DEVELOP A POLICY FRAMEWORK TO INCREASE THE TRANSMISSION FROM PRIVATE TO PUBLIC TRANSPORTATION
(WITH SPECIAL REFERENCE TO THE BATTARAMULLA ADMINISTRATIVE CAPITAL IN SRI LANKA)

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Degree of Master of Spatial Planning

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Sri Lanka

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree
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DECLARATION

I hereby confirm that, the research study that I have been submitted for the degree Master of Spatial Planning was solely completed by me. So I hereby confirm that any of the content of this study is not included in any of the previous studies, reports, thesis, Degree or Diploma works. As to my belief, the report does not content any materials that already published or written by.

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ABSTRACT

Traffic congestion can be identified as a manifesting critical problem that can be seen in urban areas around the world. It generates huge negative impacts on the urban environment. Sri Lankan statistics prove that many people in Sri Lanka spend more time on the road and they pay more for fuel. Currently, the vehicle amounts are rapidly increasing and it causes to take more time to reach a destination. Therefore, the need for pt system accessibility is acceded by developed and developing countries, due to one of the main critical issues of road traffic congestion in urban areas.

This research aims to develop a policy framework in order to reduce road traffic congestion and enhance the effective accessibility in public bus transport for the Sri Lankan community. This paper's object is to evaluate the implementation of prevailing policies to enhance the pt and to develop a policy framework to reduce the negative impacts from growing private vehicle population to the public bus transportation system in Sri Lanka.

Keywords: Public transportation, Private Transportation, Traffic congestion, Transport Policy

ACKNOWLEDGEMENT

The thesis is a final result of the hard work of mine and kind support of many individuals. And this would not be completed without the valuable support from them. Therefore I would like to thanks all the individuals who have been believing me and supporting me until the very end.

Hereby I offer my heartiest thanks to Dr Rangajeewa Rathnayaka, Head of Department of Town & Country Planning and all the lectures of the department. Foremost I will extent my gratitude to my principal supervisor Dr Chameera De Silva. As well as I offer my thanks to the non- academic staff and my all the batch mates for their support.

Finally, thank you for all my family, my friends for believe in me, support and the encouragement given in order to successfully complete this study.

Table of Contents

List of Figures

List of Tables

List of Equations

CHAPTER 01
INTRODUCTION

1.1 Introduction

This chapter explains the introduction part of the research which includes the main research idea including research aim, objectives, question, research problem and flow of study.

1.2 Research Problem

As most of the literature have identified correctly, traffic congestion can be identified as one of the manifesting critical problems in urban areas. As the studies say congestion generates huge negative impacts on the urban environment. Sri Lankan statistics prove that many people in Sri Lanka spend more time on the road and they pay more for fuel. Currently, the vehicle amounts are rapidly increasing and it causes to take more time to reach a destination. This will cause to loss Rs. 40 billion annually for Sri Lanka. This is quite a huge economic loss for the country. According to Sirimann (2013), road traffic congestion with limited road network & too many vehicles and air pollution are the causes of this. (Sirimann B., 2013). For that reason, road traffic congestion can be identified as the main transportation issue in Sri Lanka. One of the main core causes of road traffic congestion is vehicles characteristics. It means that road traffic congestion is caused mainly by the increased number of vehicles and vehicle types on public roads. 87% of the vehicle population has increased from 2008 to 2015 (RDA) (December 23, 2016. Economy, Featured, Shipping and Transport). Therefore, the demand for road space increases rapidly. Estimated statistics say that 87.1% of vehicles includes cars, motorbikes, and trishaws which fall under private transport. In comparison, encompassing mainly buses just 5.7% of vehicles belonging to pt, (Vandana H., 2017). The number of private vehicles on the roads critically surpasses the minimum number crucial for a smooth flow of traffic. So, the roads are blocked with hundreds of cars, trishaws, and motorbikes, by

each vehicle creeping through small spaces, switching lanes, and definitely captivating a lot more space on each road than pt will cover.

There are differences when using pt within Sri Lanka. This has caused to create a trend to utilize more private vehicles. The mental depression, level of services of roads, distances to bus stops, the functional capacity, people with functional limitations are such challenges of pt. Oppose to these statistics, it was identified that 51.9% uses pt from the total population, while 44.1% use private transport (Hirananda V., 2017). This displays that even with mere 5.7% of buses on the road, more than half our population use pt. Hence, overcrowding is a common issue that everyone faces. Basically, it can say that roughly 30,000 buses will get pack with half of our population daily. The direct reason for this is the inefficient pt service within the country. Pt inefficiency is unpleasantly affecting each individual of the general public. If there is a more effective and comfortable system, more people will elevate the use of pt and also this will decrease the on road vehicle amount and it will reduce the traffic also. The major reason for this disturbance traffic congestion is in-availability of policy development in a country. Developed and developing countries have been used policy development as the main strategy to enhance pt to erase road traffic.

But there are poor policies to reduce road traffic congestion at implementing stage with regarding the public bus transportation system in Sri Lankan context at present status. The country cannot curb this unproductive, massive cost and the authorities have to take the responisibility as well as actions in order to impove and modernize the public transportation, as identified by transport management expert Amal S. Kumarage (University of Moratuwa). Road widening and flyovers/highways/expressways building are considered as a solution for all these transportation problems. But according to Kumarage, what is a must is having a certain policy related to pt because the above solutions will only solve isolated individual problems. So, there is a need for transport policies for effective accessibility in public bus transport for people in Sri Lanka. The output of the research is the policy framework to erase traffic congestion and for effective accessibility in public bus transport for people in Sri Lanka. Most studies have revealed the causes, which effect to generate traffic congestion. However, they do not investigate much

about the development of the policy framework to increase the transmission from private to pt. Moreover, this study will guide planning practices in a rational manner to reduce road congestion via pt. This research aims to develop a policy framework to increase transmission from private to pt.

"What are the most suitable measures to reduce the traffic congestion in urban areas of Sri Lanka?" is the research question that has been addressed within this research. Further, the objectives of the research are as follow.

> Find Out the most suitable measures to reduce the traffic congestion in Urban areas of SL.
> Evaluate the implementation and efficiencies of prevailing policies to reduce congestion impacts in SL.
> Develop a policy framework to reduce the congestion impacts in Sri Lanka

Basically this research focuses on to find out the suitable measures in order to reduce the traffic congestion. Under that it focuses on main three objectives. Obviously the first one is to find out the most suitable measures to reduce the traffic congestion in Urban areas of SL. Developing a policy framework with these measures will be another objective under this question. It is important to evaluate the prevailing congestion reduction policies in order to create a successful policy framework.

1.3 Scope and Limitations

Many reasons can be identified that generate traffic congestion in a city because it is a broader topic to discuss. Hence this research only focused on the development of the policy framework to increase the transmission from private to pt. As same, the research selected Battaramulla Area as the study area and only considered the 500m buffer zone from the Sethsiripaya and this is because of the time constraint.

CHAPTER 02
LITERATURE REVIEW

2.1 Introduction

Planning for an accessible Public transportation system for all is a generally agreed necessity. But it is a challenge. Many countries around the world promote public transportation instead of private transportation in order to achieve sustainability in every aspect.

2.2 Current Transportation Issues in World Context

Sweden

The urban pt is provided in a differentiated system to meet the needs of various user groups in Sweden (Rosenkvist, Risser, Iwarsson, Wendel, & Stahl, 2009). There are different arguments on challenges of using pt on past studies. The perceptive functional limitations is that people cease to use pt in developing country (Rosenkvist, Risser, Iwarsson, Wendel, & Stahl, 2009).

Both governmental as well as research evaluations in Sweden have underlined the significance of the planning for different transport user groups for a long time (Olsson 2003; Stahl 1997). Thus, planning of pt for accessibility is based on mostly visual or physical functional limitations in both local and international context (Waara, 2001). Therefore, there is need of consider the people's functional limitation for better planning intervention. Moreover, transportation affect harmfully on the environment in several ways, for an example; carbon dioxide emission from the vehicles and its impact on the climate can be identified. Not only that but also that will cause to create air pollution which creates negative health effects; so it is need to be addressed correctly. (Laffel, 2006).

USA

In sequence, the carbon emissions caused by transportation sector of united State (US) has been increased 5% of the global carbon emissions. Therefore, Laffel claimed that policies can be used to ease these types of adverse costs. As a result, better usage of pt will lessen the demand for pvt transport by reducing the number of automobiles on the road.

The United State has only 1% of demand for public transit, as vast majority of people consume private transportation for daily rips (Lee, 2000). There is high contrast in convenient and appealing between private and pt in the society. Therefore, many people's opinion is that they believe public transit is not worth to wait and some believe it's unattractive as well as unreliable and unclean (Hardin, (2002) & Lee, (2000). As evidence of this, 69% (41 million) of nationwide workers had used pvt vehicles to travel to work in 1960. It rapidly risen to 88% (113 million) in 2003 (McGuckin & Srinivasan, 2003). Further, usage of overall mass transit had fallen from 6.2% to 5.3% from 1980 to 2000 (McGuckin & Srinivasan, 2003). For that reason, there is a need of consider the requirement of user group for the transport planning.

The policy proposal would address the upgrade of pt systems to achieve the sustainable development in a country (Laffel, 2006). The environmental problems related to the transport are made worse by the incremented trend of pvt vehicles. The high vehicle demand on the road generates high automobile emissions with various environmental effects (Laffel, 2006). It is better if people use pt more commonly, because it can lessen the vehicle amount on the road (Uhl & Anderson, 2001).

The cities such as New York, Chicago, Philadelphia, Cleveland, Washington, Miami, Baltimore, Buffalo, and Atlanta have been used pt systems that have highly advanced expertise in urban management and control. Therefore, these mechanisms are required a high amount of operative integrity for successful use and implementation (Fouracre et al 2003). Further, the Chicago Transit Authority (CTA) maneuvers the second largest public transit system in the United States. It assists 38 surrounding suburbs around and in the city of Chicago. The CTA delivers roughly 1.5 million trips per a

week-day, and which contains 560,000 number of trips to get to their jobs (Welch et al, 2005). Then again as identified, 45% out of all trips are traveled by mass transit to work in Atlanta (Salisbury, 1982).

Pt is economically viable. Pt in New York has minimum operational costs and it can be identified as energy-efficient. For 50 people, bus transportation needs one driver. But, about 1,400 people can be transported using one New York subway conductor through mass transit (Schumer, 1980). Although, in fact developing countries, use of modern level of investment in transportation is much lower compared to other countries.

China

However, in China it can see that they basically depend on, on-road transportation which is facilitated by extensive use of automobiles. As the result of it, traffic congestion and environmental problems was been reduced (Phipott, 1995). As an Example, less than 18% of citizens in Guangzhou had used pt for the commuting in 1998. Accordingly, in China are having useful pt systems for long term sustainable perspective.

2.3 Current Transportation Issues in Sri Lanka

According to CoMTrans Urban Transport Master Plan (2018), they have been identified several urban transport system issues in Sri Lanka. According to them and Prof. Kumarage, the main issue is related to the way Government deal with the peak transport demand and traffic concentration within city centre. In Sri Lanka traffic congestion has become a major issue. According to these studies in order to tackle the congestion, it is need to flatten the peak demand. There were several solutions can be identified when looking into past including bypass roasd, flyovers and other physical establsihments. But according to Prof. Kumarage those measures are not suffitient and there need to have policies to promote pt instead of private vehicles.

This is another issue that has been identified by the CoMTrans study. Shifting to private modes of transport has become another main issue which promotes unsustainability within the country. According to their statistic there can be seen 2.5 times increment of passengers crossing Colombo Municipal Council area by public transportation.

As a solution for most transportation issues in Sri Lanka, CoMTrans team has identified that it is need to promote an extensive and congestion free public transport network. Moreover according to them, there need to have specifically derived policies to achieve this extensive, congestion free public transportation.

As discussed previously, there are not available strong policies and its strategies at the ground context to reduce road traffic congestion with regarding the public bus transportation system in Sri Lankan context at present status. To control this massive, unproductive cost it is need to take actions by the government to improve and modernize the pt according to transport management expert Amal S. Kumarage (University of Moratuwa). Further, Prof. Kumarage highlighted that, it is need to appliance a pt policy, because the construction of expressways, highways and flyovers and widening of roads will not be the successful solutions to urban transport problems. It may be solutions for isolated individual problems. So, there is a need of transport policies for effective accessibility in public bus transport for people in Sri Lanka.

The transport policy is to warrant a reasonable entrée and optimal for safe, efficient, reliable, and integrated system of transport services and modes. The Sri Lanka already has a transport policy to enhance the pt. It needs to be satisfied the diverse public and corporate requirements for mobility for both goods and people.

Transport policy interventions in Sri Lanka anticipates to understand the current demand for mobility, to fill the gap of requirement, to identify the influenced factors on future demand, and plan to meet the forecasted need. This policy manages to provide directions based on Policy goals in order to achieve development of transport sector in Sri Lanka. Therefore, structure of the National Transport Policy in Sri Lanka is to meet their achievements as above.
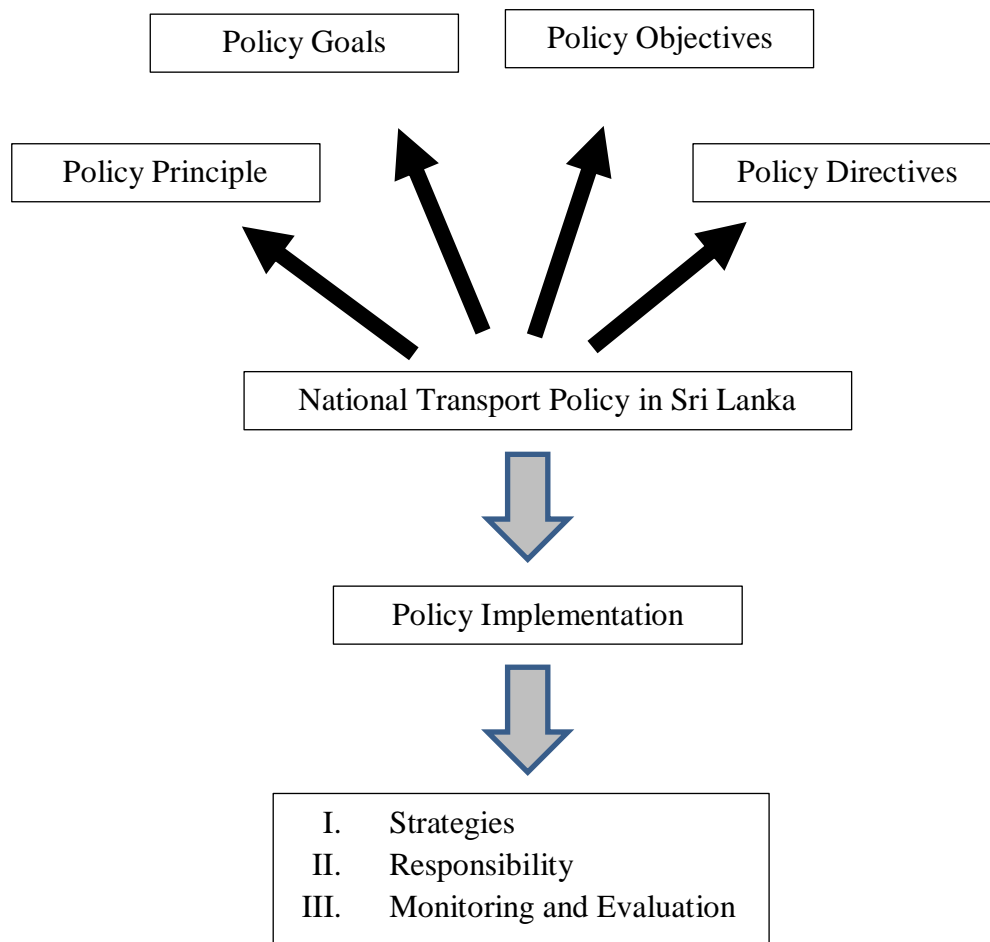
Figure 1 : Structure of the National Transport Policy in Sri Lanka
Source: Ministry of Transportation and Civil Aviation, 2009

Under Environmentally Sustainable Transportation, they have taken key initiatives as;
- National policy on air quality management, 2000
- Regulations on Mobile Emissions, Fuel Quality & Vehicle Importation standards, 2003
- Phasing out the use of Leaded Petrol (Gasoline) in 2002
- Ban on importation of two stroke three wheelers effects from 1st January 2008
- Strategic Plan for Traffic Management in Greater Colombo Area
- National Transport Policy- 2008

The most important one is the National Transport Policy in 2008.

National transport policy (2008) has several areas which needs to review.

Environmental policy – Here the government will specially look on to the deterioration of environment due to different transport activities. Here it specifically talk about noise, air quality as well as the negative impacts to the flora and fauna. So

this principle of the policy is directing technology into an environment with less pollution and it concerns about the environmental sensitive areas. Here they will step towards to the sustainable modes which emphasize less pollution. These are some policy interventions related to the environmental policy;

- Testing of emissions annually.
- Implement the Vehicle Emission Testing Program or Green Test requiring compulsory testing of all vehicles.
- Revise vehicle tax structures to encourage vehicle imports that are less polluting.
- Move away from 2 stroke technology for motor vehicles.
- All vehicles should comply with noise standards stipulated under the CEA Act and enforced under the provisions of the Motor Traffic Act.
- Adaptation of EURO II standard for both vehicles and fuels from 2010

Energy – In the national transport policy, one thing they concerns about is how to reduce the petroleum fuel dependency. They focus their way into less energy consumption modes. Here it also concerns into increasing public transportation usage, reduce unnecessary travel attempts. And also, it concerns about implementing better transport management system and improving vehicle technologies. And here it also tries to encourage the use of non-motorized transport modes.

Use of technology and research for modernization – here government tries to encourage modernizations as well as innovations to the existing transport sector. There they are trying to ensure the convenience, safety of the passengers. They have concerned about improvement of passenger terminals, passenger vehicles, improvement of control systems and improvement of safety and security systems. Here the special attention will be providing towards the information technology sector to adopt those technologies into Sri Lankan transport sector.

Under these sectors followings are the policy interventions which they have used;

- Multi modal transportation
- Integrating land use and transport
- Solving transport management issues (related to buses, trucks, vans and three wheelers)
- Infrastructure improvements (Safe, clean and cost-effective roads)
- Fuel standards
- Vehicle standards, types and legislation

Rather than that CoMTrans study mainly focus on achieving 4 main objectives.
1. Equity and affordability in public transportation
2. Efficiency of transportation system
3. Health promotion and environmental sustainability
4. Traffic security and safety in transportation

In order achieve these 4 policies; they basically focus on 4 main transport policies.
1. Promotion of Public Transport Use
2. Alleviation of Traffic Congestion
3. Reduction of Traffic Pollutants/Traffic Noise and Promotion of Health.

