International Journal of Research (IJR)

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 10 Issue 12
December 2023

Battling the Bottlelock: Evaluating Intelligent Traffic Systems in Delhi's Congestion Crisis

Dr. Sapna Dhaliwal

Associate Professor,

Mata Sundri College for Women

University of Delhi, Delhi, India

Email: sapnadhaliwal@ms.du.ac.in

Abstract:

This research paper delves into the critical issue of traffic congestion in Delhi, a city that ranks among the top 10 globally for its severe traffic jams. The study highlights the multifaceted impact of this problem, including increased fuel consumption, time wastage, and heightened traffic congestion, leading to significant economic and social costs. The alarming rise in road traffic fatalities is underscored, emphasizing the urgent need for safer travel and driving conditions in the capital. To address these challenges, the study sets forth several objectives: First of all, it evaluates the public's adaptation to online/electronic traffic management solutions; Secondly, it assess the citizens' perspectives on compliance with traffic regulations for efficient traffic control; Thirdly, it investigates the effectiveness of intelligent traffic management systems in densely populated areas like Delhi; Lastly, it analyzes the real-world applicability and response to advanced traffic management strategies. Through these objectives, the research aims to explore the feasibility and impact of smarter traffic management approaches in alleviating Delhi's congestion woes. The study employs a variety of statistical tools to analyze data collected via Google Forms, offering a comprehensive overview of current practices and public attitudes towards traffic management solutions in Delhi. The ultimate goal is to foster a more efficient, safe, and sustainable traffic environment in the city by evaluating the effectiveness of innovative traffic management techniques and promoting widespread awareness and adoption among the populace.

Keywords: Environmental impact; public health ;traffic;economic costs of congestion; air pollution

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 10 Issue 12
December 2023

1 Introduction:

"Delhi, India's sprawling capital, is a city characterized by its vibrant culture, historical significance, and rapidly growing economy. However, this growth has been accompanied by a significant challenge: traffic congestion. The city's roads are often choked with vehicles, leading to long hours of traffic jams, increased air pollution, and a considerable loss in productivity. Such conditions not only affect the daily lives of millions but also pose a substantial burden on the city's economic and environmental health.

This study begins by contextualizing the problem within the broader framework of urban growth and development in Delhi. It examines the various factors contributing to the city's traffic woes, including rapid urbanization, increase in vehicle ownership, inadequate public transportation infrastructure, and inefficient traffic management systems. The research examines the direct and indirect impacts of traffic congestion, such as heightened fuel consumption, time wastage, and increased road traffic fatalities. These issues not only represent a logistical challenge but also raise significant concerns regarding public health and safety.

Furthermore, the study acknowledges the pressing need for smarter traffic management solutions. It explores various strategies and innovations, both technological and regulatory, that could potentially alleviate the city's traffic congestion. The research focuses on evaluating the effectiveness of intelligent traffic management systems, the public's perception and usage of digital traffic solutions, and the adherence to traffic regulations in Delhi.

In addition to these aspects, the study also conducts a comparative analysis with other major cities around the world facing similar challenges. This comparison aims to glean insights and best practices that could be adapted and implemented in Delhi.

The introduction sets the stage for a comprehensive investigation into the multifaceted issue of traffic congestion in Delhi. It underscores the importance of this study in contributing to the development of more efficient, safe, and sustainable traffic systems in one of the world's most populous cities. By delving into the various dimensions of the problem and exploring potential solutions, 'Navigating the Gridlock' aims to provide valuable insights for policymakers, urban planners, and the public, paving the way for a smoother, more manageable traffic flow in Delhi."

2 RELATED LITERATURE

2.1 INDIAN PERSPECTIVE OF SMART CITIES.

Numerous intelligent traffic control schemes have been put forth in recent studies. While Paunova-Hubenova (2022) focuses on an algorithm for prioritising emergency vehicles,

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 10 Issue 12
December 2023

Dwivedi (2023) proposes an intelligent traffic controller that employs real-time visual processing to manage traffic flow. In order to optimise traffic, Javaid (2018) suggests a system that makes use of the Internet of Things and a decentralised methodology. The system prioritises emergency vehicles and predicts traffic density. In an effort to save time and lower accident rates, Medhat (2018) introduces a smart traffic information system that tracks routes and chooses the least congested one. All of these studies demonstrate how smart technologies can be used to reduce traffic jams and increase safety on the roads.

