

Examining Travel Time Reliability in Mixed Traffic Conditions in The Context of Heterogeneous Cities

Kandukuru Jagan Mohan Reddy¹, Dr. Paritosh Srivastava²

¹Research Scholar (Ph.D), Department of Civil Engineering, Noida International University(NIU), India,
Email: jaganmohanreddy120@gmail.com

²Professor, Head- Department of Civil Engineering, Noida International University (NIU), India,
Email: paritosh.srivastava@niu.edu.in

*Corresponding author. Email:

Abstract

Travel time reliability gives a sequence of understanding vehicle distribution processes in roadway operations in the context of traffic control processes. This study highlighted the introduction chapter through which aim and objectives can be identified properly. Literature review section also explained specific requirements of traffic conditions and theoretical concepts of time flow of traffic management processes. Methodology chapter provided a method for data collection through which structured data can be collected properly. Experimental and thematic analysis helped in monitoring all factors regarding traffic flow and required time for finding speed and density of traffic management processes.

Keywords: Travel time reliability, Traffic Management, Thematic analysis, vehicle distribution process

Introduction

Rationale and background

Travel time helps in identifying the nature of traffic flows and its effect on the drive route and the behaviour of drivers. In India, traffic congestion is one of the biggest problems in urban arterial roads through which drivers would not fulfil travel time expectancy. It can directly affect the transportation administration and users as well due to which transportation networks cannot be maintained adequately. For this reason, the traffic management team can make suitable decisions in following structured rules and regulations to avoid traffic congestion and maintain travel time reliability within traffic flows.

Aim and Objectives

Aim

The foremost aim of this study is to acknowledge traffic behaviour with respect to travel time reliability to recognise traffic congestion rate in Indian mixed traffic conditions.

Objectives

- To identify responsible variables for managing travel time in Indian mixed traffic conditions.
- To address issues in travel time reliabilities in Indian mixed traffic conditions.
- To recommend adequate strategies to avoid these issues in improving traffic flow operations.

Significance of the study

The significance of this study helps in identifying structured results through which the traffic management team can make appropriate decisions in avoiding traffic issues. It can also develop the process of arranging traffic travel time expectancy within Indian mixed traffic conditions.

Literature review

Traffic management process in India

Traffic management process in India faces issues in arranging traffic flows that can cause traffic congestion and critical accidents. In 2020, AI and machine learning technology will help in arranging automatic processes in traffic management systems to avoid these issues and improve traffic travel time. It can bring structured results through which drivers can easily make their decisions while performing transportation networks without any issues.

Variability of travel time

Time segment	Sample size	ATT (sec)	SD (sec)	% Variation
*SS3 Morning hours				
11:00–11:30 am	20	175	84	48.00
11:30 am–12:00 pm	15	178	71	39.89
12:00–12:30 pm	25	199	68	34.17
12:30–1:00 pm	30	199	50	25.13
1:00–1:30 pm	27	174	68	39.08
*SS2 Morning hours				
8:00–8:30 am	123	157	16	10.19
8:30–9:00 am	155	126	13	10.32
9:00–9:30 am	141	184	9	4.89
9:30–10:00 am	158	175	11	6.29
10:00–10:30 am	166	187	8	4.28
*SS1 Morning hours				
8:00–8:30 am	57	206	44	21.36
8:30–9:00 am	59	292	40	13.70
9:00–9:30 am	55	244	28	11.48
9:30–10:00 am	82	181	29	16.02
10:00–10:30 am	46	215	59	27.44
*SS1 Evening hours				
4:00–4:30 pm	116	215	41	19.07
4:30–4:30 pm	95	200	32	16.00
5:00–5:30 pm	102	211	62	29.38
5:30–6:00 pm	78	226	60	26.55
6:00–6:30 pm	102	220	41	18.64

Figure 1 Travel time and variation

(Source: As inspired by Chepuri et al., 2018)

Travel time sequence helps in presenting accurate data by analysing the license plate of each car for tracking and analysing the speed of transportation. After 30 minute of interval time, this sequence is regenerated through which transportation and traffic flow activities can be analysed successfully. According to Chepuri et al. (2018), through ATT and SD (standard deviation), traffic flow and quantity of vehicles can help traffic management team to understand required steps for controlling those heavy traffics in arterial roads of India. Through this procedure, traffic conditions and roadway operations can be analysed properly that would be beneficial for understanding time variation depending on the transportation network.

