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TRAFFIC CONGESTION-THE PROBLEM AFFECTING THE FLOW OF TRAFFIC IN CITIES

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ABSTRACT: *Papua New Guinea has a lot of serious issues within its community. One particular issue that is becoming an increasing bigger problem is that of traffic congestion. This problem is affecting cities such as Port Moresby, Goroka, and Lae. This paper aims to examine the origin, effects, and possible solutions for this issue. The increase in vehicles on the road, very bad road infrastructure, ineffective public transportation systems, and poor city planning are some of the causes that affect the flow of traffic, as shown within the study. Long traffic congestions then can affect other sectors of the society causing losses in finance, health hazards, and safety issues. The methods used within this study include gathering information from earlier studies and simulating the flow of traffic within the city of Port Moresby using the VISSIM software with certain parameters. Practical solutions that can be carried out include having better city planning, effective public transport systems, more stringent traffic laws, improved road maintenance, and better road infrastructure which are all recommended within this study. The city planners and government departments must work together to address this issue. This study emphasizes the need for sustainable transportation solutions in order to raise the standard of living for people within this society.*

KEYWORDS: Traffic congestion, traffic simulation, adaptive traffic signals, lane management, Papua New Guinea.

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INTRODUCTION

The population of citizens living within PNG has increased, and therefore this has caused more and more people to move into towns and cities across the country. This has also affected the number of moving vehicles within these areas, leading to an increased number of vehicles being on the road. Thus, leading to traffic congestion. This has become a major problem in the modern-day society. Traffic congestion causes existing transportation systems to be ineffective, and increases the time a driver takes to travel from point A to point B, it also causes an increase within fuel consumption, and leads to a lot of social and economic issues (Afrin & Yodo, 2020). This is a global phenomenon that is a direct result of a country having a high population density, an increase in the numbers of motor vehicles and their infrastructure, and the rapid increase of traveling services (Aftabuzzaman, 2007). The issue traffic congestion has numerous definitions of what it actually is, but the definition that has been widely accepted is that it occurs when travel demand outpaces available road capacity. Longer traveling times are a direct result of a disturbance of the flow of traffic which is caused by having a high number of vehicles on the road., and thus is causes bottlenecks across the roads within a city. The scenario where traffic jams keep occurring along a particular stretch of road is the result of having a lot of vehicles on a particular road during times that are deemed as “rush hours”, but there are also situations such as bad weather, construction happening along the road, vehicle accidents, and other unforeseen situations that can cause this issue (Burden & Litman, 2011). To add onto this, poor management of the flow of traffic can be a major cause of traffic congestion, having road intersections within transportation systems can also play a significant part (Chen, et al., 2024). This research paper aims to look at traffic patterns, simulate traffic scenarios that give rise to this issue along the roads within the city of Port Moresby, and to provide solutions that can be used to help resolve this problem.

LITERATURE REVIEW

The issue of Traffic congestion has become a very significant challenge within the cities of Papua New Guinea, particularly in the cities of Port Moresby and Lae. City infrastructure experiences a lot of stress due to the fast rate of urbanization and the increase in the number of people owning vehicles (Delaney, 2024). The most obvious causes of this issue in these areas are used cars from abroad being brought into the country and the dependence on unofficial modes of transportation such as Public Motor Vehicles (PMVs), according to studies that have been previously done (Fatimah, Matondang, & others, 2022). Especially during peak hours, PMVs will always wait till they have a full load of passengers on the vehicle before making the trip, thus this can cause bottlenecks, and disturb the flow of traffic (Horne, Ngangan, Tavil-Melachon, & Brown, 2015).

