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Review

Understanding Local Government Digital Technology Adoption Strategies: A PRISMA Review

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Abstract: Digital technologies are used in various local government activities. Adopting suitable digital technology strategies could enhance service efficiency, effectiveness, and accountability. The challenges of technology adoption among local governments, however, are also evident. One of the major challenges is capacity, including the lack of knowledge or awareness of how to balance the local government's resources and the strategies that need to be implemented. This challenge also forms a research gap. The study aims to consolidate the understanding of local government digital technology adoption strategies via the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). It analyses the adoption opportunities, challenges, and strategies through the lens of people, processes, and technology frameworks. The results show that: (a) Strategies concerning the people aspects include building a platform for public participation, employees' skills, and decision-makers' positive mindset development. (b) Strategies concerning the process aspects include recognizing the players' roles, having a clear aim and procedure, proper regulation, and receiving user input. (c) Strategies considering the technology aspects include understanding the effect of the technology, technological preparedness, and convenience adoption. The findings inform local government policymakers in digital technology adoption and transformation endeavors.

Keywords: technology adoption; local government; digital transformation; technology policy; urban technology; urban policy; public policy; smart city; City 4.0

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1. Introduction

Local governments play an important role as front-line service providers to citizens, providing clear benefits for cities to become smarter and more sustainable [1–3]. Citizen dependency on the local government is high, and therefore, quick responses from the local government are anticipated among citizens. To meet citizen demand, local governments are experimenting with adopting appropriate digital technology to deliver services more efficiently, effectively, and accountably [4]. These experiments are not just about adopting new technology; they are about embracing new practices, procedures, and strategies that can improve the capacity of the local government to provide services that cater to the citizens' needs [5]. Those service provisions are more comprehensive but not limited to paying bills and local taxes, checking transit schedules, issuing and renewing licenses,

supporting business start-ups, posting complaints, offering subscription opportunities to receive real-time updates and alerts, providing online ticket booking and parking slot allocation, supporting emergency services, and so on.

The popularity of smart cities or City 4.0 urbanization brought digital transformation to the forefront of urban discourse [6–9]. Even though local governments have adopted various digital technologies, many smaller or less-resourced local governments lack the capacity to research and comprehend how new technologies might improve their operations or the lives of citizens [10]. This lack of understanding makes the adoption process challenging since investment failure is likely. Therefore, when local governments introduce digital technologies, they need a proper strategy to maintain their information technology (IT) capacity, comparative advantage, current organizational operations, managerial capabilities, and other factors influencing the decision of the government authority to adopt or reject the new technology [11].

Accordingly, it is important to understand the opportunities and challenges associated with adopting technologies so that effective strategies may be developed; because it is critical to not only be aware of the challenges posed by digital technologies but also to develop plans of action that minimize those challenges and seize the opportunities for local governments [12,13].

The combination of local government and digital technologies has been the subject of numerous studies; the literature spans from investigating the benefits and challenges associated with the adoption of a specific technology among local governments, such as information and communication technology (ICT) [14–16], artificial intelligence (AI) [17], cloud computing [18], Web 2.0 [19], the influencing factors that drove technology adoption in local governments [4,11,20], the adoption of the digital technology for the sustainability of the local government [21,22], and the employees, city managers, and chief technical officers' perception on adopting digital technology for local government functions [23–25].

Even though several reviews have been carried out, none of these comprehensively looked at digital technology adoption in local government. Accordingly, this paper aims to consolidate the understanding of the landscape of local government digital technology adoption through the following main elements: (a) types of technology utilized for local government services; (b) digital technology adoption opportunities; (c) digital technology adoption challenges; and (d) strategies derived from adopting the digital technology.

This study adopted the People–Process–Technology (PPT) framework. It is defined as "the methodology in which the balance of people, process, and technology drives action: People perform a specific type of work for an organization using technology to streamline and improve these processes" [26]. Corporate management specialist Harold Leavitt developed the PPT framework in the early 1960s and published his model for bringing about organizational change [27]. Nowadays, this model has been utilized by software companies to maintain the balance of their resources. It has been used in several research fields, such as knowledge management [28], the construction sector [29], and healthcare [30], due to its ability to improve resource utilization and operational efficiency. Therefore, the study adapts this framework to the local government context. The framework consists of the following three pillars:

- People: People are referred to as the stakeholders who are internally and externally involved in the local government function, such as city managers, employees, politicians, citizens, etc. Having the right people who clearly understand their roles and responsibilities is important. They must comprehend what they must do, why they must do it, and how the changes will impact them. Any new processes or technologies cannot be implemented without the people's full support;
- Process: The process refers to a series of procedures or actions carried out to achieve a specific outcome or how people and technology achieve a desired goal. The process is concerned with how work is done in local governments;
- Technology: Technology is the tool for carrying out the government's procedures. It concerns how technology supports the work done by local governments. New tech-

nologies impact the local government the most. The local government, however, must ensure that the technology works.

These three pillars of people, process, and technology work in concert. People and processes must adjust if digital technology changes. For instance, many local governments use advanced technologies and expensive equipment. Nonetheless, the efficiency of technology depends on how it is used and managed. People's activities will be inefficient if organizations do not implement them well. They will also waste a significant portion of the benefits that technology offers. Citizens will not be able to benefit from the technology if they do not know how to use it appropriately. If the new technology does not match the existing procedures, the results will be the same or may even worsen. On the other hand, if the organization becomes overly fixated on the process, it will produce a plan that looks nice on paper but lacks the personnel or the technological resources needed to make it work. A good balance between these three pillars is the key to the success of the local government [31].

Accordingly, this paper looks at local government digital technology adoption opportunities, challenges, and strategies through a PPT framework to understand the balance between these three pillars of local governments. Following this introduction, Section 2 introduces the materials and methods. Section 3 presents the results. Section 4 presents and discusses the key findings. Section 5 concludes the paper.

2. Materials and Methods

A systematic literature review has been carried out using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol, and the following research questions were identified for the present study: How do local governments use strategies to adopt digital technologies? The literature search task was conducted in February 2023. To answer this research question, the literature was reviewed in four steps: (a) identification; (b) screening; (c) eligibility; and (d) inclusion.

2.1. Identification

The first phase of identification involves the research aim, question, keywords, and inclusion and exclusion criteria. The research aims to consolidate the understanding of local government digital adoption strategies. The university's library search engine and Google Scholar were used to search for the literature online, including Science Direct, Scopus, Web of Science, and Open Access journals. The investigation was carried out until 10 February 2023 by using the following Boolean operation ((“digital technology*” OR “digital transformation”) AND (“local government” OR “local governance” OR “municipal” OR “municipality” OR “regional council” OR “city council”) AND (“strategy*” OR “recommendation”))). The beginning date of the search was kept open. The search resulted in a total of 443 references.

2.2. Screening

In the second screening phase, this study set out specific inclusion and exclusion criteria, as shown in Table 1, to reduce the number and help screen articles effectively. The peer-reviewed English articles that suit the research aim and have the full text available online are included in the screening process. The articles that do not belong to the inclusionary criteria are eliminated. Accordingly, the records were reduced to 265. Then, the abstract was read, and the articles irrelevant to the aim were removed. Subsequently, the suitable articles were sent to phase three, which is the eligibility phase. A total of 107 articles were included in this stage.

Table 1. The literature selection criteria.

Inclusionary Criteria	Exclusionary Criteria
Peer-reviewed journal articles	Books, chapters, conference proceedings, editorials, reports
English language	Journal articles in a language other than English
Relevant to the research aim/question	Not peer-reviewed
Full-text articles	Not relevant to the research aim/question
Available online	
Published date: published before 10 February 2023	
Case study area: unspecified	
Research method: unspecified	

2.3. Eligibility and Inclusion

During the eligibility phase, the articles were fully read, their research aim was considered, and they were further narrowed down to 95, and the final round of full-text reading shortened the number of relevant papers to 60. Lastly, these 60 journal articles were categorized and analyzed (Figure 1). All 60 papers were related to a particular technology, 34 were about digital technology adoption opportunities, 34 were about digital technology adoption challenges, and 33 provided technology adoption strategies. The list of these papers is included in Appendix A.

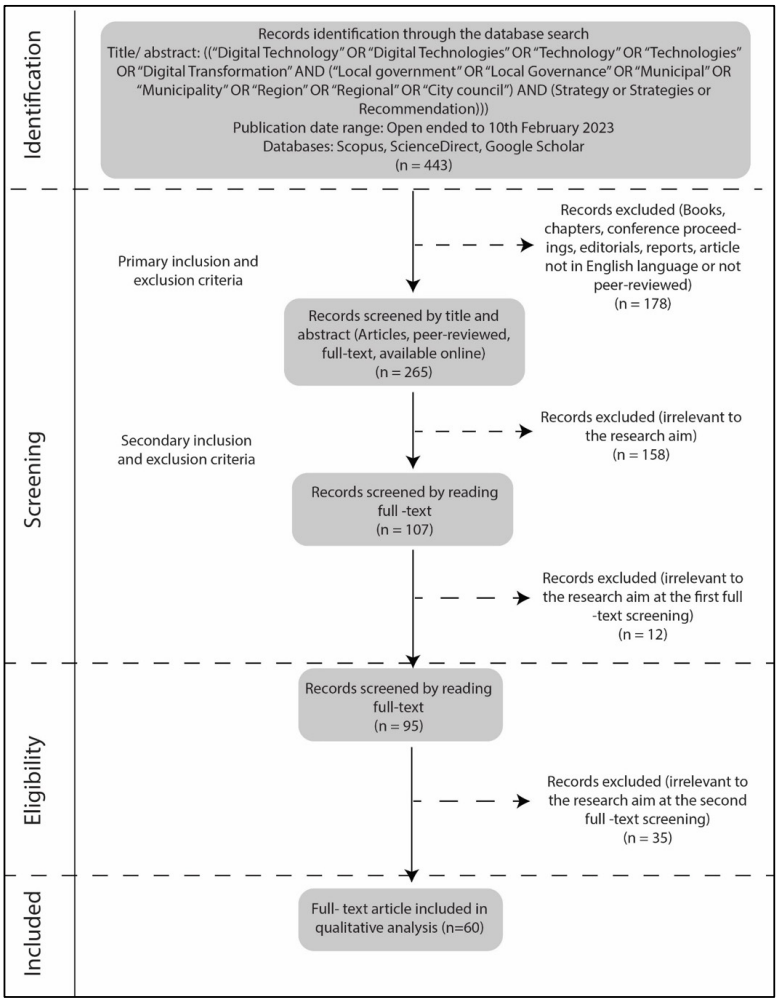

Figure 1. Summary of the PRISMA review.

Technologies offer different opportunities and challenges based on the adoption context. Strategies are considered a tool that helps capitalize on opportunities and prepare

for the organization's challenges [32]. Considering the above and the aim of the study, the literature is categorized into four areas, i.e., technology types and application areas, adoption opportunities, challenges, and strategies and is further divided into the PPT framework dimensions.

3. Results

3.1. General Observation

Initially, the research papers were classified as per published year, with [33] the contribution of the oldest article included on this subject. Until 2019, the subject area had fluctuating growth in publications, but after that date, there was a drastic growth (Figure 2). The year 2020 records the largest number of journal articles published on the topic (13). This indicates that government-forced lockdowns during the COVID-19 pandemic, which started in 2019, led to an increase in the interest in this area. Social segregation and digital technologies have been utilized to bridge the gaps between local government and citizens [34]. Eventually, it became a research-focused area.

