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Improving Digital Governance through Electronic Traffic Law Enforcement in Makassar, Indonesia

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Abstract: This study examines the implementation of the Electronic Traffic Law Enforcement (ETLE) policy in Makassar City from the perspective of digital transformation in public service delivery. A qualitative approach was employed, with data collected through observation, in-depth interviews, and documentation, and analyzed using thematic analysis supported by XMind to map relationships among key actors and implementation dynamics. The findings reveal that ETLE implementation represents a significant shift toward digital governance, improving transparency, accountability, and the effectiveness of traffic law enforcement services. Collaboration among the police, local government, judiciary, and banking institutions has contributed to more integrated and efficient policy execution. However, the study also identifies several challenges, including limited public understanding of ETLE procedures, low levels of digital literacy, and suboptimal inter-agency coordination, particularly in data integration and administrative processes. This study concludes that the effectiveness of ETLE implementation depends not only on technological readiness but also on clear policy objectives, adequate resources, public compliance, and strong institutional support. Strengthening inclusive communication, enhancing system integration, and adopting adaptive policy strategies are therefore essential. This research contributes by providing an integrative perspective on digital-based policy implementation in the context of public service transformation.

INTRODUCTION

Traffic is a crucial element in the urban ecosystem as it is closely linked to various sectors, ranging from economic activity and transport mobility to the dynamics of social interaction within the community (Korkiya et al., 2022; Rui & Othengrafen, 2023; Yannis & Chaziris, 2022). Effective traffic management will help improve mobility efficiency and overall urban productivity (Ahmed et al., 2023; Ulvi et al., 2024). Conversely, a traffic system that is not optimally organised has the potential to cause various problems, such as congestion, traffic violations and an increase in the number of road accidents (Berhanu et al., 2023; Musa et al., 2023).

In recent years, the rapid growth in the number of motor vehicles in Indonesia's major cities has presented significant challenges for urban transport management. According to data from the Central Statistics Agency, the number of motor vehicles in Indonesia has shown a consistent upward trend across all vehicle types in recent years. In 2022, the total number of vehicles stood at 152,044,200 units, dominated by motorcycles, followed by passenger cars, goods vehicles, and buses. This situation reflects the public's high reliance on private vehicles, particularly motorcycles, as the primary means of transport. The increase in the number of vehicles continued in 2023 and 2024, reaching 159,121,836 units and 166,465,914 units respectively (Badan Pusat Statistik Indonesia, 2025). Furthermore, data for 2025 shows that the number of motor vehicles has risen again to 173,703,373 units (Herawati, 2026). The surge in vehicle numbers, which is not matched by road infrastructure capacity, coupled with the limitations of effective monitoring systems, leads to an increased risk of traffic violations and a decline in road user safety (Musa et al., 2023; Ye et al., 2024).

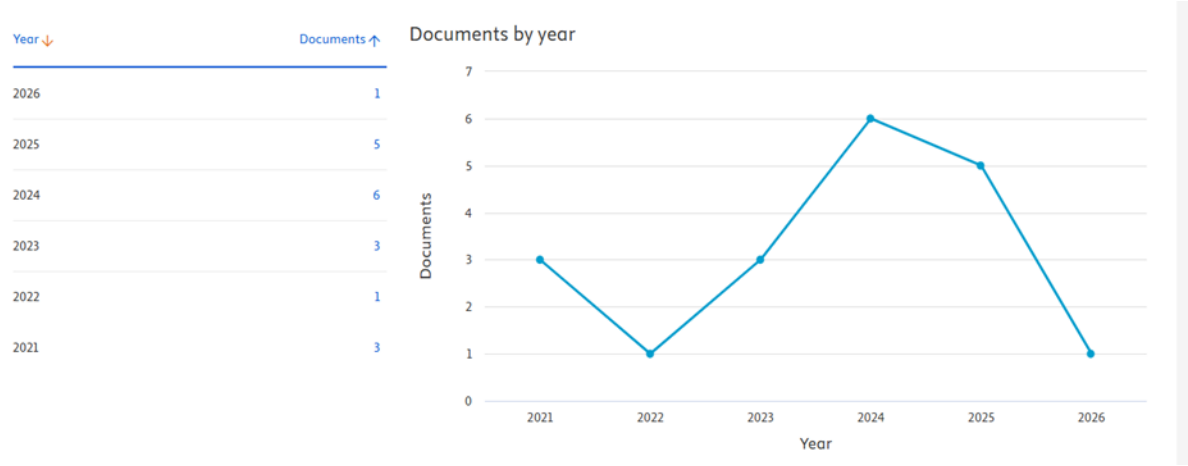
Public compliance with traffic regulations is a key factor in achieving a safe, orderly and sustainable transport system (Islam & Bhuiyan, 2024). This level of compliance not only reflects the public's legal awareness, but also reflects the effectiveness of the transport policies implemented by the government (Radtke, 2025; Shah & Asghar, 2024). Nevertheless, traffic offences remain a complex issue, particularly in urban areas with high levels of mobility (Goumiri et al., 2025; Ulvi et al., 2024). The high number of traffic offences not only disrupts traffic order but also increases the risk of accidents, resulting in social and economic losses for the community (Ajewole & Aderinto, 2026; Ehsani et al., 2023).

In response to these challenges, various countries have begun to develop digital technology-based traffic enforcement systems as part of efforts to modernise transport management. One such innovation is the implementation of ETLE, an electronic traffic enforcement system that uses CCTV technology to automatically detect and record traffic offences (Magriasti, 2025; Narullita, 2024). This system enables enforcement to be carried out objectively on the basis of digital evidence recorded by technological devices, thereby enhancing transparency, accountability and the effectiveness of traffic law enforcement.

In Indonesia, the implementation of the ETLE system is regulated by the Decree of the Chief of the Indonesian National Police No. 1 of 2021 on Electronic Traffic Law Enforcement, which was subsequently updated by the Regulation of the Indonesian National Police No. 2 of 2025 on the Enforcement of Traffic and Road Transport Offences Based on Electronic Recording Evidence. These regulations form the legal basis for the implementation of electronic ticketing systems across various regions of Indonesia, with the aim of improving road user compliance, minimising direct interaction between officers and offenders, and reducing the potential for misconduct in the enforcement process.

