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A Comprehensive Review on Enhancing Urban Efficiency in Klang Valley through Smart Sensor-Based Road Management

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ABSTRACT

Optimal urban road management is essential for city governance, yet the deficiencies in existing road banning systems have given rise to a host of issues that pose threats to the overall functionality and safety of urban road networks. These problems manifest as extended queues on crowded roads and an increase in accidents, primarily due to the disorderly parking of freight transports. Despite legislative efforts, urban cities still grapple with persistent challenges, hindering traffic flow and jeopardizing public safety. There's a need for a detailed analysis on the key issues among freight drivers and the effectiveness of phase-out terms in improving the banning system. To address this matter, the paper thoroughly examines information from the most recent literature review. This study is also supported by the transport system authorities as well as road safety experts at the Malaysian Institute of Road Safety Research (MIROS), and public perspectives from netizens. The study focuses on issues with the temporary road banning systems, particularly in the Klang Valley area specified by the Kuala Lumpur Municipality Department (DBKL). Its goal is to reveal insights into current inefficiencies in road management and propose innovative solutions. Additionally, these findings will be used to create smart sensor devices, which have the potential to transform on how urban road traffic bans can be managed. Once in place, these devices are expected to provide data-driven solutions for developing smarter cities.

1. INTRODUCTION

The Klang Valley, nestled in the heart of Kuala Lumpur, Malaysia, is a densely populated urban hub that symbolizes economic prowess and modernity. It features a skyline adorned with sophisticated high-rise infrastructure, exemplifying the city's advancement and contemporary character. The city has become a focal point for individuals seeking abundant technological advancements and lucrative job opportunities, making it an attractive destination for those aspiring to improve their quality of life. However, a noteworthy

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challenge that residents face in the Klang Valley is the issue of traffic congestion, which is exacerbated by the existing freight transportation banning system. Significantly, a substantial portion of the worldwide transportation system, amounting to 39%, hinges on freight movements. This distribution comprises 23% through trucking, 12% via rail transport, and 4% through pipeline transportation, as reported in the Key World Energy Statistics (2020). Traffic congestion poses a universal challenge for both developed and developing nations worldwide. In response to this issue, the Kuala Lumpur Municipality (DBKL) has undertaken several initiatives in recent decades. However, the primary emphasis in these efforts revolves around addressing greenhouse gas emissions to combat global warming and climate change, issues intricately connected with the challenges posed by congestion (Martins-Turner et al., 2020). In recent times, the DBKL introduced restrictions to prevent traffic congestion. Despite these measures, visibility concerns have arisen as drivers frequently violate traffic regulations. This includes operating vehicles during restricted hours, transporting construction materials without proper permits, and driving unclean vehicles on main roads, as reported in an article on the official website of the Kuala Lumpur Municipality.

Urban logistics relies significantly on freight transportation, serving as the optimal coordination and administration of the flow of goods entering, leaving, and circulating within a city. The primary objective of this management is to guarantee optimal service quality, streamline costs, and minimize associated inconveniences. Urban logistics is indispensable for maintaining seamless global transport essential to the harmony and prosperity of metropolitan life and the economy. It involves three critical components: the exchange of goods throughout the entire metropolitan trade network, logistics related to household purchase behavior, encompassing tasks like garbage hauling, specific requirements of public services, relocations, home deliveries, and postal services. Hence, there is a perceived significance in investigating both the patterns of freight activity and the corresponding infrastructure needs and solutions. This review paper intends to delve deeply into the temporary road banning system for freight transportation in the Klang Valley. It aims to illuminate the lack of structure in manual road banning, the abrupt and uncoordinated closures of intersections, and the mounting traffic congestion that affects this dynamic city. The primary goals of this study are to examine inefficiencies in freight logistics and evaluate the traffic externalities associated with road banning. Additionally, the study aims to provide insights for the proposed intelligent road banning sensor system. These objectives stem from the identified gap in literature evidence and the ongoing trends in traffic management and smart sensor technologies, emphasizing the improvement of both freight operations and the mitigation of traffic congestion in the diverse geographical context of Kuala Lumpur.

2. LITERATURE REVIEW

Drawing from prior research, inefficiencies in the freight system are categorized into four main areas: (i) long-distance transportation, (ii) local delivery solutions, (iii) Inventory management in distribution and (iv) litigations related to freight transport (Sahu et al., 2022). A separate study discovered that the operations related to freight impact factors such as accessibility, congestion, ecological effects (with variations in pollution and energy consumption), and street safety (Moufad & Jawab, 2019). In another review, the recommendation for addressing traffic noise resulting from road transport involves a combination of general and specific measures. The primary solution to environmental issues is highlighted as the enforcement of strict pollution standards on vehicles, emphasizing that relying solely on general measures may not bring about a significant reduction in road mobility (Gent, H. & Rietveld, P., 1993). Furthermore, research emphasizes the need to adopt a road safety approach for all road users, incorporating proper transportation planning and land use to curb or reverse the increasing trend in global road traffic fatalities (Jahangiri et al., 2015).