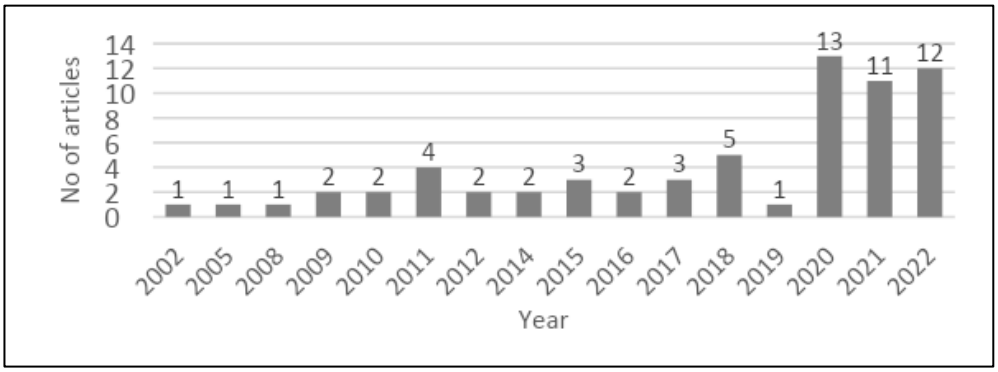

Figure 2. Publication distribution by year.

More than half of the papers (n = 43) used qualitative research methods, 18 presented the findings through quantitative methods, and only 3% followed a mixed method. Most journal articles (n = 40) were empirically tested, and 20 papers theoretically tested the subject. In total, 68% of the articles were based on surveys. Among them, 15 papers surveyed experts (managers, ICT coordinators, professors, heads of the departments, etc.), six articles were based on a staff (employees) survey, four papers were with Chief Administrative Officers (CAO), a couple of papers investigated Chief Information Officers (CIO), responsible officers, and all these papers reflected the policymakers and stakeholders' perspectives (Table 2).

Table 2. Characteristics of the reviewed articles.

Criteria	Category	No	%
Research Method	Qualitative	43	68%
	Quantitative	18	29%
	Mixed	2	3%
	Empirical	40	63%
	Theoretical	20	32%
	Mixed (empirical and theoretical)	3	5%

Table 2. *Cont.*

Criteria	Category	No	%
Case Study Area	Europe	23	33%
	Asia	19	27%
	North America	13	19%
	Oceania	7	10%
	Africa	6	9%
	South America	2	3%
Technology Type	ICT	28	47%
	Cloud Computing	11	18%
	AI	8	13%
	Web 2.0	5	8%
	Customer Relation Management (CRM)	3	5%
	Big data	2	3%
	IntTech	1	2%
	Internet-of-Things (IoT)	1	2%
	Master Data Management (MDM)	1	2%

The literature on this subject is featured in technology, government, and sustainability-orientated journals. Government Information Quarterly is a major outlet with 10 publications. In total, three articles were published in the International Journal of Information Management, and several were published by the International Journal of Cloud Application and Computing, the International Journal of Electronic Government Research, the International Review of Administrative Science, the Social Science Computing Review, and Sustainability. A total of 70 countries published articles in this field (meaning authors that have published articles in this field in diverse contexts, including 70 countries), and 63 articles conducted a single or comparative case study. European countries are the most frequently mentioned (33%), and South American countries are the least (3%).

As per Table 2, row 4, the results indicate that most articles mentioned ICT usage in local government (n = 28), cloud computing (n = 11), AI (n = 8), Web 2.0, CRM, and Big Data, IntTech, IOT, and MDM are some other technologies mentioned in the articles which are adopted for local government services. Some of these technologies have an interconnection. For example, MDM is a business and IT-related technology; but this paper looked at MDM separately to specify the technology type, which is applicable to other technologies mentioned in Table 2.

3.2. Local Government Digital Technologies

Technology adoption has a long history in the public sector, dating back to mainframe operations in the 70s and microcomputers in the 90s [15]. Local governments have also long used technologies to administer public services [35,36] as they are the frontline public service provider [1]. The extent of technology adoption capabilities, however, varies significantly between local governments [36]. It is becoming increasingly crucial to comprehend how various digital technologies influence local government operations and why certain governments adopt specific technologies over others [35].

Local governments use several digital technologies such as ICT, the Internet-of-Things (IoT), big data, AI, cloud computing, customer relation management (CRM), master data management (MDM), Web 2.0, Intech, etc., to provide their service [37]. It is evident from the literature that ICT is the dominant technology most local governments adopt. Past studies have shown that people who view technology favorably are more willing to use these

technologies [38] due to the advantages associated with it, i.e., an accelerator for economic growth, generating new ideas, improving decision-making, boosting demand, cutting costs, fostering employment and regional development, and eliminating unsustainability [39].

A critical component of management in any organization is the efficient use of resources. A study [40] stated, "over the past decades, this notion has gradually expanded in the mainstream ICT sector with the emergence of resource-sharing concepts that include cloud computing". Cloud computing is "a mechanism or model for enabling easy, convenient, on-demand network access to a shared pool of devices such as server, network, storage services, application, service and other advanced computing devices which are configurable" [41]. Cloud-based delivery models are quickly grabbing the attention of IT government leaders due to limited budgets, a lack of adequate skills, and as part of the e-Government agenda [42].

For government organizations, cloud computing results in a significant cost reduction, a decrease in the infrastructure needs for ICT, an increase in organizational performance, and better customer service delivery [18]. Still, [43] finds that many local government organizations do not adopt cloud computing because (a) it is still in the initial stage and (b) it contains a high level of risk. Transparency and complexity have been widely discussed as the risk of cloud computing directly affecting citizens' trust [40]. Although cloud computing is identified as one of the best investments in technology, implementing these technologies in local governments is being done with caution because its long-term effects are unknown [44].

In recent times, many municipalities have begun using social media as an additional channel for online communication [45], which is known as Web 2.0, i.e., Facebook, Twitter, Instagram, LinkedIn, and other applications, in general, represent the most recent development in government Internet use [46]. These technologies empower citizens, accelerate transparency, and expand democracy through two-way communication methods [46]. According to [47], with two-way communication flows, citizens will no longer be positioned as just 'end users' but as partners and cocreators of information and services.

AI is a disruptive technology that profoundly affects communities and how local government services are organized and provided [48]. AI is defined as a group of interconnected technologies and systems that can make suggestions and judgments without or with little explicit human direction by performing perceptual, cognitive, and conversational functions typical of the human mind [48,49]. Different authors have acknowledged AI systems as a unique set of technological innovations that will make public services more efficient and effective. However, it changes public administration and management significantly and will shape the future of public organizations [50] by potentially improving the quality of public services, fostering citizen trust [17], enhancing efficiencies, tackling complexity, managing repetitive tasks, and automating routine decisions [51]. There are risks here as well if AI is built on misinformation or incomplete or biased information [52–54], but experimentation with these technologies is already underway at the local level.

Local governments have built digital technology infrastructure over the past few decades and created new applications for effective digital service delivery [55]. Although many local government services have made significant advancements, the full potential of digital technology adaptation has not yet been achieved. Hence, the subsections that follow elaborate on the digital technology adoption opportunities, challenges, and strategies to reach the full potential of local governments by maintaining a balance between the people, process, and technology.

3.3. Local Government Digital Technologies Adoption Opportunities

This subsection discusses the opportunities associated with adopting digital technologies in a local government function, i.e., the advantages that could be gained through adopting digital technologies through the subsections of (a) people, (b) process, and (c) technology.

3.3.1. People

The discussion in this subsection proceeds along three points, in accordance with the opportunities received by the actors: (a) increased citizen convenience and engagement, (b) perceived usefulness, and (c) increased accountability on the part of the decision-makers. These are elaborated below, and the summarized information is presented in Table 3.

- Increased Citizen Convenience and Engagement

Citizens expect the local government to provide convenient services [4]. Local government services have typically been provided in person, at various places, and usually using paper forms. However, nowadays, many local governments use smartphone applications, kiosks, chatbots, and user-friendly web platforms to simplify the service process and reduce customer waiting times. A study [24] underlined that due to these advancements, people do not need to visit the council in person to access the services.

Along with the growth of digital technologies, people have a greater interest in getting involved with their local government. This indicates that the conventional public service organization structure (one-way interaction meaning information provided to the public by the authority rather than two-way communication) is less acceptable in a digital age. Several studies [56,57] underlined that citizens should be a part of the planning process for developing new digital government initiatives. The public and the government interact positively when they have excellent relations, which results in more open and conducive governance [20].

Accordingly, several local governments have introduced Web 2.0 [58] to allow citizen participation in (a) gathering and disseminating feedback, and local knowledge, (b) collaboration and discussion via forums, comments, opinion maps, and surveys, (c) simulation software for 3D design and budget allocation, (d) idea gathering through voting and rating, and (e) tools for analyzing comments, votes, and user behavior across the platform [19]. Given the benefits of digital technologies and the fact that they enable collaborative participation, citizens are more likely to support their adoption [4].

- Perceived Usefulness

Perceived usefulness can be defined as the expected benefits that the employee can gain through the adopted digital technologies. This includes higher accuracy and faster processing, which in turn lead to reduced workload, pressure, and employee burden [24,59]. Milton Keynes Council (UK) adopted AI technology to strengthen services and boost effectiveness throughout its planning domain. Its initiative uses open source technology, including citizen self-service and customer-facing chatbots, to respond to real-time public inquiries. The number of calls has fallen since the project's introduction in 2018, while the number of chatbots has increased. This frees up considerable time for the planning officer [59]. Employees could use this time to build their capacity to improve their competence and become experts in digital technologies [24] or sharpen their skills and knowledge to provide a more satisfactory service. Article [24] argues that digital technologies enhance public employees' capabilities and allow them to concentrate on high-level and non-routine duties.

- Increased Accountability of Decision-Makers

Decision-makers are the most powerful in local governments, giving instructions, suggestions, and direction toward boundary development [20]. Accountability refers to an institution's dedication to its work, recognition of its unique organizational position, and transparency provided to the users or customers [57]. Digital technologies increase decision-makers' accountability specifically in three aspects: (a) knowledge enhancement, (b) innovativeness, and (c) capability and authority [60].

To meet citizen demands, guide employees, handle the pressure associated with the implementation of digital technologies, and support the local government, managers need to enhance their knowledge by understanding the advantages of digital technologies and allocate adequate funds and other resources for the implementation of the technology [61–63]. Innovativeness enhances the decision-makers' openness to implementing new technology,

bringing fresh perspectives to the company, and cultivating innovative procedures that benefit the business and boost organizational performance [20]. A wide range of innovative and capable managers lower the dangers through a flexible ICT infrastructure design and the use of ICT skill-based resources [11], diversify the tasks assigned to employees, and reduce staffing restrictions. All these give more freedom to government officers to experiment with new technologies and enhance the effectiveness of the decision-makers [15].

Table 3. Local government digital technologies adoption opportunities—people.

Context	Attribute	Study
Increase citizen convenience and engagement	Citizen demand, expectation, involvement, participation, public pressure/expectation, socioeconomic attainment.	[1,4,11,20,24,39,56,57,60–62]
Perceived usefulness	Attitude, behavioral intention, ease of use, effort expectancy, knowledge management, motivated employees, performance expectancy, perceived availability, previous use, perceived usefulness, professionalization, staff request, social influence, and self-efficacy.	[15,56,57,62]
Increase the decision-makers' accountability	Efficiency changes and leadership, decision-making, managerial accountability, managerial innovations, managerial capability and authority, professional management, and support of top management.	[4,11,20,40,57,60–63]

3.3.2. Process

This subsection explains the opportunities digital technologies provide in the process under two aspects: (a) cost-effective finance management, and (b) enhanced service delivery. These are elaborated below, and the summarized information is presented in Table 4.

