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DETERMINANTS CONTRIBUTE TO TRAFFIC CONGESTION AND SOLUTIONS: THE CASE OF TUARAN BYPASS AND SULAMAN KKIP ROAD NETWORKS IN KOTA KINABALU, SABAH

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Abstract: *In Kota Kinabalu, Sabah, traffic congestion is a major issue, particularly on the Tuaran Bypass and Sulaman KKIP road networks. The purpose of this study was to identify the causes of traffic congestion and propose solutions to the problem. A survey distributed online to commuters between January 10, 2023 and February 8, 2023 collected the data. SPSS 28 was used to analyse a total of 1,136 complete responses. Poor road conditions, inadequate lanes, and ineffective traffic management were determined to be the primary contributors, with mean scores of 4.81, 4.67, and 4.51, respectively. Other significant factors include bottlenecks/poor geometry (4.56 mean value), a poor signalling system (4.18 mean value), new development projects (4.20 mean value), and inclement weather (4.20 mean value) (mean value of 4.07). The study also identified potential solutions, with road widening being the most popular (mean value of 4.70 and 81.6% of respondents strongly agreeing). Significant support was also provided for nighttime road improvements and construction (mean value 4.45), improved road safety (mean value 4.43), and public transit quality (4.29). Carpooling, on the other hand, received less support, with a mean score of 3.47, indicating the need to investigate additional alternatives. Overall, the study indicates that physical infrastructure solutions, construction practise improvements, safety enhancements, and public transportation can effectively reduce traffic congestion.*

Keywords: *Traffic congestion, road networks, poor road conditions and road widening.*

Introduction

Traffic congestion is a crucial concern in urban areas globally and can have significant implications for mobility, the environment, and the economy (Koźlak & Wach, 2018). According to Gorzelany (2023), the average U.S. motorist spent 51 hours stuck in traffic last year. This issue is particularly severe in developing nations, where the rapid growth of cities

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and the surge in vehicle ownership are significant contributors. The rise in the number of vehicles on the road results in overcrowding, slower speeds, longer travel times, and higher levels of air pollution. Additionally, traffic congestion can lead to increased fuel consumption and heightened stress for drivers, both of which can negatively impact the economy. As the number of vehicles on the road increases, available road space is shared among more people. This leads to a higher number of cars in a given area at any given time. This results in more traffic jams, which, in turn, lead to slower speeds, longer travel times, and increased levels of air pollution.

In the specific case of Kota Kinabalu, Sabah, Malaysia, traffic congestion is particularly problematic along the Tuaran Bypass and Sulaman KKIP road networks. According to (Malaysia Number of Motor Vehicle: Sabah Economic Indicators CEIC, 2021) reports that the average number of motor vehicles in Sabah from June 1996 to June 2018 was 633,757 units, with a record high of 1,299,832 units in September 2017. In March 2018, the number of motor vehicles was 1,246,574 units, which increased to 1,254,839 units in June 2018, representing a 0.66% increase over a three-month period.

Moreover, the increase in tourist arrivals, as reported by Sabah Chief Minister Datuk Seri Hajiji Noor, has significant implications for traffic congestion and road networks in the region. The Chief Minister's report indicates a 442% increase in tourist arrivals from January to May of the year 2022 (Miwil, 2022). This growth in the number of tourists could lead to a substantial increase in traffic volume, particularly along the Tuaran Bypass and Sulaman KKIP road networks, potentially resulting in congestion and other associated issues.

This study aims to investigate the determinants contributing to traffic congestion along the Tuaran Bypass and Sulaman KKIP road networks in Kota Kinabalu and propose solutions to address the issue. The study's findings are expected to provide useful insights for policymakers and urban planners to improve mobility and liveability in the city.

Problem Statement

Kota Kinabalu, like many other urban cities in Malaysia, is facing significant challenges in its sustainable transport system. The city has experienced severe traffic congestion in recent years due to a combination of factors, including rapid population growth, economic development, and adjustments in the housing sector (Besar et al., 2020). In addition, the city's Central Business District (CBD) is located in the city center, which causes a serious problem of traffic congestion in many developing countries (Mahona et al., 2019).

