Smart governance in Poland: The case study of the city of Łódź

Monika NAMYSŁOWSKA,
Full Professor at the University of Lodz, Poland
mnamyslowska@wpia.uni.lodz.pl

Aleksandra OLBRYK,
PhD Candidate and Research Assistant at the University of Lodz, Poland
aleksandra.olbryk@wpia.uni.lodz.pl

Abstract
This paper examines how Łódź, Poland's fourth-largest city, embodies emerging trends in smart governance through its innovative digital initiatives, contextualized within the legal framework for algorithmic transformation under Polish law. Focusing on national policies shaping smart governance, the study highlights key urban sectors most influenced by digitalization. Drawing on established concepts of smart cities, smart governance, e-government, and m-government, the paper evaluates how these principles are implemented in Poland. The research builds on the authors' broader work on the algorithmization of the Polish state, supported by their participation in an international project that gives a foundation for understanding Łódź's legal and operational landscape. Employing a mixed methodology of desk research, empirical analysis, case studies, and observational techniques, the study investigates current policies and interviews city administrators to gain insight into existing tools and forthcoming innovations in smart governance. These findings are grounded in the legal framework enabling these transformations. The results offer a comprehensive view of Poland's progress in digital public administration, positioning Łódź as a case study for leveraging governance technologies within legal standards. By contributing to the broader European and global discourse on smart governance, the paper fills a critical gap in the literature, as Łódź has received limited scholarly attention in this field. This study also serves as a practical guide for policymakers and practitioners aiming to implement smart governance tools within their jurisdictions, addressing both current applications and potential future developments. In light of rapid technological advancements, the paper assesses the impact of Polish law on digital governance. It explores the possibilities for future implementation, providing timely and relevant insights for academia and practice alike. The research leading to the paper was funded by the National Science Center of Poland (NCN) as part of the project entitled “Consumer Protection and Artificial Intelligence. Between law and ethics” (2018/31/B/H35/01169).

Keywords: smart cities; automation; algorithms; Polish law; public administration; E-Government.

1. Introduction: Getting to know the city of Łódź
«‘I have nothing, neither have you, nor has he’ he burst out laughing –‘So we have just enough, just exactly enough to start quite a big factory’» [1]. These words from the Polish writer and Nobel Prize in Literature winner (1924) Władysław Stanisław Reymont, in his novel *The Promised Land*, set in Łódź, Poland, have become a fitting motto for the post-industrial city. Łódź (pronounced [wut͡ɕ]) is the fourth-largest city in Poland, located in the country's center.

It has more than 652,000 inhabitants [2], while 1.1 million people reside in the Łódź agglomeration within an area of 283.2 km² [3]. First mentioned in the written records in 1332, Łódź's functions were mainly agricultural for four centuries [4]. The government's decision to locate the textile industry in Łódź entailed its rapid economic development,

drawing thousands of land-franchised farmers looking for work [5]. The city experienced an industrial surge in the early 19th century. In less than a century, between 1820 and 1914, Łódź recorded an almost 800-fold increase in its population, from merely 767 to about 600,000 inhabitants [6]. The wealthy factory owners built monumental villas and sprawling textile factories in the 1920s [7]. Due to its multicultural heritage and the diverse origins of its inhabitants, Lodz has often been referred to as the "City of Four Cultures" – Polish, Jewish, German, and Russian. This rich cultural tapestry not only influenced the city's economic development but also left an indelible mark on its cultural and social institutions, as well as its architectural and urban landscape [8].

With the 20th century came economic changes that contributed to the decline of various industries in European cities, Łódź being among them. Gradually, Łódź turned from the Promised Land into the Manchester of the East. However, with Poland's accession to the European Union on May 1, 2004, an influx of foreign investment and the arrival of a broad stream of EU funds resulted in easing the crisis of the early 1990s [9]. Eventually, Łódź found its opportunity by attracting foreign investors and restoring the splendor of 19th-century post-industrial districts, as the legacy of the former industrial city was revitalized while changing its function [4]. Many projects have been established in Łódź in the past decade, especially in the high-tech sphere [10].

At present, Łódź is implementing innovative projects. The *Integrated Development Strategy for Łódź 2020+* [11], adopted in 2012, laid the groundwork for a comprehensive approach to urban development.

The strategy's key challenges focus on improving residents' quality of life, creating a sustainable transportation network for Łódź and its metropolitan area, and revitalizing urban spaces [12]. More advanced initiatives and new strategies in Łódź align with the concepts of smart governance and smart city development, reflecting broader trends in urban modernization and public space transformation promoted by different communities – practitioners, academics, and the Polish legislator.

2. Defining smart cities

The development of the notion of smart cities marks a significant shift in the evolution of global urban reform movements, emerging as a response to sustainability imperatives and rapid technological advancements [13]. Introduced in the early 1990s [14], the term lacks a universally accepted definition, though several key interpretations have been proposed. One of the most comprehensive definitions, articulated in the European Parliament's *Mapping Smart Cities in the EU* report [15], describes a smart city as an urban area where public issues are addressed through the application of information and communication technologies (ICT), with active collaboration among various stakeholders working in partnership with city authorities. Some scholars highlight specific approaches emphasizing, apart from the ICT, the need for robust transport and telecommunication infrastructure, and the role of digital media, creative industries, and cultural initiatives [16]. Others state that a smart city distinguishes itself through its "smart" attributes, encompassing a combination of enhancements in urban infrastructure, resource management, and the delivery of public services [13].

The core of the definition of a smart city could universally be outlined as the ambition to lay the groundwork for a new economic phase by introducing transformative technologies [17]. These technologies not only redefine development trajectories across various sectors but also reshape the provision of public services, driving systemic innovation and sustainable urban growth [18]. The concept of sustainable development is based on the premise that the resources people rely on daily for business, life, and leisure are finite. Consequently, these resources should be managed to ensure the long-term preservation of ecosystems. Addressing the challenges of sustainable development can be accomplished through the integration of environmental, economic, and social policies [19].