- Cost-Effective Finance Management

Previous research emphasized that cost-effective finance management is the primary opportunity that comes from adopting digital technologies as it is the local government's economic sustainability and primary function [40,56,61]. Local governments are trying to devise cost-efficient ways to restructure their IT infrastructure to cut expenses [42]. Electronic document delivery to the stakeholders and the adoption of energy-efficient technology are basic finance management methods adopted by most local governments [22]. Meanwhile, as an advanced method, local governments adopt cloud computing as it shares a common platform and networks, decreasing hardware expenditure, maintenance expenses, and energy consumption [42]. Additionally, [25] identified several benefits of utilizing AI in local governments. Among them is cost cutting. For example, the Blackpool City Council (UK) launched Project Amber in 2020. The council deployed AI-powered space satellite imagery and analysis to identify road deterioration and potholes. After that, the data were delivered back to the repair teams. Local government repaired over 5000 potholes while saving £1 million compared to conventional maintenance techniques.

- Enhance the Quality-of-Service Delivery

Quality is a crucial facilitator for enhancing various organizational capacities and determining the success of digital technologies [22,39]. The international standards of quality, as identified by [64], are composed of five characteristics, such as (a) effectiveness, (b) efficiency, (c) satisfaction—usefulness, trust, pleasure, and comfort, (d) freedom from risk—economic risk mitigation, health and safety risk mitigation, and environmental risk mitigation, and (e) context coverage—context completeness, flexibility [64].

Local governments benefit from using digital technology to understand their constituents better, acquire deep insights into what matters to them, and increase the accessibility of service delivery [4]. Local governments have access to social media platforms such as Facebook, where they openly ask the public for feedback to create a more customer-centric experience. Similarly, by automating repetitive tasks such as bookings and confirmation emails, digital technology has the potential to save governments and municipalities a significant amount of time and money. Effective deployment of features such as service

automation will improve the client experience, expedite processes, and free up staff to concentrate on other crucial responsibilities [57].

Table 4. Local government digital technologies adoption opportunities—process.

Context	Attribute	Study
Cost-effective finance management	Budget and time, cost serving, expectation of reduced costs, funding, goal to improve service despite the increased cost, reduction in electricity and natural resource consumption.	[22,40,42,44,56,57,60]
Enhance the quality-of-service delivery	Anticipated benefits, appropriate system design, business operation, clear implementation plan, data governance, effort expectancy, goal clarity, improvement in government activity, organizational resource, organizational efficiency, performance measures, phased implementation, professional project management, strategic focus, transparency, and uncertainty.	[1,4,11,39,40,42,57,60–63]

3.3.3. Technology

This subsection discusses the opportunity associated with the adoption of technology as a tool from the perspective of (a) improved user-friendliness, and (b) reduced complexity. These are elaborated below, and the summarized information is presented in Table 5.

- Improve Usability

The adopted technology should have high-level usability or, in other words, should be user-friendly. The user interface should make the system simple to use, as services will be provided frequently [65]. Friendliness can be assessed through the language, users' culture, and accessibility for users with any disability [65,66], i.e., if the implemented digital technologies are simple to use and understand, the public will be much more likely to use them. This undoubtedly contributes to the simplification of numerous tasks that were previously carried out manually during face-to-face contact. This will save time and money when local governments streamline the procedures. User-friendliness lowers the digital gap, bringing the government and its citizens closer [65]. For example, Newham City Council (Australia) represents a population speaking more than 200 languages, and the council faces a communication problem between government employees and the local population. Then, the council introduced Futa—the multilingual chatbot which translates questions and answers, escalates complex chats to live chat operators, and supports many languages. Within six months, 10,491 inquiries were resolved automatically, 84 h less were spent on calls, and savings of £40,000 were achieved [67].

- Reduce Complexity

Complexity is the "degree of difficulty for a firm to implement the innovation" [20] (p.3). Complexity has been shown to play a significant role in the decision to adopt any new technology. The researchers looked at the complexity negatively [12,20]. Hence, it involves the determination of the organization and the employees to learn the adopted new technology. A study [61] (p.1) emphasized that "the easier an organization perceives a new technology to learn and use, the less complex the former perceive the latter to learn and use, and vice versa". Further, digital technologies can tackle the complexity associated with the traditional system, such as document maintenance, physical attendance for service consumption, repetitive tasks, and loss of data.

Table 5. Local government digital technologies adoption opportunities—technology.

Context	Attribute	Study
Improve user friendliness	Facilitating condition, integration able, interactivity, perceived ease of use, perceived benefits, relative advantage, scalable, user friendly, usability.	[1,59,65,66]
Reduce complexity	Complexity, technology interoperability, tracking complexity.	[20,40,48,59–61,66]

3.4. Local Government Digital Technologies Adoption Challenges

The continuous growth of digital technology creates direct and indirect challenges for local governments. Not only looking at an organization's opportunities but also understanding the challenges will assist in making optimal use of the resources. This subsection investigates the challenges associated with local governments' digital technology adoption under the subsections, i.e., the PPT framework.

3.4.1. People

This subsection looks at the challenges associated with digital technologies that have been faced by the actors of the local government under three aspects: (a) lack of technical staff and knowledge, (b) lack of decision-makers' support, and (c) acceleration of the inequalities in the society. These are elaborated below, and the summarized information is presented in Table 6.

- Lack of Technical Staff and Knowledge

Lack of technical staff and knowledge could impact the adoption of local government technology on employees (including decision-makers) and public aspects. Human resources with good technical knowledge can produce the best results for the local government function [20]. Meanwhile, the receivers with excellent technological understanding will be supportive of experimenting with new technology by the local government because the successful adoption of technology is based on citizen demand for the introduced technology. A study [68] indicated that most government employees are proficient in fundamental abilities such as word processing and web navigation. However, some government employees lack several specialized talents, such as programming, application development analysis, and software applications, and digital-based public services demand them. This digital knowledge deficit increases the complexity of the local government function [40].

Meanwhile, there is a general understanding that, compared to younger people, older people are less likely to use digital technology. Adopting new technologies such as AI could be difficult not only for local council staff but it could also be confusing for the general population, especially elderly people. Many authors highlighted that age and knowledge could hinder the adoption of advanced technologies [51].

- Lack of Decision-Makers' Support

Most of the literature indicated that decision-makers with positive attitudes towards adopting digital technology for local government service provision are more likely to provide/approve funding [4,20,40]. Hence, successful digital technology adoption depends on the fund secured by decision-makers and the support from decision-makers to achieve the goals. A study [69] identified three main challenges related to the lack of decision-makers' support, such as (a) no clear direction from the management, (b) lack of knowledge of technology adoption, and (c) the absence of a digital strategy. In the meantime, before they invest in new experimental technology, they demand larger rates of return [11]. Managers' attitudes are a challenge to adopting digital technology for local government functions.

- Accelerate the Inequalities of the Society

In general, local governments serve diverse local communities with different sociocultural, educational, and economic backgrounds. Each community has its level of digital

technology adoption capacity. Higher-level educated stakeholders tend to be more perceptive of technology advancements in terms of affordability and knowledge to utilize. Nevertheless, lower-level income and education communities may be unable to afford and access digital technologies due to income and digital literacy constraints [70–73]. This means the community context matters for digital government adoption, whether people in the community will use it. This will be harder when local governments adopt advanced technologies such as AI [74,75].

Table 6. Local government digital technologies adoption challenges—people.

Context	Attribute	Study
Lack of technical staff and knowledge	Web staff, lack of technology staff, lack of technical expertise, lack of technical expertise on staff, skill challenges, interpretation challenges, human resources, lack of understanding of the cloud, unqualified or inappropriate staff, and lack of organizational resources or staff.	[15,17,19,33,56,57,72,73]
Lack of decision-makers' support	Poor planning and execution of local e-government adoption, application process involved in obtaining a 311 designation, attitude towards risk, organizational and managerial challenges, bureaucratic mentality of the policymakers, IT leadership, the influence of policymakers, lack of support from managers, and bureaucratic friction.	[11,15,17,46,57,72–75]
Accelerate the inequalities in society	Social and societal challenges, social elite concentration, political ideology of a community, political participation of citizens, civic environmental groups, and sociocultural disruption.	[17,71,73,75]

3.4.2. Process

This subsection discusses the challenges associated with the adoption of local government technology from the process perspective under the four aspects: (a) lack of planning, (b) lack of internal and external collaboration, and (c) lack of ethical framework and regulation. These are elaborated below, and the summarized information is presented in Table 7.

- Lack of Planning

The local government is expected to be ready, in terms of quality of planning, human resources, sufficient funds, proper policy and regulation, procedure, etc., to adopt a technology [20]. The reason behind the lack of formalization is due to (a) the lack of a benchmarking system, i.e., no standard model to compare and understand the requirement, (b) the lack of a self-assessment guide to understanding the available and non-available resource [69], and (c) inadequate time in the planning stage leading to an overly complex adoption process [57]. Moreover, decision-makers' ignorance of technology, poor communication among the local government institutes, and attitude towards risk contribute to their failure to recognize the uncertainty that might arise. Increased uncertainty makes planning and decision-making even more challenging [11].

- Lack of Internal and External Collaboration

The efficiency of the local government service distribution depends not only on internal collaboration but also on establishing effective connectivity among various organizations [11,68]. In practice, there is significantly less collaboration within and outside of the organization, which means it is necessary to adopt new means by which a local government is to function.

The power relation within the organization creates a gap between the decision-makers and the employees. A study [76] put forward the main characteristics of this power relation as follows: (a) Until a decision-maker authorizes, employees cannot use digital technologies. (b) In general, employees who desire to make their own decisions in the local government would be immediately discouraged. (c) For a final decision, even minor issues must be brought to the attention of a decision-maker. For example, even though the junior employee wishes to adopt new technology, the decision still depends on the senior's approval.

At the same time, considering the risk factor, council managers do not want to share data and information with other institutions, which constantly limits the organization's collaboration [68], resulting in a lack of intra-organization cooperation where similar tasks are repetitively run, causing budget duplications. In contrast, this budget can be effectively invested in facilitating technology adoption matters.

- Lack of Ethical Frameworks and Regulations

Structures, protocols, and policy mechanisms are required to ensure inclusive and equitable benefits in the new digital era. The local government's technology adoption would be hindered without effective procedures and documented data quality policies [61]. Other elements, such as privacy, security, and organizational trust, are intertwined with policies. It is difficult to gain users' trust, and it will be challenging to adopt technology for government services if it cannot ensure privacy protection and reduce the collection and storage of personal information. A study [74] mentioned that numerous policy problems exist, including government surveillance, privacy, security, and communications capacity. At the same time, adopted technology will be transformed together with the public demand and growth of the technology. Failure of flexible policy and regulation to adopt digital transformation also imposes challenges on the local government.

Table 7. Local government digital technologies adoption challenges—process.

Context	Attribute	Study
Lack of planning	Degree of formalization, uncertainty, government-based facilitation condition, difficulties in operational change management, administrative culture, project management and planning, poor communication, overly complex projects, insufficient benchmarking, and process-related challenges.	[11,12,19,20,42,48,50,57]
Lack of internal and external collaboration	Centralized and decentralized decision-making, lack of collaboration among departments, decision-making shared between politicians and senior executives, organizational centralization, egoistic and lack of collaborative efforts, intra-organizational culture, and nature of the decision.	[11,19,56,68,76]
Lack of ethical framework and regulation	Government law and policy, government regulation, lack of ethical frameworks, uncertainties around legal issues, security and privacy policies, ethical and legitimacy challenges, information assurance and governance, policies are considered too slow.	[12,17,19,40,42,48,50,61,68,71,74]

3.4.3. Technology

This subsection discusses the challenges associated with the adoption of local government technology from the perspectives of (a) lack of technical infrastructure readiness, (b) lack of security and privacy, and (c) data-related challenges. These are elaborated below, and the summarized information is presented in Table 8.

