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Implementation of the Smart Parking System (SPS): A Study on Cashless Payment for Public Roadside Parking Fees in Surabaya City

Implementasi Smart Parking System (SPS): Studi Pada Pembayaran Retribusi Parkir Tepi Jalan Umum Secara Non-Tunai di Kota Surabaya

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Abstract

The advancement of Information and Communication Technology (ICT) has revolutionized numerous aspects of life, including urban management, through the adoption of the smart city paradigm. A key initiative within this paradigm is the implementation of a Smart Parking System (SPS), where cashless parking payments play a pivotal role. In 2024, the city of Surabaya introduced a cashless payment system for on-street parking (TJU) as mandated by the Mayor of Surabaya. This study explores and analyzes the development and implementation of the SPS within the framework of TJU parking management policies. A qualitative research method was employed, integrating secondary data analysis, in-depth interviews, and field observations. The analytical framework is based on Weerakkody et al.'s (2011) model, which identifies four critical factors for e-government implementation: political, technological, organizational, and social dimensions. The findings indicate that the cashless parking payment policy has encountered significant implementation challenges. Politically, government support prioritizes fiscal considerations over digital reform in parking management, and communication among stakeholders has been ineffective. Technologically, the integration of the cashless system remains incomplete. Organizationally, the responsibility for transitioning to a cashless system lies with the UPTD Parking Unit of the Surabaya Transportation Agency, which is already burdened with multiple duties, thereby affecting its performance. Socially, the digital divide presents challenges, and public safety concerns arise regarding potential crimes during cashless transactions in on-street parking areas. Moreover, public awareness of the advantages of cashless parking remains low, and the lack of accountability in cash-based transactions has further hindered the acceptance and development of SPS in Surabaya.

Keywords: *Smart Parking System; Cashless Parking Payment; E-Government; Policy Implementation; Surabaya City*

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Abstrak

Perkembangan TIK merubah berbagai aspek kehidupan termasuk tata kelola kota dengan paradigma smart city. Salah satu inisiatif smart city adalah penerapan smart parking system (SPS) dimana aspek pembayaran parkir menjadi komponen penting di dalamnya. Pada tahun 2024, Kota Surabaya menerapkan sistem pembayaran parkir non-tunai di kawasan parkir tepi jalan umum (TJU) berdasarkan instruksi Wali Kota Surabaya. Penelitian ini bertujuan untuk mengetahui dan menganalisis penerapan pengembangan SPS dalam kebijakan tata kelola perparkiran TJU. Penelitian ini menggunakan metode kualitatif yang mengombinasikan eksplorasi data sekunder, wawancara mendalam, dan pengamatan. Teori yang digunakan diadaptasi dari Weerakkody dkk (2011) yang melihat empat faktor kunci implementasi e-government: politik, teknologi, organisasi, dan sosial. Hasil analisis menunjukkan implementasi kebijakan pembayaran parkir non-tunai tidak berhasil dilaksanakan. Secara politik, dukungan pemerintah didasarkan alasan fiskal, bukan reformasi tata kelola parkir berbasis digital. Komunikasi efektif antar stakeholder juga gagal dilakukan. Dari sisi teknologi, integrasi sistem pembayaran parkir non-tunai belum dibangun. Secara organisasi, pelimpahan tanggungjawab transisi sistem pembayaran parkir terletak pada UPTD Parkir Dinas Perhubungan Kota Surabaya. Padahal UPTD Parkir memiliki banyak tupoksi lain sehingga membuat kinerja organisasi menjadi tidak optimal. Secara sosial, isu digital divide perlu mendapatkan perhatian. Selain itu, potensi kejahatan di tepi jalan umum saat melakukan transaksi juga muncul sebagai kekhawatiran masyarakat. Awareness masyarakat terkait manfaat pembayaran parkir non-tunai perlu ditingkatkan. Selain itu, faktor rendahnya akuntabilitas dari pembayaran parkir tunai juga menimbulkan resistensi terhadap pengembangan SPS di Kota Surabaya.

Kata kunci: Smart Parking System; Pembayaran Parkir Non-Tunai; E-Government; Implementasi Kebijakan; Kota Surabaya.

