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IMPLEMENTATION OF PARKING CHARGE NOTICES (PCN) THROUGH A COLLABORATIVE DIGITAL GOVERNANCE MODEL IN URBAN PARKING MANAGEMENT

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Abstract

This study aims to analyze the implementation of Parking Charge Notices (PCNs) as a digital-based parking enforcement instrument through a Collaborative Digital Governance Model in the Administrative City of East Jakarta, covering the typology of implementation, actor configuration, and model formulation. The study employed a Sequential Explanatory Mixed-Methods design. The quantitative phase utilized administrative PCN data obtained from the Jakarta Special Capital Region Provincial Transportation Agency covering the period from January 2024 to December 2025. The research population consisted of all enforcement incidents that met the established criteria, with 6,865 observations analyzed using total sampling; no survey respondents were involved in this study. The quantitative analysis employed descriptive statistics and K-Means Cluster Analysis. The qualitative phase involved 15 purposively selected informants, including transportation officials and enforcement personnel, Public Order Agency (*Satpol PP*) officers, police officers, parking operators, academics, and members of the public. The qualitative data were analyzed using Thematic Analysis with hybrid coding and integrated through a Joint Display. The findings indicate that PCN implementation is heterogeneous and encompasses three location typologies, with 99.23 percent of violations occurring on roadways. The resulting model identifies six key dimensions: implementation capacity, digital enforcement capability, regulatory capacity, communication and coordination, collaborative relationships, and public responsiveness. The study recommends typology-based enforcement, integrated digital data systems, strengthened cross-actor coordination, enhanced implementer competencies, and greater public legitimacy and information dissemination.

Keywords: *Parking Charge Notices; Collaborative Digital Governance; Parking Management; Urban Governance; Policy Implementation.*

INTRODUCTION

The growth of urban mobility has increased pressure on road space and parking facilities (Qumsiyeh & Ishaq, 2023). Parking can no longer be understood merely as a matter of providing spaces for vehicles; it has evolved into a governance issue associated with the use of public space, traffic order, institutional capacity, technology, and public behavior (Nallathati et al., 2025).

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In urban areas, the imbalance between vehicle growth and the availability of parking facilities has contributed to the emergence of parking on roadways and in locations not designated for parking. These conditions may reduce road capacity, disrupt traffic flow, intensify conflicts over the use of public space, and weaken compliance with established policies (Kubenz, 2025). In Jakarta, these challenges have become increasingly complex due to the high intensity of mobility and growing parking demand. The data used in this study indicate that approximately 3.84 million parking tickets were sold throughout 2023, with passenger cars accounting for approximately 67 percent of parking transactions (Zhou et al., 2025).

Digital transformation has subsequently created opportunities to shift parking enforcement from conventional mechanisms toward systems that are more documented, data-driven, and integrated (Shekhar, 2025). In this study, Parking Charge Notices (PCNs) are positioned as a digital-based parking enforcement instrument that enables the processes of violation identification, documentation, notification, and administrative follow-up to be carried out more systematically. However, digitalization does not automatically ensure effective policy implementation. The success of PCN implementation is also influenced by organizational capacity, the quality of digital infrastructure, regulatory clarity, the capabilities of enforcement personnel, interagency coordination, and public acceptance (Amaral, 2025). Therefore, the central issue is not merely how technology is utilized, but how it is integrated into a collaborative governance framework (Piccialli et al., 2025).

Normatively, parking management is supported by the regulatory framework governing transportation and local government. Law Number 22 of 2009 concerning Road Traffic and Transportation provides the legal basis for regulating the use of road space and the administration of road traffic and transportation (Amer, 2021). Furthermore, regional authority in parking management is supported by Law Number 28 of 2009 concerning Regional Taxes and Levies, which regulates the fiscal dimension of parking administration (Xu et al., 2023). In the Jakarta context, further provisions are established through Jakarta Provincial Regulation Number 5 of 2014 concerning Transportation, which identifies illegal parking as parking activities conducted in locations not designated as official parking areas or carried out without legitimate authority (Hess & Shoup, 2025). This framework is subsequently translated into technical regulations and enforcement Standard Operating Procedures (SOPs).

In scientific writing, these legal provisions should be presented carefully because the research materials do not provide complete information regarding the specific articles and paragraphs of each regulation. Therefore, article or paragraph numbers that are not explicitly stated in the research materials are not added speculatively. What can be established from the available research sources is that national regulations, provincial regulations, gubernatorial regulations, and SOPs form a hierarchy of implementation ranging from legal norms and the distribution of authority to enforcement procedures and the implementation of PCNs in the field.

Previous studies indicate that research on urban parking has generally focused on facility capacity, regulatory effectiveness, user behavior, parking technology, and the control of illegal parking (Jha et al., 2023). The literature on *digital governance* has largely examined the use of information technology in public services and digital government. Meanwhile, studies on *collaborative governance* emphasize the importance of multi-actor involvement, communication, coordination, trust, and the distribution of roles in addressing public problems (Evgenyevich & Vylegzhanin, 2021). Research on parking management has also demonstrated that spatial characteristics, facility capacity, institutional arrangements, and social conditions influence the success of policy implementation (Colovic et al., 2023).

Nevertheless, these three perspectives are often treated separately (Alirezazadeh & Disfani, 2024). Technology tends to be positioned as a technical instrument, collaboration as a mechanism governing relationships among actors, and policy implementation as an administrative process. This study adopts a different perspective by bringing these three dimensions together within the context of PCN implementation. By using administrative enforcement data and interviews with relevant actors, the study seeks to understand not only what occurs during PCN implementation but also how and why variations in implementation emerge.

The research problem originates from the fact that the implementation of PCNs in East Jakarta cannot yet be understood as a uniform enforcement process. An analysis of 6,865 enforcement records across 479 locations revealed differences in the intensity and characteristics of violations among locations (Pore & Nemade, 2025). Furthermore, implementation success is influenced by the relationship among implementer capacity, regulations, technology, interorganizational coordination, and public response. Therefore, the central research problem of this study is how to develop a PCN implementation governance system capable of integrating digital, institutional, regulatory, collaborative, and public-response dimensions.

The first *research gap* is substantive, as studies specifically examining PCN implementation at the administrative city level, particularly in East Jakarta, remain limited (Zong et al., 2023). The second gap is theoretical, as relatively few frameworks connect *digital governance* and *collaborative governance* in explaining the implementation of parking enforcement instruments. The third gap is methodological, as previous studies have tended to employ quantitative or qualitative approaches separately (Wang et al., 2024). This study addresses these gaps through a Sequential Explanatory Mixed-Methods design that integrates patterns derived from administrative data with in-depth explanations provided by policy implementation actors (Li et al., 2024).