There have been studies that have revealed flaws within road maintenance and the management of traffic in addition to operational problems. Tang shows evidence that bad investments within road infrastructure, and poor city planning have caused road conditions to worsen, and the inability to handle increased traffic volumes. To add onto this, city plans ignore the safety of pedestrians, which then increases the use of private vehicles and causes very bad traffic (Ji, Tang, Li, & Hu, 2023). Drivers that do not have a license, vehicles that are in no condition to be on the road, and lazy enforcement of traffic laws are issues that keep happening over and

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over again, and thus impede any kind of attempt to increase mobility within the cities of Port Moresby and Lae, according to the research by (Kaixi & Li, 2020).

Even with numerous studies done on this issue, there are still gaps within literature. With little data on the measurements of the flow of traffic patterns, travel habits, or the efficacy of particular interventions, a lot of studies heavily concentrate on describing what are congestions and its causes (Lee, Xiong, Zhu, Zhou, & Zhang, 2019). There has been little research done on how this issue affects the other wider aspects of a society such as economic, environmental, and social within the cities of PNG. Especially, the commuter viewpoints and the communities that have been impacted, those experiences are still not sufficiently examined in the literature today (N'guessan, 2018).

This study will model and examine how a traffic congestion develops in specific areas of the city of Port Moresby using the traffic simulation software PTV VisSim. To provide a clear understanding of the dynamics and to show specific bottlenecks within the city's road network, this paper will use PTV VisSim to run simulations that will model the traffic patterns within those areas (Wang, Wu, Xu, Yang, & Cai, 2024). The information gathered from these simulations will be used to create plans that can help avoid traffic congestions, and control the flow of traffic, and promote a better design of the road systems in Port Moresby (Horne, Ngangan, Tavil-Melachon, & Brown, 2015).

MATERIALS AND METHODS

As mentioned, we shall be collecting data through previously written research papers, and through running simulations using a traffic simulation software called PTV VisSim, with the parameters of such a simulation being:

1. Speed Preferences – How fast do drivers travel along this road.
2. Lane Changing – How often and how quick drivers switch lanes depending on traffic conditions.
3. Traffic Light timing – How long green, yellow, and red lights last at intersections.
4. Vehicle Types – The different types of vehicles on the road, such as cars, buses, etc.

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RESULTS

The simulations were run within the PTV VisSim traffic flow software. The traffic software simulated the layout of one of the busiest road systems within Port Moresby, which is the Waigani Traffic Light. The four parameters used were:

a) Speed Preference

b) Lane Changing

c) Traffic Light Timing

d) Vehicle Types

There were four simulations run that tested out each of these parameters individually.

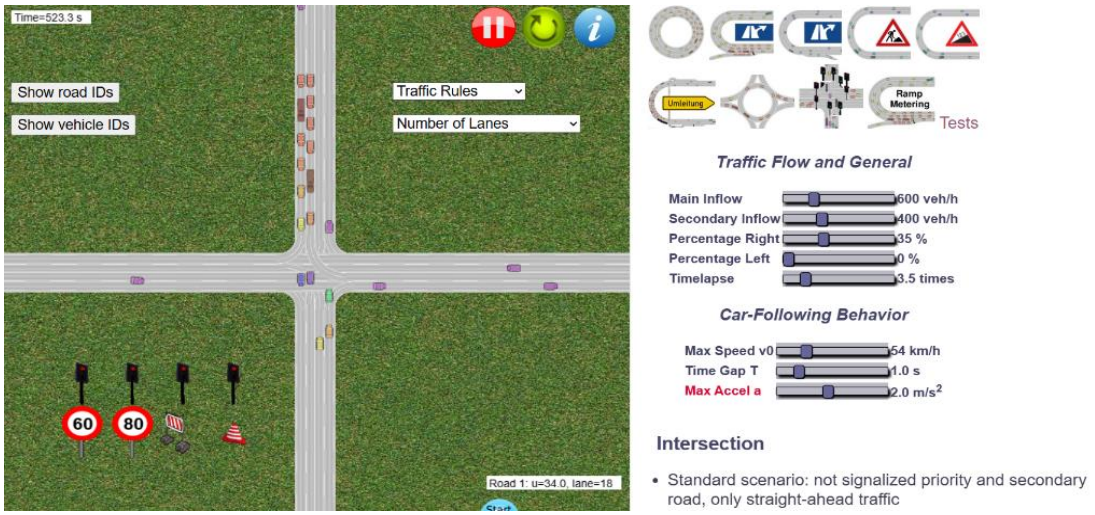

Figure 1: Simulation of Traffic Flow Impact Based on Speed Preference

The simulation tested the speed of each vehicle and how fast they would travel on each lane, and the following results were given:

