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ASSESSING THE CAUSES & IMPACTS OF TRAFFIC CONGESTION ON THE SOCIETY, ECONOMY AND INDIVIDUAL: A CASE OF MAURITIUS AS AN EMERGING ECONOMY

VENCATAYA Lomendra*, PUDARUTH Sharmila*,
DIRPAL Ganess*, NARAIN Vandisha*
Faculty of Law and Management, University of Mauritius, Mauritius

Abstract:

Mauritius has undergone massive developments during the past several years. However, along with economic progress, these developments have also been the cause of trouble for the Mauritian population as they have worsened the problem of traffic congestion. Providing state-of-the-art transportation systems is thus crucial for the proper functioning of the Mauritian economy and society. Hence, the paper explores the repercussions that traffic congestion has on the society, economy, and individual. Also, the paper seeks to examine the impact of traffic congestion on several aspects, such as worker productivity, economic growth, commuter health and safety, travel reliability, and the environment. Questionnaires have been helpful tools in obtaining quantitative data. A sample of 100 respondents, consisting of people travelling to and from Ebene and Port Louis on a daily or regular basis, was selected using convenience sampling. The data obtained were then analysed through the SPSS software. Results indicated that traffic congestion negatively impacted on various aspects of the society and economy. The study has depicted that the respondents have affirmed that traffic congestion has an adverse effect on the society, the economy, and the individual. The paper discusses important practical issues relating to traffic congestion in Mauritius, its sources and its effects on the society, the economy, and the individual. Thus, it provides insights to the Mauritian Government and policy-makers on the ways in which they can measure traffic congestion, manage traffic more effectively, adopt appropriate policies, and invest in infrastructural projects. This paper is apt, original, and a must-read as it discusses such issues as traffic congestion, its roots, and its repercussions on the Mauritian society, economy, and individual.

Key words: *Traffic Congestion; Society, Economy and Individual; Mauritius; Worker Productivity; Economic Growth; Commuter Health and Safety; Travel reliability; Environment*

1. Introduction

Traffic congestion refers to the way the movement of vehicles is delayed by one another because of limited road capacity (Rahane & Saharkar, 2014). In simpler

terms, road congestion occurs when the demand for traffic nears or surpasses the capacity of the road network (Raheem *et al.*, 2015). Numerous studies have demonstrated that traffic congestion has unfavorable impacts upon the society and economy of Mauritius. Dorsamy and Puchooa (2013) state that the problem of traffic congestion in Mauritius has been in the limelight since the 1990s, following the closure of the railway between Curepipe and Port Louis in 1964. Thus, the road is the only form of land transport available in Mauritius. A 60-kilometer motor way runs from the North to the South of the island, linking the airport at Plaisance, the urban areas of Beau-Bassin, Rose-Hill, Curepipe, Vacoas/Phoenix, Quatre-Bornes, Port-Louis, and the rural area of Pamplemousses. Therefore, the road network in Mauritius plays a crucial role in the transportation system. However, Mauritius has experienced major developments during the past few years, leading to an increase in the need for advanced transportation systems. Consequently, the road is believed to be incapable of handling the amount of traffic on the roads during peak hours. Port Louis, the Capital of Mauritius, is the business and financial centre of the island and constitutes half of the labour market. Thus, more than 150,000 people travel to Port Louis every morning (Lamy-Giner, 2011). According to Menon (2004), Port Louis faces severe traffic congestion during peak hours due to the huge number of vehicles coming into the city. Therefore, this gives rise to road congestion, which is one of the most persistent problems afflicting numerous countries around the globe. Hence, this paper seeks to provide an in-depth understanding of the key factors directing the occurrence of traffic congestion, and hoe those factors affect the society, economy and the individual. The Mauritian Government needs to strive for constant progress in enhancing the quality of the road network. To achieve this, there is an urge to determine the predictive factors that give rise to traffic congestion in Mauritius. The aim of this paper is to provide insights to the Mauritian Government and policy-makers on the ways in which they can measure traffic congestion, manage traffic more effectively, adopt appropriate policies, and invest in infrastructural projects. This study will also be relevant to bus companies, as various measures to improve public transport services will be proposed. The working population and other commuters will also benefit from this study, as it will focus on the merits of using public transport and adopting the 'carpool' culture as a means of relieving the traffic congestion problem.