Based on these problems and research gaps, this study aims to analyze the implementation of PCNs as a digital-based parking enforcement instrument in the Administrative City of East Jakarta; identify the patterns, characteristics, and typologies of implementation; analyze actor configurations, the distribution of authority, communication, coordination, and

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collaborative relationships; identify supporting and constraining factors; and formulate a Collaborative Digital Governance Model capable of improving the effectiveness of urban parking enforcement.

The primary contribution of this study lies in the development of a Collaborative Digital Governance Model that views PCN implementation as a governance system rather than merely a digital enforcement mechanism. The model is developed through the integration of quantitative and qualitative evidence and identifies six principal dimensions: Implementation Capacity, Digital Enforcement Capability, Policy and Regulatory Capacity, Communication and Coordination, Collaborative Actor Relations, and Public Response and Social Behaviour. The novelty of the study is also reflected in the use of location typologies as a basis for enforcement management. The *K-Means* analysis identifies three location characteristics, enabling enforcement strategies to be adapted to local conditions without altering existing legal standards (Sun et al., 2024). This approach expands the study of *digital governance* by incorporating institutional capacity, inter-actor relationships, and public response as components that determine the practical value of technology in implementation. Accordingly, the study contributes theoretically to public administration scholarship and practically to local governments seeking to develop parking enforcement systems that are data-driven, collaborative, adaptive, accountable, and responsive to urban characteristics.

The literature on urban parking management demonstrates a shift from conventional approaches toward governance systems that utilize technology, data, and multi-stakeholder participation (Ozkaya, 2024). Ansell and Gash (2008) define *Collaborative Governance* as a governing process that brings various actors into interaction to develop dialogue, trust, commitment, shared understanding, and collective action (Hess, 2025). This perspective is relevant to the implementation of Parking Charge Notices (PCNs) because parking enforcement involves not only local government but also transportation agencies, Public Order Agency (*Satpol PP*) personnel, law enforcement authorities, parking operators or attendants, and the public. The effectiveness of PCNs is therefore determined not merely by the availability of technology but also by the ability of actors to align authority, information, resources, and actions (Macea et al., 2023).

The second perspective is derived from Margetts and Dunleavy's (2013) concept of *Digital-Era Governance*, which positions digital technology as a mechanism for integrating information, administrative processes, and government services (Ma et al., 2023). In PCN implementation, technology enables the processes of violation identification, recording, documentation, and enforcement data management to be conducted more systematically. However, technology continues to operate within institutional and social environments; therefore, the success of digitalization requires organizational capacity, data integration, clear regulations, and compatibility with bureaucratic practices (Chiliment et al., 2024).

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Previous studies indicate that parking research has generally focused on regulations, facility capacity, *smart parking*, and enforcement effectiveness (Huang et al., 2022). A significant research gap exists because the integration of *Collaborative Governance*, *Digital Governance*, and PCN implementation remains limited, particularly within the context of Indonesian local government (Gosal et al., 2024). Therefore, the Conceptual Framework of this study connects implementation capacity, digital enforcement capability, regulatory capacity, communication and coordination, inter-actor relationships, and public response as dimensions that shape the effectiveness of PCN implementation.

Based on this framework, the following conceptual hypotheses can be formulated: H1: Implementation capacity has a positive effect on the effectiveness of PCN implementation. H2: Digital enforcement capability has a positive effect on PCN effectiveness. H3: Policy and regulatory capacity has a positive effect on the effectiveness of PCN implementation. H4: Communication and coordination have a positive effect on the effectiveness of PCN implementation. H5: Collaborative relationships among actors have a positive effect on the effectiveness of PCN implementation. H6: Public response and social behavior influence the successful implementation of PCNs.

This framework integrates three perspectives policy implementation, Collaborative Governance, and Digital Governance to develop a contextually grounded Collaborative Digital Governance Model.

METHODOLOGY

This study employed a mixed-methods approach using a Sequential Explanatory Mixed-Methods design (Wang et al., 2025), in which quantitative analysis was conducted first and subsequently explored in greater depth through a qualitative approach. This research design was selected because the implementation of *Parking Charge Notices* (PCNs) is a multidimensional phenomenon that cannot be adequately explained solely through administrative data but also requires an understanding of institutional contexts and actor behavior. The quantitative phase was intended to identify patterns, characteristics, distributions, and typologies of PCN enforcement. The qualitative phase was subsequently used to explain how and why variations in implementation occurred, particularly in relation to implementer capacity, the distribution of roles, communication, coordination, public responses, and factors supporting or constraining implementation.

The research population comprised all PCN enforcement incidents that met the established research criteria. A total of 6,865 observations were analyzed using a total sampling approach; therefore, the quantitative component of the study did not involve survey respondents. The data were analyzed using descriptive statistics and K-Means Cluster Analysis (Manggau et al., 2025) to obtain an overview and develop an implementation typology based on the characteristics of enforcement data. In the qualitative phase, the study involved 15 purposively

selected informants based on their positions, authority, experience, and direct involvement in PCN implementation (Sychterz, 2022). The informants included transportation officials and personnel, Public Order Agency (*Satpol PP*) officers, police officers, parking operators, academics, and members of the public. This approach enabled the quantitative findings not only to describe implementation patterns but also to provide contextual explanations regarding implementation mechanisms, interactions among actors, and the conditions shaping PCN implementation.

Operationally, the study was conducted through four interconnected stages. The first stage involved problem identification and the development of a conceptual framework integrating Policy Implementation, Collaborative Governance, and Digital Governance. The second stage consisted of processing and analyzing PCN administrative data. The third stage involved a *connecting* process, in which the quantitative findings were used as the basis for determining the focus of the interviews (Bowman, 2022). The fourth stage consisted of qualitative analysis and the integration of findings through a Joint Display (Ahad & Kidwai, 2025). Through this design, quantitative data addressed the question of what occurred, whereas qualitative data provided explanations of how and why the phenomenon occurred. The synthesis of both forms of evidence was subsequently used to develop the Collaborative Digital Governance Model.

The quantitative research population did not consist of individuals or survey respondents but rather of all Parking Charge Notice enforcement incidents recorded in the administrative database of the Transportation Agency of the Jakarta Special Capital Region Provincial Government between January 2024 and December 2025 in the Administrative City of East Jakarta. Following data verification and cleaning, 6,865 enforcement incidents met the criteria for analysis. Because the study utilized the entire available administrative dataset, a total sampling approach was adopted. Consequently, no sampling procedure was conducted in the quantitative phase, as all eligible units of observation were included in the analysis.

