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Android-Based Application of Dispensation Licensing System for Urban Freight Transport in Surakarta City

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Abstract-Urban freight transport poses significant challenges to traffic management, road safety, and environmental sustainability in Surakarta City. This study examines the development and implementation of the SIMABA application, operationalized as the SIDJAKA digital dispensation licensing system, for monitoring and controlling urban freight transport movements. The freight transport trip characteristic survey was conducted to identify origin-destination trips, frequency, weight and type of cargo, and distribution patterns. The road inventory survey was intended to obtain road geometry data, while the traffic count survey was done to collect traffic volume during peak hours. Meanwhile, secondary data consisting of information on road functions and bearing capacity, land use of activity centers, traffic signs, and administrative licenses submitted through SIDJAKA application from January 2020 to December 2025 were obtained from relevant institutions. This study demonstrates that the SIMABA application, implemented through the SIDJAKA system, effectively regulates the licensing of freight transport in Surakarta City. Monitoring of this application can be carried out systematically and transparently, ensuring that administrative and technical requirements, particularly vehicle roadworthiness, are met, thus ensuring more controlled urban freight transport. The analysis of origin-destination trips indicates that freight transport flows are significantly influenced by changes in the road network and infrastructure development, with the distribution activities remaining concentrated in market areas and major commercial corridors. Although effective, the system faces limitations in terms of cross-regional scale, data integration, maintenance systems, and digital user literacy, which may hinder its adoption and optimal utilization. As a future research agenda, developing the system into an integrated platform that connects cross-regional licensing, vehicle inspection systems, and electronic law enforcement is recommended to achieve greater adaptability and efficiency.

Keywords: Android, Dispensation License, Freight Transport, SIMABA, SIDJAKA

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1. Introduction

Increased mobility of people and goods closely correlates with urban economic growth. Uncontrolled urban freight transport movements have the potential to generate traffic congestion, accidents, air pollution, and infrastructure degradation. Therefore, reliable urban transport systems are required to accommodate such movements without significantly compromising safety, road service levels, and environmental sustainability [1]–[3]. Within the sustainability paradigm, Pan et al. [2] demonstrated that smart city-based urban logistics leverage the integration of Intelligent Transport Systems (ITS) and Internet of Things (IoT) technologies supported by real-time data as key instruments for controlling freight transport movements, mitigating negative externalities, and implementing efficient and sustainable freight transport policies and regulations. ITS integrates information, communication, and control technologies to enhance transport efficiency and operational performance, while IoT enables devices and vehicles to be interconnected through sensors and communication networks to generate and exchange real-time data.

Urban freight transport has become a critical component of sustainable urban mobility policies in response to growing congestion, environmental impacts, and increasing demand for goods distribution. European policy frameworks emphasize the use of ITS and IoT technologies to enable dynamic freight transport management through route optimization, regulation of operational time windows, and real-time access control, including regulatory dispensation mechanisms for specific vehicle types or operational requirements [4]. In this context, intelligent urban logistics management and effective freight transport access control require the integration of real-time data through ITS and IoT-based digital systems, accompanied by coordinated collaboration

between public and private sectors to support permitting processes, operational monitoring, and the implementation of adaptive, data-driven access policies [5]. The application of such digital technologies enables real-time monitoring, license management, service performance evaluation, and compliance control, thereby enhancing the effectiveness of data-driven urban freight transport policies [6]–[9].

In line with the advancement of ITS and IoT, recent studies have increasingly focused on the use of integrated digital platforms for urban freight transport management. Drop [3] demonstrates that IoT-enabled ITS supported by GPS-based data and real-time routing can improve traffic efficiency, safety, and environmental performance, while Bosona [10] emphasizes that such ITS also contribute to reducing delivery failures, optimizing vehicle routing, and enhancing operational sustainability. Within the context of urban logistics digitalization, Fioravanti et al. [11] introduce the concept of Urban Logistics as a Service (ULaaS) as a digital platform–based logistics ecosystem that integrates multiple stakeholders, including logistics operators and public authorities, through mobile and web-based application interfaces to support governance, coordination, and the sustainability of urban logistics systems. At the implementation level, Rosano et al. [12] show that the application of Android-based systems in urban freight transport can enhance stakeholder coordination, information transparency, and operational efficiency, thereby underscoring the significant potential of integrating mobile applications and digital systems for more effective urban freight transport management.