Distribution of travel time

Planning time index

Planning time index helps in presenting the ratio of time intervals of FTT through which distribution plotted activities in traffic conditions can be identified adequately. Through this data, the traffic management team members can make their choices to identify the ratio and provide structured guidelines to maintain time intervals in traffic.

Buffer time index

Buffer time index defines the difference between percentile travel time and average travel time that can help in analysing buffer time activities in traffic flow. In the words of Gorbunov et al. (2019), it can guide the traffic management team to understand the road segmentation and underpinning the traffic conditions

of arterial roads in India. In this way, structured operations in arranging traffic flow can be executed successfully without any issues depending on traffic flows.

Reliable buffer index

Reliable buffer index helps in measuring the travel time with reliable values that can give exceptional results of traffic conditions in India. It can guide the traffic management team to make their choices to develop their traffic conditions and increase traffic conditions without any issues in Indian traffic conditions.

Pedestrian flow

Pedestrian flow provides a way of analysing traffic volume and progression rate in traffic in terms of mixed traffic conditions. As followed by Zhu and Sze (2021), through pedestrian flow, pedestrian values and traffic management processes can allow synchronisation of all mixed traffic activities through which drivers can analyse traffic congestion. Therefore, they can make their choices to avoid that road to improve travel time reliability while performing transportation networking activities. It can increase efficiency in traffic management processes and also maintain the quality and severity in traffic management processes. It would help the traffic management team to create a structured plan for arranging traffic conditions and develop the process of avoiding complexities in mixed traffic conditions in India.

Analysis of clustering

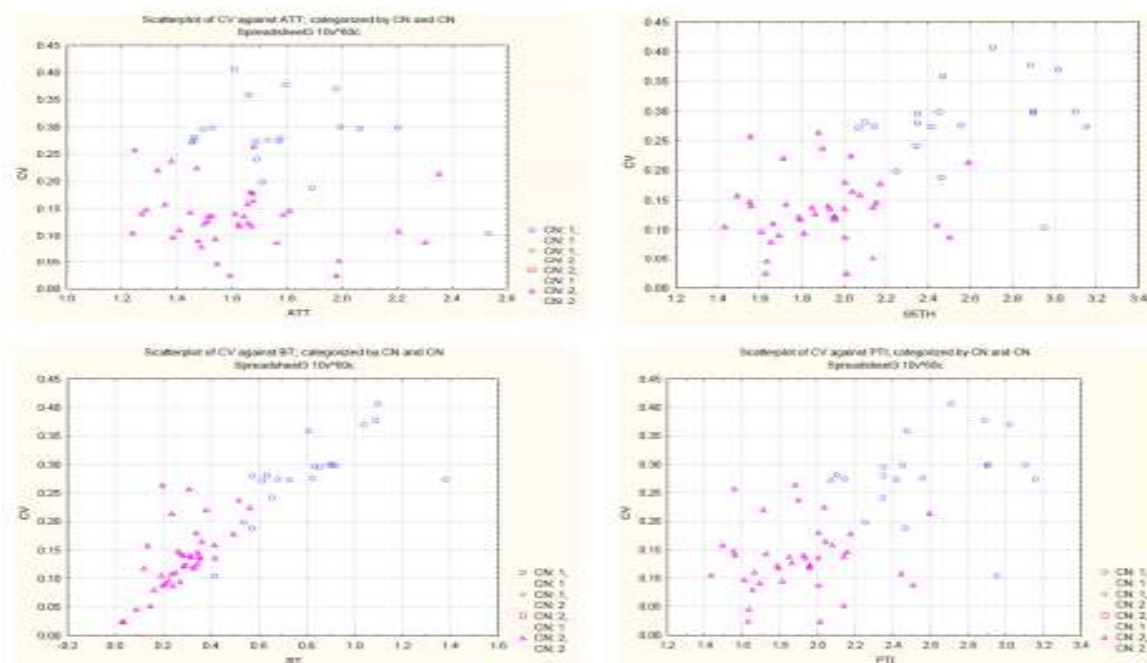


Figure 2 Clustering analysis

(Source: As inspired by Chepuri et al., 2018)