In the qualitative phase, the study involved 15 informants selected through purposive sampling (Manjaly, 2024). The selection was based on their positions, authority, experience, and direct involvement in PCN implementation. The informants represented the Transportation Agency, PCN enforcement officers, the Public Order Agency (*Satpol PP*), the Indonesian National Police, parking operators, academics, and members of the public or road users. This composition was designed to provide diverse perspectives on the implementation process, inter-actor relationships, public responses, and institutional conditions.

Accordingly, the term *sample* should be understood differently across the two phases of the study. In the quantitative phase, the entire administrative dataset was used; therefore, no sampling process was undertaken. In the qualitative phase, informants were purposively selected to obtain information with substantive relevance to the phenomenon under investigation.

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Data collection was conducted sequentially in accordance with the Sequential Explanatory Mixed-Methods design (M.K. et al., 2025). Three primary techniques were employed: documentation, in-depth interviews, and literature review. Documentation served as the primary source of quantitative data in the form of the PCN enforcement database covering the period from January 2024 to December 2025. In addition to the database, supporting documents included parking regulations, PCN implementation Standard Operating Procedures (SOPs), enforcement reports, policy documents issued by the Transportation Agency, and institutional documents related to policy implementation.

Qualitative data were collected through semi-structured in-depth interviews with the 15 informants. The interview guide was developed based on the policy implementation framework of Van Meter and Van Horn (Sebatli-Saglam & Cavdur, 2025) and the findings of the quantitative analysis. This strategy allowed the research questions to evolve in response to field findings without losing their theoretical focus. All interviews were recorded with the informants' consent and subsequently transcribed verbatim.

The literature review was conducted to strengthen the theoretical and empirical foundations of the study, particularly concerning policy implementation, *Collaborative Governance*, *Digital Governance*, parking management, and mixed-methods research. Data from various sources were subsequently compared through triangulation to identify information that was consistent, divergent, or complementary (Adem et al., 2025).

This study did not position effectiveness as the sole dependent variable to be tested conventionally. Instead, it examined the patterns, characteristics, typologies, processes, inter-actor relationships, digital conditions, and implementation mechanisms associated with PCNs. In the quantitative phase, the unit of observation was each individual enforcement incident, whereas multivariate analysis was conducted after the data had been aggregated by location. Consequently, the enforcement location became the unit of analysis for identifying implementation typologies. Administrative variables included location, date and time of enforcement, vehicle type, vehicle year, type of violation, implementing unit, and vehicle storage location.

In the qualitative phase, the conceptual analysis was guided by the six dimensions of Van Meter and Van Horn's policy implementation framework: policy standards and objectives, resources, characteristics of implementing organizations, interorganizational communication, implementer disposition, and the social, economic, and political environment (Kushwaha et al., 2022). This framework was further enriched by the perspective of *Collaborative Governance* to examine actor configurations, the distribution of roles, coordination, trust, and legitimacy (Hariwibowo et al., 2025), as well as *Digital Governance* to analyze technology, data integration, digital systems, technological capacity, and information transparency (Lubrich, 2023).

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Through this approach, the research constructs were not treated as independent variables operating in isolation but as interconnected dimensions explaining PCN implementation. This approach is consistent with the ultimate objective of the study, namely to develop a governance model integrating policy, institutions, technology, actors, and the public.

The quantitative analysis began with data preprocessing, including completeness checks, duplicate identification, data cleaning, transformation, aggregation, and standardization (Ke et al., 2024). Data processing was conducted using the R programming environment, supported by several analytical packages, including *tidyverse*, *lubridate*, *readxl*, *dplyr,* and *stringr*. These procedures were necessary to ensure that the administrative database possessed sufficient quality before being used for statistical and multivariate analyses.

The subsequent analysis employed descriptive statistics to describe the distribution of enforcement activities by time, location, vehicle type, type of violation, and administrative attributes. Spatial analysis was used to examine the geographical distribution of enforcement incidents, while K-Means Cluster Analysis was applied to identify groups of locations based on similarities in their implementation characteristics (Parmar et al., 2022). The determination of cluster quality and the optimal number of clusters was supported by evaluation measures such as the *silhouette* method and the *Gap Statistic* (Kujawski & Nürnberg, 2023). The final results were used to develop a typology of PCN implementation and to identify issues requiring further exploration through qualitative interviews.

The qualitative analysis employed Thematic Analysis with Hybrid Coding (Dukhniak & Terletska, 2022). *Deductive coding* was guided by the Van Meter and Van Horn framework, whereas *inductive coding* allowed new themes to emerge from the empirical data. The analysis progressed from *meaning units* to codes, themes, *higher-order themes*, and relationships among themes through a *thematic co-occurrence network*. The final stage involved data integration through Joint Display Analysis (Aditi & Roy, 2024). Quantitative findings concerning patterns, characteristics, and typologies were connected with qualitative findings concerning actors, coordination, supporting and constraining factors, and implementation mechanisms. This integration provided the empirical foundation for developing the Collaborative Digital Governance Model.

The quality of quantitative data was maintained through examinations of completeness, consistency, and duplication before analysis (Lee & Park, 2021). The level of data completeness can be calculated using the following formula:

Completeness = (Number of Valid Data ÷ Total Number of Data) × 100 percent

Following the verification and *data cleaning* processes, 6,865 PCN enforcement observations were considered eligible for analysis. Duplicate records were examined by comparing the identity of each incident based on location, date, time, and enforcement attributes, ensuring that each observation represented an accountable and traceable enforcement event.

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Therefore, data validity was not based on conventional survey instrument testing but rather on the quality, consistency, and traceability of administrative data.

For the qualitative data, credibility was strengthened through triangulation across the 15 informants, representing government institutions, field officers, *Satpol PP*, the police, parking operators, academics, and members of the public. The consistency of findings was assessed using the following formula:

Prevalence = (Number of Informants Mentioning a Theme ÷ 15) × 100 percent

The results showed that *Digital Enforcement Capability* and *Public Behavioral Norms* were each mentioned by 15 out of 15 informants (100 percent), while *Effective Implementation Communication* was mentioned by 14 out of 15 informants (93.3 percent), and *Policy Clarity* by 13 out of 15 informants (86.7 percent). The analytical process also generated 19 first-order themes and 5 higher-order themes, further strengthening the traceability and transparency of the data interpretation process.