2. Literature review

Traffic Congestion - A Global Phenomenon in Emerging Economies

Road congestion is a major concern for most countries across the globe (Jain *et al.*, 2012). According to Rao and Rao (2012), road traffic congestion is a matter of concern for Indian transportation professionals as most cities suffer from moderate to severe congestion. Traffic congestion in India occurs mainly because of the poor road conditions, varying road way features, poor lane discipline, inappropriate bus-stop location and design, diversity of traffic, and unrestrained on-street parking. Furthermore, in a study conducted by Zhang (2011), it was revealed that the problem

of traffic congestion is also prevalent in China, because of the inefficient public transport services that are the main means of transport for people, as well as the inverse relationship that exists between the number of vehicles and the road capacity. Additionally, Reunion Island, where the only means of travel is by road, experienced an increase of 126% in the number of private vehicles from 140,000 in 1990 to 317,000 in 2010. This is because peoples' home and the workplace are situated at a distance, and businesses are concentrated in only a few coastal cities (Lamy-Giner, 2011).

Traffic Congestion - A Global Phenomenon in Developed Countries

The Singaporean economy has experienced remarkable changes since independence in 1965. However, these developments have also brought about severe cases of traffic congestion, mostly in the city center. The large population and small land area lead to high demand for the limited road space, especially during peak periods of the day, thus causing roads to be congested (Yuan, 1997). In addition to this, past trends indicate increasing traffic congestion in Melbourne, mainly because of increased road usage, extended morning and afternoon peak periods, more time spent in traffic, underpricing of road-use, poor road infrastructure design, and the insufficient alternatives to public transport, whereas the average travel speed has gradually reduced. In 2011, the Department of Transport estimated that 77% of the 12.6 million trips made each weekday in Melbourne were by car. As Melbourne's population reaches 5.5 million people, the percentage of trips by car is expected to increase further by 41% in 2036, that is, 17.8 million trips per day (Frost, 2013). Moreover, Hill (2016) stated that London's increasing population and dynamic economy creates a burden on the road network, resulting in congested roads. This has a negative impact on businesses, the environment, and on the individuals. According to the Transport for London (TfL) performance report 2016/2017, London experienced a 1.4% decrease in average traffic speeds in the fourth quarter of 2016/2017.

Causes of Traffic Congestion

There are principally two factors causing traffic congestion, namely micro-level factors, including the high number of people on the roads at the same time, and the overflow of vehicles on the limited road space; and macro-level factors, such as land-use patterns, car ownership trends, and geographical economic development. Congestion is prompted at the micro-level, and steered at the macro-level (Tilak & Reddy, 2016). Some of the factors causing traffic congestion are listed in Table 1 below:

