linked to improved operational cost performance and efficiency gains, including process and system rationalization; on the other hand, technological history exerts pressure on budgets due to rising maintenance and security risks, presenting a continuous challenge to modernization (Caperchione et al., 2022; Irani et al., 2023). Past investments lead to sunk costs and path dependence, which reinforce suboptimal technological and organizational choices due to lock-in effects (Furneaux & Wade, 2011).

In Brazil, the legal requirement to adopt and continuously update integrated financial management and control systems adds layers of costs for development, training, integration, and support, which do not always lead to proportional improvements in accounting information quality (Aquino & Batley, 2022; Aquino et al., 2022a; Azevedo et al., 2020b; Lino et al., 2022; Sousa, 2022). Therefore, cost is not only important; it also presents a governance challenge across technological, budgetary, and regulatory decisions.

The decision to outsource or keep services in-house highlights an important point: it is not enough to compare acquisition costs; you must also consider expenses related to selecting and accrediting suppliers, contract oversight, safeguards against opportunism, and dependency risks (Furneaux & Wade, 2011). Evidence shows that outsourcing in the public sector does not always lead to cost savings. In fact, it can sometimes raise costs due to economic failures or market conditions that increase prices and create supplier lock-in (Azevedo et al., 2020a). Furthermore, producing high-quality accounting information requires specific investments and presents challenges in accurately assessing its impact on decision-making, emphasizing the importance of ongoing cost-benefit analysis (Araújo & Callado, 2020).

In this context, transaction, operational, and informational costs are fundamental to the public management problem: they influence governance decisions, may increase even with higher investment levels, and, if not tracked and managed throughout the life cycle of contracts and systems, can weaken efficiency, informational quality, and fiscal space (Ferrando & Lock, 2023; Williamson, 1985).

Additionally, different software procurement models vary significantly in their cost structures. The free and open-source software (FOSS) model relies on the voluntary and collaborative efforts of developers who create solutions based on the needs of their primary users, promising lower costs

and less complexity (Aquino et al., 2022b). In contrast, commercial off-the-shelf (COTS) software involves costs shared among multiple users and new consumers of low-customization applications, which may help reduce expenses. Lastly, the government off-the-shelf (GOTS) model refers to in-house development, where internal teams create solutions or modify systems obtained through cooperation agreements with other government agencies (Aquino et al., 2022b).

In the Brazilian context, a relevant characteristic of municipalities is that most opt to outsource accounting software, mainly adopting the COTS model. This approach is generally seen as a way to cut costs and improve service quality, a belief often based on limited empirical evidence (Azevedo et al., 2020a; Guarda et al., 2015). For example, Azevedo et al. (2020a) report that in Minas Gerais, only four out of 853 municipalities used software developed in-house, while the rest relied on contracted solutions. The use of FOSS in accounting, on the other hand, remains relatively rare in Brazil (Aquino et al., 2022b).

It is also important to note that expenditure on information systems does not always stem from initiatives taken by municipal governments themselves, as municipalities often have to adapt to new external regulations. For example, Decree No. 10,540, of November 5, 2020, resulted in increased costs for municipalities, which had to cover expenses related to system customization, staff training, and equipment acquisition (Confederação Nacional dos Municípios [CNM], 2025). Its effect on the quality of accounting information, a subject discussed in the next section, depends not only on the amount invested but, more importantly, on how these resources are managed over time.

## 3. TRANSPARENCY AND QUALITY OF ACCOUNTING INFORMATION: DEVELOPMENT OF HYPOTHESES

Since 2008, Brazil has undertaken efforts to improve the quality of public-sector accounting information by adopting new regulations to align national accounting practices with the International Public Sector Accounting Standards (IPSAS) (Diniz et al., 2015). This process includes standardizing the chart of accounts, enhancing accounting and fiscal statements, and establishing requirements for accounting information systems (Diniz et al., 2015; International Public Sector Accounting Standards Board [IPSASB], 2019).

The implementation of IPSAS in Brazil has been substantially influenced by pressures from international organizations (Neves & Gómez-Villegas, 2020). However, the slow pace of IPSAS adoption in the country is partly attributed to the need to adapt IT systems to accommodate budgetary and patrimonial dimensions simultaneously. Moreover, the widespread use of outsourced accounting software by local governments affects implementation decisions (Bilhim et al., 2022).

Improvements in the quality of accounting information are commonly regarded as a direct consequence of IPSAS adoption, as these standards seek to align public accounting practices to enhance comparability and the quality of financial information across countries. In addition, they aim to mitigate corruption and mismanagement and to strengthen transparency (Diniz et al., 2015; Neves & Gómez-Villegas, 2020).

Nevertheless, there is a need to deepen the understanding of the factors that effectively contribute to improvements in the quality of accounting information (Sousa, 2022). Setiyawati and Doktoralina (2019) argue that accounting information quality is influenced by the implementation of Information and Communication Technology (ICT) systems. Bisogno and Donatella (2022) similarly suggest

that accounting information quality may be affected, among other variables, by transparency and compliance with IPSAS. Accounting information quality depends not only on the data itself but also on the effectiveness of the systems that generate such data, reinforcing the connection with the digital infrastructure discussed previously, since the availability of high-quality data presupposes integrated, interoperable, and well-managed systems (Thoa & Nhi, 2022).

High-quality accounting information enhances transparency and accountability in public organizations (Thoa & Nhi, 2022) and can be seen as reliable information with a clear orientation, whether budgetary or patrimonial, directly influenced by ICTs. However, simply adopting technological tools does not guarantee these qualities; skilled management, process standardization, and verification routines are necessary to ensure consistency and timeliness (Cuadrado-Ballesteros et al., 2021).

