Impact of Mega transit Projects on Formal and Informal Public Transport System. A case Study of Lahore Pakistan

A thesis submitted in partial fulfillment of the requirements for the degree of

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Copyright Statement

Dedication

This project is dedicated to my Mother, my Husband and all the family members

who encouraged me and supported me throughout my research.

Acknowledgement

Abstract

Pakistan public transportation system is gradually shifting to smart and sustainable public transport system. BUS Rapid Transit projects have been introduced in mega cities like Lahore, Islamabad, Multan and Peshawar. The main objective of the study was to find the impact of Mass transit projects of Lahore on riders and traditional formal and informal public transport. The study was conducted by carrying out questionnaire survey from 300 public transport users and interviews were taken from the authorities of Punjab Mass transit authority and Lahore Transport Company (LTC). It was found that people had switched from informal transport modes and private vehicles to BRT due to decrease in transport cost. Riders were found to be very satisfied with the accessibility, security, distance and time, internal and external services provided by Mass transit buses as compare to LTC buses. LTC faced major downfall after introduction of Speedo bus service as most of its routes were taken by Speedo and many private contractors left LTC resulted in decrease in number of buses and ridership. Respondents also expressed that sitting capacity in Mass transit buses should be improved which will make it easier for senior citizen to travel and service should be provided to sub urban and peri urban areas as well. To find the impact on informal transport system, questionnaire survey and focus group discussion from 40 rickshaws and Qing qi drivers was conducted and interview was taken from the president of rickshaw union in Lahore. Drivers were found to be very unsatisfied with their income level, working hours, job satisfaction, permissible routes, distance travel per day, ridership etc. after metro and Speedo had started operating as many of their passengers have switched to them and also Qing qi and rickshaws are now banned on some of the routes after Metro and Speedo, this situation has adversely affected the business of informal sector. Developments in public transport sector will help urban planners and transport departments in planning and organization of urban growth pattern and there is a need to plan the transit-oriented development which will result in achieving the goals of smart and sustainable cities.

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Expansion in the cities led to the shift from non-motorized vehicles to motorized vehicles due to increase in trip length. In this situation, public transport can provide high-quality transportation services to people living in both suburbs and the center at a lower cost than a system which prefer private transportation service and expansion of roads but due to the presence of a low level of public transport services, middle-and higher-income people living in larger cities prefer private vehicles, either motorcycle or car, for travel (Imran,2009).

After partition in the city of Lahore, homes, workplaces, commercial areas, and community places were located at short distance to each other in a mixed land use pattern. Therefore, major transport was walking, and cycling followed by Tonga (horse-drawn carriage). Despite this fact public transport Omni Bus used to operate in the cities of Lahore and Karachi. In 1951, the Motor Vehicle Act 1939 was amended, and the Road Transport Board was established in Punjab. The Second Five Year Plan (1960-65) became the first planning document in Pakistan in which the roads sector was given priority over railways and more financial resources were assigned for it. The Second Plan started to encourage the private sector to cooperate and invest and run road based public transport. After the encouragement of private sector policy, private wagons started to operate along assigned routes to fulfill the growing demand for public transport. In the beginning, these services were reliable, fast, and comfortable, but in due course they became

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crowded and unsafe. In 1965, the Master Plan for Greater Lahore suggested a mass transit

system in a circular railway form to connect existing railway that passes through the city (Govt.

of Punjab 1973) but it was not given priority by decision makers. (Imran,2009).

In 1977, the Punjab Road Transport Corporation' (PRTC) and Punjab Urban Transport

Corporation (PUTC) were established in the province of Punjab (Lahore Development Authority

and World Bank/International Development Association 1980). The functions of the PRTC and

PUTC were to provide an efficient, adequate, economical, and properly coordinated system of

road-based intercity and urban public transport services, respectively (Imran, 2009). Omni buses

which were present already were merged into PUTC, but it had always been short of buses due to

a lack of investment by the government and international organizations. To fulfill this shortage

of buses, PUTC and the Volvo International Development Corporation completed a study for the

Model Urban Transport System in Lahore (Volvo 1980). This study recommended to continue

the mixed public and private bus system. As a result of this study, 350 Volvo buses were gifted

by the Swedish government to Lahore. These buses were added to the fleet of PUTC. Even after

addition of buses demand of public buses was not fulfilled and PUTC invited private sector to

invest by introducing leased buses scheme but all these efforts were not successful and the

public-owned bus system in Lahore managed by PUTC collapsed after being operational for a

couple of years due to lack of investment. Finally, the government disbanded the PUTC in 1998.

 In 1991, the Prime Minister's Incentives Scheme to refurbish the Public Transport Scheme was

started by the government of Nawaz Sharif (Govt. of Pakistan, Ministry of Communication

1991). This policy included incentive packages to import taxis, buses, and mini-buses for a resourceful public transport system. This policy was implemented, and the public transport fleet was upgraded. However, the policy was changed after the Nawaz government left office. In early 2000, the Integrated Master Plan (2001-2021) was prepared in Lahore to guide future development (LDA 2004a). Like all previous Master Plans prepared for Lahore, this plan gave priority to the urban road network and overlooked the potential of developing public transport. According to the plan, the first five-year program for transportation development in Lahore suggested to include 94.8 percent of funding for road development, management, and maintenance and only 5.2 percent for a public transport terminal (LDA, 2004a).

The historical review shows that several policy documents were made and tried to be implemented at the national, provincial, and local levels that highlighted the importance of public transport in one way or other but most of them resulted in failure. It is important to note here that it has been the private sector that invested in and ran public transport services in Pakistan since the early 1960s and government spent very less money on it. (Imran,2009).

Over the years, cheaper automobile financing schemes heighten the transport industry in Pakistan (Umair, 2017). People started to buy cars, rickshaws and Qing qi on installments which results in increase in owner ship of private vehicles, consequences of which are immense traffic congestion and pollution. Increase in number of vehicles leads to extension and construction of roads which promote the buying of private vehicles further. Little or no parking fee and adverse condition of formal public transport encourage people to use private or informal public transport.

Time consumption and discomfort are also the factors that dejected people from using formal public transport. Moreover, large Investment in building of new roads left no funds for advancing the public transport services in developing countries. (Imran, 2009)

But as discuss earlier there are many students and employees in Lahore who travel daily from one place to another and who cannot afford private cars or wages of informal public transport daily. They are the group of people who are always in dire need of safe, comfortable and economical public transport. As Lahore is the populous city and business hub of Punjab province and is expanding continuously, its travel demand was high from the beginning and is increasing day by day, many local private transport companies were providing inter-city and intra city public transport. Buses, minibuses, vans were fulfilling the transport need of people in very minimum rates.

In April 2009 Lahore Transport Company (LTC) was established by the Punjab Government. LTC is principally a regulatory body which has been tasked to make sure a smooth-running transport system in Lahore which will provide the commuters a safe, efficient and affordable transport service. LTC provide public transport with collaboration of private companies and issues permits to vans and buses and register and regulate informal public transport like rickshaws and Qing qi. After Metro bus system became operational LTC buses and vans were banned along metro route and to overcome it they opted for alternative routes but when feeder bus service became operation in 2017 again LTC was banned from the routes of feeder bus service which resulted in sudden decline and many of the private companies which were

providing fleet to LTC left and now there are very few buses and companies which have a partnership with LTC.

In 2013 Punjab Mass transit Authority (PMA) was established. It is a constitutional body established by the Punjab Government with. It was established for planning, construction, operation and maintenance of mass transit systems in the major cities of the Punjab, Pakistan. Its agenda is to provide safe, efficient and comfortable urban transportation system. Lahore Metro Bus service and feeder bus service are operating under it.

1.2 Formal and Informal Public Transport

Formal Public Transport services are characterized by fixed routes, schedules and stops. There are proper working hours and routes assigned and proper ticketing systems which incorporate proof of payment. Usually formal systems are subsidized in some form or other. Formal public transport system is usually managed through the granting of contracts and concessions. Informal Public Transport System does not always follow fixed routes. They do not have fixed schedules or tickets. There are no specific routes and ticketing system. It is not directly subsidized, and it is managed through the granting of operating licenses.

Formal and informal public transports are both considered necessary in an urban transportation system. The informal transport modes generally function in areas where the operation of formal transport modes is unavailable. Both transport modes can form a smooth transit system for the comfort of travelers, if only city authorities have a willingness to make it possible. (Ariva Sugandi, et.al, 2018).

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In many developing cities, informal public transport (minibuses, vans, taxis, station wagons, three-wheelers, and rickshaws) play a vital role in meeting the transport needs of the city. In many Asian, African and Latin American cities it is perhaps even the most common and widely used form of urban public transport (Qi Xie, 2010). Compared to formal public transport services these informal transportation modes can be more accessible, faster, at time

cheaper and even reliable. Informal transportation modes are providing with low-cost mobility and are also connecting travelers to mass transit and even directly to their destinations .These informal transport modes provide people with lots of benefits, particularly to the poor, such as rapid access to hospitals and clinics in case of emergency, provide jobs for un educated and low skilled migrants , and provide transport service in areas lacking formal public transport system (cervero,2007) .On the other hand, they are often unregulated, unsafe and uncomfortable mode of travelling. However, the strong presence of informal transport in the cities indicates that the transport needs are not being met sufficiently by city governments through formal public transport services. Therefore, the gap between demand and supply is met by the informal transport providers. Beyond that, informal transport is also an essential source of income for many people and in many cases, a part of larger economic interests. (Qi Xie, Armin Wagner, 2010)

Table 1.1: Formal and Informal Sector Dichotomy

Dimension	Metro and Speedo	Formal Sector (LTC)	Informal sector
Economic Standing	Middle and Lower Class	Middle and Lower Class	Lower and Middle Class
Political Influence	Strong	Strong	Weak
Legitimacy	Legal, Regulated	Legal, Regulated	Legal/Illegal, Unregulated
Society and Culture	Modern and Traditional	Modern and Traditional	Modern and Traditional
Union and Organization	Structured	Structured	Less Structured
Financing and investment	Govt. Funds and subsidies	Subsidies and private investment	Individual, Private investment
Technology	High Tech	Medium Tech	Low tech
Skill Levels	Knowledge-Based	Knowledge-Based, Cognitive	Labor-Based, Adaptive
Legal Status	Registered	Registered	Registered / Unregistered

Source: (Ariva Sugandi 1, Gobi Krishna, et.al, 2018).

1.3 Mass Transit Projects

Bus Rapid Transit (BRT) is a high-quality bus-based transit system that provides with the fast, comfortable, and cost-effective transit service. It has dedicated lanes, with bus ways and stations are mostly aligned to the center of the road, it has a system of off-board fare collection and provide with the fast and frequent operations. It provides opportunities for people to make cities

smart and sustainable. Aim of BRT is to combine the capacity and speed of a metro with the flexibility, lower cost and simplicity of a *bus* system. A BRT corridor is a section of road or adjacent roads provided by a bus route or multiple bus routes having a minimum length of 3 kilometers (1.9 miles) that has dedicated bus lanes.

Punjab Mass transit Authority (PMA) was established in 2013 to provide safe, efficient and comfortable urban transportation services in major cities of Punjab. PMA proposed an Integrated Bus Operation (IBO) solution to cater for the citywide public transport demand (IBO feasibility study report, n.d.).

Metro bus or BRT (Bus Rapid Transit System) has been introduced in Lahore in 2013 on a 27 km section of Ferozepur Road corridor. BRT corridor has total twenty-seven stations. Average station to station distance is 1.04 km. The terminal stations are Shahdara, in the North west side and Gajumata, in the South-East side. Time from one terminal to another terminal is 63 minutes. The average daily ridership of Metro Bus is 125,000 which is supported by 64 buses (Hafiz Usman Ahmed, Azeem, 2014).

Speedo or Lahore Feeder Route is a project of Daewoo Pakistan started operating in March 2017. The Punjab Mass Transit Authority (PMA) started 200 new public buses in collaboration with Daewoo on feeder routes for the Lahore Metro Bus routes. The feeder bus service connects the rest of the city with the 27-km-corridor of the Metro Bus .

Mega Transportation Projects (MTP) like Metro and Speedo Bus System aims to provide safe, efficient and comfortable public transport system at reasonable cost to make it easy for people to

travel from one place to another. In Pakistan First Mega Transit Project was Lahore Metro Bus system, which was followed by Rawalpindi, Multan and Peshawar Metro and currently Orange line Project in Lahore and Islamabad Metro Bus Extension Project are under construction and soon they are expected to be completed. Major Goals of these development projects were to develop Sustainable Urban Transportation System which will contribute to fulfill people's accessibility and mobility needs and to organize urban growth pattern and   public space utilization along the corridors through integration of land use and transit-oriented development.

These Mega Projects promises mitigation measure by minimizing the problems of traffic congestion, high transportation cost etc. When such projects are executed, they socially and economically impact informal public transportation system and the labor force, drivers, private transport companies and individuals associated with them. Government mostly promises to provide such people with better alternative sources of income or some funds but, infrastructure investment mostly have less concern in decreasing the poverty and gain of benefits from infrastructure development projects are mostly significantly less than expected. Major cause is that weak governance and unaccountable institutions open the path for corruption, which becomes the reason for distorted and falsified public investment choices, and also negligence in maintenance, this will result in lowering infrastructure development contribution to economic growth and diverting benefits intended for the poor. Infrastructure doesn't benefit the marginalized community. local public participation is not normally considered in infrastructure development as it needs to be so benefits that public considered to be getting from development

are mostly not given much heed. Consequently, the voices of the poor are mostly absent from the planning of infrastructure.

Mitigating the negative impacts of infrastructure development should be a core component of project plans rather than being an afterthought. There is a need for a paradigm shift in the understanding of how infrastructure development contributes to poverty reduction. (Lelethu, Keke,et.al ,2016) .Majumder (2012) presents a shift from the 'trickle-down approach' towards the notion of 'pro-poor growth'. Government must totally support the informal and formal public transport sectors (private transport companies) by providing well-articulated policies to improve the performance of operations and services of both the sectors together with proper, reliable and equal integration of resources.

This research explores how Lahore Mega Transit Projects impacted the Riders of public transport and Formal and Informal Public Transport sector. Informal public transport modes like LTC vans and buses were shifted to which alternative routes and what is the socio-economic impact of Mass Transit Projects on the rickshaw, Qing qi drivers and other Public and private Transport Companies and what can be done in future for betterment of informal and formal public transport sector, these all are the reasons for selection of this topic.

Table 1.2:Present formal and informal modes in Lahore

Formal Transport mode	Informal Transport modes
Metro bus Service	Rickshaw
Speedo /feeder buses	Qing qi

LTC buses	Local Taxis
LTC vans and minibuses	Uber Cars, bikes and Rickshaws
Local buses with proper routes	Careem, Cars, Bikes and Rickshaws
New smart bus service like Air lift	Carry Dabba

Table 1.3:Characteristics of Formal and Informal Sector in Lahore City

Aspect	Formal Mass Transit buses (Metro and Speedo)	Formal Traditional Public Transport (LTC)	Informal sector (Rickshaws and Qing qi)
Service Delivery	Designated and fixed routes	Designated and fixed routes	Personalized routes, adaptive
Schedule	Fixed, Passenger-driven	Fixed, Semi-fixed, Passenger-driven	Flexible, Passenger-driven
Reliability of service	Reliable	Inconsistent to reliable depending on type	Inconsistent to semi-reliable
Age Group	Young citizens	Young citizens	Young ad senior citizens
Vehicle Capacity	40-80 Passengers	15 -seat to 50-seat passengers	4-8-seat passengers
Vehicle Type	Motorized	Motorized	Motorized
Ownership	Public	Semi- Public and Private	Private, individual
Labor	Mostly Skilled	Skilled, Semi-skilled	Semi- to non-skilled labor

Organization	Punjab Mass Transit Authority	Lahore Transport Company and Private Transport Companies.	Individual, social unions & associations
User's social status	Low to medium income	Low to medium income	Low to medium income
Fare structure	Fixed, standardized	Fixed, standardized	Variable, non-standardized

Source: (Ariva Sugandi 1, Gobi Krishna, et.al, 2018).

1.4   Location of Study

Lahore is the second most populous city of Pakistan and is the biggest urban city of Punjab. It is a Capital   and the business hub of Punjab province and is continuously growing in population. Most of the province's GDP is generated from here. Increase in population has resulted in extension of its area and to fulfill the residential demands of a city a new trend of housing societies had been developed, most of which are located at the suburbs. The expansion of the cities resulted in increment of the trip length for the city residents, due to which walking, and cycling became less practicable than before, and continuous shift from non-motorized to motorized modes begin (Imran, 2009). Almost all major Educational Institutions, Hospitals and Universities are present in the city. So, people and students from all over Pakistan come to Lahore for education and employment. All of this results in high demand of public transport. There were many public and private transport facilities available at the city like LTC and local Buses, Vans, rickshaws and Qing qi but due to rapid urbanization, traffic congestion and increase in travel demand a modern and well equipped formal public transport 'Metro Bus Service' was

introduced in 2014 which was further followed by another bus service in march 2017 known as Speedo whose function is to serve at feeder routes to metro bus station. My study area is the area adjacent to the Lahore metro bus route and Speedo routes.