Introduction

The increasing penetration of the internet has revolutionized various aspects of life, including urban governance and development (Fahim et al., 2021). Advances in Information and Communication Technology (ICT) have introduced a new urban governance concept known as the smart city. The primary objectives of a smart city are to reduce operational costs, improve urban management, enhance efficiency and productivity, and ultimately elevate the quality of life for its residents (Khajenasiri et al., 2017; Baraniewicz-Kotasińska, 2022). According to Bhatnagar (2024, p. 23), the framework of a smart city consists of six core pillars of intelligence: (1) smart governance, (2) smart environment, (3) smart communication, (4) smart mobility, (5) smart living, and (6) smart participation.

Within the smart city framework, smart mobility refers to the use of technology to enhance the efficiency, accessibility, and sustainability of urban transportation systems (Faria et al., 2017). This concept encompasses a range of solutions, including app-based vehicles, real-time traffic information systems, and the integration of various transportation modes (Benevolo et al., 2016). By leveraging real-time data and ICT, smart mobility aims to reduce traffic congestion and improve urban accessibility. A specific component of smart mobility, the Smart Parking System (SPS), focuses on optimizing the management and utilization of parking spaces (Faria et al., 2017). This system employs technologies such as sensors, data analytics, and mobile applications to provide real-time information on parking availability, guide drivers to available spaces, and streamline the payment process (Fahim et al., 2017; Jameel & Zafar, 2021).

An essential and relevant feature of SPS, particularly for parking systems in developing countries like Indonesia, is its cashless payment system. Numerous studies have highlighted the advantages of electronic payment methods. Bagudu and Okolie (2022) emphasize that electronic payment systems offer faster access, reduce the risk of crime associated with cash transactions, enhance financial inclusion, provide more service options, and increase tax revenue for governments. The cashless payment feature of SPS plays a pivotal role in a city's efforts to achieve smart city status.

The city of Surabaya, the capital of East Java Province, is Indonesia's second-largest city after Jakarta and has set a target to become a smart city (Iqbal & Arieffiani, 2023). This initiative is part of the Surabaya city government's efforts to leverage ICT in improving public service quality, operational efficiency, and citizen participation in urban development. As part of this effort, Surabaya has taken steps to develop a Smart Parking System (SPS) by offering cashless payment options for parking. Through Surabaya Mayor Regulation No. 18 of 2017, the Surabaya city government has committed to transforming parking payment mechanisms by providing both cash and cashless payment options. The regulation states that parking service users may use e-payment cards and similar methods.

The implementation of this cashless parking fee policy is expected to increase the revenue of Surabaya’s local government (Manumoyoso, 2014). In recent years, Surabaya’s locally generated revenue (PAD) has fallen short of its targets. Before the

COVID-19 pandemic, Surabaya's PAD achieved 104.50% of its target in 2018 and 102.81% in 2019. However, during the pandemic, PAD realization dropped to 85.20% in 2020 and 88.81% in 2021. Among the various components of PAD, parking fees contribute significantly. In 2019, before the pandemic, parking fee revenue reached IDR 34.5 billion. Nevertheless, recent data from the Surabaya Transportation Agency indicates that post-pandemic parking fee revenues have yet to return to their pre-pandemic levels.

The shortfall in revenue contrasts with the increasing number of on-street parking locations in Surabaya. In 2019, before the pandemic, there were approximately 1,868 on-street parking points in the city. However, due to the pandemic, this number decreased in 2020 and 2021. During the recovery period in 2022, the number of parking points rose to 1,290 and increased further to 1,370 in 2023 (Suara Surabaya, 2024). Despite this growth, parking fee revenues have not shown significant improvement. This situation is suspected to be influenced by the proliferation of illegal parking in Surabaya. Although there is no official estimate of the number of illegal parking spots or the extent of revenue leakage caused by them, the Surabaya city government identifies illegal parking as a key issue in the management of urban parking (Suara Surabaya, 2024).

