EVALUATION OF RAWALPINDI-ISLAMABAD METROBUS SERVICE

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DEDICATED TO

My beloved parents (Abdul Jalil and Fauzia Yasmeen) who gave me a lot of inspiration, courage and supported me for this venture. I am thankful to my wife for boosting up my confidence and believing on my abilities. I also want to pay regards to my advisor who guided and encouraged me to complete this project successfully. I also dedicate my achievement to my Institution which provided me the platform to successfully complete this thesis.

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LIST OF ABBREVATIONS

BRT	-	Bus Rapid Transit
RWP	-	Rawalpindi
ISL	-	Islamabad
OD	-	Origin Destination
SAD	-	Saddar Station
MAR	-	Marrir Chowk Station
LIB	-	Liaquat Bagh Station
CMC	-	Committee Chowk Station
WKR	-	Waris Khan Road Station
CHN	-	Hospital/Chandni Station
REH	-	Rehmanabad Station
6RD	-	6th Road Station
SHM	-	Shamsabad Station
FAZ	-	Faizabad Station
IJP	-	IJP Road Station
POT	-	Potohar Road Station
KHJ	-	Khayaban-e-Johar Road Station
FAF	-	Fayz Ahmed Fayz Station
KSH	-	Kashmir Highway Station
CHH	-	Chaman Highway Station
IBN	-	Ibn-e-Sina Station
KAT	-	Katchery Station

PIM	-	PIMS / Centaurus Station
STE	-	Stock Exchange Station
7AV	-	7th Avenue Station
SHM	-	Shaheed-e-Milat Station
PRG	-	Parade Ground Station
PKS	-	Secretariat Station
UNK	-	Unknown

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ABSTRACT

Evaluating the performance of public transportation systems is deemed essential to facilitate operational improvement thus improving productivity and efficiency of the system. In this research, Evaluation of Rwp-Isl Metrobus Service was conducted by using two distinct approaches. One approach consisted of studying existing performance elements like trip time, trip length, weekly and hourly variation etc while the other approach was to compare Rwp-Isl Metrobus Service with international standards such as "BRT Standard 2016". In the end of this research, economic analysis was also performed and sustainability of the system was also assessed and discussed.

It was concluded that the Rwp-Isl Metrobus Service has improved people accessibility and mobility between the twin cities. Masses have been provided with speedy, cheap, safe, and quality transport to travel. Overall operational performance of Rwp-Isl Metrobus Service was found satisfactory. However it requires minor performance and overall quality enhancements to increase its productivity and utilization. Beside this, the project achieved level of "Bronze BRT" while comparing it with BRT Standard 2016, which is good as compared to Lahore BRT but still a long way to go to compete with the BRT systems around the world. In economic analysis, it was found that at the rate of Rs 20/ trip, Government of Pakistan is bearing losses in millions per year which has made this project a burden on the economy of country.

In the end, it is recommended that Feeder Bus Service should be introduced in twin cities to increase ridership of Rwp-Isl Metrobus Service. Furthermore, it was also concluded that the fare trip should be increased to atleast Rs 31/trip and daily ridership should be increased to 150,000 trips so that slowly and gradually the burden on economy of country can be overcomed.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Modal shares of public transport are on the decline in most developing countries like Pakistan. This is due to lack of availability of alternate mode to travel which has forced many to shift from public transport to personal vehicles such as cars, motorcycles etc. This shift will ultimately lead to increase in traffic congestion, bad effect on economy, increase in environmental pollution thus making the overall situation quite alarming. So living in the life where everyone has shortage of time, transportation authorities all over the world are moving towards speedy, accessible and reliable Mass Transit Systems that will help in overcoming the problems faced by the commuters. This will not only facilitate commuters but it will also help in reducing environmental pollution.

A successful Mass Transit System increases its ridership and discourages the use of private owned vehicles consequently decreasing the congestion on the roads. It provides commuters with speedy, accessible, reliable and safe transportation system. It plays a key role in improving accessibility for all individuals, thereby enhancing social cohesion between people of various classes. It is also beneficial for disabled people and senior citizens by providing them a fully accessible public transport system. But it is necessary that a transportation system must be fully utilized and performing at optimum level to give maximum benefits to its users. In this regard it is necessary that transportation system not only have to be well planned, operated, maintained and marketed but performance evaluation of transportation system must be regularly carried out to keep an eye on the productivity of the system.

Several performance evaluation studies have been conducted around the globe to analyze the performance of Bus/Rail Transit Systems and freight transport systems. These were conducting using different variables and approaches such as multimodal, sustainable, user point of view, performance indicators etc. In developing country like Pakistan, performance evaluations studies on public transport systems at government level are rarely conducted mainly due to absence of concrete policy for public transport system. But in this regard, some studies were conducted by individual researchers of different institute of Pakistan which aimed at analyzing and evaluating the performance of Lahore Bus Rapid Transit System. This includes undergraduate level research on Lahore BRT (Bus Rapid Transit) System which was evaluated using different indicators such as service frequency, product capacity, productivity, safety, utilization and qualitative aspects of service quality. In an another research, Lahore BRT System was compared with international standards such as Bus Rapid Transit System 2014 which is a tool based on international best practices. Lahore BRT was also evaluated using Key performance indicators such as Travel time saving, Service Reliability in terms of Trip Realization, Trip Punctuality, Travel Time Reliability, Schedule Adherence/on time performance etc.

In a nutshell several studies have been performed on Lahore BRT and has provided the framework and methodology to evaluate any public transportation system. But these researches lagged in some areas which are important to fully evaluate any BRT system. Some of the keys gaps/limitations were unavailability of detailed survey data which resulted in assumption based analysis on utilization and productivity of Lahore BRT System which obviously was not reliable and accurate to use. Furthermore, parameters like the average travel time, average distance travelled, comparison between working day boarding and weekday boarding, revenue

generated, average load on system, trips of each bus etc. were not computed by previous researches.