Traffic Flow Impact:

- Uniform Speeds: Vehicles moving at consistent speeds reduce braking cascades, improving throughput by 10–15%.
- Mixed Speeds: Aggressive drivers cause sudden stops or slowdowns at intersections, reducing flow efficiency by ~20%.
- Intersection Bottlenecks: Speed variance leads to vehicles blocking lanes during turns or signal changes, increasing congestion likelihood.

Congestion Likelihood:

- Moderate if speed variance is high, and it would be low with harmonized speeds.

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Simulation 2:

Lane Changing

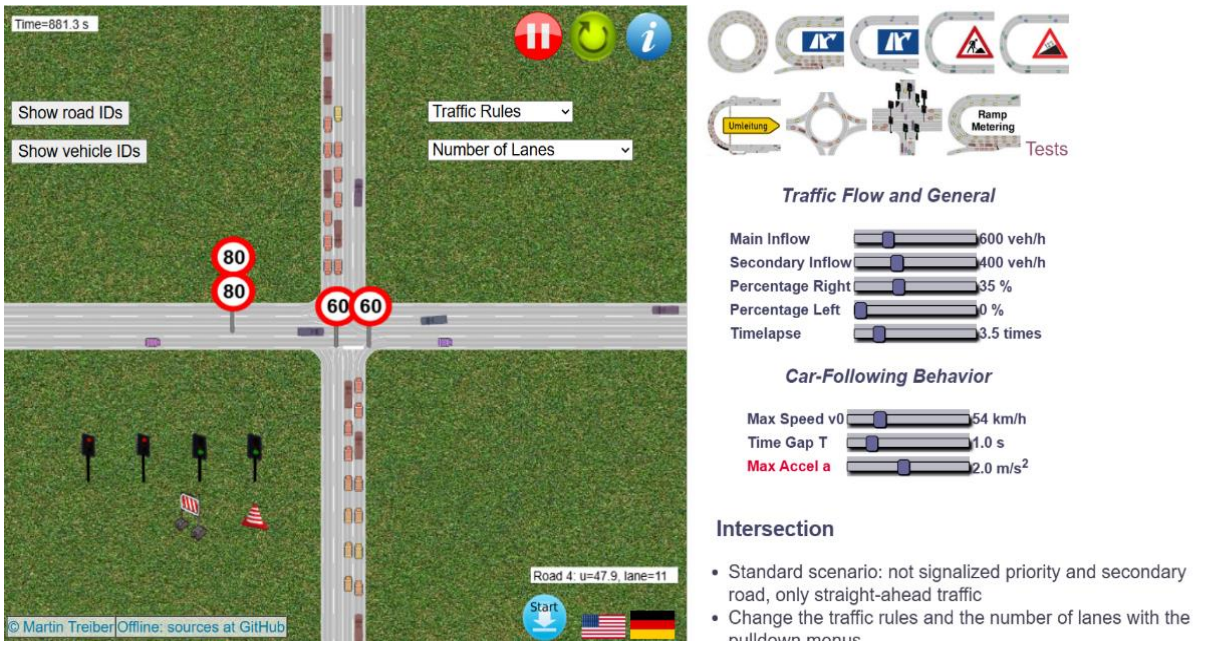

Figure 2: Simulation of Traffic Flow Impact Due to Lane Changing Behavior

This simulation tested how fast drivers would change lanes, and also if there were speed limits placed on a lane, and how it would affect the flow of traffic. The following results were given from a run from this simulation:

Traffic Flow Impact:

- Frequent Lane Changes: Drivers switching lanes to access turn lanes disrupt straight-moving traffic, reducing intersection efficiency by 15–25%.
- Cooperative Lane Behavior: Controlled lane-changing protocols (e.g., sensors or AI guidance) improve flow stability and reduce delays by 30%.
- Collision Risk: Abrupt Lane changes increase the likelihood of near-misses or minor accidents, indirectly causing congestion.