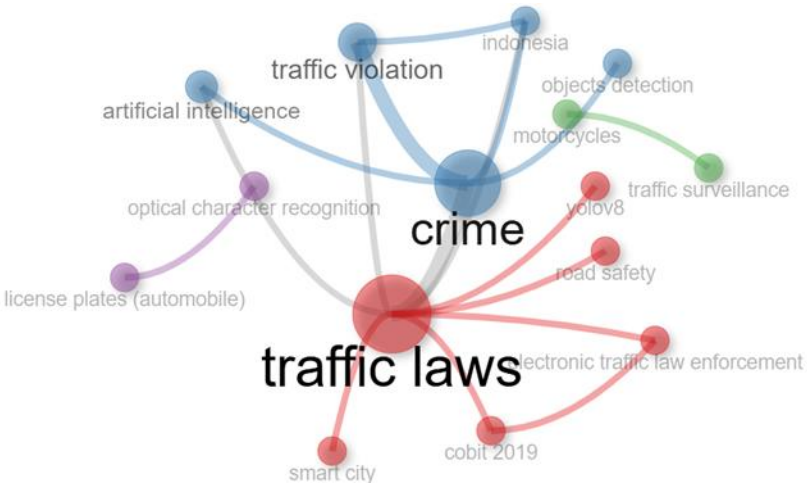
Globally, the implementation of technology-based traffic law enforcement systems has already been adopted in various countries. In Singapore, the use of automated surveillance cameras has become an integral part of the traffic monitoring system, capable of detecting various types of offences such as traffic light violations and speeding in real time (González-Aliste et al., 2023). In the UK, the use of Automatic Number Plate Recognition (ANPR) technology enables the rapid and accurate identification of vehicles, thereby improving the effectiveness of traffic monitoring (Tang et al., 2022). Meanwhile, in Australia, the speed camera enforcement system has been widely implemented and has proven effective in significantly reducing both speeding offences and the number of road traffic accidents (Shaaban et al., 2023). Various international studies indicate that the application of technology in traffic law enforcement can improve driver compliance through a deterrent effect and enhance the efficiency of the transport monitoring system.

Subsequently, the researcher conducted a search using the Scopus database with the keyword "Electronic Traffic Law Enforcement" and found a total of 19 research documents published between 2021 and 2026 (see Figure 1). The graph indicates that very few researchers have studied ETLE, particularly in the city of Makassar. Between 2021 and 2026, only 2024 saw a significant number of studies on this topic, with six documents, whilst in 2026 there was just one document as of 30 March 2026.



Picture 1.
Documents by Year.
Source: Scopus Database, 2026.

The Scopus database was analysed using the Biblioshiny tool to identify networks between the main topics and other related topics (see Figure 2). The co-occurrence network visualisation resulting from the Biblioshiny analysis shows that there are two main keywords at the centre of these connections, namely 'traffic laws' and 'crime', reflecting the research focus on traffic law enforcement from the perspective of offences as part of the phenomenon of crime. The 'traffic laws' cluster is closely linked to concepts such as 'electronic traffic law enforcement', 'road safety', 'smart city', and 'COBIT 2019', indicating a shift towards the digitalisation of law enforcement based on technology governance and its contribution to road safety and smart city development. Meanwhile, the crime cluster correlates with traffic violations, Indonesia, and motorcycles, indicating a dominant empirical context regarding traffic offences, particularly in developing countries with high motorcycle usage. Furthermore, the emergence of keywords such as artificial intelligence, optical character recognition, YOLOv8, object detection, and traffic surveillance confirms that the integration of artificial intelligence technology is a key element in supporting automated traffic surveillance and law enforcement systems. Overall, this network reflects a multidisciplinary character that combines legal, technological, and safety aspects within

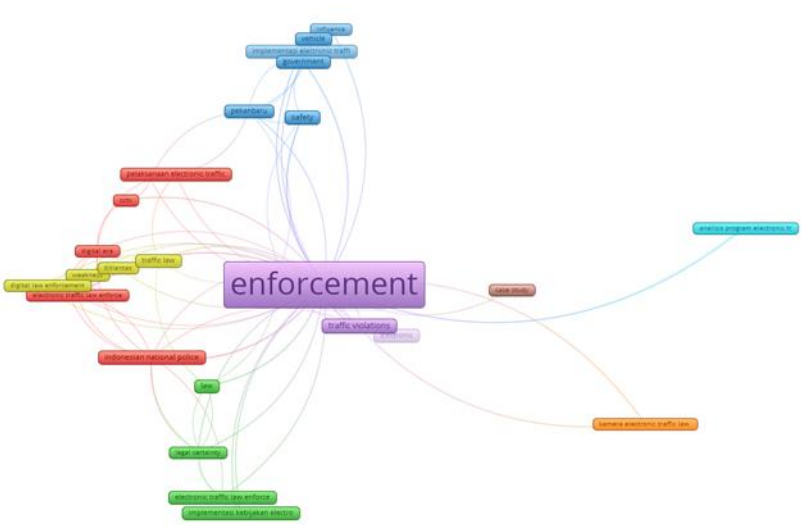


the framework of digital transformation of public services in the transport sector.

Picture 2.
Co-occurrence network.
Source: Biblioshiny, adapted by the researcher, 2026.

To further expand the scope of this research, the data sources were not limited to publications in the Scopus database but were also included in the Google Scholar database. Consequently, the researcher collected data via Publish or Perish using the keyword "Electronic Traffic Law Enforcement".

The search was limited to 200 documents within the timeframe of 2021 –2026. The data obtained was then analysed using VosViewer (see Figure 3).



Picture 3.
Co-occurrence network.
Source: VosViewer, processed by the researcher, 2026.

A co-occurrence network visualisation using VOSviewer shows that the keyword "enforcement" acts as a central node linking various thematic clusters in the study of electronic traffic law enforcement. The red cluster highlights implementation aspects such as electronic traffic law enforcement, CCTV, and the role of the Indonesian National Police, indicating a focus on the operationalisation of policy in the field. The green cluster relates to regulatory and institutional dimensions such as law, legal certainty, and electronic traffic law enforcement, reflecting the importance of a legal foundation in supporting the system's effectiveness. The yellow cluster points to digital transformation through digital law enforcement and traffic law, signifying the integration of technology into modern law enforcement systems. Meanwhile, the blue cluster highlights safety aspects and implementation contexts such as safety, vehicles, and the study area, whilst the purple cluster links traffic violations as the primary outcome of the enforcement process. Furthermore, the emergence of nodes such as electronic traffic law enforcement cameras and electronic traffic law analysis programmes indicates technology-driven development and system evaluation. Overall, this network depicts a multidimensional traffic law enforcement ecosystem, integrating technological, regulatory, institutional, and safety aspects

In Indonesia, one of the cities that has implemented the ETLE system is Makassar. Thus, the novelty of this research lies in the contextual analysis of the digitalisation of traffic law enforcement through ETLE in Makassar, as the first region to use ETLE in South Sulawesi. As one of the metropolitan cities in eastern Indonesia, Makassar faces quite complex challenges in traffic management due to the increasing number of motor vehicles and high levels of public mobility. The implementation of ETLE in Makassar began in 2021 as part of the national programme for the digitalisation of traffic law enforcement (Saharuddin & Rusliadi, 2025). In the initial stages of its implementation, surveillance cameras were installed at several strategic locations with high rates of traffic violations, such as major road junctions and areas with heavy traffic volumes.

