THE SIGNIFICANCE OF THE EUROPEAN DIGITAL STRATEGY IN THE CONTEXT OF DIGITAL TRANSFORMATION

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Summary. Digital transformation and data policy are no longer peripheral concerns but strategic imperatives at the heart of the European Union's (EU) digital agenda. More than a technological shift, this transformation signals a fundamental change in governance logic—one where data-driven decision-making, cross-sectoral innovation, and inclusive design shape the contours of public service delivery. Anchored in the European Digital Strategy (EDS), the EU's vision for a digitally resilient society is not merely a regulatory framework but a multidimensional blueprint that connects digital infrastructure with civic value. This article examines how such ambitions materialize on the ground through a case study of Vilnius City Municipality's Smart City initiative, focusing on its Mobility Map project. Through the integration of anonymized real-time mobility data, the platform exemplifies the practical application of EDS principles: transparency, responsiveness, and citizen-centered governance. It also underscores the role of municipalities not as passive implementers but as strategic agents in shaping Europe's digital transformation. Yet, the research highlights persistent asymmetries in local capacity, infrastructural readiness, and policy coherence. The EU's digital vision often collides with on-the-ground realities, from fragmented data systems to ethical dilemmas surrounding automation. The study argues that sustainable and equitable digital transformation demands not only technical proficiency but also institutional reflexivity, ethical safeguards, and adaptive leadership. Vilnius emerges as a microcosm of both the potential and the complexity embedded in Europe's digital future.

Keywords: *digital transformation, European digital strategy, smart cities, data-driven governance, urban mobility, digital infrastructure, smart governance, public sector innovation, local implementation of EU policy, real-time data analytics, citizen-centric services, urban data policy, digital public administration*

Raktiniai žodžiai: *Europos Sąjungos skaitmeninė strategija, skaitmeninė transformacija, viešasis sektorius, inovacijos, išmanusis miestas, miestų valdymas, duomenų politika, dirbtinis intelektas, skaitmeninė strategija, didieji duomenys, duomenimis grįsti sprendimai, strategijos įgyvendinimas, išmanusis valdymas, viešasis administravimas.*

Introduction

Relevance of the Topic. The modern world is inevitably moving toward a digital society, where digital transformation and data policy play a crucial role. As defined by the European Parliament (European Parliament 2024), digital transformation refers to the integration of digital technologies into both business operations and public services, while also shaping broader societal change. In this context, innovation and data-driven decision-making are no longer optional but necessary instruments in rethinking governance and service models. The EDS places particular emphasis on data policy as a strategic enabler of transformation, linking technological progress with societal well-being. In urban governance, this is especially visible in the integration of smart technologies and data infrastructures that support responsive, transparent, and efficient services. The case study presented in this article—the Vilnius City Municipality's digital mobility initiative—illustrates how data-driven approaches are being operationalized to address urban mobility challenges through locally grounded, evidence-based innovation.

Extent of Research on the Topic. Despite its policy centrality, digital transformation remains an emerging field within scientific research. Studies point to a gap between the pace of technological advancement and the development of applicable methodologies to guide its implementation in the public sector. As (Alvarenga 2020) observe, there is still insufficient research on digital governance and knowledge management in public administration. Moreover, empirical case studies from local contexts—especially within smaller EU Member States—are particularly lacking. This article seeks to fill part of that gap by offering practical insight into how digital strategy and data policy are realized at the municipal level. The empirical analysis contributes not only to theoretical discourse but also to actionable recommendations for policymakers, urban developers, and all actors engaged in smart governance. Through the lens of Vilnius, this research explores both the promise and complexity of digital transformation in contemporary urban systems.