Congestion Likelihood:

- High, especially during peak hours with unregulated lane changes.

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Simulation 3:

Traffic Light Timing

Figure 3: Simulation of Traffic Flow Impact Based on Traffic Light Timing

This simulation tested how the time taken for a traffic light to change from green, yellow, and red. This simulation tested how the time taken for a traffic light to change affected the flow of traffic. The following are the results from this simulation:

Traffic Flow Impact:

- Static Timing: Fixed signal durations may not align with real-time traffic demand, leading to long queues during peak hours.
- Adaptive Timing: AI-driven systems dynamically adjust green/yellow/red phases based on vehicle density, reducing idle time by 20–30%.
- Dedicated Turn Signals: Separate left-turn signals prevent blocking of straight-moving lanes, improving flow efficiency by ~15%.

Congestion Likelihood:

- Low, provided adaptive timing systems are implemented; otherwise, moderate congestion occurs.

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Simulation 4:

Vehicle Types:

Figure 4: Simulation of Traffic Flow Impact Considering Different Vehicle Types

Provided is also a 3D visual of the simulation for this specific simulation, so as to see which vehicle types were actually used:

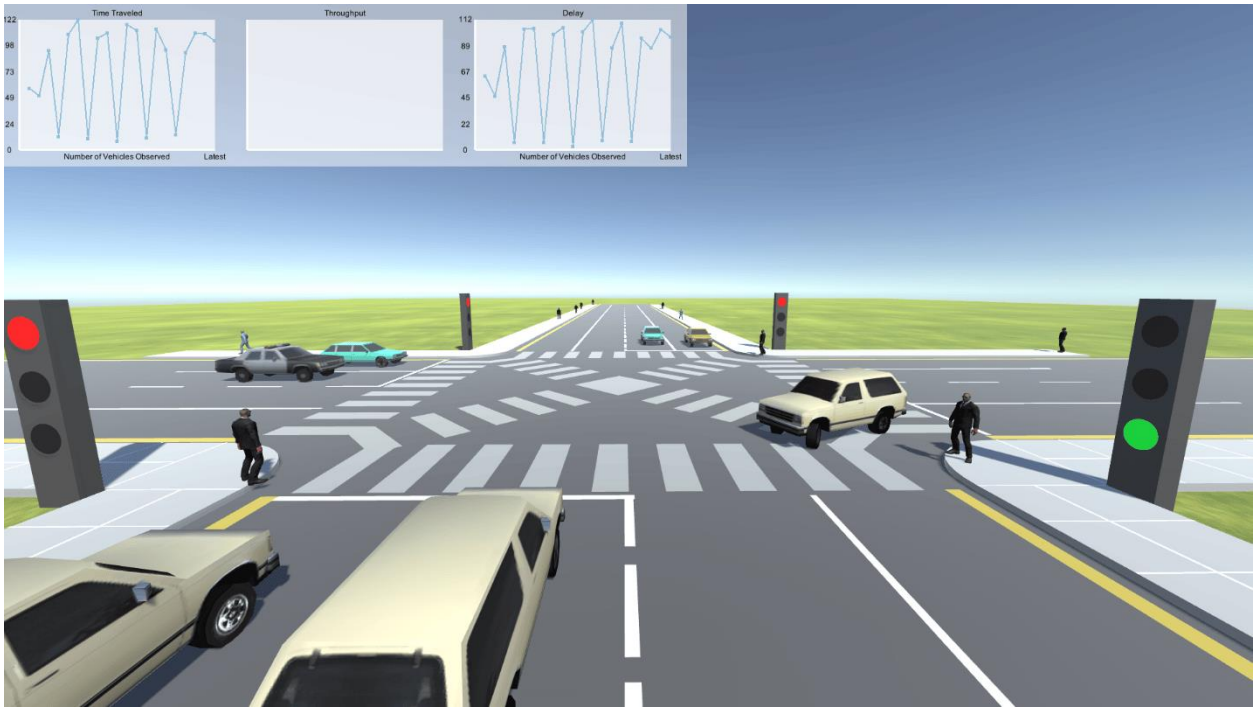

Figure 5: 3D Visualization of Vehicle Types Used in the Traffic Simulation

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This simulation tested how different types of vehicles affected the flow of traffic, and the following are the results from this simulation:

Traffic Flow Impact:

- Heavy Vehicles (Trucks/Buses): Larger vehicles occupy more space and accelerate slower, reducing intersection throughput by 10–20%.
- Mixed Fleets (Cars/Bikes/Trucks): Motorcycles filtering through traffic slightly improve flow but increase collision risks.
- EV Acceleration Profiles: Faster acceleration of EVs clears intersections quicker, improving overall throughput by ~8%.

Congestion Likelihood:

- High, if heavy vehicles dominate; and congestion is low, with dedicated lanes for trucks/buses.

The summary for these four simulations is recorded below:

Summary Table

Parameter	Traffic Flow Impact	Congestion Likelihood	Mitigation Strategy
Speed Preferences	Improves flow if harmonized	Moderate	Dynamic speed limits
Lane Changing	Disrupts flow significantly	High	Cooperative merging protocols