One of the main areas affected by traffic congestion in Kota Kinabalu is the road that connects residents from the areas of Kota Belud, Tuaran, Tamparuli, Kiulu, Sepanggar, Inanam, Lintas, Likas and Menggatal to the city center, particularly the Tuaran Bypass and Sulaman KKIP road networks. The traffic situation is particularly bad during peak hours, with many commuters experiencing hour-long traffic jams (Daily Hour-long Telipok Traffic Jam Irks Motorists, 2022). The situation is further complicated by the increase in traffic flow and vehicle ownership in Kota Kinabalu Sabah. According to statistics provided by Kota Kinabalu City Hall (DBKK) Traffic and Public Transport Department director Kalvin Liaw, the number of vehicles entering and leaving the city has risen from 77,000 per day in 2000 to an estimated 140,000 vehicles per day currently (Traffic Woes Haunt KK Residents Daily, 2016). This rise is largely attributed to an annual three to four percent increase in car ownership in the city.

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The problem of traffic congestion in Kota Kinabalu requires immediate attention, and solutions need to be developed to address the issue. Therefore, the purpose of this study is to examine the factors contributing to traffic congestion in the Tuaran bypass and Sulaman KKIP road networks in Kota Kinabalu, Sabah, and propose solutions to alleviate the problem. By identifying the contributing factors, the study aims to provide practical solutions that will improve the city's transport system, reduce traffic congestion, and enhance the quality of life of residents. The results of this study will be beneficial to policymakers, urban planners, and other stakeholders interested in improving the transport system and reducing traffic congestion in Kota Kinabalu.

Scope of the Study

The scope of this study is to investigate the factors contributing to traffic congestion along the Tuaran Bypass and Sulaman KKIP road networks in Kota Kinabalu, Sabah. The study aims to propose solutions to alleviate the traffic congestion issue and improve the transport system in the city. The study will focus on identifying the determinants of traffic congestion, including the increase in vehicle ownership, the rapid growth of cities, and the increase in tourist arrivals. The study will also consider the impact of traffic congestion on mobility, the environment, and the economy. The findings of this study will be useful for policymakers and urban planners to enhance the city's liveability and improve the quality of life of its residents. The study will also recommend solutions to address the identified determinants of traffic congestion and improve the transport system's sustainability in Kota Kinabalu.

Literature Review

Mahona et al. (2019) describe traffic congestion in developing nations has become a major issue due to the majority of Central Business Districts (CBD) being located in the city center. The average commute to work now takes significantly longer than it did before the pandemic. A common complaint about today's commute is that it takes twice as long to get there and back from work. It was soon abundantly clear that the gridlock had returned, and this time it was severe (Teh 2022). The situation is far worse in Kota Kinabalu, since Kota Kinabalu’s Central Business Districts (CBD) is located in the city center of the city.

The concept of congestion has been define from a variety of perspective by researchers. The most common definition of congestion is a situation when the demand for traffic nears or surpasses the capacity of the road network (Raheem et al., 2020). While Falcocchio & Levinson (2015) and (Rahman, Najaf, Fields, & Thill, 2021) defined traffic congestion as roadway obstruction caused by overcrowding of vehicles due to inadequate supply of road infrastructure, excessive travel demand, or poor flow of transportation modes. Therefore definition of traffic congestion summarize as a situation when the demand for traffic exceeds the capacity of the road network. It is caused by inadequate supply of road infrastructure, excessive travel demand, or poor flow of transportation modes.

Cause of Traffic Congestions

Numerous studies have identified several causes of traffic congestion in urban areas. The primary causes of traffic congestion in urban areas are listed in Table 1 below:

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Table 1: Causes of traffic congestion