This research aims to study and evaluate operational performance of Rwp-Isl Metrobus Service. It will be aiming to quantify each and every aspect of the operational performance and will cover the limitations and gaps of previous researches on this topic. In this research economic sustainability of Rwp-Isl Metrobus Service will also be assessed to calculate the operating cost of Rwp-Isl Metrobus Service per trip along with various scenario based economic analysis. This will give a brief overview on the economic sustainability of the system. Beside this several performance elements will be taken under consideration which mainly contributes to success of any mass transit system. This success is basically an increase in overall acceptability which results in increased ridership thereby increasing the productivity of system. Reflecting this discussion it can be said that better is system performance, more will be ridership and thus more will be the modal share.

The results obtained by this research can be utilized for overall assessment of Rwp-Isl Metrobus Service. This evaluation can be used to set targets with improved system performance and level of service. Possible deficiencies can be pointed out and steps can be taken to enhance these parameters to improve overall performance of system. Hence, it will not only attract riders but it will increase the modal share as well.

1.2 PROBLEM STATEMENT

By the advent of technological revolutions in world as well, masses are seeking for comfort zones in their lives. This thing is closely associated to their daily traveling and thus selection of the comfortable, efficient and cheap mode is the first preference. In capital city like Islamabad, most of the people prefer to use their own vehicles to travel rather than using public transport. This has increased traffic congestion and environmental pollution. On the other hand,

lower middle class and poor urban class is still on the mercy of public transport system. So an efficient public transport system that can serve maximum number of people with minimum time and cost is the prime need of the day.

Rwp-Isl Metrobus Service which started in mid-2015 is serving large number of people along its route. It has taken off load from local public transport that runs between Rawalpindi and Islamabad and has easen travel of commuters between twin cities. But several questions arise that whether the Rwp-Isl Metrobus Service is operating at its maximum capacity? What is its daily ridership? Can it be improved to increase its ridership? How much efficient it is? What is its actual operating cost per trip?

By keeping these and several other questions in mind, this research will shed some light on these thought provoking questions and will evaluate the performance of Rwp-Isl Metrobus Service.

1.3 RESEARCH OBJECTIVES

The specific objectives of this research on performance evaluation are as follows:

- To quantify and evaluate operational performance of Rwp-Isl Metrobus Service
- To evaluate economic sustainability of Rwp-Isl Metrobus Service
- To compare Rwp-Isl Metrobus Service with international BRT Standards
- To identify gaps and constraints in Rwp-Isl Metrobus Service and present their solutions.

1.4 SCOPE OF RESEARCH

The scope of research is limited to evaluating the existing operational Rwp-Isl Metrobus Service corridor from Saddar, Rawalpindi to Pak Secretariat, and Islamabad on the basis of survey data. It is also limited to only perform operating cost analysis.

1.5 ORGANIZATION OF REPORT

This research thesis consists of five chapters and appendix portion; brief explanation of each part is as per the following:

- Chapter 1: includes a brief but comprehensive introduction and history of public transport in Rawalpindi and Islamabad.
- Chapter 2: describes the literature review on various performance evaluation of Bus Rapid Transit System around the globe
- Chapter 3: explains the research methodology used for achieving the objectives
- Chapter 4: presents the detail of analysis performed on collected data
- Chapter 5: includes the results, conclusions and recommendations for future work.

CHAPTER 2

LITERATURE REVIEW

2.1 HISTORY OF PUBLIC TRANSPORT IN ISLAMABAD

Public transport system in Islamabad started in 1989 when People's Bus Train was started in Karachi, Rawalpindi and Islamabad by Ms. Bhutto's first government. (NTRC 1992). In this project, the National Transport Research Centre (NTRC) designed and developed a Bus Train (prime mover plus three trailers) using old discarded buses to provide high-capacity bus services at peak hours. The Awami Bus Train provided services on main corridor that had sufficient road width. Initially, this project was started in Karachi but after one year of operation, the Bus Train was shifted to Rawalpindi and Islamabad. The Bus Train had, for the first time, introduced an imaginary bus lane on the extreme left of the road. It was estimated that the Bus Train attracted a large number of commuters in Rawalpindi and Islamabad from 1991 to 1993. This service used 45 per cent of its capacity and recovered 68 per cent of its cost from fares in two years of operation (Govt. of Pakistan, NTRC 1996). However, this service was shut down due to lack of interest from the government in providing public transport services.

In 1996, under Prime Minister Benazir Bhutto's Development Programme for big cities, a mass transit project was started in the cities of Rawalpindi and Islamabad. This system was based on a rail-road mixed mode that contained an urban rail link between Rawalpindi and Islamabad connected with feeder coasters (mini buses) in Islamabad. The main objective of this service was to reduce peak-hour traffic congestion, reduce air pollution, and make use of existing railway infrastructure (Govt. of Pakistan, NTRC 1996). Initially, the train service was designed for 6,000-8,000 commuters per day. Therefore, only three train services at the frequency of 1.5 hours in the morning peak and three train services at the frequency of 3 hours

in the afternoon peak were started. However, nearly three months after it became operational, these services were reduced to four train services per day. Finally, this rail-road mass transit system was shut down due to heavy financial losses. The main reasons behind its failure were inadequate service planning, which includes the absence of feeder buses in Rawalpindi; very low frequency; lack of information about time tabling; lack of amenities on railway stations; and relatively higher fares without any time savings. Additionally, this train service caused traffic jams at the level crossing roads in Rawalpindi.

The Varan bus service started on February 23, 2000, with a fleet of 150 buses aimed at providing comfortable travelling facilities to commuters of the twin cities. The initial cost of the venture was estimated to be Rs. 60 crore. It accommodated about 200,000 passengers per day. It routes were perfectly designed and were able to fulfill the daily traveling needs of citizen of Rawalpindi and Islamabad. Unfortunately this bus service was shut down in 2005 due to accidents involving Varan Buses. In 2008, Varan buses were launched again but due to political issues it was completely shut down in 2010.

In Feb 2013, Metro Bus Service or BRTS (Bus Rapid Transit System) was first time introduced in Lahore by Government of Punjab with the objective of providing a quality bus service to the residents of Lahore. Lahore BRT was built as an inspiration for Istanbul, Turkey. It was the first of its kind and it proved to be a successful project and was remarkably accepted by the residents of the city. It has a 27 km long corridor which starts from Gajumata and ends at Shahdara with daily ridership of around 180,000 to 220,000. It was followed up by Rawalpindi-Islamabad Metro bus Service in June, 2015 which is a 22.5 km long corridor that starts from Saddar, Rawalpindi and ends at Pak Secretariat, Islamabad with average daily ridership of 138,000. The third BRT service in Pakistan was Multan Metro Bus Service was started in Jan, 2017 which is an 18 km long dedicated corridor that starts from Bahauddin

Zikriya University and goes upto Kumharanwala Chowk serving 97,000 people daily. These BRTS were introduced to provide speedy, accessible and reliable transportation services to people of different cities of Pakistan. The literature review regarding BRTS and their performance evaluation is discussed below.