Table 1.4:Number of routes and buses

Public Transport	No. of Routes	No. of buses
Metro bus Service	1	64
Speedo /feeder buses	14	200
LTC buses	7	114

Table 1.5:Route detail of buses

Metro	
Gajumata to Shahdara	
Speedo	
Babu Sabu to Raj Garh	Bhatti to Morr Samnabad
Chungi to Bagrian	Railway Station to Rana Town
Daewoo Terminal to Canal	R.A Bazar to Chungi Amar Sidhu
Shamnagar to Railway Station	Bhatti Chowk to Shadbagh
Multan Chungi to Qartaba Chowk	R.A Bazar to Civil Secretariat
Babu Sabu to Main Market	Bagrian to Kalma
Canal to Thokar	Purana Khana to R.A Bazar
Gajjumata to PKLI	Bhatti to R.A Bazar
LTC	
Niazi Chowk to Green Town	GBS to Airport
Jallo Mor To Pakka Meel	GBS to R.A. Bazaar
Railway Station to Valencia	

Number of CNG Rickshaws and Qing Qis' with route permits from 2010 to 2019

Table 1.6 : Number of CNG Rickshaws

Year	Period	CNG Rickshaw (For 3 Years)		
		New	Renewal	Total
2010	Mar-Jun	594	27	621
2010-11	July-Jun	12478	163	12641
2011-12	July-Jun	7250	510	7760
2012-13	July-Jun	4777	437	5214
2013-14	July-Jun	10657	1420	12077
2014-15	July-Jun	11668	1414	13082
2015-16	July-Jun	6313	962	7275
2016-17	July-Jun	8401	1921	10322
2017-18	July-Jun	8220	2262	10482
2018-19	July-Jun	5201	1267	6468
Total		75559	10383	85942

Source: (Lahore Transport Company)

The number of rickshaws can be more than the number provided as many of them doesn't have route permit or vehicle registration. The last Qing qi count in Lahore was done in 2015, which was 35,000. Currently it is estimated that more 60,000 Qing Qis are operating in Lahore.
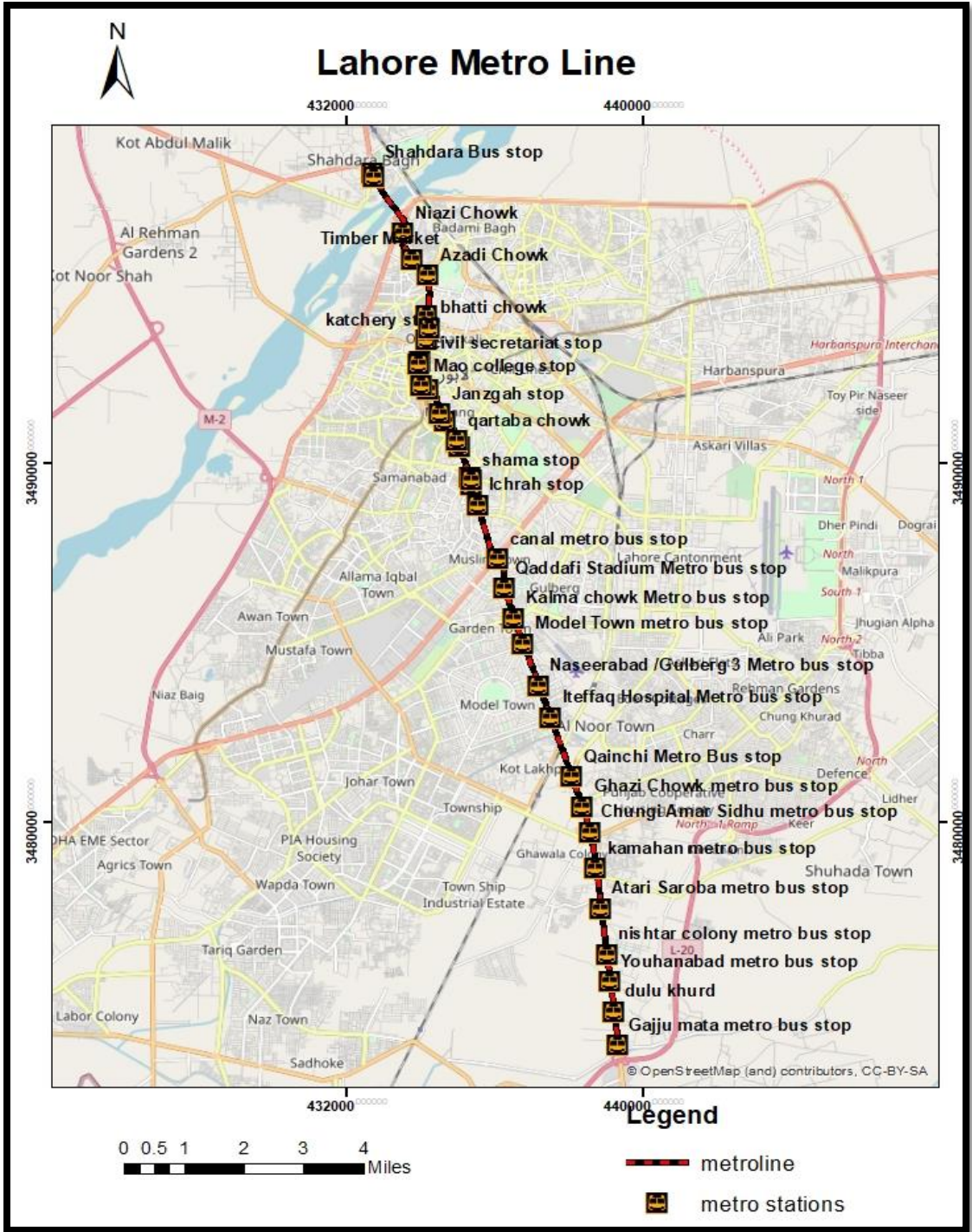
Figure 1.1:Route Map of Metro

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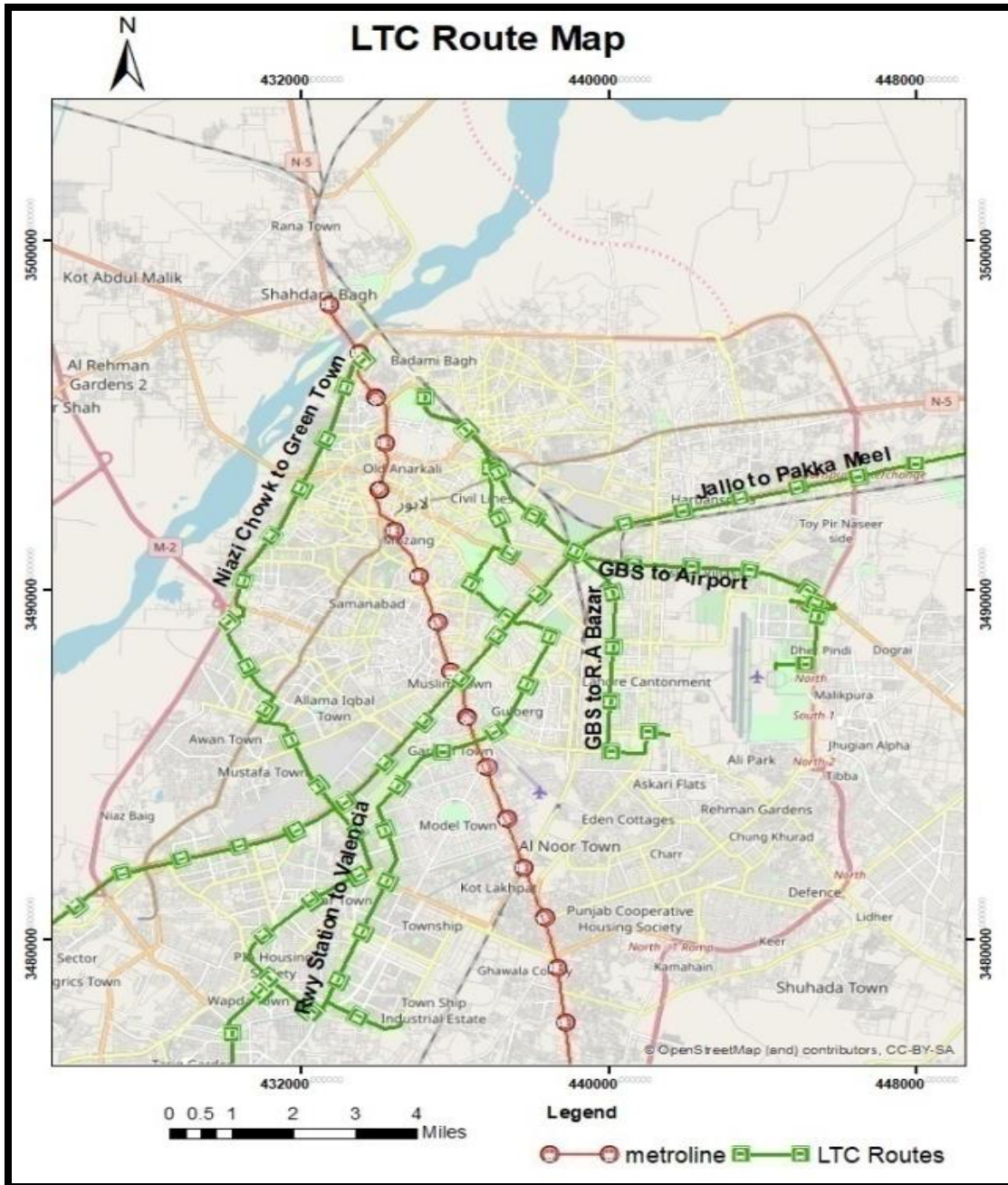
Figure 1.2:LTC Route Map
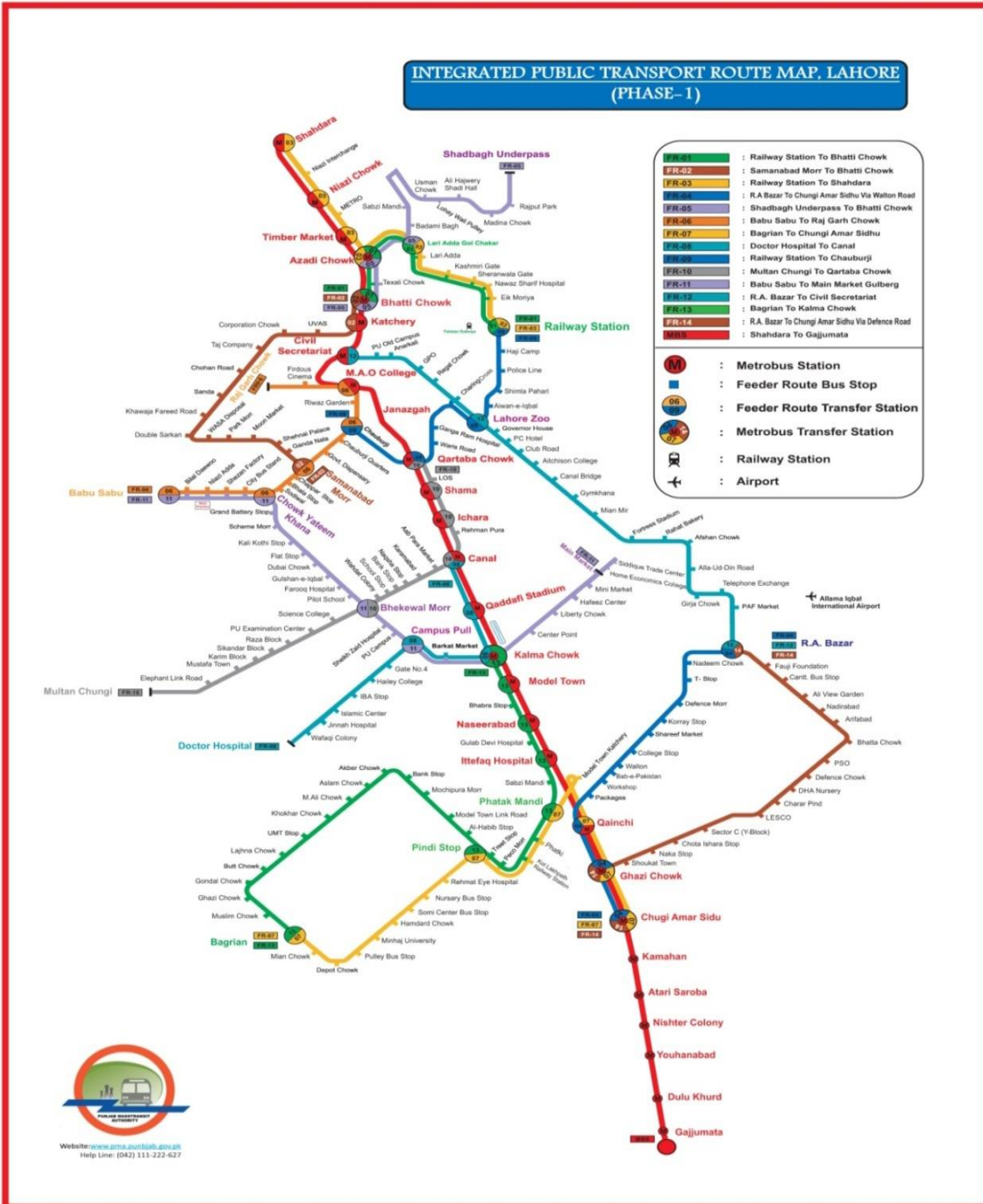
*Figure1.3.*Speedo Route Map ,From" route maps", by Punjab Mass Transit Authority, no date

(https://pma.punjab.gov.pk/routemaps).

1.5 Justification of study

 In Pakistan many researches have been carried out to determine the characteristic of Mass Transit System, but no research has been conducted to find out the impact of Mega Transit Projects on traditional formal and informal public transport sector and what did they do after Metro started operating.

1.6 Research objectives

- To investigate the characteristics of Mass Transit System, formal and informal public transport in Lahore.
- To investigate the Socio-economic impacts of metro and speedo on commuters, LTC and informal public transport sector.
- To compare the commuters 'satisfaction towards socio economic factors of metro, Speedo and LTC.
- To compare the informal public transport drivers' satisfaction before and after Mass Transit Buses

2 Literature review

With the introduction of Metro bus System in Pakistan, we can see most of the major cities like Lahore , Islamabad, Rawalpindi, Multan and now Peshawar are shifting from Informal Transport System to formal Transport System and our research is basically about the impact of this new transportation system on the old one , during my research I found out that no research had been carried out related to the impact of formal transport on informal transport in Pakistan, so in literature review we wrote the work done related on it at global level, so in this section we will find out through different case studies, research papers, debates and articles that how in other countries and cities informal and formal transport systems are operating and how they perceive them and how this will help us to achieve our objectives.

2.1 How Private Sector fill the gaps of government provided public transport?

To provide people with public transport facility is majorly considered as government's responsibility. In many developing countries due to shortcomings of resources and capacity, public transport facility provided by the government is often considered to be inadequate, so privately owned and operated public transport modes like shared auto-rickshaws, minibuses are the ones that tries to cater the mobility needs of the population. This private transport sector is not properly acknowledged for the important contribution that it makes in meeting people's mobility needs, and it has not been considered in policymaking and city planning exercises. Government authorities typically perceive these modes as a pollution contributor, unsafe and a

cause of traffic congestion because on these modes there are very few research and case studies that have been carried out. (Megha Kumar, Seema Singh et.al,2015)

2.2   What is the Role and Contribution of Informal Public Transport System?

Informal public transport modes were playing the vital role in fulfilling the mobility needs of people. These informal transport systems are found playing different roles. Modes like shared auto-rickshaws operated as the major modes of public transport on arterial and sub-arterial road networks, they provide connectivity between important demand-generating and demand-attracting points in the city, whereas modes like cycle rickshaws were found to operate in intra-city pockets that could not reach by the traditional public transport systems. It was found that the demand for informal public transport was much larger and more diverse than just for last-mile trips to line-haul systems like city buses or metro systems. Informal public transport modes were found to play an important part in Peri-urban areas mainly due to unavailability of formal public transport in these areas. Condition of informal public transport used in peri urban areas is not satisfactory many of the vehicles are retrofitted. (Megha Kumar, Seema Singh et.al,2015).