Digital Transformation in the European Union

Digital transformation is one of the EU's strategic priorities. The European Parliament (EP) plays a key role in reviewing policies aimed at strengthening Europe's capabilities in emerging digital technologies, unlocking new opportunities for businesses and consumers, enhancing digital skills, and supporting the digitalization of public services, all while

ensuring respect for fundamental rights and values (European Parliament 2024). The core priorities of the EDS include commitments to digital innovation, technology, scientific research, education system modernization, digital skill development, societal digital literacy increase, and data protection and privacy guarantees. Considering these priority areas, the EU is implementing a large-scale digital transformation aimed at strengthening the economy and improving citizens' quality of life. The EU's digital transformation strategy is focused on investments and cutting-edge technologies, such as artificial intelligence (AI), data analytics, cloud computing, and blockchain technologies, which open new opportunities for business and scientific research, while fostering sustainable economic growth and innovation (European Commission 2024). This drives the EU's primary objective, which is to strengthen and maintain its global competitiveness by leveraging its key instrument: digital innovation. The EDS defines digital transformation as the integration of digital technologies into business operations and public services, as well as its broader impact on society (Lanfranchi 2025). Given that digital transformation is essential for remaining competitive, its effective implementation is a strategic necessity.

From Definition to Action: The European Digital Strategy in the Context of Digital Transformation

The absence of a universally accepted definition of digital transformation in academic discourse has been empirically demonstrated by Cheng Gong and Vincent Ribière, who conducted a comprehensive analysis of 134 existing definitions in an effort to establish conceptual consistency.

After conducting extensive research, the scholars define digital transformation as a fundamental change process enabled by digital technologies aimed at radically improving operations and fostering innovation within an organization. This transformation seeks to create value for stakeholders by strategically leveraging key resources and capabilities (Gong and Ribiere 2021).

Researchers Justyna Dąbrowska, Argyro Almpanopoulou, and others define the concept of digital transformation as a socioeconomic shift occurring among individuals, organizations, ecosystems, and society. This transformation shapes the adoption and utilization of digital technologies, influencing the way they are integrated into various domains (Dąbrowska and Argyro 2022).

Researchers Dmitrij Plechanov, Henrik Frank (Plekhanov and Franke 2023), and others, drawing on the perspectives of Erik Brynjolfsson (Brynjolfsson and Hitt 2000), argue that digital transformation occurs when companies utilize digital technologies to develop new or modify existing business models and processes. Additionally, digital transformation supports the evolution of organizational structures, resource management, and relationships with internal and external stakeholders (Holmström 2022).

Although definitions of digital transformation vary among scholars worldwide, they

all consistently emphasize digital technologies and their impact on change processes, the creation of new structures and processes for both businesses and society, and the necessity of adapting to rapidly evolving technological environments to maintain competitiveness in the digital era.

While scholarly debates highlight the conceptual plurality of digital transformation, the EU operationalizes this fluid concept through concrete policy instruments that prioritize scientific research, innovation, and digital capacity building as the foundational pillars of a future-ready society. The promotion of scientific research and innovation is one of the EU's top priorities, with investments in these areas—particularly in digital technologies—playing a crucial role in ensuring Europe's leadership in innovation (European Commission 2024). The Digital Education Action Plan (2021–2027) and initiatives such as the European Research Area reflect the EU's commitment to developing a highly skilled workforce capable of utilizing and advancing cutting-edge technologies. These efforts outline a shared vision for high-quality, inclusive, and accessible digital education in Europe, aiming to support the adaptation of education and training systems to the digital era (European Union 2022). Europe strives for a human-centered, sustainable, and prosperous digital future (European Commission 2024), making digital education and skill development essential for a successful digital transformation. The EU aims to ensure that all citizens have access to essential digital skills (European Commission 2024), promote the modernization of education systems, and enhance access to digital resources and learning platforms. Improving society's digital literacy is fundamental, given the increasing integration of digital technologies into everyday life. The EU emphasizes the need to enhance digital literacy to ensure that every citizen can safely and responsibly use digital services (Mykytyuk and Mykytyuk 2025). EU legislation and measures in the digital space play a crucial role in ensuring the fairness and security of digital transformation. They not only foster innovation and economic growth but also guarantee that the digital society is built upon citizens' rights and freedoms.

The Core Priorities of the European Digital Strategy and Their Local Implementation

Digital transformation within the EU is not merely a technological shift but a value-driven initiative to enhance competitiveness, cohesion, and governance. The EDS defines political and regulatory priorities across all governance levels, yet its true impact depends on local-level implementation. At the heart of EDS lies the strategic use of data. The initiative to create common European data spaces reflects the belief that high-quality, secure, and interoperable data infrastructures can generate public value, particularly in sectors such as mobility, health, and energy (European Commission 2020). In parallel, by 2030, the EU aims to ensure all essential public services are accessible online (European Commission 2021).

