Analysis of Causes on Suburban Traffic Congestion Reference to Ragama town, Sri Lanka

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Abstract

A developed transportation system, connecting rail and road is an outcome of the substantial concentration of inter-related activities in an urban area. Thus, traffic congestion is inevitable. Congestion increases the travel time and decreases the efficiency of activities, consequently, congestion increases the economic cost of activities. Hence, traffic congestion is a problem for society and to the economy. A huge volume of literature is available on traffic and related research along with few concentrating on causes of congestion. Yet no studies focused on the sub-urban centers. Therefore, this research aims to analyse the causes on traffic congestion in one of the sub-urban areas of Sri Lanka. The study focused on four major issues, such as physical, technical, social, and legal. Data were collected using a five-point Likert scale questionnaire from conveniently selected 70 commuters, and in-depth interviews were conducted with five professional experts on the same factors. Analysis completed in both quantitative and qualitative approaches and the findings indicate physical and technical issues are significant in both analysis. Hence, the policy makers advise to consider the remedies more on physical and technical factors to improve the smooth flow of traffic.

Keywords: Causes, congestion, mixed methods, physical and technical factors, traffic

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INTRODUCTION

The main motives of urban planning intend towards ensuring the health, beauty, and convenience of all urban elements. However, traffic congestion is a growing problem in many cities, and it poses contradict results to the planning intention and danger to many countries around the world (Watson, 2009). This problem is especially prevalent in urban areas where the population density is high, and the number of vehicles on the road is significantly high. Along with the heavy concentration of activities traffic congestion disturbs travelers', a continuation of activities and even to the environment while affecting all the people who are engaged in urban agglomerated activities. This potential congestion problem must be identified with the concern of how to minimize congestion throughout the cities. Scholarly findings have identified that traffic congestion affects the daily activities of commuters and pedestrians and that the economic cost of traffic congestion is high (Gatersleben and Uzzell, 2007; Sidel, 2020), Day by day traffic congestion rises with a high commuter population within the urban and suburban areas around the world. Along with the urban agglomerations, all activities are concentrated one to the other causing many issues in the transportation system. The activities in an urban area are disseminated towards various paths. But traffic congestion is a complicated urban issue which must be well identified and eradicated with practicable solutions.

The Western region of Sri Lanka, where the preponderance of the country's population is concentrated, is also suffering from a significant level of traffic congestion. It is underlined that on-street parking, roads with poor carrying capacity, lower occupancy of cars and buses, a lack of pedestrianized areas, and low demand for public transit are all contributing to the traffic congestion in Sri Lanka's western region (Nagodawithana et al., 2016). The cost of congestion in Sri Lanka's Western Province was more than Rs. 20,000 million per year, which is roughly 2% of the regional GDP. When compared to global statistics, Sri Lanka has a significant influence on traffic congestion (Danthanarayana and Mallikahewa, 2021). By 2030, Sri Lanka's population is expected to increase from 20.8 million to 23 or 25 million, with half of the population living in urban and suburban regions

(Somasundaram et al., 2019). Therefore, this situation will have further effects on the country's overall sectors in the future as well. Then, officials have taken several measures to potentially alleviate the situation in Sri Lanka. Within the Colombo Metropolitan Region (CMR), the average traffic speeds have dropped to around 20 km/hr. In Sri Lanka, several methods to implement the short-term plan include regulating transportation supply and managing transportation demand. Attempts at regulating transportation demand and supply include re-distribution in the geographical way of claiming transportation, relocation and urban re-planning and re-distribution in the chronological method of demand for transportation (Jayaweera, 2017). Long-term strategies include implementing signalization, prohibiting parking, and right turns, a vehicle possession strategy compatible with street capacity, a policy for community transportation compatible with population concentration, and a policy for new modes of public transportation compatible with personal revenues (Kalansuriya et al., 2015). Nevertheless, traffic congestion and related issues are projected to worsen in the future. It is critical to address this problem as soon as feasible. Furthermore, since the nature of this problem is complicated and dynamic, present remedies are insufficient to alleviate traffic congestion in Sri Lanka.

There has been a great deal written and researched on traffic congestion and its impacts. However, the outcome has been underwhelming, particularly in suburban areas. Thus, no prior research has been undertaken on identifying and analyzing the primary reasons for traffic congestion in the suburban city of Ragama, Sri Lanka. Therefore, this study intends to analyze the causes of traffic congestion in one of the suburban areas in Sri Lanka, namely Ragama City. Advanced research must be established to pinpoint the primary reasons for traffic congestion, and the final outputs may be proposed by adopting certain outcomes to be followed to decrease the causes and achieve successful urban design across the city. The research might be concerned with other states' established approaches for removing the causes of traffic congestion. Therefore, this research study will add to existing knowledge, and the research findings can be used to advise responsible parties on how to fill existing gaps by employing necessary solutions. Thus, the primary reasons for current traffic congestion will be

highlighted in this study through both professional and commuter perspectives, which is important in the setting.