4. Reduction of Transport Accidents and Improvement of Security.

These are inter-related and by first policy, they are trying to reduce individual vehicle usage. Importantly Sri Lanka does not have specified policy framework to reduce private vehicle usage and to promote pt usage.

And there are 5 policy thrust in Sri Lanka within the National Transportation Policy.
1. Strengthen governance to create a conductive environment for the transport sector.
2. Optimize, build and maintain the use of transport infrastructure, services and networks to maximize efficiency.
3. Enhance safety, integration, connectivity and accessibility for seamless journey.
4. Advance towards green transport ecosystem.
5. Expand global footprint and promote internationalization of transport services.

Ministry of Transport and Civil Aviation can be identified as a major regulatory institution for the sector of transportation in Sri Lanka. Inter-related transport sector in Sri Lanka have identified main transport related issues such rapid growing motorization, worsening in quality of pt, outdated transport networks and increasing external costs for transport activities (Ministry of Transportation and Civil Aviation, 2009).

However, over the last two years, government policy implementation has less encouragement which use business as usual conditions without continuing a change of policy (World Bank, 2012). Improving policies and actions are to meet the requirement of current development objectives of the Government (Kumarage A.S., 2012). Further, less environment damages will be expected in sustainable transportation from the developments (Fergusson & Skinner, 1999). Several methods can be identifying that can be used to direct transportation into more ecologically sustainable manner. The past studies highlight that less vehicles on the road means that fewer negative effects. It means that use of more pt will become more environmentally sustainable by improving pt systems, encouraging the use of pt systems, discouraging the use of private transportation systems, and changing urban plans and city designs (Laffel, 2006).

One of most used approach is to expand roads (this includes increasing the number of roads and sizes which also include tunnels and flyovers) in order to erase the urban travel issues in immediate decades. As same, parallel commuting routes, improved facilities, and pt. are the other taken strategies. All types of pt. can be used as a tool to uplift the urban economies in developing countries. Within World War III period, the Japanese government implemented public policies which decreased the use of vehicles and they directed their investments into pt. (Pojani D. & Stead D., 2015).

The objectives of the research are to evaluate the implementation of prevailing policies to enhance pt and develop a policy framework to reduce the negative impacts from growing private vehicle population to public bus transportation system in Sri Lanka.

First it is need to identify what are a policy and a policy framework. Policy is a general statement. It can be about a guideline, a priority, a regulation or a procedure or a standard and about how to achieve them. The policy will direct the decision makers with a distinct path of actions in order to achieve desired goals. Public policy can be described as a government driven decision "to either act, or not act in order to resolve a problem" (Mackay, 2005). Public policy also is a bunch of actions which leads decision makers and range of other related actions within a particular field.

Policy framework is a combination of a set of policies which will be use to guide/govern the actions of organizations and groups. This broad set of policies (policy framework) will guide into new policy developments and new policy amendments.

2.4 Comparative analysis (Sri Lanka Vs World Context)
The case study was selected as from developing and developed countries in order to analyze what are the issues they use and how they've addressed those. And for the comparative analysis, there was selected countries which have different types of transport policies comparing to each other. It also was selected accordingly as developed and developing countries; so that it will give clear comparison on how to address such issues effectively.

Figure 2 Comparative policy analysis (National vs International)

Sri Lanka

Sri Lanka Mainly Focusing on achieving 4 main objectives there are

- Equity and affordability
- Efficiency
- Health Upgrade and Environmental sustainability
- Security and safety

In order to achieve the above objectives, basically focusing 4 main transport policies

1. Promotion of public transport use
2. Mitigation of traffic congestion
3. Reduction of traffic pollution, traffic noise
4. Mitigate of transport accidents, and upgrade of security

They are inter related and trying to reduce individual vehicle usage and to promote Public transport usage

There are 5 transport policy drivers within the National transport policy in Sri Lanka

1. Strengthens governance to create a conductive environment for the transport sector
2. Enhance, develop, and maintain the use of transport infrastructure, services and networks for maximize
3. Enhance safety, Integrity, connectivity, and accessibility
4. Advance towards green transport ecosystem
5. Expand globalization of transport services

Ghana

In Ghana mainly focusing on the guiding government objectives and priorities which including planning, financing, providing, maintaining, developing, and regulating the transportation services and infrastructure. They have another 3 objectives   which are focusing on

- Providing guidance for the investments
- Providing long-term decision-making platform
- Development of an effective management of transport services and infrastructure of the country

New Zealand

New Zealand is a developed country According to it government vision -2040 which is the " People and fright in New Zealand have an affordable, integrated, safe, responsive and sustainable transport system "(Ministry of Transport New Zealand-2008).Their policy derives, objectives, Policy frameworks and all are created based on this vision. They are focusing main 4 objectives those are

1. Ensuring environmental sustainability
2. Assisting economic development
3. Assisting safety and personal security
4. Improving access and mobility

Australia

Australia's vision Is the future transportation is "Australia requires a safe, efficient, reliable, and integrated national transport system that supports and enhances our nation's economic development and social and environmental wellbeing" (national transport commission-2008) They are focusing following objectives

1. Promote efficient movement of people and goods-to support sustainable economic development and prosperity.
2. Safety- to provide a safe transport system and meets Australia's mobility and lesser or without life losses and injuries of its users under the social and economic objectives.
3. Increasing accessibility and to allow equity accesses to the public resources for promote social inclusion.
4. Promote effective and efficient integration and linkage Australia's transport system by urban and regional planning at the national and international level.

Canada

Canada is mainly focusing to promote eco transport strategy within the country. Under that they are promoting 3 main programs

1. The eco goods program-aimed to reducing the environmental and health effects through the use technology
2. The eco program for mobility- aimed to help municipalities reduce urban passenger transport emission by transit ridership and b the use of other sustainable transport options
3. The eco automobile program-to encourage Canadians to buy new fuel-efficient vehicles as part of the government of Canada's plan to protect the environment.

Malaysia

In Malaysia they are also practicing following objectives to achieve their goal and Policies

1. Short term objectives
   - Address local issues relating to cause by traffic congestion
   - Encourage and improve public transportation
   - Manage traffic demand
   - Maximize the existing transport network
   - Adopt universal access principles, increase pedestrian connectivity within the world heritage site.
2. Medium term Objectives
   - Promote transport policies and improvements to minimize environmental impacts
   - Ensure that the state transport master plan is integrated with the aims of the world heritage site
3. Longer term Objectives
   - Moderate private vehicle usage-main transport use shifted to more sustainable modes
   - Make the world heritage site universally accessible

Source: Compiled by the author

2.5 Policy frameworks incorporated in World context

In Philippines, they have incorporated EST (National Environmentally Sustainable Transport) strategy for their transport policy frameworks. In their policy framework, they have been using 3 targets; which are to avoid, to shift and to improve. Within avoid it include the strategies which avoid the need to travel. Within shift it includes the strategies which shift travel to more sustainable modes. Within improve it is included strategies which improve the sustainability of modes.

Avoid	Shift	Improve
• Promote Mixed development – increase Shorter trips distance	• Provide transport facilities non - motorized users	• Adopt Euro IV specification for sulfur

• Include green architectural principles for designs of transport infrastructure • Applying travel demand strategies for avoid number of vehicle travels	• Integrate public transport network with Private transport modes and non -motorized modes • Use MRT, LTR,BRT	• Strengthening road air quality management and assessment • Develop and enhance freight transport policies

Figure 2 ASI approach Philippine

Source: Department of Transport and the Communication – Philippines (2009)

<u>The Policy Framework for the Transport Sector in Ghana consists of;</u>

- Policies ,Declarations and Agreements of the West Africa sub region ,african Union and wider ranging international bodies
- Ghana's Growth and Poverty Reduction strategy (GPRSII,2005) including earlier Long -term visions. The gateway programme , goals for sustainable development as described by international bodies and Ghana's environmental attentions as defined in Act
- Sectoral policies and objectives, largely as coordinated in GPRS II (2005), but also including its role in supporting the achieve of policy objectives for trade and industry, energy, agriculture, tourism, urban development, decentralization, land use planning, and other sector policies as they are developed
- Government objectives for multilateral development groups, as a mechanism for allocating the funds from developers
- Government objectives for joined multimodal and intermodal transport system to minimize overall transport costs
- Policies and strategies for accelerating the development of the private sector investment in Transport infrastructure and services,

Figure 3 Policy framework for the transport sector in Ghana

Source: (Laffel, n.d.)

According to Selod (2015), there are three transport policy categories.

1. Infrastructure investments
2. Price instruments

3. Regulations

According to him, all the above objectives can be categorized into following broad policies thrusts.

1. To stimulate Growth (through lower Transport cost)
2. To facilitate Social inclusion (through better access)
3. To improve environmental sustainability (through reduce environmental externalities)
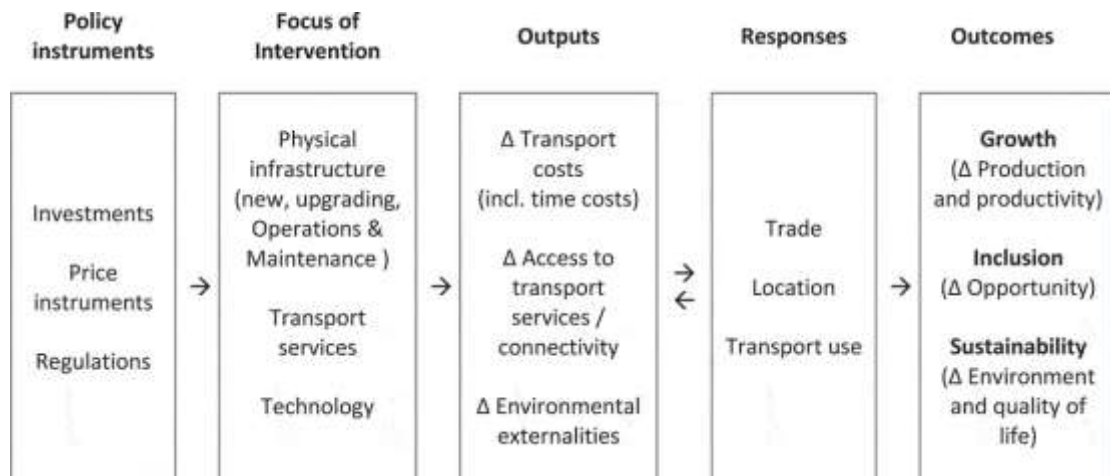
Figure 4 Transport Policies and development framework

Source: (Liu & Selod, 2015)

According to Corporate Mobility Management Initiatives (CMMI), the main aims of the policies should be,

- Allow new development in dense urban areas, already saturated with traffic.
- Control the environmental effects of large buildings/real estate developments.
- Allow flexible use of parking spaces.
- Manage the volume of traffic volume by defining the maximum number of trips which can be generated from the targeted zones.

In this framework also they promote public transportation when they focus onto reducing single car usage to travel to work. By looking into these initiatives public authorities can make policy frameworks and through these policy frameworks, they can make appropriate policies in the field of land use. For an example public transport-oriented land use development. Rather than that they can offer greater choice of high-quality modes. They can consider about transport related air quality and they can establish standards onto that. Altogether these all can be defined as sustainable transport policy and planning instruments which makes alternative mode choices possible.
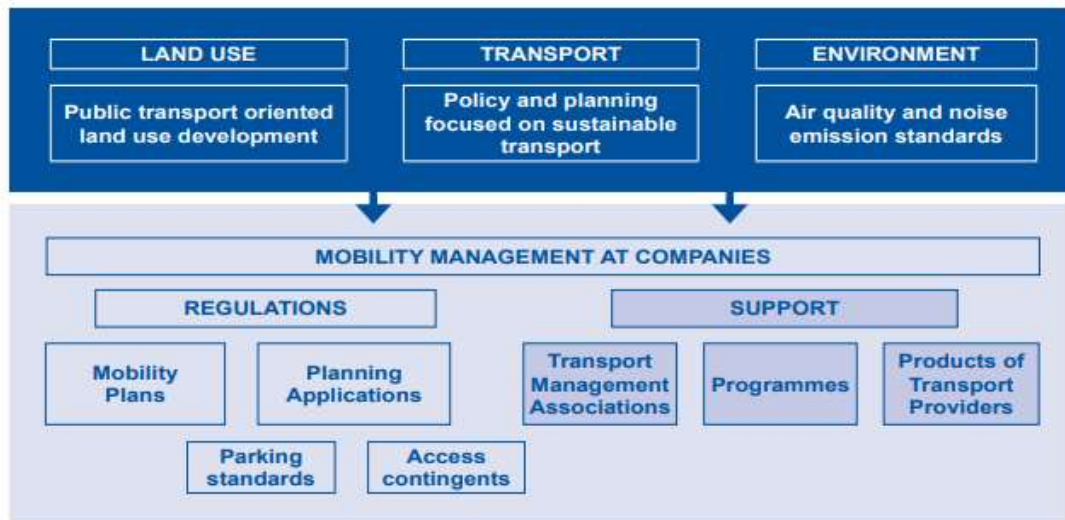
Figure 5 Policy framework to develop public transportation

Source: International Transport Forum (2010)

2.6 Most successful strategies and theories according to the Literature

Strategy 01: The push & pull approach

- Push away from private vehicles
- Pull towards public vehicles

Table 1 Important elements of public transportation that should be developed

Infrastructure	Services
Bus Lanes	Cleanliness
Cycle lanes	Frequency
Favorable pedestrian environment	Comfort
	Punctuality
	Safety

Source: Dalkmann & Sakamoto, 2012

Strategy 02: ASI approach

Table 2 ASI Approach example

Avoid	Number of journeys
Shift	Towards more sustainable and efficient transportation
Improve	Vehicle & Fuel technology

Source: Dalkmann & Sakamoto, 2012

Comparative analysis of how to use ASI approach in both developed and developing countries

Table 3 Comparative analysis of ASI approach

Strategy	Developed countries	Developing countries
Avoid	Use Transport Demand management. Land use planning, shorter supply chains & localized production in order to reduce vehicle kilometerage.	Transit oriented developments. Avoid unnecessary generation of vehicle kilometerage using transpot and land use planning.
Shift	Shift from private transportation to public transportation. Shift from aviation to public transportation. Shift from private transportation to non-motorized transportation (cycling, walking)	Improve quality of public transportation. Improve conditions for non-motorized transportation. Improve conditions for lowest emitting modes.
Improve	Improve existing transport vehicles. Ex: electrifying rail	Improve innovations on traditional transport modes. Ex: cycling rickshaws in India. Make sure the future vehicles will be more efficient.

Source: Compiled by the author

Theory 01: Car free city

Figure 6 The wide spectrum of car free development

Source: (Wright,2005)

Approaches that are ranging from traffic calming streets to totally car free city are included in the above spectrum. The taken measure will decide the level belongs to the city comparing to the spectrum.

Car free theory about promoting walking, cycling modes and discourage vehicle usage. Car free cities provides us with some great advantages like reducing air pollution, urban heat island problem, noise pollutions, petroleum dependency, greenhouse gas emissions, and the problems like traffic congestions. According to the measures we take, the stages of car free cities will be declared. For an example; prohibiting all cars will be a permanent and large-scale measure and it will declare an entire car free city. Measures related to congestion taxes will be car-lite measures and that will evaluate the roads of the cities into traffic calming roads. Restricting cars within specific zones of the cities will also be permanent and large-scale measure and it also will lead cities to have car free districts. The theory of "car free city" is explaining this spectrum of car free development. This will be a good theory to use in Sri Lanka, since it is not applied in anywhere.

Theory 02: Typified public transportation strategies for various city types
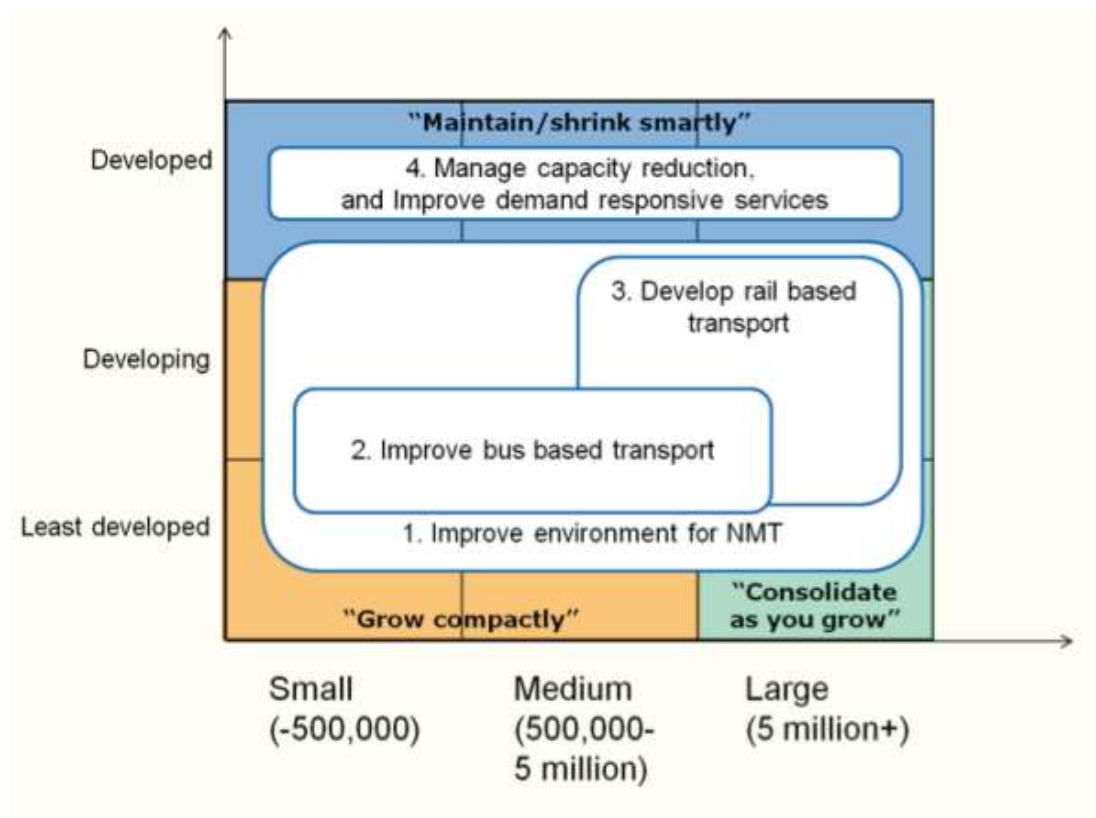
Figure 7 Typified public transportation strategies

Source: Dalkmann & Sakamoto, 2012

According to this theory the most appropriate transportation strategy for a developing country will be improving bus-based transport and developing rail-based transport.

