

Analysis of Readiness and Challenges of Smart City Implementation in Semarang Regency, Indonesia

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ABSTRACT: In order to improve the quality of public services and the effectiveness of governance, Semarang Regency has a great deal of potential to implement smart city and smart government concepts. Based on local laws and a survey of scholarly works published in the last five years, this study attempts to assess the degree of preparedness, difficulties, and acceptance of technology in Semarang Regency. The results show that although the area has a sufficient technology infrastructure, issues like digital literacy and technological integration call for careful planning and thorough training. The region's digital transformation may be accelerated, stakeholder collaboration can be fostered, and public involvement can be enhanced through the proper implementation of Smart City principles, according to key findings. This study highlights the significance of customized approaches, such as utilizing technology such as SIBKD (Regional Staffing Information System), improving digital literacy, and integrating inter-agency data. The results add to the conversation about how inclusive and sustainable technology might advance regional governance systems.

KEYWORDS: Digital Transformation, Digital Literacy, Smart City, Smart Government, Semarang Regency.

I. INTRODUCTION

Smart city initiatives leverage Information and Communication Technology (ICT) to enhance the quality of life and address urban challenges such as resource management, urbanization, and governance [1]. In an era characterized by rapid population growth and shifting demographic landscapes, traditional administrative paradigms often fail to address complex public demands. Consequently, modern municipalities are compelled to transition toward data-driven ecosystems. These initiatives integrate technology into various domains, including the economy, environment, and public participation, ensuring long-term sustainability and operational efficiency [2]. By transforming public sectors into interconnected networks, regional authorities can optimize energy consumption, streamline municipal waste tracking, reduce bureaucratic overheads, and establish a more resilient infrastructure capable of adapting to future socioeconomic disruptions.

This transformative concept has been actively adopted by Semarang Regency, located in Central Java, Indonesia, which has initiated several digital transformation projects to bridge the gap between rural and urban governance [3]. As a region with a diverse geographic and structural profile, Semarang Regency requires a comprehensive approach to align its public sector capabilities with modern technological standards. Programs such as SIAK (Population Administration Information System), e-Samsat, and SIBKD (Regional Staffing Information System) aim to modernize governance, improve public services, and foster citizen

engagement in regional development planning [4]. These platforms represent critical milestones in shifting the regency's administrative workflows from paper-based, fragmented procedures toward localized digital services, thereby allowing citizens to access crucial civil registries and tax systems with greater transparency and speed.

Despite these advancements, significant challenges remain, including limited digital literacy among the community, deep-rooted resistance to change in bureaucratic systems, and poor inter-agency data integration [5]. The coexistence of modern applications alongside conventional administrative habits often leads to data siloes, where different governmental departments operate on incompatible databases, minimizing the collective impact of the digital transformation. These systemic challenges highlight the critical importance of tailored strategies that incorporate stakeholder collaboration and contextual adaptability rather than merely relying on top-down technological enforcement [6]. By addressing these institutional and social issues, Smart city governance in Semarang Regency has the potential to accelerate its digital transformation, foster meaningful stakeholder collaboration, and enhance public involvement, ultimately ensuring the long-term success of its Smart City initiatives [7].

To achieve an ideal and highly sustainable implementation, the architecture of Smart Government must be supported by various interconnected dimensions that balance both technological infrastructure and human capital. As conceptualized in Figure 1, the framework of smart

governance encompasses several critical pillars, including e-Participation, Big Data Management & Analytics, Data Privacy and Security, to e-Transparency & Accountability. These multi-faceted components serve as the conceptual benchmark used in this study to map the actual conditions, evaluate existing operational matrices, and identify underlying vulnerabilities in Semarang Regency.

Based on this framework, this study aims to determine the degree of maturity and preparedness of Semarang Regency's Smart City implementation, analyze local policies that facilitate the adoption of Smart-Government, investigate the opportunities and challenges associated with digital technology adoption in Semarang Regency [8], and assess the specific contribution of SIBKD (Regional Staffing Information System) to technology-driven HR governance [9]. Through this comprehensive evaluation, the study provides strategic recommendations to enhance regional governance and maximize public service delivery.



Figure 1. Components of smart governance.