Author	Year	Context	Causes of traffic congestion
Chandam et al.	2020	Chennai, India	- Bad road condition, lack of no. of lanes, on road parking, lack of pedestrian pathways.
Traffic Congestion: Problems and Solutions | Ohio University	2019	US	- Traffic accidents blocking lanes, difficult weather conditions, unexpected spikes in traffic demand, traffic bottlenecks, and disabled traffic control equipment.
Paktin et al.,	2021	Kabul City	- parking illegally, encroachment of main carriageway, insufficient pedestrian facilities, low quality of public transport, mixed traffic traveling on same carriageway, lack of traffic sense, poor traffic control and management, poor maintenance of roads, inadequate drainage facilities, blocking of streets by people, improper placement of advertisements posters, and illegal dumping on roads by different people.
Hua & Abdullah, 2018	2018	Kota Kinabalu	- Bottlenecks, accidents, road conditions, road facilities, driver's driving behaviors, and unrestricted owning vehicles.
TTPA	2021	Sydney australia	- Saturation is most likely to happen when the population of a city grows faster than its infrastructure. - Road obstacles such as construction work, lane closure, an accident or double parking that hinders the traffic flow and causes the blockage. - Broken traffic signals due to malfunctioning computers. - Too many pedestrians walking on the roadway - Several trucks on the roadway because of insufficient rail freight opportunities. - Overdevelopment in the overcrowded areas where the road system is already inadequate. - Weather conditions.

Potential Solutions to Traffic Congestion

This literature review will examine several potential solutions to traffic congestion, including road widening, improving roadway operation, improving construction practices, improving safety to reduce crashes, improving the quality of public transportation, encouraging carpooling, offering flexible work schedules, timing traffic lights to control traffic, and restricting heavy vehicles during peak hours. A summary of these potential solutions is presented in Table 2.

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Table 2: Potential Solutions to Traffic Congestion

Author	Year	Context	Solution
Paktin et al.	2021	Kabul City	Improvement of Bottleneck Intersections, improvements have to be made in the U-turning, and right turning points using traffic signals and other geometric elements, Signalization Intersection and Management, Parking Improvement.
Transport	2016	Cambridge, London	This article presents several urban congestion and pollution reduction ideas from Greater Cambridge, UK. A typical urban population surrounds a dispersed rural population. Widening and narrowing roads, adding and removing bus lanes, building tunnels and a new ring road, building a light rail network, turning off traffic lights, banning cycling and cars from city centres, closing through-routes to private vehicles and car parks, and building more park-and-rides are among the ideas. The article also suggests a congestion charge, free buses, and park-and-ride services. Urban planning and transportation management researchers and policymakers can learn from these ideas' UK and global applicability.
Traffic Congestion: Problems and Solutions | Ohio University	2020	US	The role of civil engineering design in addressing roadway congestion has been widely recognized. One potential solution is the utilization of innovative road design, which can redirect the excess flow of drivers onto alternative routes, thereby reducing the probability of traffic congestion. Furthermore, the integration of alternate transportation infrastructure, such as bus lanes, bike lanes, and sidewalks, can provide travel options beyond private vehicles. Through investment in public transportation, these options can be significantly expanded, further reducing the number of private vehicles on the road and reducing congestion levels.

Methodology

To determine the causes of traffic congestion on the Tuaran Bypass and Sulaman KKIP road networks and to suggest solutions, a quantitative descriptive study is necessary. This design enables the collection and analysis of numerical data in order to understand patterns, trends, and relationships between variables, resulting in a comprehensive analysis of the problem and its solutions (Creswell, 2018).

A survey was conducted between January 10, 2023, and February 8, 2023, to collect information from commuters using the Tuaran Bypass and Sulaman KKIP road networks. The questionnaire was distributed online through a Google Form, and a total of 1,136 completed responses were received.

The questionnaire used in this study consisted of four sections, adapted from relevant literature including Cullen (2019), the City of Tempe Traffic Congestion Survey (2016), Kozlak and

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Wach (2018), Paktin et al. (2021), and Vencataya et al. (2018). The sections cover general information, traffic conditions, factors contributing to traffic congestion, and possible solutions.

A descriptive analysis was conducted using SPSS version 28 to analyze the data collected from the targeted population. Frequency tables were utilized to summarize and present the raw data.

Result and Discussion

Results of the study are presented into four sections. The first section describes the demographic characteristics of the participants. Second section is traffic conditions in both networks. The third section of the results presents determinates of traffic congestions. Final section the possible solution to mitigate traffic congestions.