LITERATURE REVIEW

Defining Traffic Congestion

In broadly, the term "congestion" refers to a scenario in which an item is used or consumed jointly by many purchasers and cannot be offered in separate components. Congestion occurs when there are many users or customers of a particular good, which has negative consequences, mostly preventing others from accessing these assets. The scenario described is prevalent in transportation, when congestion happens on a huge scale, causes a great deal of inconvenience, and has substantial expenses. Congestion exists when road travel is impeded by other cars. When demand exceeds the availability of an infrastructural facility, user fees rise, and the facility's performance declines. Transport congestion is described as the reciprocal blockage of traffic by cars caused by the current interrelationship between the speed of passing vehicles and the number of flows in situations of infrastructure capacity degradation (Sharon, 2021). In other terms, congestion is defined as an amount of vehicle traffic that surpasses the capacity of a specific route, resulting in a reduction in the performance of operating vehicles or the complete prohibition of free movement. Congestion is caused by a mismatch between travel demand and transportation service supply. The demand is caused by the intensity of movement in space and time. The supply is restricted by the historical form of the infrastructure, the degree of investment, transportation management, and operational standards. According to the European Conference of Ministers of Transport (ECMT), there is no uniform meaning of traffic congestion, and it can be evaluated in a variety of methods.

Congestion can be used quite precisely to near-jam circumstances or more widely for any limitation of efficiency owing to traffic density. Congestion might be studied as a scientifically observable phenomenon or as experienced by road users, residents, and many others, and the amount of obstruction will change depending on the technique. In motivating the need for policy changes, the subjectively felt bottleneck may be as essential as

more objective facts. Congestion in urban transportation networks is frequent not just in major enclaves, but also in medium-sized regions throughout all nations with a high degree of socioeconomic progress (Owusu and Oteng-Ababio, 2015). In cities, there is a high density of transportation demands in time and space that emerges regularly. With high traffic, a crowded road network promotes congestion at crossroads, which subsequently spreads to parts of routes between intersections and eventually to nearby intersections in a chain effect (Ferrara et al., 2018). Different forms of transport bottlenecks are recognized in the network based on the level of intensification. The growing degree of motorization and the high number of cars on roads have produced the definition of a new sort of congestion known as gridlock, which refers to traffic halting throughout the entire street system in a specific location. This type of circumstance is most common in city centres. Congestion as a transitory scenario in which the need for road space surpasses potential is an oversimplified understanding of the problem, as the form of the difference between demand and supply can vary greatly.

Congestion can be recurring (occurring on a day, weekly, or yearly basis) or non-recurrent, and it can happen throughout a system or at specific spots. The key distinction between them is the regularity of the event. Recurrent congestion occurs when the amount of traffic on a route surpasses its ability at a specific place at a regular time of day. Non-recurring congestion is produced by accidental or unanticipated occurrences that briefly raise demand or limit infrastructure performance. It might be caused by road incidents, disabled cars, road works or renovation, inclement weather, or fluctuating demand (Samal et al., 2020). Congestion is a complicated issue impacted by social, technological, and human variables. The value of each component changes from city to city over time. The amount of congestion in every city is determined by a variety of supply and demand variables. The scale and efficiency of the road network are the most important supply factors. Inadequate road network capacities can be produced by a shortage of funding for transportation infrastructure or an absence of expansion options. Other supply-side issues comprise the quantity of funding for developing public transportation as an additional mode of transportation. The quantity of travel conducted by the demographic, the share of the

workforce that travels by automobile, and population size are the primary demand factors.

Causes of Traffic Congestion

There are primarily two factors that contribute to traffic congestion: micro-level aspects including the large number of individuals on the streets at the same moment and the overspill of automobiles on the constrained road space; and macro aspects including land use configurations, car ownership dynamics, and regional economic advancement. Congestion is caused at the micro level and controlled at the macro level. Many studies, however, have typically explored three key reasons for traffic congestion in states' urban and suburban areas, such as increased automobile usage, urban sprawl, and regulated working time. Thus, the studies examine the rise in vehicle utilization in Latin America through time. Cars have grown more inexpensive and attainable as the economy has developed and earnings have increased. Moreover, they claim that as areas expand, so does the usage of automobiles.