Clustering plays a crucial role in presenting a reliable format or structure for analysing traffic values and conditions in terms of mixed traffic in India. As proposed by Li et al. (2017), through clustering, traffic management team members can make their decisions and develop the process of creating a sustainable environment after analysing the traffic flow rate. Thus, drivers can easily avoid the congestion rate and develop the mixed traffic conditions by developing the quality and structure in mixed traffic processes. Clustering can also deliver adequate results and maintain the balance in traffic volumes and traffic

situations without any challenges. It can bring a favourable impact on the traffic management process within the mixed traffic conditions in India.

Theoretical concepts

Traffic flow Theory

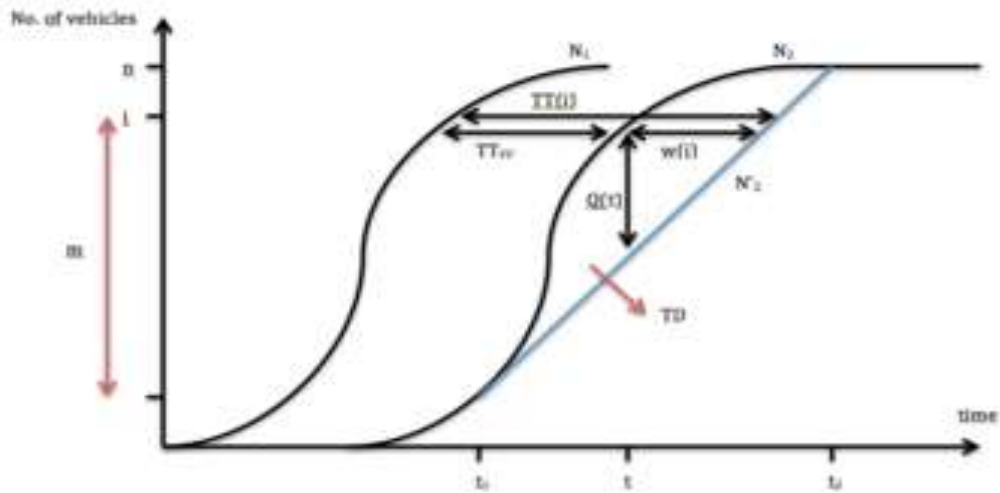


Figure 1: Traffic flow theory

(Source: As inspired by Ke et al., 2018)

Traffic flow theory helps in finding a suitable way of maintaining traffic properties by identifying performance of traffic systems in arterial roads in India. Through the assistance of this theory, the traffic management team can modify their existing traffic conditions by developing the performance of traffic systems (Ke et al., 2018).