Experts and observers believe that optimizing government revenue from parking fees can be achieved through the implementation of a Smart Parking System (SPS) utilizing cashless payment methods. The primary argument supporting this policy proposal stems from concerns over revenue leakage in Surabaya's parking fee system (Radar Surabaya, 2024). However, the implementation of cashless parking payment policies in Surabaya has faced significant challenges. Various forms of resistance have hindered the successful adoption of this system. Given the rapid advancements in ICT and urban governance innovations, particularly through the integration of SPS with cashless parking payments, studying the implementation of SPS in the management of on-street parking fees (TJU) in Surabaya becomes both relevant and valuable. This research aims to explore the potential and challenges associated with implementing cashless payment systems in Surabaya's parking fee management framework.

Research Methods

The qualitative research method is deemed appropriate for this study. Qualitative research is defined as an effort to explore phenomena deeply and comprehensively by collecting rich narrative material using a flexible research design. Data collection is essential for analysis, and multiple methods were employed in this study to gather data, including observations, in-depth interviews, and secondary documentation review.

Informants in qualitative research are individuals involved in the phenomenon under investigation and are expected to provide relevant information and data to address the research questions (Miller, 2010). This study engaged several informants, including representatives from the Surabaya City Transportation Agency, parking attendants in Surabaya, the Surabaya City Revenue Agency, the Chair of the Surabaya Parking Attendants Association (PJS), and parking service users in Surabaya.

Data analysis is a process of organizing, sorting, and synthesizing research data into a systematic and meaningful narrative. In this study, data analysis was conducted through several steps: data reduction, data presentation, and data verification. To ensure the practical and scientific validity of qualitative research, measures were taken to verify the accuracy of the findings based on specific standards. This verification process helps minimize researcher and instrument bias, especially when data obtained are perceived as too open-ended and lacking control. The triangulation method was applied in this study to enhance validity (Vivek, 2023).

Results And Discussion

Implementation of Cashless Parking Payment Policy Using the E-Government and Diffusion Framework

The implementation of the cashless parking payment system in Surabaya, which began on February 1, 2024, was discontinued after approximately one week at various parking locations across the city. The suspension of this policy was attributed to significant dynamics and resistance among the residents of Surabaya. In-depth interviews with several parking attendants revealed an agreement between the Surabaya City Government and parking attendants stipulating that the cashless parking payment

system would not be implemented. Instead, the parking attendants were required to return the parking fee contributions to the levels agreed upon prior to the COVID-19 pandemic.

With the suspension of the cashless parking payment policy—an integral step toward achieving smart city objectives—this study aims to analyze the factors underlying this outcome. The analysis is guided by the e-government implementation and diffusion theory developed by Weerakkody et al. (2011), which identifies four key components of e-government implementation: (1) political, (2) technological, (3) organizational, and (4) social aspects.

Political Aspect

In the context of e-government implementation and diffusion, the political aspect plays a crucial role in shaping how e-government initiatives are adopted, executed, and sustained. A critical subcomponent of the political aspect is government support or commitment. The success of e-government projects often depends on strong political will, which includes commitment from high-ranking political leaders to support objectives, allocate resources, and promote necessary reforms. Bwalya (2009) found that political will significantly contributes to either the delays or successes in e-government adoption, as political elites are in positions to direct policy and control resource allocation.

In Surabaya, the initial implementation of the cashless parking payment policy was supported strongly by the city government, including the Mayor of Surabaya. This robust early support was unsurprising, given the government's vested interest in parking fees as a potential source of locally generated revenue (PAD). The Surabaya City Government aimed to implement the cashless parking payment policy to boost PAD from parking fees, especially in light of fiscal pressures experienced post-COVID-19. Data from the Directorate General of Fiscal Balance (DJPK) indicates that Surabaya's PAD and parking fee revenues have not yet recovered to pre-pandemic levels.

When the cashless parking payment policy was suspended, the primary determinant was also fiscal in nature, particularly related to PAD generation. Key informants highlighted that the condition for halting the policy was the requirement for

parking fee contributions to return to pre-pandemic levels. This indicates that the government's initial support and efforts to implement the cashless parking payment policy were driven not by an intent to transform parking governance through e-government but by the goal of increasing government revenue.