Transport policies governing urban freight transport operations in Indonesia have been established through various regulatory frameworks. In general, freight transport operations must comply with regulations concerning route designation based on road class and carrying capacity, allowable vehicle weight limits, operational time windows, loading procedures, parking facilities, loading and unloading facilities, and warehousing provisions [1], [13]–[16]. To monitor and control the mobility of high-tonnage freight vehicles, the Surakarta City Government has implemented a dispensation licensing system for freight transport operating on urban roads. Such licenses are granted to freight vehicles that meet specific criteria, including those carrying indivisible oversized or overweight goods, vehicles with loads exceeding the maximum allowable axle load in accordance with road classification, and vehicles transporting essential goods and/or fuel [15].

The urban freight transport dispensation licensing system implemented by the Surakarta City Transportation Agency is still largely conventional, requiring applicants to submit license requests in person at the Transportation Agency office or at Freight Transport Control Posts (FTCP) located along major arterial roads at the city boundaries. Vehicle and route information are recorded manually by officers on license forms using typewriters, including vehicle identification, type of cargo, and the road segments traversed from the city entry point to the final destination. This condition gives rise to several limitations, including dependence on the physical presence of applicants, slow data processing and validation, low accuracy in recording routes and operational time windows, and limited system capacity for real-time monitoring and compliance tracking. Moreover, the use of physical documents increases the risk of license duplication and forgery, complicates inter-agency coordination for supervision, and creates opportunities for illegal levies, ultimately reducing transparency and the effectiveness of urban freight transport control. These limitations of the conventional dispensation permitting system, characterized by low driver compliance with permit regulations, weak operational monitoring and control, and the presence of illegal levies alongside ineffective law enforcement significantly contribute to the high incidence of urban freight transport-related traffic violations in Surakarta City [17]. This impact is reflected in data collected by the Surakarta City Transportation Agency and the Police at several observation sites along major urban road corridors, indicating an average of 26 freight transport violations per hour at each observation location.

In response to the urban freight transport challenges in Surakarta City, improvements to the existing urban freight transport monitoring and control framework are required through the development of a digital dispensation licensing system based on Android technology. The proposed system is expected to facilitate license applications for freight transport operators, prevent illegal levies, and serve as an effective, efficient, and transparent instrument for supervision, guidance, and law enforcement coordination among government agencies involved in urban freight transport operations. Accordingly, this study examines the development and implementation of the SIMABA application, operationalized as the SIDJAKA digital dispensation licensing system, for monitoring and controlling urban freight transport movements in the Surakarta City area.

2. Methods

This research was conducted in Surakarta City as a pilot study for the implementation of the SIMABA application. The study area covers the urban road network and land use of activity centers that generate and attract urban freight transport movements in Surakarta City. The research stages included problem identification, objective formulation, literature review, data collection, technical analysis, application development, application implementation, analysis of implementation results, and the formulation of conclusions and recommendations, as illustrated in Figure 1.

Furthermore, the road bearing capacity mapping of the road network was conducted based on technical pavement data and road classification obtained from the Public Works Agency, as well as traffic sign data sourced from the Surakarta City Transportation Agency. Based on the integrated analysis of freight transport trip distribution patterns, road traffic performance, and road bearing capacity, the selection of urban freight transport dispensation routes from origin to destination through urban roads was established as a key component of the dispensation recommendation letter. In the final stage of analysis, administrative analysis of urban freight dispensation licensing was conducted to formulate the design of the SIMABA application and to develop the content and format of the urban road dispensation recommendation letter.

The SIMABA application was developed using a client–server architecture that integrates a web-based server application with an Android-based client application. The online server functions as the central system service, providing web interfaces through HTTP/HTTPS protocols and managing the licensing database in a centralized manner. The server-side application was developed using the CodeIgniter PHP Framework [19], while the Android client application was built by utilizing the WebView component through the Android Studio IDE [20]. The WebView configuration was enhanced with additional programming codes to enable integration between the web interface and hardware features of mobile devices.