2.2 MASS TRANSIT SYSTEM

Mass Transit System is defined as a public transportation system that is designed to carry large number of people from one point to another though use of busses, trains etc. in lesser time. Mass Transit System is further categorized in to Rail Transit and Bus Rapid Transit and these systems are mostly used around the globe.

2.3 BUS RAPID TRANSIT

Diaz et al; (2004) defined Bus Rapid Transit as a mode which is a mean of mass transportation providing a faster service to people as compared to available alternate modes. According to him, BRT generally operates at average operating speed of 50km/hr or more and usually require exclusive right of way. Rapid Transit Services operating on dedicated right of way provide faster transport than those sharing road space with other traffic. It is a flexible system that combines variety of elements such as operational physical system in to a permanently integrated system that provides quality service.

Agarwal P.K et al; (2010) defined Bus Rapid Transit System (BRTS) as a high capacity transport system with a dedicated right of way that is implemented using busses to provide high quality level of service and time saving to people.

Norman Y. Min et al; (2006) stated that Bus Rapid Transit gives communities the best investment when comparing it with output benefits. This Bus Rapid Transit system will better

connect workers to jobs, shoppers to stores in less time and cost and will contribute in rapidly growing economy.

2.4 BUS RAPID TRANSIT BENEFITS

Agarwal P.K et al., 2010 overviews bus rapid transit system and stated that Bus Rapid Transit System (BRTS) is a pioneering, high capacity, lower cost public transport solution that can significantly improve urban mobility. BRTS is generally less costly to build than rail transit and it can be the most cost-effective means of serving a wide variety of urban and suburban environments. BRTS can provide quality performance with enough transport capacity. BRTS system can utilize a wide range of vehicles, from standard buses to specialized vehicles. Furthermore a wide range of ITS technologies can be integrated and built into BRT System to improve BRT System performances in terms of travel times, reliability, convenience, operational efficiency, safety and security. It involves designing a service plan that meets the needs of the population and employment centers in the area and matches the demand for service which is a key step in defining a BRT system. BRTS uses exclusive travel way so that the person minutes saved is more than the person minutes lost by people in automobiles, which means significant saving in travel time.

2.5 PAST RESEARCHES ON EVALUATION OF BRTS:

Hidalgo D. and Pai M. (2010) evaluated by conducting an independent evaluation to contribute with technical arguments and to provide suggestions for the corridor improvement. The authors concluded that the Delhi bus corridor has improved people mobility along the initial stretch, but requires significant improvement in performance, safety and overall quality. The project only comprised major changes in infrastructure but lacked of integrated implementation of service plans, technologies and operations.

Jaiswal A. et al; (2012) studied the impact of Bus Rapid Transit System on Ahmadabad's transport sector and analyzed the various changes that can be brought about by introduction of BRT System in other cities of India. The authors found that BRTS Ahmadabad has improved access for local riders while reducing the environmental impacts of transportation. They also discussed the characteristics of BRT like provision of dedicated lanes, frequency of operation etc.

Velmurugan S. et al. (2012) analyzed the performance of Delhi BRT corridor from Ambedkar Nagar to Moolchand after conducting various surveys like classified volume study at intersections, queue length and saturation flow studies, pedestrian volume count, Occupancy surveys, parking surveys, Speed and Delay studies, Spot speed studies, Opinion Surveys, Fuel consumption studies and Efficacy analysis of allowing other vehicles to ply on the BRT lane on experimental basis. They used parameters like Traffic flow, Passenger flow, Speed, Modal split, User rating of corridor, Road crash scene on BRT corridor etc. to evaluate the performance of corridor. They recommend a quality improvement programme and suggested to improve reliability and comfort. They used parameters like Quality of service, Travel time, Reliability, Comfort and Cost for the evaluation of Delhi BRTS. The corridor infrastructure consist of single median lanes for buses with physical segregation and double platform bus stops located close to the intersections; two lanes for general traffic; and bikeways and sidewalks on the two sides (DIMTS, 2009b). The authors evaluated the bus corridor from the supply side, and then in terms of its performance. The evaluation is qualitative in nature. In supply side evaluation the parameters are running ways, stations, traffic engineering, vehicles, services and ITS. And it is found that Delhi bus corridor still requires several adjustments on the supply side to become a high-end BRT. In performance side evaluation the parameters considered are quality of service,

travel time, reliability, comfort, cost and externalities. Reliability can be improved through physical measures like lane segregation and preferential treatment at intersections.

Chaurasia; (2014) studied the salient features and properties of BRT system with the help of various operational characteristics of BRT. They took a case study of Bhopal BRT system which is passing through the main city and market areas supported by Trunk, Standard, Complimentary and Intermediate Para Transit (IPT) routes. The BRT route is 24 km long with 82 bus stops that connects the various parts of city to sub-urban. Currently around 45,000 passengers using BRT daily and it is expected that the number of users will reach 100,000 in years to come. Therefore, BRT operating agency BCLL is proposes to procure 'Articulated Buses' (two or three buses combined together in length) to overcome the future demands of buses. At last, he is presenting an observational study of Bhopal BRT system to analyse the actual condition and gaps of BRTS. For this purpose he performed a survey on BRTS user towards BRTS and results shows that 100 % positive respond towards BRTS and 73% user travel 5-10 KM.

Gandhi et.al; (2014) on his study "Comparative Evaluation of Alternate Bus Rapid Transit System (BRTS) Planning, Operation and Design Options "explored alternate planning, operational and design options for Bus Rapid Transit Systems. In this study the authors quantified performance results for different indicators for various planning and design configurations are generated using a spreadsheet tool. Sixteen theoretical configurations, two standard designs in varying contexts and two currently operational design variations are compared. His results show that bus operational speeds in open systems are approximately 25% less than those in closed systems. However, high operational speeds do not help offset passenger transfer delays for short trips. Open systems provide higher passenger speeds than closed bus

operations for trip length less than 10km. Restricting peak bus speed to less than 40km/h for safety considerations does not hamper passenger or operational performance.