Speed Volume relationship model

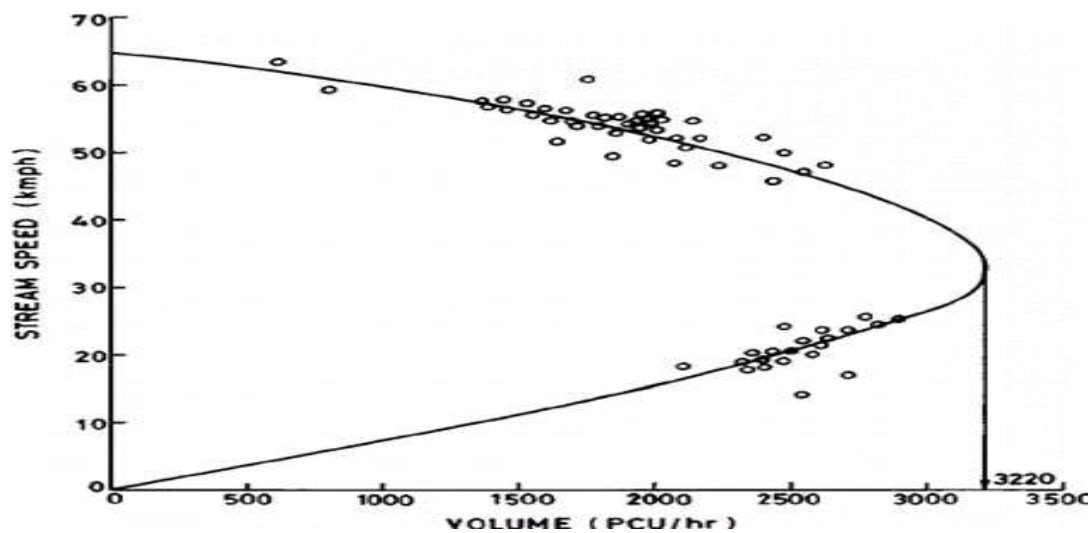


Figure 2: Speed Volume relationship model

(Source: As inspired by Yu et al., 2018)

Speed volume relationship model guides in presenting a reliable format of gathering level of speed related information. This model also provides information related to the relationship between average volume and speed of traffic conditions through which the traffic management team can incorporate structured plans for arranging traffic congestion properly (Yu et al., 2018). Issues in travel time reliabilities

Lack of continuous time distribution

Lack of continuous time distribution can decrease the process of gathering travel time of mixture traffic conditions. As proposed by Jin et al. (2018), due to this issue, changes in traffic situations cannot be identified that can directly affect the traffic management system. Thus, efficiency in travel time reliability cannot be analysed through which a traffic management team cannot decide to improve their travel time reliability in mixed traffic conditions in India.

Difficult to understand mixture distribution in travel time

Difficult to understand mixture distribution in travel time can violate the information of traffic flow operations. It can also decrease the abilities of managing time processing and mixture distribution activities in travel time durations in traffic management systems in arterial roads in India.

Strategies to overcome issues

Implementing AI technology in time distribution process

Implementation of AI technology helps in improving performance capacity and provides continuous results of travel time. It can help the traffic management team to provide that information to drivers so that they can change their travel route to avoid critical accidents and traffic congestion. As opined by Aladin et al. (2019), through these new innovative technologies, traffic management teams can make effective decisions in developing the performance agility of their traffic management system to enhance information gathering processes.

Modifying traffic management system

Modifying the traffic management system gives a reliable sequence of managing data collection processes

through traffic flow. It would give the opportunity for this team to analyse traffic flow and volumes to perform traffic management processes adequately. Through this new system, the traffic management team can easily develop their skills and knowledge to prevent those issues and improve their traffic travel time.

Materials and Methods

Research philosophy

Positivism philosophy has been used to gather practical and scientific information regarding the mixed traffic conditions in arterial roads in India. Through this philosophy, adequate measurements can be taken within this study to maintain the balance in traffic speed and density. According to Dougherty et al. (2019), through these variables, traffic flow and traffic conditions can be developed as per expectations. It can also generate a structured plan for traffic management team members that can guide drivers to understand roadway conditions and perform their tasks accordingly. It can avoid traffic congestion and also avoid critical accidents through which traffic conditions can be developed as per expectations.

Research approach

Deductive research approach has been selected to generalise critical traffic related information that traffic management teams can identify specific requirements of controlling traffic operations properly. As inspired by Alase (2017), through the assistance of this approach, traffic management teams can increase their knowledge and abilities due to which traffic management rules and regulations can be developed as per expectations. In this way, quality and structure of traffic management operations can also be executed for improving traffic flow and other crucial activities in developing traffic management systems for mixed traffic conditions in India. Through a structured plan, drivers can easily perform their transportation network without concerning any traffic related issues.