In addition to the weak commitment to e-government reform in the implementation of cashless parking management, leadership is a key factor significantly influencing the success of e-government initiatives (Alziyadat & Obidat, 2022). Effective leadership ensures a smooth transition in implementing e-government by providing clear direction, fostering collaboration, and driving the necessary changes. Effective leaders engage multiple stakeholders, including government agencies, technology providers, and the public, throughout the transition process. They work to build consensus, address concerns, and ensure that the needs and expectations of all parties are considered. A collaborative approach is critical to the successful implementation of e-government policies (Dema et al., 2023).

In the case of the cashless parking payment policy implementation in Surabaya, poor communication among stakeholders created significant barriers. According to accounts from parking attendants at various locations and the Chair of the Surabaya Parking Attendants Association, the cashless parking payment policy was neither discussed nor communicated to parking attendants before its trial implementation. This lack of engagement led to resistance and rejection from parking attendants in Surabaya.

Ineffective communication among stakeholders also increased the potential for conflict in the field. Media documentation reported heated discussions involving the Surabaya Transportation Agency (Dishub), parking attendants, police, and the Chair of the Parking Attendants Association. These disputes stemmed from the strong opposition of parking attendants to the cashless payment trial, while Dishub remained resolute in enforcing the policy. Such conflicts could have been avoided through open communication among stakeholders, particularly regarding revenue-sharing percentages and technical implementation mechanisms.

Technological Challenges

Another critical determinant of the success of e-government policy implementation is the technological aspect. Technology plays a pivotal role in e-government initiatives, serving as the foundation for digital transformation in public administration. In the cashless parking payment policy implementation, the technology used includes internet connectivity, mobile phones with mobile banking applications, e-money cards, QRIS (Quick Response Code Indonesian Standard) boards, and parking meters for e-money card tapping.

Internet access, mobile phones with mobile banking, and e-money cards must be prepared by parking service users. Meanwhile, QRIS boards were provided by Bank Jatim and distributed to parking attendants, while parking meters were supplied by the Surabaya Transportation Agency. Transactions using e-money cards require parking meter infrastructure, which offers a relatively simple mechanism (users only need to tap their e-money cards). However, users must be well-informed about this process to prepare their e-money cards in advance.

A significant issue is the limited availability of parking meter infrastructure. In Surabaya, only two locations—Taman Bungkul and Balai Kota—are equipped with parking meters. The lack of widespread infrastructure poses a major challenge to the success of the cashless parking payment policy, as many parking locations lack the necessary facilities.

According to feedback from several parking service users experienced in using QRIS for parking payments, no significant issues were reported concerning the security and privacy aspects of the cashless parking payment system in Surabaya. Financial literature also highlights that QRIS is considered an effective, fast, and secure payment mechanism (Nada et al., 2021).

The next critical aspect of cashless parking payment technology is system integration, which involves connecting all technological devices and stakeholders. For cashless parking payment mechanisms to function effectively, seamless system integration must be established among all relevant technologies and parties. However, in the context of implementing the cashless parking payment policy in Surabaya, system integration remains incomplete. While the availability of QRIS boards provides access

to cashless payment technology, it does not facilitate the integration of the broader system components. One significant issue is the lack of clarity regarding the mechanism for revenue distribution. When funds are deposited into the government's bank account by parking service users, the technical details of how the revenue is distributed remain ambiguous. It is unclear whether the revenue will be distributed in cash or via cashless transactions to parking attendants. If a cashless distribution mechanism is intended, no comprehensive database of parking attendants' bank accounts has been established in Surabaya. Field observations reveal that disputes over revenue-sharing percentages among the municipal government, coordinators, and parking attendants, as well as the technical mechanisms for revenue distribution, are central issues in implementing the cashless parking payment policy. From a technological standpoint, simply providing QRIS boards or parking meters at parking locations does not guarantee the policy's success. A fully integrated payment system is essential, encompassing the entire process—from the initial payment by parking users to the final distribution of funds among all stakeholders involved.