Hafiz Usman Ahmed and Abdul Azeem in 2014 studied and analyzed various performance characteristics of Metro bus Lahore at undergraduate level. They quantified hours of service including peak hour, frequency of buses, time headway, maximum travel time, accident record, line capacity, productivity, passenger transported per direction, average occupancy, passenger kilometers travelled etc. They also conducted different surveys to know about passenger view regarding this service and worked out evaluation of level of service and service quality. They concluded that Lahore BRT productivity is satisfactory, bus is always reaching its capacity limits, most of the time bus comes on time, safety and security is good and has high reliability. But in the end they stated that due to unavailability of Data, the research on evaluation of performance was based on assumption and might not be accurate.

Rathore and Ali (2015) studied and performed evaluation of Lahore BRTS using BRT Standards 2014. They compared different elements of Lahore BRTS with best international standards and practices to assess the performance of the rapid transit system. In this study they concluded that Lahore BRTS achieved the level of "Basic BRT" and has failed to achieved Gold Silve or Bronze. It is facing serious operational and maintenance issues that may leads towards failure of Lahore BRTS. They also found that deviation from proposed transport policies and not adhering to different transport studies carried out by JICA is one of the factors that lead towards the failure of urban transport system in Lahore.

R. Aziz et al (2015) analyzed Lahore BRT based on operational key performance indicators. They used reliable data from automated data collection system of Punjab Metrobus Authority which lead to concrete results. Their study concluded that the overall situation of bus

operation is quite good but there are some weakness that were observed in areas such as Schedule Adherence, Headway regularity etc.

Rahul D Matariya1 et al. (2017) did a study on Performance Evaluation of Bus Rapid Transit System**.** In this research they have studied analyses the performance of Delhi BRT corridor from Ambedkar Nagar to Moolchand after conducting various surveys like classified volume study at intersections, queue length and saturation flow studies, pedestrian volume count, Occupancy surveys, parking surveys, Speed and Delay studies, Spot speed studies, Opinion Surveys, Fuel consumption studies and Efficacy analysis of allowing other vehicles to ply on the BRT lane on experimental basis. They used parameters like Traffic flow, Passenger flow, Speed, Modal split, User rating of corridor, Road crash scene on BRT corridor etc. to evaluate the performance of corridor. From these results, it was observed that the traffic flows on non-BRT sections carry somewhat comparable traffic flows. Bus passenger load is higher on BRT compared to adjoining non BRT routes. The share of private on BRT is about 80% and catering 45% of passenger share whereas about 78% of privates vehicles catering to 54% share of passengers on non BRT corridor, which clearly indicates that even the lesser percentage share of private vehicles can cater more percentage share than BRT corridor. Even under the mixed traffic conditions, the percentage share of passengers loads are better off on Non-BRT conditions. There is 3% increase in average speed on BRT corridor. The corridor has been rated between ‘average’ to good compared to ‘before’ BRT scenario which was ranging between bad‟ to average‟. The average of maximum queue length is longer during normal BRT operation. The road crash data shows that there is an increase in accidents after the implementation of BRT’s.

2.6 SUMMARY

This chapter gave a brief History of Public Transport in Rawalpindi and Islamabad that started in late 70's. The journey of public transport system in Rwp-Isl started from Awami Bus Train which was followed by Mass Transit (Rail-Road mixed mode) and Varan Bus Service. These services provided good quality services to commuters but unfortunately they could not become successful due to poor transportation policies and lack of interest by government. This chapter then discussed the various definitions of BRT System and studies carried out on performance evaluation of BRT's. Several surveys and evaluation analysis were performed on different BRT's around the globe. Every BRT had different dynamics that were tackled in the suitable way and analysis was performed to assess BRTs productivity. It can be concluded that performance evaluation of BRTS is necessary to monitor the overall productivity of system. The evaluation studies by the researchers helped the competent authority to take necessary steps in enhancing their productivity and utilization. The researchers also pointed out the gaps and suggested solutions to overcome the problems that were the main factor behind lower productivity and utilization.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 GENERAL

This chapter describes the detail methodology adopted for this research study. The research work is carried out in two Phases i.e. Office Study and Field Study. In the Office study, a detailed methodology and approach was developed to meet the research objectives. This included studying literature review on Bus Rapid Transit System, analyzing Google maps, contacting Punjab Masstransit Authority (PMA) and in the end developing methodological and practical approach for moving forward to field study in order to achieve the desired results. After completion of Office Study, Field Study was started to collect primary data which proceeded by conducting different type of surveys like General Survey, OD Survey, Waiting time survey, Ridership survey, Route survey etc. as well as interviews that were conducted from the concerned personnel of Punjab Masstransit Authority. Secondary data was collected from Rwp-Isl Metro Bus Authority which included route information as well as Daily Ridership. Evaluation was carried out by analysis of primary and secondary data as well as from on ground observations.

3.2 RESEARCH METHODOLOGY

The complete research Methodology is explained with the help of flowchart shown in the Figure 3.1. It shows that the research started with the literature review of various performance evaluation studies around the globe. This helped in getting adequate knowledge about different BRTs that are currently operating around the globe. It was followed up by Data Collection Phase in which two types of data was collected i.e. Primary Data and Secondary

Data. Primary Data was collected directly from field by conducting different types of surveys while secondary data was collected from Punjab Mass Transit Authority

In the next step, raw data was converted in to useful information and evaluation was performed by detailed statistical analysis as well as by comparing operational parameters with BRT Standard 2016. In the end results of analysis is discussed and conclusions are drawn along with some recommendations.