However, the implementation of the ETLE policy in Makassar City still faces various challenges. Some of the obstacles that have arisen include limitations in technological infrastructure, the readiness of the motor vehicle data integration system, and the varying levels of technological literacy among the public (Fatmawati, et al., 2025; Nafsiah & Sahay, 2024). Furthermore, there are still members of the public who do not fully understand how the ETLE system works or the importance of complying with traffic regulations (Irfan, 2023; Solichan &

Mashdurohatun, 2023). This situation indicates that the implementation of the ETLE policy is not only related to technological aspects, but is also influenced by social and institutional factors, as well as the effectiveness of public policy.

Furthermore, existing research rarely employs a systematic bibliometric approach to map the intellectual structure of ETLE studies, resulting in a limited understanding of how key themes such as law enforcement, digitalization, and legal certainty interrelate within broader academic discourse. More importantly, empirical studies on ETLE in Indonesia remain geographically concentrated and have not sufficiently explored the evolving urban context of Eastern Indonesia, including Makassar, which presents distinct governance and infrastructure challenges.

The novelty of this study lies in the development of an integrative policy implementation analysis model by combining cross-theoretical indicators. Unlike previous studies, which tended to use a single approach, this study synthesises theoretical frameworks by drawing on key indicators from various theories, namely the clarity of policy objectives (Smith, 1973), availability of resources (Edwards III, 1980), compliance rate of the target group (Lipsky, 2010), serta dukungan lingkungan sosial-politik (Sabatier & Mazmanian, 1980). This novelty yields a simpler yet comprehensive analytical model for capturing the dimensions of policy substance, organisational capacity, public response, and environmental context. Furthermore, the empirical novelty of this study lies in its application within the context of the digitalisation of traffic law enforcement through ETLE in the city of Makassar, a topic that has so far been limited in its examination using an integrative, multi-theoretical approach within public administration studies in Indonesia.

This study therefore aims to analyse the implementation of the ETLE policy within the framework of digital governance and to identify the key factors influencing its effectiveness, not only in improving traffic compliance but also in strengthening the broader dimensions of governance, namely transparency, accountability and service innovation in Makassar.

RESEARCH METHODS

This study employs a qualitative approach with a descriptive design to analyse the implementation of the ETLE policy in improving traffic compliance in the city of Makassar. The qualitative approach was chosen because this study aims to gain an in-depth understanding of the phenomenon of policy implementation from the perspective of the actors involved in its implementation (Creswell & Poth, 2018). The research focused on the Traffic Directorate of the South Sulawesi Regional Police (Ditlantas Polda Sulsel) as the institution responsible for implementing the ETLE policy.

This study uses two types of data sources: primary data and secondary data. Primary data were collected directly through in-depth interviews with a total of 10 informants, consisting of ETLE officers, the Sub-Directorate of Traffic Enforcement, motorcyclists, and car drivers, as well as through field observations of the implementation of the ETLE policy around Andi Pangeran Pettarani Street and Urip Sumoharjo Street. This approach was applied to gain a comprehensive understanding of the practices and dynamics of policy implementation in the field.

On the other hand, secondary data was obtained from various credible written sources, such as official documents such as National Police Regulation Number 2 of 2025 concerning the Enforcement of Traffic and Road Transportation Violations Based on Electronic Recording Evidence, data on the number of violators from the South Sulawesi Regional Police Traffic Directorate, and scientific literature related to the research topic. This data was used to strengthen the analysis and provide a theoretical and contextual foundation for the phenomenon under.

Furthermore, this study utilised institutional archives from the Traffic Directorate of the South Sulawesi Regional Police, which included traffic violation data captured by ETLE cameras, policy documents regarding the electronic ticketing system, and information on the locations of surveillance cameras installed in Makassar City. This data served as a crucial source for empirically assessing the effectiveness of ETLE implementation.

Informants for this study were selected using purposive sampling, a method of selecting informants based on specific considerations in line with the research needs and objectives. This approach enabled the researchers to select individuals deemed to possess knowledge, experience and direct involvement with the phenomenon under study, particularly regarding the implementation of the ETLE policy. The informants involved in this study comprised actors with a direct role in policy implementation, as well as members of the public as road users. These parties included ETLE system operators, motorcyclists, and car drivers. It is hoped that this diversity of informants will provide a more comprehensive picture of policy implementation in the field.

The data collection techniques used in this study were based on three main approaches: observation, interviews and documentation (Moleong, 2010). These three techniques were used in an integrated manner to obtain comprehensive data and to support the triangulation process in the research. Observations were carried out directly on a number of main roads in the city of Makassar to identify road user behaviour and traffic conditions related to offences. Through these observations, the researcher was able to obtain an empirical picture of the actual situation on the ground, particularly in relation to the implementation of the ETLE system. Furthermore, in-depth interviews were conducted using a semi-structured guide, thereby allowing informants to express their experiences, perceptions, and views more broadly regarding the implementation of ETLE. Additionally, the documentation technique was utilised to supplement the research data through various sources, such as official documents, institutional reports, activity photographs, and statistical data on traffic violations recorded within the ETLE system. Thus, the combination of these three techniques is expected to yield valid and information-rich data.

Data analysis in this study employs an interactive qualitative data analysis approach, encompassing the processes of data reduction, data presentation, and drawing conclusions (Agusta, 2003). The analysis was conducted iteratively to ensure continuous interaction between data collection and interpretation. The coding process was carried out in three stages, namely open coding, axial coding, and selective coding. Open coding was used to identify key concepts emerging from the data, followed by axial coding to organise these concepts into categories and explore relationships among them. Finally, selective coding was conducted to synthesise and refine the main themes relevant to the implementation of the ETLE policy within a digital governance framework. To support the clarity of analysis, this study utilised XMind software specifically as a visual mapping tool. It was not used for coding, but rather to map and illustrate the roles and functions of each institution involved in the implementation of the ETLE policy in Makassar. Through the MindMap feature, institutional relationships were visualised to provide a clearer representation of how different actors interact and contribute within the governance system. This visualisation helped to strengthen the interpretation of findings, particularly in understanding the distribution of roles, coordination patterns, and institutional dynamics in the implementation of ETLE policy.