Organizational Aspect

The third critical factor influencing the successful implementation of the cashless parking payment policy in Surabaya is the organizational aspect. This includes organizational structure, the distribution of power among members within the structure, and the organization's internal culture (Weerakkody et al., 2009). To facilitate the transition to a cashless parking payment system, the Surabaya City Government issued Mayor Regulation No. 61 of 2023, amending Mayor Regulation No. 81 of 2021 regarding the Position, Organizational Structure, Duties, Functions, and Work Procedures of the Surabaya Transportation Agency. Under this regulation, the Technical Implementation Unit (UPT) for On-Street Parking (TJU) of the Surabaya Transportation Agency is responsible for implementing the cashless parking payment policy in Surabaya's TJU areas. The organizational structure of the UPT TJU is further governed by Mayor Regulation No. 42 of 2023.

The UPT TJU team already carries substantial responsibilities and duties. With limited personnel and the extensive scope of on-street parking areas, the additional

responsibility of overseeing the transition to a cashless payment system presents a significant challenge. Successful e-government transitions require collaboration across various sectors and, in some cases, cross-departmental coordination within the Surabaya city government. Therefore, the establishment of a dedicated task force to manage the dynamics of the transition period for the cashless parking payment policy becomes highly relevant (Chen et al., 2009; Ashaye & Irani, 2019).Such a task force would provide the necessary expertise, coordination, planning, and oversight to develop, implement, and sustain effective e-government services. This approach ensures that the organizational challenges are addressed systematically and that the transition process is managed efficiently.

Social Aspect

One of the social factors that may hinder the transition to implementing a cashless parking payment policy in Surabaya is the digital divide. The digital divide refers to disparities in access to digital technology within society. This divide is often observed between lower-income and upper-middle-income groups. However, in the context of Surabaya, which has a relatively high level of economic prosperity, the digital divide between economic classes does not appear to pose a significant issue. Nevertheless, digital disparities may still exist among different demographic groups. While the majority of Surabaya's population consists of young and productive individuals, a substantial portion of the population comprises middle-aged and elderly individuals.

In-depth interviews with parking service users also revealed concerns about the safety of using mobile phones to scan QRIS codes in public, which may increase the risk of theft or robbery. The use of QRIS scanning for on-street parking payments is perceived to carry potential security risks, particularly in a large city like Surabaya. Another key social factor affecting the success of the cashless parking payment policy is public awareness. Interviews with parking attendants and service users indicated that many residents, particularly those in certain areas such as traditional markets, are uncomfortable with cashless payment mechanisms. These individuals find the process of cashless parking payments to be complex, impractical, and devoid of any perceived

benefits for them. Addressing these social concerns, including digital access disparities, security risks, and low public awareness, is crucial for ensuring the successful implementation of the cashless parking payment policy in Surabaya.

Accountability Aspect

In addition to the four aspects outlined by Weerakkody et al. (2011), accountability is another critical factor influencing the success of the transition to a cashless parking payment system. A fundamental step in this transition is identifying the key actors involved in the parking system and understanding the hierarchy and structure of these stakeholders. Based on in-depth interviews, several key players were identified in Surabaya's parking system before the implementation of cashless payments: parking attendants, area supervisors, the Transportation Agency, the Parking Attendants Association, and local "territorial authorities".

Parking attendants in Surabaya operate under two employment arrangements: some are municipal employees receiving a monthly salary, while the majority function as partners of the Surabaya City Government. As partners, parking attendants are issued official membership cards by the Transportation Agency. These cards signify their agreement to adhere to revenue-sharing regulations, whereby 70% of the parking fees are allocated to the municipal government, and the remaining 30% is distributed among field staff, comprising 20% for parking attendants and 10% for area supervisors. This revenue-sharing rule applies uniformly across all parking locations, regardless of whether parking demand is high or low on a given day.

Although this revenue-sharing arrangement is clearly defined on paper, the cash-based payment system (using paper tickets) is challenging to monitor effectively. Transparency in cash-based parking payment systems is notably weak, as there is no reliable method to verify the exact number of vehicles parking at each location daily. Interviews with parking attendants and officials from the Surabaya Transportation Agency revealed that parking attendants are required to meet a minimum daily revenue target for submission to the agency. If attendants fail to meet this target, they face performance evaluations and potential dismissal. This lack of transparency and accountability in the cash-based system underscores the importance of transitioning to

a cashless payment mechanism. Such a system has the potential to enhance transparency, reduce revenue leakage, and ensure fair distribution of parking revenues among stakeholders.