Policy Analysis,

The subject of policy analysis was first emerged in the region of America. But after, it was spread world widely. Even within the social sciences and in the field of public administration, the subject of policy analysis plays a major role. The knowledge gain from the policy analysis will be used in to policy making, managing and evaluating. It is process to evaluating the effectiveness.

Policy analysis is about understanding the potential policies in order to address certain issues. And these potential policies need to be analyses according to its effectiveness, efficiency, and feasibility.

Policy analysis as "An applied social science discipline which uses multiple methods of inquiry and arguments to produce and transform policy-relevant information that may be utilized in political settings to resolve policy problems".

Policy analysis as "A systematic and data-based alternatives to intuitive judgements about the effects of policy or policy options" *(Dye, 1980).*

According to Dye, policy analysis is an inquiry with the multidisciplinary questions which was created in order to understand and to improve the policies. These multidisciplinary questions are,
1. What is the nature of the problem for which a solution is sought?
2. Which of the two or more courses of action should be chosen to solve the problem?
3. What are the outcomes of choosing that course of action?
4. Does achieving the outcomes contribute to solving?
5. What future outcomes can be expected if other courses of action are chosen?

The answers to these five questions will be identified as the policy-informational components;
1. Policy problem
2. Expected policy outcome
3. Preferred policy
4. Observed policy outcome
5. Policy performance

In 2000, Warren Walker created a systematic approach for the policy analysis in order to support policy making in the public sector. According to him, mainly there are 8 steps in the policy making process. Those include problem identification, objective specification, decide on criteria and select, analyze, compare the alternatives and implement the chosen alternatives. According to him, at the end it is needed to monitor and evaluate the results. When comparing the criteria if there are not any suitable ones, it is need to go for other alternatives. Also after monitor and evaluate stage if the results are not what expected, again it is time move again for different alternatives.
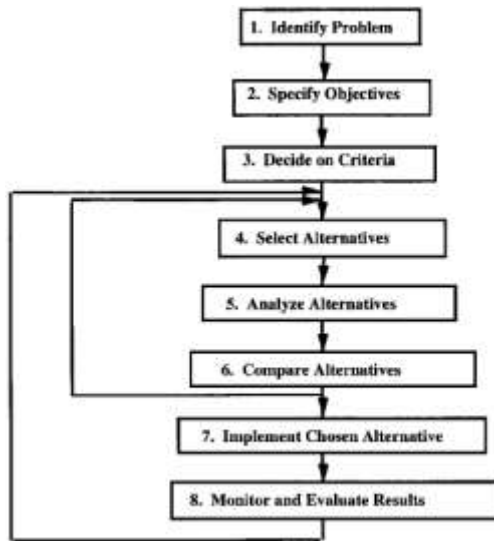
Figure 8 A systematic approach

Source: Walker,2009

Policy analysis has 5 methods, such as;
1. Description – "Produces information about observed outcomes of policies"
2. Prediction – "Produces information about the expected outcomes of policies"
3. Appraisal – Produces information about the value or worth of observed and expected outcomes
4. Prescription – Produces information about preferred policies
5. Definition – Produces information about what problem to solve

And there are 3 types of policy analysis;
1. Empirical policy analysis – This analysis will be conducted by analyzing the past policies. Thereby it analyzes the effects of those policies.
2. Evaluative policy analysis – This analysis will be conducted by evaluating the related programme. Thereby it identifies the policy option significance. Compare the objective and achieved targets is one of the valuate policy analysis methods.
3. Normative policy analysis – This analysis is about making suggestions and suggesting actions. It will analyze what will be the future courses of a given action.

2.7 Criteria Selection

Effective road based pt system (bus and Para transit) is popular for economic growth in developing cities. But, in the recent times road-based pt. services in the developing countries are not very effective and fulfill the mobility needs of people. Unreliable, inconvenient, uncomfortable, or even dangerous are the characteristics reasons to reject the bus services.

Bus Rapid Transit (BRT) is providing facilities to bus transit as well as rail transit and it is now a very popular mass transit method. According to Wright, L. & Hook, W.,(2007), it can be used an will be more suitable for medium-sized cities. It is more appropriate for large cities which have capacity to transport passenger up to 45,000 per hour per direction (Pojani D. & Stead D., 2015). Bogotá, Curitiba, and Guangzhou such few large cities have developed BRTs for quality pt (Gilbert, A., 2008).

In Asia and Africa, walking and cycling can be identified as dominant transport mode. This is also common for the developing countries. Therefore, increase of non-motorized transport modes improves the traffic safety in the cities, as it is cheaper and environmentally friendly (Dimitriou, H. & Gakenheimer, R., 2011). To throw away several transport-related problems there can be used new technologies (Chowdhury, M., 2003). Specially, in West European cities and North American cities, technological solutions related to urban transportation are making a trend. There are some advantages from applying IT related infrastructure for developing cities, although it is often having disadvantages compare to developed cities. Developing cities are not normally troubled with out-of-date IT infrastructure that should be updated.

There are number of general approaches in order to increase sustainable transport policy consciousness. From that a few explicit techniques can be used to decrease car usage percentage, those were tried but in general only in developed countries. Among these techniques, it includes techniques related to inform people related to travel patterns, travel cost and a replacement to current behavior (Rose, G. & Ampt, E., 2001). The main aim of these exercises has been to motivate people to consider the magnitudes of their travel behavior. Although cost-effective, they often require large upfront investments (Brög, W.; Erl, E.; Mense, N., 2002).

A coercive pricing mechanism is an effective tool according to transport economists in order to contain car usage levels in urban areas. Further, Singapore use cordon pricing and direct road charges Anas, A.; & Lindsey, R., 2011). Congestion charges and fuel taxes are further preferable policy options at the local, regional, or national level (Timilsina, G. & Dulal, H., 2008). At the same time, a public perception is vital factor

for sustainable urban form. Moreover, most past study illustrates various policy actions to be applied for eliminating the road congestion to meet sustainable pt as the following table.

Table 4: Policy actions for eliminating the road congestion

bcgbgc

No	Strategy / Policy Action	(Laffel, 2006)	(Vasconcellos, E.2013)	(Dimitriou, H.& Gakenheimer, R,2011)	(Chowdhury, M;2003)	(Wright, L.; Fulton, L.; 2005)	(Sussman, J; 2005)	(Shah, A.& Dal,L;2007)	(Vlek, C;2000)	(Rose, G. & Ampt, E; 2001)	(Brog, W.;Erl, E.;Mense, N;2002)	(Anas,A.;& Lindsey, R., 2011)	(Pojani D.& and Stead D; 2015)	Ministry of Transport and Civil Aviation, 2005	(Kumarage A.S., 2012)	(Gilbert, A;2008)	(Timilsina, G.& Dulal, H.,2008)	Wright, L.& Hook, W.,2007)	Total
1	Allocate more money to build new subway and bus system and expand or improve old	■												■					

	Systems																				
2	Subsidize mass Transit fees for employees																					1
3	Educate citizens to Dismantle negative Stigmas of pt																					1
4	Increase the price of personal vehicle travel																					1
5	Reduce the number of vehicle allowed in urban areas																					2
6	Change urban plans and city designs																					1
7	Sidewalks on both sides of the street																					3

8	Extensive networks of bike paths and lanes																				3
9	"Bicycle streets" Where cars are permitted but cyclists have strict right -of-way																				3
10	Special bike turn lanes leading directly to intersections																				3
11	Separate bike traffic signals with advance green lights for cyclists																				3
12	Bike parking (ranging from secured boxes to simple racks)																				3
13	Integration of																				3

#																							
	bicycles with pt																						
14	Bike -activated traffic signals at																						3
	Key intersections																						
15	Modifications of street network to create deliberate dead ends and slow, circuitous routing for cars, but direct, fast routing for bikes																						3
16	Intersections and crosswalks																						1
17	Traffic circles																						1
18	Road narrowing																						1
19	Zigzag or chicane																						1

	routes		▉																			
20	Curves		▉																			1
21	Speed humps		▉																			1
22	Artificial dead ends		▉																			1
23			▉																			1

24	Build more walking and biking paths	▉	▉	▉																		3
25	Lower speed limits for motor vehicles in cities		▉																			1
26	Speed limits and physical barriers		▉																			1
27	Strict ticketing and high penalties for motorists, pedestrians, and cyclists who violate traffic regulations		▉																			1

No.	Task																						Total
28	Improve the Pedi cabs and other non-motorized taxi services			■																			
29	Encourage the walking and cycling	■	■	■																			3
30	Mass Transport	■			■	■	■	■	■	■		■	■	■			■						12
	technology improvements (LRT, BRT, MRT)	■			■	■	■	■	■	■		■	■	■			■						
31	Fuel taxes (based on emissions)										■	■				■							3
32	Vehicle import/purchase/registration taxes (based on emissions)										■					■							2
33	Direct road charges										■												1

34	Quality of pt										■	■		■			3
35	Integrated transport network and transport System											■					1
36	Proper investment plan											■					1
37	Cordon area pricing										■					■	2
38	Parking fees										■						1

Same as, existing transportation policies around the world take diverse policy actions to mitigate negative impacts at transport sector by achieving the sustainable pt in the urban form as below.

Table 5 Policy actions to mitigate negative impacts at transport sector in world context

Country	Cause	Policy Directive	Taken Strategy	Source
Japan	• Increasing of the transportation cost • High usage of the private vehicle	• Discouraging automobile use (Private Vehicle usage) • Direct investment in to Public transportation (Improving Public transportation system)	• Mass transit system	Pojani D.& and Stead D; 2015
Singapore	• Congestion delay in peak hours • Air pollution • Accidents in the congested areas	• Discouraging the private vehicle usage	• Cordon pricing and direct road charges	Anas,A.;& Lindsey, R., 2011)
New York	• Air Pollution • Noise Pollution • Traffic Congestion • Accidents	• Improving Public transportation system • Encouraging the use of Public transportation	• Mass transit system	Fouracre et al, 2003
San Francisco, Philadelphia, Chicago, Cleveland, Miami,	• Traffic congestion • Delay • Vehicle emission	• Improve Public transportation system	• Mass transit system	Fouracre et al, 2003

buffalo, Washington, Baltimore				
Atlanta	- Traffic congestion - Delay - Vehicle emission	Improve Public transportation system	Mass transit system	(Holsendolph, 1981) (Salisbury, 1982)
Chicago	- Traffic congestion - Delay - Vehicle emission	Improve Public transportation system	Mass transit system *Chicago Transit Authority has been operated the second largest public transit system in US and it serves Chicago and its 38 suburbs, provide 1.5 Mn average rides on weekdays,*	(Welch et al, 2005)
New York	Public transportation is economically viable	Improve Public transportation system	Bild subways *230Miles of track, most energy-efficient, one conductor can transport about1,400 people*	(Schumer, 1980).
China	Vehicle emission	- Discourage of use of private vehicles - Encouraging walking and cycling	- Improve rail- based transport system - Build special lanes for Cyclists	Fouracre et al, 2003
Guangzhou	Vehicle emission	- Improve Public transportation system - Encouraging walking and cycling	Provide special bicycle streets, Walking paths	(Zhao et al, 2004) (Phipott,

				1995)
India- Delhi	• Vehicle emission • Quality of Public transport modes • Usage of private vehicles	• Improve Public transportation system • Discourage of use of private vehicles	• Bus System	(Gan, 2003)
India – Mumbai	• Traffic Congestion delay • Air Pollution • In efficiency of transportation	• Improve Public transportation system	• Improving Bus system • Improving rail way system • Improving walking, cycling, and improving conventional transport modes	(Rastogi and Rao, 2003)
Calcutta, India	• Congestion delay • Air Pollution • In efficiency of transportati	• Improve Public transportation system	• Metro Public transport system	(Perry, 2006)

	on	34		
Singapore	• Congestion delay • Air Pollution • accidents	• Discourage of use of private vehicles	• Cordon area Pricing • Road charges	(Anas,A.; & Lindsey, R., 2011)

2.8 Summary of the literature review
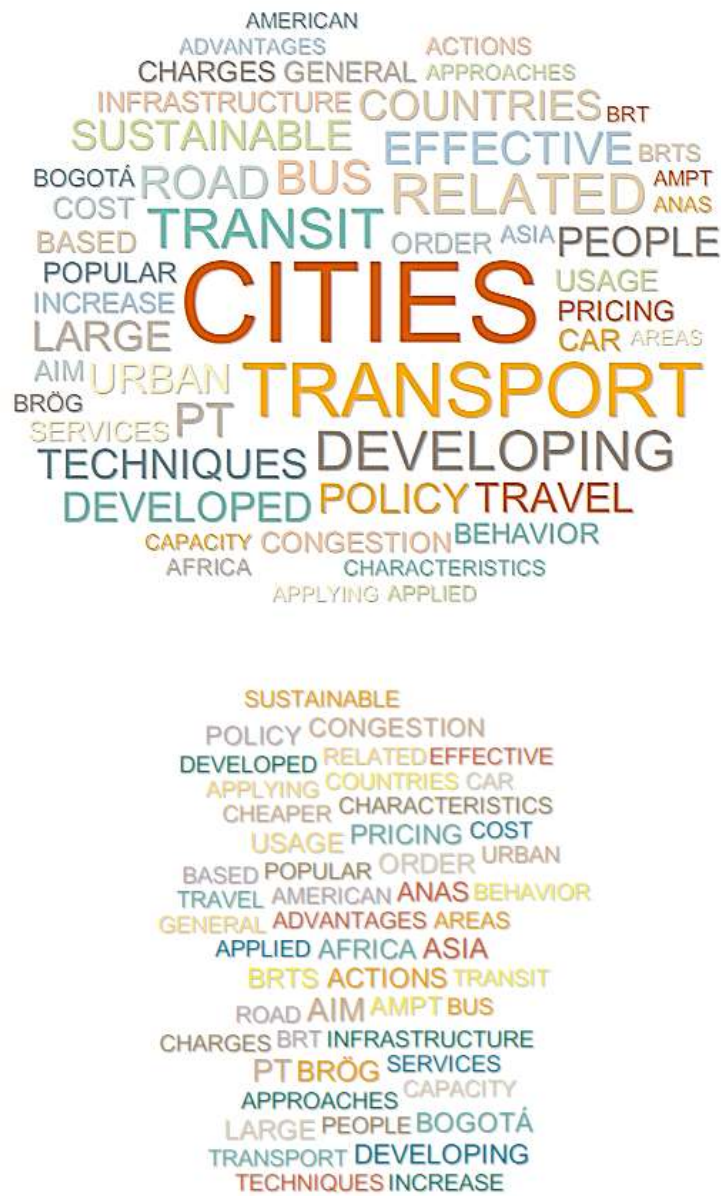
Figure 9 Word Cloud Analysis in terms of frequency

Source: Compiled by the author

Cluster Codes	Similarity	Clustered Items
	10.00	There is a **NUMBER** of **GENERAL APPROACHES** in **ORDER** to **INCREASE SUSTAINABLE TRANSPORT POLICY CONSCIOUSNESS**.
	10.00	The **MAIN AIM** of these **EXERCISES** has been to **MOTIVATE PEOPLE** to **CONSIDER** the **MAGNITUDES** of their **TRAVEL BEHAVIOR**.
	13.00	Among these **TECHNIQUES**, it **INCLUDES TECHNIQUES RELATED** to **INFORMING PEOPLE RELATED** to **TRAVEL PATTERNS**, **TRAVEL COST** and a **REPLACEMENT** to **CURRENT BEHAVIOR** (ROSE, G.
	14.00	**SPECIALLY**, in **WEST EUROPEAN CITIES** and **NORTH AMERICAN CITIES**, **TECHNOLOGICAL SOLUTIONS RELATED** to **URBAN TRANSPORTATION** are **MAKING** a **TREND**.
	8.00	To **THROW** away several **TRANSPORT-RELATED PROBLEMS** there can be used **NEW TECHNOLOGIES** (CHOWD M., 2003).
	14.00	Therefore, the **INCREASE** of **NON-MOTORIZED TRANSPORT MODES IMPROVES TRAFFIC SAFETY** in the **CITIES**, as it is **CHEAPER** and **ENVIRONMENTALLY FRIENDLY** (DIMITRIOU, H.
	9.00	In **ASIA** and **AFRICA**, **WALKING** and **CYCLING** can be **IDENTIFIED** as a **DOMINANT TRANSPORT MODE**.
	12.00	**ALTHOUGH COST-EFFECTIVE**, they **OFTEN REQUIRE LARGE UPFRONT INVESTMENTS** (BRÖG, W.; ERL, E.; MENSE, N., 2002).
	12.00	**BOGOTÁ, CURITIBA,** and **GUANGZHOU** such **FEW LARGE CITIES** have **DEVELOPED BRTS** for **QUALITY PT** (G A., 2008).
	10.00	It is more **APPROPRIATE** for **LARGE CITIES** which have the **CAPACITY** to **TRANSPORT PASSENGER** up to 45,000 per **HOUR** per **DIRECTION** (POJANI D.
	11.00	**DEVELOPING CITIES** are **NOT NORMALLY TROUBLED** with **OUT-**of-**DATE** IT **INFRASTRUCTURE** that **SHOULD** be **UPDATED**.
	13.00	There are **SOME ADVANTAGES** of **APPLYING** IT **RELATED INFRASTRUCTURE** for **DEVELOPING CITIES**, **ALTHOUGH** it is **OFTEN** having **DISADVANTAGES COMPARE** to **DEVELOPED CITIES**.
	12.00	From that a **FEW EXPLICIT TECHNIQUES** can be used to **DECREASE CAR USAGE PERCENTAGE**, those were **TRIED** but in **GENERAL** only in **DEVELOPED COUNTRIES**.
	4.00	This is also **COMMON** for **DEVELOPING COUNTRIES**.
	15.00	But, in **RECENT TIMES ROAD-BASED PT SERVICES** in the **DEVELOPING COUNTRIES** are **NOT** very **EFFECTIVE** and **FULFILL** the **MOBILITY NEEDS** of **PEOPLE**.
	9.00	Further, **SINGAPORE** uses **CORDON PRICING** and **DIRECT ROAD CHARGES** ANAS, A.; LINDSEY, R., 2011).
	15.00	A **COERCIVE PRICING MECHANISM** is an **EFFECTIVE TOOL** according to **TRANSPORT ECONOMISTS** in **ORDER** to **CONTAIN CAR USAGE LEVELS** in **URBAN AREAS**.
	11.00	**BUS RAPID TRANSIT (BRT)** is **PROVIDING FACILITIES** to **BUS TRANSIT** as well as **RAIL TRANSIT** and it is now a very **POPULAR MASS TRANSIT METHOD**.
	1.00	**EFFECTIVE ROAD BASED PT SYSTEM (BUS** and **PARA TRANSIT)** is **POPULAR** for **ECONOMIC GROWTH** in **DEVELOPING CITIES**.