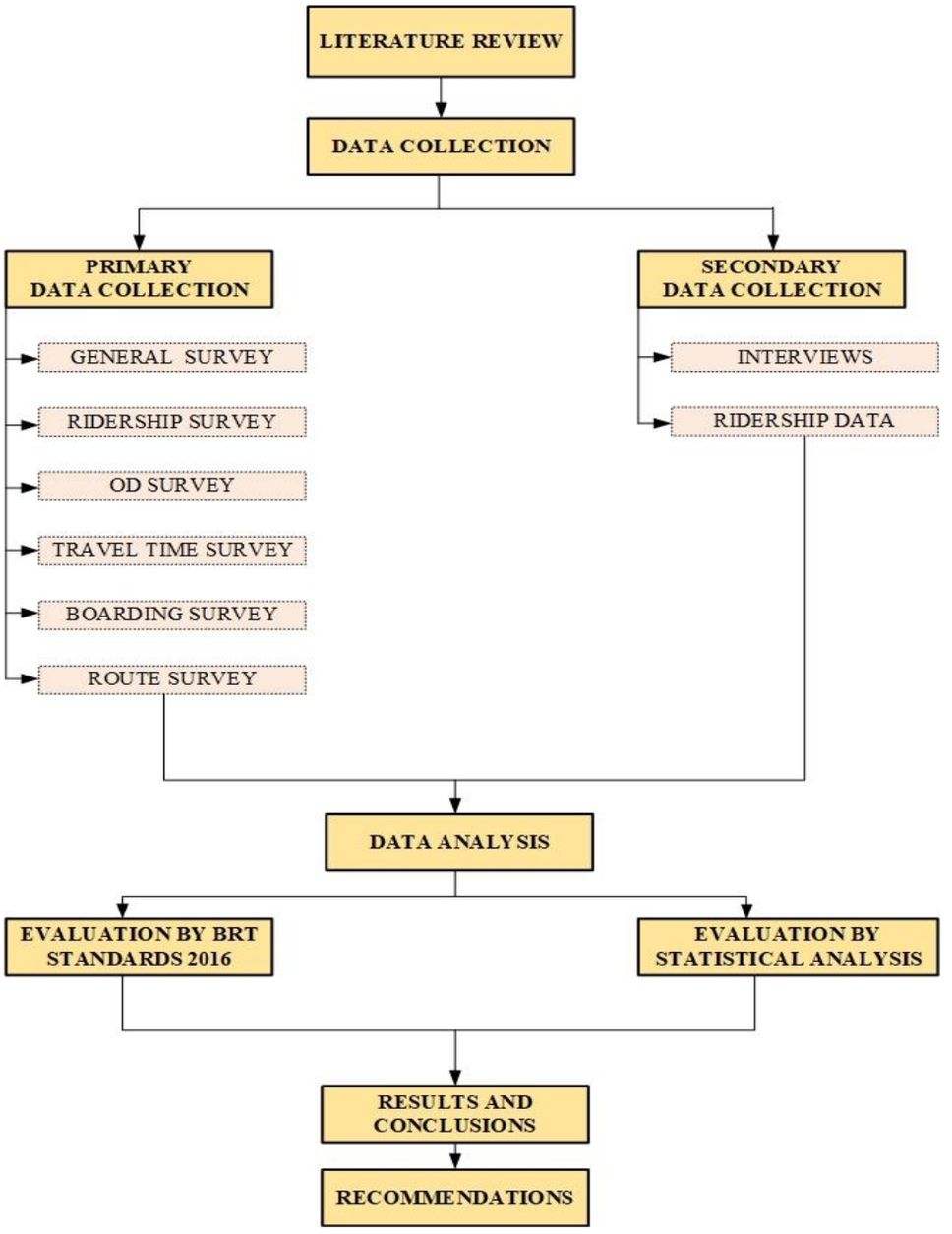

Figure 3.1: Research Plan

3.3 OFFICE STUDY

This phase of research started by performing detailed study of project so that the scope, and the methodology used to achieve the specified objectives can be defined. This was accomplished by doing a complete and thorough study of the literature that was available around the globe. Following few lines will shed some light on the information collected through Office Study.

Rwp-Isl Metrobus Service is Bus Rapid Transit service that is provided to residents of twin cities of Rawalpindi and Islamabad. It starts from Flashman Hotel, Saddar and ends at Pak Secretariat, Islamabad. Currently there is only one route which is 22.5 km long but two future extension of this route is being planned which will connect the main route. The one proposed route will start from Peshawar More and will end at New Islamabad Airport and is currently under construction since May, 2017 and is expected to be completed by March, 2018. The other proposed route will start from Faizabad and will go up to Rawat and till now, no work has been started whatsoever. For the analysis purpose, this research will only focus on the existing route that starts from Saddar, Rawalpindi and ends at Pak Secretariat, Islamabad. It is a 22.5 km dedicated corridor with 24 stations along its route. It has fleet of 64 busses and has a capacity of serving 150,000 passengers daily.

3.4 DATA COLLECTION :

By acquiring and gathering required information about the Rwp-Isl Metrobus Service and after development of detailed methodological approach to perform the field study, the next step was data collection phase which involved conducting different types of surveys for analysis purposes. This involved field work that included several PMA Office visits and field surveys. PMA Office visits were conducted to scratch out the secondary data required for the research

and primary data was collected through field surveys that will ultimately form the basis of evaluation of system performance of Rwp-Isl Metrobus Service. Beside this data collection, reference of previous performance evaluation studies was also considered to set the right direction of the study.

A survey team visited Metrobus Stations and conducted surveys on specific days and time. Surveyors boarded form starting node of the route counting the number of passengers boarding and leaving on each stop, trip length, travel time, origin and destination etc. The process was repeated for all the trips made by bus during different days. Data was then extrapolated to obtain the result of analysis. List of survey is shown below

- General Survey:
- Route Survey
    - Frequency Survey
    - Time Headway Survey
- Origin Destination Survey/Ridership Survey
- Travel Time Survey
- Travel Length Survey
- Hourly Load Survey
- Average Load per Bus Survey

As far as system performance is concerned, constraints that define system performance is obtained primarily from observations at stations and buses and secondarily from Punjab Masstransit Authority. Data is analyzed simple equations and bar charts.

3.5 DATA ANALYSIS PHASE

This portion includes the analysis of collected primary and secondary data. This included analyzing average daily ridership, travel time, trip length, average load on bus, weekly and hourly variation as well as economic sustainability of the project. It also included comparison of Rwp-Isl Metrobus Service with international standards such as “BRT Standard 2016. In the end gaps and constraints in the existing transportation system were identified and their solutions were proposed. Recommendations and suggestions that will be fruitful for Punjab Masstransit Authority in improving the productivity of the system are also given at the end of this report.

