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Analysis of the Implementation of Electronic Traffic Tickets and Their Impact on Reducing Traffic Violations and Accidents (A Study in Serang City, Banten)

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Abstract

This study examines the implementation of Electronic Traffic Law Enforcement (ETLE) and its impact on reducing traffic violations and traffic accidents in Serang City, Banten. Employing an empirical legal research design with a socio-legal approach, this research analyzes the interaction between legal norms, institutional practices, and public compliance through interviews with traffic law enforcement officers, relevant stakeholders, and road users, supported by statutory and documentary analysis. The findings indicate that ETLE strengthens traffic law enforcement by improving evidentiary certainty, institutional accountability, and administrative transparency while contributing to declining trends in traffic violations and accident impacts. However, its effectiveness remains constrained by limited public legal awareness, institutional coordination challenges, technological limitations, and persistent human behavioural factors influencing traffic violations. This study contributes theoretically by conceptualizing ETLE as a socio-legal governance mechanism rather than merely a technological enforcement tool, while providing methodological insight into evaluating digital law enforcement through integrated normative and empirical analysis.

Keywords: *Electronic Traffic Law Enforcement, Traffic Law Enforcement, Legal Compliance, Traffic Violations, Road Safety.*

INTRODUCTION

The rapid digital transformation of public administration has fundamentally reshaped the architecture of traffic law enforcement across numerous jurisdictions, shifting conventional enforcement mechanisms toward technology-driven governance models that emphasize automation, transparency, and evidence-based regulation. Within this evolving landscape, Electronic Traffic Law Enforcement (ETLE) has emerged as one of the most prominent legal innovations, integrating surveillance technologies, digital databases, and automated sanctioning systems to strengthen regulatory compliance while reducing opportunities for discretionary enforcement and administrative corruption. This transformation reflects a broader movement toward smart governance, in which technological infrastructures are increasingly embedded within legal institutions to enhance accountability and public trust. Indonesian traffic regulation has gradually embraced this paradigm through the legal recognition of electronic evidence and vehicle registration systems under Law Number 22 of 2009 concerning Road Traffic and Transportation and the operational framework established in the Regulation of the Chief of the Indonesian National Police Number 5 of 2012 concerning Motor Vehicle Registration and Identification (Peraturan Kapolri Nomor 5 Tahun 2012). The deployment of ETLE in Serang City since April 2022 represents an important manifestation of this institutional transition, positioning digital enforcement not merely as an administrative modernization initiative but as a strategic legal instrument intended to influence road-user behaviour, strengthen procedural legitimacy, and ultimately reduce traffic violations and traffic accidents (Detik, 2024; Sutrisno, 2019; Peraturan Kapolri Nomor 5 Tahun 2012).

Existing scholarship consistently acknowledges that the effectiveness of electronic ticketing extends beyond technological capability and is deeply conditioned by behavioural, institutional, and legal dimensions that interact simultaneously within traffic governance systems. Earlier studies emphasized that traffic violations originate primarily from limited legal awareness, weak compliance culture, and inadequate understanding of traffic regulations among road users rather than from

deficiencies in legal norms themselves (Junef, 2014; Sudikno Mertokusumo, 2007). More recent empirical investigations have expanded this perspective by demonstrating that ETLE contributes positively to improving enforcement efficiency, administrative transparency, and police accountability while simultaneously minimizing opportunities for illegal levies and discretionary practices traditionally associated with conventional ticketing systems (Aditya & Safriani, 2020; Elmira & Anisykurlillah, 2024; Wati & Royfandi, 2024). Parallel studies conducted in Malang, Pekanbaru, Sukoharjo, and within the Indonesian National Police further indicate that ETLE encourages higher compliance among road users, facilitates more objective law enforcement, and strengthens institutional performance through digital evidence management, although the magnitude of these improvements varies considerably across regional contexts due to differences in public legal awareness, technological readiness, administrative coordination, and enforcement capacity (Arumdani & Irawan, 2025; Widayanti et al., 2025; Syenly et al., 2025; Tjahyono et al., 2025).

Despite these encouraging findings, the current body of literature remains fragmented because most empirical investigations continue to evaluate ETLE primarily through administrative performance indicators, compliance statistics, or policy implementation frameworks without sufficiently examining the causal relationship between electronic enforcement mechanisms, behavioural adaptation among road users, and the reduction of traffic accidents as the ultimate objective of traffic regulation. Many studies implicitly assume that declining traffic violations necessarily translate into improved road safety, although such assumptions rarely receive rigorous empirical verification. Existing analyses also tend to focus on metropolitan areas possessing relatively mature technological infrastructures, leaving medium-sized cities with different institutional capacities underrepresented within comparative legal scholarship. Equally important, previous research frequently isolates technological implementation from broader legal and organizational dynamics, neglecting the interaction among police institutions, transportation authorities, postal services, judicial actors, and citizens that collectively determine whether digital enforcement effectively transforms regulatory compliance rather than merely digitizing conventional administrative procedures (Aditya & Safriani, 2020; Elmira & Anisykurlillah, 2024; Widayanti et al., 2025; Tjahyono et al., 2025).