Demographic Characteristic

This study analysed respondents' demographics using an online survey. Table 3 Survey results. 628 (55.3%) men and 508 (44.7%) women completed the survey. The largest age group was 32-38 years (30.3%), followed by 39-45 years (27.5%). The sample had the fewest 18-24 year olds (2.6%). Most respondents (57.5%) worked in the public sector, followed by the private sector (24.2%). Student and unemployed respondents were the fewest (1.7% and 0.6%, respectively). Finally, most respondents (35%) worked in Kota Kinabalu City, followed by Sepanggar (26.8%). Kiulu and Kota Belud workers were the least represented (0.3% and 1.1%). These findings reveal the demographics of the sample and can help identify biases or differences in traffic congestion perceptions in the Tuaran Bypass and Sulaman KKIP road networks.

Table 3: General Information of Respondents

General Information		Frequency	Percentage (%)
Gender	Male (1)	628	55.3%
	Female (2)	508	44.7%
Total Respondents		***1,136***	***100***
Age Group	18 – 24 years (1)	30	2.6%
	25 – 31 years (2)	151	13.3%
	32 – 38 years (3)	344	30.3%
	39 – 45 years (4)	312	27.5%
	46 – 52 years (5)	162	14.3%
	53 – 59 years (6)	112	9.9%
	60 years and above (7)	25	2.2%
Total Respondents		***1,136***	***100***
Occupation	Students (1)	19	1.7
	Unemployed (2)	7	0.6
	Self-employed (3)	86	7.6
	Rider (Grab, Maxim, Shoppe Express and others) (4)	9	0.8
	Part-timer (5)	6	0.5
	Private sector (6)	275	24.2
	Public sector (7)	653	57.5
	Retired (8)	32	2.8
	Others (9)	49	4.3
Total Respondents		***1,136***	***100***

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Work place	Sepanggar (1)	305	26.8
	Telipok (2)	42	3.7
	Tuaran (3)	59	5.2
	Tamparuli (4)	21	1.8
	Kiulu (5)	3	0.3
	Kota Belud (6)	12	1.1
	Likas (7)	150	13.2
	Luyang (8)	19	1.7
	Inanam (9)	61	5.4
	Kolombong (10)	34	3.0
	Lintas (11)	32	2.8
	Kota Kinabalu City (12)	398	35.0
Total Respondents		***1,136***	***100***

Traffic Conditions

The survey aimed to gather information on the respondents' views on traffic congestion in the Tuaran Bypass and Sulaman KKIP road networks. Table 4 shows respondents' work commute traffic delays. The majority of respondents (90.5%) reported traffic delays every day on their way to work, while 7.4% and 1.8% reported delays a few times a week and month, respectively. 4 respondents (0.4%) never experienced traffic delays on their way to work. This shows how traffic congestion affects most respondents' commutes.

Peak traffic times are the second survey finding. Table 4 shows that 57.8% of respondents experienced morning and evening traffic congestion. Congestion was most common all day (34.4%), followed by morning (4.8%) and afternoon (2.4%). Traffic congestion in the study area is severe, with most respondents experiencing congestion during both morning and evening commutes.

The survey's third finding: 3/A1/AH150 (Jalan Tuaran Bypass) (28.5%), Sulaman > Telipok > 3/A1/AH150 (9.2%), and Above All Road Network (20.4%). The most congested road network at peak hours is the Via Route Sulaman > KKIP Sepanggar > UMS (41.8%), followed by the Via Route 3/A1/AH150 (Jalan Tuaran Bypass) (28.5%).

The fourth survey finding shows that 23.2% of respondents reported arriving at work late. . 8.4% reported delays of 1 hour and 16 minutes to 1 hour and 30 minutes, 10.5% reported 1 hour to 1 hour and 15 minutes, and 5% reported 0-15 minutes. Only 2.1% of respondents had no work delays.

The fifth finding showed that most respondents (24.2%) had delays of more than 1 hour and 30 minutes when arriving home. This was followed by delays of 46 minutes to 1 hour (20.2%), 1 hour to 1 hour and 15 minutes (12.3%), 1 hour and 16 minutes to 1 hour and 30 minutes (7.8%), 31 minutes - 45 minutes (15.1%), 16-30 minutes (13.3%), and 0-15 minutes (13.3%). 2.6% arrived home late.