2.3   What could be the objectives of working on Informal transport sector?

 The major objective is to create knowledge about the existing informal public transport systems in cities and to deal with the problems of this sector identify the policy areas that need attention. The specific objectives were to study informal public transport systems in cities to find out and recognize the operational characteristics of these systems and to find out the major problems and issues related to the ways these systems operate in different cities or under different conditions.

The end objective was that for the betterment of this system and to increase the associated mobility which policy areas need the utmost attention and improvement. (Megha Kumar, Seema Singh et.al,2015)

2.4 Key Components for studying the Informal transport Sector

- Roles and contributions of informal public transport systems

- Characteristics of Vehicles (design and manufacture, etc.)

- Patterns of ownership

- Operational characteristics

  - Service types and regulatory compliance

  - Vehicle ownership patterns.

  - Regulations governing the operations of the modes

  - Area/zone of operation

  - Routes and scheduling

  - Fare pattern

  - Business model and profitability

- Safety aspect

  - Compliance with safety standards

  - Overloading and capacity utilization

  - Physical infrastructure availability

- Environmental performance

  - Vehicle age

+ Fuel types

+ Compliance with vehicular pollution-related regulations

(Megha Kumar, Seema Singh et.al,2015)

2.5   Methods that can be used for data Collection:

2.5.1   Characteristics of informal transport system

Three types of surveys (targeting drivers, passengers, and other road users) could be conducted

in   selected cities. Stakeholders like fleet operators, fleet manufacturers, government officials

etc. should be contacted for consultation. Reconnaissance surveys could be undertaken to

understand the   patterns and routes of operations of the informal transport systems. Structured

observations could be carried out by travelling on these informal transport modes and focused

group discussions could also be conducted with users, drivers, union heads and users to collect

the firsthand information. (Megha Kumar, Seema Singh et.al,2015).

2.5.2   Information of drivers of informal transport system

The social characteristics of rickshaw pullers and owner-contractors, migration statuses of

rickshaw pullers, , the economic situations of migrants in their places of origin, their earnings

and living conditions in Delhi, the forward and backward linkages regarding migration, rickshaw

rental contracts, debt and credit situations, the licensing of rickshaws, opinions on treatment by

police and MCD officials, microfinance facilities, and the impact of Delhi Metro on rickshaw

transport.(Kurosaki, 2012).

2.5.3   Evaluation criteria for Formal transport system

Influence Zone

It is a responsibility of public transport service to meet the needs of commuters. To fulfill the needs, mean to provide people with accessible stations at walking distances, save their time by providing them with efficient service so they don't have to wait much at interchanges and give them safer and reliable services. 500 m. is an ideal walking distance, so population living at a walking distance from metro station will have the highest accessibility to metro and they will use it frequently but when this distance increases and people cannot access metro station at a walking distance passengers have to use feeder system(i-e informal transport system), which means passengers have to switch their rides. A switch in transport has a big impact on passenger's journey. Generally long trip on one vehicle is preferred over short trips and switching vehicles because each time people switch, they have to face difficulties in terms of time, cost, inconvenience and uncertainty. Switching vehicles needs a good coordination of feeder (informal transport) and metro service, their schedules should be aligned so that less time will waste, combined ticketing will result in less waiting time. A trip without any transfer and a trip with one or more transfers always play a major role in choosing a transport mode. If we compare bus and metro as a transit service, both are important and are considered as a transport mode if people just don't have to switch and travel on one vehicle for a whole journey and in that case area that is at a distance of 0.5 km (walking distance) is considered as an influence zone because at that distance people can go to station by walk and they won't need any other transport service to reach the nearby station (Mukti Advani ,Geetam Tiwari, n.d.).

Feeder service and an integrated ticket

People's accessibility to metro stations will increase if a very good, coordinated and well-organized feeder system will be provided to the Metro, integrated ticket is a good option for increasing ease and accessibility. If the integration will be implemented, then the same ticket will be valid for buses and metro. However, this will result in higher ridership only if commuters will be willing to accept the added transfer cost and transfer time (MuktiAdvani)

Luggage

There is usually a restriction of carrying luggage in metro trains. Many passengers who are coming to and going from bus terminals and   railway stations have a luggage with them as it is connected to long distance travel, but they cannot use metro due to the restriction of luggage (Mukti Advani and Geetam Tiwari, n.d.).

Parking

Parking place is mostly provided outside the Metro station, but it is also used by non-metro user. People who have a monthly pass they should be provided with separate parking it will encourage them to use metro more often (Mukti Advani, & Geetam Tiwari, n.d.).

2.5.4   Methods to evaluate BRT performance

Hafiz Usman and Azeem Ahmed did Evaluation of system performance by analysis of user survey, primary and secondary data. Surveys were carried out to assess service quality while system performance was accessed based on readings observed and written in data sheet in bus

operation and data ridership data from Metro bus authority. Data was required for evaluation of system performance and service quality. To find out about service quality it was important to get opinion of metro bus users, which was taken from surveys. Sample size of 300 was taken for user survey. Team conducting the survey on specified days and they visited four Metro bus Stations. Constraints that define system performance were obtained primarily from observations at metro stations and buses and secondarily from Metro bus authority. Surveys and previous studies were used for this. Data was used and by simple equations, elements showing system performance were calculated. Data sheets were used for primary data collection. (Hafiz Usman Saeed, 2014)

2.5.5 Commuters' satisfaction

The integral part of the respondent analysis is to assess the satisfaction level of the riders by using the various satisfaction attributes or indicators. To perform the analysis in the software, satisfaction attribute is given value of 1 for neutral level, 2 for satisfied level, 3 for extremely satisfied level, 4 for unsatisfied level and 5 for the extremely unsatisfied level. Base on the mean numeric value for the overall satisfaction level, evolution of the other attributes is done (Umair,2017).

2.5.6 Outcomes after evaluation of BRT system performance

- Service Frequency and Operational Speed
- Safety
- Line Capacity

- Product Capacity

- Productivity

- Utilization

(Hafiz Usman Ahmed, Azeem, 2014).

2.6   Poverty and its relationship to Formal and Informal transport System

Poor, asset less and unskilled people who have migrated from rural areas because of poverty have been provided with the employment opportunities by the cycle rickshaw rental market. Government regulations rarely functions on cycle rickshaw pulling so it is a typical informal sector job. In this sector, a new migrant can rent a cycle rickshaw from a contractor who owns many rickshaws if he himself does not own one. Benefit of renting a cycle rickshaw rather than owning it is that migrant rickshaw pullers can go back to their villages during the peak farming period without worrying about the security of their asset. (Kurosaki,2012)

Rental rates of rickshaws in areas close to a Metro station are higher compared to the areas that are away whilst the distance to a Metro station does not affect the daily earnings of a cycle rickshaw puller, rickshaw pullers who are operating in areas closer to a Metro station work less hours per day than other pullers. These results show that the major welfare gain rickshaw pullers are getting from the increased demand is   not higher earnings per day, It's just an increased amount of leisure time only. (Kurosaki, 2012)

Modern transport infrastructure such as Delhi Metro can play a vital role in reducing urban poverty. It first increases the demand for informal transport services such as cycle rickshaws,

which results in higher per-capita earnings by rickshaw owners, Number of rickshaw pullers working in the city get increased, and rickshaw pullers get to work less hours per day but have same levels of earnings. So, by seeing these positive impacts, we can term the opening and extension of Delhi Metro   as a pro-poor infrastructural investment. (Kurosaki, 2012)

3 Methodology

3.1 Scope of the Research

The scope of my research is to investigate the impact of Lahore Metro line on informal public transportation sector how it affected the locals, commuters, private transport companies, drivers and labor force associated with the informal sector both socially and economically. Research methodology is an important step, it helps us to find out the solutions to the problems we want to work on, in a most useful way possible.

3.2 Data Collection Methods and Tools

Data collection is a very major and critical part of any research. Data collection is a process of collection of information from all the relevant resources they can either be primary or secondary data resources. Informative and accurate data helps to achieve the objectives and provide answers to research questions.

Data collected for this research was from:

- Primary data resources
- Secondary data resources

As discussed previously there is no research carryout on related to the impact of formal transport system on informal transport system in Pakistan and even globally very less work has been carried out related to our topic, so much of the data collected was from primary data resources.

To get information about the transport system before metro bus passengers' details and info was taken from LTC.

3.2.1   Field and observatory survey

As field survey was also conducted and metro and Speedo rides were taken personally, so from visual Survey and rides taken, Present condition and volume of informal and formal transport system was determined. Field survey helped us to identify and analyze the basic characteristics of our study area and through pictorial data we get to know about the existing situation and helped us to interpret real time data through visual analysis and compare it with results of questionnaire surveys. Some of the major junction points were visited like Azadi Chowk, R.A Bazar, Railway Station, Kalma Chowk, Chungi Adam etc.

Figure 3.1:LTC at Azadi chowk   **Figure 3.2:Metro at Azadi Chowk**

Figure 3.3:Motorcycle parking at Chungi Adam **Figure 3.4:Qing Qis at Azadi chowk**

Figure 3.5:Speedo stop at R.A Bazar **Figure 3.6:Illegal Qing qi communities at R.A Bazar**

Figure 3.7:LTC & informal transport at Rwy Station Figure 3.8:Speedo bus Stop at Rwy Station

3.2.2   Questionnaires Surveys

Questionnaire surveys were carried out of following communities

- General public and commuters using metro and Speedo.

- Drivers of Rickshaws and Qing Qis.

Different questionnaires were made for different target audience and questions were designed in a pattern to get the most accurate and relevant information from all the target groups which helped us to achieve our objectives.

In Questionnaire of riders, Demographic information of respondents, trip characteristics of riders, socio-economic impact of metro and comparative satisfaction analysis of Mass Transit buses and LTC buses were discussed in detail, whereas Questionnaire of rickshaws drivers contains demographic information and socio economic profile of drivers and socio economic comparative analysis of before and after Mass Transit buses .

3.2.3   Data Sampling

320 questionnaires were filled from the riders of LTC, Metro and Speedo and out of which few were incomplete. 302 questionnaires were considered. Sample size for questionnaires was determined through the formula

$$SS = \frac{z^2 * P * (1-P)}{C\char`\^2} = 267$$

New ss $= \dfrac{SS}{1 + \frac{SS-1}{POP}} = 266.7$

Where: Z = Z value =1.96

p = percentage picking a choice =0.5

 c = confidence interval =0.06

Pop=population= 330,000

Questionnaire survey was carried from general public and commuters who use metro and Speedo almost daily. Through questionnaires information regarding public satisfaction after metro construction, role of informal transport after metro construction and socio-economic situation of riders were find out.

- People at educational institutions and offices near metro stations and Speedo points whose students and staff travel on metro/Speedo/LTC daily.
- People/Riders at Metro station and Speedo points.
- Directly from riders travelling in metro and Speedo

Primary data of rickshaw and Qing qi drivers was collected by meeting the drivers of rickshaw and Qing qi directly and questions on questionnaires were asked to them and most of their responses were recorded on questionnaires by me as they were answering verbally. Data was collected on 40 questionnaires.

3.2.4 Focus Groups

Focus groups were riders of metro and Speedo bus service and drivers of rickshaw and Qing qi , five to six people from both the groups were selected and discussion was carried out related to the impact of metro and Speedo and how it affected them socially and economically. They gave us their point of views and benefits and problems they faced.

3.2.5 Formal Interviews

Formal interviews were carried out from the officials of LTC, Punjab Mass Transit Authority and Head of Rickshaw unions head. Questions were designed to get some data and information from the Transport departments and some questions were designed as a follow up to the responses of the questionnaires and some major problems that we found during literature review were also put into the interview questions.

3.3 Data Analysis

Data collected from the questionnaires and LTC was compiled and put into SPSS and Microsoft excel for further analysis. Descriptive statistics are very important to represent the raw data in a meaningful way, which allows simpler interpretation of the data(Laerd Statistics ,n.d.).Descriptive analysis like frequency analysis, mean and average calculations were performed to determine the demographic profile of riders and rickshaw drivers, which helped us to find out that our respondents belong to which social class. Trip characteristics of riders, after metro impacts and professional information of Qing qi and rickshaw drivers were also presented through descriptive analysis. Cross tabulation, correlation, clustered and stacked graphs were

made to represent the relationship between different variables and to find out the influence of one on another by defining dependent and independent variables e.g. impact of age, time/distance to reach station, occupation etc. on metro usage.   Data collected for comparative satisfaction analysis between Metro, Speedo and LTC was on Likert scale to find out how respondents feel about them, satisfaction analysis survey conducted from rickshaw drivers to determine before and after metro impact was also taken on Likert scale. Comparative analysis between Metro, Speedo and LTC and relation of different satisfaction indicators with overall satisfaction was determined through Cronbach alpha coefficient, normalization, Pearson correlation and Ordinal logistic regression. Ordinal regression was used because data of satisfaction analysis was collected in ordered form. That data was then transformed into useful and presentable information which helped to visualize, analyze and interpret the results and conclusion. All these analyses were performed by taking guidelines from different research papers. Maps were formed from the kmz files collected from LTC and some of the data was digitize by me and transformed into Maps. NVIVO was used for qualitative data analysis and word clouds were generated to find out the most frequent response.

3.4   : Flow Chart

DATA COLLECTION

Primary Data

Secondary data

Field and observatory survey

Questionnaire survey

Interviews and focused group discussion

Annual reports, case studies, research papers, data sheets etc.

Existing situation and basic characteristics

2 questionnaires for 2 different groups, rickshaw drivers and bus drivers

Expert point of views, beliefs and ideas

Content analysis

Visual analysis

SPSS, NVIVO, Arc GIS and Microsoft excel

Data analysis

Indicators based comparison before and after the metro

Data Preparation and Map Formation

Data collected from both primary and secondary data

Descriptive Analysis, Correlations, Relative Importance Index, Ordinal linear Regression

35

Conclusions and Recommendations

3.5 Challenges to Methodology

The scope of my research was to find out the impact of Mega Transit Projects like Lahore Metro line and Speedo bus service on Formal and Informal Public Transportation system and how it impacted the lives of people who were associated with it and what can be done in future for betterment of informal public transport sector. We were planning to find the impact of metro bus system on informal sector available in all major cities where metro bus is available now but due to time constraint and scope of the study we focus only on Lahore Metro Bus system .Also as no research is conducted related to this topic in Pakistan so there was very less availability of secondary data and in order to find out primary data needs to be collected through field surveys, interviews and focus group discussions which had taken more time and effort.

3.6 Unwillingness of people

To collect the maximum data we designed both open ended, close ended and Likert scale questions but this made our questionnaires very long and people were unwilling to fill them so many of the questionnaires were not completely filled so it was difficult to convince people to fill the complete questionnaire and also more time was consumed to complete our sample size.

4 Results and Findings of Impact of Mega Transit buses on Formal Public Transport

We collected data from different the riders of Metro, Speedo and LTC and some of the data was provided by LTC and collected information from PMA during the interview conduction of their official.

4.1 Socio Economic Profile of respondents

Data was taken from the riders of metro and Speedo who travel in them almost daily and most of them were university students.

Table 4.1:Profile of Respondents

Riders Profile	Category	Frequency (N)	Percentage
Riders	Metro and LTC	229	75.8
	Speedo and LTC	73	24.2
Gender	Male	134	44%
	Female	168	56%
Profession	Student	253	83.8%
	Govt. Employee	20	6.6%
	Private Employee	7	2.3%
	Private Business	5	1.7%
	Trade and Commerce	2	0.7%
	Others	15	5%

Years of education	Metric	20	6.6%
	Intermediate	28	9.2%
	Under Grad	209	68.5%
	Post Grad	45	14.8%
Age	<=15	2	0.76%
	16-20	135	44.36%
	21-25	124	40.76%
	26-30	30	9.86%
	31-40	10	3.36%
	41-50	1	0.36%
Years residing in	<1 year	27	8.9%
Lahore	1-5 years	61	20.2%
	5-10 years	31	10.3%
	10-20 years	116	38.4%
	20-30 years	62	20.5%
	30-40 years	5	1.7%

As metro has been operating for 5 years so people are aware of it so riders are mostly metro riders and Speedo is new, moreover now the card system has been eliminated, initially Speedo had a card system and people had to pay 150 rupees for it on the very first ride so people found it difficult and expensive if they only had to travel once. Metro, Speedo and LTC all have both Males and Females, but I collected most of the data from Girls Colleges and female riders so that why my respondents are mostly females otherwise riders are both male and female. Metro, Speedo and LTC have very less seats and people have to travel while standing, also students, employees who had to go daily use public transport so most of the respondents are of age 16-

38

25.As discussed earlier data was taken mostly from university students so most of the riders were students then govt. employee and so on as you can see in the table. Most of the respondents who use Metro were undergrad students they have high percentage (69%), this also shows that riders who use metro mostly are university students because they have to travel daily. Most of the riders were residents of Lahore and have been living there for a long time as you can see in thetable,10-20 years has highest percentage and then 20-30 years has second highest.