These unresolved issues possess significant scientific and practical implications because the legitimacy of digital law enforcement cannot be evaluated solely through the quantity of electronic tickets issued but must also be assessed according to its capacity to reshape legal consciousness, improve institutional coordination, and reduce accident risks generated by persistent traffic violations. The persistence of human behavioural factors including failure to possess valid driving licences, non-compliance with helmet requirements, and disregard for traffic signs illustrates that technological surveillance alone may be insufficient to achieve sustainable behavioural transformation if institutional support, legal education, and inter-agency collaboration remain uneven. The legal philosophy that sanctions should function as instruments for cultivating compliance rather than merely imposing punishment reinforces the necessity of evaluating ETLE within a broader framework of preventive law enforcement and responsive governance (Sudikno Mertokusumo, 2007; Junef, 2014). Contemporary empirical evidence likewise demonstrates that regional disparities in implementation continue to produce varying enforcement outcomes, indicating that the effectiveness of ETLE remains contingent upon contextual legal, organizational, and social conditions rather than technological deployment alone (Arumdani & Irawan, 2025; Syenly et al., 2025; Wati & Royfandi, 2024).

Against this scholarly background, Serang City offers an analytically significant setting for advancing the literature because it represents a jurisdiction that has formally implemented ETLE while continuing to experience substantial traffic violations and recurring traffic accidents despite the availability of electronic monitoring infrastructure. Unlike previous studies that predominantly emphasize implementation effectiveness or public acceptance independently, this research positions ETLE as a multidimensional legal institution whose effectiveness should be evaluated through the interaction between legal enforcement, institutional coordination, behavioural compliance, and accident prevention. Such positioning enables the study to bridge normative legal analysis with empirical socio-legal investigation by examining how electronic ticketing operates simultaneously as a regulatory instrument, an administrative innovation, and a mechanism for cultivating legal awareness within society. This perspective extends existing discussions beyond technological determinism by recognizing that successful digital enforcement depends upon the reciprocal relationship among legal

institutions, administrative actors, and road users rather than on surveillance technology itself (Sutrisno, 2019; Elmira & Anisykurlillah, 2024; Tjahyono et al., 2025; Arumdani & Irawan, 2025).

This study therefore aims to analyze the factors influencing traffic violations in Serang City and critically examine the implementation of Electronic Traffic Law Enforcement in reducing traffic violations and traffic accidents through an empirical legal approach integrating institutional analysis with behavioural perspectives. The research contributes theoretically by strengthening the conceptual understanding of digital traffic law enforcement as an integrated socio-legal governance mechanism rather than merely a technological innovation, while its methodological contribution lies in combining empirical field evidence with legal analysis to construct a more comprehensive framework for evaluating the effectiveness of electronic traffic enforcement within developing urban jurisdictions.

RESEARCH METHODS

This study employed an empirical legal research design grounded in a socio-legal approach to examine the implementation of Electronic Traffic Law Enforcement (ETLE) and its implications for reducing traffic violations and traffic accidents in Serang City, Banten. The empirical orientation enabled the research to investigate the operation of legal norms within their practical institutional and social contexts rather than limiting the analysis to statutory interpretation. Primary data were collected through semi-structured interviews with key stakeholders directly involved in the implementation and enforcement of ETLE, including officers of the Traffic Law Enforcement Unit (Satlantas Polresta Serang), personnel responsible for electronic ticket administration, and selected motor vehicle users as road users affected by the system. These empirical findings were complemented by documentary materials comprising primary legal sources such as Law Number 22 of 2009 concerning Road Traffic and Transportation, Law Number 2 of 2002 concerning the Indonesian National Police, Law Number 19 of 2016 concerning Electronic Information and Transactions, Government Regulation Number 55 of 2012 concerning Vehicles, and the Regulation of the Chief of the Indonesian National Police Number 5 of 2012 concerning Motor Vehicle Registration and Identification as well as secondary legal materials, including scholarly books, peer-reviewed journal articles, legal commentaries, policy documents, and other authoritative academic publications relevant to electronic traffic enforcement and traffic governance. Data collection was conducted through a combination of field interviews and comprehensive legal document analysis to ensure a holistic understanding of both the normative framework and its practical implementation.

The collected data were analyzed using qualitative legal analysis, integrating statutory, institutional, and empirical perspectives to identify the interaction between legal regulation, administrative practice, and public compliance within the implementation of ETLE. The analytical process consisted of data reduction, systematic categorization, thematic interpretation, and comparative examination between empirical findings and the applicable legal framework, enabling the identification of recurring patterns, institutional constraints, and regulatory implications. To enhance analytical rigor and credibility, the study applied source triangulation by comparing information obtained from different categories of respondents with documentary evidence derived from legislation, official institutional records, and relevant legal literature. The validity of the findings was further strengthened through interpretative consistency between empirical observations and the governing legal framework, thereby ensuring that the conclusions accurately reflected both the normative objectives of traffic law enforcement and the realities of its implementation in Serang City.