Table 1: Factors giving rise to traffic congestion

Factors Causing Traffic Congestion	Relevant Studies

Excessive No. of Vehicles	As stated in the Report on Study of Road Traffic Congestion in Hong Kong (2014), the excessive number of vehicles on the roads is one of the primary reasons why traffic congestion arises.
Population Growth	Raheem *et al.* (2015) postulate that as the population of a country increases, the demand for road travel also grows. They however added that the growth in population has not been complemented by the construction of new roads, thus causing roads to be congested.
Inefficient Public Transport Services	The ineffectiveness of public transport to offer services efficiently gives rise to traffic congestion, which in turn has critical repercussions on the socio-economic activities of a country (Harriet *et al.*, 2013).
Inefficient Road Traffic Management	Road congestion can occur due to the narrow and poorly constructed roads and streets that are ineffective in handling various vehicle types. This results in the inability to effectively manage traffic, creating bottlenecks that last for extended periods (Jain *et al.*, 2012).
Poor Roadway Condition	The uneven road network features, lack of lane discipline, and unsuitable bus-stop location prompt road congestion (Tilak & Reddy, 2016).
Economic Development / Urbanisation	Road congestion in cities is mostly the result of prosperous economic development, and career, accommodation and societal programs that encourage individuals to work and live closer. The remarkable increase in the number of vehicles on the roads as a result of rapid urbanization has led to a rise in traffic volume, thus causing roads to be congested in every city in India (Tilak & Reddy, 2016).
Unforeseen Circumstances	According to the 'Report on Study of Road Traffic Congestion in Hong Kong' (2014), road works are believed to be a major factor giving rise to traffic congestion. Incidents, such as roadworks, prompt the occurrence of bottlenecks and accidents, which in turn cause traffic congestion to take place (Schwietering & Feldges, 2016).

Impacts of Traffic Congestion on the Society

Two of the main external costs of transport are traffic congestion and road accidents, and thus, transport policy-makers aim at reducing their impacts on the society (Wang *et al.*, 2009). The results obtained from the survey conducted for this study showed that traffic congestion affects peoples' social life as they must begin their journey earlier in the morning and reach home later than the usual time in the evening so as to avoid traffic. Elisonguo (2013) added that in Dar Es Salaam, many children are school dropouts, drug addicts, and are engaged in sexual activities at a young age,

because their parents spend a lot more time on the roads than at home with their children due to road congestion. Congested traffic often causes accidents, due to drivers trying to get through the congested roads faster than others (Elisonguo, 2013).

Impacts of Traffic Congestion on the Economy

Some studies put forward that the relationship between transportation and productivity is vital as a well-established transportation system triggers a country's economic development (Lu *et al*., 2009). On the contrary, Eddington (2006) argued that road congestion is costly for a country's economy. Likewise, Elisonguo (2013) found that road congestion causes late arrival to workplaces, causing loss of output, missed deliveries, reduced productivity, and restricted economic growth. Choi *et al.* (2013) and Elisonguo (2013) stipulate that fuel consumption and depreciation of vehicles also tend to increase because of traffic congestion, thus leading commuters to spend more money on fuel. Businesses that have adopted the just-in-time system are more prone to be affected by traffic congestion as it is difficult to make just-in-time deliveries efficiently, thus reducing productivity and competitiveness (May and Marsden, 2010; Raheem *et al.*, 2015). Choi *et al.* (2013) and Raheem *et al.* (2015) add that businesses dealing with perishable products rely a lot on travel reliability. However, travel conditions are unreliable when roads are congested, as traffic flow is impeded, thus causing travel time to increase.

Impacts of Traffic Congestion on the Individual

An overwhelming body of literature has depicted that road congestion contributes to the aggravation of environmental conditions, including air pollution. Various authors have claimed that vehicular exhalations, triggered by traffic congestion, are the main causes of air pollution (Chakrabartty and Gupta, 2014; Elisonguo, 2013). Based on the data collected through the questionnaires, it was found that traffic congestion induces a high level of stress and frustration in commuters, especially drivers, as they are required to be more attentive and focused while driving in challenging conditions. The results obtained from the survey also revealed that accidents endanger the safety of commuters. Likewise, the survey conducted for this study generated results that depicted that commuters suffering from asthma or other respiratory problems may be prone to more serious diseases because of polluted air caused by vehicular exhalations.

3.Research methodology

Research Methodology

In line with the present research, the paper adopts both qualitative and quantitative research methods. As part of the quantitative research, a questionnaire was also designed and distributed to the target population. The questionnaire was the main tool for data collection, and it comprised of three sections on the impacts of traffic congestion. The questionnaire items were constructed and adapted from the existing

intensive literature review. In this paper, the degree to which respondents agreed that traffic congestion affected the society, economy and environment was measured on a five-point Likert Scale. Data collected through the quantitative survey were coded and recorded using the SPSS software for inferential analysis. Finally, a statistical test was carried out to analyse the difference between the population mean and the sample mean of the impacts of traffic congestion.