Research design

Research design helps in providing a structured and sequenced way of collecting specific data that would increase reliable and valid criteria of a research study. Conclusive research design has been incorporated to introduce well defined information to reach the conclusion adequately. This design helps in presenting structured results of traffic speed and density by avoiding open ended information related to mixed traffic conditions in India. As influenced by Abutabenjeh and Jaradat (2018), through this design, the traffic management team can develop their quantitative and qualitative processes. It can provide crucial and effective information regarding the mixed traffic conditions in arterial roads in India by distributing adequate information without any issues.

Data collection

Data collection method provides a significant way of managing data processing and data management activities within the research study. Mixed method has been selected for this study that includes secondary thematic and primary statistical analysis. Through these data collection processes, adequate measures can be taken to control these data collection processes. It can bring structured results through which adequate information can be gathered using experimental analysis. Moreover, thematic analysis also provides the perspectives of other authors from various journals in terms of mixed traffic conditions of India while arranging traffic management systems. It can bring structured stability within data processing and data collection processes depending on required expectations.

Sampling method

Sampling method defines a sequential way of managing qualitative and quantitative data processing through which measurements of positive and negative aspects can be analysed properly. Simple random

probability sampling method has been chosen to select four themes and experimental results to maintain the validation and reliability criteria of mixed traffic conditions in arterial roads in India. Through this method, adequacy level of transformation and also develops the process of creating sequential opportunities to deal with any kind of issues. It can also develop the process of creating any kind of situation regarding mixed traffic conditions in India.

Ethical consideration

Privacy and policy in experimental data is required to be maintained to avoid copyright issues and also develop the sequence of traffic flow operations to control effectiveness in traffic management processes. Through Data Protection Act 2018 (c.8), researchers can easily maintain the data privacy and also maintain the quality in data collection activities as well.

Data Analysis

Data analytical approach

Qualitative data analysis helps in presenting overview of authors through which positive and negative results can be gathered effectively. It can help in identifying the mixture conditions of Indian traffic situations due to which traffic congestion and traffic flow operations can be acknowledged properly. On the other hand, quantitative data analysis also provides experimental results through which structured information can be understood through which travel time of traffic can be acknowledged properly. As proposed by Chepuri et al. (2018), it can also guide the traffic management team members to make suitable decisions and improve their existing traffic related operations to maintain the balance in adequacy in traffic flows and other crucial activities.

Primary data collection

Experimental data collection process

Experimental data collection process helps in identifying practical information of traffic flow through which structured evidence can be incorporated adequately. Through the assistance of experimental data collection, adequate structure of traffic volumes and traffic management processes can give the opportunity of gathering specific information. As influenced by Chepuri et al. (2018), it would allow in creating opportunities for managing all kinds of traffic related operations by avoiding issues and complications in traffic management processes.

Sr. No	Name of distribution	Test Statistic		
		Kolmogorov-Smirnov (K-S) test	Anderson-Darling (A-D) test	Chi-square test
1.	Burr	0.04491	0.99068	11.482
2.	Log-logistic (3P)	0.05537	2.9554	33.286
3.	Lognormal (3P)	0.07728	7.6377	65.818
4.	Lognormal	0.09879	12.106	93.37
5.	Normal	0.14799	31.112	252.71
6.	Weibull	0.16478	51.195	223.34

Figure 5 Experimental results using distribution processes of travel time

Sr. No.	Name of distribution	Test Statistic		
		Kolmogorov–Smirnov (K–S) test	Anderson–Darling (A–D) test	Chi-square test
1.	Burr	0.06199	7.094	108.59
2.	Log-logistic (3P)	0.06126	11.374	116.12
3.	Lognormal (3P)	0.08522	18.272	181.11
4.	Lognormal	0.1218	36.644	306.59
5.	Normal	0.0904	16.863	138.93
6.	Weibull	0.05375	6.6114	108.12