3.6 SUMMARY:

This chapter described the methodology adopted for this research work. The first part of this chapter explained the office study where preliminary information was gathered to successfully achieve the required objective. The second part of chapter was followed by data collection phase in which several surveys were conducted in the month of March, 2017. In the end of chapter, analysis on the collected data is presented.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter describes the results of primary data collected through different surveys conducted in the field as well as secondary data collected from Punjab Masstransit Authority.

4.1 GENERAL CHARACTERISTICS

A General Survey was conducted throughout the route of Rwp-Isl Metrobus Service to get general information about the number of stations, busses fleet size, types of route, journey time etc. This survey showed that Rwp-Isl Metrobus Service has 22.5 km long dedicated corridor that uses fleet of 64 busses to serve an average of nearly 138,000 passenger per day. The service timings are from 6:00 am to 10:00 pm (16 hours) for 7 days a week. Its type of operation is Headway based. Its maximum speed is 45 Km/hr (±10%) in elevated sections & 50 Km/hr (±10%) at Grade Section. Its journey time from Saddar, Rawalpindi to Pak Secretariat, Islamabad is approximately 48 minutes 44 seconds. It has total number of 64 busses that are being operated on five routes. Its minimum dwell time is 15 seconds and maximum dwell time can be 30 seconds subject to passenger safety. Headway between busses is 3 minutes in peak time and 5-7 mins at off peak time. Detail results of this survey is given in Table 4.1.

Table 4.1: General Characteristics of Rwp-Isl Metro Bus Service

Operational On	4th June, 2015
Operating Days	7 Days a week
Timing of Service	6:00 am to 10:00 pm (16 hours)
Transit Type	Bus Rapid Transit

-Continued-

Type of Operation	Headway Based
Number of Corridor	1
Length of Route	22.5 km (8.6 km in Rwp and 13.9 km in Isl)
No of Stations	24 (10 in Rwp and 14 in Isl)
Fleet Size	64 busses
Journey Time	48 Minutes 44 Seconds
Stoppage	Every Bus Station Along The Defined Route
Maximum Speed at Grade Section	50 km/h (±10 %)
Maximum Speed at Elevated Section	45km/h (±10 %)
Maximum Dwell Time	15 seconds
Minimum Dwell Time	30 seconds subject to passenger safety
Line Capacity	4000 passengers per hour per direction
Cost of Project	Rs 44 Billion
Cost of Project (City wise)	Rs 19.47 Billion in Rwp and Rs 24.84 Billion in Isl
Construction Cost/km	Rs 1.96 Billion per km

4.6.1 OPERATIONAL ROUTES:

Route survey was conducted to get information about the number of sub-routes that are operated by Punjab Masstransit Authority at different times of day. These routes are developed and designed according to daily passenger demand during different time of the day. Data was collected for starting and ending point of route, journey time of route, no of trips taken by each route with respect to time, Headway between busses etc. Route surveys were further extended to calculate Frequency and Time Headway.

Frequency is defined as “number of vehicles per hour”. The purpose of frequency survey is to determine the number of vehicle buses operating on a particular route while Time Headway is the measurement of time between the passing vehicle and approaching vehicle in a system. The method for determining the headway was by using stopwatch. Marrir Station was fixed from Saddar Side and Parade Ground Station was fixed from Pak Secretariat Side. In these station the incoming traffic was observed and time was noted down between two consecutive buses.

By the route survey it was concluded that Rwp-Isl Metrobus Service is currently operating five routes along its main corridor. Details of each route is given below

4.6.2 ROUTE 1:

Route 1 starts from Kashmir Highway and ends at Pak Secretariat as shown in following figure 4.1

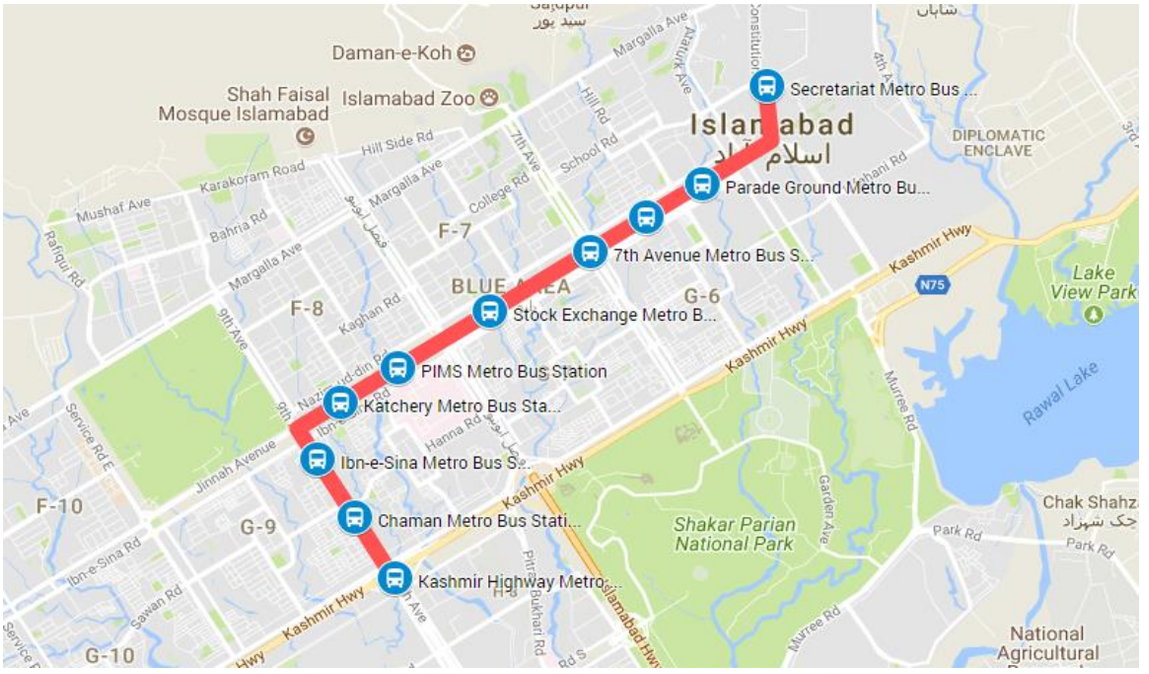

Figure 4.1: Route 1 (Kashmir Highway Station to Pak Secretariat Station)

For the whole week this route starts its service at 6:00 am and ends at 6:42 am. It performs 13 trips with a headway of 3 mins and 30 seconds between each bus on working days

and performs 6 trips with a headway of 8 mins between each bus on weekends. Table 4.2 explains the operational characteristics of this route.