AI is also a core element. The EU's AI Act (European Parliament 2025) seeks to foster human-centric, transparent, and trustworthy AI. Additionally, digital skills and inclusion are treated as prerequisites for transformation, with the Digital Decade 2030 setting targets for ICT workforce expansion and baseline digital literacy (European Commision 2025). Finally, digital autonomy and cybersecurity are emphasized as foundations of resilience. Although shaped at the EU level, these priorities are activated through national and municipal agendas. Local governments, far from passive executors, are strategic implementers. Vilnius City demonstrates this through its Smart City program, especially the Mobility Map, which exemplifies EDS-aligned innovation: leveraging real-time anonymized data for optimizing transport systems and enhancing citizens' quality of life.

The Vilnius case illustrates how EDS goals become tangible through data-driven governance. The city's use of urban mobility data directly corresponds with the EU's ambition to treat data as a public asset and a foundation for innovation. Digital transformation is not merely a technical shift but a multidimensional process that requires leadership, structural readiness, policy alignment, and social inclusivity to ensure meaningful innovation and public trust (ly 2025). Likewise, digitalizing public services in Vilnius aligns with the 2030 targets of accessibility and responsiveness.

Plans to integrate AI in mobility management further reflect the EU's commitment to ethical, responsible technology deployment. Citizen participation and digital literacy—integral to EU documents—are embedded in Vilnius' approach. The city promotes inclusion through participatory tools and open-access platforms, while ensuring alignment with EU standards such as the GDPR, fostering trust and digital security.

These parallels demonstrate not mere compliance but active local reinterpretation of supranational policy. Vilnius serves as an implementer and a contributor to the evolving European digital landscape. Ultimately, the EDS's value lies not just in its strategic texts but in its ability to inspire grounded, local innovation. The case of Vilnius highlights how EU-level ambitions can be real through coordinated local action, reinforcing the need for strong interconnection between strategic vision and operational delivery.

Implementation Challenges and Scope Limitations

While the EDS outlines a cohesive vision for digital transformation across the EU, its implementation at national and local levels remains uneven. Structural differences in digital maturity, institutional capacity, and administrative readiness continue to shape outcomes. Legal frameworks alone are not sufficient; effective application depends on organizational preparedness, policy stability, and technological integration (Boya-Lara 2025). A major challenge is the persistent digital capability gap. Many local administrations lack the infrastructure or expertise to integrate EU priorities in areas such as AI, real-time data, and open governance (Dąbrowska and Argyro 2022). Even where the strategy is formally adopted, its implementation is often hindered by fragmented coordination, underfunding,

and public sector inertia (Holmström 2022).

These challenges reflect a broader disconnect between ambitious EU policy and local operational realities. Legacy systems, cultural resistance to algorithmic solutions, and political uncertainty at the municipal level frequently inhibit meaningful progress. Sophisticated digital systems can also introduce technological friction; if not properly aligned with local workflows, they risk partial implementation or even failure.

To explore these dynamics, this article focuses on a single case—Vilnius City—not as a universal model but as an example of how EDS principles are interpreted and applied locally. The case was selected based on two factors: first, the availability of empirical data from the GDPR-compliant Mobility Map project; and second, the format limitations of this article, which precluded broader comparative analysis. Nevertheless, single-case studies carry limitations. While they allow for deep contextual insight, they do not reflect the full variety of digital governance practices across the EU. Future research should address this gap by including more cities with diverse institutional and technological conditions to evaluate how EDS priorities are adopted, resisted, or reinterpreted at local levels.