Transportation authorities should implement mitigation measures and employ tools to address the environmental impact of road infrastructure. They should also devise innovative methods to alleviate traffic

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congestion, as noted by Rivera (2021). Environmental studies emphasize the importance of mass-transit ridership, underscoring the significance of alternative transportation modes, particularly during temporary driving bans. This approach not only reduces incidents of road kills but also plays a crucial role in preventing loss of life, as highlighted by Křivda et al. (2020). Additional researchers stress the significance of discerning if issues in road safety arise mainly from user negligence or are significantly influenced by inadequately designed turbo roundabouts and overall infrastructure. Studies investigating the regulation of temporal road bans put forward a range of strategies, covering temporary traffic control, restrictions on transportation based on vehicle number plates, off-road limitations during peak hours, regulated hours for freight transportation operations, and a total ban on vehicles.

While such an approach may work for special occasions, over the long term, it gives rise to social and economic crises that can lead to failures under normal conditions. The intelligent system holds substantial potential and the ability to optimize transportation systems, ensuring efficiency, safety, smart functionality, reliability, and sustainability. Considerable attention and research efforts have been devoted to intelligent traffic systems, with the primary goal of delivering seamless solutions to alleviate congestion, the regulation of traffic through route banning has been a relatively underexplored and minimally studied aspect. This this study further supported with patent search conducted by researcher (lens.org) justified research over road banning system indeed a vital aspect, as illustrated in Fig. 1. It clearly indicates that studies related to road banning and system development as solution provider has been mostly discussed and patents in recent years.

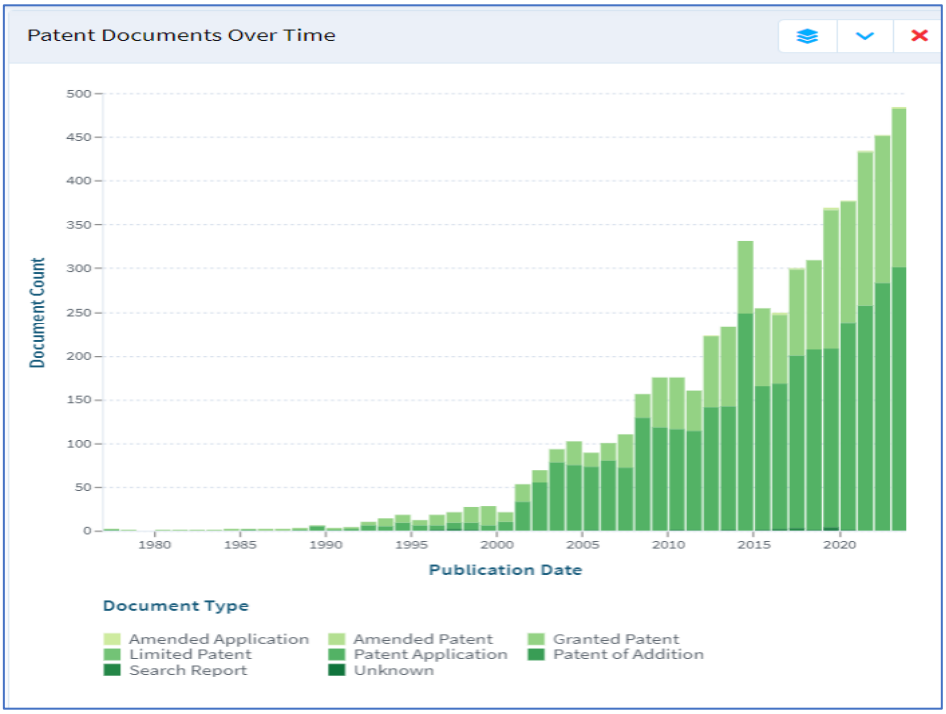

Fig 1. Simplified Patent Search on “Road Banning System” (http://lens.org/)

Therefore, implementing innovative strategies, including compliance with road transport policies, fleet renewal, promotion of public transportation, and improvement of urban traffic speed, has a substantial

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impact on reducing emissions and fuel consumption from a technical perspective, as outlined in Table 1. These identified factors will play a crucial role in establishing the foundational elements upon which the development of survey variables will be built.