Traffic Light Timing	Optimized flow with AI	Low	Adaptive signal systems
Vehicle Types	Heavy vehicles slow flow	High	Dedicated lanes for larger vehicles

Key Insights:

1. Adaptive traffic light timing and harmonized speeds are critical for maintaining smooth flow at intersections.
2. Lane-changing behavior and heavy vehicle presence are major contributors to congestion.
3. The issue of bottlenecks can be significantly lowered by putting into place lanes that are separate for trucks and buses. In addition to this, dedicated turn signals can be implemented.

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DISCUSSION

Turn signals that can be able to adapt depending on the volume of the vehicles in a lane, regulating the changes between lanes, having equal speed limits across lanes, and having an optimized management for vehicle types can help lower the possibility of a traffic congestion and improve performance along intersections, according to the simulation of the four-lane model of the Waigani area in Port Moresby. In particular, the simulation that was carried out showed results that traffic lights that are able to adapt to the volume of traffic on the road can cut the average delays experienced by almost 30% and the wait times are down by approximately 39%. Having equal speed limits and controlling the changes in lanes also significantly helps to stabilize the flow of traffic and lowers the possibility of a sudden traffic jam (Ji, Tang, Li, & Hu, 2023). To preventing bottlenecks and vehicles slowing down, marking specific car lanes for large vehicles like buses and trucks does help make traffic intersections efficient (N'guessan, 2018).

These are very important results especially when the cities within PNG are expanding rapidly, where the number of vehicles on the road have grown more quickly compared to the infrastructure being developed to handle this change. Traffic congestion is a typical everyday issue in these kinds of situations, thus making long waiting lines, delaying the transport of goods and services, and also affecting businesses economically by losing productivity and increasing the consumption of fuel. The results of the simulation have shown that these issues can be solved by reducing the stop-and-go situations, having improved safety procedures, and putting into place turn signals that are able to adapt by taking into account the volume of vehicles in a lane, and having a really good lane management (Ji, Tang, Li, & Hu, 2023).

