

How Do Urban Cities Manage Road Traffic Congestion?

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Abstract: Traffic Congestion transpires the minute the demand for transport surpasses supply at an exact point in time and in a particular section of the transport system. South African cities are facing traffic congestion characterised by dense origins and destinations with activities located in different cities. The roads and streets have congestion within the areas where individuals are attracted and benefit from economic prosperity. Congestion is the main restriction in operation because it affects the middle class and could drive changes in an urban location and movement patterns more quickly. This paper explores how urban cities manage road traffic congestion in South Africa. The paper is based on a theoretical analytical review of traffic congestion in national cities. Based on the current review, the cities such as Cape Town, Johannesburg, Durban, Tshwane, Pietermaritzburg, Port Elizabeth, East London, Bloemfontein and Vanderbiljpark are relatively experiencing a high congestion level. The paper also reviews the policies and regulations employed to monitor traffic matters and mitigate road traffic congestion in South African roads.

Keywords: Policies; Road traffic management, South African cities, Traffic congestion, Urban cities, Urbanisation

1. Introduction

Traffic Congestion transpires the minute the demand for transport surpasses supply at an exact point in time and in a particular section of the transport system (Rodrigue, Comtois & Slack, 2020). It predominantly ascends from heavily populated areas that constitute many private vehicles (Metz, 2018). An increase in this number of car ownership affects the urban traffic destructively, causing additional delays at the intersections, traffic accidents, fuel consumption, emission values and stress (Balta & Özçelik, 2020; Shen et al., 2020; Zhao & Zhang, 2012). South African cities are facing traffic congestion challenges and are characterised by dense origins and destinations with activities located around these urban cities (Van Ryneveld, 2018). However, the moment public transport provides meaningful travel time savings, then it will develop innovative services progressively to private car users who would otherwise be caught up in traffic congestion (Van Ryneveld, 2018).

The rate of traffic congestion in cities produces the situation within which the road networks could no longer accommodate the capacity of the traffic in it. Such road capacity is insufficient to accommodate trips that are made, particularly during peak hours. Cities rely mostly on infrastructure supplies and when the road capacity is inadequate, that will consecutively damage the urban economy (Glaister & Graham, 2006).

Various cities find it difficult to wrestle traffic congestion because urban cities need land space to reduce this problem. Usually, the road networks expansion and the construction of new roads are regarded as the solution to manage traffic congestion in many cities (Segola & Oladele, 2016). However, according to Olayode, Tartibu & Uchechi (2020), constructing more roads or expanding existing roads on this land could result in a shortage of spaces since urban areas are underfunded or lack intelligent transportation systems to combat traffic congestion.

Transport systems require constant attention as many commuters travel daily using these urban infrastructures. According to Chakwizira, Mudau and Radali (2014), the roads and streets have congestion within the areas where individuals are attracted and benefit from economic prosperity. Congestion of this nature is not good as it leads the province to loss of income, decrease economic activity, constrained job creation and greater cost of living (Schoeman, 2015). In South Africa, cities such as Bloemfontein, Cape Town, Durban, East London, Johannesburg and Pretoria are experiencing a relatively high level of traffic congestion. Congestion is the main restriction in operation because it affects the middle class and could drive changes in an urban location and movement patterns more quickly.

This paper explores how urban cities manage road traffic congestion in South Africa. The paper is exploratory in nature and reviews road traffic congestion

globally and South African context. The paper proceeds as follows: 1.2 literature review, 1.3 urban cities' road traffic congestion management through rapid rail systems, BRT Systems, congestion charging: e-toll and fuel levy, parking policies, carpooling or ride-sharing incentives, bike-sharing and flexible working hours and work from home initiatives, through parking policies, through car maintenance charge, policies and regulations mitigating road traffic congestion.

2. Review of Road Traffic Congestion

This section of the paper review traffic congestion comprehensively. It commences with the global context and narrowed down to the South Africa context.