Table 1. Identified Influential Factors Road Banning Issues

Type: *Low value, Bulk Freight, Medium Value, Medium Density Freight, B2B Freight for Intermediaries, B2C Freight for End-Consumers*				
Characteristics*: Building Materials, Goods for light industry, Shipments for receivers (e.g., retailer), Shipments for urban residents (e-Commerce)*				
Goods vehicle type: *Heavy duty Vehicle (HDVs), Medium-Duty Vehicle (MDVs), Light- Duty Vehicle (LDVs), Two-Wheelers*				
Crucial Urban Development: *Building infrastructure, supply-chain, retail, and service sector and crucial for customer satisfaction*				
Issue	**Factor**	**Road Banning Issues**	**Traffic Light Concern**	**Need of Intelligent System**
Setup Plan infrastructure	Planning and Accessibility	Impact of location of platform delivery	Suboptimal Traffic Signals: Fixed timing Reduced flexibility: restricted adjustability Lack of priority: priority challenges Intersection coordination: traffic complexity Limitation on analysis: lack of current research Maintenance oversight	High cost of development Need of feasibility (technical and economic) study
	Road Capacity	Adaptation of supply and demand		
	Service Performance	Goods delivery vs. time		
Road Banning	Congestion	Density of delivery and pickup in urban		Inductive loop detectors use of RFID to determine information such as traffic flow, speed, vehicle types, GPS for analysis congestion behaviour
		Inconsistent Time range		
		Variance of delivery location		
		Long hours of stop time		
		Delay of delivery		
		Spawl peak		
		Upload/Unloading average distance loss of hours		
		Sudden diversion		
		Unfamiliar Route		
		Manual notification notice board		
Road-kills	Road Safety	Raising number of accidents related to freight vehicle on urban road		IoT-enable sensor to monitor in real-time, Virtual track system monitoring, Intelligent speed adaption monitoring
		Lack of parking space during peak hours		
		Lack of speed control points in urban area		
		Number of infractions		
		Mechanical condition of vehicle		
		Inefficiency in managing driver time		
		Lack of system integration		
		Noise		
		Gas emission		
		Mental distraction		
Driver	Emotion	Stress		Use of trip-based traffic simulator
		Computer illiterate		
		Summons collection		
		High Commitment		
		Unhealthy mindset		

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The strategic interplay of planning and accessibility underscores commitment to thoughtfully positioning delivery hubs for accessibility to urban centers and integrated transportation networks. Road Capacity holds a central role, with a nuanced understanding of traffic conditions and road infrastructure to guarantee the seamless flow of goods. Recognizing the intricate impact of location on platform delivery, the plan prioritizes proximity to target markets, urban planning considerations, and logistical efficiencies. The adaptation of supply and demand is a linchpin, reflecting our commitment to a dynamic and responsive system capable of navigating varying market dynamics (Sumalee & Ho, 2018). Furthermore, the intricate consideration of goods delivery vs. time is central to our service performance, wherein we address road banning issues, optimize delivery schedules, and implement efficient routing strategies to ensure timely and reliable deliveries (Ameli et al., 2020). This setup plan, informed by comprehensive literature review findings, is intricately designed to navigate these critical elements, solidifying our foundation for a robust and adaptable platform delivery infrastructure.

Besides that, findings from the road banning and congestion, several crucial findings have emerged, shaping the core considerations for our platform delivery system. The density of delivery and pickup in urban areas stands out as a pivotal factor, necessitating meticulous planning to navigate densely populated zones effectively (Sundralingam S. et al., 2023). Addressing the inconsistency in time ranges demands a refined scheduling approach to optimize operational efficiency. The variance in delivery locations underscores the need for adaptive routing strategies to accommodate the diverse destinations within urban landscapes. Prolonged stop times, coupled with delivery delays, highlight the urgency of streamlining loading and unloading processes for enhanced efficiency (Attalla, S. M. et al.,2021). The concept of spawl peak, representing peak delivery times, requires innovative solutions to manage congestion during periods of high demand effectively. Additionally, optimizing the upload/unloading distance loss of hours emphasizes the significance of route planning to minimize travel times. Challenges such as sudden diversions and unfamiliar routes necessitate real-time adaptability and GPS-guided navigation (Trecozzi et al., 2022). The introduction of manual notification notice boards serves as a potential solution for promptly communicating critical information to drivers. These findings collectively inform the infrastructure setup plan, focusing on adaptive measures and innovative technologies to enhance the resilience and efficiency of the platform delivery system in urban environments marked by road banning and congestion.

In the realm of road safety, a few main factors are found on critical issues concerning road kills, particularly in the context of freight vehicles on urban roads. Several pressing concerns have surfaced, shaping our focus on enhancing safety measures. The escalating number of accidents involving freight vehicles in urban areas is a matter of paramount concern, necessitating proactive strategies for accident prevention. The dearth of parking spaces during peak hours amplifies safety risks, requiring comprehensive urban planning solutions to alleviate congestion and enhance safety (Ameli M. et al., 2020). Inadequate speed control points within urban areas contribute to the rising accident rates, emphasizing the need for strategic implementation of speed management measures. The prevalence of infractions poses a significant challenge, warranting rigorous enforcement mechanisms to ensure compliance with safety regulations (Wu et al., 2010). The mechanical condition of vehicles emerges as a critical factor, demanding stringent maintenance standards to prevent accidents arising from mechanical failures. Inefficiencies in managing driver time further exacerbate safety risks, underscoring the importance of streamlined scheduling and efficient route planning. The lack of system integration compounds safety challenges, necessitating a holistic approach to integrate technologies and enhance overall safety coordination (Prabha et al., 2014). Beyond accidents, noise and gas emissions from freight vehicles contribute to environmental and health concerns, necessitating sustainable practices. Additionally, the mental distraction of drivers poses a significant risk, necessitating measures to address driver focus and attention. The infrastructure setup plan is meticulously designed to address these multifaceted safety concerns, incorporating comprehensive measures to mitigate accidents, enhance vehicle maintenance, and promote overall safety and sustainability in urban freight transportation (Pani, A. et al., 2021).