In this context, the quality of accounting information is intrinsically linked to public financial management reform and to the implementation of integrated financial administration systems (SIAFICs) (Alawattage & Azure, 2021). These systems are expected to ensure that the qualitative characteristics of accounting information are met, as such characteristics are essential for supporting decision-making and directly influence managers' capacity to make informed choices (Abdelraheem et al., 2021).

Beyond technical considerations, decisions to invest in digital infrastructure and to pursue transparency and quality can be better understood through the lens of institutional theory. This perspective suggests that organizations adopt practices to gain legitimacy within their environments, often through processes of isomorphism. In the Brazilian context, three mechanisms strongly influence municipalities.

First, coercive isomorphism arises from pressures exerted by powerful actors, such as the Courts of Accounts and the National Treasury Secretariat (STN), which mandate the adoption of systems such as SIAFICs and monitor performance through rankings. Second, normative isomorphism stems from the professionalization of the field, as standards issued by the Brazilian Federal Accounting Council (CFC) and the dissemination of IPSAS define "best practices" that technology helps to materialize. Third, mimetic isomorphism occurs when municipalities, facing uncertainty, replicate the strategies of their more successful peers, as evidenced by the low dispersion observed in the quality and transparency indicators analyzed in this study.

In this context, investment in digital infrastructure is the predominant strategic response to these three pressures. Acquiring and implementing technology represents the most tangible way for public managers to signal compliance (coercive), modernity (normative), and alignment with peers (mimetic). Consequently, technology becomes the perceived pathway to achieving greater transparency, a central requirement for organizational legitimacy. Based on this premise, Hypothesis 1 (H1) is formulated as follows:

- **H1:** there is a positive association between increased digital infrastructure expenditure and enhanced transparency of accounting information.

Similarly, because the quality of accounting information is the standard for evaluating technical performance, as reflected in STN rankings, investment in systems that provide more accurate and timely data is a direct result of these institutional pressures. Therefore, the second hypothesis (H2) is proposed:

- **H2:** there is a positive association between increased digital infrastructure expenditure and higher quality accounting information.

Testing the second hypothesis requires careful consideration of how accounting information quality is measured. As part of a monitoring initiative, the STN implemented a public accounts verification system in 2019 to ensure the quality and consistency of accounting and fiscal information, known as the ranking of accounting and fiscal information quality (STN, 2023). This ranking evaluates the quality of data submitted by states and municipalities and is structured around four dimensions. It draws on information from general purpose accounting reports, namely, the Summary Budget Execution Report (RREO), the Fiscal Management Report (RGF), and the Declaration of Annual Accounts (DCA), as well as from the Accounting Balances Matrix (MSC), a database containing information on accounting balances and transactions (Lima et al., 2024).

In the accounting literature, the STN ranking has been used as a proxy for accounting information quality (Sousa, 2022). This effort aims to improve the quality of data reported by federal, state, and municipal governments, benefiting both the National Treasury and other users of this information (Gomes & Silva, 2022). Furthermore, since early 2024, the ranking has been included as one of the variables in the methodology used to calculate the payment capacity assessment of states and municipalities, which evaluates the fiscal conditions of subnational governments seeking to borrow new loans with a federal guarantee (Portaria Normativa MF nº 1.583, de 13 de dezembro de 2023).

From the perspective of the NBC TSP Conceptual Framework, the STN ranking assesses the quality of information provided by states and municipalities, focusing especially on timeliness and consistency (Lima et al., 2024).

## 4. METHODOLOGY

Using a quantitative approach, this study examines the relationship between digital infrastructure expenditure and the quality of accounting information across 644 municipalities in the state of São Paulo. The state capital was excluded because it has its own court of accounts (TCM-SP), and its data are not available in the same format, which would compromise comparability. An explicit exclusion criterion was therefore applied to ensure data homogeneity and to avoid comparability bias.

The analysis covers the period from 2019 to 2023. Data were obtained from multiple sources: the Court of Accounts of the State of São Paulo (TCE-SP) for IT expenditure; the Brazilian Institute of Geography and Statistics (IBGE) for socioeconomic variables; the Federal Administration Council (CFA) for transparency indicators; the National Treasury Secretariat (STN) for measures of accounting information quality; and the Rui Barbosa Institute (IRB) in conjunction with the TCE-SP for indicators of governance and systems integration.

The empirical strategy comprised three sequential stages. First, descriptive statistics – means, standard deviations, and the number of observations – were calculated for the key variables. These were followed by mean-difference tests using the nonparametric Mann-Whitney test to assess differences in technology investment across groups of municipalities. The Mann-Whitney test was chosen over parametric alternatives because it does not assume normality of the distributions and is more robust to outliers.

Second, a k-means cluster analysis was conducted based on per capita IT expenditure (log-transformed), resulting in three groups of municipalities. The number of clusters was chosen using the elbow method and silhouette index analysis, ensuring better separation between groups. The segmentation identified three clusters representing increasing levels of investment (low, medium, and high), allowing a structured comparison of indicators related to transparency, accounting information quality, systems integration, computerization, and IT governance.

Finally, panel data regression models were estimated, one with transparency and another with accounting information quality as the dependent variables, incorporating control variables relevant to the municipal context. The choice of a fixed effects specification was supported by both statistical tests and the need to control for unobserved, time-invariant characteristics specific to each municipality.

Breusch-Pagan tests indicated the presence of significant random effects (H1: $\chi^2 = 473.60$; $p < 0.0000$; H2: $\chi^2 = 414.76$; $p < 0.0000$), while the Hausman test revealed systematic differences between the estimated coefficients (H1: $\chi^2 = 134.63$; $p < 0.0000$; H2: $\chi^2 = 71.95$; $p < 0.0000$), thereby justifying the adoption of the fixed effects model (Fávero & Belfiore, 2024). The regressions were estimated using robust standard errors to correct for heteroskedasticity and potential autocorrelation.