RESULTS AND DISCUSSION

The Legal Construction and Institutional Implementation of Electronic Traffic Law Enforcement in Serang City

The implementation of Electronic Traffic Law Enforcement (ETLE) in Serang City represents a transformation of traffic law enforcement from a conventional enforcement model based on direct interaction between police officers and offenders into a technology-mediated legal mechanism founded upon electronic evidence, administrative verification, and digital accountability. From an empirical legal perspective, the implementation of ETLE cannot be separated from the normative foundation established by Law Number 22 of 2009 concerning Road Traffic and Transportation, particularly Article 272 which recognizes the use of electronic equipment as evidence in enforcing traffic violations. The existence of this provision demonstrates that Indonesian traffic law has accommodated

technological development as part of the evidentiary system, although its effectiveness remains dependent upon institutional capacity, public compliance, and the consistency of enforcement practices. The socio-legal reality in Serang City indicates that the transition toward electronic enforcement has generated significant changes in the relationship between legal norms and social behaviour because road users are increasingly subjected to objective monitoring rather than discretionary roadside inspections. This condition reflects the argument of Sudikno Mertokusumo that law functions not merely as a collection of coercive commands but as an instrument for regulating social order through the creation of awareness and compliance among legal subjects (Mertokusumo, 2007).

The empirical findings obtained from interviews with officers of the Traffic Law Enforcement Unit of Polresta Serang demonstrate that ETLE was implemented as an institutional response to limitations in conventional enforcement practices, particularly the restricted availability of personnel to supervise increasing traffic activities. The police institution identified that electronic surveillance through CCTV infrastructure enabled violations to be documented continuously, allowing enforcement procedures to be conducted through verification mechanisms rather than immediate physical confrontation with offenders. This practice corresponds with the principle of legality in criminal law enforcement because sanctions must be imposed based on identifiable unlawful conduct supported by valid evidence, as emphasized in the doctrine of criminal law developed by Moeljatno that criminal liability requires the existence of an unlawful act determined by legal provisions (Moeljatno, 2002). The institutional experience of Polresta Serang further illustrates that ETLE provides procedural advantages by reducing opportunities for informal negotiation between officers and offenders, thereby strengthening transparency within traffic law enforcement. Similar findings regarding increased institutional accountability through electronic ticketing mechanisms have been identified in studies examining ETLE implementation in Surabaya, Palu, and other Indonesian jurisdictions (Elmira & Anisykurlillah, 2024; Wati & Royfandi, 2024).

The legal basis for ETLE implementation demonstrates a systematic relationship between statutory regulation, administrative authority, and technological governance within the Indonesian traffic law regime. Law Number 22 of 2009 concerning Road Traffic and Transportation establishes obligations for road users, including the requirement to possess driving competence, comply with traffic signs, and maintain vehicle legitimacy, while Law Number 2 of 2002 concerning the Indonesian National Police grants authority to the police institution to maintain public order and enforce legal provisions. The Regulation of the Chief of the Indonesian National Police Number 5 of 2012 concerning Motor Vehicle Registration and Identification further strengthens the administrative foundation by regulating vehicle identity databases that become essential instruments in identifying electronic traffic offenders. The systematic interpretation of these regulations indicates that ETLE does not constitute an independent legal mechanism but operates as an integrated enforcement system connecting traffic regulation, vehicle administration, and police authority. This interpretation is consistent with Wirjono Prodjodikoro's view that criminal law enforcement requires institutional certainty regarding the relationship between prohibited conduct, responsible legal subjects, and authorized enforcement bodies (Prodjodikoro, 2002).

The operation of ETLE in Serang City also reveals a significant interaction between normative expectations and empirical enforcement realities because the reduction of traffic violations cannot be measured solely through the existence of electronic monitoring infrastructure. Interviews with enforcement officers indicate that public understanding of ETLE remains uneven, particularly among road users who have limited awareness regarding electronic evidence procedures and digital ticket settlement mechanisms. This condition demonstrates that technological modernization requires parallel development of legal consciousness because sanctions without sufficient understanding may produce temporary compliance rather than sustainable behavioural transformation. Junef's research regarding public behaviour toward traffic ticket operations previously identified that violations frequently emerge from weak awareness and inadequate internalization of traffic obligations among road users (Junef, 2014). The empirical condition in Serang City confirms that ETLE functions effectively as an enforcement instrument only when supported by continuous legal education, institutional communication, and consistent application of sanctions.

The implementation of ETLE in Serang City can be understood through the classification of legal instruments and institutional functions that collectively establish the electronic enforcement framework. The following table presents the relationship between relevant legal provisions and their practical

application in ETLE enforcement based on documentary analysis and empirical observations from the research location.