Car use has expanded dramatically in Europe as well. To be more exact, the number of automobiles in operation in Germany increased by 5.5 percent during the same period, from 43.4 million to 45.8 million (Vidal and Olivera, 2019). As per the views of Bashiru and Waziri (2008), speed bumps, poor roads, and trading activities, on-street parking, passenger loading and unloading, unauthorized bus stops, poor drainage, flooding, vehicle breakdown, small road sections, religious events, heavy traffic, parking shortages, and absence of traffic lights at some junctions were listed as causes of traffic congestion. More people need to commute to and from work, school, and other destinations as cities expand, which results in greater traffic on the roads. Urban regions also tend to have a higher population density, which means more people live and work in smaller areas, increasing traffic congestion. Congestion can develop quickly when roads and other transportation facilities are not built to handle the volume of traffic in a specific location (Leontiadis et al., 2011). Because of the concentration of people and economic potential in urban areas, there are significant transportation needs that must be satisfied simultaneously, which leads to the problem of congestion. In recent years, traffic congestion

has had a considerable negative influence on society, the economy, and the environment. The urban transport network is significantly impacted by the significant amount of delay and expense caused by congestion, particularly in densely populated areas. Due to 6.9 billion additional hours of travel and 3.1 billion extra gallons of fuel used in 2014, the traffic congestion cost US citizens a cumulative of $160 billion. Because of the growing number of cars, the existing roads are unable to handle them. The 25 most congested U.S. cities are expected to cost drivers $480 billion over the next ten years in time wasted, spent fuel, and carbon emissions, according to INRIX Roadway Insights from 2017 (Gonzalez-Aliste et al., 2023). The loss is also having a significant impact on the world economy. According to research from 2018, the overall cost of lost production in the United States as a result of this congestion is $87 billion.

Urban sprawl is another factor that contributes to regional traffic congestion. Individuals are increasingly leaving cities for many reasons. As a result, academics debated the elements that contribute to urban sprawl in European towns. They discovered that it is linked to an increasing spatial dimension. This suggests that cities prefer to expand as a result of dispersion. Cities have grown increasingly polycentric rather than mono-centric. Furthermore, urban sprawl happens when people tolerate greater commuting distances. According to Handy (2005), commuting distances in the United Kingdom have grown dramatically in recent decades. This growth is attributed to a variety of factors. Traffic congestion is also significantly influenced by ineffective land use planning. Congestion can be caused by poorly planned land use, which includes a lack of parking places, mixed-use patterns, and inadequate infrastructure for pedestrians and cyclists. Another factor contributing to traffic congestion is the absence of effective public transportation options. People are compelled to utilize private vehicles in cities with unreliable or difficult-to-access public transportation, which contributes to traffic. By reducing the number of vehicles on the road, efficient public transportation systems can ease traffic congestion. Additionally, traffic congestion is brought on by an increase in the number of vehicles on the road as the population grows. Population growth is closely correlated with traffic congestion, according to studies. The number of vehicles using the roads must be accommodated by the road

infrastructure. Congestion can happen if the roads are too narrow or there aren't enough of them. Therefore, traffic congestion is caused by poorly maintained roads and a lack of carefully planned road networks. Furthermore, it was emphasized by the research findings of Morar and Bertolini (2013) that the basic causes of traffic congestion are the increase in population and automobiles, as well as the migration of rural residents to urban areas in search of better opportunities. One of the main causes of traffic congestion is the rise in car ownership. By 2040, the World Health Organization (WHO) predicts that there will be twice as many cars on the road. The need for more road space grows along with the number of cars. Congestion is the result, particularly at peak times. Several studies have demonstrated a connection between owning a car and traffic congestion (Mahmud et al., 2012).

Furthermore, suburban housing choices, such as having a home with a garden, are more inexpensive than urban housing, despite most enterprises being in cities. On the one hand, individuals seek to satisfy their need for gorgeous housing while still being content with their jobs. Probably, these two demands will not be met close enough together, resulting in lengthier commutes. Furthermore, transitory work is becoming more popular these days, necessitating increased mobility. Many people believe that increased wages will substitute for the lengthier commute. When dedicating themselves to employment, they undervalue the true value of travel. These commuting expenses include both monetary and psychological expenditures, such as anxiety and effort.