- Lack of Technical Infrastructure Readiness

Infrastructure readiness is a barrier identified from the perspective of technological challenges. It includes precise and detailed infrastructure requirements, the availability of qualified human resources to handle the infrastructure, and infrastructure budget support, for example, internet facilities, computer servers, data centers, and disaster recovery centers [77–79]. While the internet/online facilities and the disaster recovery center are the most critical infrastructure, the online facility is determined by accessibility, availability, and speed, whereas the disaster recovery center is a precautionary measure against potential threats that could eventually compromise system continuity [74]. The failure of one of these factors will be a challenge for the local government to adopt digital technologies.

- Lack of Security and Privacy

Data security involves preventing unauthorized entry, while privacy refers to who is permitted access to the data. These are critical issues for the local government [74]. Before choosing data-driven innovation, the organization must consider data security and privacy [61]. People are concerned about protecting the privacy of their confidential information because doing so is a basic human right [18]. For example, people do not know where their information is stored in Web 2.0—an open platform where citizens' privacy is at risk while providing sensitive information and cloud computing. Hence, adopting digital technologies would be challenging for the local government without proper security and safety protocols.

- Data-Related Challenges

The data-related challenges include data integration, data availability and acquisition, data quality, absence of structure and homogeneity, data bias, and resulting inaccuracies [80]. Advanced applications such as AI and predictive analytics depend on large quantities of data. A study [25] stated that eliminating bias in training data for machine learning is the biggest challenge. AI systems always have errors unless this barrier is eliminated. The risk is, therefore, significant for a public entity. Another study [81] identified four main data quality-related issues: (a) Complex data make the data integration part difficult. (b) A large data set consumes a lot of time. (c) Advanced technology is required to process big data. (d) There is not any benchmarking setting to understand the quality of data. Without a reliable and accurate data set, implementing digital technology could be challenging for the local government.

Table 8. Local government digital technologies adoption challenges—technology.

Context	Attribute	Study
Compatibility	Lack of data integration, interoperable integration, and lack of compatibility.	[20,74,79]
Lack of technical infrastructure readiness	ICT infrastructure, lack of technology, lack of technical upgrade, unaffordability of technological investment, need to upgrade technology, underutilization of technology, technological infrastructure, IT facilities and infrastructure, effective network, data storage location, backup of data, and internet connectivity.	[15,19,20,33,48,50,56,57,71,74,79]
Lack of security and privacy	Security and privacy concerns, data security, privacy, automation risks, trust, access authorization, and data leakage.	[12,18–20,33,42,50,56,61,68,70,74]
Data-related challenges	Data bias and resulting inaccuracies, data management, availability of data and information, data challenges, and system failure.	[17,18,51,71,74]

3.5. Local Government Digital Technologies Adoption Strategies and Recommendation

Strategies are defined as effective use of the available resources. They can also be viewed as a "pattern of decisions in an organization which formulates objectives, purposes, produces, policies and plans to achieve the goals" [82]. In the local government context, digital technology adoption strategies are investigated in this subsection concerning people, process, and technology aspects.

3.5.1. People

This subsection looks at how stakeholders strategically work to resolve the barriers and use the resources to adopt digital technology for local government services by: (a) Investing in interdisciplinary skill development among employees. (b) Utilizing power with responsibility. (c) Increasing open participation. These are elaborated below, and the summary is presented in Table 9.

- Invest in Interdisciplinary Skill Development for Employees

Regarding employee-related strategies, most of the literature emphasizes the importance of skill training and workshops with the aim of helping employees adopt digital technologies [1,15,73]. The installation, management, planning, and implementation of ICT infrastructure require technical expertise [1]. A study [40] argued that by helping staff with training and information when adopting digital technologies, local governments could benefit greatly, and the adoption rate would likely increase. Meanwhile, the adoption process would accelerate by recruiting staff familiar with the technologies [77]. The staff with good knowledge is likely to: (a) Lead the team. (b) Explain the benefits to the stakeholders and organize professional development programs. (c) Educate and network with the existing staff [40]. Simultaneously, employees should be aware that, as technology quickly advances, citizen expectations for the delivery of government services also rise. Hence, attending agencies or organizations for orientation, workshops, training, and exposure is essential. Another study [15] evidenced the discrepancy between the courses offered by academic programs and practitioners' requirements at work. Therefore, future research must investigate the pedagogical methods that schools and colleges use to emphasize digital technology competencies related to local governance in undergraduate and graduate curricula.

- Utilizing Power in a Responsible Manner

Decision-makers can use rewards or penalties to motivate government officials to adopt digital technologies. Accordingly, utilizing the power of correct direction would be the most effective strategy for adopting digital technologies. For example, organizing regular meetings with employees to understand the difficulties in using digital technologies and creating a step-by-step implementation schedule so that citizens and employees find it easier to adapt to the new process [73]. The decision-makers should ensure data privacy and security by formulating a proper procedure or policy document [20,45] and properly allocating organizational resources, such as staff time and budgetary costs [57].

- Increasing Open Participation

Citizens and communities must be involved in the local government's decision-making process. Local governments are practicing Web 2.0 to ensure equitable participation [19,20,58], specifically in policymaking. While the local government expects that having a Facebook page or Twitter account is enough to garner citizen feedback, they should create social media platforms that solicit and support active public engagement [38]. Most of the public is not motivated to voice their opinion due to privacy concerns and a lack of trust in the government system. However, the local government should be open to citizens' participation by introducing accessible and affordable digital technologies [83].

Table 9. Local government digital technologies adoption strategy—people.

Context	Attribute	Study
Invest in interdisciplinary skill development for employees	Regular orientation and workshop training, professional staffing, creating incentives by rewarding individuals, identifying a "champion", training and open communication with staff, personal mastery of employees, engaging employees in adopting ICT, appropriate staff training, training civil servant's knowledge and skills, project leaders need to engage municipal government employees across multiple departments, hiring an adequate number of motivated and qualified staff.	[1,4,15,22,40,57,73,77]

Table 9. *Cont.*

Context	Attribute	Study
Utilizing the power in a responsible manner	Improve information culture and align the technology with strategic objectives. Articulate a timeline and hold regular meetings. Managers could build on an existing culture of awareness of and sensitivity to information, awareness about potential opportunities and risks associated with technologies, recognized standing and interdisciplinary skills, methodological competence, and digital background, managed by qualified people, and focus on content management. Managers must also be held accountable for implementing their projects and exercising their authority to enhance performance.	[20–22,50,57,73,83]
Increasing open participation	Enabling the user to create and tailor content requires the commitment of more resources. Open participation, collaboration, and ubiquitous engagement should be a part of the planning process.	[38,57]

3.5.2. Process

This subsection looks at what processes relate to strategies that could assist in adopting digital technologies in three aspects: (a) introducing policies and regulations, (b) proper planning and goal setting, and (c) fostering cross-sectoral collaboration. These are elaborated below, and the summarized information is presented in Table 10.

- Introducing Policies and Regulation

The creation of formal policies and regulation by the local government is required to support the adoption procedure. While the government plans to use digital technologies, it must consider options outside of technology. It is essential to have written regulations that support change, provide instructions for execution, and give legal authority for the policy and regulation implementation [1,20,73]. In the meantime, policies should elaborate on how data are handled, gathered, preserved, analyzed, deliberated, and disclosed. The level of trust and security help minimize the associated risk and encourage the user to adopt the technology without reluctance [12,21].

- Proper Planning and Goal Setting

The second factor which aligns with policies and regulation is planning and goal setting. Goal setting is a process that identifies what the local government needs to accomplish and helps create a plan to achieve target results. Policies, regulations, planning, and goal setting should be aligned to maximize the outcome [20]. The planning includes (a) technology capacity in terms of technical and human capacity [15], (b) existing infrastructure compatibility assessment [4], (c) a budget proposal to address concerns about cost, and (d) discussion with internal and external parties to get advice on security issues, etc., [40]. At the same time, at the planning stage, identifying the challenge of local government to adopt digital technologies is equally important to reduce failures while setting goals.

- Fostering Cross-Sectoral Collaboration

Increasing inter- and intra-institutional collaboration would accelerate the adoption of digital technology [84]. It has several advantages, starting from: (a) Collaboration between citizens and employees would enhance the employees' understanding of their needs, that is, to what extent they understand the digital technologies, as per the requirement of adopting the technology and improving the employees' skills so that effective services may be provided to citizens [85,86]. (b) Collaboration between different local governments—each local government has unique methods and designs for adopting digital technologies, which increases the expenditure of state government. This limitation could be overcome by adopting a set of universal development standards [87]. (c) Collaboration with stakeholders and politicians—adopting and/or implementing digital technologies in local governments requires support from stakeholders and elected leaders. Local governments must establish

channels for disseminating information about the advantages of digital innovation to gain support from politicians and stakeholders [34]. (d) Collaboration with academic institutions—local governments should collaborate with academic institutions to offer new executive education programs that can fill the knowledge gaps found in this study [88].

Table 10. Local government digital technologies adoption strategy—process.

Context	Attribute	Study
Introducing policies and regulation	There should be proper legislative and executive actions; with a rigid culture, the government needs to prepare formal regulations. Give legal status, clarify laws and regulations, and reform processes by simplifying regulations and procedures. Data protection policies should be regulated. Local governments need to establish desirable legal and policy guidelines. For security issues, proper risk assessment, information assurance, and governance, the legal system mandatorily requires e-disclosure through the municipalities' website. Legislation should regulate the use of social media by governments, and strengthen policies by compiling risk management guidelines.	[1,4,15,22,33]
Proper planning and goal setting	Equipping government agencies with relevant infrastructure, procuring external advice on security issues, developing a budget proposal to address concerns regarding costs, assessing compatibility, and building IT capacity.	[1,4,15,22,33]
Foster cross-sectoral collaborative strategies	More collaboration and interaction between local, regional, and national governments, adopting a common framework of standards for the development of e-gov websites, and creating avenues to provide information about the benefits of digital innovation. Strengthening the interactivity of websites. Community-based organizations should play active roles. Local governments should work with academic institutions. Process efficiency, effective coordination of the e-government by a coordination team, and sharing the results of the digital maturity evaluation between municipalities are very useful as they allow for comparisons with others.	[34,65,68,73,85,86,88]

3.5.3. Technology

This subsection looks at how technology relates to strategies that could assist in adopting digital technologies in two aspects: (a) building the technical infrastructure and (b) creating an enabling environment. These are elaborated below, and the summarized information is presented in Table 11.

- Building the Technical Infrastructure

The technical infrastructure is identified as a primary driver of the adoption of digital technologies by local government [4,89]. The adoption of digital technologies is made more accessible if the technical readiness level is higher. It allows government organizations to collaborate, communicate, and exchange work, making daily activities easier and utilizing technology to reduce staff time and effort. The technical infrastructure includes proper network, hardware, software, security, and privacy standards [57]. A study [89] detailed this strategy by notifying the important elements to be included, such as: (a) upgrading the equipment and ensuring consistency across all local government departments, including personal computers, servers, and desktop software, (b) creating shared information systems for the primary duties of local governments; (c) implementing appropriate security measures and technology. These include dependable firewalls, data encryption methods, and public key infrastructure (a collection of rules, policies, and processes required to create, manage, distribute, utilize, store, and revoke digital certificates), and (d) Evaluate the utilization of local government data centers with disaster recovery processes and tools.