In Poland, the concept of smart cities, in terms of its practical application within urban areas, is primarily viewed through the lens of optimizing energy management [20]. The concept of "smart development" has emerged as a successor to the politically and socially charged term "sustainable development," widely debated in research centers across Poland, including those in Łódź, during the 1980s and 1990s [18]. In Europe, a key advocate for this approach was American scholar Don Huisingh, who worked on academic contracts at universities in Sweden (Lund), the Netherlands (Amsterdam), and Denmark (Copenhagen) throughout the 1990s. Huisingh was also active in Poland during the 1980s and 1990s, particularly collaborating with institutions in Łódz [18]. According to T. Markowski, Huisingh's collaboration with the University of Łódź led to establishing the Clean Technologies Foundation "Techeko." At the same time, Łódź University of Technology launched the Pollution Prevention Center, further solidifying the city's role in advancing environmentally conscious technological initiatives [18].

The academic literature highlights the challenges of unsustainable urban development in Polish cities during the early 21st century [21]. These difficulties were attributed mainly to historical legacies, delayed modernization, insufficient resources, inefficient property markets, and regulatory frameworks poorly adapted to the demands of a market economy. In response, the implementation of smart governance solutions became essential. This approach facilitated the adoption of a combined strategy, integrating selective technological policies with horizontal innovation policies, aimed at bridging the developmental gap and aligning Poland with other European nations [18].

3. General outlook on smart cities and smart governance in Poland

3.1. Polish government policies for smart cities and smart governance

Urban development policy has evolved significantly in Poland, reflecting diverse contexts and priorities [22]. In the 1990s, the focus was primarily on quantitative indicators such as city population size, the value of fixed assets accumulated in specific areas, spatial expansion, and production volume [23]. As areas with the highest capacity to drive economic growth, cities have increasingly assumed a crucial role in shaping development policies at both the national and European levels [24]. This is evidenced by approximately 80% of Poland's population residing in urbanized areas. Consequently, effective interventions targeting social and economic processes are increasingly directed toward urban municipalities and their broader functional zones, particularly those fostering non-agricultural activities [25].

The current long-term strategy, the National Regional Development Strategy 2030 [26], addresses the issue of smart cities. A key condition for Polish regions to compete effectively in the global market is to increase their level of innovation. Strengthening regional competitive advantages will be supported by implementing the smart city concept, which gives particular attention to the use of cutting-edge technologies, particularly information and communication technologies (ICT) and open public data.

These innovations aim to enhance urban management, improve residents' quality of life, and encourage active citizen participation in shaping their cities [26]. Interestingly, the concept of smart villages also emerges within this framework as a response to the demand for innovative solutions in the governance and operation of rural areas. This approach integrates new technologies, open data utilization, and social participation while emphasizing the importance of human engagement and community-driven development [26].

Since 2018 [27], Poland has operated the Internet of Things (IoT) Working Group, a platform for dialogue between the government, businesses, non-governmental organizations, academic institutions, and research centers. The group focuses on identifying areas where improvements are needed to foster the development and dissemination of IoT applications. In its 2018 report, *IoT in the Polish Economy* [28], the authors highlighted the rapid growth of smart city solutions, which address numerous challenges arising from rapid urbanization. They also noted that these trends are expected to intensify further. The report outlined examples of European urban solutions, potential issues with their implementation in Poland, and recommendations for avoiding such obstacles [28].

As of 2024, the topics addressed by the IoT Working Group have been incorporated into the activities of the Artificial Intelligence (AI) Working Group. This group was established to identify actions necessary for creating favorable conditions in Poland for the application of AI in both the private and public sectors, as well as in scientific research [29]. The AI Working Group's most recent report, published in October 2024 [30], covered smart cities and smart governance. It particularly emphasized cybersecurity, the increased practical use of urban data in decision-making and service delivery, and the need to develop a comprehensive Smart City Strategy. The report also called for the creation of model frameworks and best practices for the Information Architecture of Smart Cities.

New principles that may impact the functioning of smart cities were outlined in the report *Competences and Governance Practices for Artificial Intelligence in the Public Sector* [31], published on November 25, 2024. This report is particularly significant given that, despite the transformative potential of AI, recent studies indicate that its adoption in the public sector remains at an early stage [32]. With growing interest in AI's role in public administration, fueled by initiatives like the EU AI Act [33], there is an urgent need to understand the specific competencies required of public managers and the governance practices necessary to effectively implement AI [31]. The report focuses on governance practices, categorized into procedural, structural, and relational dimensions [31]. The rules

can serve as a structured guide to the competencies and governance strategies essential for effectively integrating AI into public sector operations.

3.2. The prevalence of smart solutions in Polish cities

Central and Eastern European countries, including Poland, are typically absent from global smart city rankings due to their smaller size and fewer implemented innovative solutions compared to those of their Western counterparts [13]. According to the Institute for Urban and Regional Development, only 15% of municipalities in Poland have a dedicated smart city strategy, and just 9% focus on digital transformation [34]. The legal framework for municipal development strategies is provided in Article 10e et seq. of the Act of 8 March 1990 on Municipal Government, with the concept of smart cities often appearing in local resolutions [35] .

In the 2024 Smart City Index by the IMD Institute in Lausanne, Warsaw and Krakow ranked 38th and 76th [188], respectively, while no other Polish cities were included. Initiatives in major Polish urban centers, such as Warsaw, Cracow, Gdansk, Wroclaw, and Łódź, predominantly emphasize administrative strategies like e-government and e-services. Polish discourse reflects a consensus that smart city strategies are viewed as a means to address economic, fiscal, and operational challenges, alongside sustainability goals [14]. However, as highlighted in A. Sobol's analysis based on Giffinger's indicators, large Polish cities generally lag behind their Western counterparts like Glasgow and Stockholm in most dimensions of smartness. This disparity is attributed to conservative governance traditions and limited transparency, which hinder efforts to enhance citizen participation and engagement [14] [37].

Polish cities are gradually incorporating smart solutions into their operations; however, experts advise against directly replicating the strategies of Western European cities. Differences in historical context, development trajectories, and GDP levels make such transfers prone to failure [37]. Unlike cities such as Zurich or Oslo, which topped the 2024 rankings for best smart cities [35], Polish municipalities often lack comparable financial resources. Insufficient funding remains the primary barrier to digital transformation in local government offices, as reported by approximately 92% of surveyed cities. Other challenges, though less significant, include employee resistance to change (51%), limited competencies among officials (42%), and restrictive legal frameworks (40%) [36].