Traffic congestion has been exacerbated not just by urban sprawl and increased automobile use. Due set working times, it is also a reason for peak hour traffic thus working hours at most German firms range from 7 a.m. to 9 a.m., with the last shift ending between 4 p.m. and 6 p.m. As a result, traffic peak hours are frequent around this period (Afrin and Yodo, 2020). Thus, it is reasonable to suppose that roadways are underutilized outside of these hours and overutilized during these hours, resulting in traffic congestion during rush hour. Furthermore, road construction on the highways leading to and from Germany reduces road capacity, causing even greater congestion throughout rush periods. Additionally, parking has

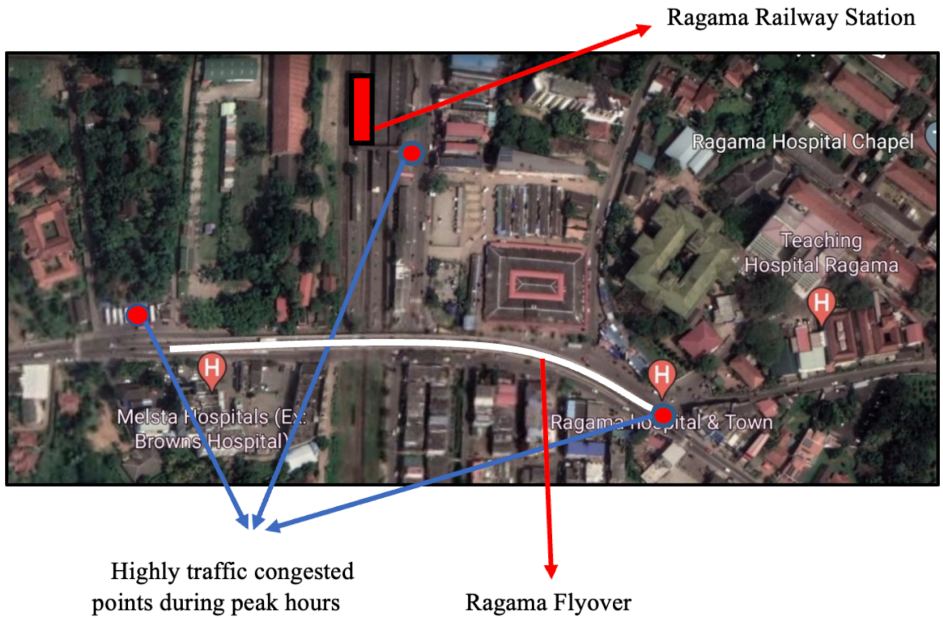
become an extreme issue which is reasonable for the traffic congestion and the absence of an e-taxi parking zone or auto stand also causes consequences on parking which led to creating traffic congestion as there the on-street parking with loading and unloading of passengers take place (There has been a lot written and studied about traffic congestion and its cabs. Thus, no previous study has been conducted on identifying and assessing the key causes of traffic congestion in Sri Lanka's suburban cities. Therefore, this research investigates the reasons for traffic congestion in one of Sri Lanka's suburban areas, Ragama town. study has been conducted on identifying and assessing the key causes of traffic congestion in Sri Lanka's suburban cities. Therefore, this research investigates the reasons for traffic congestion in one of Sri Lanka's suburban areas, Ragama town.

METHODOLOGY

Study Area

The research was conducted at Ragama town Centre, which is part of the Gampaha administrative area in Western Province, Sri Lanka. The study focuses on the current traffic congestion in the Ragama suburb, and the researchers discovered that traffic congestion extends beyond Ragama's local authority borders. Furthermore, Ragama town boasts a substantial railway station that connects key railway lines. Every day, many train passengers go from Ragama town to the Ragama Railway station. Thus, Negombo - Colombo major road and Kandy-Colombo main road are the two primary road entries to Ragama town. Both Mahabage and Kadawatha towns have two gateways available, such that the number of people travelling through Ragama town during rush hour has a high value. Hence, Ragama Township is located around 5 kilometres from the Mahabage junction on the A3 highway (Colombo-Negombo major route). The second Sri Lankan highway flyover was erected in Ragama in 1996, and it is located above the major railway line that runs from the right side of the Ragama town centre.

Figure 1: Study Area



Source: Google Earth Map (2021)

Data collection

Primary data was obtained from respondents to have a deeper knowledge of the subject under study. The self-administered survey questionnaire was employed to obtain quantitative data from participants. The commuting sample was limited to 70 respondents who passes the centre during the peak hours of 7.00 a.m. – 9.00 a.m. or 4.30 p.m. – 6.30 p.m., following the convenience sampling method. Conversely, for the qualitative study, the judgemental sampling approach is used, and the researcher can choose a sample of professionals in advance based on their expert knowledge, education level, and experience. Accordingly, in-depth interviews were conducted with five selected professionals: a valuation officer, the deputy director of the UDA Gampaha Division, the officer in charge of the Pradeshiya Sabha sub-office in Ragama, the engineer of the Ragama electricity board, and a town planner at the Urban Development Authority. Since the sample of experts has been chosen considering their experience, and the expertise knowledge regarding the case study area and the discipline