- Creating an Enabling Environment

All stakeholders in the process of digital technology adoption should be able to provide and receive services equally. Accessibility includes cost-effective, language-friendly, and user-friendly (people can understand the procedure without training) devices that all users can afford. This could be achieved when the technology used to introduce new concepts must be created at a literacy and comprehension level open to all. Increased public Wi-Fi availability, technical literacy programs, computer lab resources, and dependable infrastructure boost trust in local government and increase the use of tools for managing citizen relationships [70]. A study [90,91] advocated that local governments should create mobile engagement tools within an organization to help cover a broader range of people's perceptions. The accessibility strategy increases the actors' trust and facilitates the adoption of digital technologies.

Table 11. Local government digital technologies adoption strategy—technology.

Context	Attribute	Study
Building the technical infrastructure	Providing solid technical support for digital, push strategy and data transparency, e-government initiatives need adequate infrastructure to meet the citizens' high expectations regarding privacy and security. Set technology standards and minimum requirements.	[4,39,57,84,91]
Creating an enabling environment	The system must provide a good user experience. Governments must ensure open access to public cloud services, and internet access should be available to mobile devices. Local governments should develop mobile orientation participation tools. The introduction of technology must be designed at a comprehensive level, and technology tools and training should be accessible to the neighborhood. Expand the public Wi-Fi, technical literacy training, and computer lab resources. Reliable infrastructure will not only increase citizen trust in government but should also increase engagement with citizen relationship management tools.	[12,20,68,70,88]

4. Findings and Discussion

Local government experiments with new digital technologies and methods for their service provision play a vital role in the effective and efficient service provision of the local government. These adoption processes are complicated by uncertainties. The involved government officials must adapt to the process and technology, the process must be continuously updated, and the technology must be properly integrated into the local government system. The local government must understand the balance between people, processes, and technology to gain its full potential. The key findings are discussed below and summarized in Table 12.

Table 12. Summary of the findings.

Domain	Opportunity	Challenge	Strategy
People	■ Increase citizen convenience and engagement–citizen demand and engagement in the process. ■ Perceived usefulness–employee support, skill development. ■ Increase the decision-makers' accountability–innovativeness, capability, and authority.	■ Lack of technical staff and knowledge–level of understanding. ■ Lack of decision-makers' support–no clear direction, lack of knowledge. ■ Accelerate the inequalities of society–social, economic, and educational.	■ Invest in interdisciplinary skill development among employees–skill development workshop. ■ Utilizing the power in a responsible manner–decision-makers authority. ■ Increasing open participation–accepting people's opinions.

Table 12. *Cont.*

Domain	Opportunity	Challenge	Strategy
Process	■ Cost-effective financial management–cost-effective solution. ■ Enhance the quality-of-service delivery–effectiveness, efficiency, satisfaction, freedom from risk, and context coverage.	■ Lack of planning–no benchmarking, no planning. ■ Lack of internal and external collaboration–collaboration with others. ■ Lack of ethical framework and regulation–No standard procedure, no flexibility.	■ Introducing policies and regulation–formulization. ■ Proper planning and goal-setting strategies–resource allocation, time frame, etc. ■ Foster cross-sectoral collaboration–employee–citizen, other local government, academic institution.
Technologies	■ Improve user friendliness–language, culture, and disability concerns. ■ Reduce complexity–employees adopt new technology, the complexity of the traditional method.	■ Lack of technical infrastructure readiness–internet, computer server, etc. ■ Lack of security and privacy–hacking and no understanding of the data storage. ■ Data-related challenges–integration, quality of data.	■ Building the technical infrastructure–software, hardware, standards. ■ Creating an enabling environment–devices, affordability, language.

4.1. Understanding the Actors

Internal actors, such as employees, decision-makers, and external key actors, such as citizen politicians, stakeholders, and so on, are connected to the local government system. Technology in local government cannot work without building the capacity of the actors first [4,57]. The difference between a successful and a poor local government is the presence of the right actors having the right attitude towards adopting digital technology. A stusy [22] stated that "improvement of information culture is fostered by constant improvement in digital and sociocultural competencies of employees and managers of the public administration as well as their personal mastery and creative attitudes".

Actors' social, cultural, economic, and educational backgrounds vary greatly. As a result, the decision-making style, working style, and adoption style will vary [75]. For example, citizens from low-income backgrounds cannot afford to pay for the hardware. Citizens with less digital literacy increase the workload for employees, employees with less digital literacy slow down service delivery, and citizens with higher educational backgrounds put more pressure on decision-makers. Decision-makers and employees with less digital literacy and strategy might lead to system malfunction.

- Nothing in an organization is more crucial than excellent communication, particularly when implementing solutions for technology and processes. So, citizens should speak up first by outlining their needs in detail [84]. In other words, citizens should be enthusiastic communicators and not hold back when sharing their thoughts with the local government. Accessible and organized communication leads to the flow of ideas, which inspires the local government to understand the requirement of the people and accordingly introduce digital technology. Meanwhile, the local government needs to open platforms where citizens can share their thoughts and ideas without affecting their privacy—it also needs to actively solicit input from residents through outreach, as just because a platform is there does not mean it will be used. A study [92] underlined that social media sites such as Facebook and Twitter engage the audience actively; it also goes beyond simply having an account there;
- Secondly, the local government needs employees with the appropriate talents and skills to handle digital technologies. It includes experience and attitude with skills, as these are equally crucial to ensuring a successful implementation of digital technology [1]. Additionally, the local government should offer skill-training workshops to hiring staff and current employees who are already familiar with the technology to keep up with the updates [73];
- Thirdly, these activities will be practically feasible if the decision-makers cultivate a constructive attitude towards the employees and citizens by accepting their needs and requirements [57].

4.2. Formulating the Process

Having the right processes in place aligned with the right employees helps to know what must be done to ensure that citizens receive the required services. Citizens require local governments to provide high-quality services. Describing how services are provided is more important than the types of services being offered [93]. Thus, when local governments design the process, the four matters described below should be considered for the effective implementation of digital technologies [31].

- The actors should understand how they fit in the process, what their role is in it, and what they need to achieve throughout the process. For example, decision-makers must be held responsible for carrying out the plan and use the authority and skill to allocate local government resources, such as employees' time and budgetary costs, responsibly [57];
- The local government should have a reasonable goal and a procedure to achieve the goal. Thus, improving these procedures will impact process efficiency the most [20];
- To improve the success of digital innovation, local governments must develop acceptable legal and regulatory standards rather than just adopting regulation out of isomorphic pressure [34];
- Getting feedback from the actors and constant improvement are important for the process to have the best effect [15].

4.3. Technology as a Tool

The actors should understand that technology does not address all the problems. It is a tool the actors use to implement the process and which aids in automating some of the steps. A study [19] argued that "identifying the main causes for limited or ineffective citizen engagement with local government activities requires us to look beyond the technology itself". Therefore, before implementing digital technology, local governments should have a proper understanding of:

- The effect of the equipping technology on the actors' productivity and ability to simplify employees' and citizens' lives, the challenges they might encounter, and the means to resolve them [1];
- The local government should adequately understand the level of digital readiness across service delivery, planning and development, and internal systems before implementing digital technology. Because the implementation of digital technology is more accessible, the technical readiness level is greater [4];
- Technology has far more reach than we could have imagined and knows no bounds. Therefore, rather than adopting complex technologies, technology should be easy to use, affordable, and comprehended. People should not feel overwhelmed by it [70].

Local governments' starting point may be chosen according to the resources, capacity, availability, and other factors. For instance, the local government can determine the citizens' needs and capabilities before creating the procedure and implementing the appropriate technology. In addition, decision-makers may decide to spend money on technology while also retraining their employees or developing processes for skill development. However, to minimize risk and maximize impact, the interaction between the three elements must be balanced correctly.

Despite challenges, the future of technology adoption in local government holds great promise. Edge computing, virtual reality, the sixth generation (6G) networks, multimodality machine learning models, and blockchain, among other emerging technologies, are actively transforming the landscape of local governance and citizen services. Edge computing [94,95] offers a range of benefits, including reduced latency, greater data privacy and security, increased accessibility, and increased resilience and durability. It not only reduces costs but also allows for the efficient deployment of IoT and the facilitation of effective disaster response and emergency management. Virtual reality (VR) [96,97] is gaining traction as a driver of citizen participation, accessibility, training, urban planning, remote

collaboration, public safety, cultural heritage protection, and data analysis. Its impact will extend to encouraging inclusiveness and creative governance solutions.

The 6G network [94] integration will result in improved connection, higher capacity, easy access to cloud services, and seamless integration with VR and augmented reality (AR) technologies. These developments will enable data-driven decision-making, strengthen cybersecurity safeguards, and help IoT scale. As a result, they will improve service delivery, stimulate urban planning projects, and spark innovation. Multimodality machine learning models [98] will play a pivotal role in augmenting natural language understanding, citizen engagement, data analysis, accessibility, information processing, language translation, risk detection, and decision-making. Their adoption would enable comprehensive data analysis, facilitate effective communication, streamline processes, and empower inclusivity and informed governance. Blockchain technology [99,100] stands as a bulwark for data security, streamlined processes, smart contracts, citizen identity management, supply chain traceability, citizen engagement, data sharing, and improved financial transaction efficiency. Its incorporation will foster openness and trust and improve the government's efficiency [101,102].

4.4. Limitations and Further Research

There are some limitations to this study: (a) The number of local councils which developed their digital strategy reports, e.g., Northern Beaches Council Digital Transformation Strategy, Digital Strategy of the London Borough of Sutton and the Royal Borough of Kingston Upon Thames (2018–2021), Digital Transformation Strategy of Bayside (2018–2021), Digital Strategy of Croydon–UK (2019–2024), Digital Strategy of Logan City Council (2019–2022), Digital Strategy–Brent (2022–2026), Digital Unley, City of Palmerston Digital Strategy 2021, eMandurah (2012), and Whitehorse City Council Information Technology Strategy (2020–2025). Nonetheless, this study only reviewed journal articles. (b) Each digital technology has its opportunities, challenges, and strategies, but this study focused on the general idea of digital technology. Future studies will address these constraints, and we will continue our endeavors to contribute to these exciting developments.

Meanwhile, this research identifies the directions for future research on digital technology adoption in the public sector, more specifically for the local government administration: (a) Application of the PPT framework for the local government sector is a relatively new research approach, whereas it has been a proven framework for improving the operational efficiency in the private sector. Further research based on this framework in the public sector may be extended to the means to the adoption of technology on raising public sector operational efficiency. (b) Understanding the interconnectivity of these attributes through quantitative methods would assist the local government policymakers in developing the strategy more precisely and reducing resource overlap.

5. Conclusions

This research reviews the technology adoption opportunities, challenges, and strategies through the lens of the PPT framework. This framework provides an understanding of how the balance between the people, process, and technology aspects should be maintained to successfully implement digital technologies.

The findings indicate several opportunities and challenges in adopting digital technology for local government activities. The opportunities are increasing citizen convenience and engagement, perceived usefulness, increased accountability among decision-makers, cost-effective financial management, enhanced service delivery, improved user-friendliness, and reduced complexity. The challenges include the lack of technical staff and knowledge, the lack of decision-makers' support, accelerated societal inequalities, lack of planning, internal and external collaboration, ethical framework, technical infrastructure readiness, security, and challenges related to privacy and data.