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Within the realm of freight transportation, drivers often grapple with computer literacy challenges that extend beyond mere technological inefficiency. When drivers overlook critical messages or remain unaware of new posts and timing adjustments on highlighted routes, the consequences can be far-reaching, contributing to a cascade of issues (Trecozzi et al., 2022). In an industry where adherence to regulations and real-time updates is paramount, a lack of effective engagement with digital systems can lead to unintentional violations and, subsequently, summons. The cognitive load of managing physical aspects of freight transportation alongside navigating digital tools places a considerable burden on drivers, impacting their mental well-being (Kujawski & Nürnberg, 2023). The fear of unknowingly accumulating violations and the frustration of grappling with unfamiliar technology collectively contribute to heightened stress levels. Addressing these computer literacy challenges necessitates a comprehensive approach, encompassing targeted training programs, user-friendly interfaces, and effective communication strategies. Recognizing the impact of computer literacy on mental well-being is crucial for fostering a supportive environment within the freight transportation industry, ultimately contributing to the safety and mental health of drivers on the road (El Ouadi et al., 2022).

These factors are positioned to act as the essential components for constructing survey variables. The advancement of this less-explored research not only highlights the current gap in the literature but also underscores the crucial role of this study in propelling forward an improved intelligent banning system for a safer freight transport delivery system. Consequently, the literature review combines various models, extracting factors pertinent to the inefficiencies of road banning in relation to driver behavior. It further underscores the imperative need for an intelligent system to augment overall road safety. The identified factors serve as the foundational elements pivotal to the meticulous development of survey variables in our research initiative. This exploration addresses a significant gap in existing literature, drawing attention to the underexplored realm of freight transport delivery safety. The study's significance lies in its approach towards the development of an intelligent banning system, a critical component for fostering a safer and more efficient freight transport delivery system. Through a comprehensive literature review, various models are synthesized, elucidating factors relevant to the inefficiencies in current road banning practices. This synthesis extends from scrutinizing driver behavior to articulating the imperative need for an intelligent system, forming the basis for our research methodology.

The survey, a key component of this study, will be designed to yield invaluable insights that will not only inform the development of a prototype sensor system but also contribute substantially to understanding user behavior. The culmination of these insights will have a profound impact on road safety management, as the prototype sensor system aims to be a pioneering solution in mitigating risks associated with freight transport. Furthermore, the integration of such advanced sensor systems holds the potential to contribute significantly to environmental sustainability. By enhancing the efficiency of freight transport, the proposed system can lead to reduced traffic congestion and, consequently, lower vehicular emissions, contributing to cleaner air and aligning with broader goals of environmental conservation. Thus, our research endeavors extend beyond immediate safety concerns to encompass a holistic approach that integrates technological innovation with environmental stewardship.

3. METHOD

The research methodology section assumes a paramount role in our scholarly inquiry, intricately weaving together a systematic approach to planning, executing, and articulating the findings of the study, augmented by the incorporation of smart literature review practices. The initial phase, helmed by the first author, involves the formulation and refinement of research questions. These queries are meticulously crafted to address contemporary challenges inherent in the domain of freight transportation, specifically homing in on the design intricacies of the prevailing manual road banning system. A distinctive aspect of our methodology is the infusion of smart literature review elements at this stage, wherein advanced search

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techniques, such as leveraging artificial intelligence algorithms and citation analysis, guide the formulation of research questions by identifying gaps and trends within the existing body of knowledge. Subsequently, the second author undertakes an exhaustive literature search across diverse databases, utilizing smart review techniques to streamline the process and enhance the relevance of the identified literature. By employing intelligent algorithms and data-mining approaches, literature search not only expedites the extraction of pertinent information but also ensures a comprehensive understanding of the current state of knowledge. This integration of smart literature review practices significantly enriches the contextual landscape, allowing for a nuanced analysis of the identified challenges and informing subsequent phases of our research. As emphasized earlier, this research paper differentiates itself from a conventional literature review by opting for a systematic literature review (SLR). The rationale for this choice arises from the heightened scientific rigor provided by the SLR, characterized by a well-defined search methodology and stringent evaluation criteria—features frequently lacking in traditional literature reviews. Furthermore, the application of an SLR substantially reduces the chances of overlooking pertinent articles, setting it apart from the potential gaps in coverage that might occur in a traditional literature review (Zhankaziev, S et al., 2018).

Moreover, Azhar, D. et al. (2012) highlighted three essential considerations for the selection and implementation of a systematic literature review: (i) it provides a systematic and thorough methodology for consolidating the available evidence on treatments, technologies, or a particular subject, serving as an invaluable instrument for aggregating empirical insights. This is evident in its ability to assess both the advantages and limitations, as demonstrated in the evaluation of agile methodologies, (ii) it stands out in identifying gaps within the existing body of research, thereby providing valuable guidance for future investigations and studies. Additionally, these reviews not only provide a structured framework but also (iii) establish a contextual foundation for emerging research initiatives. They facilitate the seamless integration of new studies into the broader realm of existing knowledge, thereby making a significant contribution to the advancement of the field (Gao et al., 2019). Culminating in the synthesis of accumulated knowledge, the authors collaboratively compile and present the findings in a meticulous and comprehensive report. This report serves not only as a testament to the outcomes of our investigation but also as a blueprint illuminating the proposed intelligent road banning sensor system. Through the infusion of smart literature review elements at every stage, our research methodology not only establishes a robust framework but also exemplifies a commitment to leveraging cutting-edge techniques for advancing the intellectual rigor and coherence of our scholarly pursuit.