4.2   Service Characteristics of Mass Transit Buses

Table 4.2:Trip characteristics of Riders

Characteristics	Category	Frequency (N)	Percentage
Distance from workplace/educational institution(km)	<1 km	16	5.5%
	1-5 km	42	14%
	5-10 km	67	22.3%
	10-15 km	80	26.6%
	15-20 km	44	14.6%
	20-30 km	42	14%
	>30 km	10	3.3%
How often they travel on metro /Speedo per week	0-2 times	79	26.2%
	2-4 times	37	12.3%
	4-6 times	34	11.3%
	6-8 times	33	10.9%
	8-10 times	55	18.2%
	More than 10 times	64	21.2%

How long have they been travelling on Metro/Speedo (years)	0-1 yrs.	114	37.7%
	1-2 yrs.	111	36.8%
	2-3 yrs.	35	11.6%
	3-4 yrs.	33	10.9%
	4-5 yrs.	9	3%
Purpose of using Metro/Speedo	School/College/University	193	63.9%
	Work	46	15.2%
	Shopping	34	11.3%
	Recreation	20	6.6%
	Other	9	3%
Distance travel to reach metro/Speedo station	0-2 km	149	49.3%
	2-5 km	67	28.8%
	5-10 km	41	13.6%
	10-15 km	16	5.3%
	>15 km	9	3%
Time to reach metro/Speedo Station (mins)	1-5 mins	77	26%
	5-10 mins	89	30.1%
	10-15 mins	49	16.6%
	15-20 mins	48	16.2%
	20-30 mins	27	9.1%
	>30 mins	6	2%
Waiting time at a station and bus stop for metro/Speedo bus and LTC Public transport	1-5 mins	16	54.2%
	5-10 mins	3	30.6%
	10-15 mins	92	10.6%
	15-20 mins	32	4.3%
	>20 mins	13	0.3%

Table 4.3:Mean and Standard deviation of trip characteristics of Riders

Characteristics	Mean (μ)	Standard Deviation (σ)
Distance from workplace/educational institution(km)	13.98 km	9.03
How often they travel on metro /Speedo per week	6.8 times	4.2
How long have they been travelling on Metro/Speedo (years)?	1.89 yrs	1.25
Purpose of using Metro/Speedo	1.7(student-govt employee)	1.09
Distance travel to reach metro/Speedo station	4.27 km	4.66
Time to reach metro/Speedo Station (mins)	13.2 mins	9.46
Waiting time at a station and bus stop for metro/Speedo bus and LTC Public transport	7.10 mins	4.87

Most of the people who use metro are living far from their workplace or educational institution as almost 27% riders are living 10-15 km away from their target destination, so they prefer to use metro as it is less costly. People use metro many times a week depends upon their usage and frequency of visits to places located near metro station so we have two large figures, there are 26% who use metro just 1-2 times a week and there are 21% riders who use metro/Speedo more than

10 times, it shows they use them daily for going and returning from their jobs and colleges & universities. As most of our riders are undergrad so it shows most of them has started using Metro when they took admission in colleges or universities as (0-1 and 1-2) years has highest percentage, moreover after Speedo started operating Metro usage has increased further. Most of the students use metro/Speedo buses for travelling to their educational institutions and then people use it to travel for work etc. This shows that Metro/Speedo is very beneficial for students as it costs less and has fixed timings and routes and especially female students told that it is safer than local buses. Riders who prefer to use metro and Speedo are the ones who can reach metro stations in less time and travel only 0- 2 km. Because as the distance to stations increases people have to use other informal public transport or private vehicle firstly to reach metro station and then travel by metro so people mostly don't prefer it as it also increases their travel cost if they use rickshaw or Qing qi first and then metro. Maximum riders reach Metro/Speedo in 5- 10 minutes and this time is in correspondence to the mode of travelling like some riders reach to stations on motorcycles, some by walk and some use rickshaws or Qing Qis. From the table we can depict that Metro, Speedo and LTC buses are mostly on time as (1-5) minutes has highest percentage it shows people don't have to wait much, from this result we can also tell that time interval between two buses is less and people don't have to wait for the next bus for the longest time.

4.3   Transport Modes

Before Mass Transit buses respondents used to travel in rickshaws, Qing Qi etc and now to reach station they use different mode of transport.

Table 4.4:Modes of Transport before and after BRT

Transport mode used before Metro and Speedo buses.	Frequency	Percentage	Transport mode to reach Metro Stations and Speedo stops	Frequency	percentage
By walk	15	6.1%	By walk	127	41.6%
Rickshaw	83	33.6%	Rickshaw	81	26.6%
Qing qi	6	2.4%	Qing qi	7	2.3%
Motorcycle	55	22.3%	Motorcycle	42	13.9%
Car	28	11.3%	Car	16	5.3%
Local bus	14	5.7%	Local bus	7	2.3%
Local Van	15	6.1%	Local Van	4	1.3%
Cycle	1	0.4%	Cycle	2	0.7%
Daewoo Bus Service	2	0.8%	Careem	2	0.7%
LTC	19	7.7%	Uber	2	0.7%
Speedo	1	0.4%	Speedo	8	2.6%
Taxi	5	2.0%	LTC	2	0.7%
Private Van	1	0.4%	Private Van	1	0.3%
University Bus	2	0.8%	University Bus	1	0.3%

Table 4.4 shows that Rickshaws, Motorcycles and cars were used as major mode of travelling

before Metro and Speedo started operating. It means those who used to travel by rickshaws and

private transport (motor cycles and cars) have shifted to metro, which can be a major factor of

decongestion along the BRT route, decrease in transport cost and Comfortability are major

reasons of switching from informal and private transport to formal public transport system. Table also shows that most of the riders reach to metro stations by walk followed by rickshaw and motorcycles. As discuss earlier that percentage of people who travel less distance to reach metro/Speedo stations are more in number that is why most of the riders reach to stations and stops by walk.

4.3.1 Distance Travel to reach Metro Station w.r.t Mode of Transport

Cross Tabulation is done to find that respondents use which transport mode for different distances e.g. for less distance like 0-2 kilometers respondents prefer to go to the station by walk.

Table 4.5:Transport Mode vs Distance travel to reach metro/Speedo station

Transport Mode	How much distance do/did you travel to reach metro/Speedo station? (kms)					
	0-2 km	2-5 km	5-10 km	10- 15 km	>15 km	Total
By walk	90	37	0	0	0	127
Car	3	4	8	1	0	16
Careem	0	0	1	1	0	2
Cycle	0	1	0	1	0	2
Local bus	3	2	2	0	0	7
Local Van	2	2	0	0	0	4
LTC	1	0	0	1	0	2
Motorcycle	20	13	4	2	3	42
Private Van	0	1	0	0	0	1

Qing qi	2	3	2	0	0	7
rickshaw	25	20	22	9	5	81
Speedo	3	3	1	0	1	8
Uber	0	1	0	1	0	2
University Bus	0	0	1	0	0	1
Total	**149**	**87**	**41**	**16**	**9**	**302**

Table 4.5 shows that people who are travelling 0-2 km and 2-5 km are mostly coming by walk, whereas rickshaw is the second famous mode of transport to reach Metro stations. Table also illustrates that People who are travelling more than 5 km are using rickshaws mostly to reach metro stations. Motorcycle is the third most used mode of transport for reaching stations.
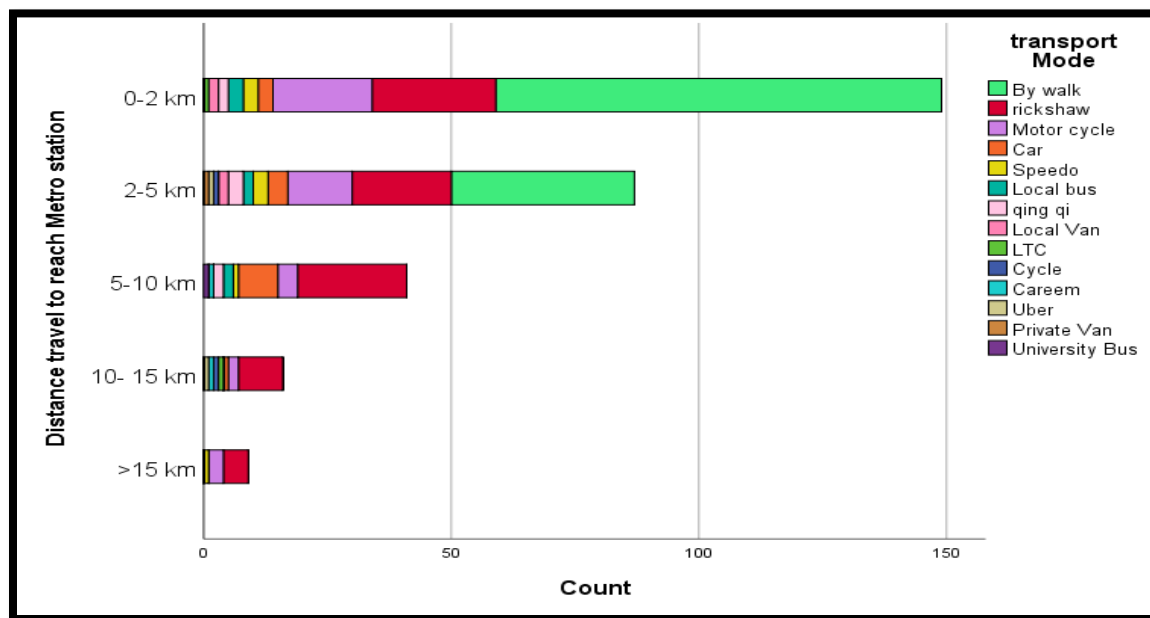
Figure 4.1:Transport Mode vs Distance travel to reach metro/Speedo station

4.3.2 Time to reach Metro Station w.r.t Mode of Transport

Here again crosstabulation is done between mode of transport to reach metro station and time to reach metro station to find out that which transport mode is used by people for different time intervals for example those who reach metro station in more than 20 minutes mostly prefer to use rickshaw.

Table 4.6:Time to reach Metro Station vs Mode of Transport

Transport Mode	How much time does/did it take to reach metro/Speedo Station? (mins)						Total
	1-5mins	5-10 mins	10-15 mins	15-20 mins	20-30 mins	>30 mins	
By walk	43	37	16	27	2	0	125
Car	2	4	3	6	0	0	15
Careem	0	0	1	1	0	0	2
Cycle	1	0	0	0	1	0	2
Local bus	1	2	2	1	0	0	6
Local Van	0	1	1	1	1	0	4
LTC	1	0	0	0	1	0	2
Motorcycle	8	16	5	5	4	4	42
Private Van	0	1	0	0	0	0	1
Qing qi	0	3	1	2	1	0	7
rickshaw	20	20	18	5	15	1	79
Speedo	1	4	1	0	1	1	8
Uber	0	1	0	0	1	0	2
University Bus	0	0	1	0	0	0	1
Total	77	89	49	48	27	6	296

Table 4.6: shows that Maximum people who reach station by walk are the ones to whom metro station is at 1-5 minutes, also 5-10 minutes is the time which is consumed by maximum riders to reach metro.
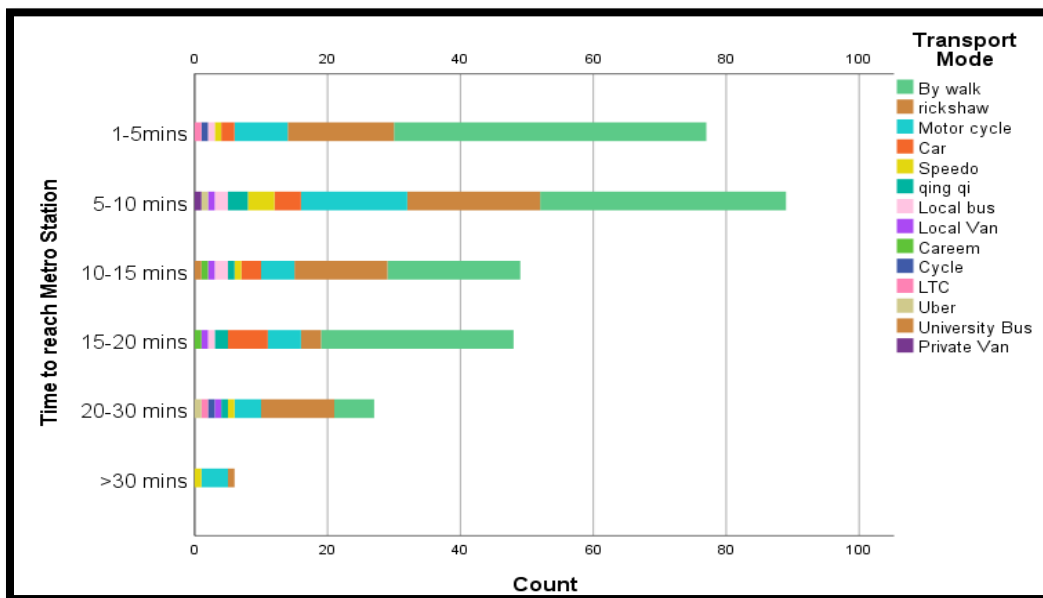
Figure 4.2: Time to reach Metro Station vs Mode of Transport

4.4 Most Frequent places that rider's visit using Metro/Speedo

Table 4.7:Most Frequent places to visit by Metro/Speedo riders

Most Frequent places to visit by Metro/Speedo riders		
Ferozepur road	Shahdarah	Arfa tower
Model town	Anarkali	Azadi chowk
Kalma chowk	Mall road	Canal road
		Gajumata
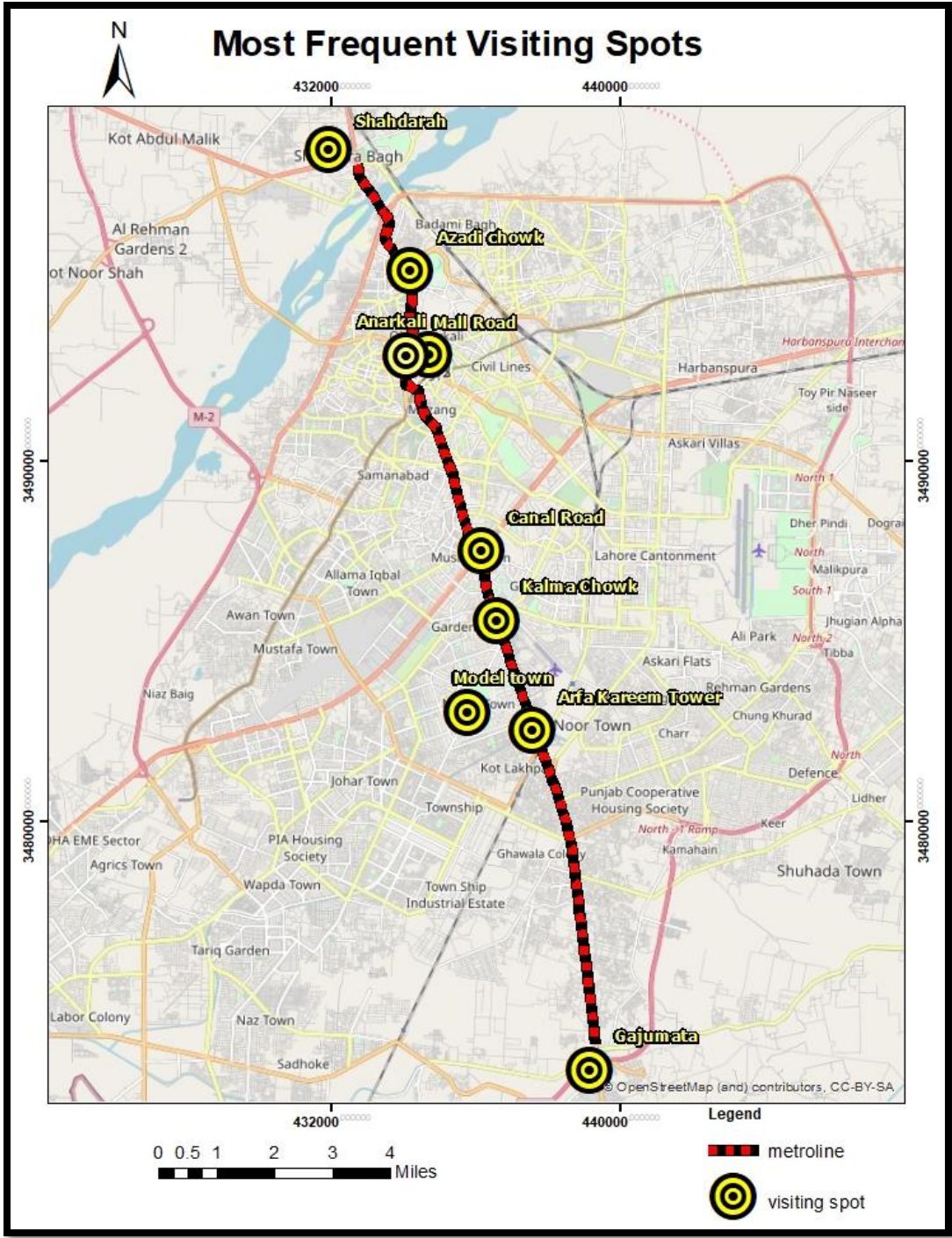
Figure 4.3:Map of most frequent visiting spots of Metro riders

Model town, Kalma chowk and Shahdarah are the major visiting spots of people using Metro.