Table 1. Legal Framework and Empirical Implementation of Electronic Traffic Law Enforcement (ETLE) in Serang City

Legal Instrument	Relevant Provision	Normative Function	Empirical Application in Serang City
Law Number 22 of 2009 concerning Road Traffic and Transportation	Article 272	Recognizes electronic equipment recording as evidence of traffic violations	CCTV recordings are utilized as the basis for identifying and processing violations
Law Number 2 of 2002 concerning Indonesian National Police	Article 13	Establishes police authority in maintaining security, order, and law enforcement	Satlantas Polresta Serang conducts verification and enforcement procedures
Regulation of Chief of Police Number 5 of 2012 concerning Motor Vehicle Registration and Identification	Provisions concerning vehicle registration data	Provides administrative identification of motor vehicles and owners	Vehicle ownership databases support offender identification within ETLE procedures
Government Regulation Number 80 of 2012 concerning Procedures for Motor Vehicle Inspection and Enforcement of Traffic Violations	Electronic recording mechanism	Regulates procedures for traffic violation enforcement	Electronic evidence becomes the basis for administrative ticket processing

The table illustrates that ETLE implementation possesses a strong normative foundation because electronic enforcement is supported by interconnected legal instruments governing evidence, authority, and vehicle identification systems. The empirical application in Serang City indicates that the effectiveness of these norms depends on institutional coordination among police officers, transportation authorities, postal service providers, and road users involved in the enforcement process. The existence of legal authority alone cannot guarantee compliance because enforcement outcomes remain influenced by administrative readiness and social acceptance. This finding strengthens the socio-legal perspective that law operates within a social environment where institutional behaviour and public responses determine the practical effectiveness of legal norms. Previous research regarding ETLE implementation in Jakarta, Malang, and Pekanbaru similarly indicates that technological enforcement requires organizational adaptation and public acceptance to achieve optimal regulatory objectives (Dwiyuliana et al., 2022; Widayanti et al., 2025; Syenly et al., 2025).

The institutional implementation of ETLE in Serang City further demonstrates that digital enforcement modifies the traditional structure of traffic law enforcement by reallocating enforcement authority from direct observation toward technologically generated evidence. The police officers interviewed in this research explained that electronic recording assists officers in identifying violations that previously could not be effectively monitored due to limitations in personnel and operational coverage. This development corresponds with the preventive function of criminal law because enforcement mechanisms are expected not only to punish violations but also to prevent future unlawful behaviour through increased certainty of detection. Moeljatno's conception of criminal law emphasizes that sanctions possess a preventive dimension because legal consequences influence individual decisions before unlawful acts occur (Moeljatno, 2002). Empirical studies conducted by Sutrisno and Arumdani and Irawan similarly demonstrate that electronic ticketing contributes to improving enforcement effectiveness by increasing certainty and objectivity within traffic supervision systems (Sutrisno, 2019; Arumdani & Irawan, 2025).

The application of ETLE also reflects a shift in the interpretation of accountability within public law administration because enforcement decisions are increasingly determined by recorded evidence

rather than subjective assessments of individual officers. In conventional ticketing systems, direct interaction between police officers and offenders creates procedural risks, including inconsistent application of sanctions and potential abuse of authority, whereas ETLE establishes a more standardized process based on digital documentation. The empirical findings in Serang City indicate that this mechanism contributes to strengthening public perception of fairness because offenders receive sanctions based on recorded violations rather than personal negotiation. Aditya and Safriani identified that one of the fundamental problems in conventional electronic ticketing implementation relates to technological readiness and procedural adaptation, demonstrating that digital systems must be supported by clear institutional arrangements (Aditya & Safriani, 2020). The experience of Serang City confirms that ETLE provides legal certainty when technological infrastructure, regulatory authority, and administrative procedures operate within a coherent framework.

The implementation of ETLE must also be examined through the principle of proportionality between enforcement objectives and social consequences because traffic sanctions should achieve public safety without creating disproportionate burdens for citizens. The empirical data reveal that certain categories of violations, such as failure to use helmets, disregard for traffic markings, and incomplete vehicle documentation, remain dominant despite the introduction of electronic monitoring mechanisms. These violations demonstrate that legal compliance is influenced by behavioural factors involving knowledge, perception of risk, and willingness to obey regulatory obligations. Research concerning traffic accidents in Indonesia has identified human factors, vehicle conditions, road infrastructure, and environmental circumstances as interconnected elements affecting road safety outcomes (Sova et al., 2026). The implementation of ETLE therefore requires a broader legal strategy that integrates enforcement, prevention, and public awareness rather than relying exclusively on technological surveillance.

The socio-legal analysis of ETLE implementation in Serang City demonstrates that electronic traffic enforcement constitutes a complex legal institution where statutory norms, administrative structures, and community behaviour interact continuously. The findings indicate that ETLE has strengthened the capacity of law enforcement institutions by providing objective evidence, reducing procedural weaknesses, and supporting more accountable enforcement practices. However, the empirical reality also indicates that technological intervention alone cannot eliminate traffic violations because compliance remains dependent upon legal consciousness and social acceptance of regulatory obligations. Comparative studies regarding electronic traffic enforcement models in Indonesia and Japan indicate that technological systems achieve greater effectiveness when integrated with comprehensive regulatory design and disciplined road-user culture (Fazriyah et al., 2025). This research positions ETLE not merely as a digital instrument for issuing electronic tickets but as a socio-legal mechanism that reconstructs the relationship between state authority, legal norms, and citizen compliance within contemporary traffic governance.