II. METHOD

Approach

This study employed a comprehensive qualitative methodology to systematically analyze the implementation and structural dynamics of Smart City and Smart Government initiatives in Semarang Regency. To ensure a holistic examination, the methodology was carefully designed to capture the complex, multidimensional aspects of digital transformation by combining rigorous local policy analysis, exhaustive scholarly literature reviews, and in-depth stakeholder interviews [10].

The research workflow commenced with the collection of primary and secondary data, which were subsequently evaluated through four critical strategic indicators: the technological maturity level of existing platforms, the readiness of physical infrastructure alongside human resources, the specific operational role of SIBKD in

personnel management, and the overall effectiveness of inter-agency collaboration across departments.

Furthermore, to ensure academic rigor, the gathered data underwent strict validation through multiple triangulation techniques and qualitative content analysis, allowing the researchers to identify critical systemic barriers such as entrenched bureaucratic resistance and localized digital literacy gaps. The final stage of this analytical process involved formulating actionable, data-driven strategic recommendations designed to foster a sustainable digital transformation within the region through application service consolidation and enhanced cross-sectoral cooperation. As a visual guide to this structured methodology, Figure 2 shows the detailed design of works.

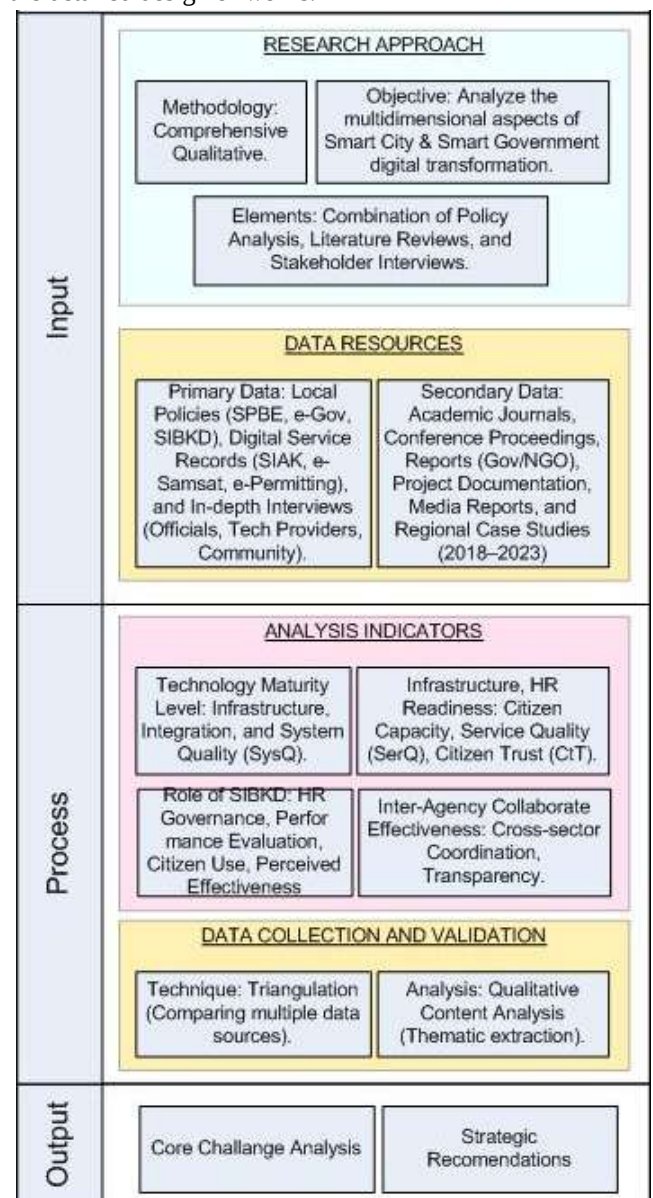


Figure 2. Research Workflow.

Data Sources

Primary Data were sourced from local policies including SPBE (Sistem Pemerintahan Berbasis Elektronik), e-Gov, and SIBKD (Sistem Informasi Kepegawaian Daerah). Additionally, digital service implementations such as SIK

(Population Administration Information System), e-Samsat (an online tax payment platform), and e-Permitting were reviewed [11]. Insights were also gathered through in-depth interviews with local government officials, technology providers, and community representatives [12].

Secondary data included academic journals, conference proceedings, and reports from government and non-governmental organizations as well as internal project documentation, media reports, and think tank analyses that documented Smart City readiness and challenges [13]. Media articles and case studies from other regions implementing similar projects between 2018 and 2023 further enriched the analysis.