of the research study, the study findings and outcomes of the data analysis will contribute to minimising the existing traffic congestion within the area. As shown in Table No I, a five-point Likert scale questionnaire and interview questions were constructed based on the primary elements discovered during the literature study, such as social, physical, technical, and legal concerns. These variables are considered independent variables of the study while the waiting time that the commuters spent on the road has been considered the dependent variable. Under the physical aspect, the absence of a main bus stand, issues with the road network system and the traffic control system, pedestrian crossings and the railway crossing, lack of proper parking areas and issues with road maintenance were considered while under the legal aspect, problems with the rules and regulations, symbolized road signals have been considered. And under the social aspect, issues with the population and the pedestrians' behaviour, illegal encroachments have been considered.

Data Analysis

Two approaches were used to analyse the data. A content analysis was carried out as per the qualitative research approachBased on the quantitative approach, the questionnaire data was evaluated employing both descriptive and inferential statistics. "Frequencies, valid percentages, means, and standard deviation" are all examples of descriptive statistics. These were employed to summarise the demographic data of the participants as well as traffic concerns as part of the surveys. Inferential statistics were produced and utilised to conclude how significant the sample was in presenting the picture of the relationships between waiting times (independent variables) and traffic concerns (dependent variables) by utilising Pearson Product-Moment Correlation Coefficient. Data acquired from respondents was loaded into a computer and analysed using statistical packages for social scientists (SPSS) Version: 26, which helped to summarise the coding data and accelerated data processing.

Table 1: Operationalization of Variables

Variables	Reference
Physical and technical issues	
Lack of infrastructure, improper traffic engineering, and absence of multimodal transportation corridor investments.	(Koliba *et al.,* 2011)
Roads with low capacities, fewer occupancy vehicles and bus lanes, lack of pedestrian-only streets	(Kumarage, 2004)
Inadequate parking facilities and pedestrian facilities	(Samal, 2020)
Multiple bus stands and bus stops	(Tang, 2009)
Limited parking facilities and capacities, poor designing of the road network systems, lack of road capacity	(Worldbank, 2013)
Legal issues	
Poor monitoring of law enforcement	(Worldbank, 2013)
Defects on signalization, lack of policy for community transportation companionable with population concentration, lack of policy for new means of public transportation	(Kumarage, 2004)
Absence of strict rules and traffic law implementation	(Samal, 2020)
Ineffective traffic police, poor management of the traffic signal lights	(Cosgrove, 2007)
Social issues	
Parking of buses beside roads	(Tang, 2009)
On-street parking, the higher number of trips	(Koliba et al., 2011)
Poor road disciplines	(Agyapong & Ojo, 2018)
Entering of an excessive number of private vehicles towards the city	(Chakrabartty & Gupta, 2014)
Variances of office times and school times and a higher number of private vehicles on roads	(Samal, 2020)
Illegal encroachments, illegal stops and the transits by other vehicles, random stopping of vehicles, the random crossing of pedestrian crossings, on-street parking	(Worldbank, 2013)

Excessive number of private vehicles on roads, accidents, lack of lane discipline	(Vencataya *et al.,* 2018)
Random parking of vehicles, excessive ownership of private vehicles, the poor discipline of drivers	(Cosgrove, 2007)

Source: Survey Data (2021)

RESULTS AND DISCUSSION

Results

Qualitative Data Analysis

Demographic profile of the experts: - The researcher has conducted a qualitative analysis to analyze the main influential causes for the existing traffic congestion within Ragama town centre. Therefore, five experts have been chosen and interviewed after considering their knowledge and experience within this case study area and their demographic profile is indicated in Table 2. Valuation officer, the Deputy Director of the UDA Gampaha branch, the Officer in charge at the Pradeshiya Sabha sub-office in Ragama town, the engineer of the Ragama electricity board, and a Town planner at the UDA Battaramulla branch.