Research Methodology

This study applied a qualitative case study approach to examine how the EDS is implemented at the municipal level. A case study design was selected because it enables the in-depth exploration of a specific instance of digital transformation in a real-world setting, allowing the researchers to identify not only existing implementation practices but also systemic gaps and areas for future improvement. This approach was most suitable for achieving the study's objective: to uncover how EU-level digital policy is translated into local governance structures and to analyze the institutional, technological, and strategic factors influencing that process. Vilnius City's Smart City initiative—specifically its Mobility Map—was selected as a representative, data-rich example of municipally driven digital transformation aligned with EU policy goals. This platform was chosen due to its exclusivity and the fact that anonymized real-time mobility data are held and processed only by a limited number of authorized entities. The data were collected during the first quarter of 2024 and sourced directly from the platform, which aggregates real-time data from telecommunications providers under GDPR-compliant agreements. These data were selected for their accuracy, objectivity, and relevance to mobility-related service delivery. The analysis employed descriptive and comparative methods to assess how the platform reflects EDS priorities such as data utilization, AI potential, and digital service quality. In addition, strategic document analysis and direct observation were used to contextualize findings and evaluate alignment with EU benchmarks. The combination of multiple sources ensured triangulation of evidence and a more comprehensive understanding of local digital governance dynamics. The reliability of this research was supported by the objectivity of the data, their lawful acquisition, and the transparency of collaboration with municipal actors.

All data were processed in a secure and confidential manner, with full awareness from institutional stakeholders regarding their research use. Alternative methods, such as surveys or interviews, were deemed insufficient for capturing the systemic and infrastructural dimensions critical to understanding policy implementation. By employing case-based and document analysis, this methodology enabled a systemic and context-sensitive examination of how digital transformation unfolds at the urban level, revealing not only structural innovations but also underlying social and institutional changes within the municipality.

Digital Strategy of Vilnius City

The EU has the potential to serve as a global example of a society where business and public sector entities leverage data-driven decision-making to improve outcomes (European Commission 2020). To effectively manage resources, deliver high-quality services to residents, and enhance competitiveness, every city requires a comprehensive digital strategy. The application of a digital strategy in urban governance helps address existing challenges while delivering multifaceted benefits aimed at improving citizens' quality of life. This includes, but is not limited to, better integration of public transportation systems, more efficient waste management, and advanced healthcare services. A well-designed digital strategy positions Vilnius as a global benchmark in digital transformation, utilizing digital innovation to drive progress. The success of this strategy depends on how effectively the city can engage diverse stakeholders in the digital transformation process. The importance of implementing a digital strategy and data policy is particularly crucial for cities, especially Vilnius—the capital of Lithuania—as these approaches foster economic growth and innovation while ensuring citizen well-being, effective urban governance, and sustainable city development. Digital transformation in cities is inevitable, and its success depends on multiple factors, including strategic planning, data policy, technological infrastructure, and citizen engagement. These elements must work harmoniously toward a common goal: creating a smart, sustainable, and vibrant city. The digital transformation of cities and its implementation strategies have received significant attention in scientific research and literature. Studies highlight key benefits and challenges, emphasizing the importance of digital transformation in enhancing urban infrastructure and public services. A central focus is placed on the need to integrate various data sources and technologies to improve quality of life and address urban challenges effectively. In urban planning, the use of big data analytics provides deeper insights into citizen behavior, transportation usage, and environmental quality. Big data and digital technologies are among the most critical elements in the management and planning of smart cities. According to Kandt and Batty (Kandt and Batty 2021), a new generation of big data analytics offers substantial benefits, including real-time forecasting, improved quality of life, and optimized transportation flow. Furthermore, digital technologies integrated into urban governance enable cities to achieve desired outcomes. Sensor networks, connected through the Internet of Things

(IoT) and linked to computational platforms, continuously process large streams of data, facilitating new decision-making approaches. Urban analytics using big data is widely applied in city management and planning, making it a fundamental component of smart city development and governance. The VILNIUS2IN initiative outlines Vilnius' strategic digital direction, emphasizing the importance of an integrated smart city approach. This strategy is based on six core principles and focuses on nine key areas, including: Administration, Mobility, Education, Environment and Urban Development, Culture, Health and Well-Being, Social Protection, Safety and Security, and Economic Development. These focus areas align with the EU Digital Strategy's objectives to strengthen digital infrastructure and services, emphasizing citizen engagement and innovation-driven development. Mobility as a Strategic Priority: Mobility is one of the key strategic priorities in Vilnius' Smart City digital strategy. A significant R&D project, Efficient Mobility Management and Administration in Vilnius, aims to create advanced services for urban transportation. One of its flagship initiatives, the Vilnius Mobility Map, is designed as an interactive platform integrating all available data sources that influence urban movement and transportation. This tool will provide real-time insights and optimize urban mobility management for Vilnius and its surrounding metropolitan area.