Research ethics were applied primarily during the collection and processing of qualitative data. Interviews were conducted with informants based on the relevance of their positions, experience, and involvement in PCN implementation. Interviews were recorded only after obtaining the informants' consent, and the recordings were subsequently transcribed to maintain the accuracy of the information provided.

Confidentiality was also an important component of data management. The raw data used in the analytical process were documented in anonymized form, while research documentation was designed to maintain transparency without improperly disclosing information that could identify individual informants. These ethical principles were particularly important because the study involved government officials, law enforcement personnel, parking operators, academics, and members of the public.

Overall, the research methodology was designed to generate robust empirical evidence while providing an in-depth contextual explanation of the phenomenon under investigation. The integration of quantitative and qualitative data enabled the study to move beyond merely mapping PCN implementation and toward explaining the relationships among implementation capacity, digital technology, inter-actor coordination, and public responses. Therefore, the Sequential Explanatory Mixed-Methods approach served as the principal methodological instrument for developing a contextually grounded Collaborative Digital Governance Model for PCN implementation in urban parking management in the Administrative City of East Jakarta.

RESULTS

Descriptive Analysis Results and Location Typology of Parking Charge Notice Implementation

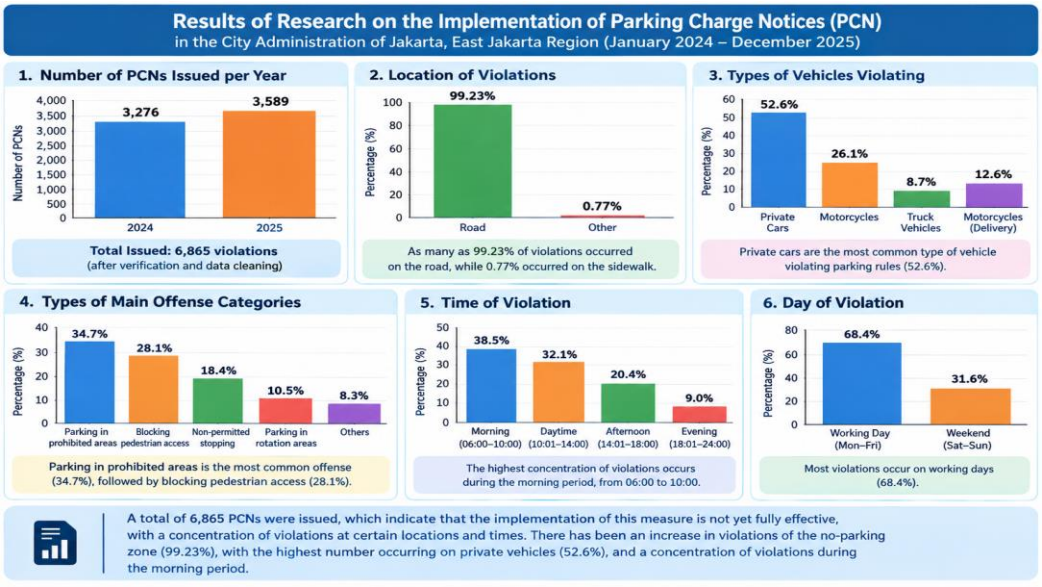
The findings indicate that the implementation of *Parking Charge Notices* (PCNs) in the Administrative City of East Jakarta from January 2024 to December 2025 resulted in 6,865

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enforcement incidents that underwent verification and *data-cleaning* procedures. Each observation represented a single enforcement incident and contained administrative information regarding the location, date, time, vehicle characteristics, type of violation, and implementing unit. The use of the complete administrative dataset enabled the study to describe implementation based on actual field enforcement incidents rather than on the perceptions of survey respondents. Accordingly, the analysis provides empirical evidence of how PCN enforcement was carried out across temporal, spatial, vehicle-related, and other operational dimensions.

Descriptively, the distribution of the 6,865 enforcement incidents indicates that PCN implementation was not evenly distributed across the entire study area. Enforcement activities showed particular concentrations according to location and temporal characteristics. The spatial findings reveal variations in enforcement intensity across locations, indicating that each area possesses distinct operational characteristics. These results suggest that parking problems addressed through PCNs are shaped by specific geographical contexts. Therefore, high or low levels of enforcement at a particular location should be understood as reflecting environmental characteristics, patterns of activity within the area, and operational enforcement conditions rather than simply serving as indicators of policy success or failure.

Of the total observations, 99.23 persent of enforcement incidents occurred on roadways, whereas 0.77 persent occurred on sidewalks. This distribution indicates that roadways constitute the primary spaces in which violations targeted by PCN enforcement occur. The finding provides important information for local governments in determining surveillance and enforcement priorities. In addition, temporal patterns indicate that enforcement activities tended to be concentrated on weekdays and during the morning through late-morning periods. This pattern demonstrates a relatively consistent operational characteristic in enforcement activities while also suggesting that surveillance and enforcement strategies can be adjusted to the patterns of incidents identified in the field data.



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The figure shows that PCN implementation in East Jakarta is multidimensional, as indicated by the increase in enforcement actions from 2024 to 2025 and their concentration on roadways, passenger vehicles, weekdays, and the morning-to-midday period. The three location typologies demonstrate spatial heterogeneity across the study area. These findings highlight the need for enforcement strategies that are based on data, location characteristics, and operational conditions.

K-Means Cluster Analysis was used to identify heterogeneity in the characteristics of PCN enforcement locations based on verified administrative data (Yan et al., 2022). Of the 6,865 enforcement incidents recorded across 479 locations in East Jakarta between January 2024 and December 2025, each location was grouped according to similarities in enforcement and vehicle characteristics. Mathematically, K-Means minimizes the sum of squared distances between each observation and its cluster center (*centroid*), expressed as min $\Sigma_i\Sigma_k \|x_i - \mu_k\|^2$, where x_i represents the characteristics of a location and μ_k represents the cluster centroid (Lu et al., 2025). The cluster structure was assessed using the *silhouette* method and the *Gap Statistic* (Ludwisiak & Mazur-Milecka, 2024), resulting in three location typologies. Cluster 1 exhibited relatively high enforcement intensity with greater vehicle diversity. Cluster 2 was characterized more strongly by goods vehicles and special-purpose vehicles, whereas Cluster 3 represented the largest group of locations, dominated by passenger vehicles and displaying the most common enforcement pattern. These findings demonstrate that PCN enforcement follows different spatial patterns across locations. Therefore, enforcement should not be implemented uniformly but should instead be tailored to the characteristics of each location typology as a basis for developing a more adaptive and data-driven *Collaborative Digital Governance* approach.