Sampling Plan

The target population comprises of people working in Ebene and Port Louis, and those who were conveniently available to partake in the study. The sampling procedures were certainly aimed at satisfying the main demographic variables and the targeted same frame consists of all relevant types and the right mix of individuals to ensure that it reflects and represents the whole population. In the process of data collection, structured questionnaires were mainly used as research instrument for this paper, and these were distributed to the respondents on a face-to-face basis, as well as via social media, e-mail, and in offices through friends and relatives.

4. Empirical findings

Part A: Demographic Profile of Respondents

Table 2: Demographic Profile of Respondents

Gender	Frequency	Percentage (%)		Residential Location	Frequency	Percentage (%)
Male	42	42		North	28	28
Female	58	58		South	14	14
				East	20	20
				West	10	10
				Central Plateau	27	27
				North West	1	1
Age Group	**Frequency**	**Percentage (%)**		**Income Group**	**Frequency**	**Percentage (%)**
18 - 25	39	39		Less than Rs 5,000	7	7
26 - 33	21	21		Rs 5,000 - Rs 9,000	13	13

34 - 41	22	22	Rs 10,000 - Rs 14,000	11	11
42 - 50	9	9	Rs 15,000 - Rs 19,000	22	22
Above 50	9	9	Rs 20,000 - Rs 24,000	13	13
			More than Rs 25,000	22	22
			Not Applicable	12	12
Driver's License	**Frequency**	**Percentage (%)**	**Own Private Car**	**Frequency**	**Percentage (%)**
Yes	66	66	Yes	51	51
No	34	34	No	49	49

n=100

Table 2 demonstrates the profile of respondents, where most respondents, being working people, represent 63% of the sample, while the remaining 37% represent the non-working people, consisting mainly of students. Out of the 63%, 35% of respondents work in Port Louis, 23% work in Ebene, and 1% work in each of the following areas: Beau-Bassin, Coromandel, Grand-Bay, Pamplemousses and Phoenix. Most of the respondents belong to the age group of 18 - 25 years, representing 39% of the sample. Many respondents are from the North (28%) and the Central Plateau (27%). Moreover, in the survey questionnaire, 48% of respondents selected 'Bus' as their daily transport mode, while 46% chose 'Private Car', followed by 5% who chose 'Motorcycle', and 1% who chose 'Taxi'. Additionally, 49% of the people surveyed rated the public transport service as 'Average', while 27%, 20% and 4% rated it as 'Good', 'Poor' and 'Excellent' respectively. Furthermore, 82% of respondents believe that traffic congestion is an ever-increasing problem in Mauritius, and 47% of respondents state that the problem of traffic congestion is serious.

Part B: Empirical Findings

Table 3: Mean Analysis - Causes of Traffic Congestion

	N	Mean
Economic Development	100	2.46
Excessive no. of Vehicles	100	1.97
Population Growth	100	2.48
Inefficient Public Transport Services	100	1.86
Unforeseen Circumstances	100	2.22
Poor Road Network	100	2.39
Job Centralisation	100	2.07
Lack of Workplace Flexibility	100	2.14

Statements on 'Causes of Traffic Congestion' in the questionnaire were based on a Likert Scale, whereby a mean value of 1 meant that respondents strongly agreed, while a mean of 5 meant that the respondents strongly disagreed with the statements. As indicated in Table 3, for a sample size of 100, the mean values of 2.46, 2.48, 2.22, 2.39, 2.07 and 2.14 for 'Economic Development', 'Population Growth', 'Unforeseen Circumstances', 'Poor Road Network', 'Job Centralisation' and 'Lack of Workplace Flexibility' respectively, indicate that respondents, on average, agree that traffic congestion is partly the result of these factors. Also, by looking at the mean values of 1.97 and 1.86 for 'Excessive no. of vehicles' and 'Inefficient Public Transport Services' respectively, it can be deduced that respondents, on average, strongly agree that these two factors are the main causes of traffic congestion.