Table 2: Demographic profile of the experts

Demographic Character	Expert No. 1	Expert No. 2	Expert No. 3	Expert No. 4	Expert No. 5
Gender					
Male	√		√	√	
Female		√			√
Educational Level					
Ordinary Level					
Advanced Level					
Diploma		√	√	√	
Graduate	√	√			√
Working Experience					
More than 5yrs experience	√	√	√	√	√

Source: Survey Data (2021)

Insufficient planning of the road network system results in various issues such as limited road capacity, congested hospital and flyover junctions, and a lack of designated bus turning points, main bus stand, and roadside bus parking. Additionally, private vehicles are often parked haphazardly on roads due to a lack of proper parking areas and inadequate road maintenance. Pedestrians also tend to crossroads illegally instead of using designated pedestrian crossings, leading to traffic congestion in areas around pedestrian and railway crossings. Despite government regulations for traffic management, some drivers and pedestrians disregard road and traffic signals, creating further problems. Moreover, illegal encroachments and unauthorized parking of vehicles, often by fruit and vegetable vendors, shopkeepers, and mobile shops, further reduce available road space. During peak hours, the high volume of commuters, compounded by population growth and the increasing number of private vehicles on the road, exacerbates these problems. The views of the experts are lined up according to the above-mentioned issues. They are qualitatively described below.

Respondent 01:

Respondent 01 stated that Ragama town centre has multiple bus stands that people have established over time for their convenience, without following planning techniques. The construction of the Ragama flyover has resulted in a new argument as people do not use pedestrian crossings and instead park their vehicles on the roads. The increase in private vehicle usage has exacerbated the issue. The respondent believes that the improper parking of buses beside the roads and the flyover is a primary cause of traffic congestion. Long-term road maintenance work and on-street parking are also culprits. The respondent suggests that plans should be implemented based on financial restrictions, and Ragama town should be developed as a main junction on the main line due to its high commuter population and town centre activities during peak hours.

Respondent 02:

Respondent 02 believes that the absence of a main bus stand is the major cause of traffic congestion in Ragama town centre. The use of private

vehicles and illegal encroachments beside the roads, where pedestrians buy goods from unauthorized shops, has also reduced road capacity. The respondent suggests that building a main bus stand connected to the market route and the hospital can alleviate the problem. Continuing fine charges for violating rules and regulations is also recommended to enforce discipline and improve traffic flow.

Respondent 03:

Respondent 03 faced transportation difficulties in Ragama town during peak hours and agreed that people tend to cross the roads instead of using pedestrian crossings. An alarming program for pedestrians at pedestrian crossings is suggested. The absence of a proper road system, bus turning points, a main bus stand, and parking of buses beside the roads are major contributors to traffic congestion. Fruit and vegetable vendors and additional counters in front of shops are also problematic. The respondent recommends a well-designed modern app for finding alternative roads during peak hours and improving the public transportation system. Developing a multi-modal transport hub main bus stand within the town centre is the overall suggestion.

Respondent 04:

Respondent 04 believes that the road capacity is not sufficient, and buses parked beside the roads contribute to traffic congestion. The allocation of land for a main bus stand with bus circular paths is suggested, along with a multi-storied car park for private vehicles with easy access to shops. The construction of an overhead bridge linking the hospital entrance road and the bus stands is also recommended. Illegal encroachments need to be relocated to new places as they cause congestion, and unused spaces should be utilized properly. Planning issues have created congestion throughout the town, and good coordination between planning and resource utilization is necessary to develop a major bus stand, traffic control system, and multi-storied car park.

Respondent 05:

Respondent 05 has noted that the width of roads in Ragama town is insufficient for the high volume of vehicles passing through. Given that Ragama serves as a central hub for travel to neighboring towns, it experiences significant commuter traffic. Respondent 05 suggests that the current road capacity may not be adequate for efficient transportation within the town. To address this issue, she recommends constructing a multi-storied car park to reduce on-street parking. She also proposes conducting traffic surveys to identify major road capacity issues. Additionally, she emphasizes the need for a regulatory system to monitor town planning and enforce laws prohibiting selling on roads. Respondent 05 observes a lack of effective traffic management rules and regulations in the town, leading to non-compliance by drivers. To improve this, she suggests installing more visible road signals. Furthermore, as the Ragama Hospital is a key destination, congestion at the hospital and flyover junction is problematic. To alleviate this issue, Respondent 05 proposes building an overhead pedestrian bridge connecting the hospital to the town centre, which would reduce the flow of pedestrian traffic and ease congestion in the town centre.