4.5   Benefits and problems of Metro/Speedo

According to respondents Mass transit buses have many benefits but also problems as well, we had put their responses in NVIVO, and these were the most prominent responses.

Table 4.8:Benefits and problems of Metro/Speedo

Benefits	Problems
Time saving	Buses are overcrowded
Economical	Less number of seats
Punctual	Time consuming
Comfortable	Behavior of people is rude and indecent at times
Safe and Secure	

Figure 4.4:Benefits of Metro/Speedo   **Figure 4.5: Problems of Metro/Speedo**
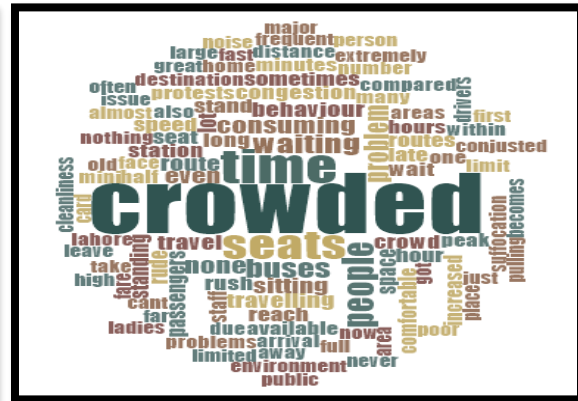
4.6 Factors Influence Metro usage per week

There are many riders who use mass transit buses on weekly and daily basis there are different factors which influence the usage of metro like gender , profession etc.

4.6.1 Gender and Profession influence on metro usage
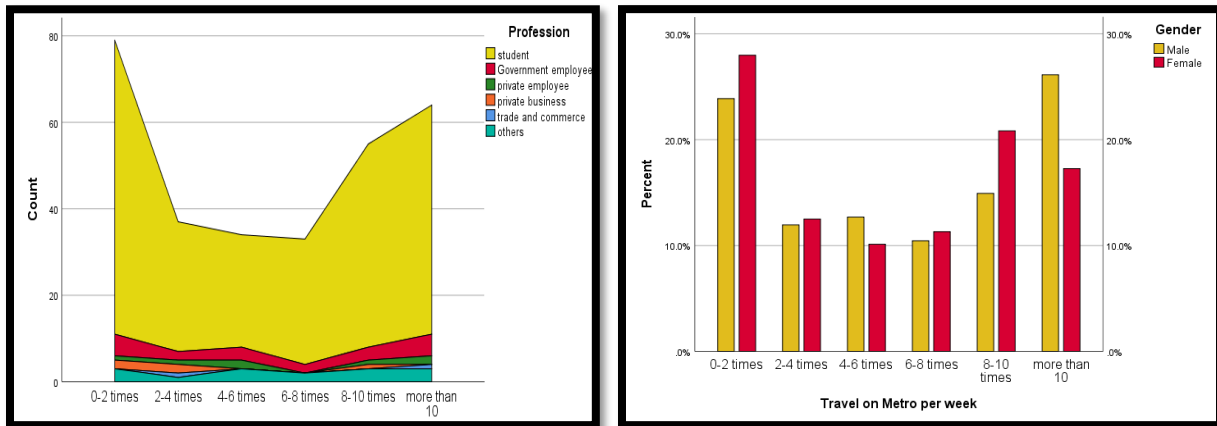
Figure 4.6:profession influence on metro usage Figure 4.7:Gender influence on metro usage

Figure 4.7 shows that more percentage of female use Metro/Speedo for 0-2 times a week and 8-10 times a week as the values are between 20 to 30 percent, while highest percentage (>25%) of male population use it more than 10 times a week. Figure 4.6 shows that students are the ones who are using Metro/Speedo more often and highest percentage of them is using it for 0-2 times a week after that more than 10 times have highest percentage, whereas government Employee and other professions are using it very less.

4.6.2 Purpose of travelling and decrease in travel cost influence on metro usage
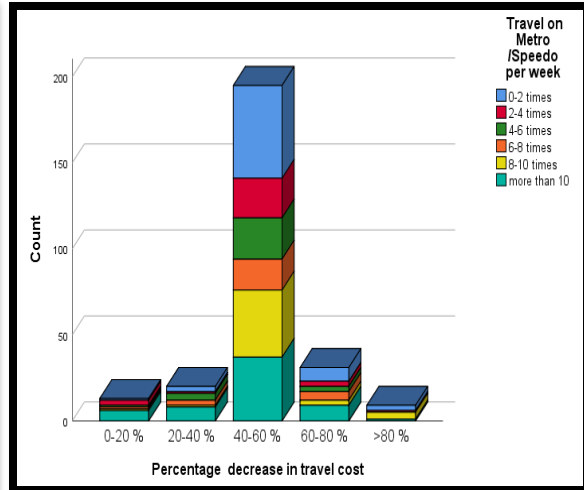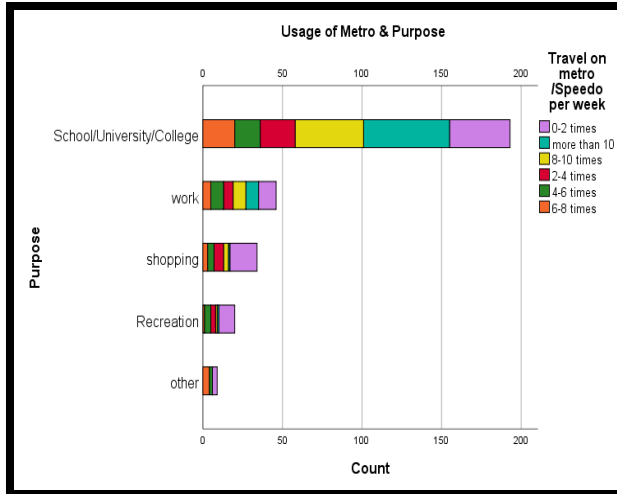
Figure 4.8:Purpose & Metro usage　　　**Figure 4.9:decrease in travel cost & Metro usage**

Figure 4.8 shows that for travelling to Schools, Colleges and Universities metro usage is more and maximum numbers of students are using it for more than 10 times a week as illustrate from graph after that 0-2 times has high response in all the professions. Figure 4.9 shows that most of the riders had 40-60% decrease in travel cost after they started travelling on Metro/Speedo but it has a slight effect on usage of metro per week as for every percentage decrease in cost 0-2 times and more than 10 times travel on metro has greater percentage.

4.6.3 Influence of Age, Time and distance on metro usage

Correlation is done to find out the relation between usage of metro and age, time and distance, for example if people use metro more than senior citizens relation between age and usage will be negative and vice versa.

Table 4.9:Correlation between Metro usage Age, time and distance.

	Usage of metro per week	Age	Time taken to reach station	Dist., travel to reach station	Distance from home to workplace
Usage of metro per week	1				
Age	-.021	1			
Time taken to reach station	-.042	-.143*	1		
Distance travel to reach metro/Speedo station	-.040	-.051	.570**	1	
Distance from home to workplace	.132*	-.041	.137*	.261**	1

As we can see from the table 4.9 there is a negative correlation between Usage of metro per week and Age, time taken to reach and distance travel to reach metro/Speedo station. It shows as the age of the riders increases they are less likely to use metro, as metro has more standing capacity so senior citizens don't find it comfortable for travelling, as the time consume to reach station increases there is less chances of using metro because people had some times use other mode of transport to reach metro , so they do not prefer using it more often, similarly as the distance to station increases there is a decrease in metro usage as people will find it difficult to reach station first and then travel to other places .There is a positive association between usage of metro and distance from home to work which means people who had a to travel larger distances use metro more often because it can save their transport cost and provide them with comfortable source of transport.

4.7 Impact after Metro and Speedo

Mass transit buses have impacted the life of daily commuters in a positive and negative way so respondents gave their feedback regarding impact on different indicators after mass transit buses.

Table 4.10:Impact on different indicators after Mass Transit Buses

Indicators	Category	Frequency	Valid Percent
Accessibility after	Increase	282	93.7%
Metro and Speedo	Decrease	10	3.3%
	Remain Same	9	3%
Impact on Travel	Increase	27	8.9%
Cost after	Decrease	268	88.7%
Metro/Speedo	Remain Same	7	2.3%
Percentage decrease	0-20%	13	4.9%
in travel cost	20-40%	20	7.5%
	40-60%	195	72.8%
	60-80%	31	11.6%
	>80%	9	3.4%
Parking facility at	Yes	50	16.6%
Metro Stations	No	227	75.2%
	Don't Know	25	8.3%
Condition of Traffic	Increase	78	25.7%
Congestion after	Decrease	144	47.5%
Metro and Speedo	Remain Same	81	26.7%
Rickshaw fares	Increase	105	34.8%
	Decrease	68	22.5%
	Remain Same	129	42.7%

Traffic Accidents	Increase	90	29.8%
after Metro and	Decrease	166	55%
Speedo	Remain Same	46	15.2%
Formal, Informal,	Formal	131	43.4%
Uber & Careem	Informal	17	5.6%
	Both (Formal &	25	8.3%
	Informal)	129	42.7%
	Uber and Careem		

Table 4.10 shows that almost 94% riders believe that accessibility to health centers and universities increased after Metro and Speedo; it represents very positive response of riders and positive impact of Mega Transit buses. Metro and Speedo also has a very positive impact on riders regarding the cost as almost 89% riders responded that travel cost to work decrease while only 11% has an opinion of increase or remain the same. As discuss earlier most of the respondents were students so students benefitted from it the most and it helped them in providing affordable public transport. Almost 73% of riders have 40-60% decrease in travel cost after they started using Metro and Speedo, which is almost a saving of half of the travel cost. This shows a very positive economic impact of Mass Transit buses and this factor encourages in further advancement of such projects. According to 75 percent riders there is no parking facility available at Metro Stations and only around 17% responded that parking facility is available and around 8 percent don't know whether it is available or not. This shows that parking facility even if present is not availed by the some riders as they don't know if it exists or not.47 percent of the respondents believe that congestion decrease which is a very positive response and this factor

also shows the positive impact of metro on riders may be ground realities are different but public opinion shows that people are happy with the performance of Mass Transit Buses. According to 43 percent respondent's rickshaw rent after Metro/Speedo remains the same but around 35 percent believe that it increases, and 23% percent believe that it decreases. Around 55 percent riders responded that traffic accident decreases after Metro and Speedo, which shows that Metro and Speedo are safe and sound mode of transport according to public and as compare to local transport before there are a smaller number of accidents now. People gave almost the same preference to Formal Public Transport and Uber & Careem but for informal and both (formal and informal) percentage is very less, It shows that people prefer Uber and Careem over informal public transport because of its door to door and comfortable service and also route buses as they are also economical and reliable source of transport.
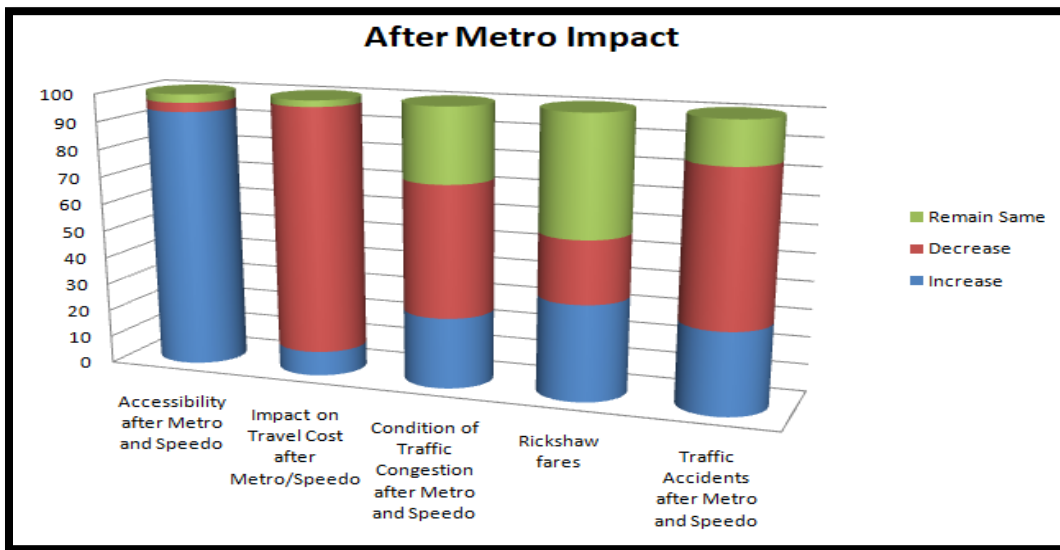
Figure 4.10:After Metro Impact

Figure 4.10 shows that metro has positive impact on accessibility, travel cost, traffic congestion and traffic accidents whereas no radical impact on rickshaw fares.

According to the details provided by Mass Transit Authority, decongestion is one of the major positive impacts of Metro. Economic activity around the corridor has increased as many house workers(maids) have started working only along the Metro route, some shopping Malls and universities are established near the route like packages Mall. Parking facility for both Car and motorcycles are provided from Model town to Ittefaq Hospital. PMA is going to launch an app for tracking the location of nearby Metro and Speedo. There are proper CCTV cameras installed in all the buses, also security of Mass Transit buses is properly monitored. From July 1st there is an increase in fare of metro bus service from Rs 20 to Rs 30, this increase in fare has resulted in decrease in passengers turnout, as no complete analysis and study has been conducted to find out the exact figures so according to PMA approximate decrease in ridership is 180000 to 150,000 for Metro and 150,000 to 135,000 of feeder bus service.

Table 4.11:Impact of fare on ridership

	No. of buses	Passengers/day before fare increase	Passengers/day before fare increase
Metro	64	180,000 approx.	150,000 approx.
Speedo	200	150,000 approx.	135,000 approx.

Source: Punjab Mass Transit Authority

4.8 Impact on LTC after Metro and Speedo

LTC was primarily a regulatory body which has been tasked to ensure a smooth running transport system in Lahore, But after establishment of Punjab Mass Transit authority and introduction of metro and Speedo buses, many operators who were in contract with LTC to provide intra city transport left, because routes on which Metro and Speedo started to operate LTC buses were barred from there. After Metro LTC was not affected much and its buses were shifted to different routes but after Speedo started operating on 14 routes with the fleet of 200, LTC buses and Vans face major downfall as most of its routes were taken by Speedo.

But after august 2018 there has been considerably less investment in public transport in Lahore. The buses operating in Lahore were procured in 2012 and have lived past their design life. As the condition of the bus deteriorates, LTC was unable to provide the same service level, breakdowns occur more often and finally it is put out of service. Due to this reason the number of buses has significantly decreased, so due to decrease in number of operational buses in 2018-19, the ridership on LTC routes was bound to decrease. Currently only two operators are in contract with LTC . M/s Bandial Transport is operating 30 vehicles on 1 route without e-ticketing system. M/s Platform (Al-Bayrak) is operating 114 vehicles with e-ticketing system. Previously PAKOZ, Niazi, Daewoo, First Bus, Awais travelers etc. were providing buses to LTC.