The shortcomings of cities in Poland do not disqualify them as candidates for implementing smart city principles. Instead, these challenges present opportunities to improve the functioning of local government administration [38]. The increase in Poland's urban population raises the need for efforts to organize space to make optimal use of urban space and public services [38]. Developing innovation systems at the county level offers several advantages: a relatively high level of social capital, fostering informal ties between entrepreneurs and innovators; alignment between counties' legal functions and the goals of innovation systems, such as supporting local development and knowledge transfer; and the potential to establish best practices in innovation management, which are currently underdeveloped.

Furthermore, innovation systems could counteract brain drain and depopulation by making counties more attractive to the creative class, contributing to sustainable development, and professionalizing local administration [38].

4. City of Łódź and its smart governance and smart city solutions

4.1. Strategy for the Development of Łódź 2030+

The foundation for Łódź's development as a smart city lies in the *Strategy for the Development of Łódź 2030+* [39], implemented in November 2021. Under the slogan *A City Built Together,* the strategy envisions transforming Łódź into a participatory urban environment collaboratively shaped by its residents. The document outlines four main strategic objectives, 26 thematic areas, and 12 specific investment projects worth over 8 billion PLN [40]. Its goals encompass ensuring safety and access to essential resources, education, and intelligent infrastructure; fostering economic and social development through revitalization programs, service expansion, creative industries, and business tourism; enhancing recreational and cultural opportunities; and implementing projects in culture, art, ecology, urban management, and spatial planning [39].

A central priority of the strategy is advancing Łódź's transformation into a smart city. The document highlights rapid technological development as a significant opportunity for the city, aiming to harness it fully to support sustainable development and address societal needs [39]. Referring to the concept of a smart city, the strategy emphasizes the importance of viewing the city as a network of collaborative relationships grounded in a sense of community and an open, diverse, and secure urban environment [39].

The strategy identifies open data as a key tool for achieving smart city objectives, enabling stakeholders to co-create urban development. It prioritizes tasks associated with smart governance, including intelligent energy management for municipal facilities, housing and communal resource management, social policy, and traffic, parking, and payment systems. It also stresses the need for real-time information systems and online data sharing with residents and application developers. However, achieving these goals requires enhancing wireless networks and telecommunication standards, particularly focusing on cybersecurity [40].

Environmental considerations are also a cornerstone of Łódź's smart city vision. The strategy underlines raising ecological and climate awareness among residents, fostering positive attitudes, strengthening the city's ecological systems, and supporting pro-environmental initiatives aimed at achieving a zero-emission urban model.

4.2. Smart governance in practice

4.2.1. Smart Lodz

To prepare this paper, an interview was conducted on December 3, 2024, with Wojciech Ciesielski, Chief Information Officer at City of Łódź Office, who provided insights into the activities and strategic projects of Smart Lodz [41], a unit operating under Information Technology Department, Division of City Digitization. This unit is responsible for implementing smart city technologies aimed at transforming municipal governance and infrastructure. Among the priority initiatives is the comprehensive inventory of municipal

data, including internal datasets for administrative use and publicly accessible information planned for integration into an open data portal. Scheduled for launch in winter 2025, this portal will provide access to data on municipal buildings, statistics, and city projects, promoting transparency and civic engagement. Another flagship project involves the development of a digital twin of Łódź, which was created using laser scanning technologies. This digital twin aims to integrate data across various administrative sectors, enabling holistic analysis of urban infrastructure such as transportation networks, sewage systems, and public safety frameworks, thereby facilitating coordinated planning and efficient responses to urban challenges.

Furthermore, the city is expanding its use of robotic process automation (RPA) within administrative operations. Currently deployed in eight systems, RPA tools support tasks such as identifying unpaid municipal fees, streamlining the issuance of payment notices, and automating repetitive processes.

Plans are underway to extend these applications to additional administrative functions. Additionally, efforts to improve internal efficiency include the development of a fully digital document management system, which will eliminate paper-based processes, optimize invoice handling, and align with national-level digitization initiatives. This project is currently undergoing testing and represents a critical step towards modernizing municipal operations.

Łódź is also fostering partnerships with private sector entities to pursue innovation. Through initiatives such as the Urban Tech Hub, launched by the Polish Development Fund [42], the city collaborates with startups and entrepreneurs specializing in smart technologies. This program has facilitated cooperation between municipalities and 20 startups, encouraging the co-creation of innovative solutions tailored to urban challenges. These projects underscore Łódź's commitment to advancing smart city principles, enhancing administrative efficiency, and promoting sustainable urban development.

4.2.2. Open data

Considering that open data policies are one of substantial elements of smart city policies [43], [44, 45], the Łódź was introduced in December 2015 as part of the *Łódź - An Open City* Program. This policy identifies open access as a foundational pillar of the urban community. The publication of information is framed as a means to facilitate citizen participation in city governance and an opportunity to strengthen social trust. The data made available covers diverse aspects of urban life in Łódź.

As part of the open data policy, the municipal resources provide information on various topics, including residents' places of birth, popular names given to newborns, and the number of permanent residents, broken down by district, gender, and age group. Other publicly accessible datasets include registers of legal acts, public transport schedules, and a calendar of municipal events. Data on environmental protection notifications and spatial planning are also shared in urban planning and architecture.

Additionally, lists of vehicle inspection stations, driver training centers, councilors' interpellations, and job opportunities at the City of Łódź Office are available online [43]. Łódź also provides spatial and planning data through online platforms, granting citizens access to local land-use plans, property boundary maps, and other source materials [46]. These datasets include detailed plans that offer sufficient resolution to distinguish individual buildings and architectural features, promoting transparency and informed civic engagement in urban development processes [47, 48]. Open data processes will be further developed within the activities of the Smart Łódź municipal unit.

4.2.3. Participatory budgeting as a smart city tool

One of the thriving aspects of smart cities and smart governance tied to social participation is the participatory budgeting process [201, 196], which relies on digital tools. This initiative can be situated between the second and third generations of smart city tools [48] and has proven to be an effective means of engaging residents in addressing various urban issues, both large and small. Participatory budgeting aligns with various citizen participation instruments and fits within the broader concept of open governance [48].