3.1 Research questions (RQs)

The primary objective of this academic inquiry was to systematically examine the intricate interrelationships stemming from an in-depth investigation into inefficiencies within the domain of freight logistics and the ensuing traffic externalities resulting from the imposition of road banning measures. This study aimed to attain comprehensive insights into the ramifications associated with road banning practices, with a specific emphasis on the potential integration of an intelligent road banning sensor system. To methodically guide the research process, the study meticulously formulated specific research questions, each tailored to elucidate distinct facets of the complex interplay between traffic externalities, freight transport dynamics, and the efficacy of measures involving the restriction or prohibition of road use. The research questions outlined were as follows: (i) What is the correlation between traffic externalities and freight transport? (ii) How does road banning negatively affect traffic? (iii) What are the main issues and limitations with current road banning management.?

The first research question aimed at establishing a thorough understanding of the relationship between traffic externalities and the intricate network of freight transport operations. By delving into the multifaceted dynamics inherent in this relationship, the study endeavored to unravel the complex connections between the externalities generated by traffic and their implications for the efficient functioning of freight logistics systems. The second research question focused on a detailed scrutiny of the

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adverse impacts of road banning on traffic dynamics. Through this line of inquiry, the study sought to explicate the challenges and inefficiencies arising from current road banning practices, shedding light on their repercussions for both traffic flow and the broader infrastructure of freight transport. The third and final research question centered on the exploration of the real issue and limitation freight transportation management face and to suggest potential role of an intelligent road banning sensor system which serves as next phase of this study. This inquiry aimed to discern the feasibility and effectiveness of integrating advanced sensor technologies to optimize road banning procedures, thereby enhancing the overall efficiency and safety of freight transport systems. The formulation of these research questions served as a methodological compass, systematically guiding the investigation and analysis of the complex interdependencies inherent in the nexus of freight logistics, traffic externalities, and road banning practices within an academic framework.

3.2 Defining research strategy

The review's targeted search strategy was methodically constructed, entailing a systematic and thorough identification of the pertinent population, judicious selection of relevant resources, formulation of meticulously crafted search queries, and the establishment of clearly delineated inclusion and exclusion criteria. The process of selecting search terms was thoughtfully guided by the research questions and subjected to rigorous verification to ensure alignment with the overarching research objectives, as elucidated in Table 2. The designated search string, as articulated in Table 3, was strategically deployed for comprehensive searches across five specified online databases. This methodological approach involved the adept application of Boolean operators, meticulously designed to precisely pinpoint primary articles essential for contributing substantively to the study's research objectives. The structured and deliberate nature of the search strategy reflects a commitment to exhaustively survey the existing literature, while upholding the standards of precision and relevance necessary for the acquisition of pertinent information in support of the review's academic rigor.

Table 2. Search keywords

Sensor Based Light Control	Strategy, and Characteristics
Traffic management	Approach, and outcomes.
Dynamic Sensor Network	Self-adaptive and self-organizing
Sensory intelligent system	Smart sensor, and management

Table 3. Search string

Primary search query
["Sensor Control" OR "Road Traffic Management" OR "Adaptive sensor system" OR "Intelligent sensor system" OR "Self-organizing road traffic information]"

3.3 Carrying out review procedure

In undertaking the practical execution of the systematic review, a methodological framework grounded in the established guidelines was diligently followed. This section outlines the systematic and transparent approach guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations. The adherence to PRISMA guidelines was integral to ensuring methodological rigor and enhancing the overall transparency of the review process. The structured and evidence-based nature of PRISMA serves as a robust foundation for conducting systematic reviews and meta-analyses, offering a comprehensive checklist to facilitate the clear reporting of key elements. The

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initiation of the review process involved the meticulous implementation of the established protocol, as elucidated in Fig. 2. The systematic execution of the review process, guided by the PRISMA framework, thus underscored a commitment to methodological excellence and the production of robust, evidence-based insights.