Table 4.12:Rider ship detail from Sep 2016 to August 2019

Month	Subsidized	Suburban	Total	Per Day
Sept 16	1,361,291	371,163	1,732,454	57,748

Oct 16	1,484,146	367,211	1,851,357	59,721
Nov 16	1,519,608	382,695	1,902,303	63,410
Dec 16	1,630,429	412,918	2,043,347	65,914
Jan 17	1,483,675	354,759	1,838,434	59,304
Feb 17	1,502,527	360,248	1,862,775	66,528
Mar 17	1,213,690	308,087	1,521,777	49,090
Apr 17	916,928	249,723	1,166,651	38,888
May 17	1,301,662	366,428	1,668,090	53,809
Jun 17	1,035,888	321,147	1,357,035	45,235
Jul 17	1,383,311	397,080	1,780,391	57,432
Aug 17	1,399,472	340,046	1,739,518	56,113
Sept 17	1,258,522	354,661	1,613,183	53,773
Oct 17	1,425,989	370,071	1,796,060	57,937
Nov 17	1,281,867	310,722	1,592,589	53,086
Dec 17	1,357,626	353,408	1,711,034	55,195
Jan 18	1,339,750	341,011	1,680,761	54,218
Feb 18	1,190,262	310,192	1,500,454	53,588
Mar 18	1,294,839	332,916	1,627,755	52,508
Apr 18	1,300,827	301,128	1,601,955	53,399
May 18	1,177,384	280,759	1,458,143	47,037
Jun 18	958,694	241,575	1,200,269	40,009
Jul 18	1,057,810	200,954	1,258,764	40,605
Aug 18	1,012,278	196,520	1,208,798	38,993
Sept 18	1,026,621	186,277	1,212,898	40,430
Oct 18	1,121,902	167,438	1,289,340	41,592
Nov 18	986,804	128,118	1,114,922	39,819
Dec 18	1,037,693	112,996	1,150,689	41,096
Jan 19	1,087,338	10,304	1,097,642	35,408

Feb 19	929,939	-	929,939	33,212
Mar 19	1,035,444	-	1,035,444	33,401
Apr 19	987,461		987,461	32,915
May 19	798,626		798,626	25,762
Jun 19	683,789		683,789	22,793
Jul 19	760,384			
Aug 19	644,347			

After January 2019 sub urban routes stopped operating.
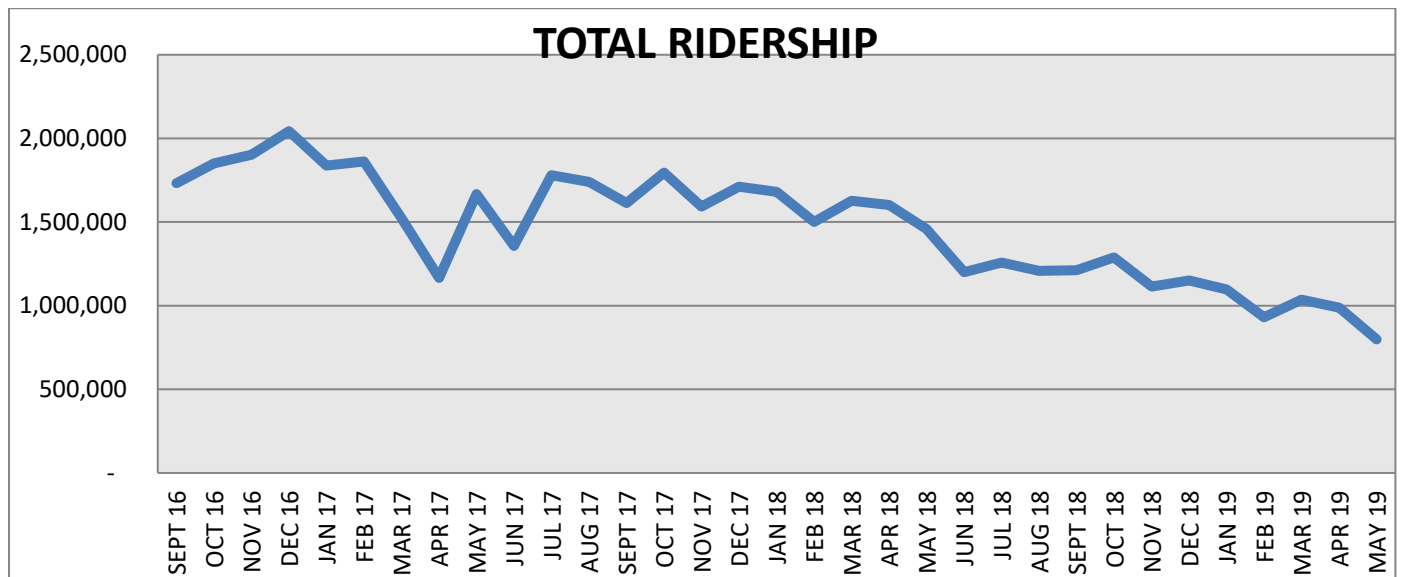
Figure 4.11:Ridership from Sep 2016 to August 2019

Source:(This data is given by LahoreTransport Company)

Table 4.13:Difference in number of buses and operators from 2016 to 2019

Year	Estimated No. of buses	No. of Operators
2016	340	8
2017	251	6
2018	250	6
2019	144	2

4.9   Comparative Satisfaction analysis of Metro, Speedo and LTC

Level of service of buses can be determined through two parameters, Operational performance and transportation hygiene. Operational performance includes travel time, waiting time, occupancy, reliability and regularity of service, whereas transportation hygiene   includes comfort, cleanliness, staff behavior and noise (sumon,2005).

Customer satisfaction studies are proven to be an important factor in optimizing the services provided to users (Belayneh,2010). Satisfaction analysis was conducted to evaluate the riders' satisfaction with the services provided by LTC, Metro and Speedo. Satisfaction analysis was conducted on Likert scale with

1= very satisfied, 2= satisfied, 3= neither satisfied nor dissatisfied, 4 = unsatisfied, 5= very unsatisfied.

Five major parameters to determine the level of service provided by these buses were accessibility, Distance and time, security, internal & external services and economy. Commuters' response to all the indicators has been taken and the value with the maximum response has been shown in the table below.

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Table 4.14:Satisfaction Response of Riders of LTC, Metro and Speedo

Indices	Indicators	LTC	Metro/Speedo
Accessibility	Accessibility to health units	Neither Satisfied nor Dissatisfied	Neither Satisfied nor Dissatisfied
	Accessibility to Educational Institutions	Neither Satisfied nor Dissatisfied	Very satisfied
	Accessibility to Offices	Neither Satisfied nor Dissatisfied	Neither Satisfied nor Dissatisfied
	Accessibility to Recreational areas	Neither Satisfied nor Dissatisfied	Neither Satisfied nor Dissatisfied
Distance & Time	Distance travel to catch the transport	Neither Satisfied nor Dissatisfied	Satisfied
	Waiting time	Unsatisfied	Satisfied
	Travel time	Neither Satisfied nor Dissatisfied	Satisfied
	Time Interval between two buses	Unsatisfied	Satisfied
Security	Satisfaction of Travelling alone	Neither Satisfied nor Dissatisfied	Very satisfied
	Measures of security to decrease Harassment	Unsatisfied	Neither Satisfied nor Dissatisfied
	Security in terms of attitude of opposite sex	Satisfied	Satisfied
	Security in terms of lighting at Stations.	Unsatisfied	Satisfied
	Security in terms of staff attitude towards girls.	Neither Satisfied nor Dissatisfied	Very satisfied
	Security in terms of separate space provided for men and women	Satisfied	Very satisfied
	Level of Security in terms of Emergency exits and Cameras	Unsatisfied	Very satisfied
	Drivers and Operators behavior	Unsatisfied	Satisfied

Services Internal	Cleanliness of Buses	Neither Satisfied nor Dissatisfied	Very satisfied
	Standing Capacity	Unsatisfied	Neither Satisfied nor Dissatisfied
	Number of Seats	Very unsatisfied	Neither Satisfied nor Dissatisfied
	Comfort ability of Seats	Neither Satisfied nor Dissatisfied	Neither Satisfied nor Dissatisfied
	Condition of Buses	Unsatisfied	Satisfied
	Air Condition facility	Neither Satisfied nor Dissatisfied	Very satisfied
	Internet Provision	Very unsatisfied	Very unsatisfied
Services External	Ticketing System	Satisfied	Very satisfied
	Cleanliness of Station	Neither Satisfied nor Dissatisfied	Very satisfied
	Routes of Transport System	Neither Satisfied nor Dissatisfied	Satisfied
	Parking facilities at Stations	Neither Satisfied nor Dissatisfied	Neither Satisfied nor Dissatisfied
	Condition of Bus stops	Neither Satisfied nor Dissatisfied	Satisfied
	Pedestrian paths and Bridges	Neither Satisfied nor Dissatisfied	Satisfied
Travel cost	Daily travel cost	Satisfied	Very satisfied

Table 4.15:Mean and Standard Deviation of riders' responses of each index

index	Satisfaction mean LTC	Std. Dev	Satisfaction mean Metro/Speedo	Std. Dev
Accessibility	3	0	2.5	1
Distance and Time	3.5	0.57	2	0.44
Security	3.1	0.89	1.6	0.74

Services internal	4.1	0.83	2	1
Services external	2.8	0.4	1.8	0.75
Overall Satisfaction	3.4	0.82	1.9	0.8

Mean scores of overall satisfactions and all other indicators show that riders are partially satisfied to very unsatisfied with the services of LTC and are satisfied with the services of Metro and Speedo.

4.9.1 Cronbach alpha Coefficients

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is a measure of scale reliability. As we can see   values of all the dimensions are between 0.65 to 0.83 which also demonstrates reasonable reliability of all the dimensions as values are near 0.7 or greater than that, this shows our scale is reliable.

Table 4.16:Cronbach alpha coefficients of LTC, Metro and Speedo

Cronbach alpha Coefficients	Cronbach alpha Coefficients LTC	Cronbach alpha Coefficients Metro
Accessibility	0.781	0.7
Distance and Time	0.651	0.67
Security	0.725	0.829
Services internal	0.737	0.67
Services external	0.702	0.708

4.9.2 Relative importance Index

Relative importance index analysis allows identifying most of the important criteria based on participants' replies and it is also an appropriate tool to prioritize indicators rated on Likert- type scales.(Raja,2018)

Relative Important Index=$(5n5+4n4+3n3+2n2+1n1)/(A*N)$

n5= Number of respondents for Very Satisfied

n4= Number of respondents for Satisfied

n3= Number of respondents for Partially Satisfied/Neutral

n2= Number of respondents for Unsatisfied

n1= Number of respondents for Very unsatisfied

A=Highest weight (5)

N=number of respondents=302

Table 4.17:Frequency of satisfaction responses for each indicator of Mass Transit

Metro	Accessibility	Dist. & Time	External Services	Internal Services	Security
Very Satisfied	29	50	18	32	48
Satisfied	110	121	137	89	117
Neutral	122	104	124	137	111

Unsatisfied	35	24	21	39	24
Very Unsatisfied	6	3	2	5	2

Table 4.18:Relative Importance Index for Mass Transit

Mass Transit	Accessibility	Dist. & Time	External Services	Internal Services	Security
Very Satisfied*5	145	250	90	160	240
Satisfied*4	440	484	548	356	468
Neutral*3	366	312	372	411	333
Unsatisfied*2	70	48	42	78	48
Very Unsatisfied*1	6	3	2	5	2
Total	1027	1097	1054	1010	1091
A*n	1510	1510	1510	1510	1510
RII	0.68013245	0.726490066	0.698013245	0.668874172	0.722517
Importance	4	1	3	5	2

As Table 4.18 shows according to the importance index of mass transit distance and time has more importance followed by security, it shows riders will be happy with the buses whose security and distance and time services are adequate.

Table 4.19: Frequency of satisfaction responses for each indicator of LTC

LTC	Accessibility	Dist. & time	external services	internal services	security
Very Satisfied	5	8	2	1	7
Satisfied	45	30	19	16	29
Neutral	214	151	199	69	225
Unsatisfied	30	100	79	207	35
Very Unsatisfied	8	13	3	9	6

Table 4.20: Relative Importance Index for LTC

LTC	Accessibility	Dist. & Time	External Services	Internal Services	Security
Very Satisfied*5	25	40	10	5	35
Satisfied*4	180	120	76	64	116
Neutral*3	642	453	597	207	675
Unsatisfied*2	60	200	158	414	70
Very Unsatisfied*1	8	13	3	9	6
Total	915	826	844	699	902
A*N	1510	1510	1510	1510	1510
RII	0.605960265	0.547019868	0.558940397	0.462913907	0.597351
Importance	1	4	3	5	2

Table 4.20 shows for LTC Accessibility has more importance followed by security, it shows for LTC   people will get satisfied if accessibility to areas will increase.

4.9.3 Correlations

As our data is ordinal so spearman correlation will be used, The Spearman rank-

order **correlation coefficient**   is a nonparametric measure of the strength and direction of

association that exists between two **variables** measured on at least an **ordinal** scale (Leard

Statistics, n.d.). Before performing regression analysis between dependent and independent

variables, correlations were computed, as done by Belayneh(2010) to find the association of

satisfaction attributes with overall satisfaction and to find if multicollinearity exist between

independent variables. correlation helps us to find out that which independent variables should

be used as predictors in regression analysis. In all the tables satisfaction attributes are

significantly associated with each other and overall satisfaction as p is less than 0.01, r values are

positive in both the tables, so it shows a positive linear relationship among all the variables.

Values along the main diagonal are 1 in both tables because variable is always perfectly

correlated with itself. If Values are greater than 0.5 and are positive it shows a strong and

positive association between the variables (Lisa, n.d.).

LTC

Table 4.21:Correlation of overall satisfaction and other satisfaction indicators

LTC	Overall satisfaction	Accessibility	Security	Internal services	External services	Date and time
Overall satisfaction	1.000					
Accessibility	.562[**]	1.000				
Security	.710[**]	.495[**]	1.000			
Internal services	.562[**]	.447[**]	.554[**]	1.000		
External services	.627[**]	.339[**]	.447[**]	.438[**]	1.000	
Date and time	.599[**]	.432[**]	.464[**]	.511[**]	.393[**]	1.000

There is a high association between overall satisfaction and all other indicators of satisfaction as values are greater than 0.5, there is a highest association between security and overall satisfaction, which shows that for riders' satisfaction security is a major aspect that contributes towards overall satisfaction. Correlation between independent variables is not greater than 0.75 so there is no multicollinearity, and all the variables can be used as predictors in regression analysis.

Mass Transit

Table 4.22: Correlation of overall satisfaction and other satisfaction indicators

Mass Transit	Overall satisfaction	Accessibility	External services	Distance and time	Internal services	Security
Overall satisfaction	1.000					
Accessibility	.598**	1.000				
External services	.730**	.438**	1.000			
Distance and time	.714**	.513**	.608**	1.000		
Internal services	.554**	.273**	.500**	.335**	1.000	
Safety and security	.799**	.486**	.616**	.599**	.490**	1.000

For Mass Transit again all the satisfaction attributes and overall satisfaction have high association with each other as values are greater than 0.5, from lowest 0.6 for accessibility to highest 0.76 for security, it shows that for metro riders security is the major aspect that influence

the overall satisfaction, also the correlation values for independent values are less than 0.75 so they can be used as predictors for ordinal regression.

4.9.4 Ordinal logistic Regression

Ordinal logistic regression (often just called 'ordinal regression') is used to predict an ordinal dependent variable i.e. a variable whose value exists on an arbitrary scale where only the relative ordering between different values is significant, given one or more independent variables. As with other types of regression, ordinal regression can also use interactions between independent variables to predict the dependent variable ("Laerd Statistics", n.d.). formula for regression is given below:

$$logit(P(Y \leq j)) = \beta j0 + \beta 1x1 + \cdots + \beta pxp$$

Y= Ordinal outcome, j= categories,β= co efficient, p = no. of predictors

We have conducted ordinal regression for both modes of transport with overall satisfaction being a dependent variable and indexes of accessibility, distance & time, security, internal and external services as independent variables .For tables if significance is less than 0.05 i.e. p<0.05 than we reject the null hypothesis otherwise we accept it. Four major tables that we get our given below.

Table 4.23:Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
		LTC		
Intercept Only	431.081			
Final	0.000	431.081	5	0.000

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METRO				
Intercept Only	590.982			
Final	0.000	590.982	5	0.000

(Null hypothesis: There is no significance difference between baseline model and final model.)

Chi square is the difference between -2LL values of intercept and final model and p<0.05 so we reject the null hypothesis it indicates that the Final model gives a significant improvement over the baseline intercept-only model. As for all the modes $p < 0.05$ it tells us that the model gives better predictions than if we guessed it based on the marginal probabilities for the outcome categories.

Table 4.24:Goodness-of-Fit

	LTC			Mass Transit		
	Chi-Square	**df**	**Sig.**	**Chi-Square**	**df**	**Sig.**
Pearson	18.392	256	1.000	110.061	551	1.000
Deviance	25.234	256	1.000	80.219	551	1.000

(Null Hypothesis: The observed data is having the goodness of fit with the fitted model)

The next table in the output is the *Goodness-of-Fit table*   This table contains Pearson's chi-square statistic for the model (as well as another chi-square statistic based on the deviance). These statistics are intended to test whether the observed data is consistent with the fitted model. We start from the null hypothesis that the fit is *good*, as p value is greater than .05 we accept the null hypothesis and conclude that the data and the model predictions are similar and models fits the data well for all the   modes of transport.

Table 4.25:Pseudo R-Square

	LTC	Mass Transit
Cox and Snell	0.760	0.859
Nagelkerke	0.956	0.985
McFadden	0.901	0.952

In linear regression, R^2 (the coefficient of determination) summarizes the proportion of variance in the outcome that can be accounted for by the explanatory variables, larger R^2 values indicates that more variation in the dependent variable can be explained with the maximum value of it be 1, For logistic and ordinal regression models it not possible to compute the same R^2 statistic as in linear regression so three approximations are computed instead. ("ReStore", 2011), as R^2 values are greater than 0.7 we can say maximum variation can be explained by independent variables for both LTC and Mass Transit .