### 4.1 Estimated variables and models

Box 1 presents the variables used in the two-panel data regression models, in which transparency and accounting information quality serve as the dependent variables. The alignment of the variables with hypotheses H1 and H2 was established to ensure theoretical adherence and methodological coherence. Population size, municipal gross domestic product (GDP) per capita, and system integration were included as control variables.

The econometric equations estimated in the regressions are presented below:

$$Transparency_{it} = c_o + \beta_1\, IT\ Expenditures_{it} + \beta_2\, IT\ Governance_{it} + B_3 Integration_{it} + B_4 Population + \beta_5 GDP_{it} \quad (1)$$

$$Quality_{it} = c_o + \beta_1 IT\ Expenditures_{it} + \beta_2 IT\ Governance_{it} + B_3 Integration_{it} + B_3 Transparency_{it} + B_4 Population + \beta_5 GDP_{it} \quad (2)$$

The choice of control variables is justified by the fact that municipal population size may be a determinant of accounting information quality. Municipalities typically differ in terms of administrative and financial structures as well as fiscal conditions (Sousa, 2022), and they also exhibit varying levels of access to advanced technologies and information management capacity (Azevedo et al., 2020a).

In addition, system integration is a critical technological factor, particularly in municipal contexts, where fragmented systems can compromise information quality and increase the risk of inaccuracies (Azevedo et al., 2025; Margariti et al., 2022). To mitigate these risks, Brazilian legislation mandates the

adoption of integrated financial administration and accountability systems (Aquino et al., 2022b). These justifications for the control variables also strengthen the internal validity of the econometric model.

The dependent variable related to hypothesis H1 (transparency) was created using the transparency management dimension from the Municipal Governance Index (IGM) developed by the Federal Administration Council (CFA). The IGM methodology relies on indicators covering planning, personnel, transparency, and information management. The index aims to help public managers evaluate governance practices and allow citizens to see how municipalities use public resources to create public value (CFA, 2020).

For the dependent variable related to hypothesis H2 (accounting information quality), the percentage of correct assessments in the Accounting and Fiscal Information Quality Ranking was used as a proxy. This ranking, developed and updated annually by the National Treasury Secretariat (STN), evaluates fiscal and accounting data across Brazil (Camargos & Azevedo, 2025; Lima et al., 2024). The ranking was chosen because rankings and indicators are widely used as tools for governance and performance evaluation, guiding decisions aimed at continuous improvement. Additionally, it has become a common proxy for accounting information quality in the literature (Gomes & Silva, 2022). Its annual availability and ability to compare across government entities further justified its selection.

**BOX 1 RESEARCH VARIABLES**

| Dependent Variables (DV) | Content | Source |
|---|---|---|
| H1 – Transparency of accounting information | IGM/CFA indicator for the dimension of municipal management transparency. The indicator is calculated considering the indicator for the management-transparency dimension. | CFA (2022) |
| H2 – Accounting information quality | Average number of correct answers in the ranking for information representing accounting quality. | STN (2023) |
| **Independent Variable (IV)** | | |
| Digital infrastructure expenditure | Value of expenditure liquidated for all economic categories associated with IT expenditure (logarithm). | TCE-SP (2023a) |
| **Control Variables** | **Formula** | |
| Population | Calculated logarithm of the population per municipality. | IBGE (2022) |
| GDP per capita of municipalities | Calculated logarithm of the GDP of the municipalities produced per inhabitant, transformed into a logarithm. | IBGE (2022) |
| IT Governance | The results of the Municipal Management Effectiveness Index (IEGM) (A-C) were converted into numerical values from 1 to 5, where (1) – C and (5) – A. | IRB/TCE-SP (2023) |

*(Continue)*

| Dependent Variables (DV) | Content | Source |
|---|---|---|
| Transparency | IGM/CFA indicator for the dimension of municipal management transparency. The indicator is calculated considering the indicator for the management-transparency dimension. | CFA (2022) |
| Integration between systems | Information collected by the IEGM of the TCE-SP in the I-Gov IT dimension, which represents the integration between systems. | IEGM/IRB (2023) |

**Source:** Elaborated by the authors.

A variable based on digital infrastructure expenditures (IT expenditures) was created as an independent variable. It was developed using data obtained from the transparency portal of the Court of Accounts of the State of São Paulo (TCE-SP), which compiles information from municipal budget execution. Prior studies emphasize the relevance of IT investments for enhancing accountability and access to public information (Aquino et al., 2022a).

These investments in digital infrastructure include initial capital expenditures, the purchase and deployment of information systems, contractual commitments, resources designated for system maintenance, and investments in staff and user training (Furneaux & Wade, 2011). Their goal is to enhance the quality of accounting information provided by governments (Cuadrado-Ballesteros et al., 2021). Therefore, the implementation of this variable was designed to accurately measure technology-related expenditures and their potential to improve transparency and accounting quality.

Information on digital infrastructure spending was calculated based on a prior selection of specific economic expenditure categories, limited to those directly related to technology-related transactions (Box 2). The first step was to import data from a CSV file. The original dataset provided by the TCE-SP contains highly disaggregated information on expenditures, reporting each budget commitment, settlement, and payment transaction individually, along with details on suppliers, expenditure descriptions, sources of funds, government functions and subfunctions, and transaction values.

After importing the data into statistical software, several transformations were performed to prepare the dataset for analysis. Initially, variables were created to categorize and classify expenditures. To identify expenditures made solely by municipal governments, a variable indicating "municipality" was constructed and coded as 1 for municipal governments and 0 for other entities. This process facilitated the analysis of municipal-level spending. Additionally, a variable called "source of funds" was created to differentiate treasury-funded expenditures (coded as 1) from other earmarked expenditures (coded as 0), ensuring that the analysis remained aligned with the research objectives.