2.2 Advancements and Challenges in Smart Traffic Management Systems

Numerous studies examine the opportunities and difficulties associated with smart traffic management. In order to improve efficiency and safety, Kathuria (2022) highlights the necessity of a traffic management system that can collect and make use of data from several sources. Both Omar (2020) and Mandal (2019) emphasise the use of technology to improve traffic flow and lessen congestion; Omar suggests a system for monitoring and controlling traffic that is inexpensive, while Mandal suggests a distributed method for real-time traffic analysis. In order to lessen traffic and accidents, Medhat (2018) introduces a smart traffic information system that uses cameras to monitor routes and deliver real-time data. When taken as a whole, these studies demonstrate how effective smart traffic management systems can be in tackling the problems of safety and traffic congestion. As per Ayush,(2022)various traffic management protocols utilising various technologies including Wi-Fi, Artificial Intelligence, Cloud Computing, Radio Frequency Identification(RFID), and other disruptive methods like Internet of Things and data science are examined for Indian traffic circumstances . Both Chavan (2022) and Nitin (2021) emphasise the necessity of better traffic management, with Chavan focusing on the possibilities of technology like RFID, Wi-Fi, and AI. Singh (2019) and Dubey (2020) concentrate on particular applications; Singh suggests an urban vehicle counting system, while Dubey supports an adaptive traffic control system.

2.3 Smart City Initiatives in other countries

On a global scale, several novel strategies for intelligent traffic control have been put forth. Djahel (2015) highlights the potential of social media and smart automobiles for congestion monitoring, underscoring the necessity of strong traffic management systems in smart cities. Both Javaid (2018) and Tiwari (2020) concentrate on leveraging the Internet of Things (IoT) to optimise traffic flow; however, whereas Tiwari's system incorporates real-time data for emergency vehicle prioritisation, Javaid's approach uses decentralised algorithms. A unique intelligent internet-of-vehicles management system based on cloud computing and IoT is introduced by Leng (2011), and it has the potential to greatly enhance road traffic. All of these studies highlight how crucial real-time data and cutting-edge technologies are to solving global traffic issues. Tara Vanlı, Akın Marşap (2018) in order to better understand the relationship between smart project management techniques and

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 10 Issue 12
December 2023

smart city project success in various SC projects located in Europe, a quantitative correlational study was carried out in this article. Based on the analysis, a conceptual framework outlining a comprehensive view of SC project management was proposed.

Though a lot of research on the topic has been done, there are still limited insights into the managerial angle. This paper aims to fill this gap by exploring through a lens of management in order to develop a deeper understanding of Smart traffic management projects.

3.Motivation & Objective of the study

3.1 Motivation for the study

This proposed study aims to address the severe traffic congestion in Delhi, a city ranked among the top ten globally for worst traffic jams. The research focuses on transforming Delhi into a smart city by revolutionizing its traffic management systems. Traditional methods are falling short in managing the dynamic challenges of urban traffic, impacting daily life, environmental sustainability, and economic growth.

The core of the research is to explore the implementation of intelligent or 'smart' digital systems to efficiently manage traffic flow in Delhi. It attempts to examine various smart tools and techniques, assessing their practicality in the unique urban setting of Delhi. An essential part of the study is to evaluate the impact of these technological innovations on the city's residents, focusing on how software advancements can optimize existing systems to reduce congestion and improve overall urban life quality.

Ultimately, the study aims to contribute to developing a smoother, eco-friendly, and economically feasible traffic system in Delhi, offering valuable insights for policy-making and technological strategies in urban planning and smart city projects.

3.2 Objective of the study

- To explore the extent to which residents and commuters in Delhi are adapting to and engaging with online and electronic traffic management systems.
- To assess the perspectives of Delhi's citizens regarding the adherence to traffic rules and regulations.
- To determine the success rate of intelligent traffic management systems in mitigating traffic congestion in Delhi.
- To examine the practical implications and on-ground responses to the implementation of smarter traffic management techniques in Delhi.

4.RESEARCH DESIGN

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 10 Issue 12
December 2023

This study is focused on evaluating the current state of smart traffic management in Delhi and the public's perception of these systems.

Instrument Design: A comprehensive questionnaire, tailored to the study's objectives, serves as the primary data collection tool, ensuring focused and relevant insights.