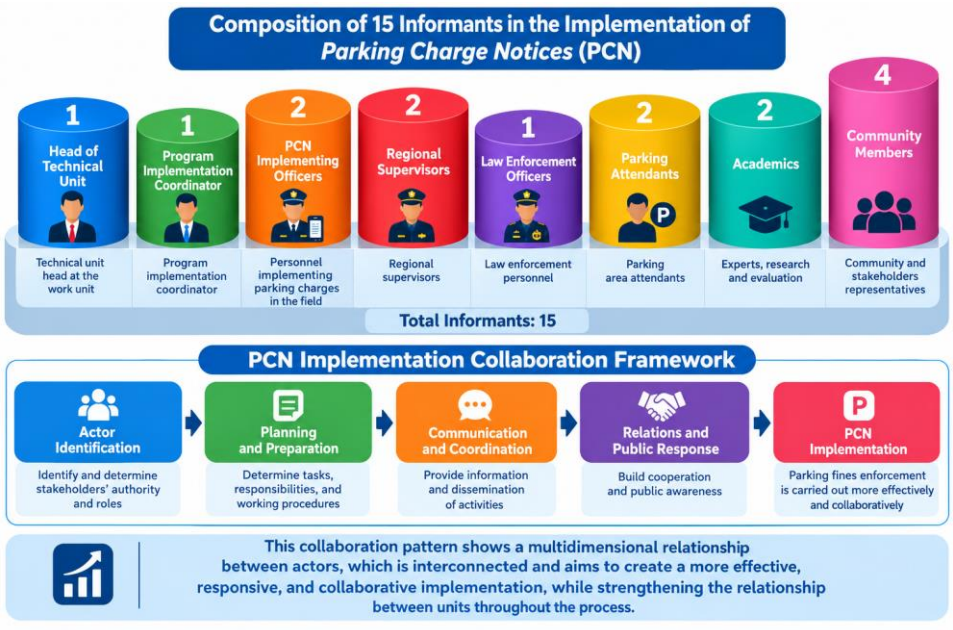
This study did not employ regression analysis, Structural Equation Modeling (SEM), or statistical hypothesis testing to determine causal relationships among variables. Therefore, the term *empirical assessment* in this study refers to the process of matching the conceptual framework with field evidence obtained through administrative data and interviews. The quantitative phase identified patterns and typologies of implementation, while the qualitative phase explained the context, mechanisms, and conditions underlying these variations. This approach enabled the study to address not only the question of *what happened*, but also *how* and *why* the implementation process occurred within the context of urban parking governance.

The qualitative analysis involved 15 informants representing local government agencies, PCN enforcement officers, the Public Order Agency (*Satpol PP*), the Indonesian National Police, parking operators, academics, and members of the public. The *hybrid coding* process generated 19 first-order themes, which were subsequently consolidated into five higher-order themes: *Implementation Capacity, Public Response and Social Behaviour, Policy and Regulatory Capacity, Communication and Coordination,* and *Economic and Policy Outcomes*. These findings indicate that PCN implementation is not merely perceived as an enforcement activity but rather as a process involving organizational capacity, regulatory frameworks, communication, coordination, public behaviour, and policy and economic consequences.

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The field data also revealed a relatively strong level of consistency across several themes. *Digital Enforcement Capability* and *Public Behavioral Norms* were mentioned by all 15 informants, resulting in a prevalence of 100 percent for each theme. *Effective Implementation Communication* was identified by 14 informants, or 93.3 percent, while *Policy Clarity* and *Staff Adequacy* were each identified by 13 informants, or 86.7 percent. *Public Acceptance* emerged from 12 informants, representing 80 percent of the sample. Meanwhile, *Effective Interagency Coordination* was identified by 8 informants, or 53.3 percent. These findings suggest that digital enforcement capability and public behavioural norms were the most consistently recurring themes in the experiences of informants, whereas interagency coordination demonstrated a comparatively lower level of occurrence.

The qualitative findings from the 15 informants further indicate that PCN implementation takes place within a heterogeneous multi-actor environment. The informants consisted of one division head, one section head, two PCN enforcement officers, two *Satpol PP* officers, one police representative, two parking operators, two academics, and four members of the public. Empirically, the pattern of collaboration developed through the following configuration: actor configuration → role distribution → communication and coordination → relationships and public response → PCN implementation. This pattern demonstrates interconnections among multiple dimensions rather than a simple cause-and-effect relationship.



Description: The figure illustrates the configuration of 15 informants representing various stakeholders, including government institutions, implementing agencies, law enforcement authorities, parking operators, academics, and members of the public. The collaborative process unfolds through several stages: actor configuration, role distribution, communication and coordination, stakeholder relationships and public response, and ultimately PCN implementation. The overall process demonstrates the interconnectedness of multiple dimensions within a heterogeneous multi-actor environment.

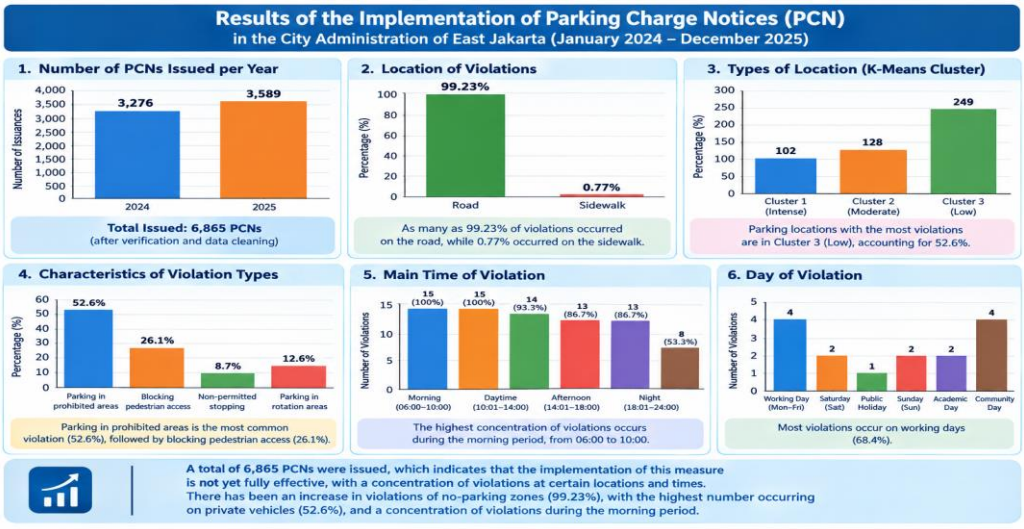
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Integration of Findings and the Collaborative Digital Governance Model

Based on the *Joint Display*, the integration of data from 6,865 enforcement incidents across 479 locations with interviews involving 15 informants resulted in six dimensions of the *Collaborative Digital Governance Model*: *Implementation Capacity, Digital Enforcement Capability, Policy and Regulatory Capacity, Communication and Coordination, Collaborative Actor Relations,* and *Public Response and Social Behaviour* (S & Seshasayee, 2025). The qualitative data further strengthened the model through the identification of 19 *first-order themes* and 5 *higher-order themes*. Notably, *Digital Enforcement Capability* and *Public Behavioral Norms* emerged from all 15 informants (100 percent), indicating that technology must be supported by implementation capacity, regulatory frameworks, coordination, inter-actor relationships, and public acceptance.