Figure 10 Cluster Analysis

Source: Compiled by the author

CHAPTER 03
METHODOLOGY

3.1 Introduction

The chapter explains data collecting techniques and analysis methods by taking the theoretical basement from the literature review. So the chapter consists of data collecting methods, the justification for the study area, data analyzing techniques, case study selection and selection of sample size and etc.

3.2 Methodology
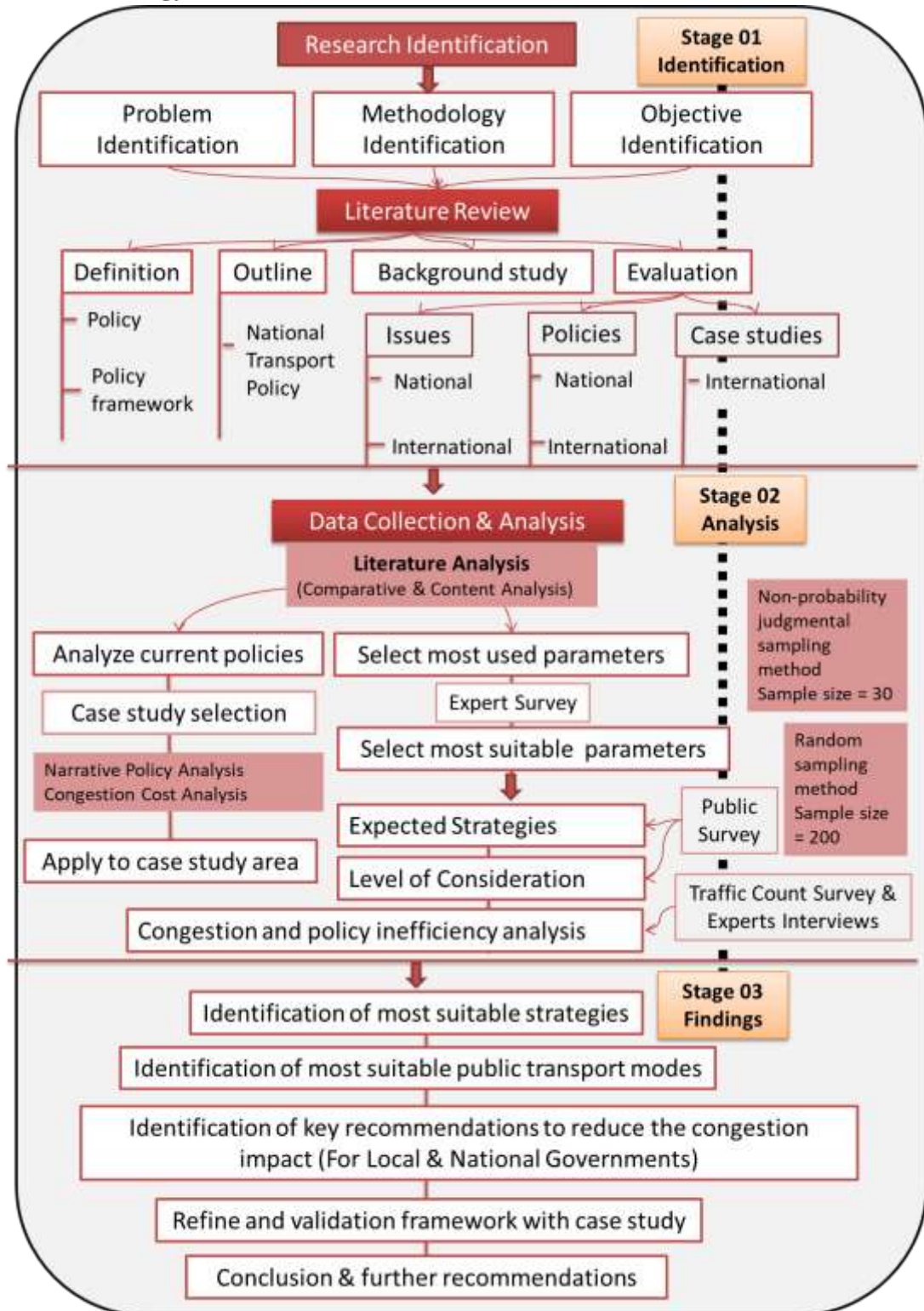
The methodology has three stages as the research identification stage, data collection and analysis stage and finally identification of findings stage. Within the identification process the problem, methodology and the objective will be identifies in accordance with the literature review.

"What are the most suitable measures to reduce the traffic congestion in urban areas of Sri Lanka?" is the research question that has been addressed within this research. Further, the objectives of the research are as follow.

Find Out the most suitable measures to reduce the traffic congestion in Urban areas of SL.

Evaluate the implementation and efficiencies of prevailing policies to reduce congestion impacts in SL.

Develop a policy framework to reduce the congestion impacts in Sri Lanka

To address the research question, which is to find out most suitable measures; four types of literature reviews will be used. Those are;

- Studying what are the policy, policy analysis and the policy frameworks
- Studying National Transport Policy
- Studying transport issues in both national and international countries
- Studying transport policies in both national and international countries
- Studying international case studies related to congestion

After reviewing the above areas it is supposed to conduct a literature analysis which includes both comparative and content analysis.

First in order to prove that there is a congestion problem in current situation and to understand it may be worse in future, the narrative policy analysis and congestion cost analysis were used. Rather than that, one of most active areas was selected as a case study and checked whether there is a congestion or not. By using traffic impact assessment, it was analyzed whether there will be a congestion in the near future with all those upcoming developments. Exactly identify whether there is a congestion problem or not is a good step before suddenly stepping into finding the measures against it.

Secondly, in order to select most suitable measures that were mentioned in the literate, the content analysis will be conducted. Again to find out the most suitable measures, public view as well as expert view will be identified. After by comparing all three

results, most suitable measures to reduce congestion in urban areas of Sri Lanka will be identified.

Third, the research offers 4 valuable findings.

1. Most suitable strategies in order to reduce the traffic congestion in urban areas of SL.

2. Most suitable transport modes in order to reduce the traffic congestion in urban areas of SL.

3. Key recommendation for local and national governments in order to reduce the congestion impacts

4. Developed policy framework and an evaluation framework in order to reduce traffic congestion by transferring from private vehicle uses to public transportation.

3.3 Introduction to study area

In Sri Lanka, Battaramulla is the administrative capitol which recognized as the study area. Battatamulla is located in Western Province, Colombo district, Sri Lanka. It is a superb city of Colombo district. At the same time, administrative activities represent a large part of the study area.

3.4 Justification for the Study Area

Traffic congestion can be identified as one of the major transportation related issue in Sri Lanka. When the population is increased, automatically urban areas are getting congested. The study area was selected considering the below criteria (Hasnat, Hoque, & Islam, 2016);

1. High administrative activities in the surrounding areas.
2. High rate of accidents reported in recent times.
3. High duration of blockage event.
4. High traffic volume.
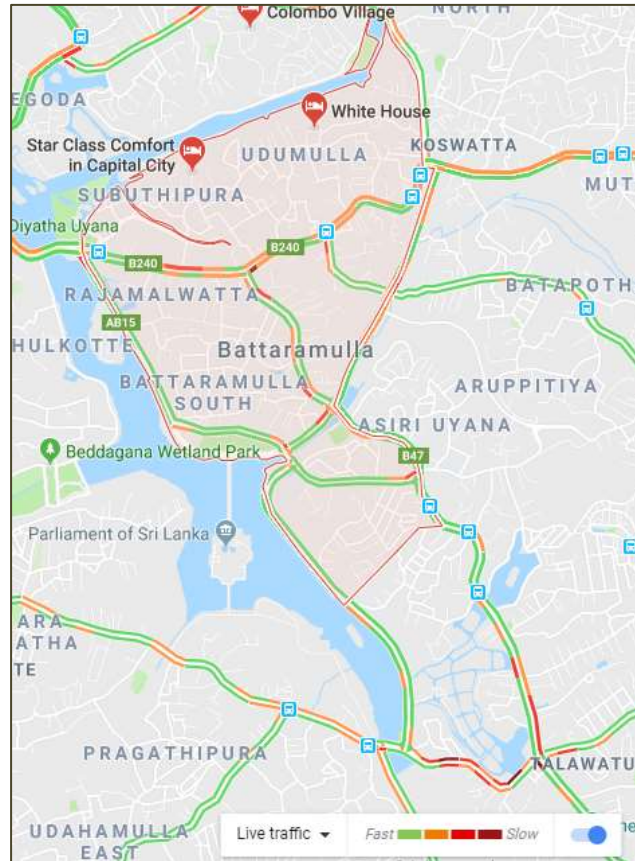
Figure 11 Study area

Source: Google Maps

From last year roads around Sri Lanka Sri Jayewardenepura near parliament was congested heavily (2012-01-06, Daily Mirror). Therefore, many temporary traffic control solutions have offered, which costs time, energy and money for motorists, bus passengers and pedestrians (2017/12/23, Daily News).

3.5 Sampling Method

For the expert survey, total 30 experts were selected using Non- Probability Judgemental Sampling technique. There the author used snowballing technique, where one professional suggest another one. For the expertise survey, the 30 experts were selected from six institutions; Urban Development Authority (UDA), Ministry of Transportation & Civil Aviation, Road Development Authority (RDA), National Physical Planning Department (NPPD), Central Environmental Authority (CEA) and University of Moratuwa. Expertise were chosen from Transportation and Logistics

Management Department (TLM), Civil Engineering Department, and Town and Country Planning Department (TCP) in University of Moratuwa.

Rather than expertise questionnaire survey, the interviews were conducted. The main aim of the expertise survey was to select most suitable parameters in order to reduce traffic congestion in urban areas of Sri Lanka. This judgmental sampling technique can identify as a more accurate tool when selecting parameters and criteria to make decisions.

Public perception survey was conducted using 200 people. The sample size was calculated using Solvin's formula. Census population data for Battaramulla was used for the calculation.

$$n=N/(1+NE^2)$$

n= Sample size

N= Population size

E= Error Tolerance

Equation 1 Solvin's Formula

Source: Maduwanthi & Marasinghe, 2015

Error tolerance (margin of error) was 5% as the selected confidential interval is 95%. Total population size for the Battramulla area is 75,633.

$$n=N/(1+NE^2)$$

$$n= 75,633/(1+(75633*0.05^2)$$

n= 398

In order to expect a high accuracy it is need to have least 400 respondents to the survey. But because author selected only Sethsiripaya area (500m buffer zone) and

due to time limitation, only 200 respondents was used for the public perception survey.

3.6 Data Collection Method

Both primary and secondary data were used in the process.

Primary Data Collection

Primary data were collected via Semi-structured interviews, observatory (field) surveys, expertise Surveys (via discussion). For these, specialists within the transport planning field were used. Primary data was used to analyze key strategies and recommendations to reduce traffic congestion.

Secondary Data Collection

As the secondary data, a database from the Road Development Authority was used. Several other literature reviews were used while doing analysis. The secondary data were used for the comparative and content analysis.

3.7 Method of Analysis

Semi-structured interviews in amalgamation with a qualitative content analysis was performed by relevant most past studies (Rosenkvist, Risser, Iwarsson, Wendel, &Ståhl, 2009). As the past studies, the author used a mixed approach which includes both quantitative and qualitative methods. As the data collection methods author used Expertise Survey, Public Survey, Traffic counts, and Multi-Criteria Decision Process. And as for the analysis, author used both qualitative and quantitative analysis. It includes Comparative and content analysis (qualitative), Narrative policy analysis (qualitative), Traffic count survey analysis (quantitative), public perception analysis (quantitative), expertise perception analysis (both qualitative & quantitative) and Congestion cost analysis (quantitative).

CHAPTER 04
RESULTS AND FINDINGS

4.1 Introduction

Results and findings are based on the collected data though various types of surveys like Traffic Count Survey, Manual Classifies Count Survey, Expert Survey/Interviews, Public Perception Survey, and Analysis of Google Earth.

4.2 Narrative Policy Analysis

First it is need to analyze that whether there's a need to have better policy directives and policy framework in order to reduce traffic congestion within urban areas. First step to achieve that is using "Narrative Policy Analysis" (Roe,1994).

Usually "Narrative Policy Analysis" is used for the purposes like to understand the policy problems and to reformulate intractable policy problems. By looking into several arguments, it narrates and defines the problems related to policies.

Here it summarizes the ideas of experts about the transport policies in Sri Lanka. The main finding of this analysis was most of the experts believe there need to have policy reforms and well created policy directives and framework in order to reduce the traffic congestion and related transport issues in Sri Lankan urban areas.

Table 6 Narrative Analysis

Interviewed Experts	Narrations
Urban Development Authority Urban Planner	As the main problem is traffic congestion, the main solution will be public transportation. It is need to develop public transportation in many ways. The quality and etc. The second important thing that was identified as a planner is to have better policies. Before creating a policy, it is need to have policy framework to guide and after the policy it is need to have evaluation process to measure the success. That will be the most needed part to Sri Lanka.
Ministry of Transport an Civil Aviation Transport planner	In Sri Lanka the main problem is inefficiency. Inefficiency in using land,

	resources and time. Sure, there are some infrastructures as roads, highways, flyovers and etc. but the poor management programmes, financial deficiencies, beat this development process. And as the main important thing, decision makes should have specific planning strategies for specific problems.
Academic Expert University of Moratuwa Lecturer	In Sri Lanka, there is a lack of adequate research about the transport policies and etc. There are traditional methods to evaluate the policies like cost-benefit, advocacy coalition and etc. But there are lack of research that focusing on those methods. Ongoing transport problems show that there need to have better and reformed policies to face all those issues.
Road Development Authority Transport Engineer	The physical infrastructures are adequate for the developing country like Sri Lanka. What is must to focus are regulations and policies. There need to have better well focused policies and there need to have well focused and strict regulations.
National Physical Planning Department Town Planner	What is horrible in Sri Lanka is the congestion and public transportation. Because of the congestion there is a huge time waste. Even though they are trying to get rid of private vehicles, the conditions of public vehicles are horrible. They are overcrowded, have not enough facilities. What country need is better policies, regulations and plans.

Source: Compiled by the author using experts' interviews

The following figure also explains about the positive and negative effects that has been identified by the transport expert professor Kumarage (2015).

Policy	Positive effects	Negative effects
Provision of rural roads	Many villages have reasonable access to towns and main roads. This has improve rural quality of life.	The large number of rural roads has become too expensive to maintain. Many have fallen to disrepair. Although access is available, mobility (speed of travel) is poor. The concentration on building rural roads has left the trunk road network largely stagnant over the period of review.
Affordable bus fares	Bus fares have decreased in real terms over the period of review. Consequently, mobility by bus has increased. Also density of urban population has been kept low, as commuting was affordable.	Public Transport Operators have been increasingly unable to meet costs. This has results in inadequate supply and poor quality, most notably high overloading.
Subsidy to rural bus services	Quality of rural life further improved in early years as access to essential services and markets improved.	Bus services were cross-subsidized. The inability of the state to continue provide adequate funds for these uneconomic services led to the deterioration of all bus services. Furthermore, the continuing practice of providing bus services to all rural communities has discouraged the private sector from developing unconventional services, which in most countries are found to be more appropriate.
Subsidy for educational; and worker travel	Provided further relief to already low fares. Access to urban schools and jobs were further increased.	The demand that was generated by discounted fares led to capacity limitations particularly in the suburban sectors. This is seen in the rail sector where at present 70% of the suburban travel is on subsidized fares.
Differential fuel and vehicle taxation policies	The instrumentation of taxation as part of a pro poor policy was initially aimed at providing public transport and goods transport at cost. Private vehicles and petrol were taxed primarily as fiscal measures. They were however successful in keeping vehicle growth on par with transport infrastructure growth.	Changing vehicle technology has led to has led to a complete breakdown, of this policy. Different measures are been used by the non-poor to own and operate moto vehicles falling outside the high tax bands. This has resulted in the overwhelming increase of diesel use.

Figure 12 Policy effects analysis

Source: (Kumarage. 2015)

The step that national transport policy has taken towards an environmentally sustainable transportation is bit promising. There are some policies related to environmentally sustainability, saving energy and etc. But on authors view, the national transport policy needs to be recreated. There is no policy evaluation method; therefore, it is hard to identify the policy effectiveness. But when look into the existing transport problems like congestion and all, it is aggregable to say that the current national transport policy is failing.

For an example; currently the policy to encourage less energy used transport mode use, is not effective. Some other policies and taxes and ways are crashing with this policy. Therefore, it is need to evaluate the current effectiveness of the policy and it is time to make an exact framework and policies descriptively and wisely.

The policies related to non-motorized mode uses, para-transport is not properly working. Innovations are very less even though it encourages innovations and modernizations to the transport sector. If the policies are a bit of a success there won't be this much of transportation issues in Sri Lanka is the author's argument.

And also, from 2008 to 2020 the situation of Sri Lanka, as well as the measures use within international countries were rapidly changed. Even though there are new editions to the policy, it is time to create a new policy with better policy frameworks, principals and evaluation frameworks.

4.3 Traffic Analysis of the Selected case study

A 500m radius area from the edge of Sethsiripaya was selected as the research stuy area. (Annexure 1: location Map). Many administrative institutes and many supportive activities such studios, food shops, groceries, financial institutes could be seen closed to the site. Same as that, in the vicinity there are many middle (class) residential places. (Annexure 2: Land use Map). A significant impact due to the existing environment is happened in order to Battaramulla Junction, Subuthipura Junction, Parliament Junction, and Polduwa Junction, as same Kaduwela Road (B240), Parliament Road (AB15), Battaramulla-Pannipitiya Road (B47), Polduwa Road, and Sri Subuthipura Road within the 500m radius area from the edge of Sethsiripaya. There are many bus routes (both private and public bus services) going via Kaduwela Road (B240) such as 17 (Panadura-Mahanuwara) (Battaramulla-Kurunegala), 170(Athurugiriya-Fort), 177 (Kaduwela-Kollupitiya), 190 (Balangoda-Fort), 171 (Pelawatta-Fort), 174 (Kottawa-Borella), 190 (Meegoda-Fort), 122 (Avissawella-Fort), 99/174 (Bandarawela-Colombo), 163 (Dehiwala-Videshasewa), and 100/1

(Kalutara-Colombo) etc. At the same time, Kaduwela Road (B240) is the main access road to enter the administrative activities.

The total traffic counts of Polduwa Road, Kaduwela Road (B240), Battaramulla-Pannipitiya Road (B47), Sri Subuthipura Road, Subuthi Mawatha, and Parliament Road (AB15) are approximately 7300, 28800, 16700, 6000, 1400, 36500 respectively (Annexure 3: Study Area). Vehicle classification, traffic flow and directional distribution of the significant roads within the study area is as follow.