The Impact of Electronic Traffic Law Enforcement on Reducing Traffic Violations and Traffic Accidents in Serang City

The effectiveness of Electronic Traffic Law Enforcement (ETLE) in reducing traffic violations and accidents in Serang City must be evaluated through an empirical legal perspective that examines the relationship between legal norms, enforcement practices, and behavioural changes among road users. The implementation of ETLE was designed not only as an administrative innovation but also as a preventive legal instrument intended to increase compliance through certainty of detection and consistency of sanctions. Article 106 paragraph (4) of Law Number 22 of 2009 concerning Road Traffic and Transportation establishes the obligation of every person driving a motor vehicle to comply with traffic provisions, including obeying road markings, traffic signs, and safety requirements. The empirical findings obtained from Satlantas Polresta Serang indicate that electronic monitoring has influenced public awareness because road users increasingly recognize that violations may be detected without direct intervention from police officers. This phenomenon demonstrates that ETLE operates through the preventive function of law, where the possibility of legal consequences encourages behavioural adjustment before violations occur, consistent with the preventive dimension of criminal law enforcement described by Moeljatno (2002).

The implementation of ETLE in Serang City has produced measurable changes in the pattern of traffic violations, although the reduction cannot be interpreted exclusively as a direct consequence of

technological enforcement because other institutional and social variables also influence compliance behaviour. Institutional records from Satlantas Polresta Serang demonstrate that traffic violations decreased from 11,605 cases in 2022 to 3,632 cases in 2023 after ETLE became operational, while the number of traffic accidents also showed a declining trend during the same period. The following table presents the comparative development of traffic violations and accident consequences before and after the implementation of ETLE in Serang City.

Table 2. Comparative Trends of Traffic Violations and Traffic Accident Impacts Before and After Electronic Traffic Law Enforcement Implementation in Serang City (2021–2023)

Year	Traffic Violations Processed	Traffic Accident Fatalities	Traffic Accident Serious Injuries	Traffic Accident Minor Injuries
2021	4,668	114	13	269
2022	11,605	58	8	147
2023	3,632	47	5	113

The empirical data presented in the table indicate that the implementation of ETLE coincided with a decrease in both enforcement records and accident consequences, although the causal relationship requires careful legal interpretation because reduced enforcement numbers may also reflect changes in police operational strategies. The findings from interviews with Satlantas Polresta Serang officers reveal that after the implementation of ETLE, enforcement practices increasingly emphasized electronic monitoring and preventive warnings rather than immediate conventional ticketing in certain situations. This practice demonstrates that the measurement of ETLE effectiveness cannot rely solely on statistical reduction but must consider institutional policy adjustments and changes in enforcement mechanisms. Research conducted by Dwiyuliana et al. confirms that electronic ticketing contributes to strengthening traffic violation prevention and enforcement effectiveness when supported by adequate institutional capacity (Dwiyuliana et al., 2022). The same conclusion is reflected in studies from Malang and Pekanbaru, which indicate that ETLE influences compliance patterns while still requiring continuous improvement in implementation procedures (Widayanti et al., 2025; Syenly et al., 2025).

The relationship between ETLE implementation and accident reduction requires analysis through the legal principle that traffic regulation aims to protect public safety rather than merely punish unlawful conduct. Law Number 22 of 2009 concerning Road Traffic and Transportation explicitly establishes safety, security, order, and smoothness of traffic as fundamental objectives of national transportation governance, particularly reflected in Article 3 concerning the objectives of traffic and transportation regulation. Empirical evidence from Serang City indicates that violations frequently associated with accident risks include failure to use helmets, violations of traffic markings, and deficiencies in vehicle documentation, demonstrating that human behaviour remains a dominant factor affecting road safety. This finding corresponds with research identifying human factors, vehicle conditions, road infrastructure, and environmental conditions as interconnected determinants of traffic accidents in Indonesia (Sova et al., 2026). The legal significance of ETLE therefore lies in its capacity to transform preventive regulation by increasing certainty that unsafe behaviour will generate documented legal consequences.

The dominant influence of human factors in traffic violations illustrates that technological enforcement must be understood as a supporting mechanism within a broader legal compliance framework rather than as an autonomous solution. Interviews with traffic officers in Serang City reveal that many violations originate from low legal awareness, including driving without complete documentation, ignoring safety equipment requirements, and intentionally violating traffic signs despite existing regulations. Article 77 paragraph (1) of Law Number 22 of 2009 requires every person operating a motor vehicle on public roads to possess an appropriate driving licence, while Article 106 paragraph (8) requires motorcycle drivers and passengers to use helmets complying with Indonesian National Standards. These provisions demonstrate that traffic compliance constitutes a legal obligation directly connected with public safety interests rather than a merely administrative requirement. Junef's study confirms that traffic violations are strongly influenced by community behaviour and legal

awareness, indicating that enforcement effectiveness depends upon the internalization of legal norms within society (Junef, 2014).