Data Collection: The survey method targets Delhi's vehicle-owning residents to capture contemporary perspectives on traffic management. This primary data is supplemented with secondary data from existing literature for a comprehensive analysis.

Methodological Approach: A descriptive research methodology is employed, focusing on current traffic management conditions in Delhi. The study aims to describe and explain these conditions, especially how residents perceive and interact with smart traffic systems.

Data Analysis: Hypotheses are tested using Chi-square tests for analysing categorical data and ANOVA for continuous data. These statistical methods, executed via Microsoft Excel, are designed to explore relationships and differences among the data.

Sample Design: The sample includes 80 respondents from Delhi, primarily vehicle owners who regularly commute within the city or to neighbouring areas. Data collection was facilitated through an online survey distributed via WhatsApp, and the responses were systematically organized and analyzed.

This design provides a structured approach to understand the impact and effectiveness of smart traffic management in Delhi, blending primary and secondary data with quantitative analysis techniques.

5.DATA ANALYSIS

5.1 Evaluating Adaptation to Online/Electronic Traffic Management

This section outlines the analysis conducted to understand how individuals are adapting to the online/electronic management of traffic-related processes in Delhi. The analysis was guided by the tools outlined in the research methodology, namely the Chi-square test and ANOVA.

The hypothesis (Ha) being tested posits that handling the online system for filing licenses and challans, as well as carrying electronic documents, is more convenient for younger applicants.

A significance level (α) of .05 was set for the ANOVA test. To facilitate the ANOVA test, the independent variable (age) was treated as categorical, while the responses to the three Likert scale questions (pertaining to E-License and E-Challan) were aggregated to form a continuous variable.

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 10 Issue 12
December 2023

TABLE 1 – Result of Anova Testing pertaining to E-License and E-Challan

ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	802.1266	1	802.1266	542.6176	1.18E-52	3.901761
Within Groups	230.6076	156	1.478254			
Total	1032.734	157				

(Alternate Hypothesis) H_a--- Handling online system of filing for license and challan and carrying electronic documents for same is more convenient for young applicants is accepted because p(1.18E-52)<.05.

There was a statistically significant difference between groups as determined by ONE-WAY ANOVA (F(1,156)=542.6, p=1.18E-52 That means Handling online system of filing for license and challan and carrying electronic documents for same is more convenient for young applicants.

5.2 Objective 2-Assessing Citizens' Perspectives on Traffic Rule Compliance

Objective 2 of the study aims to examine citizens' perspectives on adhering to traffic rules as a measure of effective traffic management. To understand this, we posed several questions to respondents like perception of traffic, response of CCTV surveillance, speed control post -CCTV installation, driving license possession. To analyze the data collected, Chi-square testing was utilized. The primary hypotheses tested were:

Null Hypothesis (H0): Females possess more driving licenses than males.

Alternative Hypothesis (Ha): Females possess fewer driving licenses than males.

A significance level (α) of .05 was set for the hypothesis testing.

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 10 Issue 12
December 2023

TABLE 2- Expected Frequency Table for Driving License and Gender

Count of Do you have your Driving License?			
Frequencies	Male	Female	Grand Total
Yes	29.9625	17.0375	47
No	21.0375	11.9625	33
Grand Total	51	29	80

Expected frequency= Row Total* Column Total/ Grand total

Chi Square formula for calculating p value in Excel is- CHITEST (actual range, expected range).Then the p value= 0.00016<.05 So, Alternate Hypothesis Ha--Females have fewer driving licenses than males is accepted. With critical value=3.84<14.15 so alternate hypothesis is accepted.

So a CHI SQUARE test of independence was performed to examine the relation of having driving license with gender. The relation between these variable was significant, $X^2(1, 80)=14.15$, p=0.00016.

5.3 Objective 3:- Assessing the Success of Intelligent Traffic Management in Delhi

H0--Traffic signals are not considered important for traffic management across the different gender.

Ha--Traffic signals are considered important for traffic management across the different gender.α=.05

TABLE 3- Expected Frequency for traffic rules and Gender

Count of Gender Female-1 Male-2 Transgender-3	Column Labels		
Row Labels	1	2	Grand Total
1	29.9625	21.0375	51
2	15.275	10.725	26
3	1.175	0.825	2
5	0.5875	0.4125	1
Grand Total	47	33	80

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

CHI SQUARE = $\sum(O-E)^2/E$

Chi Square formula for calculating p value in Excel is- CHITEST (actual range, expected range)

Then the p value= 0.0390. So, Alternate Hypothesis Ha--Traffic signals are considered important for traffic management across the different gender is accepted. With critical value=7.81<8.36 so alternate hypothesis is accepted.