There is a high vehicle attraction to Battaramulla direction in morning peak time and, high trip generation to other suburbs at evening peak time, due to the job purpose (Figure: Traffic Flow Distribution on Kaduwela Road-B240). Without any doubt, this traffic count survey show that there is high vehicle composition on motor cycle, three wheeler and car which is more that 20% within the study area (Figure: Traffic Flow Distribution on Kaduwela Road-B240 and Figure: Traffic Flow Distribution on Polduwa Road).
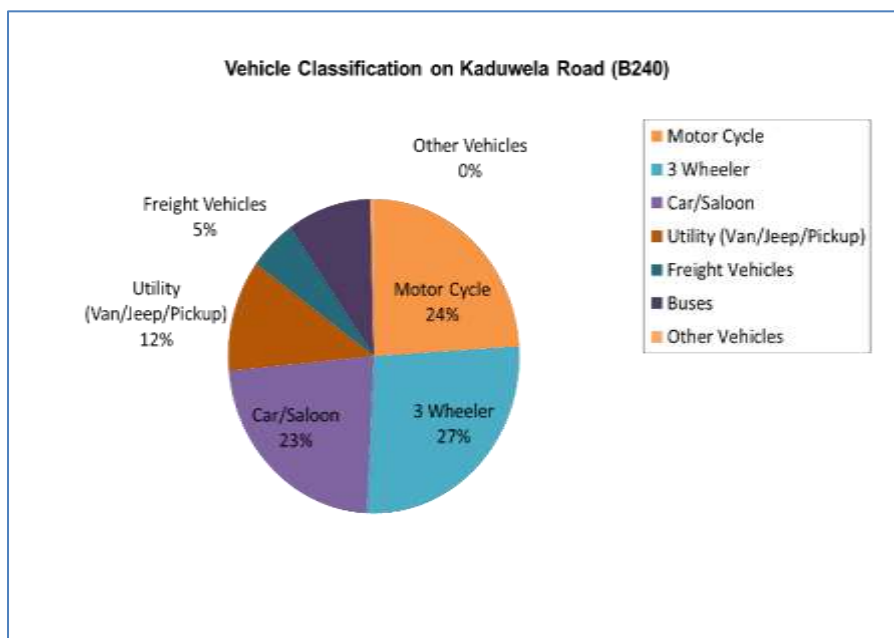
Figure 13Vehicle Classification on Kaduwela Road (B240)

Source: Traffic Count Survey, 2018
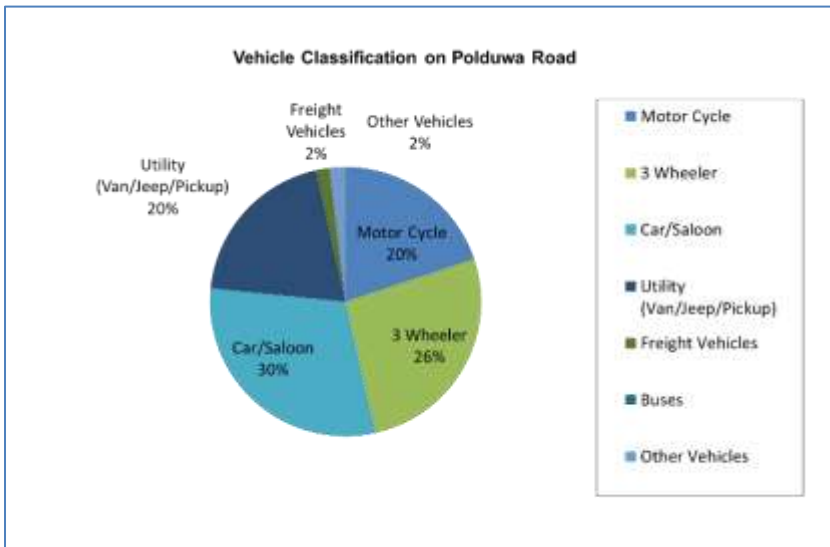
Figure 14 Vehicle Classification on Polduwa Road

Source: Manual Classifies Count Survey, 2018
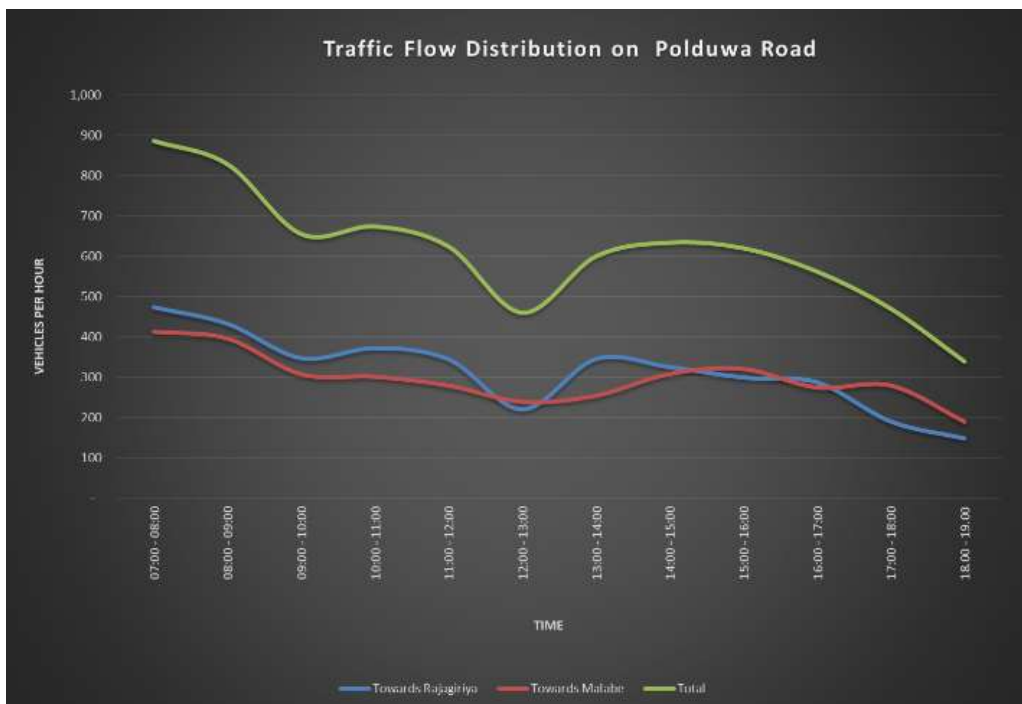
Figure 15 Traffic Flow Distribution on Polduwa Road

Source: Traffic Count Survey, 2018
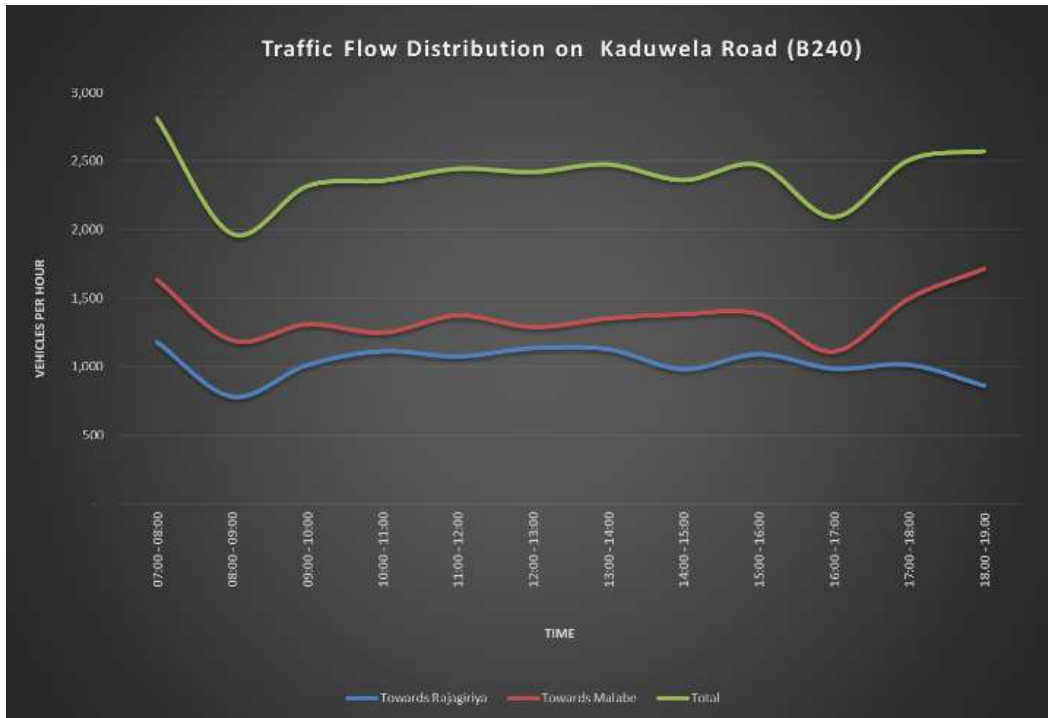
Figure 16 Traffic Flow Distribution on Kaduwela Road

Source: Traffic Count Survey, 2018
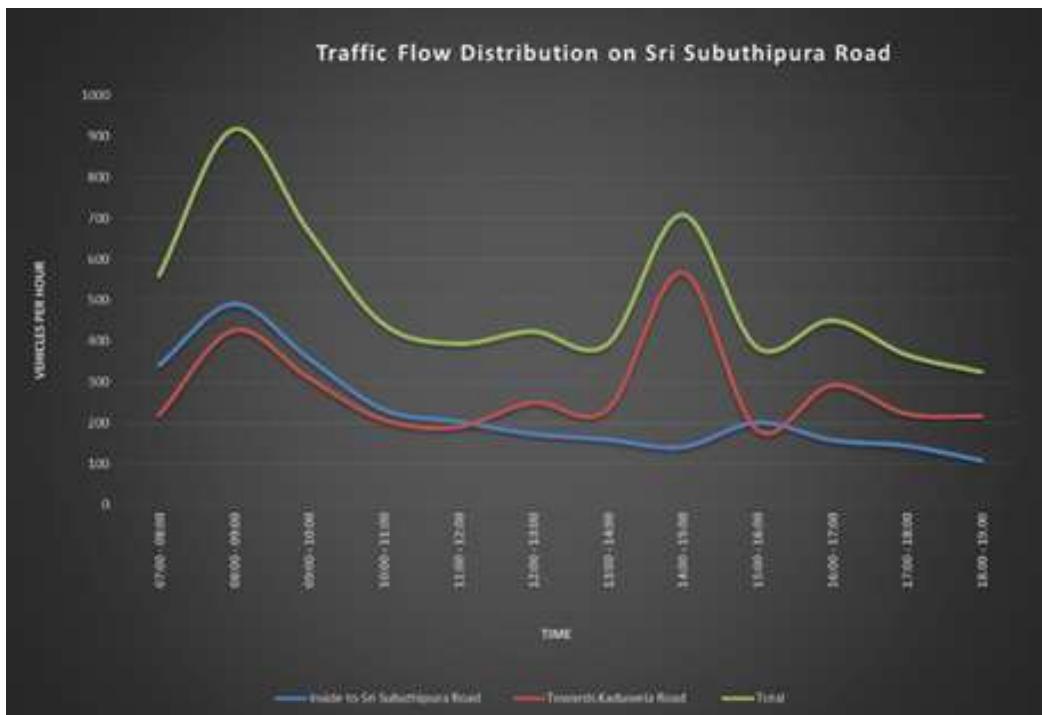
Figure 17 Traffic Flow Distribution on Sri Subuthipura Road

Source: Traffic Count Survey, 2018
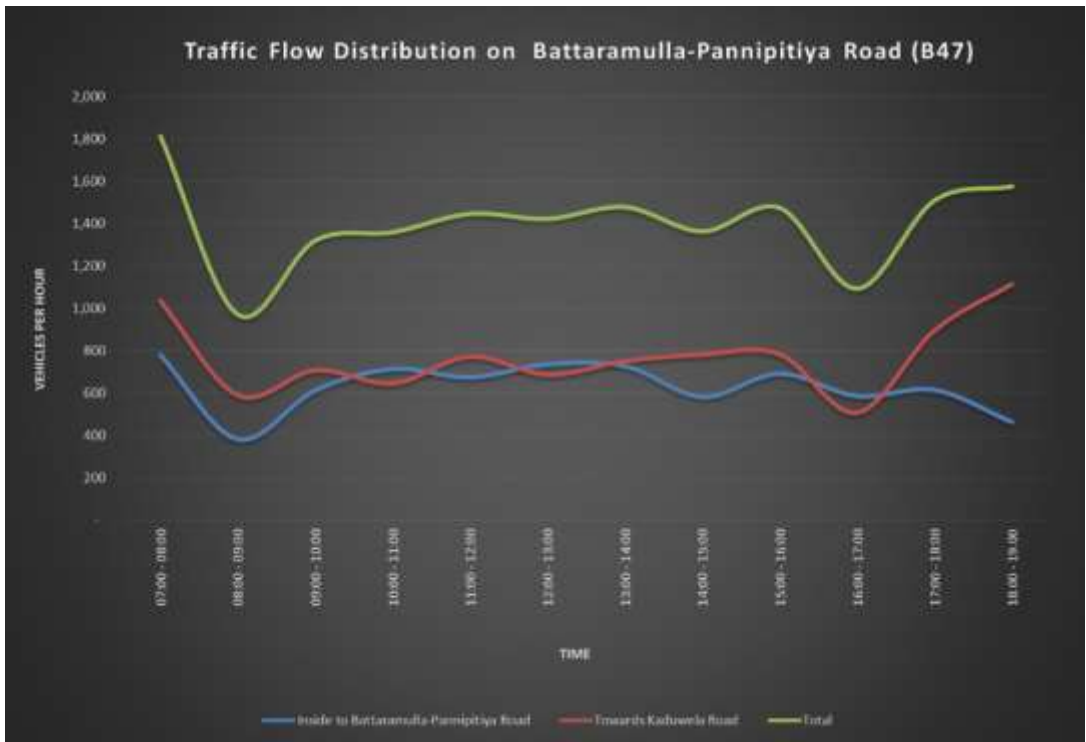
Figure 19 Traffic Flow Distribution on Battaramulla - Pannipitiya Road (B47)

Source: Traffic Count Survey, 2018
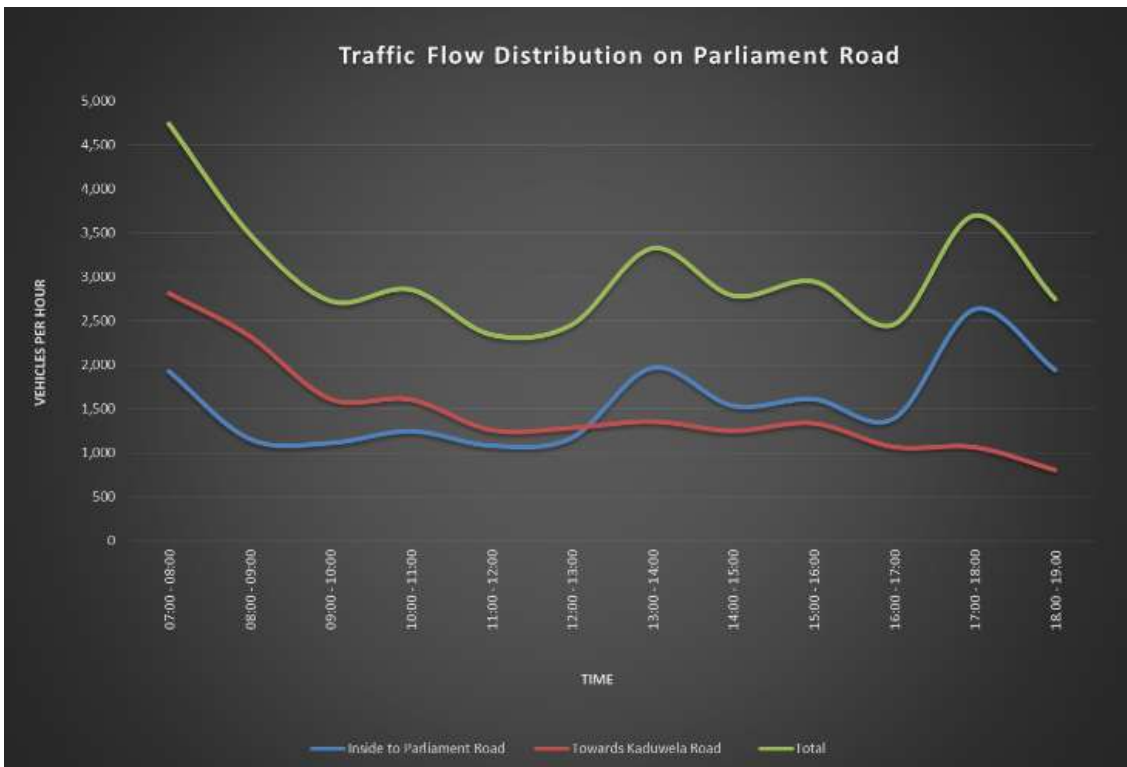
Figure 18 Traffic Flow Distribution on Parliament Road

Source: Traffic Count Survey, 2018
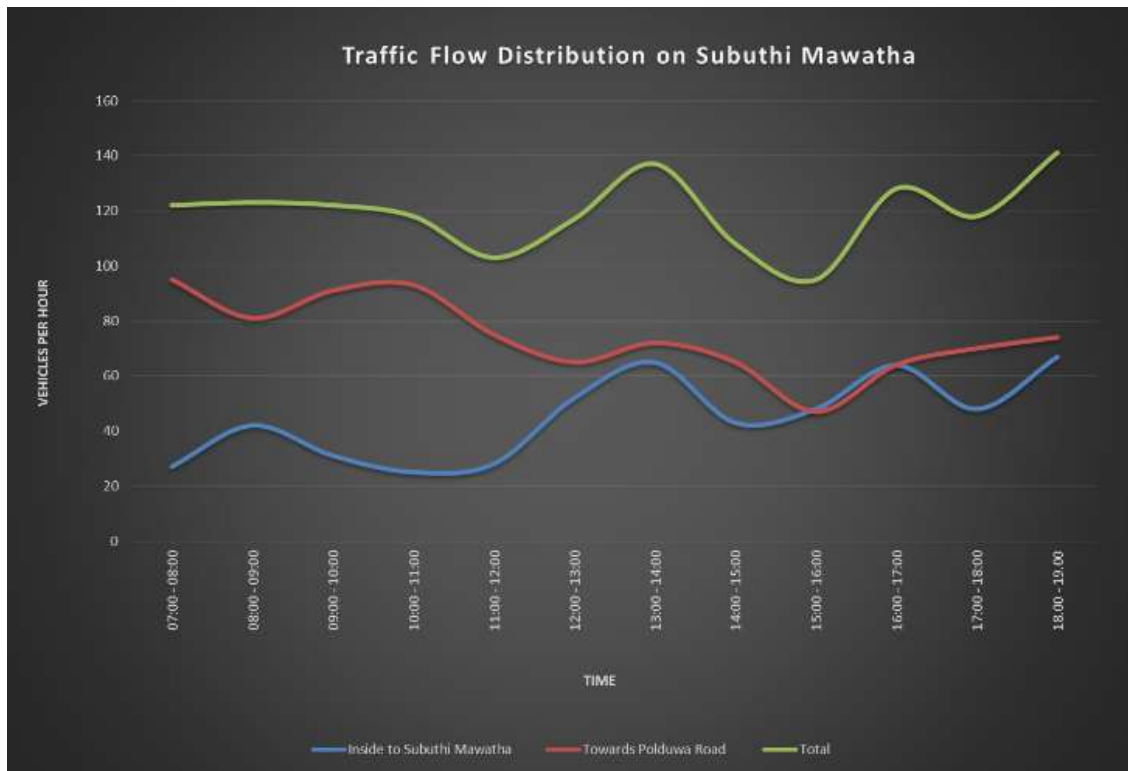
Figure 20 Traffic Flow Distribution on Subuthi Mawatha

Source: Traffic Count Survey, 2018

Table 7 Directional Distribution of Nearby Road

Polduwa Road	
Towards Rajagiriya	Towards Malabe
51.53%	48.47%
Kaduwela Road (B240)	
Towards Rajagiriya	Towards Malabe
42.86%	57.14%
Sri Subuthipura Road	
Inside to Sri Subuthipura Road	Towards Kaduwela Road
45.06%	54.94%
Subuthi Mawatha	

Inside to Subuthi Mawatha	Towards Polduwa Road
37.71%	62.29%
Battaramulla-Pannipitiya Road (B47)	
Inside to Battaramulla-Pannipitiya Road	Towards Kaduwela Road
45.25%	54.75%
Parliament Road (AB15)	
Inside to Parliament Road	Towards Kaduwela Road
51.35%	48.65%

Source: Traffic Count Survey, 2018

The total traffic counts at junctions of Subuthi Mawatha Junction, Parliament Junction, Polduwa Junction, Polduwa Road Junction, Battaramulla Junction and Sri Subuthipura Road Junction are approximately 7850, 75600, 6450, 30350, 42600 and 31900 respectively. There are number of other small junctions within the 500m study area which are formed by the small streets. Therefore, impacts on such intersections and roads within the study area can be considered negligible as vehicle turnings are very small.