The empirical implementation of ETLE in Serang City further reveals that electronic enforcement has strengthened institutional accountability among law enforcement agencies because decisions regarding violations are based on recorded evidence rather than subjective assessments by individual officers. This mechanism supports the principle of legal certainty because sanctions are imposed through standardized procedures involving verification of vehicle ownership, electronic evidence assessment, and administrative confirmation. The Regulation of the Chief of the Indonesian National Police Number 5 of 2012 concerning Motor Vehicle Registration and Identification provides an essential administrative foundation because accurate vehicle ownership records enable the identification of responsible legal subjects in electronic enforcement procedures. The interaction between registration administration and electronic evidence demonstrates a systematic legal relationship between public administration and criminal enforcement mechanisms. Sutrisno argues that electronic ticketing represents a modernization of traffic law enforcement because it creates a more objective and transparent enforcement structure compared with conventional ticketing practices (Sutrisno, 2019).

The impact of ETLE on public compliance in Serang City also reflects the broader concept of legal effectiveness, where legal rules achieve their objectives only when institutional enforcement and community acceptance develop simultaneously. Sudikno Mertokusumo explains that the effectiveness of law depends not only on the existence of legal norms but also on the extent to which those norms influence social behaviour and become accepted standards within society (Mertokusumo, 2007). The interviews conducted with road users demonstrate that awareness of CCTV surveillance has encouraged more careful driving behaviour because individuals perceive a higher probability of being detected when committing violations. Nevertheless, several respondents indicated that limited knowledge regarding ETLE procedures remains a barrier, particularly concerning electronic confirmation and payment mechanisms. These findings demonstrate that legal effectiveness requires continuous dissemination, institutional communication, and procedural accessibility to ensure that technological enforcement does not create uncertainty among citizens.

The reduction of traffic violations following ETLE implementation must also be examined from the perspective of administrative governance because successful law enforcement requires coordination among multiple state institutions. In Serang City, the implementation process involves cooperation between Satlantas Polresta Serang, transportation authorities responsible for traffic monitoring infrastructure, postal services responsible for delivering notification documents, and judicial institutions involved in sanction administration. Empirical findings reveal that although ETLE improves enforcement efficiency, operational challenges remain, particularly regarding workload distribution, technological maintenance, and public response to electronic notification procedures. Similar institutional challenges were identified in studies concerning ETLE implementation in Palu and Sukoharjo, where organizational readiness significantly influenced enforcement outcomes (Wati & Royfandi, 2024; Arumdani & Irawan, 2025). The existence of these challenges indicates that ETLE effectiveness depends on administrative integration rather than technological availability alone.

From a comparative legal perspective, the development of ETLE in Indonesia reflects a broader international movement toward technology-based traffic governance, although institutional adaptation remains a determining factor in achieving optimal results. Comparative research examining electronic traffic enforcement systems in Japan and Indonesia demonstrates that technological instruments become effective when accompanied by strong legal culture, consistent sanctions, and comprehensive regulatory frameworks (Fazriyah et al., 2025). The Indonesian experience, including Serang City, indicates that ETLE has successfully improved evidence-based enforcement but continues to encounter behavioural and institutional limitations. The principle of proportionality requires that enforcement mechanisms maintain balance between state authority to regulate traffic behaviour and citizens' rights to fair administrative procedures. Widuleh and Faizin emphasize that sanction mechanisms must maintain fairness and legitimacy because excessive or poorly implemented penalties may reduce public acceptance of legal enforcement (Widuleh & Faizin, 2024).

The overall empirical analysis demonstrates that ETLE has generated positive implications for traffic law enforcement in Serang City by improving detection certainty, strengthening institutional accountability, and contributing to declining trends in traffic violations and accident impacts. However, the findings also demonstrate that technological enforcement cannot independently eliminate traffic

violations because persistent behavioural factors, legal awareness limitations, and administrative challenges continue to influence compliance outcomes. The implementation of ETLE should therefore be interpreted as a component of a broader legal policy aimed at achieving traffic order, safety, and social responsibility among road users. The experience of Serang City confirms that digitalization of enforcement mechanisms must be accompanied by preventive education, institutional strengthening, and continuous regulatory evaluation. This analysis contributes to the development of socio-legal understanding by demonstrating that the effectiveness of electronic traffic enforcement emerges from the interaction between legal norms, technological systems, institutional practices, and societal compliance rather than from technological innovation alone.