At the same time, the opportunities and the strategies must be well aligned to resolve the challenges. Accordingly, the people-related strategies invest in interdisciplinary skill development among employees, utilizing the power responsibly and increasing open participation. The process-related strategies introduce policies and regulations, proper

planning, and goal setting and foster cross-sectoral collaboration. Finally, the technology-related strategies build the technical infrastructure and create an enabling environment. These findings are useful for the policymakers to keep up the balance with the available resources and achieve the full potential of the adopted technology.

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Appendix A

Table A1. Local government technology adoption opportunities.

Study	Journal	Title	Year	Framework Element	Description
[63]	Journal of Information Technology and Politics	The digital world of local government: a comparative analysis of the United States and Germany	2009	People	■ Professional management; ■ Demographic characteristics; ■ Presence of chief administrator; ■ Full-time employees working for city hall; ■ Socioeconomic attainment among residents in terms of education and wealth;
				Process	■ Organizational resources;
[66]	Online Information Review	E-government evolution in EU local governments: a comparative perspective	2009	Process	■ Transparency;
				Technology	■ Interactivity; ■ Usability; ■ Web site maturity;
[57]	Government Information Quarterly	The adoption of centralized customer service systems: a survey of local governments	2009	People	■ Public pressure/ expectations for customer service; ■ Elected official's pressure; ■ Staff request;
				Process	■ Goal to improve services despite increased cost; ■ Expectation of reduced costs;

Table A1. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[58]	International Journal of Organization Theory and Behaviour	Digital governance success factors and barriers to success in Prague	2011	People	■ User-friendliness; ■ Motivated employees; ■ Recruitment and retaining employees; ■ Managerial support; ■ Managerial accountability; ■ Citizen involvement; ■ Political support; ■ Reputable and known technology;
				Process	■ Budget and time; ■ Performance measures; ■ Appropriate system design; ■ Clear implementation plan; ■ Professional project management; ■ Phased implementation; ■ Goal clarity;
				Technology	■ Effective communication; ■ Adequate infrastructure;
[64]	Government Information Quarterly	Customer relationship management (CRM) technology and organizational change: evidence for the bureaucratic and e-Government paradigms	2011	People	■ Efficiency changes and leadership; ■ Management change;
				Process	■ Organizational change;
[59]	International Journal of Electronic Government Research	Electronic transformation of local government: An exploratory study	2011	People	■ Perceived usefulness; ■ Perceived motivation;
				Process	■ Compliance with local government organization's policy;
				Technology	■ Perceived ease of use; ■ Perceived compatibility; ■ Complexity; ■ Relative advantage; ■ Trustworthiness;
[42]	International Journal of Cloud Applications and Computing	Cloud computing in local government	2012	Process	■ Cost serving; ■ Economic of scale; ■ Strategic focus;
[80]	The Journal of Contemporary Issues in Business and Government	An investigation of the main factors to be considered in cloud computing adoption in Australian regional local councils	2015	Technology	■ Cost;
[11]	Information and Management	Investigating factors influencing local government decision-makers while adopting integration technologies (IntTech)	2015	People	■ Personality; ■ Perceptions; ■ Attitudes to risk; ■ Ethics and values; ■ Knowledge of integration technologies; ■ Managerial capability and authority; ■ Culture and climate; ■ Politics; ■ Management style;
				Process	■ Nature of decision; ■ Uncertainty; ■ Centralized and decentralized decision-making; ■ Organizational compatibility;
[45]	Government Information Quarterly	Factors influencing social media use in local governments: The case of Italy and Spain	2016	People	■ Size of the population; ■ Income level;

Table A1. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[1]	Transforming Government: People, Process, and Policy	Are government employees adopting local e-government transformation? The need for having the right attitude, facilitating conditions and performance expectations	2017	People	■ Performance expectancy; ■ Social influence; ■ Attitude;
				Process	■ Effort expectancy;
				Technology	■ Facilitating condition;
[15]	State and Local Government Review	Conceptualizing e-government from local government perspectives	2018	People	■ Political competition and citizen adoption; ■ Technical skill; ■ Professionalization; ■ Sheer size of the workforce;
[67]	IOP Conference Series: Materials Science and Engineering	A study of application and framework smart city in Bandung: a survey	2019	Technology	■ Reliable; ■ Interoperable; ■ Scalable; ■ User-friendly; ■ Integrable;
[62]	International Journal of Information Management	Determinants of master data management adoption by local government organizations: An empirical study	2019	People	■ Top management support; ■ Citizen demand;
				Process	■ Data governance; ■ Technological competence;
				Technology	■ Complexity; ■ Quality of master data;
[12]	Computer Law and Security Review	The role of government regulations in the adoption of cloud computing: A case study of local government	2020	Process	■ Quality of service; ■ Flexibility;
				Technology	■ Cost;
[43]	Government Information Quarterly	Assessing information security risks in the cloud: a case study of Australian local government authorities	2020	Technology	■ Data transmission; ■ Data storage; ■ Data privacy; ■ Risk management; ■ Security control; ■ Awareness; ■ Backup; ■ Encryption; ■ Trustworthiness; ■ Service level agreement;
[16]	Sustainability	Digital transformation and knowledge management in the public sector	2020	People	■ Quality of organization's knowledge management;
				Process	■ Complementing each other for significant improvement in the public sector;
[61]	Lecture Notes in Business Information Processing	Digital transformation in the public sector: identifying critical success factors	2020	People	■ Change management; ■ Leadership engagement; ■ Citizen participation;
				Process	■ Organizational culture; ■ Skill development program; ■ Funding; ■ Political stability; ■ Regulatory framework;
				Technology	■ Data security; ■ IT architecture; ■ Interoperability; ■ Data-driven agility; ■ Telecommunication service quality;

Table A1. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[23]	Journal of Accounting and Investment	Determining factors of cloud computing adoption: a study of Indonesian local government employees	2020	People	■ Performance expectancy; ■ Effort expectancy; ■ Perceived availability; ■ Behavioral intention;
[69]	Journal Komunikasi: Malaysian Journal of Communication	Digital transformation of the government: a case study in Indonesia	2021	Technology	■ Data transmission; ■ Data storage; ■ Data privacy; ■ Risk management; ■ Security control; ■ Awareness; ■ Backup; ■ Encryption; ■ Trustworthiness; ■ Service level agreement;
[20]	Sustainability	Citizens' or government's will? Exploration of why Indonesia's local governments adopt technologies for open government	2021	People	■ Organizational culture; ■ Support of top management; ■ Managerial innovativeness; ■ Strategic goal; ■ Citizen/Community demand; ■ Political influence;
				Process	■ Policy and regulation; ■ Legislation; ■ Bandwagon effect;
				Technology	■ Perceived benefits; ■ Compatibility; ■ Complexity; ■ ICT infrastructure;
[43]	Information Technology and People	Cloud computing technology adoption: an evaluation of key factors in local governments	2021	People	■ Top management support; ■ Organization size;
				Process	■ Cost; ■ Anticipated benefits;
				Technology	■ Compatibility; ■ Complexity; ■ Security concern;
[24]	Journal of Public Affairs and Development	Adoption of artificial intelligence (AI) in local governments: an exploratory study on the attitudes and perceptions of officials in a municipal government in the Philippines	2021	People	■ Previous use of AI; ■ Perceived usefulness; ■ Perceived ease of use; ■ Social influence; ■ Facilitating conditions; ■ Self-efficacy; ■ Attitude towards using AI; ■ Behavioral intention to use AI;
[22]	Information Systems Management	The contribution of ICT adoption by local governments to sustainability—empirical evidence from Poland	2021	People	■ Improvement in social and political life;
				Process	■ Reduction in electricity and natural resources consumption; ■ Improvement in governments activity; ■ Improvement in management and decision-making;
[40]	Information Systems Frontiers	Assessment of complexity in cloud computing adoption: a case study of local governments in Australia	2022	People	■ Knowledge management;
				Process	■ Business operations;
				Technology	■ Data processing capability; ■ Technology interoperability;

Table A1. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[89]	Government Information Quarterly	Determinants of digital innovation in the public sector	2022	People	■ Age;
				Technology	■ Electoral competition;
[34]	Information Technology and People	Assessing the drivers of the regional digital divide and their impact on eGovernment services: evidence from a South American country	2022	People	■ Education; ■ Income; ■ ICT usage;
[4]	Sustainability	Exploring driving factors of digital transformation among local governments: foundations for smart city construction in China	2022	People	■ Citizen's expectation; ■ Superior pressure;
				Process	■ Organizational efficiency; ■ Public service delivery;
				Technology	■ Technology readiness;
[48]	AI and Society	Artificial intelligence in local governments: perceptions of city managers on prospects, constraints, and choices	2023	Technology	■ Creating efficiencies; ■ Tackling complexity; ■ Managing repetitive tasks; ■ Processes and decisions; ■ Automating routine decision; ■ Minimizing errors and improving productivity.

Table A2. Local government technology adoption challenges.

Study	Journal	Title	Year	Framework Element	Description
[33]	Public Administration Review	The evolution of e-government among municipalities: Rhetoric or reality?	2002	People	■ Lack of technology staff; ■ Lack of technical expertise;
				Process	■ Lack of financial resources;
				Technology	■ Lack of technical upgrade; ■ Security issues; ■ Privacy issues;
[56]	International Journal of Electronic Government Research	Citizen-initiated contacts with Ontario local e-government: administrators' responses to contacts	2005	People	■ Lack of technology/web staff; ■ Lack of technology/web expertise; ■ Staff resistance to change; ■ Lack of support from elected officials; ■ Lack of information about e-government applications;
				Process	■ Lack of financial resources; ■ Issues relating to convenience fees for online transactions; ■ Lack of collaboration among departments;
				Technology	■ Issues regarding security; ■ Issues regarding privacy; ■ Need to upgrade technology;

Table A2. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[57]	Government Information Quarterly	The adoption of centralized customer service systems: a survey of local governments	2009	People	■ Application process involved in obtaining a 311 designation; ■ Lack of support from elected officials; ■ Unfamiliar with the technology; ■ Lack of technical expertise among staff;
				Process	■ Too expensive;
[85]	Journal of E-Governance	Impact of citizen relationship management (CRM) on government: evidence from U.S. local governments	2010	Process	■ Lack of funding; ■ Difficulty for departments to give up control of their customer management;
				Technology	■ Contact channels such as Web, over-the-counter, and email lack alignment, which cause conflict and confusion; ■ Security and privacy concerns with customer data; ■ Underutilization of this technology;
[73]	Policy & Internet	Digital divides in urban e-government in South Korea: exploring differences in municipalities' use of the Internet for environmental governance	2010	People	■ IT leadership; ■ Human resource; ■ Social elite concentration; ■ Political ideology of a community; ■ Political participation of citizen; ■ Civic environmental group;
[83]	International Journal of Organization Theory and Behavior	Digital governance success factors and barriers to success in Prague	2011	Process	■ Financial resource;
				People	■ Lack of training or education; ■ Unqualified or inappropriate staff; ■ Lack of organizational resources or staff; ■ Lack of support from managers; ■ Poor support from elected officials;
				Process	■ Lack of planning; ■ Poor communication and overly complex projects; ■ Mission creep;
[79]	International Journal of Cloud Applications and Computing	A framework for analysing the impact of cloud computing on local government in the UK	2011	People	■ Choices of vendors;
				Process	■ Business process change; ■ Information assurance and governance; ■ Product and approach;
[42]	International Journal of Cloud Applications and Computing	Cloud computing in local government	2012	Process	■ Service level agreement; ■ Business process change; ■ Project management and planning;
				Technology	■ Security and reliability of data; ■ Privacy and access;
[11]	Information and Management	Investigating factors influencing local government decision-makers while adopting integration technologies (IntTech)	2015	People	■ Culture and climate; ■ Perception; ■ Attitude towards risk;
				Process	■ Organizational compatibility; ■ Nature of decision; ■ Uncertainty; ■ Centralized and decentralized decision-making;