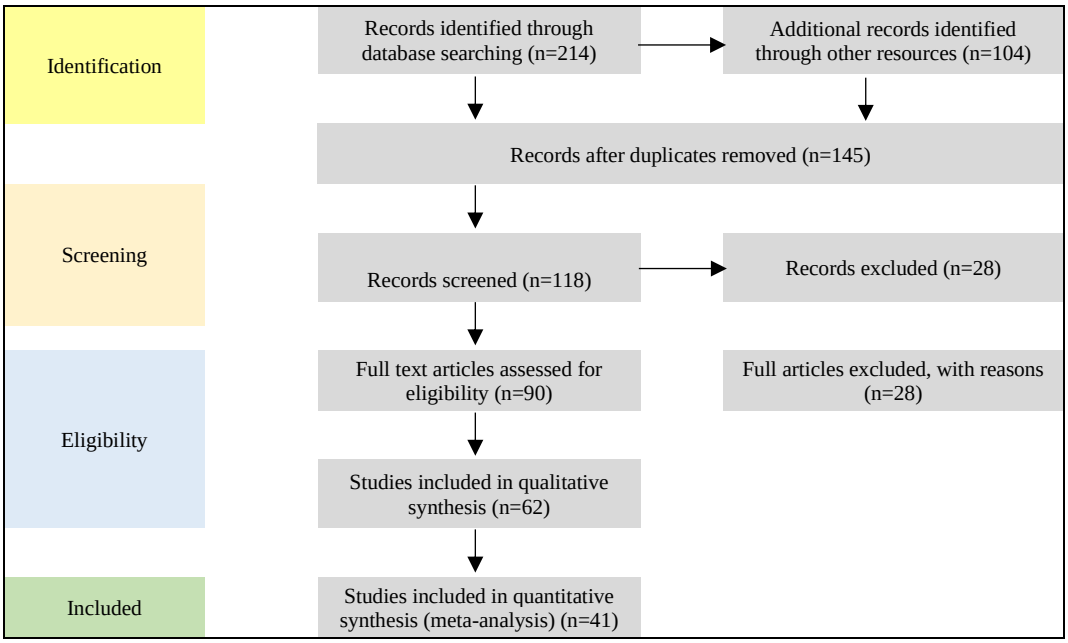

Fig 2. Research Strategy

This protocol served as a roadmap, delineating the procedural steps essential for conducting a thorough and systematic review. To commence, a pilot search for relevant research was conducted, marking the preliminary phase of information gathering. This initial exploration aimed to refine search strategies, identify potential challenges, and ensure the comprehensive coverage of the topic under investigation. Subsequently, a judicious selection of studies was undertaken, adhering to the predefined inclusion and exclusion criteria outlined in the PRISMA guidelines. This discerning approach ensured that the chosen studies were pertinent to the research questions and met the predetermined criteria for methodological quality.

4. RESEARCH FINDINGS

This section succinctly summarizes and discusses the responses to the research questions. In addressing each research question, we utilized pertinent articles sourced from the data extraction form, as outlined in Table 3. This study meticulously carried out a Systematic Literature Review (SLR), strictly following provided guidelines. The approach involved a comprehensive search across diverse databases, employing predefined keywords to extract pertinent research materials. The primary goal was to delve into the relationship between traffic externalities and freight transport, specifically addressing three key research objectives: (i) the adverse effects of road banning on freight transportation, (ii) the impact of road banning towards traffic congestion in Klang Valley, and (iii) main issues and limitation with current road banning management.

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This study examined the current state of researchers and was conducted over the period spanning 2018 to 2022. Out of a total of 145 papers, 39 were carefully chosen, as illustrated in Fig. 2. Regarding research question 2 (RQ 2): How does road banning negatively affect traffic? The focus of the research was on identifying the most extensively researched topic in road safety by researchers. Table 4 presents the findings, categorizing these topics into three distinct groups. Among the 39 papers examined, 14 employed a conventional design approach, whereas 16 were classified as utilizing a smart design technique. Furthermore, among the 39 researchers, 9 have placed primary emphasis on self-organizing and adaptive design methodologies. Regarding research question 3 (RQ3): What are the main issues and limitations with current road banning management? This research is fundamentally dedicated to identifying and addressing contemporary shortcomings and gaps within the prevailing academic discourse.

However, the conventional method of paper examination proved inadequate in addressing specific shortcomings and weaknesses that were recognized, including: i) implementing road diversions to optimize time efficiency., ii) enhancing the usability of sensors for drivers to anticipate road closures before reaching their destination, and iii) prioritizing driver information to assess safety measures and receive crucial vehicle input. Despite the intelligent design approach presented in the reviewed paper, several flaws were identified, including: i) lack of a dynamic time interval, ii) insufficient learning capacity, iii) Inadequate prioritization of emergencies, and iv) limited intelligent features. Nevertheless, the collected and reviewed papers addressing self-organizing and adaptive methodologies exhibited the following shortcomings: i) reliance on manual dynamic time intervals, ii) lack of alternative route information., iii) inadequate provision of driver information, and iv) insufficient integration of smart features.

Table 4. Studies relevant to research questions

RQ No.	No of Studies
RQ 1	[2]
RQ 2	[14]
RQ 3	[20]

Table 5. Summary of RQ 3 findings

Approach	Articles	Offered Features			
		Flexi time	Road Diversion	Learning ability	Intelligent features
Conventional	[3]-[7]	No	Yes	No	No
	[10][12]	No	No	No	No
	[15]	Yes	Yes	No	No
Self-organizing and adaptive Intelligent Road Banning Design	[14][17]	No	No	Yes	No
	[18][19]	No	Yes	No	No
	[21][23]	No	Yes	No	Yes
	[24][25]	No	No	No	No
	[26][22]	No	Yes	Yes	Yes

4.1 Research Discussion

Despite reviewing several papers, none have fully examined the following key areas related to improving urban freight transportation: i) manual dynamic time intervals: the current systems rely on manual adjustments of time intervals which can be improved with more automated solutions., ii) lack of alternative route information: there is a need for providing real-time alternate routes to help drivers avoid traffic congestion and delays., iii) inadequate driver information provision: current systems do not provide sufficient information to drivers regarding road bans or other restrictions, leading to confusion and potential violations., and iv) insufficient integration of smart features: existing systems lack seamless integration of

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smart features designed to ease the communication of road ban information to drivers well in advance. As a result, this paper analyzed most of the available research work on freight transportation and road banning control architecture. Over the last 20 years, extensive research has focused on examining the traditional design methodology. After many years of investigation and analysis, there is now a comprehensive grasp of its fundamentals and uses, resulting in numerous significant findings. However, several areas for improvement have been identified within this approach, including: i) the lack of automatic adjustment of time intervals; ii) insufficient provision of alternatives routes information; iii) deficiencies in supplying drivers with necessary information; and iv) ineffective incorporation of intelligent features.