RESULTS AND DISCUSSION

The Ideal Policy

Smith (1973) view on ideal policy emphasises that public policy must be formulated clearly and realistically, and must have objectives that are understandable to all actors involved in the implementation process. An ideal policy not only involves the formulation of normative objectives, but also takes into account implementation strategies, the readiness of the implementing organisation, and the policy's suitability to the social conditions of the community. Consequently, the success of policy implementation is heavily influenced by the extent to which the policy can be operationalised by the implementing authorities and understood by the target groups as the parties directly affected by the policy.

The ETLE policy in Makassar demonstrates a structured approach to implementation, underpinned by a robust regulatory framework. One of the key legal foundations for the implementation of the ETLE system is Regulation of the Indonesian National Police No. 5 of 2021 on the Electronic Enforcement of Road Traffic and Transport Offences. This regulation provides

legal legitimacy to the police to optimise the use of digital technology in automatically detecting, recording, and processing traffic offences through the electronic ticketing system. With this regulation in place, the implementation of ETLE serves not only as a law enforcement tool but also as part of the digital transformation in public services within the traffic sector, prioritising the principles of transparency, accountability, and efficiency.

The implementation of ETLE demonstrates a transformation in the traffic law enforcement system, which is increasingly based on digital technology. This system enables enforcement processes to be carried out automatically through the use of surveillance cameras and data integration, thereby enhancing transparency and reducing direct interaction between law enforcement officers and offenders. This is consistent with research from Taeihagh (2021) which states that the use of digital technology in public policy, particularly in the transport sector, can enhance the effectiveness of oversight whilst minimising the potential for irregularities in the law enforcement process. Similar findings have also been highlighted by Amiruddin et al., (2025) & Candra et al., (2025) which indicates that the implementation of the electronic ticketing system in Indonesia has contributed to improved public compliance and transparency in the enforcement of traffic offences. However, the findings of this study also show that the level of public understanding of the ETLE mechanism remains uneven. Some members of the public do not yet fully understand the procedures for confirming offences or the process for paying fines electronically. This is in line with what was stated by Pülzl & Treib (2017) that the policy must be properly communicated to the public prior to its implementation. This situation highlights a gap between the policy design and the level of readiness of the public as the target group; consequently, a more comprehensive and sustainable policy communication strategy is required to support the optimal implementation of ETLE.

The use of surveillance camera technology and the integration of digital data enable enforcement processes to be carried out automatically without direct interaction between officials and offenders, thereby potentially minimising instances of misconduct in law enforcement. From a policy innovation perspective, this situation indicates a shift from conventional models towards a more objective and standardised technology-based system. This is in line with Prayitno, (2023) which states that technological innovation in public policy can improve the efficiency and effectiveness of the system, provided that such innovation can be understood and adopted by the public as the primary users.

However, the findings of this study indicate that the public's level of understanding of the ETLE policy remains varied, suggesting that the innovation adoption process has not yet proceeded optimally. Whilst some members of the public are indeed aware of the existence of ETLE through various media, procedural understanding such as enforcement mechanisms, confirmation of violations, and payment of fines remains relatively limited. This situation aligns with the Technology Acceptance Model proposed by Davis, (1989), which emphasises that acceptance of a technological system is heavily influenced by the ease with which users can understand it and their perception of its benefits. When the public does not yet fully understand how ETLE works, the level of acceptance and compliance with the policy also tends to be suboptimal.

The gap between the policy's normative objectives and the public's level of understanding indicates the existence of an implementation gap in the policy implementation process. From the perspective of policy implementation according to Grindle (2017) emphasises that the success of a policy is determined not only by the policy design itself, but also by the characteristics of the target group, including their level of knowledge and readiness to respond to the policy. Therefore, although ETLE is conceptually an innovation capable of improving the quality of law enforcement, the effectiveness of its implementation depends heavily on the extent to which the public understands and is able to adapt to the system. Consequently, a more systematic and inclusive public awareness and education strategy is required to minimise gaps in understanding, so that

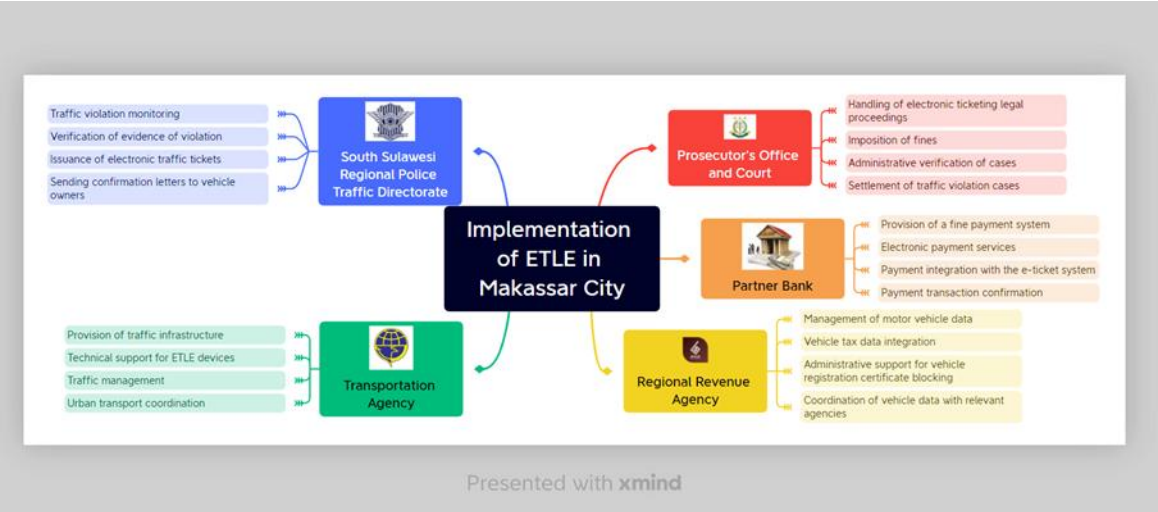
the policy's objectives of enhancing transparency, accountability, and the effectiveness of public services can be optimally achieved.