At present, level of services remains "A" in each hour throughout the day in Polduwa Road, Sri Subuthipura Road, and Subuthi Mawatha. Thus, there are few changes in level of services at several time slots in Kaduwela Road (B240) and Parliament Road thorough out the 12-hour period at present condition. It shows that the Kaduwela Road (B240) and Parliament Road already congested with the urban land use pattern in Battaramulla area.

The Outer Circular Express Way (Toll Road) is nearly 9 km across Kaduwela Road (B240) to the Sethsiripaya. Most trips are distributed towards Sri Jayawardenepura Kotte (Administrative Capital) and Colombo (Commercial Capital) by the Outer Circular Express Way (Toll Road) via Kaduwela Road (B240). Therefore, slightly higher congestion level can be seen within this section and another special case is the

development density seems to be bit higher within the area. Therefore, Kaduwela Road (B240), Parliament Road (AB15) and Parliament Junction are distributed nearly 28800, 36500, and 75600 of vehicles respectively.

Sethsiripaya Stage I and Stage II buildings have been provided in and out entrances for the officers (including VIP) via Sri Subuthipura Road. As same, lack of parking facilities is near the Polduwa Junction for the trips (non-officers) coming for the offices. Therefore, the road is covered by vehicles from the illegal parking activities. Consequently, Sri Subuthipura Road is getting blocked at present status.

Any major or minor development will cause to generate traffic. It will lead to the congestions and thus to improvement of existing infrastructure. When assessing overall impact of a development, it is must to assess the demand for the road network that was created by the development.

There will be favorable impacts as well as adverse impacts on the system, when changing the traffic environment that was created by a new development in an area. Large scale a development always leads to an intolerable amount of traffic (in and out) and the road network's efficiency is massively affected by this. "Sethsiripaya Stage-III" Office Complex will be established at near future. With that, automatically vehicles attractions will be increased. Consequently, level of services of the nearby roads can be changed negatively. Office Complex is constructed on land of existing Diyatha Car Park. More than 1,500 people are attracting to Diyatha Uyana even weekday. Therefore, it limits the parking facilities for the attractions also. At a result of that, people are usually adopted to park vehicles both sides of the nearest roads. It is also a critical disturbance for the free flow of the roads. so, the problem is if there are no any proper traffic management strategies for a new development or if it has no ability to provide required parking facilities it will create another problems filling up the road side parking and reduce the road capacity. This will lead to affect neighborhood privacy and amenities. Last but not least it will also impact on the road safety. As same, the level of service of the nearby roads can be affected with the upcoming development also. Therefore, there is a high requirement on long-term

traffic management strategies for Bttaramulla area in present condition and future also.

Time Slot	Polduwa Road	Sri Subuthipura Road	Subuthi Mawatha	Kaduwela Road (B240)	Parliament Road (AB15)
7.00 am to 8.00 am	A	A	A	C	C
8.00 am to 9.00 am	A	A	A	B	B
9.00 am to 10.00 am	A	A	A	B	A
10.00 am to 11.00 am	A	A	A	C	B
11.00 am to 12.00 noon	A	A	A	C	A
12.00 noon to 1.00 pm	A	A	A	C	A
1.00 pm to 2.00 pm	A	A	A	C	B
2.00 pm to 3.00 pm	A	A	A	C	A
3.00 pm to 4.00 pm	A	A	A	C	B
4.00 pm to 5.00 pm	A	A	A	B	A
5.00 pm to 6.00 pm	A	A	A	C	B
6.00 pm to 7.00 pm	A	A	A	C	A

Figure 21 Level of Condition at present condition

Source: Traffic Count Survey, 2018

So according to the above traffic survey and also according to public survey and the literature there is huge traffic congestion in Battaramulla as the Administrative Capital in Sri Lanka. And the future condition will be worse comparing to present condition. So the traffic survey findings and narrative analysis findings together prove that there need to have better policies, guides, directives and strategies in order to face the future conditions.

4.4 Congestion Cost Analysis

The source of the analysis is from "A Policy Proposal for Managing Land Transport in Sri Lanka" by Prof. Kumarage.

1996 Congestion cost

- Estimated vehicle hours in Colombo Metropolitan Region= 332,953.7 vehicle hours per day
- Estimated vehicle kilometers in Colombo Metropolitan Region= 7,519,656.9 vehicle kilometers per day
- Estimated network speed= 22.58 km/hr
- Vehicle hours for 30 km/hr = 250,655.2 vehicle hours/day
- <u>Lost vehicle hours due to congestion = 82,298.7 vehicle hours/day</u>

Assumptions	
Number of Days of the Year	=300
V1: congestion speed	=22.58Km/hr
V2: desired speed	=30km/hr
C1: Maintenance cost (Average vehicle) in congested speed	=11.82 Rs/Veh_Km
C2: Maintenance cost (Average vehicle) in Desired speed	=9.8 Rs/Veh_Km
VOT	=135.50Rs/veh_hr

Value Of Operating Cost= Veh_km*(C1-C2)*300

=7,519,656.90*(11.82-9.8)*300

=4,556,912,081.40

= Rs 4.6 bn per annum

Value of Time= Veh_km *(1/V2-1/V1) * VOT *300

=7,519,656.90*(1/22.58-1/30)*135.40*300

=3,702,405,615.49

=3.7bn Per annum

Total Congestion cost =Value of time+Value of operating cost

In 1996

Congestion Cost = 8.3bn per annum

2015 Congestion cost (based on the assumption of 75% growth from 1996 to 2018 (Defining Urban Sprawl in the Sri Lankan Context: With Special Reference to the Colombo Metropolitan Region,2015 & Turning Sri Lanka's urban vision into policy and actions, 2015)

- Estimated vehicle hours in Colombo Metropolitan Region= 582,669 vehicle hours per day
- Estimated vehicle kilometers in Colombo Metropolitan Region= 13,159,399.6 vehicle kilometers per day
- Estimated network speed= 22.58 km/hr
- Vehicle hours for 30 km/hr = 438,646.3 vehicle hours/day
- Lost vehicle hours due to congestion = 144,022 vehicle hours/day

✛ Vehicle Operating Cost (VOC) per Annum

Value Of Operating Cost= Veh_km*(C1-C2)*300

=13,159,399.60*(20.7-17.6)*300

=12,238,241,628.00

= Rs 12.2 bn per annum

Value of time   = veh_km*(1/V2-1/V1)*VOT*300

=13,159,399.6*(1/22.58-1/30)*237.13*300

=Rs. 93,614,652,814.44 per annum

=Rs. 93.6 bn per annum

In 2015

Congestion Cost = 105.8bn per annum

The congestion cost has been increased over the years. And the lost hours were also increased due to congestion. Comparing 1996 to 2015 there were huge changes more than 50%. So there should have better plans policies regarding congestion issue for next 10 years also. The vehicle ownership level also has increased from 1998 to 2015 from 64% (Kumarage, 2015).
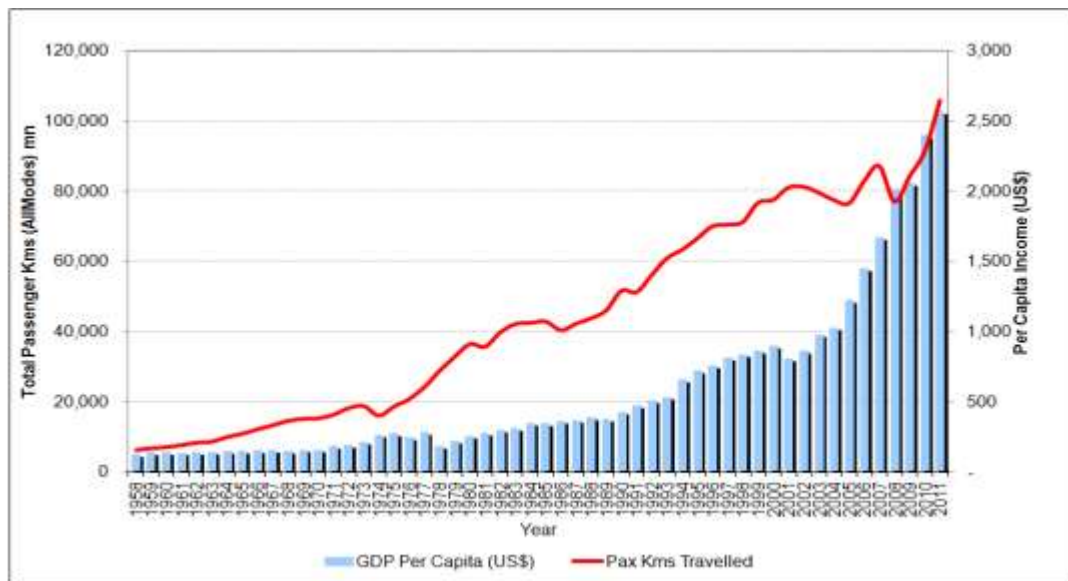
Figure 22 Growth of passenger traffic 1958-2011

Source: (Kumarage 2011)
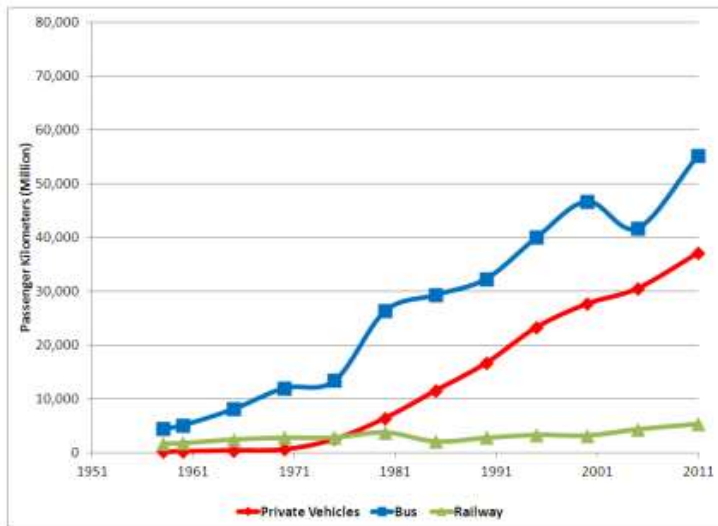
Figure 23 Passenger Kms by Mode 1958-2011

Source: (Kumarage 2011)

The above figures explain the transport growth within 1958 to 2011.

2011 Mode	Vehicle km Operated (mn)		Passenger km Carried (mn)		2.7 mn Vehicles Freight Ton km Carried (mn)	
Bus	1,379	5%	55,177	55%		0%
Railways	9	0%	5,365	5%	134.8	2%
Private Vehicles	16,605	60%	25,759	26%		0%
Para-Transit	4,841	18%	11,348	11%		0%
Goods/Land Vehicles[32]	4,819	17%	2,585	3%	6436	97%
Water Transport	3	0%		0%	32	0%
Total	27,657	100%	100,236	100%	6603	100%
2021					4.8 mn Vehicles	
Bus	1,524	3%	60,950	41%		0%
Railways	13	0%	7,211	5%	291	2%
Private Vehicles	36,245	66%	57,065	38%		0%
Para-Transit	7,328	13%	19,381	13%		0%
Goods/Land Vehicles	9,474	17%	4,973	3%	11,526	97%
Water Transport	3	0%		0%	32	0%
Total	54,586	100%	149,579	100%	11,849	100%
2031					7.8 mn Vehicles	
Bus	1,124	1%	44,946	20%		0%
Railways	17	0%	9,690	4%	628	3%
Private Vehicles	80,253	72%	128,136	57%		0%
Para-Transit	11,136	10%	33,315	15%		0%
Goods/Land Vehicles	18,628	17%	9,632	4%	18,774	97%
Water Transport	3	0%		0%	32	0%
Total	111,161	100%	225,719	100%	19,435	100%

Figure 24 Road traffic growth 2011-2031

Source: (Kumarage 2011)

The above figure also explains how the private vehicle usage is growing.

This result proves that the congestion is a hindrance for both people and the national economy of the country. And at the same time this result also proved that there need to have better policies, guides, directives and strategies in order to face the future conditions.

The above four titles explained that there is a problem called traffic congestion and the current policies are not much efficient towards facing to the upcoming threats. So there is a need to have better policies, guides and framework, directives and strategies. The latter part of this chapter will explain the solutions towards this situation.

4.5 Public Perception Analysis

The past studies show that the best solution to erase the traffic congestion is to improve the pt in Sri Lanka (Urban Development Authority, 2017) especially in Battaramulla also. Also, 100% of expertise survey results prove it. As same, 100% of public or communities are required quality, comfortable, efficient and safe pt for easy access.
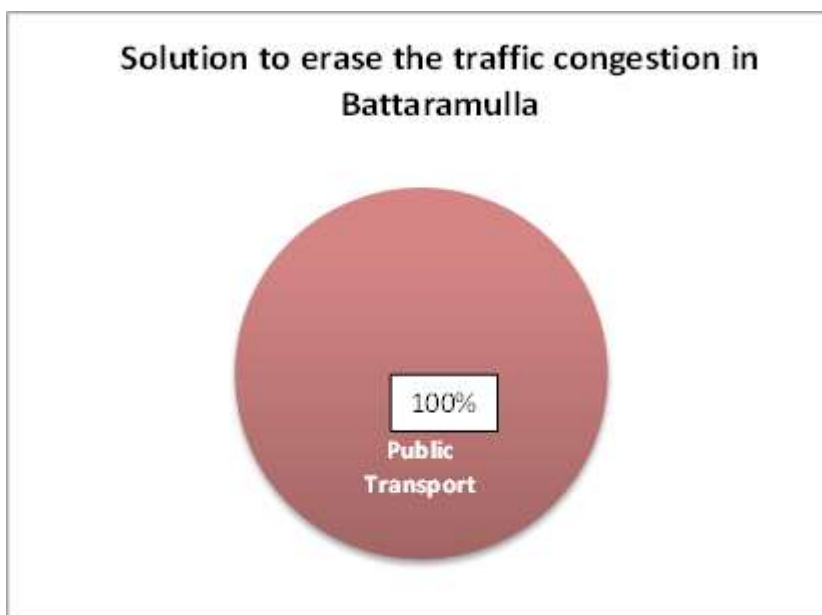
Figure 25 Solution to erase traffic congestion in Battaramulla according to public perception

Source: Public Perception Survey, 2018
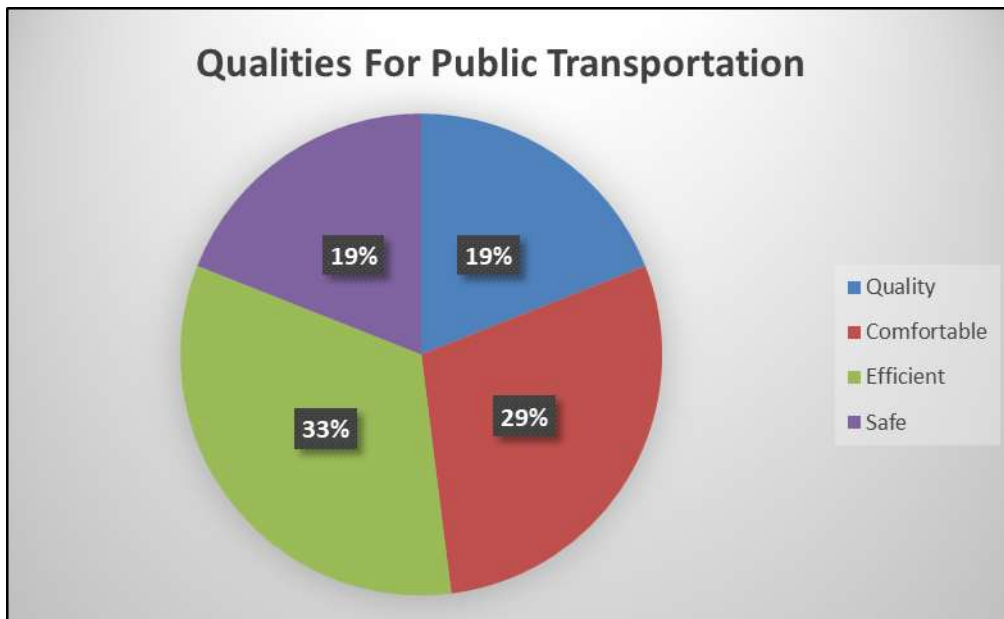
Figure 26 Expected qualities for Public transportation by public