In Poland, the idea of participatory budgeting emerged relatively late, first implemented in 2011 by Sopot, a city in the north of Poland [50]. Following Sopot's lead, other Polish cities, including Łódź and Poznań, adopted the mechanism, allocating significant sums for its execution. Łódź's participatory budget stands out as the largest among those implemented by Polish cities [50].

The 12th edition of the Łódź Participatory Budget 2024 allocated PLN 34.7 million for project implementation [51]. This includes PLN 25.7 million for neighborhood-level projects and PLN 9 million for city-wide initiatives. In the 11th edition, over 73,300 residents cast over 522,260 valid votes [51]. Any Łódź resident can propose a project with the support of at least 15 other residents. Projects can be either neighborhood-specific or city-wide, with the cost not exceeding the budget allocated for the respective area or PLN 2 million for city-wide projects [51].

Voting is conducted via an online platform [52]. This year's edition featured 848 proposed projects, with 258 approved projects, including several addressing smart city themes [52]. One notable city-wide project is *Fix Łódź* (“Napraw Łódź”), a smartphone application designed to report urban issues [53]. The app enables residents to quickly and easily notify the city of problems such as potholes, damaged sidewalks, vandalized greenery, or illegally parked vehicles. This project received funding of PLN 650,000 [54], highlighting its importance in fostering civic engagement and utilizing technology to improve urban living conditions.

4.2.4. Smart revitalization projects

Łódź is a post-industrial city that is actively implementing numerous revitalization projects. The area requiring revitalization occupies 17.83 km², representing 6.08% of the city’s total area. The value of ongoing multi-year projects currently amounts to PLN 981.08 million [55]. As such, revitalization issues are significant for residents regarding quality of life, aesthetics, and the city’s budget. The online platform *rewitalizacja.uml.lodz.pl* allows Łódź

residents to track the progress of revitalization efforts and the status of revitalized areas. This portal was developed as part of the project *ICT Spatial Services in the Revitalized Urban Area of Łódź,* executed by the Łódź Geodetic Center [56].

Through the *rewitalizacja.uml.lodz.pl* portal, residents can access information about the most significant revitalization projects in the city, including eight projects under the *Revitalization of the Central Łódź Area,* the revitalization of the Księży Młyn district, and other smaller initiatives. The platform provides detailed descriptions of each project's scope of work, such as renovations of tenement houses, buildings, roads, and public spaces, along with an updated schedule and information on completed activities [56].

Additionally, as part of the EU-funded *ICT Spatial Services in the Revitalized Urban Area of Łódź* project, digital 3D models of revitalized areas were made available on an online platform [57]. These visualizations offer residents a better understanding of the city's spatial changes, allowing them to assess and engage with the planned transformations [58]. Thus, citizens are part of the revitalization process.

4.2.5. Smart city solutions in traffic management

Smart city solutions in Łódź extend to traffic management and urban safety, as exemplified by the Area Traffic Management System, the largest intelligent transport system (ITS) implemented in any urban agglomeration in Poland [59]. This system integrates advanced technologies, including cameras and video monitoring across nearly 60 intersections and remote traffic signal control. Most intersections are equipped with modern signal controllers, induction loops, detectors, sensors, and fiber-optic connections linked to the Traffic Management Center operated by the Łódź Board of Roads and Transport.

Real-time traffic information is made accessible through the ITS platform, offering users comprehensive data on traffic conditions, road incidents, restrictions, and live CCTV camera feeds [60]. Additionally, the city employs electronic driver information boards and Passenger Information Systems, such as electronic displays at tram stops [56], supported by the *myBus Online* mobile application. These systems enhance urban mobility by providing real-time public transport schedules and service updates [61].

4.2.6. A safe smart city

Łódź has implemented a comprehensive camera system to enhance urban safety [56]. The Municipal Monitoring System (SMM), managed by the City Guard, conducts 24/7 surveillance of public spaces.

The SMM comprises 1,365 cameras deployed across 459 locations, including 217 cameras operated by the Board of Roads and Transport in Łódź, positioned at 141 sites. Recorded data from the system is retained for up to 30 days [62].

The camera network covers key transportation routes, historical landmarks undergoing revitalization, and areas of significant public activity, such as banks, government offices, and religious institutions. Notably, some camera placements are determined through public input and financed via the participatory budget [62]. For instance, a thermal imaging

camera was installed in a city park, enabling effective monitoring even in low-light conditions or adverse weather [56]. The system's video feeds are accessible not only to the City Crisis Management and Security Department but also to the regional and municipal police headquarters and the City Guard. This integration across municipal and law enforcement agencies underscores Łódź's commitment to utilizing smart surveillance technologies to ensure public safety and respond effectively to emergencies [56].

5. Country-wide innovations that facilitate the deployment of smart infrastructure in Łódź

5.1. ePUAP system

Several initiatives undertaken at the central government level have proven highly beneficial from the perspective of smart cities and smart governance. The examples below illustrate that Poland is not merely fostering individual smart cities but is also striving to establish a nationwide system of smart governance and mobile government (m-government). M-government refers to the use of mobile devices and applications by government authorities to facilitate rapid communication and interaction with citizens [63].

One notable example is the ePUAP platform (Electronic Platform of Public Administration Services).

This IT system enables public institutions to provide services through a single online access point. The legal framework for ePUAP is minimal, specifying only essential elements such as the availability of information about electronic inbox addresses, terms of use defined in secondary legislation, and partial regulation of identification and authentication methods [64].The platform operates under the supervision of the minister responsible for digitalization, who establishes its scope and operational rules through regulations.

Launched in 2008, ePUAP underwent significant enhancements with the introduction of ePUAP2 in 2009. This updated system expanded its functionality by introducing the "trusted profile." The trusted profile, a free alternative to a qualified electronic signature, enables users to authenticate documents electronically, reducing the need for in-person visits to administrative offices and streamlining administrative processes [65]. This development remains one of the pivotal ones for the digitalization of the Polish state, which, in turn, makes the administration smarter. In addition to facilitating communication with public authorities, the platform supports data exchange among institutions via the Central Document Template Repository (CRD). The CRD ensures uniformity in document standards, accelerates the deployment of new services, and lowers operational costs [65].