These findings reinforce the view Dunn, (2017) which states that the success of policy implementation is greatly influenced by the effectiveness of policy communication to the target groups. Policy communication that is not conveyed evenly can lead to differences in public perception regarding the objectives of the policy being implemented. In the context of ETLE implementation in Makassar, some members of the public still view this policy merely as a tool for enforcing violations, rather than as a government effort to foster road safety awareness and discipline.

This situation indicates that although the ETLE policy has been formulated ideally at the regulatory level, the effectiveness of its implementation still requires strengthening in terms of policy communication, public outreach, and institutional coordination so that the policy's objectives can be optimally achieved in improving public compliance with traffic regulations. In the context of regional implementation, Makassar is the first area in South Sulawesi to have implemented the ETLE system since 2021 as part of the Indonesian National Police's programme for the modernisation of technology-based traffic law enforcement. The initial implementation of the ETLE system in Makassar marks a significant step in the digital transformation of traffic law enforcement at the regional level, whilst also serving as a model for other districts and cities in South Sulawesi. Through the use of surveillance cameras and the integration of traffic violation data systems, this policy is expected to enhance the transparency of enforcement, reduce the potential for direct interaction between officers and offenders, and foster a culture of road discipline within the community.

Availability of Resources

The resource availability indicator is used to analyse the capacity of the implementing organisation to support the successful implementation of the policy, as stated by Edwards III, (1980). Resource availability focuses on the quality and quantity of competent human resources, as well as the availability of supporting facilities and infrastructure, particularly technological infrastructure. In the context of implementing the policy on the digitalisation of traffic law enforcement through ETLE in Makassar City, this indicator is crucial because the system's effectiveness depends heavily on the ability of officials to operate the technology, understand working procedures, and be supported by equipment such as surveillance cameras, system networks, and adequate data processing centres. Consequently, the more optimal the availability of human resources and infrastructure within the implementing organisation, the greater the likelihood of successfully implementing the policy in an effective and sustainable manner.



Picture 4.
Visualisation of the Roles of Implementing Organisations.
Source: Prepared by the researcher using Xmind, 2026.

As illustrated in Figure 4 above, the implementation of ETLE in Makassar demonstrates a technology-based traffic enforcement system that involves various agencies within a single integrated operational mechanism. This system utilises CCTV technology to automatically detect traffic offences, which are then processed through an electronic ticketing mechanism without direct interaction between officers and offenders. The implementation of the ETLE system forms part of efforts to modernise traffic law enforcement by utilising digital technology to enhance the effectiveness of monitoring, transparency, and accountability in the process of enforcing traffic offences (Adhitia et al., 2025). With this digital system in place, the process of identifying offences can be carried out more objectively as it is supported by visual evidence recorded via surveillance technology.

In terms of its implementation structure, the Traffic Directorate of the South Sulawesi Regional Police acts as the key body responsible for monitoring traffic offences, verifying evidence of offences recorded by cameras, issuing electronic fines, and sending confirmation letters to vehicle owners. This role demonstrates that the police hold a central position in the operation of the ETLE system, as they possess the authority in the traffic law enforcement process. The use of ETLE technology enables police officers to carry out surveillance more effectively than conventional methods, which rely on the physical presence of officers on the ground (Febriansyah et al., 2025). Research shows that the implementation of electronic traffic fines can improve the efficiency of law enforcement whilst reducing the potential for undetected violations in manual systems.

In addition to the police, the Makassar City Transport Department plays a key role in supporting the implementation of ETLE through the provision of traffic infrastructure, technical support for ETLE equipment, the management of traffic management systems, and the coordination of urban transport. Infrastructure such as the installation of surveillance cameras, the management of technology networks, and integration with traffic control systems form part of this agency's responsibilities. The availability of adequate technological infrastructure is a key factor in the successful implementation of digital-based policies such as ETLE. Without stable infrastructure support, automated surveillance systems cannot function optimally in detecting traffic violations (Won, 2020).

However, based on interviews with the Traffic Directorate and data obtained in the field, the condition of the Electronic Traffic Law Enforcement (ETLE) camera infrastructure in Makassar City shows a significant decline. In the initial implementation phase in 2021, 16 ETLE cameras were installed in various strategic locations. However, as time progressed, only around nine cameras remained functional, while the remainder were damaged and had not yet been fully repaired or replaced. This decline has resulted in reduced coverage of digital-based surveillance, particularly in areas with high mobility. Furthermore, the limited installation of cameras in areas such as Jalan Tanjung Bunga also indicates an uneven distribution of ETLE infrastructure. This situation indicates challenges in the maintenance and development of technological infrastructure, which ultimately impacts the effectiveness of ETLE policy implementation in supporting optimal traffic law enforcement.

The Traffic Directorate also stated that the problem of ETLE camera damage in Makassar City is not only caused by technical factors, but also related to institutional aspects and budget management. Repair and maintenance of damaged ETLE cameras is not entirely the responsibility of the regional police, but rather falls under the coordination of the Indonesian National Police (Polri), the central institution that manages the ETLE program nationally. This is because the procurement of ETLE infrastructure, including cameras and their supporting systems, is carried out through a centralized mechanism. Consequently, when equipment is damaged, the repair process must be coordinated with the central level, which often takes time and impacts the slow recovery of camera function in the regions. This condition indicates that the sustainability of ETLE operations depends not only on technological readiness, but also on the

effectiveness of institutional governance and financing mechanisms within a centralized management system.

In the area of vehicle administration, the Regional Revenue Agency (Bapenda) plays a role in the management of motor vehicle data, the integration of vehicle tax data, and the provision of administrative support in the process of blocking vehicle registration certificates (STNK) for offenders who have not settled their fines. The integration of vehicle data with the ETLE system enables the identification of vehicle owners to be carried out more quickly and accurately. This demonstrates that the management of vehicle administrative data is a crucial component of a technology-based law enforcement system. This statement is further reinforced by what was conveyed by Balaji (2025) & Wisdayanti et al., (2026) that the digitisation of vehicle administration data also contributes to improving accountability and efficiency in public administration.