2.1 Global Context

Globally, road traffic congestion establishes a challenge for both well-built and developing urban cities. Traffic congestion has negative implications, which commonly affect productivity and socio-economic development and mainly generate a loss of travel time and fuel costs. Commuters experience the discomfort of travelling along the crowded highways and require solutions from public official (Thomas et al., 2018). One of the unanimous problems encountered in many cities involves excessive traffic streams on the road created by private vehicles (Tang, 2021). The condition transpires in heavily populated urban areas through increased levels of congestion (Metz, 2018). This congestion involves urban movement, which spreads subsequently through the accumulation of economic activities. Traffic is not unintentionally dispersed throughout the space, nevertheless, the compressed traffic is regularly nearby the city centre where economic activities are concentrated (Tang, 2021).

The development in big cities attracts immigration and intensifies the population. The growth of population in urban cities encourages the demand for travelling. Tang (2021) affirmed that businesses and people in metropolitan areas compete for space, characterised by outward expansion, which is attracted by productivity gains and amenities in the cities. Additionally, low-income households are likely to live in the pretentious and suffer significantly from the negative consequences of increased congestion (Moyano et al., 2021). However, the sustainable solution for mitigating urban congestion

and other traffic-related problems calls for understanding urban traffic congestion characteristics and effective management of existing infrastructure through appropriate planning and control measures (Zhong et al., 2021). Proper transport systems with an adequate road network could minimise road traffic congestion and be crucial for cities and regions. The section that follows will discuss the road traffic congestion in South African cities.

2.2 Road Traffic Congestion in South African Cities

Irrespective of countless efforts to alleviate congestion, certain cities are incredibly still facing challenges that keep on increasing. South Africa still considers road traffic congestion to be an inevitable outcome of scarce transport resources. The condition has led main freeways and roads experiencing high levels of congestion and consequently high pollution levels (Moyo, Kibangou & Musakwa, 2020). Therefore, there is a high demand for travel needs in the cities. This challenge mainly affects multiple metropolitan towns in the country, including the Central Business District (CBD). According to Feikie, Das and Mostafa (2018), the country faces ongoing development that might leave 71.3% of the South African population living in urban areas by 2030. This situation is predictable to reach nearly 80% by 2050.

The current vehicle ownership in the country is presently around 210 vehicles/1 000 population (Stander & Brink, 2016.). Because of the improved individual economic conditions, the motor vehicle population is growing at a relatively high rate. Table 1 on the next page indicates the most congested cities in South Africa and the average hours spent in congestion.

Based on Table 1, Cape Town is the most congested city with 25% of peak period traffic and -49.1 hours spent in congestion. The second crowded city is Johannesburg during peak hours, with 18% and hours spent in congestion equivalent to 46.8. Durban is the third most congested city in South Africa, with 17% were the hours spent in congestion equal to -30.2. Pretoria is the fourth most congested in South Africa, with 15% and 28.1 hours spent in congestion. According to Stander and Brink (2016), shifting commuting trips to public transportation, ride-sharing services, and promoting telecommuting whenever possible would reduce traffic on the urban roads. The following sub-section discusses

Table 1: Most Congested Cities in South Africa and the Average Hours Spent in Congestion

Driving Time Spent in Congestion							
City	2016 All Cities Rank (2015)	2016 INRIX Traffic Scorecard Rank (2015)	Hours Spent in Congestion	ICI	Peak	Daytime	Overall
Cape Town	33 (53)	28 (29)	-49.1	8	25%	12%	13%
Johannesburg	44 (62)	33 (31)	v 46.8	7.3	18%	7%	9%
Durban	158 (189)	-	-30.2	5.1	17%	8%	9%
Pretoria	191 (186)	87 (85)	v 28.1	4.3	15%	5%	7%
Pietermaritzburg	384 (417)	-	^ 19.8	4	12%	10%	9%
Port Elizabeth	401 (292)	-	v 19.1	3.3	11%	6%	6%
East London	437 (487)	-	^ 17.7	3.2	11%	7%	7%
Bloemfontein	470 (421)	-	v 16.1	3.1	9%	6%	6%
Vanderbiljpark	1013 (1009)	-	^ 4.9	1	3%	2%	3%

Source: Wheels24 (2016)

how road traffic congestion in South African cities is managed. The sections below include managing through rapid rail systems, managing through BRT systems, managing through congestion charging: e-toll, managing through parking policies and managing through car maintenance charge.