So a CHI SQUARE-test of independence was performed to examine the relation of having traffic management with gender. The relation between this variable was significant, $x^{2(}3, 80) = 8.36$ p=0.0390.

OBJECTIVE 4:- Evaluating the Response to Smarter Traffic Management Techniques

Hypothesis framed: - H0- People who follow basic rules of driving does not likely to followsmart techniques in managing traffic.

Ha-- People who follow basic rules of driving are more likely to follow smart techniques inmanaging traffic.

TABLE 4- Expected Frequency for following of traffic rules.

Count of Have you availed for FASTag for your vehicle?	Column labels			
Row Labels	Yes	No	Not yet	Grand Total
1	24.8625	18.4875	7.65	51
2	14.1375	10.5125	4.35	29
Grand Total	39	29	12	80

CHI SQUARE = $\sum(O-E)^2/E$

Chi Square formula for calculating p value in Excel is- CHITEST (actual range, expected range)

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

Then the p value= 0.0140. So, Alternate Hypothesis Ha-- People who follows basic rules of driving are more likely to follow smart techniques in managing traffic is accepted. With critical value=5.99<8.526 so alternate hypothesis is accepted.

So a CHI SQUARE-test of independence was performed to examine the relation of having traffic management with gender. The relation between these variable was significant, $x^{2(}2, 80) = 8.526$ p=0.0140.

Another hypothesis:-

ANOVA test was conducted to test hypothesis- Ha--- People who are scared of CCTV cameras are likely to follow traffic rules more.

As to test Anova to make independent variable continuous three likert statements were summed up of CCTV with α=.05.

Table 5- Table of Anova Testing For CCTV

Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
1	79	112	1.417722	0.246349		
8	79	629	7.962025	5.908796		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1691.703	1	1691.703	549.6874	5.37E-53	3.901761
Within Groups	480.1013	156	3.077572			
Total	2171.804	157				

(Alternate Hypothesis) Ha---People who are scared of CCTV cameras are likely to follow traffic rules more is accepted because p (5.37E-53) <.05.

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 10 Issue 12
December 2023

There was a statistically significant difference between groups as determined by ONE-WAY ANOVA (F (1,156) =549.7, p=5.37E-53. That means people who are scared of CCTV cameras are likely to follow traffic rules more.

6. CONCLUSION & FINDINGS OF THE STUDY:

Through statistical analyses conducted using Excel, the research explored various aspects of traffic management and the role of citizens in mitigating congestion.

The findings underscore the significance of traffic rules adherence and the adoption of smarter traffic management techniques. One of the key insights from the hypothesis testing is the gender disparity in driving license ownership, with females holding fewer licenses than males. This insight opens avenues for further exploration into gender-specific barriers or trends in driving in Delhi.

Moreover, the study reveals that individuals who consistently follow basic driving rules are more inclined to adapt to smarter traffic management methods. This suggests a positive correlation between rule adherence and openness to technological advancements in traffic management. The implementation of systems like FASTag, which has shown potential in easing traffic at toll booths, is a testament to the benefits of smart traffic solutions.

The adoption of online systems for traffic-related processes, such as license applications and challan payments, has been notably more prevalent among younger citizens. This shift towards digital solutions aligns with global trends in traffic management and reflects a growing preference for efficiency and reduced paperwork. The role of CCTV cameras in traffic management emerged as particularly significant. The study found that the presence of CCTV cameras has a marked impact on driving behaviour, with individuals more likely to adhere to traffic rules when aware of surveillance. This highlights the importance of technological interventions in enhancing road safety and compliance.

In end, it can be concluded that this research reaffirms the necessity of integrating smarter techniques in traffic management and fostering a culture of rule compliance among citizens. The findings suggest that embracing technological innovations and ensuring public awareness and cooperation are vital for effectively managing traffic in a bustling metropolis like Delhi. Future studies and policy initiatives should focus on these aspects to further improve the city's traffic conditions and enhance the quality of life for its residents.