Figure 1. Vilnius City Mobility Map. The figure was created by the authors based on the project "Efficient Mobility Management and Administration in Vilnius."

Figure 1 illustrates the Vilnius City Mobility Map, which enables the tracking of transportation intensity across Vilnius, including the movement of cars, public transport, pedestrians, and cyclists. The system allows traffic monitoring over selected time intervals, e.g., daily, weekly, monthly, and yearly. The color intensity of street lines visually represents traffic density, indicating how busy specific streets are at different times.

This project is part of the Smart City vision, developed using cutting-edge technologies and innovations. As a pilot initiative, it aims to become an integral component of smart

city service management and urban planning. The role of the virtual mobility map is essential, as it helps identify and monitor the busiest and most congested areas, allowing for data-driven problem-solving related to urban infrastructure in Vilnius. The mobility map is built on anonymized data provided by mobile network operators.

By analyzing citizen mobility patterns, the system will enable more efficient public transport route planning, optimize traffic light synchronization, and improve overall traffic flow. Additionally, integrating artificial intelligence, such as AI-powered urban analytics, could significantly enhance these capabilities and redefine how cities understand traffic patterns, optimize mobility, and plan infrastructure upgrades, especially when relying on anonymized mobile network data (Umeike 2025). Another key objective of the virtual mobility map is to identify how residents travel to and from specific institutions, detect accident-prone areas, and pinpoint traffic congestion hotspots. The interactive Vilnius City Mobility Map currently does not incorporate AI; however, the integration of AI technologies could significantly enhance autonomous monitoring of problematic areas and issue identification. As noted in research (Vanderhorst 2024), the absence of a unified framework for integrating digital twin and metaverse technologies has resulted in fragmented development, limited accessibility, and inadequate consideration of ethical dimensions such as data privacy and information security, despite the promise these tools hold for improving urban resilience and real-time decision-making. By leveraging machine learning algorithms, AI could help detect pedestrian crossing needs and changes, optimize urban lighting based on real-time mobility data, and improve public safety and well-being in Vilnius.

Additionally, AI could support pedestrian pathway condition monitoring, prioritizing maintenance and repair efforts according to traffic flow intensity. Another critical aspect is mobility forecasting, which would allow for accurate assessments of transportation dynamics and traffic flow patterns. Currently, traffic congestion negatively affects travel time and public safety, making data-driven infrastructure improvements essential for enhancing urban mobility and optimizing transportation planning.

Conclusions and Recommendations

This study shows that digital transformation is a structural shift and not only a technological change, which is vital for modern public governance. The EDS aligns innovation with institutional reform through data-driven services. The Vilnius case highlights both public value creation through smart mobility and challenges such as local capacity gaps, resistance to change, and ethical risks in automation.

To enhance policy relevance, several actionable recommendations are proposed:
1. Strategic Alignment Across Levels: National and municipal authorities should harmonize digital transformation goals with EDS priorities through integrated policy frameworks and resource planning.

2. Strengthen Local Capacities: Invest in digital skills and infrastructure at the municipal level to reduce technological asymmetries between EU regions.
3. Institutionalize Feedback Loops: Introduce mechanisms for continuous monitoring, citizen feedback, and agile adaptation of digital strategies.
4. Ethical Governance: Establish clear ethical standards and oversight mechanisms for data use, algorithmic transparency, and AI integration in public services.
5. Pilot and Scale: Use cities such as Vilnius as experimental sandboxes to test scalable digital innovations before broader EU-wide adoption.

Future research should explore comparative case studies across diverse EU cities to better understand how EDS principles adapt to differing sociopolitical and infrastructural contexts. Policymakers and urban planners are encouraged to move beyond compliance-based implementation and instead treat digital strategy as a living, evolving system that must remain responsive to citizens' needs, risks, and values.

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