2.2.1 Managing Through Rapid Rail Systems

In Gauteng, particularly Johannesburg and Pretoria, the Gautrain project serves the rapid transport service, providing safe, efficient, and reliable service to commuters and airport travellers. Its objectives included improved accessibility and mobility in Johannesburg and Pretoria by decreasing traffic congestion on the overcrowded highway between the two cities (Fombad, 2015). Gautrain Rapid rail system is regarded as the first high-speed rail in the African continent and is destined to reduce road traffic congestion and sustain accelerated economic growth and development (Fombad, 2015; Thomas, 2013).

Although the Gauteng government recently requires contributions and commentaries on the proposed Gautrain extension, according to Thomas (2013), this rapid rail system provides a spotlight to the wealthy class of individuals in the region. King & Ssamula (2008) added that Gautrain's success would be based on the feeder's superiority and further transport service integration. Pojani & Stead (2015) argued that developing cities could construct such systems over a few kilometres in a few limited corridors because of high cost, which does not meet the broader transport needs of the population.

2.2.2 Managing Through BRT Systems

The government of South Africa developed a public transport strategy to expediate the public transport sector. Various cities adopted Bus Rapid Transit systems to address urban transport challenges (Mamabolo & Sebola, 2018; Bannister & Esteves, 2017). The BRT system is commuter-friendly and cost-effective over a long distance. It delivers affordable, reliable, and secure public transport services to provide economic benefits compared to other public transport systems because it operates at a flat rate (Adewumi & Allopi, 2013). The success of the Johannesburg BRT system guided other cities in South Africa such as Cape Town, Nelson Mandela Bay, Rustenburg, Ekurhuleni, Johannesburg and Tshwane to execute this initiative (Green Transport Strategy, 2018-2050).

Comparing the BRTs service to standard buses, the BRTs are more effective with improved accessibility and mobility, speed, and provide affordable connectivity and reliable services for various requirements (Merkert et al., 2017; Weakly & Bickford, 2015). Vermeiren et al. (2015) added that implementing the bus rapid transit system within the areas would decrease the travelling time by half. The separate lane enables this system to have lower headways and accommodate higher peak period loads. The introduction of the intersection can only minimise the delay (Adewumi & Allopi, 2013). Thus, the system delivers pedestrian safety, convenience and features dedicated bus-only lanes and bus stations that are safe, comfortable, protected from the weather (Bannister & Esteves, 2017). Furthermore,

the service also accommodates both the physically challenged and able commuters in these secure access facilities.

2.2.3 Managing Through Congestion Charging: E-Toll and Fuel Levy

Congestion charging means ensuring that drivers using valuable and road spaces are liable to make a financial contribution. One approach to reduce road traffic congestion is to charge car owners according to the level of congestion. Various cities considered the implementation of the road pricing to reduce the traffic congestion since the execution from London, Stockholm and Singapore (Hess & Börjesson, 2017). In Gauteng, through South Africa National Road Agency Limited, the government introduced e-toll networks as part of congestion management measures. These compel travellers to replace private vehicles with public transport to ensure that journey times are quicker and more reliable.

As part of the congestion charging strategy, the South African government introduced various measures, including fuel levy, to make public transport more accessible, cheaper, faster, and more reliable. The government has proposed increasing the fuel levy to achieve revenue-raising objectives to meet the finance target (Green Transport Strategy, 2018-2050). The increase in transport fuel will suppress the demand for private vehicle usage, ultimately reducing traffic congestion on the roads.