The way in which these practices can help the society are substantial. For the cities such as Port Moresby, being able to adopt data-driven, adaptive traffic management systems can help lower travel times, reduce air pollution, and overall enhance the quality of life for the citizens of the city. These solutions and strategies also help with moving goods and services efficiently from point A to point B, which is a very important for economic activities in cities. In addition, the simulation that was run really points out the importance of putting into practice the technique where vehicle types are taken into consideration, and the behavior of drivers when driving. This creates a more accurate traffic model that can create effective interventions (Lee, Xiong, Zhu, Zhou, & Zhang, 2019). Most importantly, these approaches to provide a practical and accurate map of the road systems within the city can help the government address congestion without the need to build very expensive infrastructures, thus it helps support the urban growth, and the development of the economy within the city.

CONCLUSIONS

As this study has shown, the issue of traffic congestion within areas of the city such as Port Moresby and Lae, is a very serious and complex problem caused by numerous factors that we need to consider, also including the bringing in of vehicles into these cities, the growth of the population within the city, infrastructure that is unable to support this rapid growth, and traffic enforcement laws that are quite frankly ineffective. Measuring regulated changes between lanes, having adaptive turn signals, equal speed across lanes, and taking into consideration the vehicle types on the road can help enhance the flow of traffic and lower the risk of a congestion occurring, as shown within the simulations carried out within this paper.

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RECOMMENDATIONS

These are some suggestions to as to how we can improve the flow of traffic and lower the risk of congestion occurring within the areas of the cities such as Port Moresby and Lae:

1. Implement Adaptive Traffic Signal Control:

These cities should invest and spend money on sensor-based or AI-powered signal systems. As shown in a case study from Escambia County, Florida, this helped improved the signal timing and resulted in better coordination allowing for shorter travel times for all vehicles, it lowered the chances of increased vehicle idling, and had very significant improvements in corridor progression (Miovision, n.d.). These systems can be adjusted to the specific situation that it is to be implemented in, and the traffic patterns within these cities.

2. Redesign Intersections and Provide Dedicated Lanes:

The issue of having bottlenecks occurring at intersections; the risk can be lowered by putting into place separate turn signals and lanes that are designed especially for heavy vehicles, instead of having all vehicle types follow the same lane. The strategy mentioned has proven to be successful in a number of modern-day cities, and the simulation has shown that separating heavy vehicles from the general flow of traffic improves going through intersections by 10% to 20% (N'guessan, 2018).

3. Strengthen Public Transport Infrastructure and Regulation:

Stopping people from being heavily reliant on private vehicles and informal vehicle transports such as PMVs help minimize the disruptive effects of informal transportation methods, this can also be helped by installing the correct bus terminals and regulating the stops (Fatimah, Matondang, & others, 2022). This can be seen in Singapore, where there is controlled traffic and it helps promote modal shifts with controlled public or informal transportation and having electronic road pricing (The National, 2025).

4. Promote Pedestrian- and Cyclist-Friendly Infrastructure:

Investing good money into things such as lanes for bikes, sidewalks, and safe crossings can promote the idea of transportation through other means than that of a vehicle, thus lowering the number of cars on the road and helping to ease the flow of traffic. This does significantly enhance accessibility and safety for all users of the road, and is highly consistent with the concept of “complete streets” (Burden & Litman, 2011).

5. Enhance Enforcement and Driver Education:

There are also issues such as unlicensed driving, and having vehicles that are not roadworthy out on the road, in addition to these issues there is also reckless driving behavior that results in traffic congestion, disrupting the flow of traffic, and accidents. All these issues can be addressed by regularly enforcing the traffic laws within the city, along with carrying out public awareness of the dangers of driving (Kaixi & Li, 2020).

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An approach that is coordinated, and multifaceted, where it combines investing within proper infrastructure, having regulatory reforms, and behavioral changes within drivers is significant and important to solving the issue known as traffic congestion within the cities of PNG. Thus, this helps us move forward toward a more sustainable, efficient, and allows much more urban mobility by implementing such practices. To add onto easing the flow of traffic, these recommendations can help improve economic activities, public health, and the general standard of living within these cities.

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