Area supervisors (katar) are community members appointed by the UPT of the Surabaya Transportation Agency to oversee parking operations. Their responsibilities include reporting the total revenue collected, the number of parked vehicles, and other relevant details such as reporting times. Area supervisors verify the revenue submitted by parking attendants against recorded data and reports. This process includes reconciliation to ensure there are no discrepancies in the collected amounts. Once verified, the calculated parking revenue is submitted to officials at the Surabaya Transportation Agency as official municipal income.

However, the cash-based ticketing system lacks transparency, coupled with the operational relationships among the various actors, making the system highly prone to revenue leakage. Parking attendants often submit only the minimum required amount set by the Transportation Agency, as there is no incentive for them to report the full revenue based on the actual number of parked vehicles. Similarly, area supervisors and Transportation Agency officials lack any motivation or incentive to rigorously monitor or enforce compliance within the cash-based system. This cash-based payment system creates ample opportunities for financial gains through revenue leakage, undermining accountability. Such practices inevitably foster resistance to implementing a transparent and accountable cashless parking payment system, as it would close off these financial loopholes. Addressing these systemic issues is essential for ensuring the successful transition to a cashless parking payment policy.

Discussion

From the perspective of electronic government (e-government) development stages, the implementation of the cashless parking payment system in Surabaya remains at an early maturity level. Referring to the Hiller and Belanger Maturity Model (2006), e-government comprises five stages: (1) Information Dissemination, (2) Two-Way Communication, (3) Transaction, (4) Integration, and (5) Electronic Participation.

At the Information Dissemination stage, the public can access government service information through official government websites. The next stage, Two-Way Communication, enables the public not only to access information but also to interact by filling out forms or providing comments on the website. This stage facilitates direct interaction between the public and the government. In the Transaction stage, the public can conduct financial transactions via government-built systems. The subsequent stage, Integration, involves both vertical and horizontal system connections, allowing all user needs—including those of citizens, businesses, and government—to be interconnected and accessible. Finally, at the Electronic Participation stage, the public actively engages in political activities, such as voting, through online applications (Ogunleye & Van Belle, 2016).

The implementation of the cashless parking payment system in Surabaya does not fully align with the stages outlined in the Hiller and Belanger model (2006). While the system has reached the Information Dissemination stage through the availability of cashless payment services and financial transactions, it has not progressed to the Two-Way Communication stage. Moreover, it has yet to achieve System Integration, which is crucial for ensuring seamless interaction between various stakeholders and systems. In practice, the implementation of the cashless parking payment policy requires an e-government maturity level that encompasses the Integration stage. The lack of system integration has significantly hindered the effective implementation of the policy in Surabaya. From a technological perspective, the failure to achieve full system integration has been a critical factor leading to the suspension of the cashless parking payment policy.

Conclusion

Based on the discussion above, it can be concluded that the implementation of the Smart Parking System (SPS) in the management of on-street parking (TJU) in Surabaya, particularly in the aspect of cashless payment, was unsuccessful and only operated for one week. There was no continuity in the development of the SPS for managing TJU parking using digital mechanisms in Surabaya. Four main factors hindered the

successful transition to cashless parking payments: political, technological, organizational, and social.

From a political perspective, inconsistent government support and a failure in stakeholder communication significantly obstructed the transition. In terms of technology, the lack of system integration impeded the process. From an organizational standpoint, delegating the responsibility for transitioning to cashless parking payments to the UPTD Parkir TJU under the Surabaya Transportation Agency yielded suboptimal results. On the social front, issues such as the digital divide between younger and older population groups, concerns about crimes occurring during roadside transactions, and low public awareness further hindered the transition process.

Additionally, the low accountability of the cash-based parking payment system created significant resistance among field stakeholders within Surabaya's parking ecosystem. These barriers highlight the need for a more comprehensive and integrated approach to successfully implement a cashless parking payment system in the future.

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