Table 4: Mean Analysis - Impacts of Traffic Congestion on the Society

	N	Mean
Fuel Consumption	100	1.65
Air Quality Affected	100	1.71
Late Delivery of Goods	100	2.82
Accidents	100	2.44
Passage of Emergency Vehicles Obstructed	100	2.03

Statements on 'Impacts of Traffic Congestion on the Society' in the questionnaire were set based on a Likert Scale, whereby a mean value of 1 represents 'Strongly Agree', while a mean value of 5 represents 'Strongly Disagree'. From Table 4, the mean values of 2.82, 2.44 and 2.03 for 'Late Delivery of Goods', 'Accidents' and 'Passage of Emergency Vehicles Obstructed' respectively, indicate that respondents, on average, agree that traffic congestion produces these impacts on the society. By looking at the mean values of 1.65 and 1.71 for 'Fuel Consumption' and 'Air Quality Affected' respectively, it can be deduced that respondents, on average, strongly agree that traffic congestion has a negative effect on fuel consumption and air quality.

Table 5: Mean Analysis - Impacts of Traffic Congestion on the Economy

	N	Mean
Late Arrival to Workplace	100	1.55
Poor Employee Performance	100	1.79
Reduced no. of Productive Hours	100	2.06
Economic Growth Obstructed	100	2.37

Statements on 'Impacts of Traffic Congestion on the Economy' in the questionnaire were set based on a Likert Scale, whereby a mean of 1 = 'Strongly Agree', whereas a mean of 5 = 'Strongly Disagree'. As per Table 5, the mean values for 'Reduced no. of Productive Hours' and 'Economic Growth Obstructed' are 2.06 and

2.37 respectively. These values denote that respondents, on average, agree that traffic congestion reduces the number of productive hours at the workplace, and obstructs economic growth. Moreover, the mean values for 'Late Arrival to Workplace' and 'Poor Employee Performance' are 1.55 and 1.79 respectively, meaning that respondents strongly believe that traffic congestion leads employees to arrive late at their workplace and causes them to perform poorly at work.

Table 6: Mean Analysis - Impacts of Traffic Congestion on the Individual

	N	Mean
Safety of Commuters Affected	100	2.11
Stress	100	1.79
Health Problems	100	1.91
Frustration	100	1.99
Social Life Affected	100	2.03

Statements on 'Impacts of Traffic Congestion on the Individual' in the questionnaire were based on a Likert Scale, whereby a mean of 1 represents 'Strongly Agree', while a mean of 5 represents 'Strongly Disagree'. As shown in Table 6, the mean values for 'Safety of Commuters Affected' and 'Social Life Affected' are 2.11 and 2.03 respectively. These signify that respondents, on average, agree that traffic congestion endangers the safety of commuters and disrupts their social life. Also, the mean values of 1.79, 1.91 and 1.99 for 'Stress', 'Health Problems' and 'Frustration' respectively, validate that respondents, on average, strongly believe that traffic congestion is the source of stress, frustration and other health problems in an individual.

5. Managerial implications of the study

The study has brought about some fascinating findings about the impacts that traffic congestion has upon the Mauritian society, economy, and the individual. These findings should be taken into consideration by the Mauritian Government, policy-makers, bus companies, the working population, as well as the general public. The empirical findings have demonstrated that people believe that traffic congestion negatively impacts upon the society, economy and the individual. Hence, the Mauritian Government and other concerned parties must ensure that the repercussions of traffic congestion on the society and the economy are reduced.