Furthermore, judicial institutions including the Public Prosecutor's Office and the courts play a strategic role in handling legal proceedings for traffic offences detected through the ETLE system. This role encompasses the imposition of fines, administrative verification of cases, and the electronic resolution of offence cases, thereby ensuring that the entire law enforcement process proceeds in accordance with applicable legal procedures and provides legal certainty for the public. Consequently, ETLE functions not only as a technology-based monitoring tool but is also systematically integrated into the judicial mechanism as part of a comprehensive law enforcement system (Fanani, 2025; Rojabi & Kurniawan, 2026). Meanwhile, partner banks play a key role in supporting the implementation of ETLE by providing an electronic system for the payment of traffic fines. This service includes payment integration with the e-tilang system, digital transaction facilities, and automatic payment confirmation, which makes it easier for offenders to fulfil their obligations without having to visit a police station or court in person. The digitisation of these payments reflects efforts to transform public services, focusing on improving efficiency, transparency, and ease of access to services for the public (Humairoh et al., 2025; Latupeirissa et al., 2024).

Overall, the implementation of ETLE in Makassar demonstrates that the success of technology-based law enforcement policies depends heavily on the effectiveness of collaboration and coordination between the institutions involved. The integration of the police, local government, the judiciary and the banking sector reflects a collaborative governance model that emphasises the importance of cross-sectoral synergy in achieving policy objectives. This is in line with the view Ostrom (2010) emphasises that the success of managing complex public systems is largely determined by the ability of actors to establish sustainable institutional cooperation. Furthermore, Pollitt & Bouckaert (2017) emphasises that cross-organisational coordination is a key prerequisite for achieving effective policy integration, particularly in the context of technology-driven public sector reform. Furthermore, Kooiman (2004) states that modern governance requires dynamic interaction between various actors within policy networks, meaning that the success of implementation depends heavily on the quality of inter-institutional relationships and communication. However, in practice, the intensity of inter-institutional coordination in the implementation of ETLE in Makassar has declined, particularly in terms of data integration and the administrative processes for enforcing penalties, which risks undermining the overall effectiveness of the policy. This situation indicates that although the policy design has moved towards a collaborative model, the challenges in maintaining consistent coordination and system integration remain crucial factors that need to be strengthened to ensure the sustainability and optimisation of ETLE implementation.

This situation has resulted in sub-optimal performance in several stages of the ETLE system, such as the process of sending violation confirmation letters, the settlement of fines, and the blocking of vehicle registration certificates (STNK) for offenders who fail to respond to electronic penalty notices. This demonstrates that institutional coordination is a key factor determining the effectiveness of technology-based policy implementation. Without a stable and sustainable coordination system, even an ideally designed policy risks encountering obstacles during the implementation phase. This aligns with the view Lundin, (2007) & Peters, (2015) which explains that the success of public policy implementation is heavily influenced by the

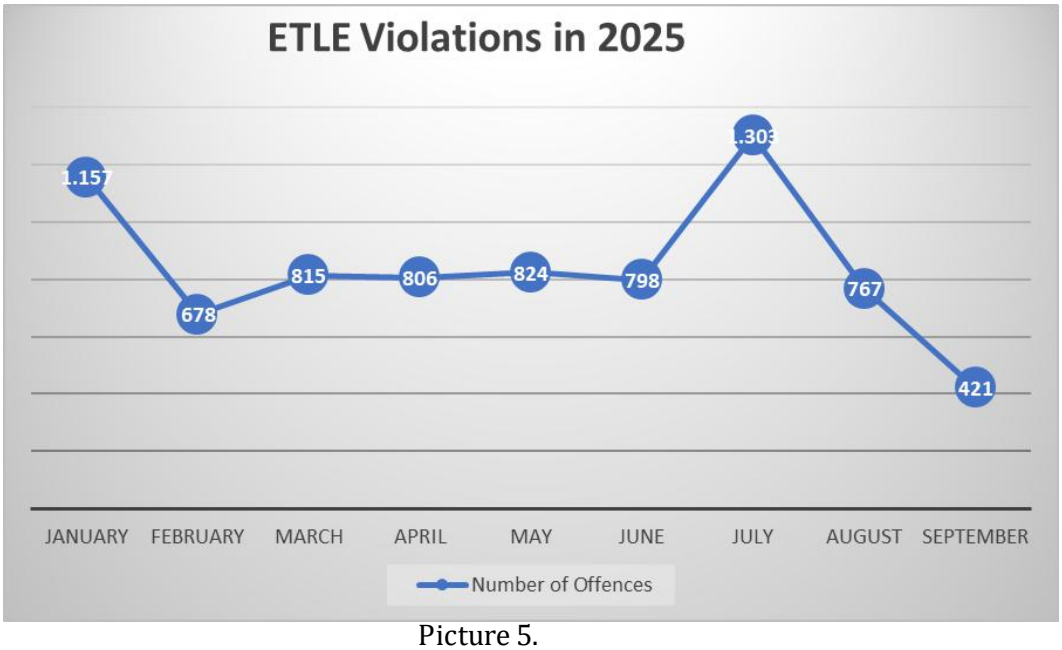
ability of government organisations to establish effective coordination systems between work units and between agencies.

Compliance Rate of The Target Group

The target group is a key element in the policy implementation process, particularly when examining how policies are implemented in practice. In this study, the approach adopted draws on the theory Lipsky (2010) which emphasises the role of interaction between the target group and frontline officials (street-level bureaucrats). The target group is understood as individuals or communities who are directly affected by the policy and, at the same time, act as key determinants of the success of its implementation through their behaviour (Sager & Gofen, 2022). Therefore, an indicator of the target group's compliance rate is used, reflecting the extent to which the public adheres to policy rules in their daily lives. Khan et al., (2024) & Wang et al., (2025) argues that compliance is influenced not only by an understanding of the policy, but also by experiences of interaction with law enforcement officers, perceptions of the policy's fairness, and the specific on-the-ground situation. In the context of the implementation of ETLE in Makassar City, this can be observed through changes in road users' behaviour regarding compliance with traffic regulations in response to the electronic enforcement system.

Based on the research findings, the target group's response to the ETLE policy in Makassar City shows a significant degree of diversity. Some members of the public, particularly motorists operating in urban areas, have understood that ETLE is a technology-based traffic monitoring system aimed at improving compliance and driving discipline. They consider that enforcement mechanisms using camera recordings provide a higher degree of objectivity and reduce the potential for direct interaction with officials, making the system perceived as more transparent and accountable. This perception indicates a tendency towards acceptance of the use of technology in traffic law enforcement, particularly when the system is deemed to provide tangible benefits to the public. This is in line with the view Marikyan et al., (2023) & Nazari-Shirkouhi et al., (2023) which emphasises that the level of technology adoption is greatly influenced by the extent to which users perceive the benefits of the implemented system.