The findings demonstrate that *Parking Charge Notices* (PCN) are not merely digital instruments for imposing sanctions on parking violations, but also constitute part of a broader transformation in urban parking governance. Quantitatively, the study analyzed 6,865 enforcement incidents across 479 locations between January 2024 and December 2025. The field data revealed an uneven distribution of enforcement actions, with 99.23 percent occurring on roadways and 0.77 percent on sidewalks, and identified three location typologies through K-Means Cluster Analysis. These findings indicate differences in the characteristics and intensity of enforcement across locations.

The quantitative findings were subsequently explored in greater depth through interviews with 15 informants. The analysis generated 19 *first-order themes*, which were grouped into 5 *higher-order themes*. *Digital Enforcement Capability* and *Public Behavioral Norms* emerged from all 15 informants (100 percent), while *Effective Implementation Communication* was identified by 14 informants (93.3 percent). *Policy Clarity* and *Staff Adequacy* were each identified by 13 informants (86.7 percent). These results confirm that the successful implementation of PCN requires the integration of technology, organizational capacity, regulatory frameworks, communication, coordination, inter-actor relationships, and public response.



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Description: The figure presents the research findings based on 6,865 enforcement incidents across 479 locations during 2024–2025. Enforcement activities increased in 2025 and were predominantly concentrated on roadways and involved passenger vehicles. The K-Means Cluster Analysis identified three location typologies, while interviews with 15 informants highlighted the importance of digital capability, public behaviour, communication, policy capacity, resource adequacy, and inter-actor coordination in the implementation of PCN.

DISCUSSION

Implementasi Parking Charge Notices sebagai Proses Collaborative Digital Governance

The findings indicate that the implementation of *Parking Charge Notices* (PCNs) in the Administrative City of East Jakarta cannot be understood merely as the application of digital technology to enforce parking violations. Rather, PCNs constitute part of a broader governance process that brings together technology, organizational capacity, regulatory frameworks, inter-agency coordination, and public response. Analysis of the enforcement data revealed variations in patterns according to location, time, vehicle characteristics, and types of violations. These differences subsequently produced three location typologies through *K-Means Cluster Analysis*. The findings demonstrate that PCN implementation is heterogeneous in nature; therefore, a uniform enforcement strategy across all areas may not be capable of responding optimally to local conditions.

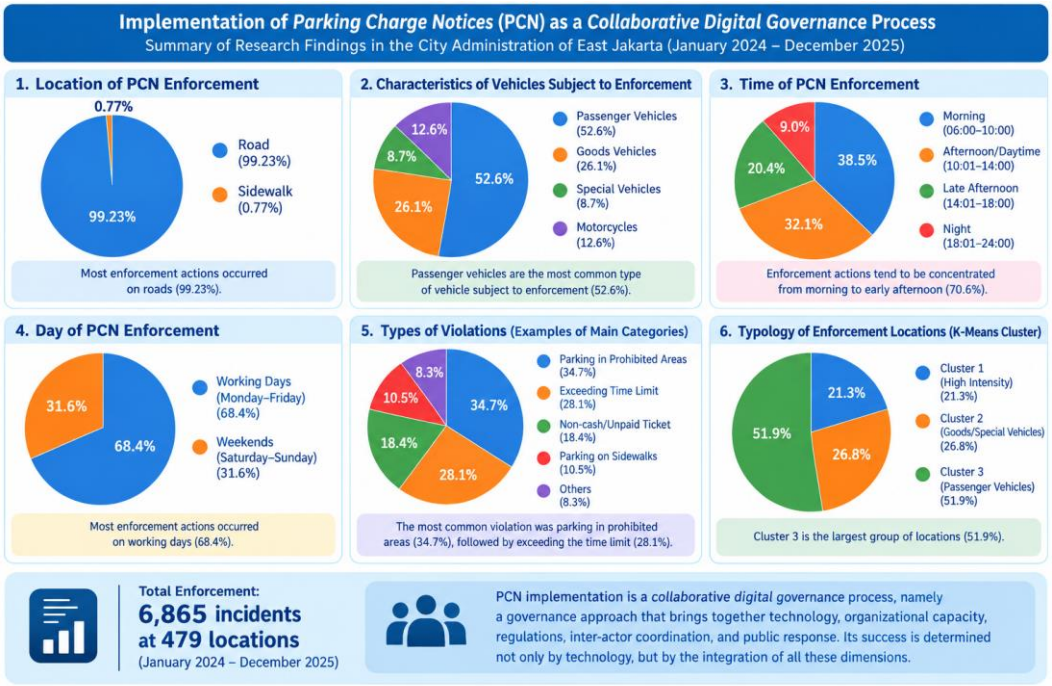
These empirical variations were further explained through qualitative analysis. The implementation of PCNs is influenced by the interrelationships among implementation capacity, digital capability, regulatory clarity, communication, coordination, inter-actor relationships, and public acceptance. This indicates that technology does not operate independently in determining policy success. Digital systems generate meaningful benefits only when supported by organizations capable of managing data, implementing procedures consistently, providing adequate resources, and establishing effective working relationships with other actors. In this context, PCNs are more appropriately positioned as instruments for transforming urban parking governance rather than merely as electronic systems for imposing sanctions.

These findings also extend previous studies that have predominantly examined parking from the perspectives of regulation, facility capacity, enforcement, *smart parking*, *parking pricing*, and policy effectiveness. Previous studies have demonstrated that parking problems are associated not only with the behaviour of vehicle users but also with limited facilities, weak enforcement, and inadequate coordination among stakeholders (Reddy et al., 2023). Meanwhile, studies on *Digital Governance* have largely emphasized the use of technology and information, system integration, and digital capacity (Divakar et al., 2022). This study connects these two perspectives through a collaborative approach. Accordingly, digitalization is not viewed as a stand-alone solution but as part of an institutional system that requires coordination and the alignment of interests among multiple actors.