2.2.4 Managing Through Parking Policies

Universally, the parking provision is obligatory at minimum rates arranged by municipal regulations or national policy documents (Scheepers & Venter, 2017). The South African parking standards stipulate the minimum parking rates available for urban cities. According to Hitge and Roodt (2006), the parking standard was developed to ensure that vehicles can quickly be taken off the street network once they arrive at the destination. Since the urban activities and movement relationship has owed its changing character to road space pricing and parking policies, the parking standard criterion is expected to relieve traffic congestion and permit other traffic flow to reach their destinations quickly. Therefore, an increase in the South African population requires the strength to adapt to new development without jeopardising the excellence and productivity of the services concerned (Feikie, Das & Mostafa, 2018). The minimum parking policies were employed to

guarantee that the trip demand could be adjusted off the road network to prohibit traffic congestion from passing (Hitge & Roodt, 2006).

2.2.5 Managing Through Carpooling (Ride-Sharing) Incentives

Even though the arrangement existed in the centuries, carpooling has recently made a regeneration through the internet and smartphone or hailing technology (Vanderschuren & Baufeldy, 2018). Carpooling is a way people share their rides with other commuters travelling in the same direction. This transportation system is a promising way to deal with urban transport challenges. Commuters contribute by reducing travelling costs, carbon footprint and road traffic congestion and benefit from using high occupancy lanes, commuting time (Rabbitt & Ghosh, 2016; Shaheen et al., 2012). Carpooling encouragements include different types such as designated driver, alternating and employer carpools. In Cape Town, (Vanderschuren & Baufeldy, 2018) found various potential ride-share markets that include low-income households that are improbable of owning a car rapidly. The ride-sharing services for low-income households usually concentrate on social needs and the potential impacts for high-income households are economical and environmental.

2.2.6 Managing Through the Bike-Sharing Scheme

South African municipalities are rapidly transforming the public transport system because the number of private vehicles has increased (SUTP, 2020). Bicycle sharing schemes are significantly sustainable transport interventions typically aimed at individuals who do not own bicycles and are intended to balance public transport (Jennings, 2011). The scheme provides fast and easy access with low deposit and documentation and encourages commuters to employ this system for short urban trips. According to Shaheen et al. (2012), the system operates typically in the central business district with numerous desirable destinations of short movement patterns to and from the public transport interchange. Bike-sharing has assisted in conquering numerous obstacles using the bicycle as a mode of transportation, including safety concerns, space for storage, maintenance, weather, travel patterns, and overall cost.

The scheme is currently insinuated in Cape Town and Tshwane cities (Jennings, 2014; SUTP, 2020). Public bicycle systems received increased attention

in the city of Cape Town. However, "the business models that is determined by advertising revenue, automation, and credit card possession are likely to exclude the urban poor, who live beyond the central city and seldom can afford the security requirements such systems may require" (Jennings, 2014). The city of Tshwane is also the foremost since the event held in October 2020 of prioritizing the walking and cycling initiatives (SUTP, 2020). The could increase the cycling rate in cities, contribute to an integrated multimodal transport system and help resolve congestion issues, poor air quality, high greenhouse gas emissions and lack of transport options.

2.2.7 Managing Through Flexible Working Hours and Work from Home Initiatives

Flexible working arrangements (FWAs) refer to employment practices that provide employees with less rigid structures to execute their daily work and operate in variable working hours (Masuda et al., 2012). When it is not obligatory for an employee to perform the work within regular hours from 9:00 to 17:00, the decision regarding hours can be taken before or after the time frame to complete a day's work. In South Africa, certain companies already applied flexible working hours and work from home arrangements. Professional workers could progressively perform work outside regular working hours while being away from the workplace or the comfort of their homes (Conradie & De Klerk, 2019). Workers adjust their work programmes to assist in other responsibilities and this approach leads to less congested roads during peak hours.

2.3 Policies and Regulations to Monitor and Mitigating Road Traffic Congestion

The government of South Africa supported the citizens and introduced policies and regulations to guide and restrict road behaviours on national, provincial and regional roads. Walters (2014) stated that the Republic of South Africa (RSA) government implemented strategies and policies to develop and support public transport. This section of the paper debates the policies and regulations employed to monitor traffic matters and mitigate road traffic congestion in South African roads infrastructures.