Table A2. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[80]	The Journal of Contemporary Issues in Business and Government	An investigation of the main factors to be considered in cloud computing adoption in Australian regional local councils	2015	People	■ Provider dependability; ■ Employees' knowledge;
				Technology	■ Internet connectivity; ■ Data storage location (policy issues related to data storage); ■ Integration; ■ Data back-up; ■ Transportability;
[75]	Journal of Information Security and Applications	An investigation of the challenges and issues influencing the adoption of cloud computing in Australian regional municipal governments	2016	People	■ Availability of different providers; ■ Influence of policymakers; ■ Lack of understanding of the cloud;
				Process	■ Cost;
				Technology	■ Security and Privacy; ■ Trust; ■ Data management; ■ Infrastructure; ■ Effective network; ■ Security and loss control over data; ■ Data storage location; ■ Backup of data; ■ Integration;
[77]	American Review of Public Administration	Determinants of information and communication technology adoption in municipalities	2016	People	■ Governmental stakeholder influence and non-governmental stakeholder influence; ■ Work routines; ■ Personal constraints;
				Process	■ Organizational centralization;
[1]	Transforming Government: People, Process, and Policy	Are government employees adopting local e-government transformation? The need for having the right attitude, facilitating conditions and performance expectations	2017	People	■ Age and length of work experience;
[46]	Social Science Computer Review	Governance models for the delivery of public services through the web 2.0 technologies: a political view in large Spanish municipalities	2017	People	■ Bureaucratic mentality of the policymakers;
[15]	State and Local Government Review	Conceptualizing e-government from local government perspectives	2018	People	■ Web staff; ■ Lack of information about e-government application; ■ Lack of support from elected officials; ■ Poor planning and execution of local e-government adoption; ■ Security and privacy;
				Process	■ Lack of financial resource;
				Technology	■ Lack of technology;

Table A2. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[19]	International Journal of Information Management	Beyond technology: identifying local government challenges for using digital platforms for citizen engagement	2018	People	■ Digital illiteracy and digital divide; ■ Availability of human resources;
				Process	■ Institutional framework; ■ Process related challenges; ■ Intra-organizational culture;
				Technology	■ Internet accessibility; ■ Technological advancement; ■ Data management;
[18]	Future Computing and Informatics Journal	A proposed hybrid model for adopting cloud computing in e-government	2018	Technology	■ Lack of data control; ■ Security and privacy control; ■ System failure; ■ Access authorization; ■ Data leakage;
[62]	International Journal of Information Management	Determinants of master data management adoption by local government organizations: an empirical study	2019	Process	■ Government policy;
				Technology	■ Relative advantage; ■ Data security;
[12]	Computer Law and Security Review	The role of government regulations in the adoption of cloud computing: a case study of local government	2020	People	■ Competition; ■ Public awareness; ■ Management;
				Process	■ Government-based facilitation condition; ■ Firm-based facilitating condition;
				Technology	■ Security; ■ Privacy;
[76]	Journal of Information Technology Teaching Cases	Digital transformation: learning from Italy's public administration	2020	People	■ Sociocultural disruption; ■ Political upheaval; ■ Digital literacy; ■ Bureaucratic friction;
[17]	Government Information Quarterly	Implications of the use of artificial intelligence in public governance: a systematic literature review and a research agenda	2021	People	■ Organizational and managerial challenges; ■ Skill challenges; ■ Interpretation challenges; ■ Social and societal challenges;
				Process	■ Ethical and legitimacy challenges; ■ Political, legal, and policy challenges; ■ Economic challenges;
				Technology	■ Data challenges;
[20]	Sustainability	Citizens' or government's will? Exploration of why Indonesia's local governments adopt technologies for open government	2021	People	■ Personal competence;
				Process	■ Degree of formalization;
				Technology	■ Compatibility; ■ ICT Infrastructure; ■ Security and Privacy concerns;

Table A2. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[43]	Information Technology and People	Cloud computing technology adoption: an evaluation of key factors in local governments	2021	People	■ Employees knowledge;
				Process	■ Government regulation; ■ Information intensity;
[69]	Journal Komunikasi: Malaysian Journal of Communication	Digital transformation of the government: a case study in Indonesia	2021	People	■ The competency of employees who are well-versed in ICT is minimal;
				Process	■ Policies are considered too slow; ■ Not having a working culture of electronics; ■ Egoistic and lack of collaborative efforts
				Technology	■ Lack of data integration;
[24]	Journal of Public Affairs and Development	Adoption of artificial intelligence (AI) in local governments: an exploratory study on the attitudes and perceptions of officials in a municipal government in the Philippines	2021	People	■ Anxiety;
[74]	Journal of Indonesian Legal Studies	Confronting e-government adoption in Indonesian local government	2021	People	■ Human resource–Human resources must be structured and managed with E-government goals in mind. A well-trained and motivated workforce is critical to E-government success;
				Process	■ Law and Policy–The application of Information Technology and Communication (ICT) to the government may encounter legal or policy barriers Legislatures must ensure that laws are updated to recognize electronic documents and transactions. Policymakers implementing E-government must consider the impact of law and public policy;
[72]	IOP Conference Series: Earth and Environmental Science	Smart city development innovation strategy and challenges for the government of Jember Regency	2021	People	■ Artificial intelligence of human resources; ■ Social adaptation of the community and development of application systems;
				Process	■ Security and privacy policies;
				Technology	■ Availability of data and information; ■ IT facilities and infrastructure;

Table A2. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[50]	Government Information Quarterly	Technological frames, CIOs, and artificial intelligence in public administration: a socio-cognitive exploratory study in Spanish local governments	2022	People	■ Inequality; ■ Citizen literacy; ■ Suppliers control; ■ Social unawareness;
				Process	■ Budget; ■ Governance framework; ■ Regulation; ■ Administrative culture;
				Technology	■ Digital divide; ■ Technological infrastructure; ■ Data privacy; ■ Data security; ■ Human labor elimination;
[78]	Technological Forecasting and Social Change	Smart territories and IoT adoption by local authorities: a question of trust, efficiency, and relationship with the citizen-user-taxpayer.	2022	People	■ Organizational and human experience in new technologies;
				Process	■ Decision-making shared between politicians and senior executives;
				Technology	■ Lack of needed infrastructure;
[34]	Information Technology and People	Assessing the drivers of the regional digital divide and their impact on eGovernment services: evidence from a South American country	2022	People	■ Age; ■ Rurality;
[71]	JSTOR	Trust, tech, and tension: digital citizen engagement and urban	2022	Technology	■ Communication; ■ Time; ■ Trust;
[24]	AI and Society	Artificial intelligence in local governments: perceptions of city managers on prospects, constraints, and choices	2023	People	■ Lack of trust and resistance from users–particularly senior citizens; ■ Limited local council personnel knowledge and experience;
				Process	■ Lack of ethical frameworks and regulations; ■ Limited in-house know-how and difficulties in validating autonomous decisions; ■ Limited funds for adoption and deployment; ■ Difficulties in operational change management; ■ Uncertainties around legal issues;
				Technology	■ Data bias and resulting inaccuracies; ■ Unaffordability of technological investment; ■ Automation risks;

Table A3. Local government technology adoption strategies.

Study	Journal	Title	Year	Framework Element	Description
[33]	Public Administration Review	The evolution of e-government among municipalities: rhetoric or reality?	2002	Process	■ To enhance the effectiveness of their e-government practices, many municipal governments will need to move towards a higher level of e-government development, which will require more technical, personal, and financial commitments; ■ Municipal governments also need to establish systematic and comprehensive e-government plans in which they assess available resources and address related legal issues such as privacy and security;
[66]	Online Information Review	E-government evolution in EU local governments: a comparative perspective	2009	Process	■ To increase the contribution of websites to promoting transparency, accountability, and openness and to alter the bureaucratic relationship between government and citizens, governments and policymakers will have to strengthen the interactivity of their websites soon;
[73]	Policy & Internet	Digital divides in urban e-government in South Korea: exploring differences in municipalities' use of the internet for environmental governance	2010	Process	■ Collaborative partnerships should be fostered between the different levels of government to resolve the digital divide; ■ Budget constraints and limited technical expertise found in local governments. To address this problem, the central government should develop programs that provide financial subsidies and technological assistance, enabling municipalities to adopt state–of art technologies for local governance innovations; ■ Community-based organizations should play active roles in helping cultivate social networks promoting civic interest in accessing public information online;
[58]	International Journal of Organization Theory & Behaviour	Digital governance success factors and barriers to success in Prague	2011	People	■ At the individual level–training and ensuring that employees have adequate access to continued professional development was identified as the most critical factor; ■ Before new programs are implemented, project leaders need to engage municipal government employees across multiple departments; ■ Hiring adequate number of motivated and qualified staff; ■ Managers must also be held accountable for implementing their projects and engage in professional project management that properly allocate organizational resources like staff time and budgetary costs; ■ Citizens should not only be engaged in digital governance, but they should also be a part of the planning process for developing new digital government initiatives;
				Process	■ New technology projects must not be overly complex, and adequate planning must be conducted to ensure proper implementation;
				Technology	■ E-government initiatives need adequate infrastructure to fulfill the high expectations for privacy and security by citizens;
[79]	International Journal of Cloud Applications and Computing	A framework for analyzing the impact of cloud computing on local government in the UK	2011	Process	■ For security issues proper risk assessment, information assurance and governance, service level agreements, and policies are areas that will require further investigation;

Table A3. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
				People	■ Managers could build on an existing culture of awareness of and sensitivity to information and technologies to positively contribute to e-government success and use;
[86]	International Journal of Information Management	E-government and citizen's engagement with local affairs through e-websites: the case of Spanish municipalities	2012	Process	■ More collaboration and interaction can be developed within and across governments, and this can also positively contribute to relationships between local, regional, and national governments; ■ Since e-government results from the interaction between government employees and citizens, it is important to know how government employees perceive e-government and to what extent they are aware of all aspects related to the e-government projects to their viability and potential impacts;
[80]	The Journal of Contemporary Issues in Business and Government	An investigation of the main factors to be considered in cloud computing adoption in Australian regional local councils	2015	People	■ Cloud service providers may need to improve their interaction with regional councils that are involved in cloud computing, to create a healthy environment for cloud computing adoption and to remove any doubts surrounding this technology;
[45]	Government Information Quarterly	Factors influencing social media use in local governments: the case of Italy and Spain	2016	People	■ Qualified people should manage social media applications to prevent the misuse of these tools, so there is a need to identify new organizational roles in the municipality, such as social media manager; ■ Politicians should focus on content management on Facebook pages and on information provision that properly addresses different users' needs;
				Process	■ Legal system mandatorily requires e-disclosure through municipalities' websites, and legislation should regulate the of social media governments;
[93]	Government Information Quarterly	Are small cities online? Content, ranking, and variation of U.S. municipal websites	2017	People	■ While user orientation means more than just having a Facebook page or Twitter account, those tools may be used to fully engage the public. Enabling users to create and tailor content requires a higher commitment of resources and effort from the city and possibly input from a contractor;
[1]	Transforming Government: People, Process, and Policy	Are government employees adopting local e-government transformation? The need for having the right attitude, facilitating conditions and performance expectations	2017	People	■ Employees should understand technology is rapidly improving. At the same time, citizen expectations of government service delivery are also rising, and therefore regular orientation, workshops, training, and exposure to agencies or organizations are highly required;
				Process	■ The e-government transformation should be adoptable by considering financial, technical, political, and structural support; ■ There should be proper legislative and executive actions to ensure that the transformation efforts have legal bases;