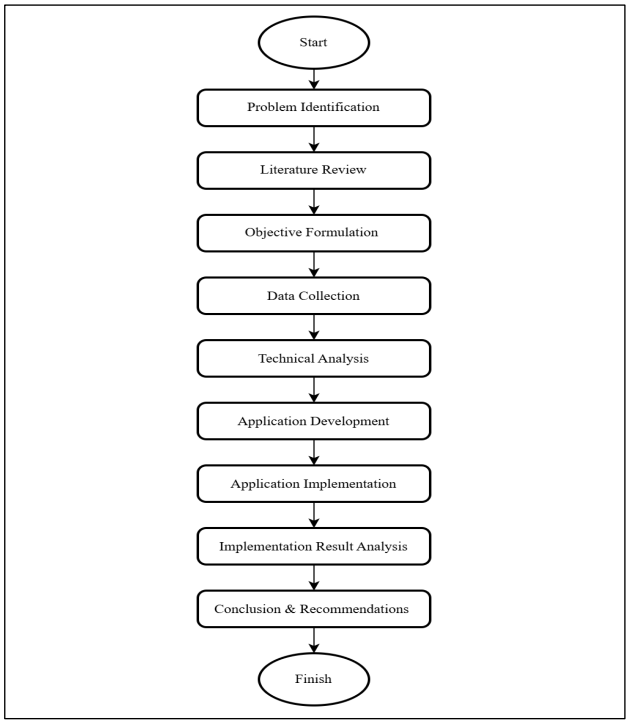

Figure 1. Research stages

The dispensation licensing system of the SIMABA application has been implemented at the Surakarta City Transportation Agency under the name SIDJAKA application since May 2019. In this study, the SIDJAKA application database was analyzed for the period from 2020 to 2025 to identify and analyze the characteristics of urban freight transport trips and system performance, which subsequently served as the basis for formulating the study's conclusions and recommendations.

3. Result and Discussion

1. Urban Freight Transport Dispensation Routes

Data on the origin and destination of urban freight transport trips, traffic operational conditions, and road bearing capacity, traffic sign locations, as well as parking and loading/unloading restrictions, were analyzed to serve as the basis for determining the dispensation routes. Figure 2 presents a map illustrating the distribution patterns of urban freight transport trips, road bearing capacity, and the Level of Service (LOS) of the road network during morning and afternoon peak hours.

Urban freight transport dispensation routes were designated only through city roads that comply with applicable regulations [1], [13]–[16] and were adjusted based on the integrated results of the data analysis. For heavy-tonnage freight transport vehicles, route selection was carried out on road segments with sufficient structural capacity to bear vehicle loads, adequate lane width for smooth traffic flow, and a low level of service. In addition, routes also considered side frictions such as intersections, parking areas, and loading/unloading zones to minimize congestion risk and ensure traffic safety.

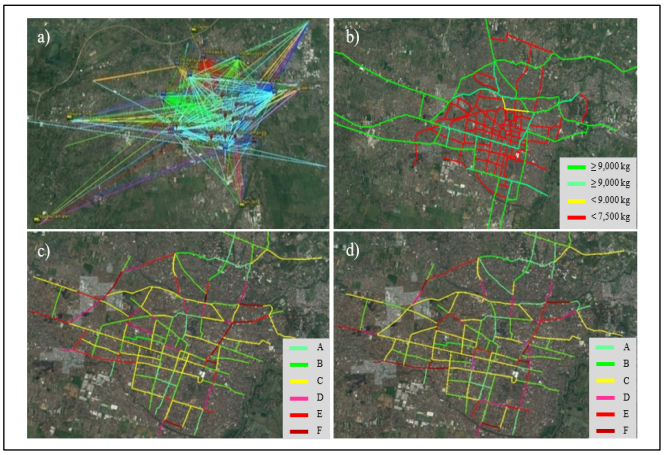

Figure 2. Maps of a) distribution pattern of urban freight transport movement b) road capacity c) LOS at morning peak hour and d) LOS at afternoon peak hour

The origin and destination points of urban freight transport dispensation routes were determined based on major roads serving as entry and exit points of Surakarta City, as well as locations of activity centers within the city. Origins were established on the major arterial roads at the city boundaries, where FTCS Banyuanyar, FTCS Gemblegan, FTCS Jajar, FTCS Jurug, FTCS Kadipiro, FTCS Pasar Jongke, FTCS Pucang Sawit, FTCS Ring Road, and FTCS Semanggi are located, as shown in Figure 3. Whereas destinations included markets, commercial and service areas, public facilities, and certain road segments that function as trip generation and attraction zones for urban freight transport movement. From 9 origin points and 129 destination points, a total of 1,760 urban freight transport dispensation route combinations were generated, connecting each origin to its corresponding destination.