Subsequently, a variable was created to identify expenditures related to information and communication technology. This variable was generated from a predefined list of technology-related expenditure classifications, assigning 1 to technology-related expenditures and 0 to all other expenditures.

## BOX 2 IT RELATED EXPENSES

| Expense Code | Code Name | Function |
|---|---|---|
| 33904016 | Software rental | Software rental. |
| 33903994 | Application software acquisition | Acquisition of data processing programs. |
| 33903047 | Basic software acquisition | Acquisition of basic (off-the-shelf) software. |
| 33904001 | Information and communication technology equipment rental | Information and communication technology equipment rental. |
| 33904022 | Maintenance and conservation of information and communication technology | Maintenance and conservation of information and communication technology. |
| 33904099 | Other IT Services – Legal Entity | Data processing, software development and maintenance, ICT support and infrastructure, technical services, digitalization. |
| 33914000 | Information and communication technology services – legal entity – intra-OFSS | Equipment and software rental, software development and maintenance, information and communication technology, digitalization, training, data processing. |
| 33924000 | Information and communication technology services | Equipment and software rental, software development and maintenance, technical services, equipment maintenance, and digitalization. |
| 33223900 | Third-party services – legal entity | Equipment and permanent material rental; software; and others. |
| 33323900 | Other third-party services – legal entity | Equipment and permanent material rental; software; and others. |
| 33723900 | Other third-party services – legal entity | Equipment and permanent material rental; software; and others. |
| 33903901 | Periodical and annual subscriptions | Expenses incurred with software; and others. |
| 33903017 | Data processing material | Expenses incurred with materials used in the operation and maintenance of data processing systems. |
| 33903618 | Equipment maintenance and conservation | Expenses incurred with repair, maintenance and adaptation services for data processing machines and equipment. |
| 33903912 | Rental of machinery and equipment | Expenses incurred for the remuneration of machinery and equipment rental services. |
| 33903995 | Maintenance and conservation of data processing equipment | Records the value of expenses incurred for maintenance and conservation services of data processing equipment. |
| 44904000 | Information and communication technology services – legal entity | Equipment and software rental, software development and maintenance, ICT infrastructure, digitalization. |
| 44905235 | Data processing equipment | Expenses incurred for all devices, equipment, and machines used in the data processing of any nature. |

**Source:** Elaborated by the authors, based on Anex II – Accounting Records Tables – Auxiliaries 2023 – v_16 (TCE-SP, 2023b).

Only liquidated expenditures were considered in the analysis. Following this initial filtering, a database was constructed containing only the liquidated values for the selected expenditure categories, restricted to municipal governments. Data for the dependent and control variables were then merged into a single dataset.

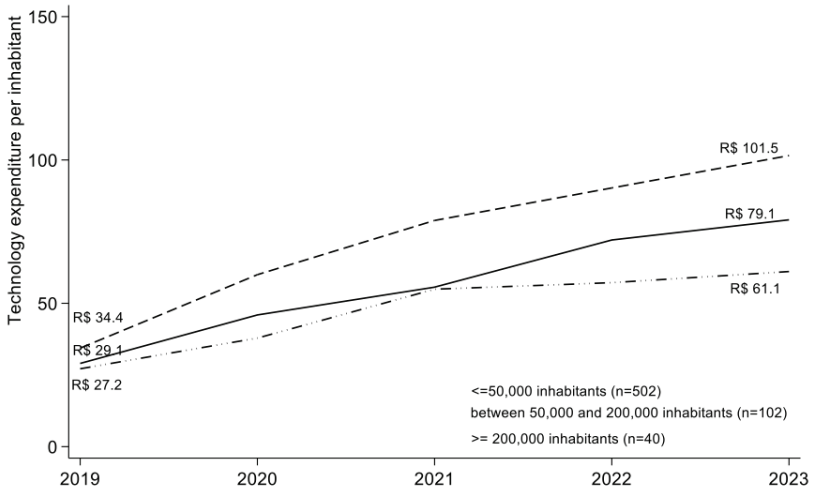
The database was subsequently consolidated in stages for analytical purposes. In the first stage, the data were aggregated across multiple dimensions, including year, municipality, administrative unit, and other relevant characteristics, thereby restricting the analysis to technology-related expenditures incurred by municipal governments. In the second stage, the dataset was further summarized by removing program- and action-level variables, while maintaining a focus on expenditures aggregated by year, municipality, and other core characteristics.

After importing, the expenses were categorized to identify those related to IT. Only the liquidated values were considered, limiting the analysis to municipal governments. The database was built in stages: first aggregating the data by municipality and year, then removing secondary variables to focus on consolidated IT expenditure. This approach aimed to reduce data noise, improve the reliability of intermunicipal comparisons, and ensure methodological consistency in subsequent analyses.

## 5. RESULTS AND ANALYSIS

IT expenditure increased significantly across municipalities of all sizes during the period, as shown in Figure 1. The average growth in technology spending (adjusted for inflation) was 138%, with large municipalities (those with more than 200,000 residents) experiencing the highest increase at 195%. This growth likely reflects the need for technological investments driven by the COVID-19 pandemic, which significantly accelerated developments in government digital infrastructure, as well as the impact of national legislation requiring the adoption of integrated systems (Decreto nº 10.540, de 5 de novembro de 2020). This situation emphasizes the connection between legal requirements and the rapid growth of investments in digital infrastructure.

**FIGURE 1 EXPENDITURE ON TECHNOLOGY BY MUNICIPALITY SIZE**




**Note:** Values are expressed in current prices, adjusted for inflation using the Broad National Consumer Price Index (IPCA).