The ePUAP platform also centralizes access to various electronic public services, standardizes administrative document templates, and enhances interoperability between automated and AI-based systems within the state. These features position ePUAP as a cornerstone of Poland's efforts to advance smart governance and m-government, contributing to greater administrative efficiency and accessibility.

5.2. mObywatel app

One of the most widely utilized digital tools in Poland is the mCitizen (mObywatel) mobile application, developed by the Research and Academic Computer Network (Naukowa i Akademicka Sieć Komputerowa – Państwowy Instytut Badawczy – NASK) [66] and further enhanced by the Central IT Center under the direction of the Ministry of Digital Affairs.

Launched in October 2017 [67], the mCitizen app operates under the regulatory framework provided by the Law on Access to Public Information [68]. A significant upgrade, mCitizen 2.0, was introduced in 2023, coinciding with the enactment of new legislation to integrate a broader range of digital administration solutions. This legislative update [69] established a comprehensive framework for the app's operation, including enhanced identity verification and authentication mechanisms, alongside conditions for the delivery of its digital services [70].

The mCitizen app simplifies interactions with public administration by enabling users to create "wallets" of personal documents [71]. The central feature is the mID (mDowód), a digital identity document equivalent in legal validity to a physical ID card, featuring its series, number, and expiration date [72]. Public and financial institutions must accept the mID, with exceptions limited to international border crossings and applications for new ID cards [73]. The app facilitates access to personal data from public and private registers, including legal records and information on items linked to the user or their dependents. It also supports functionalities such as document storage, verification, and sharing, using a trusted profile for authentication, and electronic payments for administrative services [70]. Given that the app is intended for residents, not only Polish nationals, the mCitizen app accommodates Ukrainian nationals who entered Poland after February 24, 2022 by providing an electronic identification document [74].

Simultaneously, mCitizen provides access to various services, including driver's licenses, vehicle registration data, drug prescriptions, and educational or professional ID cards. Another feature, the ePayments, is currently piloted in 58 cities [75]. It allows users to pay administrative fees directly via their smartphones. Moreover, the app is a gateway to other e-government services and online forms [76]. This greatly facilitates all the administrative procedures and day-to-day activities performed by the citizens of smart cities. Since the mID launch, the app has experienced nearly 5.1 million downloads, including over 600.000 new users who had not previously engaged with the mCitizen platform [77].

5.3. Public Information Bulletin

A central feature of smart governance is ensuring access to information [78], exemplified in Poland by the Public Information Bulletin (Biuletyn Informacji Publicznej, BIP). This ICT-based platform operates as a unified system of websites, mandating public authorities and other entities to maintain their own BIP pages [79]. Introduced in 2001 under the Law on Access to Public Information, the BIP was a forward-looking initiative, launched when internet access in Poland was still limited and many public offices lacked websites [80]. The legislation set minimum content standards, making it a legal requirement to uphold these websites [81].

The BIP is the official system of unified public records. It ensures free and continuous access to public information through its leading portal, www.bip.gov.pl, and individual webpages managed by public entities such as municipal offices, courts, and utility companies [82]. These entities are legally required to disclose specific information, including their legal status, competencies, governing bodies, assets, procedures for handling cases, and details of registers, records, and archives. The system also includes guidelines for accessing these data sources [83].

Designed to provide a centralized and easily navigable repository, the BIP system features a user-friendly interface accessible from any internet-enabled device [84]. A key advantage lies in its security and reliability: only authorized individuals can publish information on official entity pages, ensuring data authenticity and protection against unauthorized modifications. This structured approach underpins transparent governance and fosters trust between public authorities and citizens, aligning with the principles of smart governance.

5.4. Electronic Document Management System

Efficient administrative functioning relies on effective document flow to streamline procedures [85].

To this end, work began in 2016 on implementing the Electronic Document Management System (Elektroniczne Zarządzanie Dokumentacją – EZD RP), a unified platform for document management across Poland. The initiative aims to establish a standard for EZD-class systems in public administration, facilitating faster and more efficient case processing [37]. The legal basis for EZD RP includes the Law of 14.07.1983 on the national archival resource and archives [86] and the Prime Minister's 2011 Ordinance on office instructions, unified thematic files, and the organization and operation of institutional archives [87]. These regulations govern documentation practices for both electronic and paper formats.

EZD is an ICT system designed to manage documentation electronically, enabling clerical tasks, case processing, and creating and storing electronic documents. From January 2025, government entities will be required to adopt the system for electronic deliveries. Local government units, metropolitan associations, and budgetary entities must also comply with these requirements for registered electronic correspondence delivery by January 2025 and hybrid public services by October 2029 [88]. Furthermore, beginning in January 2028, all public entities must use an EZD-class system for case documentation [88].

The *Digital State Strategy* sets an ambitious goal: by 2035, all entities performing public tasks are expected to use electronic document management systems, ensuring full digital integration in public administration processes [89].

6. Conclusions: The challenges and perspectives of the smart city of Łódź

Łódź employs a variety of smart city solutions developed at both the municipal and national levels; however, their implementation faces significant challenges. While national plans outline general smart city objectives, there is insufficient support from the central government in the form of actionable strategies, coordinated funding programs, or expertise tailored to the specific needs of local offices [90].

This lack of a unified approach from central institutions, such as the Ministry of Internal Affairs and Administration or the Ministry of Digital Affairs, implies that the advancement of smart city initiatives, including AI systems, largely depends on the financial policies and capacities of individual municipalities [91].

Complex public procurement procedures further complicate the development of these systems.

Designing and implementing a smart city system for a local administration is a lengthy process requiring substantial resources and specialized knowledge, often straining the capabilities of local government units [91].

Another challenge to the effective functioning of smart city infrastructure is residents' level of digital competence. Although internet accessibility in Poland is high, with less than 5% of households lacking internet access in 2023 [92], digital exclusions remain prevalent. This exclusion stems from a lack of digital skills, attitudes, and knowledge [245]. In 2021, 63% of individuals aged 16 to 74 who did not use the internet cited a lack of necessity, while 50% identified a lack of skills as the primary barries [245].