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The finding that the involvement of multiple actors does not automatically produce effective collaboration also represents an important aspect of understanding PCN implementation. Collaboration is determined not simply by the number of institutions involved but by the clarity of role distribution, the quality of communication, coordination mechanisms, trust, and the capacity to establish shared objectives (Sahu, 2024). Thus, PCN implementation demonstrates that interorganizational relationships constitute an essential component of the process through which policy is translated into practice. This perspective is consistent with the need to understand policy implementation as a process that unfolds within complex institutional and social environments (Lachapelle et al., 2025).

Theoretically, this study contributes by integrating the perspectives of *Policy Implementation*, *Collaborative Governance*, and *Digital Governance*. These three perspectives serve complementary functions. *Policy Implementation* helps explain the operational conditions and capacities required for policy implementation (DuBose, 2023); *Collaborative Governance* explains actor configurations, role distribution, communication, coordination, trust, and legitimacy (Mepham, 2023); while *Digital Governance* addresses the use of technology and data, system integration, and digital capabilities (Jordan, 2025). Their integration produces an understanding that digital governance is fundamentally a process of *socio-technical governance*, connecting technological systems with human and institutional capacities (Nakandhrakumar et al., 2022).



Description: The figure illustrates the pattern of PCN implementation in East Jakarta based on location, vehicle type, time, day, type of violation, and location typology. Enforcement actions occurred predominantly on roadways, involved passenger vehicles, took place on weekdays, and were concentrated during the morning to midday period. These findings confirm

that PCN implementation is heterogeneous and requires data-driven enforcement and monitoring strategies tailored to the characteristics of different areas.

Implications, Contributions, and Novelty of the Collaborative Digital Governance Model

The practical implications of this study indicate that PCN management should be directed toward enforcement strategies based on data and the characteristics of specific areas. The three location typologies identified in this study can serve as a basis for determining enforcement priorities, personnel deployment, operational schedules, and monitoring requirements. This approach is more adaptive than applying a uniform enforcement strategy because it takes into account the distinctive characteristics of each location. Enforcement data should also be developed beyond its function as an administrative archive and transformed into an information resource that supports evidence-based decision-making (Polischuk, 2024). In this way, government authorities can identify concentrations of violations, determine priority locations, and evaluate the development of enforcement activities more systematically.

Institutional strengthening also represents an important implication of the study. Coordination among the Transportation Agency, the Public Order Agency (*Satpol PP*), the Police, parking operators, and the public needs to be strengthened through clear divisions of authority, standardized working procedures, data-sharing mechanisms, and shared performance indicators. At the implementation level, human resource capacity should be enhanced, particularly in the use of digital technology, understanding of regulations, verification of evidence, and communication with the public. At the same time, the implementation of PCNs should be accompanied by transparent public communication regarding policy objectives, enforcement procedures, the rights and responsibilities of vehicle users, and mechanisms for resolving related issues. Such an approach is essential for strengthening legitimacy and reducing public resistance (Fazelpour & Abdi, 2025).

The primary novelty of this study lies in the development of a *Collaborative Digital Governance Model* that integrates policy implementation, collaborative relationships, and digital technology within the context of urban parking management. Previous studies have tended to examine these three perspectives separately (Kamil et al., 2025), whereas this study connects them through a *Sequential Explanatory Mixed Methods* design. The quantitative phase was used to explain patterns, characteristics, and typologies of enforcement, while the qualitative phase was employed to understand the actors involved, coordination processes, enabling and constraining factors, and mechanisms underlying variations in implementation. The findings from both phases were subsequently integrated to develop the model.

The resulting model consists of six main dimensions: *Implementation Capacity, Digital Enforcement Capability, Policy and Regulatory Capacity, Communication and Coordination, Collaborative Actor Relations,* and *Public Response and Social Behaviour*. These six dimensions demonstrate that the successful implementation of PCNs results from the interconnectedness of organizational capacity, technology, regulatory frameworks, coordination, inter-actor relationships, and public behaviour. Technology becomes a source of effectiveness only when it

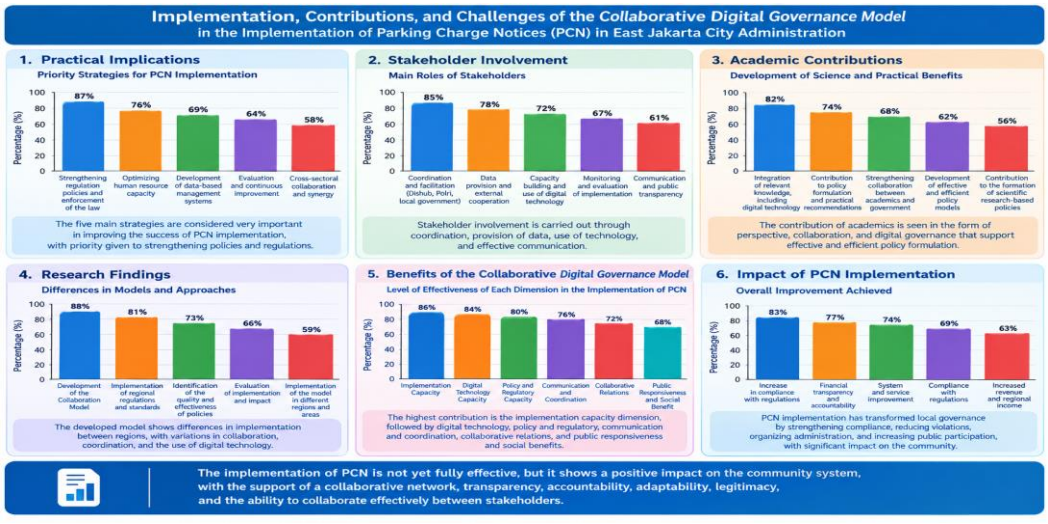
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is integrated with institutional capacity and broader governance arrangements. Therefore, the success of PCN implementation should not be assessed solely on the basis of the number of enforcement actions undertaken, but also on the ability of the system to deliver enforcement that is coordinated, transparent, accountable, adaptive, legitimate, and publicly acceptable.

Overall, this study confirms that *Parking Charge Notices* (PCNs) constitute an instrument for transforming urban parking governance by integrating technological, institutional, regulatory, and social dimensions. Based on 6,865 enforcement records across 479 locations, PCN implementation demonstrated spatial and operational variations, indicating that enforcement strategies need to be adapted to the characteristics of different areas. These quantitative findings were subsequently explored in greater depth through qualitative analysis, providing a more comprehensive understanding of implementation capacity, coordination, inter-actor relationships, and public response.