**Source:** Elaborated by the authors.

Brazilian law requires municipalities to implement integrated financial management and control systems (Decreto nº 10.540, de 5 de novembro de 2020). Along with ongoing updates mandated by oversight agencies, this requirement has prompted government entities to continually invest in software development, training programs, and incur substantial costs related to creating or outsourcing integrated financial management systems (Aquino & Batley, 2022; Aquino et al., 2022a; Azevedo et al., 2020b; Lino et al., 2022). Beyond meeting regulatory requirements, these investments are strategic for increasing transparency and improving accounting information quality, which are key objectives of this study.

Descriptive statistics indicate that the average IT expenditure per capita is BRL 50.60, with substantial dispersion, highlighting socioeconomic heterogeneity among municipalities and potentially affecting their administrative capacity and available financial resources (Table 1). The coefficient of variation of 145% indicates that municipalities in the upper quartile invest at least three times the median, corroborating the structural asymmetries identified by Aquino et al. (2022b) and suggesting that IT investment patterns vary widely across municipalities, with some allocating significantly more resources than others.

In contrast, the transparency and accounting information quality indices exhibited relatively modest variation – 17% and 18%, respectively – suggesting the presence of institutional isomorphism among municipalities, as discussed by Beneyto (2021) and Sousa (2022). This pattern may be influenced by coercive, normative, and mimetic pressures that tend to standardize practices, even across municipalities operating in distinct socioeconomic contexts.

In addition to serving as a foundation for public administration reforms, the digitalization of municipalities is essential, as accounting reports and budgetary and financial information are the primary outputs of public management. The variation in municipal size, GDP per capita, and IT expenditure suggests that larger municipalities may possess greater economic capacity and, consequently, more resources to invest in IT (Azevedo et al., 2020b). This may result in higher levels of transparency and improved accounting information quality, although this relationship should be empirically tested due to the possible influence of intermediate factors, such as administrative efficiency and political priorities.

**TABLE 1 DESCRIPTIVE STATISTICS OF VARIABLES**

| N = 3220 | | | | | |
|---|---|---|---|---|---|
| Variables | Mean | Min. | Max. | Standard deviation | Coefficient of Variation(%) |
| Ranking accuracy – proxy for accounting information quality (%) (1) | 0.82 | 0 | 0.99 | 0.15 | 18 |
| Transparency level (2) | 7.82 | 2.29 | 10 | 1.36 | 17 |
| Net expenditure on technology (per inhabitant) (3) | 50.60 | 0 | 1.730 | 73.66 | 145 |
| IT Governance Index (4) | 1.72 | 1 | 5 | 1.07 | 62 |
| Integration of systems with accounting (4) | 0.52 | 0 | 1 | 0.25 | 47 |
| GDP per capita (5) | 40.048 | 8.020 | 457.518 | 37.912 | 95 |
| Population (thousand inhabitants) (5) | 52.9 | 0.837 | 1.405 | 122.8 | 232 |

**Note:** Coefficient of variation calculated according to Graf-Vlachy (2018).

**Source:** Elaborated by the authors based on (1) (STN, 2023); (2) (CFA, 2022); (3) (TCE-SP, 2023); (4) (IRB, 2023); (5) IBGE (2022).

The moderate dispersion observed in the IT integration and IT governance variables supports the aforementioned findings and indicates that relevant differences may exist among municipalities with respect to accounting practices and system integration. According to the literature, insufficient integration remains a challenge for many municipalities, which continue to operate isolated and fragmented systems. Such fragmentation can lead to delays in information disclosure, difficulties in reconciling accounting data, and reduced reliability of financial statements (Azevedo et al., 2025; Margariti et al., 2022). Moreover, adopting unified platforms that comply with regulatory requirements may be a key factor in enhancing transparency and the quality of accounting information, aligning with the hypotheses proposed in this study (Bisogno & Donatella, 2022).

The variables for transparency and accounting information quality showed low variation relative to their means, indicating that most municipalities tend to hold similar positions in the quality ranking and exhibit comparable transparency levels. As discussed by Beneyto (2021) and Sousa (2022), this finding suggests that municipalities are influenced by their institutional environment, information availability, and neighboring jurisdictions, which lead them to adopt similar accounting practices and indicator levels. The literature shows that such convergence results from regulatory pressures and uncertainties caused by social pressures, fiscal decentralization, and other institutional factors.

The variables examined above are those that, according to existing literature, have the greatest influence on transparency and accounting information quality. Accordingly, this study focused on these specific variables to analyze their effects on the features of accounting information, laying the basis for the statistical analyses in the following sections.

### 5.1 Effects of technology expenditure on the transparency and quality of accounting information

Accounting information entails costs, particularly because its potential to influence decision-making or reduce uncertainty is difficult to measure. The costs associated with producing accounting information include outsourcing software, hardware, and other IT services, as well as system maintenance, implementation, and negotiation. These expenditures affect the public budget and, consequently, influence the allocation of resources to public policies in areas such as health, education, and social development.

In the public sector, choosing between outsourcing IT services and building in-house systems should consider not only cost reduction but also the collective interest. Public managers' decisions may result in vendor dependence, ongoing maintenance and consulting expenses, or costs associated with the implementation and development of proprietary systems. In the latter case, governments may subsequently face sunk costs, a concern noted in the literature on technological innovation trade-offs in the public sector (Aquino & Batley, 2022).

Table 2 presents the results of the two estimated regression models, which assess the effects of technology expenditure from 2019 to 2023.