The majority of respondents reported significant delays getting to work and home. Work and home arrival delays averaged over 1 hour and 30 minutes. As the workday progresses, delays increase, with the later time slots reporting the most delays. Traffic congestion is a major issue for respondents, especially during peak travel times. The majority of respondents reported delays getting to work or home.

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Overall, these results indicate that traffic congestion on the Tuaran Bypass and Sulaman KKIP road networks is a significant problem that affects a large number of people's daily lives. Moreover, this traffic gridlock is set to worsen in the future if measures are not taken to address the underlying causes. The government should take proactive steps to implement effective solutions to alleviate traffic congestion and improve the flow of traffic.

Table 4: Respondents' Views on Traffic Congestion

Traffic Congestion Data		Frequency	Percentage (%)
How often does traffic delay your trip to work?	Never	4	0.4
	Every daya	1028	90.5
	A few times a week	84	7.4
	A few times a month	20	1.8
Total Respondents		***1,136***	***100***
The peak period of Traffic congestion	Morning	54	4.8
	Afternoon	27	2.4
	Evening	7	0.6
	Morning & Evening	657	57.8
	All day	391	34.4
Total Respondents		***1,136***	***100***
The Most Congested Road Networks at Peak Hours	Via Route 3/A1/AH150 (Jalan Tuaran Bypas)	324	28.5
	Via Route Sulaman > KKIP Sepanggar > UMS	475	41.8
	Via Route Sulaman > Telipok > 3/A1/AH150 (Jalan Tuaran Bypas)	105	9.2
	Above all Road Netwok	232	20.4
Total Respondents		***1,136***	***100***
Arriving at work with an average delay	Not late	24	2.1
	0 – 15 minutes	57	5.0
	16 – 30 minutes	136	12.0
	31 – 45 minutes	203	17.9
	46 – 1 hour	239	21
	1 hours to 1 hours 15 minutes	119	10.5
	1 hours 16 minutes to 1 hours 30 minutes	95	8.4
	More than 1 hours 30 minutes	263	23.2
Total Respondents		***1,136***	***100***
Arriving at home with an average delay	Not late	29	2.6
	0 – 15 minutes	51	4.5
	16 – 30 minutes	151	13.3
	31 – 45 minutes	171	15.1
	46 – 1 hour	230	20.2
	1 hours to 1 hours 15 minutes	140	12.3
	1 hours 16 minutes to 1 hours 30 minutes	89	7.8
	More than 1 hours 30 minutes	275	24.2
Total Respondents		***1,136***	***100***

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Determinants of Traffic Congestions

Table 5 details the thirteen factors that cause traffic congestion on the Tuaran Bypass and Sulaman KKIP road networks in Kota Kinabalu, Sabah. The survey had 1,136 respondents and used a five-point Likert scale, with 1 for "strongly disagree" and 5 for "strongly agree." This will show how much respondents agree or disagree with each determinant.

Results revealed that the most significant causes of traffic congestion were poor road conditions, insufficient lanes, and ineffective traffic management, with respective mean scores of 4.81, 4.67, and 4.51. With a mean contribution of 3.38, accidents contributed the least. Other significant contributors to traffic congestion included bottlenecks and poor geometry (mean value 4.56), a poor signaling system (mean value 4.18), a new development project (mean value 4.20), and inclement weather, including rain and floods (mean value 4.20). (mean value of 4.07). Even though accidents are the least significant contributor to traffic congestion, they still have a notable impact and should not be ignored. This is because accidents can cause traffic to come to a standstill, reducing the flow of traffic and creating long delays. Additionally, accidents can cause drivers to become distracted or drive more cautiously, which can lead to slower speeds and further exacerbating traffic congestion. Other causes include road geometry-induced bottlenecks, a poor signaling system, new development projects, and inclement weather.

The finding suggests that the majority of respondents believe that a variety of factors contribute to traffic congestion in the Tuaran Bypass and Sulaman KKIP road networks, with a particular emphasis on poor roadway conditions, lack of a number of lanes, and inefficient traffic management. This is due to the fact that these road networks have seen significant increases in traffic volume over the years, without any corresponding increases in infrastructure or traffic management measures. As a result, the roads experience frequent traffic congestion and delays, leading to frustration among drivers. With this finding, the researcher can suggest solutions to the local authorities to overcome the problem of traffic congestion in the area.