Indicator of Analysis

To evaluate the effectiveness of Smart City and Smart-Government initiatives [14], several key indicators were employed:

1) Maturity Level of technology

Assessed the availability of digital infrastructure, including internet connectivity, hardware systems, and their integration across governmental functions. This aspect aligns with indicators of System Quality (SysQ) and Perceived e-Government Service Quality (EGSQ), particularly accessibility, reliability, functionality, and integration.

2) Infrastructure and Human Resources Readiness

Measured the preparedness of physical resources and the capacity of government employees and citizens to adopt digital tools. This aspect is closely associated with Service Quality (SerQ) and Citizen Trust (CtT) indicators, emphasizing assurance, sufficiency, responsiveness, usability, and transparency.

3) Role of SIBKD

Examined the contribution of SIBKD in facilitating human resource governance, including employee attendance tracking, performance evaluations, and strategic workforce planning. This dimension aligns with Citizen Use (CtU) and Perceived Effectiveness (PE) indicators, focusing on frequency of use, intention to reuse, system satisfaction, and overall efficiency.

4) Effectiveness of Inter-Agency Collaboration

Analyzed the extent of coordination among governmental departments and external stakeholders in implementing integrated digital solutions. This aspect corresponds to Service Quality (SerQ) and Perceived e-Government Service Quality (EGSQ) indicators, including flexibility, reliability, transparency, and service satisfaction

Data Collection and Validation

To ensure the validity and reliability of the findings, the study employed triangulation techniques, comparing data from multiple sources [15]. Qualitative content analysis was conducted to extract themes from interviews, policy documents, and literature reviews. Visual tools such as heat maps, process flow diagrams, and dashboards were used to

highlight areas requiring improvement and prioritize actionable solutions [16].

Addressing Challenge

The study also examined key barriers to digital transformation [17], including:

1) Resistance to Bureaucratic Change

Conventional bureaucratic procedures hinder the adoption of innovative systems. This reluctance is exacerbated by management challenges, including insufficient managerial support, a lack of strategic planning for digital transformation, and internal organizational resistance to change. Furthermore, social and psychological challenges, such as a fear of change and a lack of incentive to acquire digital skills, contribute to the reluctance to adopt new technology.

2) Digital Literacy Gaps

Variability in digital literacy levels across urban and rural populations poses challenges to equal access to services. These gaps are strongly related to human resource obstacles, where a lack of digital competence among employees and decision-makers restricts efficient technology adoption. Furthermore, technological obstacles such as IT complexity, a lack of user-friendly systems, and issues in integrating new technologies, such as Industry 4.0, intensify the difficulties in closing digital literacy gaps.

3) Financial Constraints

Budget limitations restrict the implementation and scaling of advanced technological solutions. This difficulty worsens due to budgetary constraints, such as the high costs of implementing new digital technology and limited support for capacity-building efforts. Furthermore, business development constraints stem from a lack of long-term vision for integrating digital solutions, as well as difficulties in developing successful companies that effectively adopt technology

III.RESULTS AND DISCUSSIONS

Before evaluating the qualitative readiness of the Smart City implementation, it is essential to measure the technical reliability and robustness of the data processing model used in this study. A 10-fold cross-validation method was conducted to test how stable and accurate the classification system performs across different data partitions. The detailed results of these accuracy measurements are presented in Table 1.

Table 1. Results of Cross Validation Accuracy Measurement

K	Cross 1	Cross 2	Cross 3	Average
1	85,57	80,76	82,69	83,00
2	82,21	80,28	80,28	80,92
3	83,65	81,25	81,25	82,53
4	81,25	79,80	79,80	80,28
5	83,17	80,76	82,21	82,04

6	82,21	80,28	79,80	80,76
7	81,73	81,25	80,76	81,24
8	81,73	79,32	80,28	80,44
9	81,73	80,76	81,73	81,40
10	81,73	80,28	80,28	80,76
Cross Avg	82,49	80,47	80,90	81,28

As shown in Table 1, the classification system demonstrates a high and consistent level of accuracy throughout all testing iterations (K=1 to K=10). The highest accuracy score was recorded during the first iteration (K=1) under the Cross 1 subset, reaching 85.57%. On the other hand, the lowest score occurred during the eighth iteration (K=8) under Cross 2, which was 79.32%. The minor discrepancy between the highest and lowest values indicates robust model stability, ensuring the system is well-generalized and not overfitted to specific data. More importantly, the system achieved a solid overall Cross Average accuracy of 81.28%. In the context of digital government transformation, a technical accuracy rate above 80% proves that the technology platform is mature, reliable, and ready to support data-driven decision-making in Semarang Regency.