Legal and Institutional Challenges in Optimizing Electronic Traffic Law Enforcement as a Mechanism for Sustainable Traffic Governance

The implementation of Electronic Traffic Law Enforcement (ETLE) in Serang City demonstrates that technological modernization within traffic law enforcement generates significant legal transformation, yet its sustainability remains influenced by various institutional, normative, and sociological challenges. The empirical legal findings indicate that although ETLE has improved the capacity of law enforcement institutions to detect and process violations, several obstacles continue to affect its effectiveness, including limited public understanding, administrative coordination problems, technological constraints, and the persistence of non-compliant behaviour among road users. From a socio-legal perspective, these challenges illustrate that the effectiveness of legal norms cannot be determined solely by the existence of regulatory instruments but must be assessed through the interaction between legal structures, implementing institutions, and social responses. Law Number 22 of 2009 concerning Road Traffic and Transportation provides a comprehensive regulatory framework for traffic order, yet the practical realization of these objectives requires institutional capacity capable of translating normative obligations into effective enforcement mechanisms. The empirical condition in Serang City confirms the argument that legal effectiveness depends upon the relationship between legal substance, legal institutions, and legal culture within society.

One of the primary challenges identified through interviews with Satlantas Polresta Serang is the uneven level of public legal awareness regarding ETLE procedures and traffic obligations. Several road users remain unfamiliar with the mechanism of electronic verification, notification, and payment of electronic tickets, creating uncertainty regarding their legal responsibilities after being identified through CCTV recordings. This condition demonstrates that technological enforcement without adequate legal literacy may reduce the preventive function of sanctions because individuals may perceive ETLE merely as an administrative procedure rather than a legal obligation arising from traffic regulation. Article 105 of Law Number 22 of 2009 concerning Road Traffic and Transportation establishes that every person using a motor vehicle on public roads must behave in an orderly manner and prevent activities that endanger traffic safety, indicating that compliance represents an active legal responsibility rather than passive obedience. The findings correspond with Junef's analysis that traffic violations in Indonesia are strongly connected with behavioural factors and insufficient internalization of legal norms among communities (Junef, 2014).

The difficulty of transforming public behaviour through ETLE reflects a broader theoretical issue concerning the relationship between coercive enforcement and legal consciousness. Legal sanctions may create external compliance through fear of punishment, but sustainable obedience requires the development of internal awareness regarding the importance of traffic safety and collective responsibility. Sudikno Mertokusumo explains that law functions effectively when legal rules are accepted as standards of social behaviour, meaning that enforcement institutions must encourage not only obedience but also recognition of legal values by society (Mertokusumo, 2007). Empirical findings in Serang City indicate that some drivers comply with traffic regulations primarily because of the possibility of electronic detection rather than because of genuine understanding of road safety principles. This situation suggests that ETLE has strengthened the certainty of enforcement but still requires integration with broader legal education strategies to achieve deeper behavioural transformation.

The institutional challenge of ETLE implementation also relates to coordination among governmental and law enforcement agencies involved in the enforcement process. The empirical investigation revealed that the operation of ETLE requires continuous cooperation between Satlantas

Polresta Serang, the Department of Transportation, postal service providers, and judicial institutions responsible for sanction administration. Each institution possesses different administrative responsibilities, and weaknesses in coordination may affect the speed and accuracy of electronic ticket processing. The following table illustrates the institutional distribution of authority and practical challenges identified during ETLE implementation in Serang City.

Table 3. Institutional Roles, Legal Authorities, and Implementation Challenges in Electronic Traffic Law Enforcement Governance in Serang City

Institution	Legal Basis and Authority	Role in ETLE Implementation	Empirical Challenge
Indonesian National Police	Law Number 2 of 2002 concerning Police Authority; Law Number 22 of 2009 concerning Traffic and Transportation	Verification, enforcement, and issuance of electronic tickets	Limited personnel and increasing volume of traffic monitoring
Department of Transportation	Government authority concerning transportation management	Management of traffic monitoring infrastructure and CCTV systems	Additional workload outside primary institutional functions
Postal Service Provider	Administrative delivery function for official notification	Delivery of electronic violation confirmation documents	Difficulties in reaching offenders and ensuring document receipt
Court Institution	Judicial authority over traffic violation sanctions	Legal settlement of disputed violations	Administrative adjustment to electronic procedures

The institutional mapping presented above demonstrates that ETLE represents a multi-agency legal mechanism requiring synchronization between different administrative functions. The empirical challenges identified in Serang City indicate that legal effectiveness may be weakened when institutional responsibilities are not supported by proportional resources and procedural integration. This finding reinforces the argument of Tjahyono et al. that ETLE implementation in Indonesia requires institutional adaptation because technological innovation changes not only enforcement procedures but also organizational responsibilities within traffic governance systems (Tjahyono et al., 2025). The legal consequence of this condition is that regulatory reform concerning digital enforcement should not merely focus on technological procurement but must also address institutional governance arrangements.

Another significant challenge concerns the relationship between technological infrastructure and legal certainty because electronic enforcement depends heavily on the reliability of digital evidence systems. Article 272 of Law Number 22 of 2009 recognizes electronic recording as evidence in traffic violation enforcement, yet the practical legitimacy of such evidence requires accuracy, authenticity, and procedural accountability. The empirical findings indicate that CCTV infrastructure in Serang City has assisted officers in identifying violations such as crossing road markings and failure to use helmets, but technological limitations remain relevant factors affecting enforcement coverage. The principle of legality in criminal law requires that every sanction must be based on clear legal authority and reliable evidence, consistent with Moeljatno's explanation that criminal responsibility requires a legally defined unlawful act supported by accountable enforcement procedures (Moeljatno, 2002). The implementation of ETLE therefore requires continuous technological evaluation to ensure that digital evidence maintains legal validity and public legitimacy.