Table 5: Factor Contributing to Traffic Congestion

No	Factors	1	2	3	4	5	Mean
1	Excessive No. of vehicle	87 (7.7)	75 (6.6)	163 (14.3)	235 (20.7)	576 (50.7)	**4.00**
2	Population growth	92 (8.1)	77 (6.8)	219 (19.3)	260 (22.9)	488 (43.0)	**3.86**
3	Inefficient public transport service	83 (7.3)	81 (7.1)	180 (15.8)	181 (15.9)	611 (53.8)	**4.02**
4	Inefficient traffic management	25 (2.2)	21 (1.8)	102 (9.0)	192 (16.9)	796 (70.1)	**4.51**
5	Poor roadway condition	11 (1.0)	9 (0.8)	26 (2.3)	92 (8.1)	998 (87.9)	**4.81**
6	Lack of number of lanes	16 (1.4)	17 (1.5)	61 (5.4)	140 (12.3)	902 (79.4)	**4.67**
7	Economic development/urbanization	49 (4.3)	49 (4.3)	219 (19.3)	259 (22.8)	560 (49.3)	**4.08**
8	New development project	41 (3.6)	55 (4.8)	170 (15.0)	241 (21.2)	629 (55.4)	**4.20**

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No	Factors	1	2	3	4	5	Mean
9	Poor signalling system	33 (2.9)	72 (6.3)	192 (16.9)	200 (17.6)	639 (56.3)	**4.18**
10	Accident	104 (9.2)	178 (15.7)	346 (30.5)	204 (18.0)	304 (26.8)	**3.38**
11	Poor weather such as rain and floods	57 (5.0)	69 (6.1)	190 (16.7)	236 (20.8)	584 (51.4)	**4.07**
12	Festival seasonal and school holidays	87 (7.7)	97 (8.5)	190 (16.7)	224 (19.7)	538 (47.4)	**3.91**
13	Bottlenecks /poor geometry	19 (1.7)	27 (2.4)	83 (7.3)	178 (15.7)	829 (73.0)	**4.56**

Possible Solution to Mitigate Traffic Congestions

The data in Table 6 presents the results of a survey conducted to understand the strategies that can be implemented to reduce traffic congestion in the Tuaran Bypass and Sulaman KKIP road networks in Kota Kinabalu, Sabah. The survey asked respondents to indicate their level of agreement on various solutions to reduce traffic congestion, with options ranging from strongly disagree to strongly agree.

With a mean value of 4.70, respondents preferred road widening. The majority (81.6%) strongly agrees that widening the route would relieve congestion. The mean score of 4.56 supported improving roadway operations. This indicates that people believe that widening the road would be the most effective solution to reduce congestion, while also acknowledging that improving roadway operations would be beneficial as well.

Night-time road upgrades and construction were another favoured approach. With a mean value of 4.79, 86.4 percent of respondents strongly agree or agree that this would work. Safety to reduce crashes and public transit quality also garnered significant support, with mean ratings of 4.67 and 4.57, respectively. Night-time construction and upgrades can reduce the impact on traffic and commuters. Additionally, better road safety and improved public transportation can help reduce the number of accidents and make the area more safe, while providing an efficient and reliable way to get around.

Nonetheless, a mean value of 3.47 supported carpooling. 27.6% were doubtful or disagreed that carpooling would relieve congestion. Flexible work schedules and heavy vehicle restrictions during peak hours garnered less support, with mean values of 4.07 and 4.47, respectively. Despite the fact that the majority of respondents agreed that carpooling would help relieve congestion, many were still doubtful or disagreed. This suggests that carpooling alone may not be enough to solve the problem of congestion, and other solutions such as flexible work schedules and heavy vehicle restrictions during peak hours should be explored.