Table 4.26:Parameter Estimates

		Estimate	df	Sig.	Exp (B)
				LTC	
Threshold	[overall satisfaction= 2]	38.213	1	0.000	
	[overall satisfaction = 3]	54.870	1	0.000	
	[overall satisfaction = 4]	69.635	1	0.000	
Location	Accessibility	2.634	1	0.000	13.92862
	Security	3.859	1	0.000	47.41585
	Internal services	3.409	1	0.001	30.23238

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	External services	3.393	1	0.000	29.75394
	Dist. and time	2.158	1	0.000	8.654687
	Mass Transit				
Threshold	[Overall Satisfaction =1]	15.799	1	0.000	
	[Overall Satisfaction =2]	28.603	1	0.000	
	[Overall Satisfaction =3]	42.080	1	0.000	
	[Overall Satisfaction =4]	51.249	1	0.000	
Location	Accessibility	1.860	1	0.000	6.423331746
	Distance and time	2.316	1	0.000	10.13675888
	External services	2.121	1	0.000	8.336338685
	Internal services	1.948	1	0.000	7.011680749
	Safety and security	3.278	1	0.000	26.52016967

The Parameter estimates table is the core output, it tells us about the relationship between our explanatory variables and the outcome. The threshold coefficients are not usually interpreted individually. They just represent the intercepts ("Restore", 2011). As you can see in the table all the independent variables are statistically significant ($p<0.05$) . We have also calculated odds ratio from parameter estimates by taking exponent of estimates store them in separate variables .All the odds ratio are positive which shows that increase with the satisfaction of internal and external services, security provided, accessibility, distance travelled, waiting time and time interval between two buses of LTC and Mass Transit buses increases there will be an increase in overall satisfaction. Security has the highest odds ratio value followed by external and internal services for LTC and incase of Mass Transit again security has the high value followed by

distance and time. It means more the riders are satisfied with security more they will be satisfied with the overall services provided by the buses.

Table 4.27:Test of Parallel Lines

Model	-2 Log Likelihood	Chi-Square	df	Sig.
		LTC		
Null Hypothesis	.000			
General	.000[b]	.000	10	1.000
		Mass Transit		
Null Hypothesis	.000			
General	.000[b]	.000	15	1.000

This test compares the ordinal model which has one set of coefficients for all thresholds (labeled Null Hypothesis), to a model with a separate set of coefficients for each threshold (labeled General). If the general model gives a significantly better fit to the data than the ordinal (proportional odds) model (i.e. if *p<.05*) then we are led to reject the assumption of proportional odds. But here p > .05 so we won't reject the proportional odd assumption i.e. the explanatory variables have the same effect on the odds regardless of the threshold. So, for all modes of transport we will conclude that ordinal model gives better result than general model.

5 Results and Findings of Impact of Mega Transit buses on Informal Public Transport

We conducted survey to get the information from drivers of informal public transport to get insight of how mass transit buses affected their lives and business. So we met fort rickshaw drivers and conducted their interview and collected data on questionnaires. Below is the summary of information they gave us.

5.1 Profile of Drivers

Table 5.1:Rickshaw drivers' profile

Drivers Profile	Category	Frequency (N)	Percentage
Mode of transport	Rickshaw	23	57.5%
	Qing qi	17	42.5%
Age	12-20 yrs	6	15%
	20- 30 yrs	19	47.5%
	30-40 yrs	12	30%
	40-50 yrs	3	7.5%
Status	Single	7	82.5%
	Married	33	17.5%
Years residing in Lahore	0-5 yrs	2	5%
	5-10 yrs	8	20%
	10-20 yrs	22	55%
	20-30 yrs	4	10%
	30-40 yrs	4	10%
Distance from home to workplace (km)	2-5 km	30	75%
	5-10 km	4	10%

	10-15 km	5	12.5%
	15-20 km	1	2.5%
Living with family or without	With Family	37	92.5%
	Alone	3	7.5%
Family type	Joint	20	50%
	Nuclear	17	42.5%
	Alone	3	7.5%
Number of family members	1-5 members	6	16.2%
	5-10 members	16	43.2%
	10-15 members	9	24.3%
	15-20 members	5	13.5%
	>20 members	1	2.7%
Number of family members who are employed (including you)	1	13	33.3%
	2	9	23.1%
	3	8	20.5%
	4	3	7.7%
	5	6	15.4%
Family members who are rickshaw and Qing qi Drivers (including you)	1	29	70%
	2	9	22.5%
	3	3	7.5%
Number of School going children	0	5	13.9%
	1	7	19.4%
	2	10	27.8%
	3	7	19.4%
	4	6	16.7%
	5	1	2.8%

Years of education	None	19	48.7%
	Primary	2	5.1%
	Secondary	9	23.1%
	Metric	6	15.4%
	Intermediate	3	7.7%
Vehicle you own	None	19	47.5%
	Rickshaw	13	32.5%
	Qingqi	8	20%
House you live in is	Rented	34	85%
	Own	6	15%
Rent	5k-6k	3	8.8%
	6k-8k	14	41.2%
	8k-10k	13	38.2%
	10k-12k	4	11.8%

Around 58 percent respondents are rickshaw drivers while the rest are Qing qi drivers. Table shows that most of the drivers belong to the age group of 20-30 but one negative thing that we can see is youngsters from 12 – 20 years are also driving rickshaw for earning.83% Rickshaw drivers are married, and 17 percent are single. Table illustrates that most of the drivers have been living in Lahore from ten to twenty years. Most of the drivers live near to the workplace almost 2-5 km away. Almost 93 percent of the drivers are living with their families in Lahore. 50 percent of the drivers are living in joint and 43 % are living in nuclear families and only around 7 percent are living alone. Most of the drivers have 5- 10 members as most of them are living in joint family. In most of the rickshaw drivers' families' only one family member is employed as

most of the drivers are living in joint families it shows that most of them are responsible solely for bread and butter of their family. Table shows higher percentage of one member as rickshaw /Qing qi driver. Around 49 percent rickshaw drivers are not educated, and 5 percent are primary, around 23 percent are secondary, and 15 percent are metric and 8 percent are intermediate pass. 48% of drivers don't own any vehicle while the rest own their rickshaws or qing qi, they don't have any other vehicle.85 percent drivers are living in rented house, which further adds to their expenses.41 percent of the drivers have their rent ranges from 6000 to 8000 while 38 percent has 8000-10000 house rent.

5.2   Professional Information

In this section drivers were asked question regarding their profession and their responses are summarized in the table below.

Table 5.2:Professional Information of Drivers

Characteristics	Category	Frequency (N)	Percentage
Do you have a valid license?	Yes	2	5%
	No	38	95%
Is your vehicle registered?	Yes	14	35%
	No	26	65%
Driving on this route since	0-2 yrs	3	7.5%
	2-4 yrs	13	32.5%
	4-6 yrs	7	17.5%
	6-8 yrs	12	30%
	8-10 yrs	5	12.5%

You are driving vehicle	Full time	38	95%
	Part Time	2	5%
Vehicle you are driving is made by :	Company Made	15	37.5%
	Customized	25	62.5%
Vehicle you are driving is:	Own	15	37.5%
	Rented	18	45%
	Company Owned	7	17.5%
Vehicle age	0-2 yrs	6	15%
	2-4 yrs	6	15%
	4-6 yrs	20	50%
	6-8 yrs	6	15%
	8-10 yrs	2	5%
Do you have a regular pick and drops customer?	Yes	30	75%
	No	10	25%
Pick and drop locations	School and Colleges	25	83%
		1	3.3%
	School, Colleges and Offices Residential Area	4	23.3%
Did metro bus provide benefit to your community?	Yes	1	2.5%
	No	39	97.5%
Is your vehicle working as a feeder service to metro?	Yes	37	92.5%
	No	3	7.5%

Avg. Number of trips to metro station per day	0-5	8	21.1%
	5-10	12	31.6%
	10-15	13	34.2%
	15-20	5	13.2%
Did you face difficulty after metro started operating?	Yes	30	75%
	No	10	25%
Are you part of any local association or Rickshaw Union?	Yes	8	20%
	No	32	80%
Are your rickshaws registered on ride-hailing apps like Uber/Careem?	Yes	5	12.5%
	No	35	87.5%

Table 5.2 shows a very alarming situation as 95 percent of the drivers doesn't have a license. One of the major negative factors is that 65 percent vehicles are not even registered, which means there is no official record of them. Many of the rickshaws started driving on the route along metro line after metro started operating. 95 percent of rickshaw drivers are driving full time and it's the only source of income that they have. Around 63% drivers are driving rickshaws which they have bought from workshops or have ask them to make it for them as company made rickshaws and Qing qi's are less than 37 percent. Table shows highest percentage for rented vehicles 45 percent and 37.5 percent are owned rickshaws and 17.5% are company owned. Most of the rickshaws and Qing qi are 4-6 years old. 75 percent of rickshaws and Qing qi are providing regular pick and drop service to school, colleges, offices and residential areas. Around 98% drivers have responded that metro and Speedo have declined their business. Around

92.5% rickshaws and Qing Qis are providing feeder service to metro stations and Speedo stops because of their door to door service. Around 34% of rickshaws and Qing Qis have 10-15 trips to metro station per day and 32 % have around 5-10 trips per day, which means people are using rickshaws and Qing Qis excessively for reaching metro stations.80% drivers responded they are not part of unions while 20% are part of it and they stand by their unions. Around only 13 percent rickshaws are registered on Uber and Careem while the rest are not, some of them are of opinion that Uber and Careem rates are less and don't give them enough profit. 53% respondents believe that number of rickshaws and Qing Qis increased after metro. 92% drivers responded that the fare remain the same after Metro/Speedo and if increased it is only because of increase in petrol and LPG rate.100 % of drivers responded that government did not provide them with any kind of support after Metro/Speedo. 100% responded that they were not driving vans and buses before Metro/Speedo.

5.3 Influence and comparison of different characteristics on each another

Different indicators are related to each other for example drivers under age of eighteen might not have valid license and above the age of 18 might have it so we draw comparative graphs in SPSS to define the relation of different factors with each other.

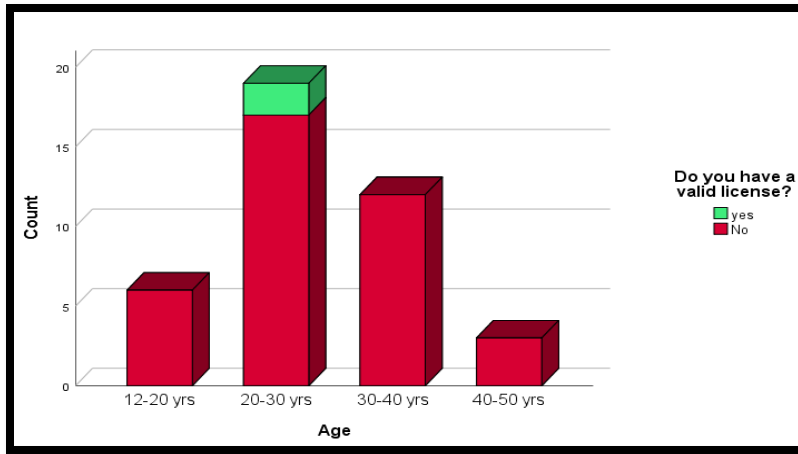### 5.3.1 Comparison of Age and Valid License

Figure 5.1:Comparison of Age and Valid License

Figure 5.1 shows that all most all age groups doesn't have a valid license only two drivers from age group 20-30 have a valid license, it shows that having a license doesn't depend on age group of drivers, it depends on willingness of driver.

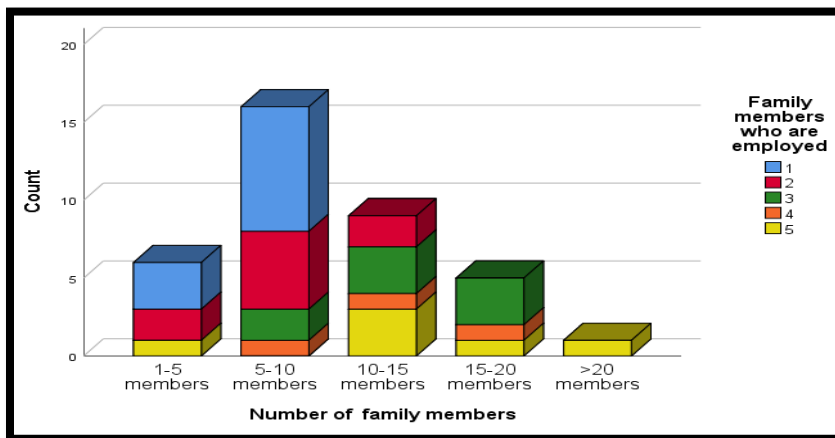### 5.3.2 Number of family Members and employed members

Figure 5.2:Number of family Members and employed members

As mentioned in the table most of drivers are living in joint families so graph shows that as the number of family members increased employed family members percentage also increased as you can see from the figure there is no percentage of one employed member as family members increased from 10-20.

5.3.3 Comparison of Income of drivers /day vs. vehicle status
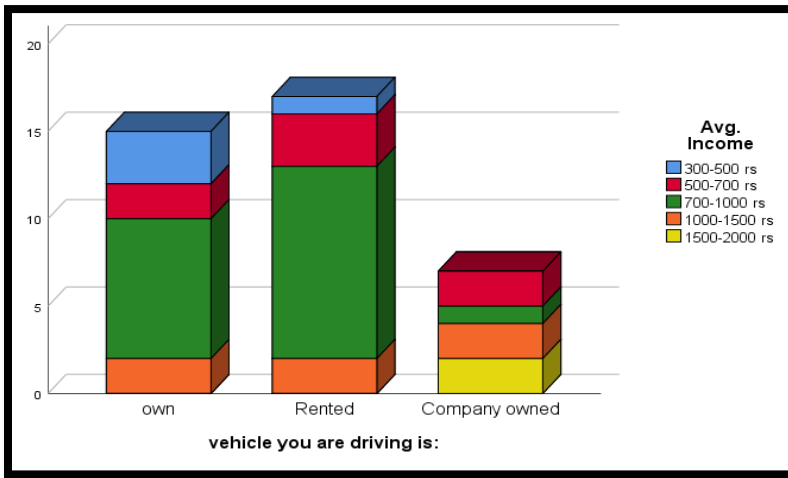

Figure 5.3:Comparison of Income of drivers /day vs. vehicle status

Graph shows that drivers who have company owned vehicles have more earnings and those who have their own and rented vehicles have less and most of them earn rupees 700-1000/day.

5.3.4 Customized & Company made vehicles which are registered
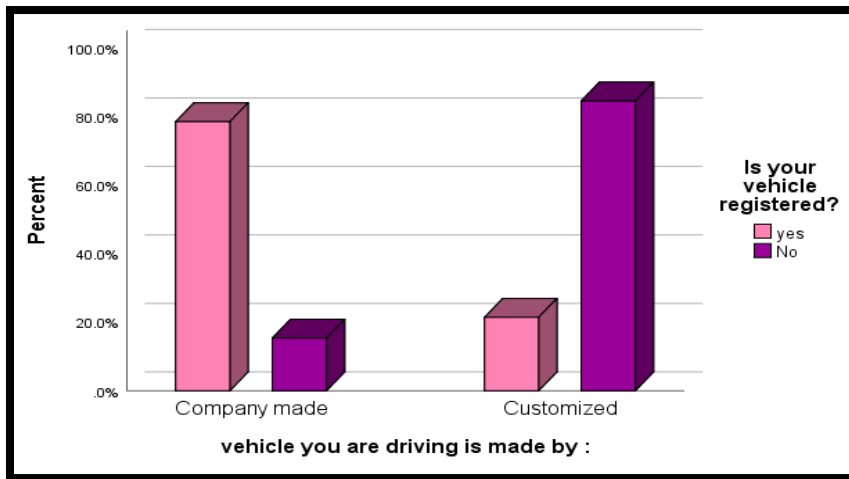
Figure 5.4:Customized & Company made vehicles which are registered

Graph shows that more company made vehicles are registered than customized as around 80% of

companies made are registered and only 20% of customized vehicles are registered.

5.4 Comparison Before and After Metro and Speedo

In this section rickshaw drivers told us about the conditions before and after mass transit buses

that how after metro their income and other things get effected.