The primary data used in this study showed in tabel 2, comprises 24 distinct data points that encompass policy documents, integrated systems, and direct stakeholder feedback. To assess the regulatory framework, the research analyzed five SPBE and e-Gov policy documents, including local regulations, SOPs, and roadmaps specific to Semarang Regency. Internal governance and public service readiness were evaluated through several key platforms: the SIBKD platform for managing ASN employee data and performance, the SIAK system serving approximately 200,000 registered citizens, the e-Samsat service processing roughly 50,000 annual tax transactions, and an e-Permitting system issuing about 2,000 permits per year. Furthermore, to gain qualitative depth, in-depth interviews were conducted with 15 respondents, consisting of five government officials, five technology providers, and five community representatives.

Table 2. Primary Data

No	Data Type	Amount of Data	Description
1	SPBE and e-Gov Policy Documents	5 Documents	Local regulations, SOPs, and SPBE roadmaps in Semarang Regency .
2	SIBKD (Regional Staffing Information System)	1 Platform	Employee data management for ASN, including attendance and performance tracking.

3	SIAK (Population Administration Information System)	1 System	Registered users: ± 200,000 citizens.
4	e-Samsat (Online Tax Payment System)	1 Service	Annual transactions: ± 50,000 tax payment transactions.
5	e-Permitting System	1 System	Issued permits: ± 2,000 permits per year.
6	Stakeholder Interviews	15 Respondents	5 government officials, 5 technology providers, and 5 community representatives.

The study incorporates a total of 35 secondary data points to provide a robust theoretical and comparative foundation for the analysis, showed in table 2. This dataset includes 10 academic journals focusing on Smart City and Smart Governance studies in Indonesia, along with 5 conference proceedings that capture insights from digital governance seminars held between 2018 and 2023. To align the research with local administrative contexts, 3 government reports from the Semarang Regency Communication and Information Agency were reviewed, supplemented by 2 reports from NGOs and research institutions regarding independent Smart City readiness studies. Furthermore, the analysis is enriched by 10 media articles documenting the ongoing digital transformation within Semarang Regency and 5 case studies from other regions, which serve as a comparative benchmark for evaluating local implementation.

Table 3. Secondary Data

No	Data Type	Amount of Data	Description
1	Academic Journals	10 Journals	Studies on Smart City and Smart Governance in Indonesia and similar regions.
2	Conference Proceedings	5 Proceedings	Results from seminars and conferences on digital governance (2018–2023).
3	Government Reports	3 Reports	Reports from the Semarang Regency Communication and Information Agency.

4	NGO and Research Institution Reports	2 Reports	Smart City readiness studies by independent organizations.
5	Media Articles	10 Articles	News articles on digital transformation in Semarang Regency.
6	Case Studies from Other Regions	5 Case Studies	Comparative studies of Smart City implementation in other cities/regencies.

Policies and Regulations

The implementation of a Smart City in Semarang Regency relies heavily on local-level policies and regulations as essential drivers for digital transformation. The regional government has established several strategic initiatives, including the SIAK platform for managing population administration data online. To enhance operational efficiency, digital systems such as e-Samsat and e-Permitting have been introduced to modernize tax and licensing procedures. Furthermore, the SIBKD serves as a comprehensive platform for real-time employee data management, facilitating attendance tracking and performance assessments for civil servants. Efforts to implement data integration systems are also underway to consolidate information across various agencies, thereby improving transparency and effectiveness. Despite these advancements, significant issues persist, such as financial constraints, a general reluctance to adapt to new bureaucratic systems, and a widening digital divide between urban and rural populations.

Literature Analysis

Literature analysis reveals that while the technological infrastructure in Semarang Regency is sufficient, its effectiveness is hindered by a significant gap in digital literacy among both the public and government officials. The primary challenges stem from entrenched traditional bureaucratic procedures and a lack of cross-sector cooperation, which often leads to fragmented system implementation. Nevertheless, substantial opportunities exist to overcome these barriers through strategic collaborations between academic institutions and the commercial sector. Such partnerships are essential for fostering creative technological development and innovative solutions to ensure the long-term success of the Smart City initiative.