Consequently, adaptive self-organization models were tested, analyzed, and compared in this study. This study undertook a comprehensive analysis of existing research on freight transportation and road banning control architecture, with a specific focus on addressing critical safety concerns and deficiencies within the current system. The findings underscore a notable gap in the literature, as none of the examined papers thoroughly explored the designated criteria essential for ensuring safety and efficiency in urban freight transportation. These criteria include i) non-dynamic time intervals determined manually, ii) lack of availability of alternate route details, iii) inadequate supply of driver information, and iv) limited integration of intelligent features to support proactive alerts for drivers regarding upcoming road conditions. The absence of a holistic consideration of these criteria within the reviewed literature has significant implications for the safety and operational efficacy of road banning measures for freight transport. The identified gaps highlight the need for an optimal solution that addresses these specific challenges. Notably, the lack of attention to manual dynamic time intervals and the absence of alternative route information poses inherent risks to both drivers and road users. Furthermore, the deficiency in providing drivers with timely information exacerbates safety concerns and contributes to operational inefficiencies. To further justify these findings, Fig. 3 illustrates research and novelty patented particularly related to studies related to road banning and system development. It shows that, in recent times this study became an important aspect despite the initiatives developed by government globally. Subsequently, these findings showed the imperative need for a solution that could ease logistic management and ultimately reduce road accidents that are caused by freight transport. The goal of this study is therefore to prove the need to further the study in the planned directions by the researcher and her team.

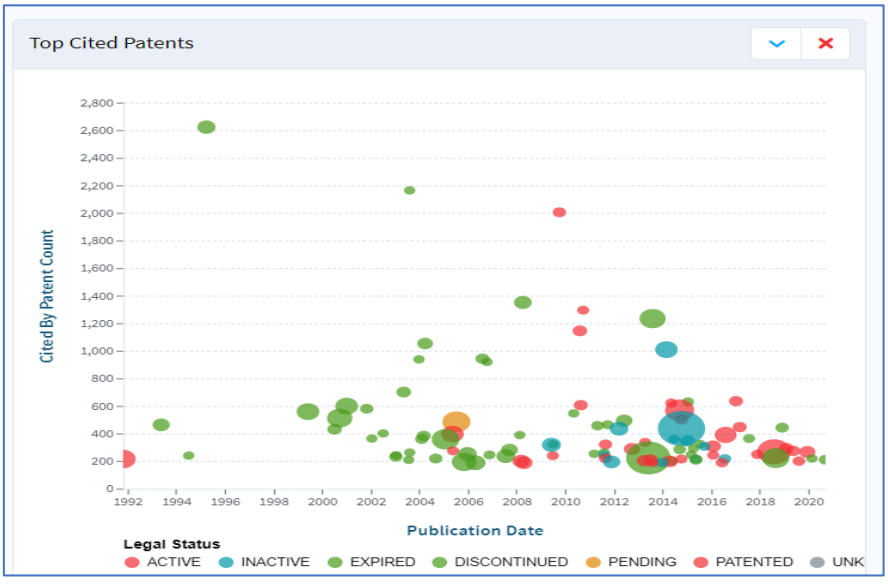

Fig 3. Most cited patents on Road Banning System extracted from (http://lens.org/)

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In response to these shortcomings, this paper advocates for the exploration and implementation of adaptive self-organization models. These models were rigorously tested, analyzed, and compared in the study, aiming to offer innovative solutions to the identified deficiencies. By addressing the limitations of the conventional design approach, particularly the lack of manual dynamic time intervals, absence of alternative route information, inadequate driver information provision, and insufficient integration of smart features, adaptive self-organization models present a promising avenue for enhancing safety and efficiency in urban freight transportation. The results of this analysis contribute valuable insights that can guide the development of advanced road banning systems with sensor aided mechanisms, ultimately fostering safer and more streamlined freight transport operations in urban environments. The article under examination falls short in two areas regarding intelligent transportation solutions for traffic violation enforcement: firstly, it fails to provide sufficient driver-related information; secondly, there is insufficient integration of smart functionalities, resulting in a less than optimal intelligent system. Numerous intelligent design approach papers neglect addressing solutions for traffic management during road closures and implementing smart tire technologies, contrary to their stated claims.

4.2 Discussion and Conclusion

The primary goal of this research was to actively conduct a systematic and comprehensive literature review covering the years 2018 to 2022. The focus was on exploring prominent techniques outlined in a carefully selected collection of research articles and other reviews. Specifically, the aim was to discern and analyze the innovative methodologies and technologies proposed within the identified literature, thereby contributing to a refined understanding of intelligent systems in the context of road banning traffic control design. This systematic literature review sought to serve as a repository of knowledge, providing researchers and practitioners with valuable insights, recommendations, and potential solutions to address the evolving challenges in road traffic and congestion management.