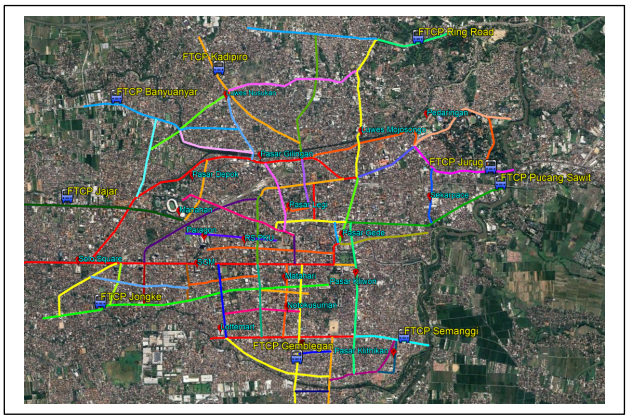

Figure 3. Location of major arterial roads at the city boundaries

The dispensation routes were subsequently entered into the SIMABA application database and represented as geographic coordinates, including latitude and longitude. These coordinate notations were then used as the database for the web-based system to map the origins and destinations of urban freight transport dispensation routes. For example, the longitude and latitude coordinates at points along the dispensation route from FTCP-Jajar to Pasar Kliwon are presented in Table 1, while Figure 4 illustrates this route on Google Maps.

Table 1. The longitude and latitude coordinates at points along the urban freight transport route from FTCP-Jajar to Pasar Kliwon.

Route	Coordinate
Adi Sucipto Street – A. Yani Street – S. Parman Street – Monginsidi Street – A. Yani Street – Urip Sumoharjo Street – Juanda Street – Kapten Mulyadi Street – Pasar Kliwon	-7.550128501432999,110.7883328884479::-7.553624, 110.799714:: -7.551203, 110.810370:: -7.552239, 110.821485:: -7.553549, 110.823261:: -7.557872, 110.824522:: -7.559497, 110.834937:: -7.560096, 110.837083:: -7.566416, 110.833496:: -7.566786, 110.833983:: -7.575422, 110.832413

2.Administration of urban freight transport dispensation licensing system

Administration of urban freight transport dispensation licensing system analysis is carried out to design the SIMABA Apps and dispensation recommendation letter contents. The SIMABA Apps design and the dispensation recommendation letter contents are related to dispensation license provisions, which include applicant data, vehicle data, operational time data, type of cargo data, origin and destination of urban freight transport trips, and licensing period. Applicant data includes name, address, and National Identification Number. Vehicle data are related to the Vehicle Registration Certificate and motor vehicle test letter. In order to guarantee data transparency, pictures of the Vehicle Registration Certificate, motor vehicle test letter, and vehicle condition are included. Weight of vehicle permitted (gross weight, GW) data is categorized in 5,501 kg - 14,000 kg and above 14,001 kg. The operational time for GW 5,501 kg - 14,000 kg is outside of 06.00 - 09.00 and 16.00 - 19.00, while for above 14,001 kg is outside of 06.00 - 19.00. The type of cargo of goods is adjusted to the categories specified in the applicable regulations [15]. The licensing period is divided into two categories: one day and seven days.

3. Dispensation licensing system application

The SIMABA application is designed to be simple and user-friendly, targeting urban freight transport stakeholders, including truck drivers, freight transport operators, and business owners. The flow of the application can be seen in Figure 5. After filling out a form with personal information data, a user can use the application to request a dispensation of his/her vehicles by undertaking a login process. At a successful login process, the user can have user menu (Figure 5(b)) and start to apply for a dispensation license request (Figure 5(c and d)). If the requirements of dispensation license are satisfied, the user can view the detail of his dispensation license as seen in Figure 5(e, f, g and h). Figure 5(e and f) contain details of the dispensation data, where Figure 5(g and h) describe the route/path of the vehicle and an explanation of its direction. At the end, the user can download the dispensation document as shown in Figure 5(i and j). The document is treated as a legal dispensation license issued by the DoT of Surakarta City and must be declared at any inspection by a DoT service member.