2.3.1 Urban Transport Act 78 of 1977

This Act was publicised to promote planning and adequate urban transport facilities (Urban Transport Act 78 of 1977). As Chakwizira (2013)

alluded, metropolitan areas especially in Gauteng, have differently changed although reinforced by transport systems designed for their unique conditions. The developments in the regions have increased, making it challenging to access cheap and safe public transport facilities. The relevant clause stipulates in section 22 that any local authority may regulate the size, class or number of motor vehicles under any applicable approved transport plans that may enter any specified portion of the metropolitan transport area (Urban Transport Act 78 of 1977). According to van Ryneveld (2018), rising congestion intensifies the contention for providing public transport to evade a significant decline in urban competence through the number of motor vehicles using the road network. The planning of South African transportation developed into a constitutional planning action as represented by this act.

2.3.2 Draft Revised White Paper on National Transport Policy, 1996

The policy document discusses the topics related to road, road traffic law enforcement, funding of the road traffic management, adjudication of road offences, improvement of road user skills, knowledge and attitudes, incident management, engineering discipline, international harmonisation and lastly, the Non-motorised transport. The policy statements under road include improving road safety and encourage, promote and plan the use of NMT and attracting public transport to discourage private vehicle usage in the country's road infrastructure.

2.3.2.1 Road Transport Demand Management Policy Statements

The principle under road transport demand management guideline includes reducing the demand for travel by single-occupancy vehicles, integrate NMT philosophy in spatial development strategies and cover congestion mitigation in urban areas through a broad-based approach that is aligned with National Land Transport Act (Draft Revised White Paper on NTP, 1996). The policy further states that traffic demand measures will be introduced in order to reduce freight volumes on the road network (e.g. bulk minerals, liquid, gas and agriculture products). Overloading Control Centres should be improved and the network should be expanded. The introduction of a heavy vehicle fee to cover the true cost of the environment and road infrastructure deterioration associated with road haulage will be investigated.

2.3.2.2 Road Traffic Safety Regulation Policy Statements

In order to manage and control the road traffic in South African roads, a continued integrated road traffic quality management and monitoring approach are implemented between the DoT and the provincial authorities. The regulations include road traffic control, road traffic administration and information systems, and road and traffic engineering (Draft Revised White Paper on NTP, 1996). The five pillars of safer roads and mobility, safer vehicles, safer road users, post-crash response, road safety management and related policies addressed in the National Road Safety Strategy will be implemented.

2.3.2.3 Improvement of Road User Knowledge, Skills and Attitudes Policy Statements

The policy statement on improving road user knowledge, skills, and attitudes includes providing a solution to road traffic problems that can only be reached if the need to focus on the human aspects of road traffic is fully recognized. The improvement as a road traffic management function is a priority due to the inadequate emphasis of this function in the past and given the tremendous importance in achieving acceptable levels of road traffic quality.

2.3.2.4 Incident Management Policy Statements

The policy statement includes guidelines that should be used by road traffic authorities when managing the incident. The rules could be either on coordination and cooperation between the various parties concerned with providing road traffic-related emergency services and attention provided to the procedures for the management of incidents where dangerous substances are involved.

2.3.3 National Road Traffic Act 93 of 1996

According to Anchang et al. (2020), the management and control, safety and capabilities of the drivers and vehicles altogether with the usage and operations of the roads in South Africa are generated under the establishment of the National Road Traffic Act 93 of 1996. The main goal that is adhered to under the act is to provide for road traffic matters which shall apply uniformly throughout SA and for matters connected therewith. This act was emphasised to also deal with the empowerment of the traffic officers to regulate and control traffic upon any public road and give such direction as necessary for traffic safety and efficient regulation (National Road Traffic Act 93 of 1996). The

act mainly focuses on the fitness of the drivers, fitness of vehicles, operator fitness, road safety, dangerous goods, road traffic signs and general speed limit, accidents and accident reports, reckless or negligent driving, inconsiderate driving, driving while under the influence of intoxicating liquor or a drug having a narcotic effect, and miscellaneous offences, registration and licensing of motor vehicles, manufacturers, builders and importers.