On the other hand, there are still sections of the public who do not yet have a sufficient understanding of the operational mechanisms of the ETLE system, including the process of confirming offences and the procedures for settling penalties. This situation indicates that the dissemination of policy information has not yet been fully effective in reaching all sections of society. From the perspective of innovation diffusion, Horani et al., (2025) & Iyelolu et al., (2024) states that the success of innovation adoption depends heavily on the effectiveness of communication and the public's level of knowledge regarding the innovation in question. Consequently, variations in public response may be influenced by differences in digital literacy, access to information, and the public's ability to adapt to new technologies. Therefore, there is a need to strengthen public communication strategies that are more targeted and sustainable in order to enhance the public's overall understanding, thereby ensuring that the implementation of ETLE can proceed more effectively in achieving policy objectives. The number of violations from January to September 2025 is shown in Figure 5 below.



Picture 5.
Traffic Offences in 2025.
Source: Traffic Directorate, South Sulawesi Regional Police, 2026.

Figure 5, titled "ETLE Violations in 2025", illustrates the trend in the number of traffic violations detected by the ETLE system from January to September 2025. Generally, the data shows fluctuations in the number of violations each month. In January, 1,157 cases were recorded, which then fell quite significantly in February to 678 cases. Thereafter, there was a rise again in March to 815 cases, followed by relative stability in April (806 cases), May (824 cases), and June (798 cases). This indicates that during the March–June period, the number of violations tended to hover around 800 cases per month, signifying a violation rate that remains quite high but is relatively stable. The peak in violations occurred in July with 1,303 cases, the highest figure during the observation period. This surge may be attributed to several factors, such as increased public activity, intensified enforcement via ETLE cameras, or heightened mobility during a specific period. Following July, the number of violations fell again in August to 767 cases, and dropped more sharply in September to 421 cases, the lowest figure in the graph.

Overall, this graph indicates that the implementation of ETLE is capable of consistently monitoring violations, yet the public's compliance with traffic regulations remains subject to unstable fluctuations. The sharp decline in September may indicate increased public awareness, the deterrent effect of technology-based law enforcement, or changes in the intensity of surveillance. Therefore, further efforts such as public awareness campaigns, road safety education, and strengthened inter-agency coordination are required to ensure that the implementation of ETLE is more effective in improving public compliance with traffic regulations.

These findings can be explained using the Technology Acceptance Model (TAM) developed by Davis (1989) and has been extensively explored in contemporary digital policy research. This model explains that the level of public acceptance of technology is influenced by two main factors: perceived usefulness (the perceived benefits of the technology) and perceived ease of use (the ease with which the technology can be used). In the context of ETLE, the public will tend to adjust their traffic behaviour when they understand that the system is effective in detecting offences and carries tangible legal consequences. Consequently, the higher the public's perception of the ETLE system's effectiveness and ease of use, the greater the likelihood of behavioural change towards traffic compliance.

In the implementation of ETLE, camera-based surveillance systems and the electronic transmission of evidence of violations demonstrate a paradigm shift in law enforcement towards a more objective and data-driven system. This approach aligns with the concept of digital

government, which emphasises the importance of utilising digital technology to enhance the performance of public organisations and strengthen governance that is responsive to technological developments. Through digital systems, the processes of monitoring and enforcing traffic violations can be carried out more systematically, reducing the potential for direct interaction between officials and offenders, and increasing transparency in the law enforcement process.

The successful implementation of technology-based policies such as ETLE depends not only on the availability of digital infrastructure, but also on the readiness of government institutions to manage such systems, the integration of data across agencies, and the public's ability to adapt to digital monitoring mechanisms (Fatmawati et al., 2025; Irfan, 2023). Recent research shows that digital transformation in the public sector requires institutional capacity, inter-organisational coordination and public digital literacy to ensure that technology-based policies can be implemented effectively (Balaji, 2025; Gil-Garcia et al., 2018; Mergel et al., 2019). Therefore, in addition to strengthening technological infrastructure, the government also needs to develop strategies for policy communication and public education, as well as improve the public's digital literacy, so that the implementation of ETLE can sustainably improve public compliance with traffic regulations.

Furthermore, this phenomenon can also be understood through the perspective of Digital Era Governance put forward by Dunleavy, (2006). This approach emphasises that the use of digital technology in the public sector aims to enhance efficiency, transparency and accountability in service delivery and policy enforcement. In the context of ETLE, the use of surveillance cameras and automated enforcement systems represents a transformation of public administration towards a more modern, data-driven system. However, the success of its implementation depends heavily on the readiness of government institutions, the integration of systems across agencies, and the public's ability to adapt to these technology-based monitoring mechanisms. Therefore, in addition to strengthening technological infrastructure, public education strategies and the improvement of digital literacy are also required so that the implementation of ETLE policies can be more effective in increasing public compliance with traffic regulations.

Consequently, a more inclusive and sustainable public communication strategy is required so that the public can understand the objectives and mechanisms of the ETLE policy more comprehensively. An educational approach through the mass media, social media, and the involvement of road user communities can serve as a strategic step in raising public legal awareness regarding the importance of road discipline.

The fluctuating decline in violations seen over several periods, particularly after a spike in July and a significant decline in September, can be interpreted as the result of a combination of enforcement factors and public behavioral responses. This decline likely reflects the deterrent effect of the ETLE system, where road users begin to adjust their behavior after realizing that violations are automatically recorded and have real legal consequences. Furthermore, increased exposure to information related to ETLE, both through the media and through direct experiences of people receiving electronic tickets, has also raised awareness of the importance of complying with traffic regulations. However, field findings also indicate that public compliance tends to be partial, with higher levels on roads with ETLE cameras installed, while violations remain relatively frequent in locations not monitored. This suggests that compliance is still situational and dependent on the availability of technology-based monitoring. Therefore, this fluctuation confirms that changes in public behavior are still in the adaptation phase, requiring ongoing efforts through strengthening outreach, education, and expanding the coverage of ETLE infrastructure to ensure more consistent and equitable compliance.