Overall, the finding suggests that respondents believe that physical infrastructure solutions such as road widening and improved roadway operation, as well as improvements to construction practices, safety, and public transportation, would be the most effective ways to reduce traffic congestion in the Tuaran Bypass and Sulaman KKIP Road Networks. Respondents also suggested that improving public transportation options would be the most effective way to reduce traffic congestion in the two road networks, particularly by increasing the frequency of public transportation services, making them more affordable, and increasing the number of

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routes available. Additionally, they suggested that providing more bike lanes, sidewalks, and better traffic flow management could help reduce traffic congestion.

Table 6: Strategies to Reduce the Traffic Congestion

No	Solution	1	2	3	4	5	Mean
1	Widen road	16 (1.4)	12 (1.1)	62 (5.5)	119 (10.5)	927 (81.6)	**4.70**
2	Improve roadway operation	25 (2.2)	24 (2.1)	90 (7.9)	153 (13.5)	844 (74.3)	**4.56**
3	Improve construction practices (night time road upgrades and construction)	12 (1.1)	10 (0.9)	32 (2.8)	101 (8.9)	981 (86.4)	**4.79**
4	Improve safety to reduce crashes	9 (0.8)	22 (1.9)	52 (4.6)	171 (15.1)	882 (77.6)	**4.67**
5	Improve quality of public transportation	17 (1.5)	29 (2.6)	78 (6.9)	179 (15.8)	833 (73.3)	**4.57**
6	Encourage car pooling	145 (12.8)	113 (9.9)	314 (27.6)	186 (16.4)	378 (33.3)	**3.47**
7	Offer flexible work schedule	76 (6.7)	47 (4.1)	230 (20.2)	157 (13.8)	626 (55.1)	**4.07**
8	Traffic light timed to control traffic	29 (2.6)	32 (2.8)	172 (15.1)	216 (19.0)	687 (60.5)	**4.32**
9	Restrict heavy vehicles during peak hours	45 (4.0)	25 (2.2)	106 (9.3)	131 (11.5)	829 (73.0)	**4.47**

Conclusion

In conclusion, the study and survey on traffic congestion in the Tuaran Bypass and Sulaman In conclusion, the study and survey on traffic congestion on the Tuaran Bypass and Sulaman KKIP road networks in Kota Kinabalu, Sabah, have presented valuable insights into the issue's major contributing factors and potential solutions. The results of the survey indicate that improvements to physical infrastructure, such as road widening and improved roadway operations, as well as advancements in construction practises, safety measures, and public transportation options, would have the greatest effect on reducing traffic congestion. The findings have significant managerial implications for local authorities and related ministries, who can use this information as a decision-making guide and consistently monitor the progress of implemented solutions to ensure their effectiveness in reducing traffic congestion. These research findings provide a foundation for the development of more effective localised traffic management policies and strategies. It also emphasises the significance of evaluating the progress of existing initiatives and developing new ones to effectively reduce traffic congestion. These strategies should centre on enhancing infrastructure and implementing intelligent technology to improve traffic flow. Additionally, community-based approaches should be supported to ensure that all road users' needs are met. In conclusion, it is crucial to concentrate on strategies that can assist in reducing traffic congestion, such as improved infrastructure, intelligent technology, and community-based initiatives. This will ensure that all road users are able to travel more safely and efficiently.

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Overall Limitations of the Research

Overall, this study's limitations include its reliance on self-reported data from a survey of local residents, which may not fully represent the complexity of traffic congestion on the Tuaran Bypass and Sulaman KKIP road networks. Local authorities and transportation experts, who could have provided additional insights, were not consulted for this study. In addition, the survey was limited to the opinions of local residents and may not be applicable to other regions. In addition, the survey did not investigate other significant issues, such as the economic and environmental effects of traffic congestion. In addition, because this survey is a cross-sectional study, the results should be interpreted with caution because causality cannot be established. In future studies, it would be advantageous to conduct more thorough, multifaceted research that includes input from a variety of stakeholders and data gathered over time.

Directions for Future Research

There are several future research directions suggested: a larger sample size may be necessary for generalizing the findings to a larger population, expanding the research to include other road networks in Sabah and other cities in Sabah, studying the effect of different road and transportation infrastructure on traffic congestion, assessing the effectiveness of various traffic management strategies on reducing congestion, examining the impact of socio-economic factors on traffic congestion and potential solutions, and inquiring into the impact of socio-economic factors on traffic congestion and potential solutions.

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