Table 4.2: Operational Characteristics of Route 1

Route No	1
Route Starting Point Route Ending Point	Kashmir Highway Station Pak Secretariat Station
Route Type	Forward
Route Start Time	6:00 am
Route End Time	6:42 am
Journey Time	20 mins 38 seconds
Route Length	9 kms
Working days (Mon-Fri)	
No of Busses in use/day	13
No of Trips/day	13
Time Headway	3 minute 30 seconds
Weekends (Sat-Sun)	
No of Busses in use/day	6
No of Trips/day	6
Time Headway	8 minutes

4.6.3 ROUTE 2:

Route 2 starts from Faiz Ahmad Faiz Station to Saddar as shown figure 4.2. This route starts its service at 6:00 am and ends at 6:33 am and is operated throughout the week.

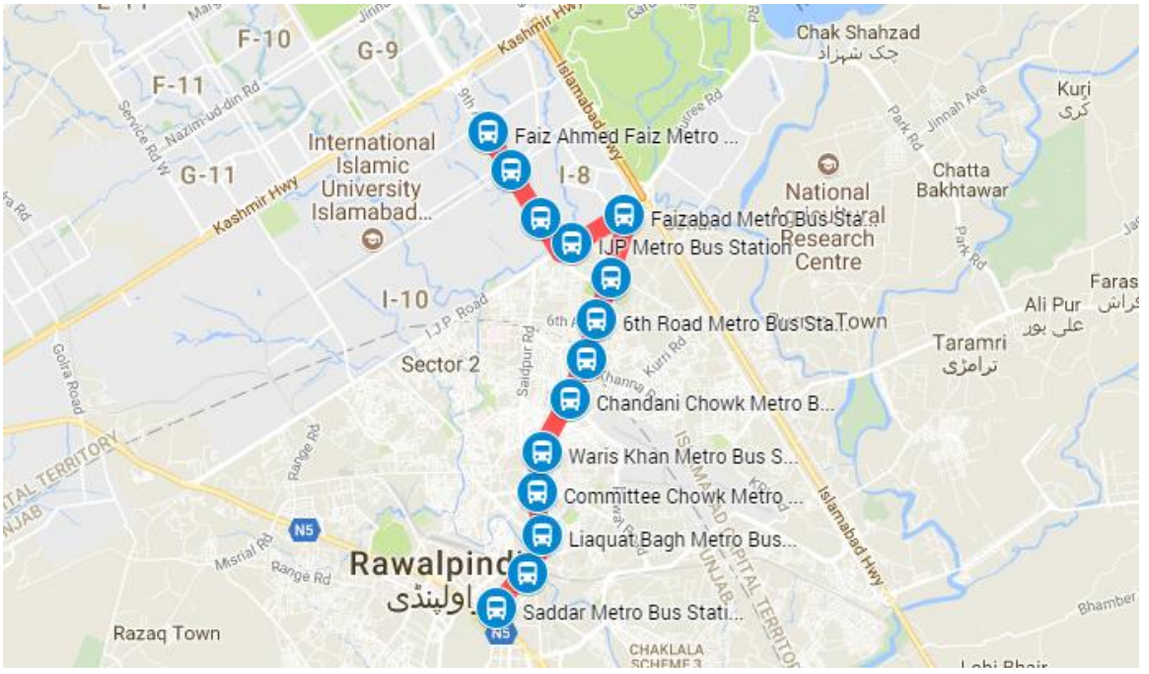

Figure 4.2: Route 2 (Faiz Ahmad Faiz Station to Saddar Station)

It performs 12 trips with a headway of 3 mins and 30 seconds between each bus on working days and performs 6 trips with a headway of 8 mins between each bus on weekends. Table 4.3 explains the route operational characteristics of Route 2.

Table 4.3: Operational Characteristics of Route 2

Route No	2
Route Starting Point Route Ending Point	Faiz Ahmad Faiz Saddar
Route Type	Backward
Route Start Time	6:00 am
Route End Time	6:33 am
Journey Time	28 mins

-Continued-

Route Length	12.5 kms
Working days (Mon-Fri)	
No of Busses in use/day	12
No of Trips/day	12
Headway	3 minute
Weekends (Sat-Sun)	
No of Busses in use/day	6
No of Trips/day	6
Headway	6 minutes

4.6.4 ROUTE 3

Route 3 starts from Saddar Station and ends at Pak Secretariat as shown in figure 4.3.