Social and Political Support

Environmental factors are external elements that play a role in determining the success of policy implementation, encompassing social, economic and political conditions, as well as institutional support within a policy system. In this study, the indicator used is socio-political environmental support, which refers to the level of broad public acceptance, political stability, and support from stakeholders such as local governments, law enforcement agencies and other

relevant institutions. Unlike point (c), which focuses on the level of compliance of the target group in responding to policies directly at the individual or user community level, the indicator in point (d) places greater emphasis on the macro context that shapes the overall policy implementation climate. This approach emphasises that external factors and political system support have a significant influence on the sustainability of policy implementation (Sabatier & Mazmanian, 1980). This is in line with the view expressed by Ines Mergel, who states that digital transformation in the public sector is heavily influenced by the readiness of the organisational environment, institutional support, and the government's ability to integrate technology with governance processes (Mergel, 2019).

The research findings indicate that the policy environment in Makassar City has a significant influence on the effectiveness of ETLE implementation. From an institutional perspective, support from the local government and various relevant agencies, such as the Department of Transport and the Regional Revenue Agency, is a key factor in supporting the operation of the ETLE system. This support is evident in the provision of infrastructure facilities, the development of information technology systems, and inter-agency coordination in the management of technology-based traffic surveillance systems. The importance of this institutional support is in line with the view Gil-Garcia et al., (2018) which emphasises that the success of digital policies depends heavily on inter-organisational integration and cross-sectoral coordination in the delivery of technology-based governance.

In addition to institutional support, environmental factors also relate to the capacity of government organisations to manage digital innovation. The implementation of technology-based policies requires public institutions to be capable of managing information systems, integrating data, and ensuring the operational sustainability of the technologies used. In this context, Janssen & Van der Voort (2020) explains that the successful implementation of digital policies within government is heavily influenced by an organisation's capacity to manage technology, including the bureaucracy's ability to adapt to changes in digital-based working systems. However, several environmental constraints are still evident in the implementation of the ETLE policy in Makassar. One of the main constraints is limited technological infrastructure, such as an unstable internet connection in some locations and damage to surveillance cameras, which has led to a reduction in the number of active surveillance points. This situation demonstrates that the success of technology-based policies is highly dependent on the readiness of the digital infrastructure supporting the system's operations. According to Miriam Lips, digital transformation in the public sector requires adequate technological infrastructure support, as infrastructure limitations can hinder the effectiveness of implementing policies based on electronic systems (Lips, 2019).

Research findings indicate that the policy environment in Makassar City significantly influences the effectiveness of ETLE implementation through inter-agency integration. The local government plays a role in fostering policy and system synergy, while the Transportation Agency supports this by providing traffic infrastructure. Administratively, the Regional Revenue Agency (Bapenda) plays a crucial role in managing the motor vehicle tax system, which is linked to ETLE violation data. This integration allows for the automatic identification of any violations recorded by cameras based on vehicle data, thereby integrating the violation status into the overall vehicle administration system. Specifically, violators who fail to pay their electronic traffic ticket fines will face administrative consequences, including delays in the vehicle tax payment process. This occurs because the system marks the vehicle as still having outstanding violations, preventing the vehicle owner from proceeding with the vehicle registration (STNK) validation process until the fines are settled. In other words, paying the traffic ticket fines becomes an administrative prerequisite for accessing vehicle tax services. This mechanism creates stronger compliance enforcement pressure, as it not only impacts the legal aspects but also directly impacts the public services needed by the community. Therefore, the link between traffic fines and vehicle tax payments strengthens ETLE's function as a law enforcement instrument as well as administrative control within the digital governance framework.

In addition to technological factors, social conditions within the community also influence the effectiveness of ETLE implementation. Although some members of the public are beginning

to show greater awareness of the need to comply with traffic regulations, there are still instances of undisciplined driving behaviour in certain areas. This indicates that social behavioural change cannot occur overnight, but rather requires a gradual process of adaptation. From a digital public policy perspective, Margetts & Naumann (2017) explains that the success of technology-based policies is heavily influenced by the level of public acceptance of technology and their ability to adapt their behaviour to the digital surveillance systems in place.

Furthermore, environmental factors are also linked to the level of digital literacy among the public as users of technology-based public services. The ETLE policy essentially requires the public to understand the mechanisms of law enforcement based on electronic systems, including the process of verifying offences and paying fines digitally. Therefore, the level of digital literacy among the public is a key factor in supporting the success of this policy. According to Dwivedi et al., (2021), Digital transformation in public services requires enhancing the public's ability to understand and utilise technology so that digital policies can be implemented effectively and inclusively.

Consequently, the sustainable implementation of ETLE in Makassar City requires stronger collaboration between the local government, law enforcement agencies and the public as road users (Saharuddin & Rusliadi, 2025). Such collaboration is key to establishing an effective, transparent and sustainable traffic law enforcement system. This is in line with the view of Donald F. Norris, who emphasises that the success of digital policies in the public sector depends heavily on inter-agency collaboration, the integration of government systems, and public participation in supporting the implementation of technology-based policies (Norris & Reddick, 2021).

Furthermore, based on the research findings, environmental factors play a decisive role in the successful implementation of the ETLE policy in Makassar City. A conducive policy environment in terms of institutional support, technological infrastructure readiness, and public awareness is a key element in ensuring that technology-based policies can be implemented effectively. Without adequate environmental support, policies that have been well-designed conceptually are likely to face obstacles during the implementation phase. Therefore, strengthening synergies between local government, law enforcement agencies, and the public must be continuously pursued through improvements in digital infrastructure quality, enhanced inter-agency coordination, and sustainable public education programmes. It is hoped that these efforts will create a more adaptive policy environment and support the sustainability of the technology-based traffic law enforcement system in Makassar.

CONCLUSSION

The implementation of Electronic Traffic Law Enforcement (ETLE) in Makassar reflects a significant shift towards digital governance in traffic law enforcement, characterised by the integration of surveillance technology, data systems, and automated enforcement mechanisms. This study contributes to the literature by demonstrating that the effectiveness of digital-based policies is not solely determined by technological capacity, but also by the interaction between institutional coordination, public acceptance, and administrative integration. In particular, the linkage between electronic enforcement and administrative services such as the requirement to settle traffic fines before vehicle tax payment illustrates how digital governance can strengthen compliance through integrated control mechanisms.

However, the findings also reveal that the success of ETLE implementation remains contingent upon the level of public understanding and institutional synergy. Variations in digital literacy and uneven policy communication contribute to inconsistent compliance, while challenges in inter-agency coordination and infrastructure readiness continue to affect implementation performance. Therefore, this study highlights that digital governance in public policy implementation requires not only technological innovation, but also adaptive institutional capacity, integrated systems, and inclusive public engagement. Future research is encouraged to

expand the geographical scope and adopt mixed-method approaches to further enrich the understanding of digital policy implementation in diverse contexts.

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