**TABLE 2 ESTIMATED MODELS: EFFECTS OF IT EXPENDITURE ON TRANSPARENCY AND INFORMATION QUALITY**

| | Transparency of accounting information (H1) | Accounting information quality (H2) |
|---|---|---|
| Expenditure on technology | 0.0968 *** (3.21) | 0.0127 *** (3.63) |
| IT Governance | 0.0582 (1.56) | 0.0032 (0.73) |
| System integration | 0.7801 *** (4.36) | 0.0506 ** (2.43) |
| Level of transparency | -- | 0.0043 * (1.88) |
| Population | 16.6417 *** (5.57) | 0.3558 (1.02) |
| GDP per capita | 1.1441 *** (5.5) | 0.1027 *** (4.23) |
| Prob > F | 0.0000 | 0.0000 |
| Between | 0.0378 | 0.0093 |
| Within | 0.0741 | 0.0342 |
| N | 3.220 | 3.220 |

**Source:** Elaborated by the authors.

In the panel models, a 10% increase in per capita IT expenditure increases the transparency index by 0.97 points ($\beta = 0.0968$; $p < 0.01$). Although the effect on accounting quality is statistically significant ($\beta = 0.0127$; $p < 0.01$), its magnitude is considerably smaller: a one-standard-deviation change in expenditure explains only 3% of the average improvement in the National Treasury

Secretariat ranking. This finding suggests that, while the effect on quality exists, it is less immediate and likely more dependent on institutional and managerial factors.

Transparency and the quality of accounting information are directly affected by the availability of IT resources at the municipal level. The results show that public policies aimed at strengthening digital infrastructure and system integration can enhance both transparency and the quality of accounting information. Accordingly, policies focused on expanding digital infrastructure, promoting interoperability, and offering technical training can boost these effects, going beyond just acquiring equipment.

#### *5.1.1 Transparency of accounting information (H1)*

The results indicate that the estimated coefficient for IT expenditure is positive (0.0968) and statistically significant at the 1% level, suggesting that increased IT investment is directly associated with higher transparency in accounting information. This finding reinforces existing literature highlighting the role of technology in enhancing accountability and access to public information (Aquino et al., 2022b). Additionally, the positive relationship confirms that IT investment helps ensure compliance with regulatory requirements and promotes an environment of improved accountability.

In this context, transparency should not be seen simply as a regulatory or legislative obligation, but as a fundamental element of accounting information quality and of strengthening external users' trust in public institutions. Therefore, the results do not provide enough evidence to dismiss hypothesis H1, which claims that increased expenditure on digital infrastructure is linked to greater transparency of accounting information. This finding indicates that fiscal capacity and scale effects may partly explain differences in technology adoption and, as a result, in information disclosure.

Additionally, the results indicate that socioeconomic factors also influence investment in technology (Sousa, 2022). The variables GDP per capita and population exhibit positive, statistically significant coefficients, suggesting that municipalities with higher GDP per capita and larger populations tend to invest more in IT. This investment, in turn, contributes to greater transparency, as municipalities with higher revenues are better able to allocate resources to modernize their financial management systems.

Another relevant factor identified in the analysis is the integration between accounting systems and other core administrative systems. The magnitude of the coefficient (0.7801) indicates that technical interoperability may have a stronger effect than incremental increases in IT budgets, as system integration reduces redundancies and strengthens informational consistency.

Although the coefficients are statistically significant, their magnitudes warrant careful attention. The coefficient for technology expenditure (0.0968) suggests that a 10% increase in per capita expenditure results in approximately a 0.97-point rise in the transparency index. In comparison, the coefficient for system integration (0.7801) indicates an effect roughly eight times larger than that of direct IT expenditure. This finding implies that platform integration plays a key role in transparency, as integrated systems facilitate real-time data sharing, database consolidation, and reduction of manual data entry, thereby minimizing errors and enhancing accountability.

Recent literature further indicates that organizations with higher IT maturity and resources are more likely to adopt artificial intelligence tools, whereas those with limited capacity tend to be excluded from this agenda (Ribeiro & Segatto, 2025). Therefore, investing only in hardware and software is not enough; systems must be interoperable and capable of generating public value, highlighting the

importance of investments focused on integration (Azevedo et al., 2025; Margariti et al., 2022). A well-integrated digital infrastructure can also reduce operational failures and improve efficiency in public management, ensuring greater timeliness and accuracy in disclosed data.

Overall, the findings indicate that investment in IT plays a significant role in improving the transparency of accounting information. However, the impact of such investment is substantially amplified when system integration extends beyond formal compliance and is effectively embedded in operational processes.

### *5.1.2 Accounting information quality (H2)*

The results confirm that per capita IT expenditure has a positive and statistically significant coefficient ($\beta = 0.0127$, $p < 0.01$), reinforcing the relationship between IT investment and the quality of accounting information, as documented in the literature (Cuadrado-Ballesteros et al., 2021; Thoa & Nhi, 2022). Nevertheless, the relatively small magnitude suggests that meaningful improvements in quality require IT investment to be complemented by effective management processes, standardization, and technical staff training.

This finding indicates that municipalities allocating more resources to digital infrastructure tend to produce accounting data that are more accurate, complete, and timely, thereby enhancing reliability for managers, oversight bodies, and society at large (Cuadrado-Ballesteros et al., 2021; Thoa & Nhi, 2022; Uña & Pimenta, 2016). Accordingly, there is insufficient evidence to reject hypothesis H2, which posits that higher investment in digital infrastructure is associated with better accounting information quality.

Beyond IT investment, the analysis shows that regional economic conditions also affect accounting information quality. GDP per capita is positively and statistically significantly associated with IT investment ($\beta = 0.1027$, $p < 0.01$), suggesting that municipalities with stronger economic conditions are more likely to invest in IT and, consequently, to achieve higher informational quality (Azevedo et al., 2020b).

System integration also emerges as a relevant factor, showing a positive and statistically significant effect ($\beta = 0.0506$, $p < 0.05$). The adoption of systems aligned with regulatory requirements can be a differentiating factor in improving the reliability and accounting information quality, thereby strengthening control mechanisms and accountability to society (Bisogno & Donatella, 2022).