These challenges underscore the necessity for public administration to adopt proactive measures. The residents of Łódź require not only increased digital awareness and accessibility but also reliable public services delivered through smart solutions. In this context, initiatives such as the AI-powered system currently under development by the Smart Łódź unit, aimed to streamline the drafting of environmental decisions by improving the data flow on land parcels between municipal departments [91], are of great importance. Such projects exemplify the city's commitment to leveraging technology to address administrative inefficiencies and meet the evolving needs of its citizens.

References

[1] W. Reymont and A. Knopf, The Promised Land, 1928.

[2] S. O. i. Lodz, "Data about Lodz voivodeship," 2024. [Online]. Available: https://lodz.stat.gov.pl/dane-o-wojewodztwie-lodzkim. [Accessed 20 November 2024].

[3] C. o. Ł. Office, "Łódź w pigułce," 2024. [Online]. Available: https://uml.lodz.pl/dla-mieszkancow/o-miescie/lodz-w-pigulce/. [Accessed 20 November 2024].

[4] J. Jakóbczyk-Gryszkiewicz, "Łódź u progu XXI wieku," *Studia Miejskie,* vol. 8, 2011.

[5] J. Jakóbczyk-Gryszkiewicz, "Łódź ciągle ziemią obiecaną?," *Konwersatorium Wiedzy o Mieście,* vol. 36, no. 6, 2021.

[6] M. Koter, "Geneza układu przestrzennego Łodzi przemysłowej," *Państwowe Wydawnictwo Naukowe,* 1969.

[7] J. Jakóbczyk-Gryszkiewicz, "Walory turystyczne pałaców łódzkich fabrykantów," *Turyzm* , vol. 8, no. 2, 1998.

[8] G. Karpińska, "Miasto wymazywane: historia łódzkiego przypadku," *Studia Etnologiczne i Antropologiczne,* vol. 8, 2024.

[9] W. Cudny, "Model przemian miasta postsocjalistycznego – przykład Łodzi," *Studia Miejskie,* vol. 4, 2011.

[10] D. Stawasz and B. Banachowicz, "Łódź po 20 latach transformacji – osiągnięcia i perspektywy dalszego rozwoju," *Studia miejskie,* vol. 4, 2011.

[11] C. o. Ł. Office, "Zintegrowana Strategia Rozwoju Łodzi 2020+," 2015. [Online]. Available: https://partycypacjaobywatelska.pl/wp-content/uploads/2015/10/lodz_projekt_strategii_zintegr_rozwoju_lodzi_2020.pdf. [Accessed 20 November 2024].

[12] F. O. Business, "Łódź – SMART CITY," 2017. [Online]. Available: https://focusonbusiness.eu/pl/wiadomosci/lodz-smart-city/9808. [Accessed 20 November 2024].

[13] M. Kola-Bezka, "Smart cities in Central and Eastern Europe: viable future or unfulfilled dream?," *Journal of International Studies,* p. 9, 2016.

[14] G. Masik, "Smart City strategies and new urban development policies in the Polish context," *Cities,* vol. 108, 2021.

[15] C. Manville, "Mapping Smart Cities in the EU. Study," *Directorate General for Internal Policies,* 2014.

[16] R. Hollands, "Will the real smart city please stand up?," *City: Analysis of Urban Trends, Culture, Theory, Policy, Action,* vol. 12, no. 3, 2008.

[17] I. Drobot, "Attacks against data security in smart cities: hypothetical scenarios or reality?," in *Proceedings of the 5th International Conference on Machine Intelligence & Security for Smart Cities (TRUST),* 2024.

[18] T. Markowski, "Strategiczne dylematy polityki innowacyjnej zorientowanej na inteligentne specjalizacje," *Studia Komitetu Przestrzennego Zagospodarowania Kraju PAN,* vol. 155, 2013.

[19] B. Gontar, "Deployment of Smart City Concept in Poland. Selected Aspects," *Management of Organizations: Systematic Research,* vol. 67, 2013.

[20] I. Wieczorek, "Wstęp," *Zarządzanie w jednostkach samorządu terytorialnego,* 2015.

[21] A. Noworól, "Zarządzanie miastem: podstawy teoretyczne," *Strategiczne zarządzanie miastem: w teorii i praktyce Urzędu Miasta Poznania,* 2011.

[22] T. Kaczmarek and Ł. Mikuła, "Ustroje terytorialno-administracyjne obszarów metropolitalnych w Europie," *Bogucki Wydawnictwo Naukowe,* 2007.

[23] M. Murzyn, "Dziedzictwo kulturowe a rozwój miasta," *Zeszyty Naukowe Akademii Ekonomicznej w Krakowie,* vol. 587, 2002.

[24] P. Makulski, "Nowoczesne technologie komunikacyjne jako narzedzia wspierajace zarzadzanie miastem," *Wydawnictwo Uniwersytetu Łódzkiego,* 2015.

[25] T. Markowski, "New externalities in development of creative and intelligent city– theoretical concept," *Studia Regionalia,* vol. 51, 2017.

[26] "“National Strategy for Regional Development 2030," Resolution No. 102 of the Council of Ministers, 2019.

[27] "Dołącz do Grupy Roboczej ds. Internetu Rzeczy (IoT)," *Ministry of Digital Affairs,* 2018.

[28] L. Maśniak, "IoT w Polskiej Gospodarce Raport Grupy Roboczej do spraw Internetu Rzeczy przy Ministerstwie Cyfryzacji," 2019.

[29] "Grupa Robocza ds. Sztucznej Inteligencji (GRAI)," *Ministry of Digital Affairs,* 2024.

[30] "Transformacja Polski dzięki wykorzystaniu inteligentnych rozwiązań cyfrowych Studium programu," *AI Working Group,* 2024.

[31] R. Medaglia, "Competences and governance practices for artificial intelligence in the public sector," Luxembourg, 2024.

[32] K. Steculа and R. Wolniak, "Artificial Intelligence in Smart Cities—Applications, Barriers, and Future Directions: A Review," *Smart Cities,,* vol. 7, no. 3, 2024.