The *Collaborative Digital Governance Model* developed in this study positions PCN implementation as an integrative governance process. Its six dimensions *Implementation Capacity, Digital Enforcement Capability, Policy and Regulatory Capacity, Communication and Coordination, Collaborative Actor Relations*, and *Public Response and Social Behaviour* are interconnected in supporting policy implementation. Organizational capacity provides the foundation for implementation, technology strengthens enforcement processes, regulatory frameworks provide legitimacy, while communication and coordination connect the various actors involved.

Furthermore, collaborative relationships and public response determine the sustainability of implementation (Nurahman et al., 2025). The model demonstrates that technology cannot operate independently but must be supported by institutional arrangements and social participation. The study's principal contribution lies in integrating the theories of policy implementation, *Digital Governance*, and *Collaborative Governance* through a *Sequential Explanatory Mixed Methods* approach. This approach makes it possible to explain empirical patterns through the context of actors, coordination mechanisms, institutional capacity, and social conditions, thereby producing a model that is both conceptually relevant and practically applicable to strengthening urban parking governance.



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Description: The bar diagram illustrates that the *Collaborative Digital Governance Model* positions PCN enforcement as an integrated process. Its priorities include strengthening implementation capacity, utilizing digital technology, ensuring regulatory clarity, enhancing coordination among actors, fostering collaborative relationships, and promoting positive public responses. These six dimensions are interconnected to produce enforcement that is adaptive, transparent, accountable, legitimate, and sustainable.

CONCLUSION

This study concludes that the implementation of Parking Charge Notices (PCN) in the East Jakarta Administrative City constitutes a complex, heterogeneous, and multidimensional policy process. An analysis of 6,865 enforcement records across 479 locations from January 2024 to December 2025 demonstrated that enforcement activities were not evenly distributed. Most violations occurred on roadways, while enforcement activities were concentrated primarily on weekdays and during the morning to late-morning period. Furthermore, the K-Means Cluster Analysis identified three location typologies, indicating differences in enforcement characteristics across areas.

These quantitative findings were subsequently explained through qualitative evidence concerning implementation capacity, digital capability, regulation, communication and coordination, collaborative relationships, and public response. The integration of both phases demonstrates that PCN cannot be understood merely as a technological instrument for strengthening parking enforcement. Its successful implementation depends on the capacity of government institutions and relevant actors to connect technology with institutional capacity, regulatory frameworks, coordination mechanisms, human resources, infrastructure, and public acceptance. Accordingly, this study confirms that PCN implementation represents a process of socio-technical governance that requires the integration of policy, technology, organizations, actors, and society.

The implications of this study can be viewed from theoretical, institutional, and public policy perspectives. Theoretically, the findings reinforce the understanding that digital transformation in public administration cannot be adequately explained solely by the existence of technology or information systems. Digitalization must be situated within an institutional environment involving organizational capacity, inter-organizational relationships, regulation, communication, and public response. The findings support the development of the Collaborative Digital Governance Model, which connects policy implementation with *Collaborative Governance* and *Digital Governance*. This integration provides the perspective that technology functions as an enabler, whereas institutional capacity and collaboration determine how technology is translated into legitimate and sustainable implementation practices.

From a practical perspective, local governments need to develop a more integrated governance system for PCN implementation. Enforcement data should not merely serve as administrative records but should be utilized to determine priority locations, operational

schedules, and enforcement strategies. Differences in location typologies can provide a basis for developing more adaptive strategies. At the same time, coordination among the Transportation Agency, the Police, the Civil Service Police Unit (*Satpol PP*), parking operators, and the public should be strengthened through clear role allocation, structured communication mechanisms, and consistent information exchange. PCN implementation should also be accompanied by improved public information and the provision of adequate parking alternatives so that enforcement does not merely increase the number of enforcement actions but also promotes compliance and behavioral change among the public.

This study has several limitations that should be considered when interpreting its findings and applying the proposed model. First, the research locus was specifically limited to the East Jakarta Administrative City; therefore, the identified implementation characteristics were strongly influenced by the institutional, geographical, social, infrastructural, and mobility conditions of the area. Consequently, the resulting model cannot automatically be generalized to all urban areas in Indonesia without considering local contexts. The selection of East Jakarta was based on the complexity of its parking problems, the availability of administrative data, and the involvement of multiple actors in PCN implementation.

Second, the study focused on patterns, characteristics, typologies, processes, inter-actor relationships, digital conditions, and implementation mechanisms rather than measuring PCN effectiveness as a dependent variable through causal testing. Therefore, the number of enforcement actions cannot be directly interpreted as evidence of improved policy effectiveness. Third, the quantitative data primarily described enforcement incidents recorded in the administrative system and therefore did not fully capture broader policy consequences, such as behavioral change, long-term compliance, public perceptions, or impacts on traffic congestion. Fourth, the qualitative findings represent the perspectives of informants selected based on their involvement in and relevance to PCN implementation. These limitations provide opportunities for future research to examine the model in broader contexts and employ more comprehensive outcome indicators.

Based on these findings and limitations, this study recommends the further development of PCN implementation through a Collaborative Digital Governance approach that is more adaptive to location-specific characteristics. Local governments should use the location typologies identified through the analysis as a basis for determining enforcement priorities, personnel allocation, operational schedules, and public communication strategies. The PCN digital system should also be developed into an integrated platform capable of combining enforcement data, location, time, vehicle characteristics, violation history, and other supporting information to facilitate evidence-based decision-making.

From an institutional perspective, stronger cross-organizational coordination is required through clear authority arrangements, standardized operational procedures, data-sharing mechanisms, and shared performance indicators. The capacity of enforcement personnel should

also be enhanced, particularly in the use of technology, understanding of regulations, evidence verification, and communication with the public. From a social perspective, the government should expand public education regarding the objectives, procedures, rights, and obligations associated with PCN implementation in order to strengthen public legitimacy. The development of parking infrastructure should also proceed alongside enforcement efforts, as inadequate parking facilities may increase public resistance.

For future research, the Collaborative Digital Governance Model should be tested in other cities or regions with different characteristics. Subsequent studies may employ longitudinal designs to examine changes in behavior and compliance before and after the implementation of PCN. In addition, further quantitative research may investigate the relationships among enforcement intensity, location characteristics, public acceptance, changes in parking behavior, and policy outcomes. Comparative studies across regions are also important for identifying which dimensions of the model are universal and which are highly dependent on local contexts. In this way, the development of the model can extend beyond the East Jakarta context and evolve into a more generalizable framework for digital parking governance in Indonesian urban governments.

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