Table 3: Identification of the main causes of traffic congestion in Ragama town

Main criteria	**Respondent / Factor**	**Res. #1**	**Res. #2**	**Res. #3**	**Res. #4**	**Res. #5**	**Total**
Social Issues	Population and the pedestrians' behaviour	√	√	√			3
	Illegal encroachments		√	√	√	√	4
Physical and Technical Issues	Absence of a main bus stand		√	√	√	√	4
	Road network system and traffic control system	√		√	√	√	4
	Pedestrian crossings and the railway crossing	√	√	√		√	4

	Lack of proper parking areas and issues with road maintenance	√		√	√	√	4
Legal Issues	Rules and regulations		√	√		√	3

Source: Interview Data (2022)

Table 3 reflects the main causes of traffic congestion in Ragama town. Accordingly, it concludes that the majority has responded to the physical and technical issues. Improper road network layout causes issues with road capacity and hospital and flyover intersections. The absence of bus turning points, main bus stops, bus parking on undefined roads, private vehicle parking on undefined roads, the lack of a good traffic management process or traffic management system, and the lack of adequate parking spots and road maintenance concerns could also be identified as the context's main physical and technical issues. Thus, responses reported that individuals occasionally cross roadways instead of utilizing pedestrian crossings. There is a traffic bottleneck near the pedestrian crossings and railway crossings In Ragama Suburb. Subsequently, on the legal aspects, there are laws and regulations for traffic management implemented by the government. Some drivers and pedestrians are failing to obey traffic signals and road signs in this circumstance. Finally, unlawful encroachments and unlicensed parking of automobiles harm society by reducing the amount of road space available. This might be attributed to roadside fruit and vegetable stands, merchants, and mobile stores, as well as more counters outside establishments and vehicles. During peak hours, there is a large commuting population. The number of private automobiles on the roadways during peak hours is growing due to population expansion.

Quantitative Data Analysis

Demographic Analysis

As shown in Table 4, the majority of the respondents in the selected sample are males, and it is 64.3%. The female percentage is 35.7%, and females are the minority in responding to the questionnaire survey. The majority of

respondents in the sample are between the ages of 25 and 34, accounting for 35.71 percent of the entire sample. In the questionnaire survey, the 55- 64 year age group had the second highest response rate. The respondents in the 55 and older age category are among the least responsive, with an average response rate of 8.57 %. Hence, Ragama inhabitants made up the major portion of those who responded. They have a 62.86 percent contribution rate. Outside of Ragama, other respondents account for 37.14 percent of the entire sample. Most respondents in the survey, 62.86 percent, utilize public transit. Apart from public transit, 18.57 percent of individuals utilize private vehicles as their means of mobility.

Table 4 : Demographic Analysis

Description	Frequency	%
Gender		
Male	45	65
Female	25	35
Age		
<25 years	12	17
26-34 years	25	36
35-44 years	13	19
45-54 years	14	20
>55 years	6	8
Residency		
Yes	44	63
No	26	37
Transport Mode		
Public	44	63
Private	13	19
Office Service	7	10
By foot	2	3
Other	4	5

Source: Survey Data (2022)

Reliability Statistics

The reliability of statistics reflects how well it is free of bias and so assures consistent assessment throughout time and across different elements in the

tool. In other terms, the reliability of a test indicates the steadiness and uniformity with which the tool assesses the idea and aids in determining the usefulness of a study. According to table 5, all produced Cronbach's Alpha values of the questionnaire questions are greater than 0.7, implying that all components under consideration have high reliability and no items were removed from the model. It signifies those constructions are entirely significant.

Table 5: Reliability Statistics

Variables	Cronbach's Alpha	Sig.	Number of Items
Social	.705	.004	7
Physical and Technical	.806	.003	12
Legal	.705	.004	2

Source: Survey Data (2022)

Descriptive Statistics of Likert Scale Questions

The mean and standard deviation of each questionnaire response was also calculated. Most elements have mean values ranging from 3.23 to 3.46. This leads to the conclusion that these things are closer to an agreement. Most of the variables have a standard deviation of nearly one, indicating that there is little statistical variation.

Table 6: Mean and Standard Deviation of the Variables

Variables	Mean	Std. Deviation
Social	3.23	0.936
Physical and Technical	3.46	0.965
Legal	3.39	1.047

Source: Survey Data (2022)

Correlation Analysis

The investigation was expanded to determine the scope of the problems caused by traffic congestion. Correlation analysis was performed to demonstrate the level of the connection or relationship between the variables concerned. Pearson's Product Moment was used to compute inter-correlation coefficients (r). Accordingly, it was investigated to see if there

is a link between people's waiting times and the problems mentioned. The correlation data are shown in Table 7.

Table 7: Correlation Results of the Variables

		Waiting Time	Social Issues	Physical and Technical Issues	Legal Issues
Waiting Time	Pearson Correlation	1	.280*	.368**	-.047
	Sig. (2-tailed)		.019	.002	.699
	N	70	70	70	70
Social Issues	Pearson Correlation	.280*	1	.398**	-.128
	Sig. (2-tailed)	.019		.001	.293
	N	70	70	70	70
Physical and Technical Issues	Pearson Correlation	.368**	.398**	1	.108
	Sig. (2-tailed)	.002	.001		.372
	N	70	70	70	70
Legal Issues	Pearson Correlation	-.047	-.128	.108	1
	Sig. (2-tailed)	.699	.293	.372	
	N	70	70	70	70
*. Correlation is significant at the 0.05 level (2-tailed).					
**. Correlation is significant at the 0.01 level (2-tailed).					