2.3.4 Road Traffic Management Corporation Act, 20 of 1999

The act is sanctioned to improve the overall quality of road traffic services such as safety, security, order, discipline, and mobility on the roads. This involvement is necessary since providing safe, accessible, affordable and reliable transportation of goods and passengers is critical to the country's development (Sebola & Mamabolo, 2018). Therefore, public transport and road traffic regulation are crucial in developing safety and quality of life for all citizens. Moyana (2008) stipulated that the number of road traffic crashes is directly proportional to the level of lawlessness and drivers' misbehaviour on South African roads. Cooperation and coordination between the national, provincial and local spheres of government are required to support the respective road traffic strategic planning, regulation, facilitation and enforcement (RTMC Act, 1999).

2.3.4.1 Draft National Road Traffic Law Enforcement Code

In chapter 14 of this code, the purposes of the traffic patrol officers include reducing traffic congestion and accidents hazards through systematic enforcement of traffic laws. The traffic laws consist of discipline through strict proactive and reactive control actions. Patrol officers should also know about the geographical area of assignment and the current problems around it. According to Moyana (2008), since there is a challenge of significantly reducing the deaths on the roads, the corporation is responsible for monitoring and evaluating quality and safety in road traffic. Law enforcement prioritises administering road traffic issues that create recurrent interruptions, dangerous circumstances and damaged road infrastructure. The code further states that traffic patrol could assist the offender in re-entering the traffic flow to avoid further disruption. Officers must also manually direct pedestrians or vehicles to flow when traffic controls signal malfunction.

2.3.4.2 Administrative Adjudication of Road Traffic Offences Act, 46 of 1998

The Act aims to promote road traffic quality by providing a scheme to discourage road traffic contraventions and facilitate road traffic infringements. The Act also supports the prosecution of offences in terms of the national and provincial laws relating to road traffic and implements a points demerit system. As mentioned by Anchang et al. (2020), the pilot project implementing the administration of the act, such as the demerit point system for traffic offences, has been rolled out in the metropolitan areas of Tshwane and Johannesburg. The objects of this act are to encourage compliance with the national and provincial laws relating to road traffic and to promote road traffic safety; to encourage the payment of penalties imposed for infringements and to allow alleged minor infringers to make representations; to penalise drivers and operators who are guilty of violations or offences through the imposition of demerit points leading to the suspension and driving licenses cancellation, professional driving permits or operator cards.

2.3.5 Draft National Non-Motorised Transport Policy

The strategic objective of this act embraces enabling Non-Motorised Transport as a feeder system to other modes of transport. One of the public transport strategic objectives is to improve public transport and NMT services to attract private car drivers and increase the proportion of commuters to utilise these services instead of private cars (Draft Revised White Paper on NTP, 2017: 35). The policy promotes a reliable, healthy, affordable, accessible and safe transport mode and reduces traffic fatalities of vulnerable non-motorised road users (Draft National NMT policy, 2008). Municipalities maximise and support NMT as part of their networks, both operationally and infrastructure provision.

3. Conclusion

This paper explored ways in which urban cities manage road traffic congestion in South Africa and abroad. A theoretical analytical review was conducted. The global road traffic congestion, the South African context and the management of road traffic congestion in South African cities. Additionally, the policies and regulations to monitor and mitigating road traffic congestion were discussed.

The paper revealed that South Africa still considers road traffic congestion as an unavoidable results of

scarce transport resources since the circumstances led the regional, provincial and national roads with high level of traffic congestion. Therefore, there is a high demand for travel needs in the cities. This challenge mainly affects multiple metropolitan towns in the country, including the Central Business District (CBD). The paper further disclosed that cities such as Cape Town, Johannesburg, Durban, Tshwane, Pietermaritzburg, Port Elizabeth, East London, Bloemfontein and Vanderbiljpark are relatively experiencing a high congestion level.

The paper concludes with the policies and regulations to monitor and mitigating road traffic congestion. The South African government supported the citizens and introduced policies and regulations to guide and restrict road behaviours on national, provincial and regional roads. At present, some of the stakeholders are still not familiar with appropriate policies and regulations involved concerning road traffic congestion. Therefore, it is suggested that further empirical investigation should be conducted into the subject to avoid future misunderstanding in the South African roads.

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