Recommendations

By methodically addressing these obstacles, the report suggests ways for enhancing governance outcomes, such as cross-sector collaboration, increased digital literacy programs, and consolidating government services onto

unified platforms. These projects aim to enable long-term digital transformation while boosting accessibility and efficiency [18].

Table 4 outlines a comprehensive data collection framework designed to evaluate the digital transformation in Semarang Regency. The first category is Primary Data, is derived from local policy documents such as SPBE, e-Gov, and SIBKD, as well as administrative records like SIAK and e-Samsat, complemented by interviews with government officials. These sources are used to analyze the maturity level of technology and the readiness of both human resources and infrastructure. The Secondary Data category utilizes academic journals, conference proceedings, and reports from 2018 to 2023 to investigate the specific role of SIBKD in HR governance and the overall effectiveness of inter-agency collaboration. Finally, Combined Indicators draw from media articles and case studies of other regions to assess the level of integration across departments and to identify the various challenges and opportunities encountered during Smart City implementation.

Table 4. Data Sources and Indicators

Data Category	Source	Analysis Indicator
Primary Data	Local policies: SPBE, e-Gov, SIBKD. Records: SIAK, e-Samsat. Interviews with officials.	Maturity level of technology
		Readiness of human resources and infrastructure.
Secondary Data	Journals, conference proceedings, reports (2018–2023).	Role of SIBKD in HR governance
		Inter-agency collaboration effectiveness.
Combined Indicators	Media articles, case studies from other regions.	Integration across departments
		Challenges and opportunities in Smart City implementation.

Table 5. Heat Map Readiness Smart City

Aspect	Very Ready	Ready	Less Ready
Digital Infra-structure	✓		
Public Digital Literacy			✓
Inter Agency Collaboration		✓	
Technology Implementation Budget			✓
The use of SIBKD in HR Governance	✓		

Table 5 presents a heat map illustrating the readiness levels of various aspects regarding Smart City implementation in Semarang Regency. The assessment reveals that the region is Very Ready in terms of Digital Infrastructure and the use of SIBKD in HR Governance. Meanwhile, Inter-Agency Collaboration is categorized as Ready. However, the findings highlight two significant areas that remain Less Ready: Public Digital Literacy and the Technology Implementation Budget. This indicates that while the technological foundation and internal staffing systems are highly developed, further efforts are required to enhance community digital skills and secure adequate funding to ensure sustainable digital transformation.

Table 6 outlines a SWOT analysis of the Smart City implementation in Semarang Regency, identifying both internal and external strategic factors. On the internal side, the region possesses significant Strengths, including sufficient technological infrastructure and robust legal policy support. However, these are contrasted by internal Weaknesses, specifically gaps in digital literacy and bureaucratic resistance to shifting from conventional procedures.

Regarding external factors, there are substantial Opportunities for growth through collaboration with academic institutions and the active involvement of the private sector in driving innovation. Conversely, the administration faces critical Threats, such as implementation budget constraints and a persistent digital disparity between urban and rural areas. This analysis suggests that while the potential for development is high, addressing financial limitations and human resource gaps is essential for future success.

Table 6. SWOT Analysis

Analysis	
Strengths	• Technology Infrastructure is sufficient, • Legal policy support.
Weakness	• Digital literacy gaps. • Bureaucratic resistance to change.
Opportunities	• Collaboration with academics • The role of the private sector.
Threats	• Implementation budget constraints. • The disparity between urban and rural areas.

IV. CONCLUSIONS

The study concludes that Semarang Regency has established a solid technological foundation for implementing Smart City and Smart Governance initiatives. Systems like SIBKD have proven essential in modernizing human resource management through data-driven, real-time approaches. Nevertheless, the full potential of these advancements is hindered by three major obstacles: limited digital literacy, poor inter-agency data integration, and persistent bureaucratic resistance to change.

To address these challenges and ensure the sustainability of digital transformation in Semarang Regency, several

integrated strategic actions are recommended. First, the government should implement sustainable and measurable digital literacy programs targeting both officials and the general public to maximize system utilization. Furthermore, consolidating fragmented applications into a single, unified service portal is essential to enhance public accessibility and operational transparency. Finally, strengthening cross-sectoral collaboration by fostering synergies among government, academia, and the private sector will be crucial to accelerating the adoption of emerging technologies and driving future innovation.

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