The relationship between system integration and accounting information quality may also affect the reputation of public entities. Because the accounting quality ranking is based on the quality of reported data, municipalities that invest in integrated systems may improve their ranking and public perception of governance quality (Lima et al., 2024).

Proper implementation and maintenance of digital infrastructure not only mitigate errors and enhance data security and reliability, but also signal public managers' commitment to modernization and transparency. To realize these benefits, managers must prioritize not only technological acquisition but also staff training and internal process adaptation.

Finally, although the R-squared values indicate that the model explains only part of the variation in the dependent variable, suggesting the influence of additional factors, the fixed-effects F-test confirms the joint significance of the coefficients ($\chi^2 = 15.17$, $p < 0.01$), validating the model choice. This result indicates that, while digital infrastructure and system integration are important determinants,

accounting information quality is also affected by institutional, regulatory, and operational elements. This emphasizes the need for policies that consider indicators of integration and technological maturity, rather than relying only on spending metrics.

### 5.2 Additional robustness analysis

The digitalization of the public sector involves multiple internal factors (financial resources, IT staff, and appropriate systems) and external factors (pressure from oversight bodies, regulatory and legislative requirements, and external users of accounting information). In municipalities across the state of São Paulo, local governments follow their own digitalization agendas, with no fully standardized process, despite legislative mandates and imposed deadlines.

This heterogeneity results from differences in municipal size, financial capacity, administrative ability, fiscal conditions, and access to information technologies (Azevedo et al., 2020a; Sousa, 2022). These findings highlight the importance of analyzing not only the investment volume but also the structural and organizational factors that support technological adoption in the public sector. Table 3 illustrates these variations across municipalities.

**TABLE 3 IT INVESTMENT LEVELS, GROUPED BY INVESTMENT LEVEL**

| Dimensions | Group 1 (n = 165) | | Group 2 (n = 351) | | Group 3 (n = 128) | | Diff. groups (*) |
|---|---|---|---|---|---|---|---|
| | High investment | | Intermediate | | Low investment | | (3-1) |
| | Mean | SD | Mean | SD | Mean | SD | (p-value) |
| IT expenditure per capita | 106.71 | 87.9099 | 37.21 | 11.2753 | 14.98 | 13.3309 | *** |
| Quality | 0.8239 | 0.1034 | 0.8179 | 0.0976 | 0.8003 | 0.1071 | ** |
| Transparency | 7.9095 | 0.8662 | 7.8225 | 0.9125 | 7.6799 | 0.8609 | ** |
| Integration | 0.524 | 0.2091 | 0.5227 | 0.2204 | 0.4975 | 0.2249 | |
| IT Governance | 1.8436 | 1.0243 | 1.7452 | 0.9472 | 1.5046 | 0.7295 | *** |

**Note:** The groups were created considering the average expenditure (amount paid) per inhabitant throughout the time series (2019 to 2023). (*) Mean test: Mann-Whitney non-parametric test.

**Source:** Elaborated by the authors.

A key finding is the significant difference in how technological resources are prioritized. Cluster analysis shows that high-investment municipalities (Group 1) spend an average of BRL 106.71 per person on IT initiatives. This investment level correlates with stronger IT governance compared to other municipalities ($p < 0.001$), as increased spending requires and supports more structured IT control and management mechanisms.

This result aligns with the literature emphasizing that the absence of long-term planning, shortages of qualified personnel, and unrealistic implementation timelines hinder the success of digitalization initiatives (Cohen et al., 2007; Guarda et al., 2015). In this context, IT governance in Group 1 is about 1% higher than in Group 3 ($p < 0.001$), reinforcing the idea that financial resources and institutional capacity develop together (Irani et al., 2023).

Conversely, system integration does not vary much among high-, medium-, and low-investment groups. At first glance, this finding seems inconsistent with the regression results, where integration was statistically significant. A likely explanation is that higher financial investment does not necessarily lead to better-quality integration. Municipalities with lower average spending might operate integrated systems that have been consolidated over time, while those with higher spending could be in transitional phases, implementing newer but still fragmented solutions.

This interpretation aligns with the literature, showing that integration decreases manual data entry and errors only when consolidation processes are sufficiently developed. Therefore, financial investment is necessary but not enough for interoperability; planning, training, and change management are also essential (Ribeiro & Segatto, 2025).

Transparency in accounting information is also positively affected by IT investment. Municipalities that spend more on IT show significantly greater transparency than those spending less ($p < 0.0247$), indicating that digitalization improves the availability and accessibility of accounting data and boosts public accountability (Setiyawati & Doktoralina, 2019). This finding supports hypothesis H1, as shown in the econometric model.

Similarly, municipalities with higher IT expenditures demonstrate better accounting information quality ($p < 0.0372$). The literature shows that accounting quality is affected by transparency, adherence to international standards (IPSAS), and the efficiency of technological systems (Bisogno & Donatella, 2022).

Moreover, as noted by Beneyto (2021), municipalities tend to imitate one another due to regulatory, normative, and uncertainty-driven pressures. Consequently, improvements in accounting quality may result both from IT investment and from spillover effects, whereby neighboring municipalities adopt similar practices (Sousa, 2022). The adoption of IPSAS and the implementation of SIAFICs play a central role in standardizing public accounting and improving financial information quality (Diniz et al., 2015). Overall, the results support hypothesis H2, indicating that higher investment in digital infrastructure is associated with improved accounting information quality.

SIAFICs have significant potential to reduce errors and improve transparency (Bisogno & Donatella, 2022). In this context, the findings emphasize the importance of public policies that encourage investment in digital infrastructure to improve accounting information quality. The convergence of results suggests that digital investment promotes improvements in both transparency and accounting quality, especially when supported by strong governance structures and deliberate system integration efforts. Ultimately, these findings align with IPSASB (2019) recommendations concerning the consolidation of SIAFICs.