Table A3. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[90]	Quality Management	Digital technologies and the modernization of public administration	2018	Process	■ Providing improved public services using e-government; ■ Promoting adoption of e-government services; ■ Optimizing the use of ICT in governmental operations;
[15]	State and Local Government Review	Conceptualizing e-government from local government perspectives	2018	People	■ Professional staffing-IT skills among local government employees;
				Process	■ Empirical testing of e-government models; ■ Best practices; continuous focus on the factors and determinants of success and, more importantly, identify challenges to e-government implementation and strategies to reduce IT failures; ■ IT capacity–IT capacity refers to both technical capacity and human capacity in an organization;
[21]	Ecological Economics	Digital transformation and localizing the sustainable development goals (SDGs)	2020	People	■ Public and administrative policymakers in developing countries should direct/encourage investment in the "The digital Network Architecture" (DNA) infrastructure;
				Process	■ Developing countries need to review their institutional competence in dealing with information data; collection, preservation, analysis, deliberation, disclosure, and standards of confidentiality as well as privacy protection along the lines of recent initiatives and legislation to reduce the risk of infringement of individual privacy;
[84]	Government Information Quarterly	Know-how to lead digital transformation: the case of local governments	2020	People	■ Local governments and IT service providers should establish a public–private partnership with the purpose of (I) transferring contact-related knowledge to IT service providers from local governments about their organizational processes and (ii) co-creating some of the requisite know-how to enact an integrated enterprise system to support a high level of cooperation among stakeholders with process management; ■ Recommendation 2. Local government managers should outsource to IT service providers for their competencies in enacting integrated enterprise systems, and then focus on developing the core competence to manage a selection of the most regarding innovations and the best plans for implementing these innovations in support of improved public service delivery; ■ Recommendation 3. Key stakeholders in public service delivery, such as policymakers in higher-tier governments, local governments chief administrative officers and the citizens and businesses served, should demand that managers of multiple local governments actively work in joint problem-solving teams to identify opportunities to exploit private sector know-how to manage digital transformation; ■ Recommendation 4. Policymakers in higher-tier governments should exercise their authority to promote performance evaluation and incentive pay schemes for local governments that are explicitly linked to exploring and exploiting private sector know-how to manage digital transformation;
				Process	■ Recommendation 5. Local governments should work with academic institutions to develop an integrated knowledge base specific to the local government contact, supplemented with additional in-depth case studies examining municipal governance that leverages private sector know-how to manage digital transformation; ■ Recommendation 6. Local governments should work with academic institutions to design executive education programs specifically to close the knowledge gaps identified in this research;

Table A3. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[12]	Computer Law and Security Review	The role of government regulations in the adoption of cloud computing: a case study of local government	2020	People	■ Cloud service providers must make a significant effort to assure users that their data are safe. Market forces may drive service providers to differentiate themselves regarding higher levels of security, and the government should play a role by proactively implementing cybercrime laws and data-breach legislation;
				Process	■ Government regulations must clarify the applications used in the delivery of cloud services–The government can encourage the availability and adoption of cloud computing through tax adjustments to service providers, subsidies to low-income people, and management of the wireless spectrum. Fostering data portability and the expansion of broadband capacity through market-led and technology-neutral regulations can help to ensure a wider diffusion of services; ■ Data protection policies regulated by the government could play a critical role in the adoption of cloud computing by Australian regional governments;
				Technology	■ Governments must ensure open access to public cloud services. Access to the fundamental infrastructure of cloud com-putting should not be driven by biased pricing and should not offer an unfair benefit to other users;
[39]	Procedia Computer Science	Exploring levels of ICT adoption and sustainability: the case of local governments from Poland	2020	People	■ Government units should focus on increasing the personal mastery of employees, employees' creativity, digital literacy, and the sociocultural competencies of employees; ■ Engage employees in adopting ICT and enhancing digital competencies by employing incentive systems;
				Process	■ The adoption of the latest management concepts and the alignment between information society strategy and ICT adoption by government units are needed;
[22]	Information Systems Management	The contribution of ICT adoption by local governments to sustainability—empirical evidence from Poland	2021	People	■ Improvement of information culture;
				Process	■ Improvement of ICT management;
				Technology	■ Improvement of ICT quality;
[92]	International Journal of Teaching and Case Studies	E-government and digital transformation in Libyan local authorities	2021	People	■ Set technology standards and minimum requirements; communication infrastructure be developed across the country; establish common information system; standards and technologies for website development; security measures and technologies need to be introduced; data centers with disaster recovery procedure and technology, partnership with local and national technology and service companies;
				Process	■ Provide appropriate training, exposure to successful e-government strategies and projects, attitude and adaptability, and a coordinated roadmap for transition; ■ Process efficiency. Task and process documentation, process improvement;

Table A3. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[69]	Journal Komunikasi: Malaysian Journal of Communication	Digital transformation of the government: a case study in Indonesia	2021	Process	■ Strengthen policies by compiling risk management guidelines, service management guidelines, and ICT audit management guidelines; ■ Effective collaboration of the e-government by a coordination team that involves related institutions; ■ To make effective use of the architecture and map of the e-government plan; ■ Accelerate the integration of e-government services to stop government agencies from building their applications and encourage shared applications. It is to prevent silos in central and regional government agencies; ■ Develop the apparatus' ICT competence, inculcating digital work culture in government organizations and developing partnerships both in government organizations and the other institutions that have adequate ICT capacity;
				Technology	■ Preparing digital infrastructure technology, specifically by building a shared e-government infrastructure, utilizing broadband networks for accessibility, utilizing cloud-based applications, and developing technology-based services 4.0 (cloud computing, artificial intelligence, big data, and the internet of things);
[43]	Information Technology and People	Cloud computing technology adoption: an evaluation of key factors in local governments	2021	People	■ Identify a "champion" for the adoption and eventual handover of the project;
				Process	■ Assess the compatibility of current IT infrastructure with cloud technology; ■ Develop a budget proposal to address concerns about costs; ■ Procure external advice on security issues;
[74]	Journal of Indonesian Legal Studies	Confronting e-government adoption in Indonesian local government	2021	People	■ Articulate a timeline for implementation in a step-by-step approach so the reforms will not seem overwhelming to the bureaucracy; ■ Hold regular meetings between e-government policy leaders and the involved workforce so employees are active participants; ■ Create incentives by rewarding individuals and agencies that apply the reforms rapidly;
				Process	■ Consult with stakeholders to assess how existing laws may impede the desired results; ■ Give legal status to the online publication of government information; ■ Clarify laws and regulations to allow electronic filings with government agencies; ■ Reform processes by simplifying regulations and procedures;
[87]	Smart Cities and Regional Development Journal	Smart government in local adoption-Authorities in strategic change through AI	2021	People	■ This also includes fast and binding communication, the use of digital technologies, and casual culture of ideas without hierarchical barriers in decision-making practice. To experience this, company ambassadors with recognized standing and interdisciplinary skills, methodological competence, and digital background are required in work processes that are critical to success;
				Process	■ It is agreed that barriers such as separate data silos within the authorities or access to public administration data for cooperation partners and service providers have a significant influence factor for the further development and development of the maturity of automated systems. In this respect, coming up with a phrased strategy with goals and principles of action is the first and necessary step for many authorities to deal with the concept of data usage and the associated ecosystem;

Table A3. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[20]	Sustainability	Citizens' or government's will? Exploration of why Indonesia's local governments adopt technologies for open government	2021	People	■ Top management support in terms of aligning the technology with the strategic objective is one of the steps that third-party vendors can consider, increasing the probability of adoption;
				Process	■ As an institution with a rigid culture, the government needs to prepare formal regulations to support the adoption process; ■ The government also needs to align the adoption initiative with the regional strategic goals;
				Technology	■ The system must provide a good user experience so that the government officers who use the system can operate it efficiently;
[83]	International Review of Administrative Sciences	Strategic alignment of open government initiatives in Andalusia	2022	People	■ Pull strategy–open participation; ■ Networking or Mingling strategy–Open collaboration and ubiquitous engagement;
				Technology	■ Push strategy–data transparency;
[40]	Information Systems Frontiers	Assessment of complexity in cloud computing adoption: a case study of local governments in Australia	2022	People	■ Training and open communication with staff are necessary to boost organizational knowledge;
[50]	Government Information Quarterly	Technological frames, CIOs, and artificial intelligence in public administration: a socio-cognitive exploratory study in Spanish local governments	2022	People	■ Awareness of potential opportunities, and risks, of AI technologies in public organizations, need to be widely (and wisely) fostered in governmental settings, including political appointees, general managers, and street-level bureaucrats in the recipe;
[91]	NISPAcee Journal of Public Administration and Policy	Digital transformation of Slovenian urban municipalities: a quantitative report on the impact of municipality population size on digital maturity	2022	Process	■ Municipalities must ensure that the e-government concept is not only aimed at providing a large number of services to increase efficiency and effectiveness, opting for a top-down approach according to the need of the municipal administration but that decisions are made on the needs of the citizens, a bottom-up approach; ■ Sharing the results of the digital maturity evaluation between municipalities is very useful as it allows for comparison with others, especially those who are more advanced in terms of digital transformation, and allows those seeking advice to become more aware of best practices, leading to fewer mistakes and better digital transformation outcomes;

Table A3. *Cont.*

Study	Journal	Title	Year	Framework Element	Description
[89]	Government Information Quarterly	Determinants of digital innovation in the public sector	2022	Process	■ Support of such stakeholders and elected officials is essential to adopting and/or implementing digital innovation in local governments. To obtain such support from stakeholders and legislators, local governments must create avenues to provide information about the benefits of digital innovation; ■ Local governments need to establish desirable legal and policy guidelines which are crucial for enhancing the effectiveness of digital innovation rather than just jumping on the bandwagon of adopting legitimate innovation due to isomorphic pressure;
[78]	Technological Forecasting and Social Change	Smart territories and IoT adoption by local authorities: a question of trust, efficiency, and relationship with the citizen-user-taxpayer	2022	People	■ Appropriate staff training and recruiting personnel, who have already implemented technological innovation, can help develop the capacity for innovation implementation;
				Process	■ The state's public communication policies towards local authorities and citizens can reduce the fears and reluctance of managers to adopt technological innovations. The state must encourage in its communication policy a kind of mimicry favorable to innovation between public agents, managers, and citizens;
[34]	Information Technology and People	Assessing the drivers of the regional digital divide and their impact on e-government services: evidence from a South American country	2022	Process	■ Each local government e-websites followed different designs, which accelerated the cost of e-gov–this limitation could be mitigated by adopting a common framework of standards for the development of e-gov websites and the online services provided to citizens; ■ Local government should include as a priority in their strategic planning the implementation of online services that require user authentication and, consequently, design data privacy and protection policies;
				Technology	■ Internet access should be available for mobile devices to be adopted by a broader range of citizens; ■ Local governments should develop mobile orientation participation tools;
[71]	JSTOR	Trust, tech, and tension: digital citizen engagement & urban	2022	People	■ Expanding public Wi-Fi access, technical literacy training, computer lab resources, and reliable infrastructure will increase citizen trust in government and engagement with citizen relationship management tools;
				Technology	■ The introduction technology must be designed at a reading and comprehension level that is accessible to all; ■ Technology tools and training should be accessible to neighborhoods that have previously experienced disinvestment;
[4]	Sustainability	Exploring driving factors of digital transformation among local governments: foundations for smart city construction in China	2022	People	■ Training civil servants' knowledge and skills;
				Process	■ Equipping government agencies with relevant infrastructure;
				Technology	■ Providing solid technical support for digital transformation.

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