Source: Survey Data (2022)

According to Table 7, the association between waiting time and social concerns was statistically significant at the 0.05 threshold, with a Pearson correlation value of +0.280. This shows that there is a positive association between waiting time and societal problems. Thus, the association between waiting time and physical and technical concerns was statistically significant at the 0.01 level, with a Pearson correlation value of +0.368. This shows that there is a positive association between waiting time and physical and technical concerns. The Pearson correlation between waiting time and legal concerns is -0.047. This shows that there is a negative association between waiting time and legal concerns. However, the correlation study results indicate that waiting time is positively associated with physical and technical concerns and that when physical and technical issues increase, the waiting time of commuters is increasing in Ragama town during traffic jams. For commuters, this will result in increased time and financial

expenditures. However, based on the correlation analysis results, it can be inferred that the commuters answered the legal-related answers in the questionnaire without a thorough knowledge of the legal concerns. As a result, a negative Pearson correlation coefficient was calculated between waiting time and legal difficulties. Physical and technical components have been recognized as the most critical difficulties inside the Ragama town Centre as the major reasons for the present traffic congestion, according to both qualitative and quantitative data analysis results. The results of the qualitative and quantitative data analysis agree, supporting the indication that the most major factor for the present traffic congestion in Ragama town.

DISCUSSION

According to the views of Bashiru and Waziri (2008), it was emphasized that many factors such as "speed bumps, poor roads, and trading centres and related activities, on-street parking, passenger loading and unloading beside roads, unauthorized bus stops, poor drainage, flooding, vehicle breakdown, small road sections, religious events, heavy traffic, parking shortages, and absence of traffic lights at some junctions" are leading for traffic congestion and at the same time Leontiadis et al. (2011) has confirmed that higher population density and the higher traffic volume than transportation facilities makes more traffic congestion. The research findings of Morar and Bertolini (2013) further highlighted the fact that the main contributors to traffic congestion are an increase in the number of people and cars, as well as the movement of people from rural to urban regions in quest of better opportunities. Also, parking has become a major problem that is understandable given the traffic congestion, and the lack of an e-taxi parking zone or auto stand also has an impact on parking and contributes to traffic congestion because on-street parking and passenger loading and unloading occur there (Parvez, 2020).

When analyzing the results of this study it can be emphasized that this study contributes by analyzing the main influential causes for existing traffic congestion within Ragama town as major problems with the traffic jam around multiple bus stands, availability of several bus stands in the absence of a main bus stand, parking of buses beside roads, less capacity of the roads, absence of a traffic light system, improper planning of road network

system, congestion around pedestrian crossings, inaccuracy of the railway crossing, unavailability of the parking areas, on-street parking and parking of buses beside the flyover and hospital junction. If there is any chance of policy change, these factors must be considered in mitigating the existing traffic congestion in the Ragama town centre. Since there is no study taken place to identify the main causes of traffic congestion within suburban areas of Sri Lanka, this study has contributed to future research by confirming that the main causes of existing traffic congestion within Ragama town are physical and technical factors. Therefore, by minimizing the Physical and technical issues, traffic flow can be controlled in practice within the Ragama Town centre. The study contributes to making probable improvements for the existing gap within the case study area.

CONCLUSION

The primary aim of this research is to determine the reasons for traffic congestion in the suburban city of Ragama city, Sri Lanka. According to the qualitative research methodology, physical and technical concerns are responsible for the current traffic congestion in Ragama Town Center. Using quantitative research techniques, it was discovered that physical and technical concerns had a strong link with commuter waiting time. Therefore, Physical and Technical Issues are the main prominent causes of the current traffic congestion in the Ragama suburb. The research findings may be applied to present regulations and by establishing traffic mitigation strategies in the case study location. According to the expert responses, the inappropriate planning of Ragama town and the development failure of the Ragama flyover were spotlighted, while some experts proposed introducing a modern app for people to identify the most congested times and routes so that they can be avoided during peak hours to reduce the effect of the congestion. However, congestion cannot be completely avoided due to the expansion in people and vehicles, particularly motorcycles and passenger automobiles. The majority of experts who offered congestion mitigation methods also stated that tight traffic regulations, decentralization of vital organizations, limiting roadside activities, and enough parking facilities may help reduce congestion.

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