It is very crucial for the Mauritian government to ensure that accidents, air pollution, and other factors affecting the society as a result of road congestion are lessened. The Government should be able to measure traffic congestion and manage traffic more effectively so that less time is spent in traffic. This will result in reduced air pollution and fuel consumption. Moreover, companies that deliver perishable products, or those that adopt the 'Just-In- Time' approach, and emergency vehicles are affected when roads are congested. Thus, if traffic is managed more effectively, the delivery of

goods will be made on time, and the passage of emergency vehicles will not be obstructed. Traffic rules and regulations must be stringent enough to deal with the problem of road congestion on a daily basis. There is also a need for better synchronisation of traffic lights along the motorway to Port Louis, more specifically at Place D'armes.

Traffic congestion also has a major impact on the economy. When roads are congested, employees reach their workplace late, and they often feel fatigued because of the time spent in traffic. Traffic congestion affects a person's psychology as it impacts upon the mental capacity of commuters. As a result, employees' performance at work is affected and the number of productive hours is reduced. This causes loss of output, thus hindering the economic growth of a country. As such, the Government should invest in feasible infrastructural projects so that roads are less congested, especially during peak hours. Improving the existing road infrastructure, or even expanding the road capacity, might help to handle the ever-increasing number of vehicles on the roads, at least in the short term or medium term. Access-management and road-pricing policies will also be effective in reducing the problem as vehicles might be denied access to some roads or may be charged for travelling on certain roads. Changes in the work schedules, such as 'Flextime', will also help alleviate the traffic congestion problem as people will have different travelling times, and some may also be able to work from home. Moreover, building smart cities will also help improve traffic flow on the roads. Smart cities will allow several offices to delocalise to other parts of the island, thus directing traffic to different parts of the island.

Road congestion negatively impacts upon the safety of commuters. Commuters' safety is threatened when accidents occur as a result of traffic congestion. When roads are packed with vehicles, people want to reach their destination earlier. While doing so, they tend to drive carelessly, causing accidents on the roads and endangering peoples' safety. Additionally, people feel stressed and frustrated as they have to drive in challenging circumstances, giving rise to other health-related issues. Peoples' social life is also affected by traffic congestion as they have to begin their journey earlier in the morning and arrive at home later than usual in the evening in order to avoid traffic. Hence, the 'carpool culture' can be promoted as an effective solution to the problem of traffic congestion in the short term. Carpooling will help in reducing the number of vehicles on the roads, thus reducing the amount of carbon dioxide exhaled by vehicles. This will also be beneficial to commuters as they will be travelling with 2 or more individuals, allowing them to socialise more. Moreover, enhancing the quality of public transport services and introducing the Light Rail Transit system will improve and modernise the public transport system in Mauritius.

6. Conclusion

Far from having reached its apex, assessing the repercussions of traffic congestion still needs more research and practice. There is strong empirical evidence in this paper demonstrating that people do believe that traffic congestion negatively

affects different aspects of a society, economy and an individual. This is where the Government's as well as other policy-makers' roles become vital. Eminently, the empirical findings can be a useful and pragmatic tool for policy-makers, bus companies, and even the general public of Mauritius to re-orient their strategies and habits, and opt for an approach that is in the best interest of the various stakeholders.

Overall Limitations of the Research

The paper has some potential limitations, such as a larger sample size could have been chosen. Results might be biased due to unforeseen circumstances. Furthermore, the lack of qualitative analysis could have resulted in various aspects not being considered. Also, the study focused mainly on the individual, the economy and the society as whole, thus ignoring the views of other parties concerned, such as the National Transport Authority (NTA), the Road Development Authority (RDA), the Mauritius Police Force (MPF), as well as the Government.

Directions for Future Research

Further research can be carried out to develop a broader conceptual framework to assess the impacts of traffic congestion on the society, the economy and the individual, as well as on various other aspects with more explicit results. Additionally, the operational performance, such as the quality, flexibility of service, dependability, speed, and cost, of the public transport can be assessed. Future researchers can also conduct a study on the causes of traffic congestion. Using the study on the impacts of traffic congestion, additional research could be extended toward assessing the different ways in which traffic congestion can be mitigated in Mauritius through alternative modes of transportation.

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