## 6. CONCLUSIONS AND IMPLICATIONS

This study analyzed the relationship between IT investment and the levels of transparency and accounting information quality in municipalities in the state of São Paulo between 2019 and 2023. The results indicate that higher per capita IT expenditure is positively associated with both indicators.

The research sought to determine whether the volume of resources invested in IT is associated with higher levels of transparency and accounting information quality in São Paulo municipalities during the period under analysis. Although the literature frequently highlights concerns about the costs of accounting reforms (Lima & Lima, 2019), empirical studies examining the magnitude of such expenditures and their effects remain limited.

As its main conclusion, the study identifies a positive and statistically significant association between IT investment levels and indicators of transparency and accounting quality. The coefficient of 0.0968 for transparency indicates a 0.97-point increase for every 10% increase in per capita IT expenditure, whereas the coefficient of 0.0127 for accounting quality corresponds to only a 3% increase relative to the average progress observed over the period. These results reveal distinct marginal contributions across the analyzed dimensions, highlighting the complexity inherent in administrative modernization processes.

The dispersion analysis reinforces this heterogeneity. A coefficient of variation of 145% in IT expenditure indicates substantial disparities among municipalities, with the top quartile investing at least three times the median. In the cluster analysis, this asymmetry is reflected in a per capita difference of BRL 106.71 between the high-investment and lowest-investment groups, as well as an average increase of 0.23 points in the transparency index.

The robustness of the econometric models strengthens confidence in the findings. Nonetheless, the relatively modest impact on accounting quality and the absence of differences in system integration across clusters suggest that qualitative factors not captured in this study may shape the observed effects. Notably, the lack of a statistically significant difference in the "integration" variable between the clusters, despite its significance in the econometric models, points to the need for further investigation into the roles of technological maturity stages and change management processes within municipal governments.

Recent literature indicates that the use of artificial intelligence techniques remains limited to a small group of organizations and that substantial heterogeneity exists across entities with differing levels of IT capacity. Organizations with higher technological maturity are more likely to adopt AI tools, while those with limited capabilities tend to remain excluded. This evidence reinforces the central message of this study: allocating financial resources to digital infrastructure alone does not guarantee improvements in transparency and accounting information quality. Municipalities must also develop institutional capabilities that enable system integration and the effective extraction of value from available technologies.

In summary, the findings suggest that investments in digital infrastructure contribute to greater transparency and improved accounting information quality. However, the magnitude of the integration coefficient highlights that system interoperability plays an even more decisive role. Accordingly, public policies should prioritize the integration and alignment of information systems with regulatory standards, ensuring data exchange, reducing manual entries, and producing timely and reliable information, in line with national guidelines such as SIAFIC. These efforts must be accompanied by training for civil servants and strategic management of digital transformation, as the effectiveness of IT expenditure ultimately depends on its capacity to generate public value and enhance communication between government and society.

The results suggest several important implications. First, they are relevant for the National Treasury Secretariat and the Federal Accounting Council, institutions that act as rule-makers (Aquino & Batley, 2022) and are responsible for designing and monitoring accounting and fiscal standards. These entities should consider the costs of digital infrastructure when creating or modifying automated data collection systems, such as the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI). They may also consider the importance of collecting specific information on technology-related expenditure resulting from newly imposed standards and reports, including discussions on

the organization of budget classifiers to capture and disclose such data. Furthermore, incorporating indicators of system integration and technological maturity into monitoring frameworks, rather than relying solely on expenditure measures, would provide a more comprehensive assessment.

Second, the findings have implications for the courts of accounts, which act as primary oversight bodies and rule-enforcers of accounting information (Aquino & Batley, 2022). These institutions should intensify their monitoring of the adequacy of municipal digital infrastructure, given its positive effects on transparency and the quality of accounting information.

Finally, the study offers implications for rule-appliers, including mayors and public managers. IT expenditure should be strategically planned, as it positively affects transparency and accounting information quality. Moreover, prioritizing integration between accounting systems and other administrative systems is essential, given its impact not only on transparency and accounting quality but also on the efficiency of electronic public services (Azevedo et al., 2025).

More broadly, the results highlight implications for the ongoing expansion of data collection systems by external stakeholders such as courts of accounts, the National Treasury, and ministries. These actors have repeatedly increased the level of detail required from local governments, often causing an overload of activities in municipal accounting departments, commonly called accountability overload, while ignoring the costs of adapting and maintaining local systems like SIAFICS. This dynamic also creates overlapping informational requirements (Lima et al., 2025).

This study has limitations. First, data availability was restricted over the analyzed period, which covered only the years from 2019 to 2023. This temporal scope may not capture all effects occurring before or after this interval. Future research should therefore incorporate longer time series to better identify trends and patterns. Second, the lack of standardization in expenditure category codes, particularly at the level of budget item disaggregation, limits comparability across states and constrains interstate analyses. Such comparisons would enhance understanding and enable more robust contributions to public management. The inclusion of qualitative metrics, such as technological maturity, system integration, and staff training, would also enrich future analyses.

In line with these directions, future studies could apply alternative statistical methods to estimate the causal effects of IT investments on accounting outcomes, considering exogenous funding or regulatory shocks that affect groups of municipalities at different points in time.

Interstate comparisons using harmonized databases would further allow researchers to assess whether the disparities observed in São Paulo are replicated in other Brazilian states, thereby deepening understanding of how institutional arrangements and administrative capacity shape outcomes. Finally, cost–benefit analyses incorporating accounting impact measures, operational efficiency indicators, and improvements in public service delivery could provide valuable insights for policymakers assessing the economic and social returns of IT investments.

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## DATA AVAILABILITY

All the data supporting the results of this study are published within the article. The primary data used can be accessed directly from the sources indicated in the methodology.

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