[33] "laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828," *Official Journal of the European Union,,* 13 June 2024.

[34] A. Miazga, "Cyfryzacja urzędów miast, Instytut Rozwoju Miast i Regionów," 2022.

[35] K. Wojciechowska, "Polish smart city – the legal perspective," *Studia Iuridica,* vol. 99, 2023.

[36] "IMD Smart City Index," 2024.

[37] A. Sobol, "Inteligentne miasta versus inteligente miasta versus zrównoważone miasta," *Studia Ekonomiczne,* vol. 320, 2017.

[38] J. Fazlagić, "Jak wykorzystać koncepcję smart cities oraz pokrewną smart specialization do wsparcia rozwoju mniejszych miast w Polsce," *Zarządzanie w jednostkach samorządu terytorialnego,* 2016.

[39] C. o. Ł. Office, "Strategia Rozwoju MIasta Łodzi 2030+," 2024.

[40] T. Łódź, "Radni przyjęli strategię rozwoju miasta Łodzi do 2030 roku," 2021.

[41] "Smart Lodz," *LinkedIn.*

[42] "PFR uruchomił Urban Tech Hub – przestrzeń rozwijania nowych technologii dla miast i organizacji," *Polish Development Fund,* 2024.

[43] "Otwarte dane," *City of Łódź Office,* 2017.

[44] C. Ciuchi, "Challenges and opportunities in designing data structures for a smart city," in *Smart Cities International Conference (SCIC) Proceedings*, 2023.

[45] E. Przeybilovicz, "Challenges and opportunities in designing data structures for a smart city," *Local Government Studies,* vol. 48, no. 1, 2020.

[46] Łódzki Ośrodek Geodezji, "Nowa Mapa Łódź," 2017. [Online]. Available: https://nowa.mapa.lodz.pl/.

[47] National Institute of Local Government, "Rozwiązania Smart City w Polsce,," 2023. [Online]. Available: https://www.google.com/search?q=rozwi%C4%85zania+smart+city+w+%C5%81odzi&rlz=1C5CHFA_enPL935PL937&oq=rozwi%C4%85zania+smart+city+w+%C5%81odzi&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIGCAEQRRg80gEINTA0NWoxajSoAgCwAgE&sourceid=chrome&ie=UTF-8#:~:text=Rozwi%C4%85zania. [Accessed 20 November 2024].

[48] City of Poznań Office, "Budżet obywatelski, czyli smart city 2.5," 2020. [Online]. Available: https://www.poznan.pl/mim/smartcity/news/budzet-obywatelski-czyli-smart-city-2-5,154391.html. [Accessed 29 November 2024].

[49] D. Kumar, "Actual Practices of Citizen Participation in Smart Cities," *Smart Cities and Regional Development Journal,* vol. 8, no. 2, 2024.

[50] M. Kalisiak-Mędelska, "Budżet obywatelski w Polsce. Analiza porównawcza Łodzi i Poznania," *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu,* vol. 443, 2016.

[51] City of Łódź Office, "Budżet Obywatelski Łódź 2025. Niemal 35 mln złotych na realizację zadań! Od kiedy głosowanie?," 2024. [Online]. Available: https://lodz.pl/artykul/budzet-obywatelski-lodz-2025-niemal-35-mln-na-realizacje-zadan-od-kiedy-glosowanie-64057/. [Accessed 29 November 2024].

[52] XII Edycja Budżetu Obywatelskiego. [Online]. Available: https://budzetobywatelski.uml.lodz.pl/. [Accessed 30 November 2024].

[53] XII Edycja Budżetu Obywatelskiego, "Napraw Łódź – aplikacja na smartfona do zgłaszania problemów w przestrzeni miejskiej," 2024. [Online]. Available: https://budzetobywatelski.uml.lodz.pl/szczegoly-projektu-2025-1401705137-1401705686-584231d63b354d5fadfa846d610cae7b . [Accessed 30 November 2024].

[54] City of Łódź Office, "Wyniki ŁBO 2024/2025," 2024. [Online]. Available: https://uml.lodz.pl/budzet-obywatelski/lbo-2024/2025/zlozone-projekty/wyniki-lbo-2024/2025/ (30.11.2024).. [Accessed 30 11 2024].

[55] M. Ślebocka, "The Social Aspect of Revitalization – The Łódź City Case Study," *Journal of Finance and Financial Law,* vol. 2, no. 30, 2021.

[56] A&S Polska, "Smart City," 2019. [Online]. Available: https://aspolska.pl/wp-content/uploads/2019/06/lodz.pdf. [Accessed 20 November 2024].

[57] City of Łódź Office, "Informatyczne usługi przestrzenne w rewitalizowanej strefie wielkomiejskiej miasta Łodzi(2016-2022)," 2016. [Online]. Available: https://rewitalizacja.uml.lodz.pl/rewitalizacja/wybrane-projekty-rewitalizacji/informatyczne-uslugi-przestrzenne-w-rewitalizowanej-strefie-wielkomiejskiej-miasta-lodzi-2016-2022/. [Accessed 25 November 2024].

[58] "Rewitalizacja Łodzi," 2022. [Online]. Available: https://360.mpu.lodz.pl/. [Accessed 25 November 2024].

[59] Sprint, "ITS w Łodzi," 2015. [Online]. Available: https://sprint.pl/pl/realizacje/its-lodz. [Accessed 1 December 2024].

[60] ITS Lodz, 2015. [Online]. Available: http://its.lodz.pl/. [Accessed 1 December 2024].

[61] Mybus online, 2012. [Online]. Available: http://www.taran.com.pl/mybusonline/. [Accessed 1 December 2024].

[62] City Guard in Łódź, "Monitoring," [Online]. Available: https://strazmiejska.lodz.pl/jak-i-co-zalatwic/monitoring/. [Accessed 1 December 2024].

[63] K. Erturk, "Trends in E-Governments: From E-govt to M-govt," *World Applied Sciences Journal*, vol. 28, no. 13, 2013.

[64] G. Szpor and K. Wojsyk, "Ustawa o informatyzacji działalności podmiotów realizujących zadania publiczne," *Article 19(a),* 2015.