Figure 6 Experimental results of using distribution process of vehicle quantity

From this experimental results, burr and 3P logistics operations can be identified properly that can help in gathering chi-square test values. Using distribution process, accurate experimental results regarding A-D test and chi-square test have been gathered. In burr, the result of A-D test is 7.094 from vehicle and 0.99068 from travel time. This result can help in identifying the vehicle quantity with respect to travel time. The Chi-square value of vehicle quantity of Burr is nearly 108.59 and travel time is approximately 11.482. These experimental results can give opportunities for traffic management team to make proper decisions in controlling the traffic congestion rate without any challenges. According to Dhamaniya and Chandra (2018), speed prediction model is very important rather than travel time that can give a proper results using experimental analysis. However, according to Chepuri et al. (2018), travel time is crucial rather than speed through which travel time can explain the quantity of vehicles according to traffic management processes. This comparison can give proper results that speed prediction and travel time duration can help traffic management team to make proper decisions and develop their experimenting activities.

Secondary data collection

Thematic analysis

Theme 1: Optimising the control of automated and connected vehicles in arranging travel time in mixed traffic conditions

Automated and connected vehicles are responsible for analysing traffic conditions with the help of automated GPS in mixed traffic flow. It can help these vehicles to present a way of arranging travel time through which structured traffic management operations can be operated successfully. According to Zhao et al. (2018), it can also allow in avoiding complications in mixed traffic conditions through which structured operations can be operated successfully. It can also help traffic management teams to avoid the complexities in understanding heavy traffic flows in mixed traffic situations in India. It can also develop the process of creating a sequenced plan for managing travel time through connected and automated vehicles in transportation networks for drivers.

Theme 2: Pedestrian flow in terms of speed and density of mixed traffic conditions in India

Level of services takes accountability in identifying the relationship between density and speed with the help of pedestrian flow. Through this flow, the traffic management team can identify specific requirements of controlling all operations regarding traffic that include traffic schedule, travel time, speed, density and volume. As proposed by Golakiya and Dhamaniya (2020), through these variables, level of adequacy in traffic conditions can be analysed that can guide team members to follow a sequence path for maintaining the structure of traffic flow management. It can also guide drivers to avoid complexities in mixed traffic conditions and guide drivers to make their choices by controlling traffic situations in India. In this way, heavy traffic conditions and critical accidents can be avoided properly in the mixed traffic conditions in India.

Theme 3: Importance of clustering process in managing traffic flow activities

The significance of the clustering process helps in presenting a reliable structure for gathering specific information that is responsible for managing traffic flow activities. It can bring structured requirements for handling all kinds of information related to traffic management systems. In this way, quality and structure of all traffic flow activities can allow in creating sequential opportunities in avoiding these issues and improve data processing operations. As inspired by Rossi et al. (2017), through the assistance of traffic flow activities, the traffic management team can create a structured sequence for controlling traffic schedule and travel time to avoid traffic congestions. It can also allow in creating a sequence for mitigating all types of issues and improve traffic schedule management within mixed traffic conditions in India.

Conclusion

From the above study, it has been concluded that travel time helps in identifying traffic flow activities through which specific measures can be taken to control all activities regarding traffic management operations. The traffic management team can make suitable decisions in developing their traffic scheduling, speed and density to deliver specific information related traffic. It can develop the process of creating opportunities in analysing traffic conditions due to which quality processes can help in managing traffic travel time properly. In this way, structure and effectiveness in traffic management processes can be developed as per requirements.

Linking with objectives

First objective has met in the literature review section by identifying appropriate variables to maintain the traffic travel time properly. Second objective has been met in the thematic data analysis sections by identifying issues related to maintain the traffic travel time within arterial roads in India. Third objective has been met in the thematic data analysis by identifying effective strategies to control these issues of traffic management processes.

Recommendations

From the above study, it can be recommended that the traffic management team is expected to make suitable decisions in developing their existing traffic performance to understand travel time and other crucial activities. It can generate a structured plan for managing all types of events in traffic management processes.

Future Scope

Theoretical and practical information regarding traffic conditions are required to be incorporated within future by maintaining the travel time within traffic management processes. It can develop the quality and validity within research study by providing quality information within mixed traffic conditions in India.

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