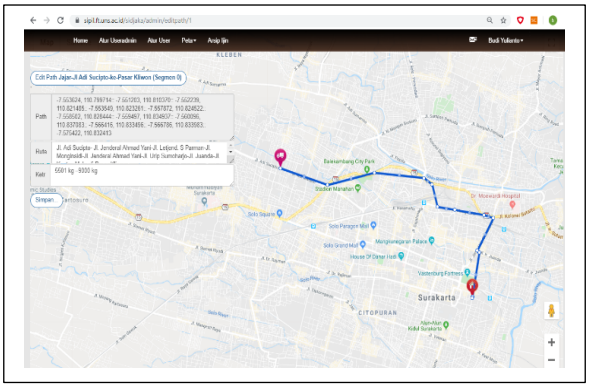

Figure 4. The urban freight transport route from FTCP-Jajar to Pasar Kliwon on the Google map.

4. Implementation of the SIMABA Application

The SIMABA application, as a digital dispensation licensing system, has been adopted by the Surakarta City Transportation Agency and implemented under the name SIDJAKA application (see Figure 6), which is accessible via the Google Play Store. Prior to its operational implementation, the regulatory provisions governing freight transport dispensation licenses on urban roads were formally established through applicable legislation, providing a clear legal framework for the system's implementation [21].

To identify movement patterns of urban freight vehicles along dispensation routes, all license applications submitted through the SIDJAKA application were collected and comprehensively analyzed. The application automatically stores application records within its database dashboard, generating systematic and structured information. The analyzed dataset covers the period from 1 January 2020 to 31 December 2025, enabling longitudinal observation of trends and dynamics in dispensation license applications. A monthly summary of urban freight dispensation permits during this period is presented in Table 2.

The decline in the number of urban freight dispensation licenses during the 2020–2025 period reflects the increasing effectiveness of freight transport control in Surakarta City. Through the SIDJAKA digital licensing system, monitoring and verification of license applications are conducted in a systematic and transparent manner. The system filters freight vehicles that do not meet administrative and technical requirements, particularly those with invalid vehicle roadworthiness certificates, thereby preventing them from obtaining dispensation licenses. These findings confirm that the SIDJAKA application functions effectively in ensuring regulatory compliance and controlling urban freight transport operations in accordance with prevailing regulations.

Figure 5. User interface of the SIMABA Application

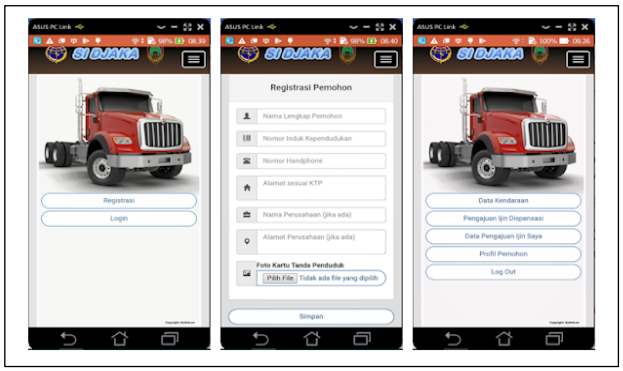

Figure 6. SIDJAKA application

Table 2. Number of dispensation license

Year	2020	2021	2022	2023	2024	2025
Month	Number of dispensation license					
January	779	1,009	893	685	735	590
February	953	991	886	626	621	604
March	976	1,047	1,050	726	586	542
April	749	1,203	874	471	539	520
May	515	907	754	689	590	553
June	740	982	840	595	541	626
July	938	745	789	641	656	648
August	1,174	928	857	644	538	622
September	1,074	929	695	571	579	675
October	1,163	809	708	699	588	706
November	1,085	913	643	639	529	523
December	1,020	851	589	595	613	629
Total	11,166	11,314	9,578	7,581	7,115	7,238

The analysis of freight transport trip origin patterns indicates that freight transport movement in Surakarta City is strongly influenced by changes in the road network resulting from infrastructure development (see Table 3). During the 2020–2021 period, freight transport flows were dominated by the Kolonel Sugiyono Street and Ir. Sutami Street corridors. With the commencement of the Elevated Rail–Underpass 7 Intersections Joglo construction phase (August 2022–December 2024), a significant shift occurred, characterized by a decline in trips originating from Kolonel Sugiyono Street and Adi Sumarmo Street, alongside a sharp increase in freight transport flows from Adi Sucipto Street as the primary alternative route. During this period, trips from Ring Road Street tended to decrease due to changes in accessibility and traffic engineering measures. After the infrastructure became operational in 2025, freight transport movement patterns adjusted again, marked by an increase in flows from Adi Sumarmo Street and a reduced dominance of Adi Sucipto Street, indicating a recovery toward a more balanced road network distribution.