Source: Public Perception Survey 2018

Public sees improving public transportation might be the only possible solution against the congestion issue. Within the public perception survey it was also collected preferred strategies to mitigate the congestion impact. Among the mentioned strategies people mostly selected Road Charges on private vehicles, Light Rail Transport (LRT), and Improvement of existing rail transport system as the possible solutions. Rather than that they wanted improve public transportation system with the improvement of existing bus service also.
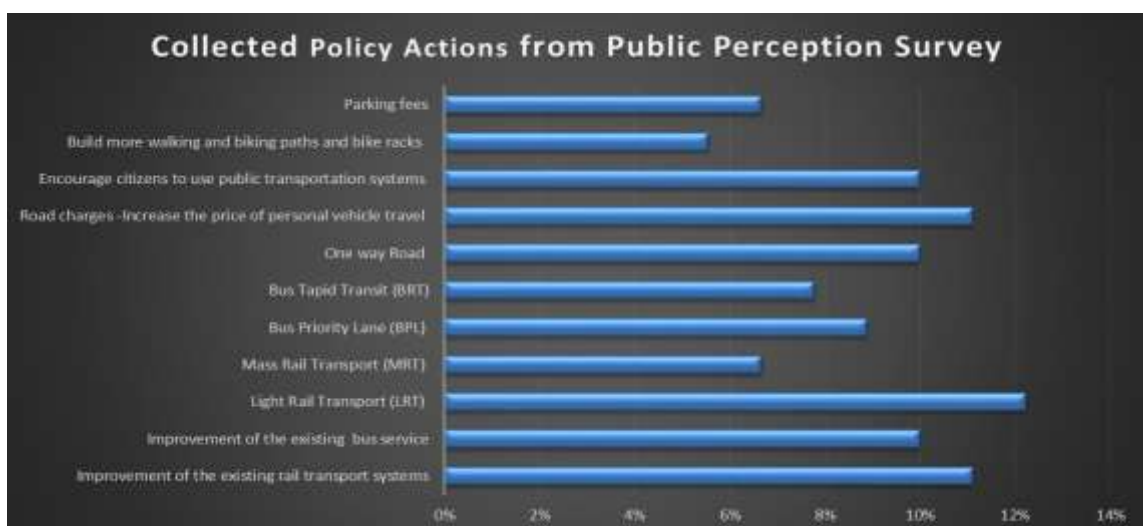
Figure 27 Collected Policy Actions from Public Perception Survey

Source : Public Perception Survey, 2018

4.6 Expert Perception Analysis

According to the expert perception survey also, the main solution for the traffic congestion will be promoting public transportation while discouraging the private vehicles. Apart from that, mostly taken strategies (policies, actions or plans) to reduce congestion impact were collected through the survey.

Table 8 Taken Strategies to reduce congestion impact in urban areas of Sri Lanka

Location	Cause / Reason	Taken strategies
Colombo, Dematagoda, Maradana	▪ Congestion at Railway Station	Star bus service specially for staff from Dematagoda, Maradana
Kandy	▪ There are few entrances to the Kandy city. ▪ The heavy vehicles create a traffic in the city limits. ▪ Most of narrow roads can be observed within the Kandy city.	Restricted to enter the heavy vehicles from the entry nodes to Kandy City within the time limit from 6 am to 9 am.
Kandy / Colombo	▪ Large supply of vehicle parking encourages to use own vehicles.	Regulate the parking and restrict the road side parking. Increase the parking rates at regulated parking areas.
Galle Road (Partially- From Moratuwa to Fort)	▪ Traffic congestion	Bus Priority Lane (BPL)
Galle Road / Colombo Municipal Council Area	▪ Traffic congestion ▪ Minimize the private vehicle usage	Parking charges for Motorized vehicles
Makumbura	▪ Congestion at Highway Interchange ▪ Integrate the transport services	Multimodal Transport Hub

	▪ As a prime center for high traffic circulation	
Colombo	▪ Providing of comfortable and safe journey to the community	Improvement of luxury and safety services
Rural Areas	▪ To easy access from rural areas to urban areas	Introduction of more bus services
Orugodawatta, Kelaniya	▪ Accident risk on pedestrian and vehicle movements ▪ Traffic congestion	Crossing Bridge
Kesbewa Junction – 120 Bus Route at Piliyandala	▪ Traffic congestion	Bypass Road
Wakwella Road - Galle	▪ Traffic congestion	One-way Road
Colombo city area	▪ Traffic congestion	Shuttle service

Source: Compiled by the author through the expert survey, 2018

And also, the future (to be) planning strategies, proposals and proposed developments were collected through the survey.

Table 9 Future planning strategies, proposals and proposed developments

Location	Cause / Reason	Planned strategies
Other corridors towards Colombo	▪ Traffic congestion	Other corridors towards Colombo also to be considered the Bus Priority Lane (BPL).
Galle road -All the corridors towards Colombo which having Bus Priority Lane (BPL)	▪ Traffic congestion	From Bus Priority Lane (BPL) to Bus Rapid Transit (BRT)
From Panadura to	▪ Mitigate the road	Enhancement of railway

Veyangoda	congestion	network
		Railway Electrification
Pettah to Malabe	▪ Mitigate the traffic congestion	Light Rail Transit (LRT)
Battaramulla	▪ Mitigate the traffic congestion	Multimodal Transport Hub
Kelaniya to Pettah	▪ Traffic congestion	Light Rail Transit (LRT)
Pettah	▪ Erase the congestion level within the city limit	Multimodal Transport Hub
Galle Road – From Ratmalana to Pettah	▪ Traffic congestion	Introduction of park and ride facility with luxury bus service under CTB.
Port City Project	▪ Traffic congestion	Underground highways and tunnels
Colombo suburban areas	▪ Low condition of Railway system ▪ Unsafe of community beside the railway line. ▪ Reduce the road congestion	Railway Line improvement Kelani Valley Double Line Electrification
Veyangoda to Panadura	▪ Road congestion	Railway Electrification
Negombo-Colombo	▪ Road congestion	Railway Double Line improvement
Kelani River up to Hanwella	▪ Traffic congestion	Water Transportation along Kelani River

Source: Compiled by the author through the expert survey, 2018

And through the provided strategies, experts were selected the following strategies as the best strategies to face the congestion impact in urban areas. Here they were selected the following strategies by comparing it with the world context.

According to the selected strategies, mostly they were voted on Railway improvement and electrification, Light Rail Transport (LRT), Mass Rail Transport (MRT). Bus Priority Lanes (BPL), Bus Rapid Transit (BRT), Road Charges on private vehicles, and Promote Public Transportation.

Table 10 Collected Policy Actions from Expert Survey

Source: Experts Survey 2018

4.7 Comparison and the most suitable strategies

Table 11 Comparison of the selected strategies through several analysis types

Content Analysis from the Literature	Public Perception Analysis	Expert Perception Analayis
• Discourage Automobile use • Mass Transportation • Sidewalks on both sides of the roads • Bicycling paths, lanes and other related infrastructure • Encourage non-motorized transportation • Taxes • Quality of Public Transportation	• Road Charges on private vehicles • Light Rail Transport (LRT) • Improvement of existing rail transport system	• Railway improvement and electrification • Light Rail Transport (LRT) • Mass Rail Transport (MRT) • Bus Priority Lanes (BPL) • Bus Rapid Transit (BRT) • Road Charges on private vehicles • Promote Public Transportation.

Source: Compiled by the author

The compared results of the above three analysis, was again analyzed through the experts interviews, because in the interviews they have added their own thought about the strategies. So the strategies of "Road charges on privet vehicles, Railway Improvement, Mass transportation, Light Rail Transportation, Taxes, Quality of public transportation, Promote Cycling and Promote walking" were again analyzed through the expertise ideas.
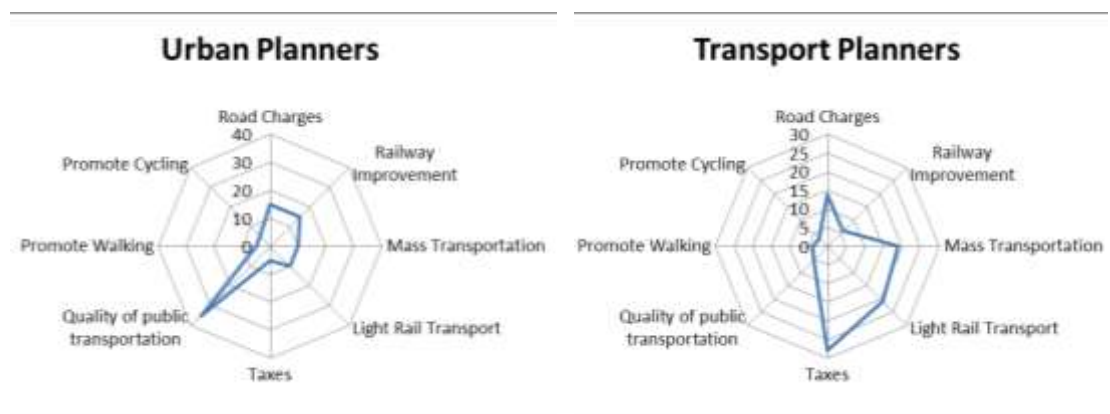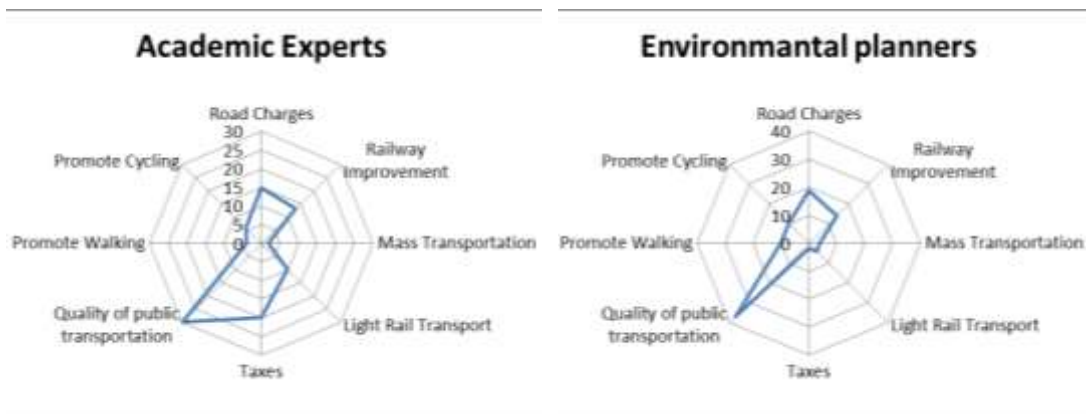
Figure 28 Different professionals' Perceptions analysis

Source: Compiled by the author through Expert's perception surveys
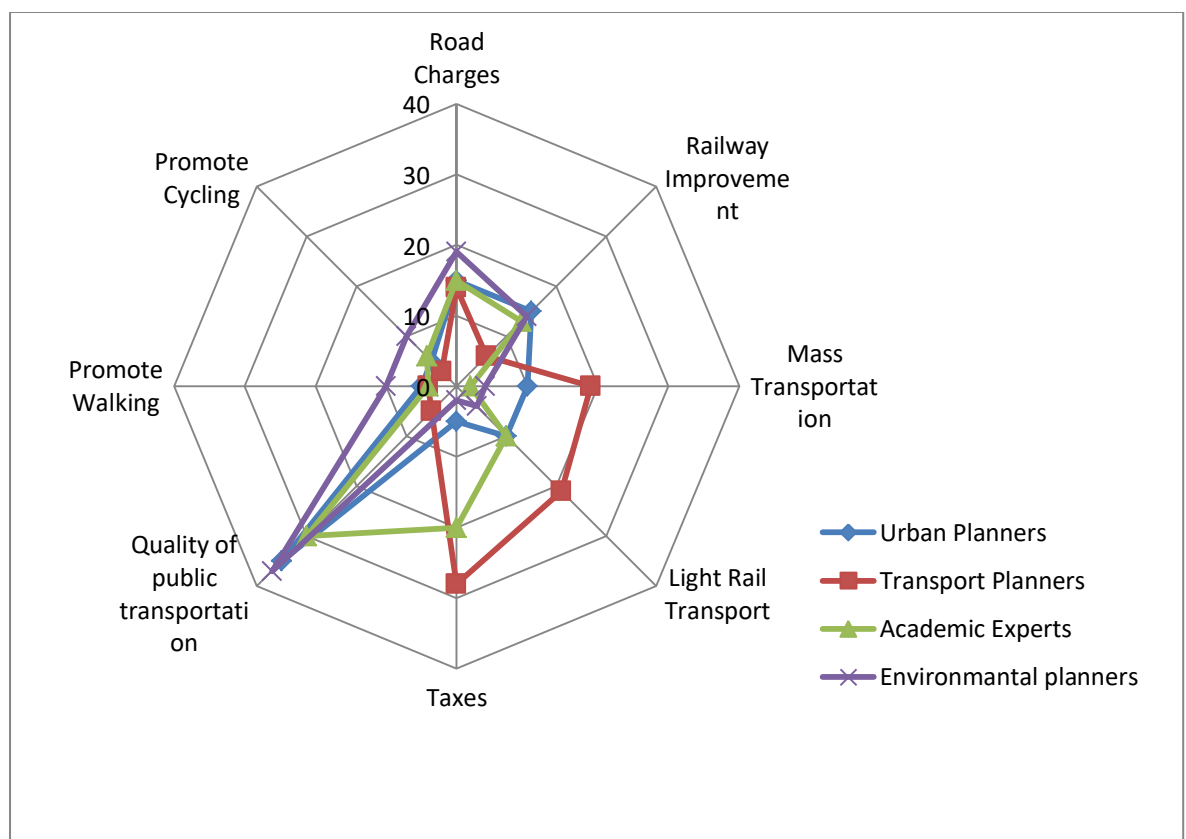
Figure 29 Comparison of Experts' Solutions

Source: Compiled by the author through Expert's perception surveys

Through this analysis five most suitable strategies were selected,

1. Quality of public transportation

2. Taxes
3. Light Rail Transportation
4. Mass Transportation
5. Road Charges

4.8 Applicability of different public transport modes into Sri Lankan context

According to key characteristics and strengths, these public transport modes were analyzed in order to understand the applicability to Sri Lanka.

Public Transport modes	Grow Compactly	Consolidate as you grow	Maintain/shrink smartly
Bicycles (Public)	Low	Low	Medium
Paratransit	High	Medium	Low
BRT (Bus Rapid Transit)	Medium	High	Medium
LRT (Light Rail Transit)	Low	Medium	High
Heavy rail and metro system	Low	Medium	Medium
Demand responsive transport and Taxis	Medium	Medium	High
Conventional Bus	High	High	High
Waterborne transport	Medium	Medium	Medium

Figure 30 Applicability of different public transport modes into Sri Lankan context

Source: Compiled by the author based on Low Carbon Green Roadmap for Asia and the Pacific: Urban Transport, 2019

4.9 Key recommendations based on Expertise Interviews

Multi-model transportation system includes having various modes connect with one another. Ex: cycling, walking, public transit or automobile and etc.). Multi model transport has several advantages including improve the convenience o the passengers, encourage the public transport usage, economies of scales in transport negotiations.

Through the multi model transportation technique, government encourage into using available infrastructure efficiently and they focused on to reduce the transport cost, not only the direct cost it will reduce the indirect cost as well (ex: human resources).

Multi–modal transportation framework includes the mass transport modes of travel primarily classified as follows:
-Rail based Modes
- Metro Rail Corridor

- Ring Rail
- Light Rail Transit
- Mono Rail
- Integrated Rail cum Bus Transit, etc.

-Road based Modes
- Regular Buses
- Mini Buses
- Double Decker Buses
- Articulated Buses
- Express Buses
- Trolley Buses
- Guided Buses and Battery Operated Buses
- Trams
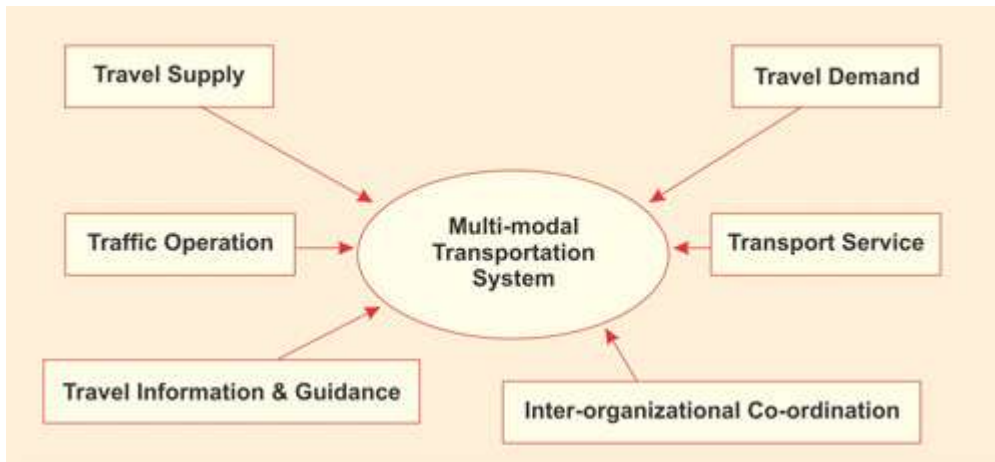
Figure: Components of multimodal transport system

Source: NBM&CW, 2018

Basically, there were two recommendations for a congestion free urban area.

1. Moving away from private motorized transportation (Pushing away)
2. Moving towards more sustainable transportation
   - Road space reserving
   - Sustainable modes
   - Integrated modes
   - Service formalization

Key recommendations for Local and National Governments

Table 12 Narrative Analysis of Key Recommendation

Objective	Recommendations
Create an institutional framework in order to develop integrated and	Create authorities targeting more integrated transport services. They should

sustainable transport policies	be considering not only the transportation but also the other areas that matters. For ex: Land use & Housing
Make sure of adequate support of finance for the transport management	Create an urban transport fund. Focus on sustainable transport & specially on non-motorized and public transportation
More focused on long term planning	Integrated transport and land use master plans should be ther while incorporating both regional & local plans
Create a favorable environment in order to move towards more sustainable transportation	According to the on-field professionals, the key to the congestion problem is to create a bunch of basic policy package in order to pull away from private vehicles. For that there need to have definite policy framework for a successful policy creation.

Source: Compiled by the author using Experts' interviews

As the experts suggest the latter part of this chapter is focusing onto creating a policy framework to reduce the congestion impacts on urban areas of Sri Lanka.