[65] G. Michalczuk and A. Zalewska-Bochenko, "Platforma e-PUAP jako przykład elektronizacji usług administracji publicznej dla ludności," *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu,* vol. 450, 2016.

[66] mCitizen, "Pytania i odpowiedzi," 2024. [Online]. Available: https://info.mobywatel.gov.pl/pytania-odpowiedzi. [Accessed 1 December 2024].

[67] Ministry of Digital Affairs, "Wystartowała aplikacja mObywatel," 2017. [Online]. Available: https://www.gov.pl/web/cyfryzacja/oficjalna-premiera-aplikacji-mobywatel-transmisja-online. [Accessed 1 December 2024].

[68] "Law of 6.09.2001 on access to public information(Ustawa o dostępie do informacji publicznej)," *Official Journal of 2022 item 902.*

[69] "Law of 26.05.2023 on mCitizen app (Ustawa o aplikacji mObywatel)," *Official Journal of 2024 item 307.*

[70] A. A. Kania and et al., Zasady wydawania dokumentów i udostępniania danych w ramach rejestrów publicznych, C.H. Beck, 2024.

[71] M. Grabowska, "Koncepcja jednolitego portalu e-Government dla obywatela w Polsce," *Obywatel w centrum działań e-administracji w Unii Europejskiej, Księgarnia Akademicka,* 2023.

[72] mCitizen, "Dokumenty mDowód," 2024. [Online]. Available: https://info.mobywatel.gov.pl/dokumenty/mdowod. [Accessed 1 December 2024].

[73] Ministry of Digital Affairs, "Nowa jakość cyfrowych usług publicznych – startuje mObywatel 2.0," 2023. [Online]. Available: https://www.gov.pl/web/cyfryzacja/nowa-jakosc-cyfrowych-uslug-publicznych--startuje-mobywatel-20. [Accessed 1 December 2024].

[74] mCitizen, "Dokumenty DIIA," 2024. [Online]. Available: https://info.mobywatel.gov.pl/dokumenty/diia. [Accessed 1 12 2024].

[75] mCitizen, "Lista urzędów w pilotażu," 2024. [Online]. Available: https://www.gov.pl/web/eplatnosci/lista-urzedow-w-programie . [Accessed 1 12 2024].

[76] Ministry of Digital Affairs, "mObywatel w przeglądarce," 2024. [Online]. Available: https://www.gov.pl/web/eplatnosci/lista-urzedow-w-programie . [Accessed 1 12 2024].

[77] Ministry of Digital Affairs, "Ponad 5 mln Polaków korzysta z mDowodu," 2023. [Online]. Available: https://www.gov.pl/web/cyfryzacja/ponad-5-mln-polakow-korzysta-z-mdowodu. [Accessed 1 12 2024].

[78] A. Noworól, "Smart governance and metropolitan dimension, Case for Krakow, Poland," *Smart Cities and Regional Development Journal,* vol. 2, no. 1, 2018.

[79] A. Mika, "Znaczenie Biuletynu Informacji Publicznej w zapewnieniu jawności działań administracji publicznej na przykładzie zamówień publicznych," *Wydawnictwo Uniwersytetu Wrocławskiego,* no. 323, 2017.

[80] K. Izdebski, "Article 8," *Ustawa o dostępie do informacji publicznej,* 2023.

[81] I. Kamińska and M. Rozbicka-Ostrowska, "Article 8" in I. Kamińska and M. Rozbicka-Ostrowska (eds.) Ustawa o dostępie do informacji publicznej. Komentarz," Wolters Kluwer, 2015.

[82] B. Wilk, Prawne i praktyczne aspekty udostępniania informacji w Biuletynie Informacji Publicznej, C.H. Beck, 2020.

[83] Public Information Bulletin, "Czym jest BIP," 2024. [Online]. Available: https://www.gov.pl/web/bip/czym-jest-bip. [Accessed 1 December 2024].

[84] K. Izdebski, "Article 9," *Ustawa o dostępie do informacji publicznej,* 2023.

[85] R. Raczko, "Elektroniczne zarządzanie dokumentacją w e-administracji," *Roczniki Kolegium Analiz Ekonomicznych,* vol. 44, 2017.

[86] "Law of 14.07.1983 on the national archival resource and archives (Ustawa o narodowym zasobie archiwalnym i archiwach)," *Official Journal of 2020 item 164.*

[87] "Ordinance of the President of the Council of Ministers of 18.01.2011, on the registry instruction, uniform material file lists and the instruction on the organization and scope of operation of company archives," *Official Journal of 2011 no. 14 item 67.*

[88] Gov.pl, "Funkcje system EZD," 2024. [Online]. Available: https://www.gov.pl/web/ezd-rp/funkcje-systemu. [Accessed 1 December 2024].

[89] Gov.pl, "EZD ważnym elementem strategii cyfryzacji Polski," 2024. [Online]. Available: https://www.gov.pl/web/ezd-rp/ezd--waznym-elementem-strategii-cyfryzacji-polski. [Accessed 1 December 2024].

[90] Ministry of Digital Affairs, "W drodze ku doskonałości cyfrowej Raport końcowy z badania rynku na temat gotowości wdrożenia, poziomu wiedzy i wykorzystania nowych technologii cyfrowych w jednostkach samorządu terytorialnego," 2023. [Online]. Available: https://cwd.info.pl/wp-content/uploads/2024/01/Raport_koncowy_z_badania_samorzadow_terytorialnych_Ministerstwo-Cyfryzacji.pd. [Accessed 1 December 2024].

[91] A. Olbryk, Interviewee, *Information obtained during an interview with Wojciech Ciesielski – the Chief Information Officer of the City of Łódź.* [Interview]. 2 October 2024.

[92] Statistics Poland, "Information society in Poland," 2023. [Online]. Available: https://stat.gov.pl/en/topics/science-and-technology/information-society/information-society-in-poland-in-2023,2,13.htm. [Accessed 2 December 2024].

[93] P. M. o. 2. i. 318., Ed."Digital Competence Development Program" (Program rozwoju kompetencji cyfrowych)," *Resolution No. 24 of the Council of Ministers of 21.02.2023 on the establishment of a government program.*