Table 3. Number of dispensation licenses based on trip origin

Trip Origin	2020	2021	2022	2023	2024	2025
FTCP Banyuanyar (Adi Sumarmo Street)	1,068	877	17	27	62	954
FTCP Gemblegan (Yos Sudarso Street)	1,203	1,505	1,915	1,487	1,279	1,515
FTCP Jajar (Adi Sucipto Street)	870	1,401	2,873	3,400	3,402	2,759
FTCP Jurug (Ir. Sutami Street)	2,662	2,605	1,818	1,416	1,300	1,219
FTCP Kadipiro (Kol. Sugiyono Street)	3,811	3,649	2,350	1,114	980	591
FTCP Pasar Jongke (Dr. Radjiman Street)	951	941	454	85	71	67
FTCP Pucang Sawit (Ir. Juanda Street)	39	29	1	1	1	1
FTCP Ring Road (Ring Road Street)	560	287	150	51	20	129

FTCP Semanggi (Kyai Mojo Street)	2	20	0	0	0	3
Total	11,166	11,314	9,578	7,581	7,115	7,238

The analysis of ten freight transport trip destinations indicates that distribution activities in Surakarta City are primarily concentrated in market areas and major commercial corridors (see Table 4). Pasar Legi remained the dominant destination throughout the 2020–2025 period, despite a gradual downward trend. Pasar Gede and Pasar Kliwon experienced fluctuations in trip volumes but continued to serve as significant distribution hubs. Meanwhile, urban corridors such as Dr. Radjiman Street, Yos Sudarso Street, and Veteran Street exhibited more variable movement patterns. The substantial decline in trips to Yos Sudarso Street and Suryopranoto Street by 2025 suggests a reduced contribution of these corridors to the urban freight distribution system. These findings indicate that the SIDJAKA application functions as a data-driven digital licensing system that is adaptive to changes in the road network and the dynamic origin–destination patterns of urban freight transport in Surakarta City.

Table 4. Number of dispensation licenses based on trip destination

Trip Destination	2020	2021	2022	2023	2024	2025	Total
Pasar Legi	4,627	4,218	2,924	1,789	1,672	1,355	16,585
Pasar Gede	797	767	885	819	740	661	4,669
Dr Radjiman Street	408	473	717	652	581	532	3,363
Yos Sudarso Street	507	736	444	278	183	37	2,185
Veteran Street	299	479	469	207	182	113	1,749
Pasar Kliwon	304	370	274	354	433	390	2,125
Gajah Mada Street	307	231	309	203	164	57	1,271
Dewi Sartika Street	311	223	197	167	110	87	1,095
Luwes Nusukan	372	259	49	45	16	13	754
Suryopranoto Street	476	200	15	5	3	4	703

This study identified the main limitations of the urban freight dispensation licensing system in Surakarta City, particularly concerning cross-regional scalability, integration of vehicle technical data, and users' digital literacy readiness. The findings contribute scientifically by demonstrating that the effectiveness of a digital licensing system is determined not only by technology but also by institutional integration, data interoperability, and user capacity. As a future research agenda, developing the system into an integrated cross-regional platform connected with vehicle inspection systems and electronic law enforcement is a crucial prerequisite for achieving adaptive, consistent, and sustainable urban freight transport control.

4. Conclusion

This study demonstrates that the SIMABA application, implemented through the SIDJAKA system, effectively regulates the licensing of freight transport in Surakarta City. Monitoring of this application can be carried out systematically and transparently, ensuring that administrative and technical requirements, particularly vehicle roadworthiness, are met, thus ensuring more controlled urban freight transport. The analysis of origin-destination trips indicates that freight transport flows are significantly influenced by changes in the road network and infrastructure development, with distribution activities remaining concentrated in market areas and major commercial corridors. While effective, the system faces limitations in terms of cross-regional scale, data integration, maintenance systems, and digital user literacy, which may hinder optimal adoption and utilization. As a future research agenda, developing the system into an integrated platform that connects cross-regional licensing, vehicle inspection systems and electronic law enforcement is recommended to achieve greater adaptability and efficiency.

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