1. Coercive Pricing Mechanism
- Proper investment plan
  - i. Allocate money orderly for prioritized projects to earn financial benefits and for efficient transportation
- Fuel taxes (based on emissions) on private vehicles
- Vehicle import/purchase/registration taxes (based on emissions) on private vehicles
- Direct road charges on private vehicles
- Cordon area pricing on private vehicles
- Parking fees and restrictions on private vehicles
- Subsidize mass transit fees for employees
- Increase the price of personal vehicle travel
- Congestion charges on private vehicles
- Privatization of Sri Lanka Railway Department

2. Proper Regulation Monitoring system
- Proper Monitory plan for Rules and regulations
- Organizational structure among planning institutes need to be modified
- Strict ticketing and high penalties for motorists, pedestrians, and cyclists who violate traffic regulations
- Zoning development policy to be controlled the ribbon development

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1. Encourage citizens to use public transportation systems
- Educate citizens to dismantle negative stigmas of public transportation
- Efficient bus operation and management system

2. Improve the Pedi cabs and other non-motorized taxi services

3. Enhance the shuttle service within internal city limits

4. Enhance the quality of public transport and attention to passenger comfort
- Improvement of the existing bus service

5. Encourage the trend on walking and cycling

6. Office bus staff transport improvement

Policy Actions / Strategies

Policy Directive 01
Improving public transportation systems

Policy Directive 03
Discouraging the use of private transportation systems

Policy Directive 02
Encouraging the use of public transportation systems

Policy Directive 04
Changing urban plans and city designs

Policy Actions / Strategies

---

1. Discourage citizens from using automobile for travel
- Reduce the number of vehicles allowed in urban areas
- Lower speed limits for motor vehicles in cities

2. Provide alternative routing instructions

---

1. Improvement Infrastructure for walking and Cycling
- Build more walking and biking paths
- Sidewalks on both sides of the street
- Extensive networks of bike paths and lanes
- "Bicycle streets" where cars are permitted but cyclists have strict right-of-way
- Special bike turn lanes leading directly to intersections
- Separate bike traffic signals with advance green lights for cyclists
- Bike parking (ranging from secured boxes to simple racks)
- Integration of bicycles with public transport
- Bike-activated traffic signals at key intersections
- Modifications of street networks to create deliberate dead ends and slow, circuitous routing for cars, but direct, fast routing for bikes

2. Apply the speed limits and physical barriers
- Intersections and crosswalks
- Traffic circles
- Road narrowing
- Zigzag or chicane routes
- Curves
- Speed bumps
- Artificial dead ends

3. Mass Transport improvements
- Metro Rail Transit (MRT)
- Light Rail Transit (LRT)
- Bus Rapid Transit (BRT)

4. Provide Bus Priority Lane (BPL)

5. Provide Parallel commuting routes

6. Integrated transport networks and transport Systems

7. Railway Improvements

8. Railway Electrifications

9. Build new subway and one way

10. Enhance the inland and marine water transportation

11. Redesigning the existing infrastructure on Parking
- Remove the street parking and open pedestrian ways only for pedestrians
- Providing the off street parking spaces

12. Logistic enhancement
- Good movement restrictions
- Allowance in the city and outside

13. Introduce the park and ride system

14. Development of expressways to connect main cities

15. Improvement of Multimodal Transport Hub

16. Develop the mega city centers

Figure 31 Further Directives and Actions through the Literature

Source: Compiled by the author

4.10 Policy Framework and the Evaluation Process

By organizing the facts gathered by the surveys and reviews here the author has derived a policy framework that can be used by the government in order to control the traffic congestions.

"A policy framework is document that sets out a set of procedures or goals, which might be used in negotiation or decision-making to guide a more detailed set of policies, or to guide ongoing maintenance of an organization's policies" (Monash University. 2019).

The stage one is about the government existing policy drivers related to the congestions. Stage 2 is about public needs and the barriers. Stage 3 is about the congestion reduction factors, directives as identified from this study. These 3 stages will guide more detailed set of policies and it will guide ongoing maintenance of existing policies.

As the author proposed in the evaluation process, it can use to evaluate existing policies and future policies. Through that responsible agencies can check whether the policies are reducing the traffic or not and whether the policies are discouraging the individual vehicle usage while promoting public transportation or not.
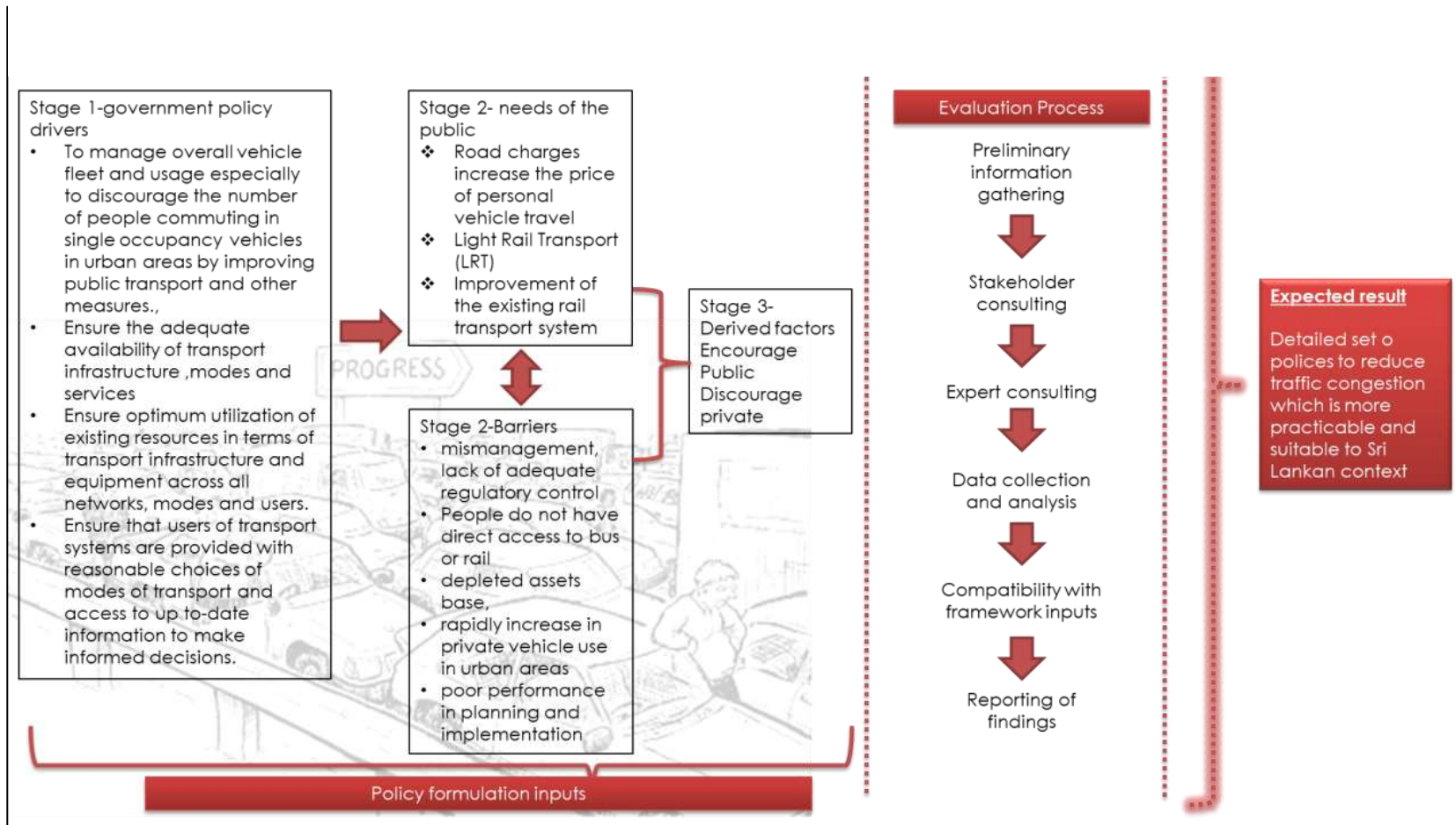
Figure 32 Policy Framework and the Evaluation Process

Source: Compiled by the author

CHAPTER 05
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Traffic congestion can be identified as a manifesting critical issue in urban areas of all over the world. It generates huge negative impacts on the urban environment.

Sri Lankan statistics proves that many people spend more time on the road and they pay more for fuel. Currently the vehicle amounts are rapidly increasing and it cause to take more time to reach to a destination. Therefore, need of pt system accessibility is acceded by developed and developing countries, due to one of the main critical issues of road traffic congestion in urban areas

This research aims to develop a policy framework in order to reduce road traffic congestion and enhance the effective accessibility in public bus transport for the Sri Lankan community. This papers object are as follows;

> Find Out the most suitable measures to reduce the traffic congestion in Urban areas of SL.
>
> Evaluate the implementation and efficiencies of prevailing policies to reduce congestion impacts in SL.
>
> Develop a policy framework to reduce the congestion impacts in Sri Lanka

As the first part of the research, the literature review was conducted. In order to summarize the literature review word count analysis, and phrase analysis were used. And also most suitable strategies to reduce the traffic congestion were selected through a content analysis. And through a comparative analysis, strategies from developed and developing countries were analyzed. To address the research question, which is to find out most suitable measures; four types of literature reviews will be used. Those are;

- Studying what are the policy, policy analysis and the policy frameworks
- Studying National Transport Policy
- Studying transport issues in both national and international countries
- Studying transport policies in both national and international countries

- Studying international case studies related to congestion

In order to prove that there is a congestion problem in current situation and to understand it may be worse in future, the narrative policy analysis and congestion cost analysis were used. Rather than that, one of most active areas was selected as a case study and checked whether there is a congestion or not. By using traffic impact assessment, it was analyzed whether there will be a congestion in the near future with all those upcoming developments. Exactly identify whether there is a congestion problem or not is a good step before suddenly stepping into finding the measures against it.

In order to select most suitable measures that were mentioned in the literate, the content analysis will be conducted. Again to find out the most suitable measures, public view as well as expert view will be identified. After by comparing all three results, most suitable measures to reduce congestion in urban areas of Sri Lanka will be identified.

In order to collect data, public perception surveys, traffic count surveys, experts perception surveys, expert interviews were used. 30 expertise were interviewed and 200 people were surveyed.

First it the congestion issue and the policy inefficiency were analyzed by using traffic survey, congestion cost analysis and expert perceptions. Second it was analyzed what will be the most suitable solutions in order to reduce the congestion in urban areas of Sri Lanka. Third, a policy framework and an evaluation process were created as a guide to future policies in order to reduce traffic congestion.

For the traffic survey 500m buffer zone from Sethsiripaya, Baththaramulla was selected as the study area. Public perception survey was also conducted based on this study area.

In developing cities, it can be observed that they neglect non-motorized transport policy and it's relating infrastructure. Sri Lanka has a transport policy, but in the implementation stage it makes some limitations. So there is a need to implement congestion reduction policy in Sri Lanka in order identify suitable strategies. For example the framework can be use to achieve the quality public transportation. To develop the framework, it was used an opinion survey of stakeholders and experts.

As the final output of this research project, it was analyzed the most suitable strategies to reduce congestion. And it was analyzed the applicability of different public transport mode types into the Sri Lankan Context. And the study provides key recommendations for local and national governments of Sri Lanka in order to reduce traffic congestion. And finally the study provides a policy framework and an evaluation process in order to guide the future policies and to evaluate prevailing policies and to reduce the traffic congestion in urban area.

So, the research offers 4 valuable findings.

1. Most suitable strategies in order to reduce the traffic congestion in urban areas of SL.

2. Most suitable transport modes in order to reduce the traffic congestion in urban areas of SL.

3. Key recommendation for local and national governments in order to reduce the congestion impacts

4. Developed policy framework and an evaluation framework in order to reduce traffic congestion by transferring from private vehicle uses to public transportation.

According to perception of urban planning, the types of researches are really useful to make decisions on policy development.

5.2 Recommendation for future work

There are traditional methods as well as modern methods to analyze policies. For examples; Advocacy coalition framework, Policy network analysis, Punctuated equilibrium, Frame reflexive policy analysis, argumentative discourse analysis and etc. In this research only the Narrative Policy Analysis was used as an analysis method and that is the basic form of policy analysis method of the all methods.

If the future research can focus on these types of policy analysis it would be great, because there is a lack of adequate transport policy analysis research in Sri Lanka.

The policy framework can also be further improved utilizing more parameters like further land use parameters, economic and environmental parameters and etc.

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ANNEXURES

ANNEXURE 1: LOCATION MAP

ANNEXURE 2: LAND USE MAP

RESIDENTIAL AREA

MIXED USE

RESIDENTIAL AREA

B469

Institution of Incorporated
Engineers Sri Lanka

Water's Edge

OPEN SPACES

WATER BODY

B120

Diyatha Uyana

ADMINISTRATIVE AREA

Auditor General's
Department

Sethsiripaya Stage I

Suhurupaya

Sethsiripaya Stage II

Post Office

B240

Ceylon Electricity Board, Distribution
Division 03 - Headquarters

COMMERCIAL USE

B47

WATER BODY

ADMINISTRATIVE AREA

Ministry of Lands

MIXED USE

Ministry of Environment

ANNEXURE 3: STUDY AREA

Rajagiriya Direction

Malabe Direction

Vehicle Trips - 7850

Subuthi Mawatha
Vehicle Trips - 1400

Ramya Mawatha

Subuthi Mawatha Junction

Polduwa Road
Vehicle Trips - 7300

Lake Road / Lake Dr.

Weera Mawatha

Sri Jayawardenepura Mawatha

Vehicle Trips - 6450

Polduwa Junction

Polduwa Road

Polduwa Road Junction

Vehicle Trips - 6000

Parliament Junction

Vehicle Trips - 30350

Sri Subuthipura Road /Sri Subuthi Road

Battaramulla Junction

Vehicle Trips - 75600

Kaduwela Road (B240)
Vehicle Trips - 28800

Vehicle Trips - 42600

Subuthipura Junction
Vehicle Trips - 31900

Sri Jayawardenepura Mawatha / Parliament Road
Vehicle Trips - 36500

Battaramulla-Pannipitiya Road (B47)
Vehicle Trips - 16700

ANNEXURE 4: EXPERT SURVEY SHEET

Expertise Survey

Research Project
Department of Town and Country Planning, University of Moratuwa

Research Topic: Develop a Policy Framework to increase the transmission from private to pt. (With special reference to the Battaramulla Administrative Capital in Sri Lanka)

This questionnaire survey is carried to get better background study on the research idea associated with the practice in Sri Lankan context. So, the purpose of this survey is to identify the suitable policies to mitigate the traffic congestion in Battaramulla via enhancing the pt. Further, the data which are collected from this survey will be used only for academic purpose.

Date   :

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Name of the interviewer   :

…………………………………………………………………

Designation   :

…………………………………………………………………

Contact detail   :

…………………………………………………………………

1. What are the mostly taken strategies achieving the policies to enhance the pt in Sri Lankan context?

Location	Cause / Reason	Taken strategies

2. What type of necessary strategies achieving the policies to enhance the pt in Sri Lanka compare with the world context?

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3. Select the suitable strategies achieving the policies to mitigate the traffic congestion in Battaramulla via enhancing the pt? OR other strategy:

Allocate more money to build new subway and bus systems and expand or improve old systems	
Fuel taxes (based on emissions)	
Vehicle import/purchase/registration taxes (based on emissions)	
Direct road charges Cordon area pricing	
Parking fees	
Subsidize mass transit fees for employees	
Increase the price of personal vehicle travel	
Congestion charges	
Strict ticketing and high penalties for motorists, pedestrians, and cyclists who violate traffic regulations	

Discouraged automobile use
Reduce the number of vehicles allowed in urban areas
Lower speed limits for motor vehicles in cities
Encourage the walking and cycling
Build more walking and biking paths
Sidewalks on both sides of the street
Extensive networks of bike paths and lanes
"Bicycle streets" where cars are permitted but cyclists have strict right-of-way
Special bike turn lanes leading directly to intersections
Separate bike traffic signals with advance green lights for cyclists
Bike parking (ranging from secured boxes to simple racks)
Integration of bicycles with pt
Bike-activated traffic signals at key intersections
Modifications of street networks to create deliberate dead ends and slow, circuitous routing for cars, but direct, fast routing for bikes
MRT
LRT
BRT
Intersections and crosswalks
Traffic circles
Road narrowing
Zigzag or chicane routes
Curves
Speed humps
Artificial dead ends
Remove the street parking and open pedestrian ways only for pedestrians
Provide Bus Priority Lane (BPL)
Provide bus ways
Parallel commuting routes
Provide alternative routing instructions
Integrated transport networks and transport System
Improvement of the existing rail transport systems
Improvement of the existing bus service
Build new subway and one way
Water Transport System
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ANNEXURE 5: PUBLIC PERCEPTIONS SURVEY SHEET

Public Perception Survey

Research Project
Department of Town and Country Planning, University of Moratuwa

Research Topic: Develop a Policy Framework to increase the transmission from private to pt. (With special reference to the Battaramulla Administrative Capital in Sri Lanka)

This questionnaire survey is carried to get better background study on the research idea associated with the practice in Sri Lankan context. So, the purpose of this survey is to identify the public requirement to mitigate the traffic congestion in Battaramulla via enhancing the pt. Further, the data which are collected from this survey will be used only for academic purpose.

1. Date   :
   ....

2. Name of the interviewer   :
   ....

2. Contact detail   :
   ....

3. Where are you come from:
   ....

4. Travelling Mode:
   ....

At Present Condition:

5. Travelling time for whole journey (in and out):
   - To come –
   - To go to origin -

6. Travelling cost for whole journey (in and out):
   - To come –
   - To go to origin -

7. What kind of qualities are required from pt for easy access? (Eg: quality, comfortable, efficient and safe)

....
....

Build more walking and biking paths
Sidewalks on both sides of the street
Extensive networks of bike paths and lanes
"Bicycle streets" where cars are permitted but cyclists have strict right-of-way
Special bike turn lanes leading directly to intersections
Separate bike traffic signals with advance green lights for cyclists
Bike parking (ranging from secured boxes to simple racks)
Integration of bicycles with pt
Bike-activated traffic signals at key intersections
Modifications of street networks to create deliberate dead ends and slow, circuitous routing for cars, but direct, fast routing for bikes
MRT
LRT
BRT
Intersections and crosswalks
Traffic circles
Road narrowing
Zigzag or chicane routes
Curves
Speed humps
Artificial dead ends
Remove the street parking and open pedestrian ways only for pedestrians
Provide Bus Priority Lane (BPL)
Provide bus ways
Parallel commuting routes
Provide alternative routing instructions
Integrated transport networks and transport System
Improvement of the existing rail transport systems
Improvement of the existing bus service
Build new subway and one way
Water Transport System