The primary goals of this review were twofold: first, to critically examine and synthesize the diverse approaches adopted in the design of intelligent systems for road banning traffic control, and second, to distill practical recommendations and solutions that can inform the development and enhancement of road traffic management strategies. The systematic exploration was conducted with meticulous attention to detail, emphasizing the identification of emerging trends and the evaluation of the effectiveness of various methodologies proposed in the literature. By delving into the wealth of research articles, the study aimed to elucidate the current landscape of intelligent systems applied to road banning, offering a comprehensive overview of innovative ideas and technological advancements.

The research methodology was anchored in a systematic and rigorous process involving the meticulous preparation, execution, and subsequent reporting of findings. The review process encompassed a judicious selection of pertinent articles, application of predefined inclusion and exclusion criteria, and a thorough analysis of the identified literature to distill key insights. Despite the comprehensive nature of the review, the results highlighted a conspicuous gap in the establishment of a definitive design for intelligent systems capable of effectively sensing traffic dynamics and providing adept solutions. This insight serves as a critical foundation for future research endeavors, signaling the need for continued innovation and refinement in the realm of road banning traffic control design to address the persistent challenges associated with urban congestion and traffic management.

4.3 Limitations

This section recognizes the continuous nature of research and aims to address the study's limitations and constraints, which may have impacted its results. By doing so, we hope to promote transparency and encourage future investigations by other researchers in this field. In emphasizing the dynamic aspect of research, this section outlines the study's limitations and restrictions, which might have influenced the outcomes. Our goal is to ensure transparency while inspiring additional exploration from scholars who

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share our interests. In this effort, we thoroughly searched several databases including ScienceDirect, Scopus, Web of Science, Emerald, and Google Scholar, restricting our search to English-language publications. As such, it's crucial to acknowledge that limiting our review to English-language sources might have led to the overlook of relevant studies published in other languages. According to the comprehensive literature review, there is a pressing need for more studies in freight transportation and smart traffic light control that prohibits certain vehicles. Specifically, the research highlights a significant lack of progress in creating advanced sensors for these systems that have intelligent features and learning abilities. The SLR emphasizes the crucial requirement for additional investigation into freight transportation and the regulation of traffic lights to restrict specific types of vehicles. A key takeaway from the study is the glaring absence of advancements in developing intelligent sensing technology with smart functions and learning capacities for such systems. Moreover, the study identifies a significant lack of current research focused on developing new solutions to alleviate traffic congestion. As such, we encourage and invite researchers to join us in our ongoing study, working together to fill these crucial gaps exist in the field, and the Internet of Things (IoT) and machine learning (ML) have assumed pivotal roles in addressing a diverse array of real-world challenges. Therefore, current road blocking systems require cutting-edge design methods that include essential features such as: i) utilizing machine learning algorithms to accurately detect and analyze objects or vehicles; ii) dynamically optimizing wait times for both pedestrians and vehicles through efficient management, leading to improved road productivity and reduced traffic congestion; iii) providing an automated diversion feature for freight drivers during peak hours or in case of emergencies; and iv) enabling road users and drivers to understand and gain valuable insights from collected data using user-friendly interfaces and tools.

5. CONCLUSION

Over the last two decades, the primary focus of extensive research has remained largely tied to traditional design methodologies in the study of congestion mitigation strategies through road banning measures. This prolonged examination has brought to light a series of conspicuous limitations that impede the effectiveness of such systems. These limitations encompass the absence of i) lack of manual adjustment for dynamic timing intervals, ii) absence of options for alternate routes, iii) insufficient provision of relevant driver information., and iv) poor integration of smart features leading to a disjointed user experience. Despite the comprehensive scrutiny of papers focusing on adaptive self-organization approaches also showed limitations, particularly the absence of certain aspects: i) providing information to both drivers and traffic controllers, and ii) integration of intelligent features. Unfortunately, the adaptive self-organization models did not fully address the complex issues surrounding the design of traffic-free road systems. These models primarily concentrated on modifying user behavior, without adequately considering other crucial factors such as policy adaptation in low-income countries, incorporating multi-modal transportation alternatives, and promoting holistic approaches encompassing pre-crash, crash, and post-crash interventions. Furthermore, the articles that delved into the intelligent design approach, contrary to expectations, revealed a lack of requisite learning capabilities and intelligent attributes. Consequently, the proposed systems frequently fall short in accommodating the complexities of real-world traffic conditions. These circumstances include variables such as number of vehicles and pedestrians, as well as delays and waiting times for road users. The collective findings emphasize the need for a paradigm shift in the design and implementation of road banning traffic systems, urging the incorporation of advanced features that address the identified limitations and enhance adaptability to the dynamic nature of urban traffic scenarios. This insight underscores the imperative for innovative solutions that integrate intelligence and learning capabilities to create road banning systems that effectively navigate the intricacies of contemporary traffic challenges.

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7. CONFLITS OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

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