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 10 Issue 12
December 2023

7.LIMITATION AND FUTURE RESEARCH

This study, focused on evaluating traffic management among vehicle-owning citizens of Delhi, encountered several limitations that should be acknowledged. Firstly, the target population was restricted to Delhi residents who own vehicles. This limitation means that perspectives from citizens of other states, which could offer comparative insights, were not included. Additionally, the study did not encompass interviews with traffic police, who play a crucial role in traffic management and could have provided a more comprehensive understanding of the issues at hand.

The sample size of the study was another constraint, with only 80 participants. While this number provided initial insights, a larger sample could offer a more robust analysis and a broader generalization of the findings.

For future research, there is an opportunity to focus on the practical implementation of smarter traffic management techniques, possibly expanding the study to include different states beyond Delhi. Such research could provide a more diverse and comprehensive understanding of traffic management challenges and solutions across varied urban environments.

References

Bell, M. (2011). How can traffic engineers help manage our environment? Traffic Engineering and Control, 52, 51-57.

Chavan, R., Ayush, A., Aski, V. J., Chaubey, A., Sharma, A., & Dhaka, V. S. (2022). Comprehensive Review on Intelligent Traffic Management System in India. 2022 8th International Conference on Advanced Computing and Communication Systems (ICACCS), 1, 2055-2061.

Digital Transformation: Management of Smart Cities. (2023). doi: 10.1108/978-1-80455-994-920231004

Djahel, S., Doolan, R., Muntean, G., & Murphy, J. (2015). A Communications-Oriented Perspective on Traffic Management Systems for Smart Cities: Challenges and Innovative Approaches. IEEE Communications Surveys & Tutorials, 17, 125-151.

Durga, M., Shanmuganathan, D., & Srivastava, D. (2020). Evaluating the Feasibility of Different Approaches to Decrease Road Traffic Congestion in India. EngRN: Operations Research (Topic).

Dubey, K., & Gupta, T. (2020). Adaptive Traffic Control System: The Smart And Imperative Traffic Control System For India. 2020 International Conference on Intelligent Engineering and Management (ICIEM), 91-96.

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 10 Issue 12
December 2023

Dwivedi, A. D. (2023). Smart Traffic Management System. International Journal for Research in Applied Science and Engineering Technology.

Errampalli, M., Senathipathi, V., & Thamban, D. (2015). Effect of Congestion on Fuel Cost and Travel Time Cost on Multi-Lane Highways in India. International Journal for Traffic and Transport Engineering, 5.

Javaid, S., Sufian, A., Pervaiz, S., & Tanveer, M. (2018). Smart traffic management system using Internet of Things. 2018 20th International Conference on Advanced Communication Technology (ICACT), 393-398.

Leng, Y., & Zhao, L. (2011). Novel design of intelligent internet-of-vehicles management system based on cloud-computing and Internet-of-Things. Proceedings of 2011 International Conference on Electronic & Mechanical Engineering and Information Technology, 6, 3190-3193.

Mandal, P., Chatterjee, P., & Debnath, A. (2019). An Intelligent Highway Traffic Management System for Smart City. Advances in Intelligent Systems and Computing.

Medhat, H. (2018). A Smart Traffic Information System. International Journal of Computer Applications, 180, 7-11.

Nitin, T., Sharma, U. K., Singh, V. K., Dnyandeo, K. S., & Singh, K. (2021). Survey of Intelligent Traffic Management Systems with Emergency Vehicle Detection: A Review.

Paunova-Hubenova, E., & Trichkova-Kashamova, E. (2022). Algorithm for traffic management with priority for emergency vehicles. 2022 XXXI International Scientific Conference Electronics (ET), 1-5.

Tara, Vanlı., Akın, Marşap. (2018). Smart Cities, Smarter Management: Developing a Smart Framework for Smart Cities Management in Europe. Social Science Research Network.

Tiwari, A. (2020). Smart Traffic Management System using IoT. International Journal for Research in Applied Science and Engineering Technology.

Tiwari, P., & Purohit, D. P. (2020). Study Of Traffic Congestion & Controlling Strategies At Ramleela Square, Vidisha (Mp) Mp Sh 19.

Received: *22 November 2023*
Revised: *1 December 2023*
Final Accepted *7 December 2023*

DOI: https://doi.org/10.5281/zenodo.10279408