Table 5.3:Comparison of different characteristics before and after Mass Transit buses

Characteristics	Category	Before Metro		After Metro	
		Frequency (N)	Percentage	Frequency (N)	Percentage
Avg. Income	300-700 Rs	1	2.6%	11	28.2%
	700-1000 Rs	8	20.5%	20	51.3%
	1000-1500Rs	27	69.2%	6	15.4%
	1500-2000Rs	3	7.7%	2	5.1%
Avg. No. of trips/day	5-10	10	25.6%	14	35.9%
	10-20	15	38.5%	14	35.9%
	20-30	12	30.8%	10	25.6%
	30-40	1	2.6%	1	2.6%
	40-50	1	2.6%	0	0%
Estimated Avg. fare /trip	40-50 Rs	2	5.1%	2	5.1%
	50-100 Rs	0	0%	20	51.3%
	100-150 Rs	27	69.2%	12	30.8%
	150-200 Rs	7	17.9%	5	12.8%
	200-250 Rs	3	7.7%	0	0%
Avg. No. of passengers per day	0-10	6	15.4%	11	28.2%
	10-20	12	30.8%	5	12.8%
	20-30	14	35.9%	17	43.6%
	30-40	5	12.8%	5	12.8%
	40-50	1	2.6%	1	2.6%
	>50	1	2.6%	0	0%
Avg. distance you travel daily?	10-20 km	6	15.4%	11	28.2%
	20-40 km	21	53.8%	24	61.5%
	40-60 km	8	20.5%	4	10.3%
	60-80 km	4	20.3%	0	0%
Estimated Number of Qing qi and rickshaws along the route	50-100	15	38.5%	19	48.7%
	100-300	10	25.6%	14	35.9%
	300-500	11	28.2%	2	5.1%
	500-1000	3	7.7%	3	7.7%

	1000-2000				2.6%
Rickshaw rent/day	70-150 Rs	10	41.7%	17	70.8%
	150-200 Rs	8	33.3%	6	25%
	200-250 Rs	1	4.2%	1	4.2 %
	250-300 Rs	5	20.8%	0	
Working hours/day	7-8 hrs.	26	66.7%	6	15.4%
	8-10 hrs	7	17.9%	12	30.8%
	10-12 hrs	6	15.4%	18	46.2%
	12-14 hrs	0		3	7.7%
Avg. Parking fee per day	Rs 10-20	27	69.2%	31	79.5%
	Rs 20-50	4	10.3%	5	12.8%
	Rs50-70	6	15.4%	1	2.6%
	Rs 70-100	2	5.1%	2	5.1%

Table 5.4 shows average income before the mass transit buses was high than after metro/Speedo as you can see from the table that 69.2% percent had average income between 1000-1500 Rs and percentage decreased after metro as 51 percent has average income of 700-1000 Rs after metro. Number of trips 10-20 and 20-30 has more percentage in before metro graph (i.e. 38.5 % and 30.8%) and 5-10 and 10-20 has more percentage in after metro graph (i.e. 35.9 % of both), it shows that number of trips have reduced after metro and hence affected the income of rickshaw and Qing qi drivers. In before Metro/Speedo graph 100-150 Rs fare/trip has highest percentage of 69 while in after graph 50-100Rs has highest percentage, which is 51.3%. It shows that fare per trip reduces after Metro/Speedo. In table number of passengers per day shows that 20-30 passengers per day has highest percentage in both after and before column but in before metro graph 10-20 passengers has higher percentage than after metro graph, also in before metro graph

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there is some percentage for greater than 50 passengers while in after metro graph there is null value for greater than 50 passengers. As distance travel by rickshaws before and after Metro shows 20-40 km has highest percentage of approximately 54 and 62 percent respectively, Overall percentages show that distance travel by drivers before Metro/Speedo is higher than after Metro/Speedo. Table shows that according to drivers' 50-100 rickshaws and Qing Qis are present along metro route before and after metro as they have highest percentage of responses. Before Metro Graph shows that 41 percent drivers used to pay rickshaw rent from Rs.70-150 before Metro/Speedo while around 71 percent drivers are paying rent from 70-150 Rs. after Metro, it shows rickshaw rent has decreased after Metro according to respondents. Before Metro and Speedo 67% drivers used to work 7-8 hours a day, where as 18% used to work 8-10 hrs. and only 15% worked for 10-12 hrs., but after Metro/Speedo 46% drivers work for 10-12 hrs. ,31% for 8-10 hrs. ,8% for 12-14 hrs. and only 15% work for 7-8 hrs. ,it shows that to earn more drivers have to work more because after metro there income has decreased. Metro and Speedo doesn't affect much on parking fee they almost remained same.

Table 5.4:Mean and Standard deviation of Indicators

Indicators	Before Metro		After Metro	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**
Avg. Income	1241 Rs	270.2	891 Rs	310
Avg. No. of trips/day	20	9.4	14.6	8.03
Estimated Avg. fare /trip	153	38.8	115	24.47

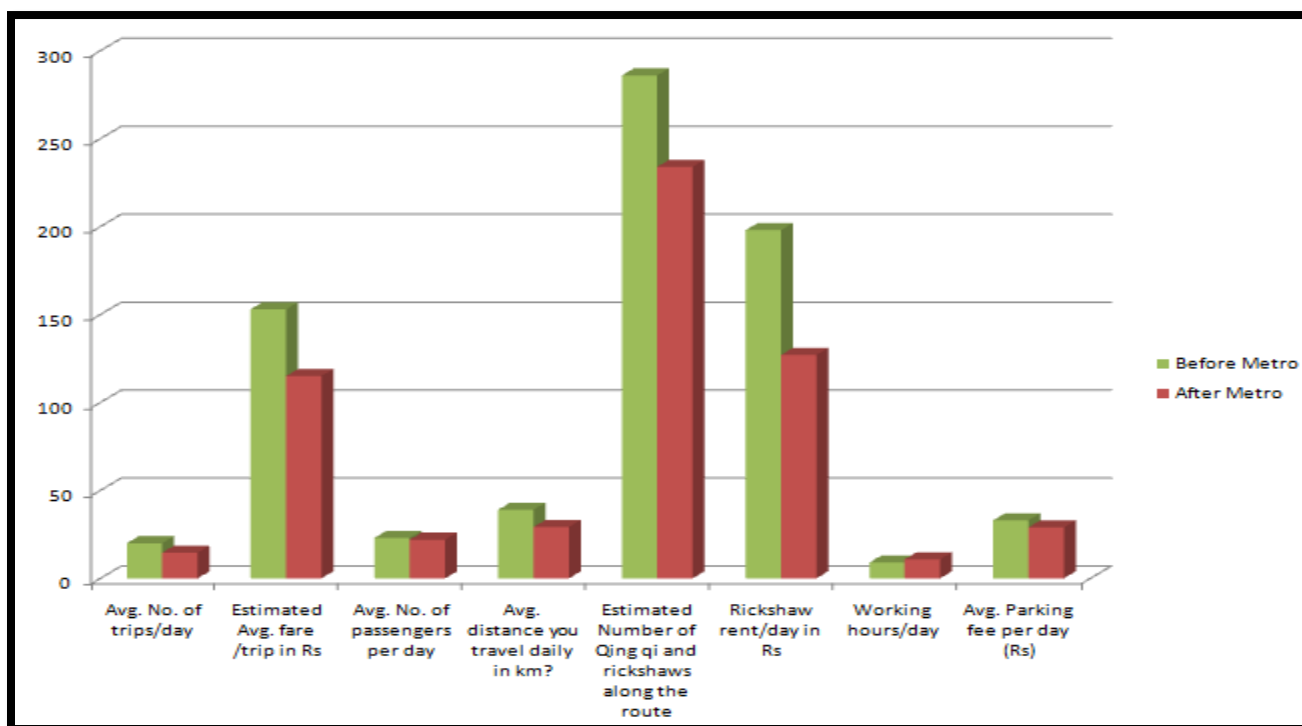|				
Avg. No. of passengers per day	23	11	22.	10.3
Avg. distance you travel daily?	39km	15.1	29.2km	9.2
Estimated Number of Qing qi and rickshaws along the route	286	254	234	279
Rickshaw rent/day	198 Rs	59	127 Rs	49.2
Working hours/day	9 hrs	1.5	10.8 hrs	1.6
Avg. Parking fee per day	33 Rs	22.7	29 Rs	19.7

Figure 5.5:Satisfaction Comparison of indicators before and after Metro

5.5 Satisfaction analysis of drivers before and after Metro and Speedo

Satisfaction indicators

Very satisfied 2. Satisfied 3. Partially satisfied 4. Unsatisfied 5. Very unsatisfied

Drivers' response to all the indicators has been taken and the value with the maximum response has been shown in the table below.

Satisfaction Analysis

Table 5.5:Satisfaction responses of drivers before and after Mass transit buses

Indicators	Before Metro/Speedo	After Metro/Speedo
Income level	2	3
Working hours/day	2	3
Stress level reduction	2	4
Relationship with fellow workers	1	3
Job security	2	4
Number of trips per day	2	3
Number of passengers travelling	1	2
Number of Qing qi and Rickshaws	1	3
Distance you travel daily	2	4
Routes on which you are travelling	2	3

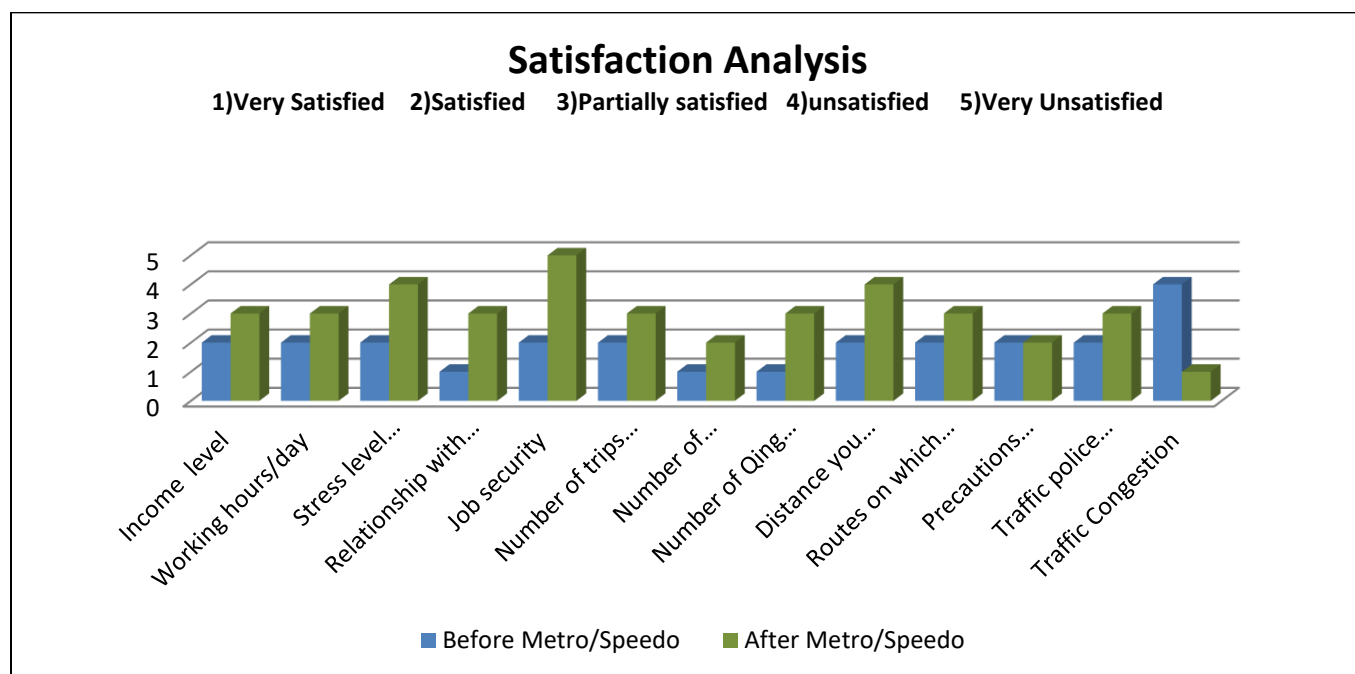|		
Precautions toward traffic accidents reduction	2	2
Traffic police assistance	2	3
Traffic Congestion	4	1

Figure 5.6:Satisfaction Analysis

Before Metro around 58 percent drivers were satisfied with their income level and after metro only 42% showed partial satisfaction. These figures show that income level reduced after Metro/Speedo and drivers are not satisfied with it. Before Metro maximum numbers of drivers was satisfied with the working hours and after Metro 40% are only partially satisfied, it shows that working hours were less before so drivers were happy with the working hours before. Stress

level has increased among drivers after metro/Speedo as they have to earn more, and expenses has also increased due to inflation. Metro/Speedo has raised competition environment among drivers as everyone is struggling to earn more, so this factor has affected their relationship with fellow workers as they were very satisfied with it before metro/Speed and partially satisfied after them. Before Metro 65% drivers were satisfied with their Job security but after Metro around 53% are very unsatisfied with their job security as in many areas LTC has banned Qing Qis or rickshaws so they don't allow them to drive ,this factor has reduced the security of their job .Drivers were more satisfied with the number of trips per day before as compare to after Metro/Speedo. Before metro/Speedo there were a greater number of passengers but after metro many of them switched to BRT so drivers' satisfaction with the ridership has decreased a bit. Drivers were very satisfied with number of rickshaws and Qing Qis before metro as compare to after metro.

As drivers now have to travel more distance to get the passengers so they are not very satisfied with the distance they have to travel after Metro/Speedo. Many routes were prohibited for Qing Qis and rickshaws after Metro/Speedo so they cannot take their vehicle there which had adversely affected the ridership of Qing Qis and rickshaws. Traffic accidents and traffic police assistance remained almost same after BRT so drivers' response to them doesn't vary much but as informed by PMA congestion has decreased after metro and speedo, so drivers are also very satisfied with the traffic congestion after Metro and Speedo.

6   : Conclusions and Recommendations

6.1   Conclusions

Mass Transit buses both Metro and Speedo has a positive impact on public transport riders of

Lahore. They are advanced, modern, comfortable and secure mode of transport. From our survey

it was found that riders are satisfied with the services provided by Metro and Speedo as compare

to LTC. Female riders are quite satisfied with the security provided by them due to which ration

of females to travel alone in public transport has increased which is a very positive impact. These

modern transit buses have increased accessibility and are time efficient and cost effective. Those

that were travelling in rickshaws, motorcycles and cars have switched to Metro and Speedo

which had resulted in decrease in congestion, pollution and transport cost. Due to decongestion,

separate routes and trained drivers there are less traffic accidents of public transport in

comparison to the past. Results show that more development in mass transit services will lead to

sustainable urban commuting in developing countries but recently due to increase in fare of Mass

transit buses, according to PMA there is approximately 20 to 25 percent decrease in ridership.

These mega transit buses especially feeder bus service has adversely affected the business of

LTC buses due to banning of routes along feeder routes many contractors left them, which had

resulted in decrease in number of their buses and ridership also the condition of their buses has

deteriorated and no investment has been made for new buses so there are now very less routes

operated by them.

Informal public transport like rickshaws and Qing Qis also suffered due to Mass transit buses

especially along the routes where they are banned. Our survey had revealed that their daily

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income had decreased, and they had to work more hours to earn adequate amount of money. Government had not provided any incentives for informal transport drivers when they had introduced new modern transit buses.

6.2   Recommendations

Mass transit buses has received a positive response from riders but it is a transport mode which is suitable to youngsters, due to less number of seats it's difficult for the senior citizens to travel in them for long distances, new buses especially for senior citizens should also be introduced. Lahore is a mega city and its area has extended a lot in past years due to introduction of housing schemes in sub urban and peri urban areas so cost efficient public transport service should be provided in these areas to make it easy for people to travel in less cost, some of the private buses are running but no formal public transport is available. The recent increase in fare had decreased the ridership; it should not be increased to that extent because in this way increase in fare will go in vain as profit won't be increase much. Speedo bus card system was introduced for tracking the route pattern, but it was not properly integrated as its first-time payment was high and proper awareness was not provided to riders about it, so when new system is launched it should be cost effective and properly introduced to the riders on how to use it. When a new system is introduced previous ones should also be taken care of, LTC should be provided with the new buses and routes to stable their business and LTC should also maintain its buses and improve the services provided, it was a complaint from the riders of LTC that there was no proper air conditioning in LTC buses.

Rickshaws and Qing qi should work in alignment with the public transport network, because they fill the gaps of public transport by providing service to areas where public transport is not provided. Rules should be made about fare and Proper routes should be assigned to them and proper check and balance on route permits should be established. Government must totally support the informal and formal public transport sectors (private transport companies) by providing well-articulated policies and Transit oriented development should be encouraged which will also promote the idea of sustainable city. Strict actions should be taken to make sure that only company made, and registered rickshaws and Qing Qis are running, and all the drivers of rickshaws and Qing Qis should have valid license. If all these policies will be made and properly implemented than informal public transport will also play a vital role in fulfilling city's travel demand in a sustainable way.

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