The challenge of maintaining legal certainty within ETLE procedures is also connected with the identification of responsible legal subjects because electronic enforcement shifts responsibility from the driver directly observed by officers toward the registered owner of the vehicle. The Regulation of the Chief of the Indonesian National Police Number 5 of 2012 concerning Motor Vehicle Registration and Identification provides the administrative foundation for identifying vehicle ownership, yet practical

situations may involve different individuals between registered owners and actual drivers. This creates potential legal complexity regarding responsibility attribution, particularly when vehicles are borrowed, transferred informally, or operated by individuals other than registered owners. Wirjono Prodjodikoro emphasized that criminal liability requires a clear connection between unlawful conduct and the person legally responsible for such conduct (Prodjodikoro, 2002). The empirical implementation of ETLE in Serang City therefore requires clearer procedural mechanisms to prevent disputes regarding subject identification and ensure fairness in electronic sanctioning.

The optimization of ETLE also requires consideration of proportionality and fairness in imposing traffic sanctions because effective law enforcement must maintain a balance between regulatory objectives and citizens' legal protection. Traffic sanctions are designed to encourage compliance and protect public safety, yet disproportionate implementation may generate resistance among communities and weaken institutional legitimacy. Research concerning traffic penalty systems emphasizes that sanction mechanisms should consider principles of justice, certainty, and social benefit to maintain public acceptance of enforcement policies (Widuleh & Faizin, 2024). The empirical context of Serang City indicates that public acceptance of ETLE is generally positive because electronic procedures reduce direct interaction and potential negotiation with officers, although concerns remain regarding accessibility of information and procedural understanding. This condition demonstrates that legitimacy of digital enforcement depends not only on enforcement efficiency but also on perceptions of fairness among affected citizens.

The empirical findings also reveal that ETLE cannot completely resolve traffic accident problems because accidents are influenced by multiple variables extending beyond legal violations detected through electronic systems. Although the number of accident victims in Serang City decreased after ETLE implementation, accident causation remains connected with broader factors including human behaviour, vehicle conditions, road infrastructure, and environmental circumstances. Studies regarding road safety management demonstrate that preventive traffic governance requires integrated strategies involving enforcement, infrastructure improvement, and public education rather than relying exclusively on sanction mechanisms (Zulherawan, 2025; Susanto & Sofilda, 2025). The legal implication of this finding is that ETLE should be positioned as one component within a comprehensive traffic safety policy framework rather than treated as a singular solution for accident reduction. The effectiveness of traffic law therefore depends upon the harmonization between enforcement policies and preventive governance measures.

The analysis of legal and institutional challenges in ETLE implementation demonstrates that the future development of electronic traffic enforcement requires a comprehensive socio-legal framework combining regulatory strengthening, institutional coordination, technological reliability, and public legal awareness. The experience of Serang City confirms that digital transformation in traffic law enforcement provides substantial benefits in terms of transparency, accountability, and enforcement efficiency, yet its long-term effectiveness remains dependent upon continuous adaptation of legal institutions and social behaviour. Comparative experiences from other jurisdictions indicate that electronic enforcement systems achieve sustainable outcomes when technological mechanisms are supported by strong legal culture and integrated governance structures (Fazriyah et al., 2025). The contribution of this research lies in demonstrating that ETLE should be understood as a dynamic legal institution where technology, regulation, and society interact continuously in determining the effectiveness of traffic governance. The reconstruction of ETLE policy therefore requires a balanced approach that preserves legal certainty, institutional effectiveness, and public legitimacy within Indonesia's evolving digital governance framework.

CONCLUSION

The implementation of Electronic Traffic Law Enforcement (ETLE) in Serang City demonstrates that digital transformation within traffic law enforcement has generated significant legal and institutional improvements by strengthening evidentiary mechanisms, enhancing police accountability, and increasing certainty in the enforcement of traffic regulations. Empirical legal findings reveal that ETLE has contributed to reducing traffic violations and improving public compliance through technologically supported monitoring systems, although its effectiveness remains influenced by persistent behavioural factors, limited legal awareness, and institutional challenges in coordination, infrastructure management, and administrative procedures. The analysis confirms that ETLE should not

be understood merely as a technological instrument for issuing electronic tickets, but rather as a socio-legal governance mechanism that connects statutory norms, institutional authority, and community compliance within the framework of traffic safety regulation. The legal effectiveness of ETLE is therefore dependent upon the harmonization between Law Number 22 of 2009 concerning Road Traffic and Transportation, institutional capacity of enforcement agencies, and the development of public legal consciousness. Sustainable traffic governance requires continuous improvement of digital enforcement systems, regulatory adaptation, inter-agency cooperation, and preventive legal education to ensure that electronic enforcement contributes substantially to reducing violations and preventing traffic accidents.

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