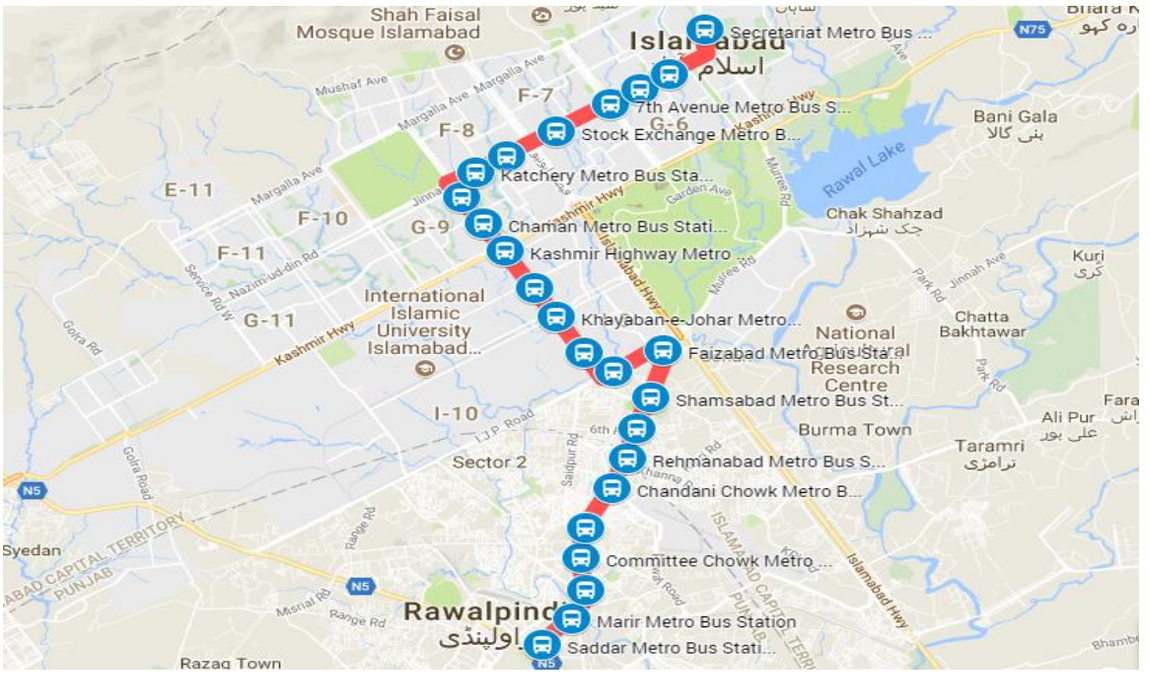

Figure 4.3: Route 3 (Saddar Station to Pak Secretariat Station)

For the whole week this route starts its service at 6:15 am and ends at 10:00 pm. It performs 625 trips with a minimum headway of 2 mins and 45 seconds between each bus on working days and performs 1081 trips with a minimum headway of 2 mins and 45 seconds between each trip on weekends (Sat-Sun). Table 4.4 explains the route operational characteristics.

Table 4.4: Operational Characteristics of Route 3

Route No	3
Route Starting Point Route Ending Point	Saddar Pak Secretariat
Route Type	Forward and Backward
Route Start Time	6:15 am
Route End Time	10:00 pm
Journey Time	57 mins
Route Length	22.5 kms
Working days (Mon-Fri)	
No of Busses in use/day	42
No of Trips/day	625
Time Headway	2 min and 45 seconds
Weekends (Sat-Sun)	
No of Busses in use/day	40
No of Trips/day	553 for Saturday & 528 for Sunday
Time Headway	6 minutes

4.6.5 ROUTE 4

Route 4 starts from Liaquat Bagh Station and ends at Pak Secretariat Station as shown in the figure 4.4.

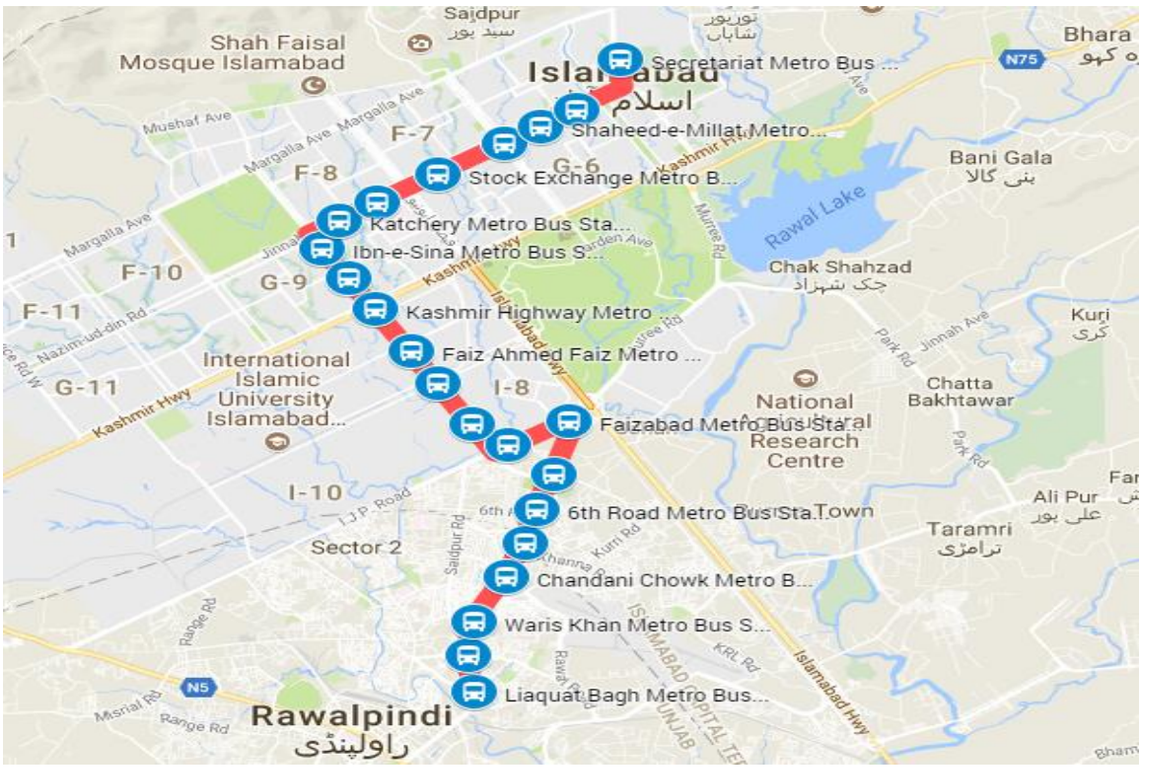

Figure 4.4: Route 4 (Liaquat Bagh Station to Pak Secretariat Station)

For the whole week this route starts its service at 7:15 am and ends at 9:36 pm. It performs 18 trips with a headway of 8 mins 15 seconds between each bus on working days. This route is not operated on weekends. It has a journey time of 45 mins. Table 4.5 explains the route operational characteristics.

Table 4.5: Operational Characteristics of Route 4

Route No	4
Route Starting Point	Liaquat Bagh

-Continued-

Route Ending Point	Pak Secretariat
Route Start Time	7:16 am
Route End Time	9:36 am
Journey Time	45 mins
Route Length	20.5 kms
Working days (Mon-Fri)	
No of Busses	18
No of Trips	18
Time Headway	8 minute 15 seconds

4.6.6 ROUTE 5

Route 5 starts from PIMS Station and ends at Saddar Station as shown in the figure 4.5

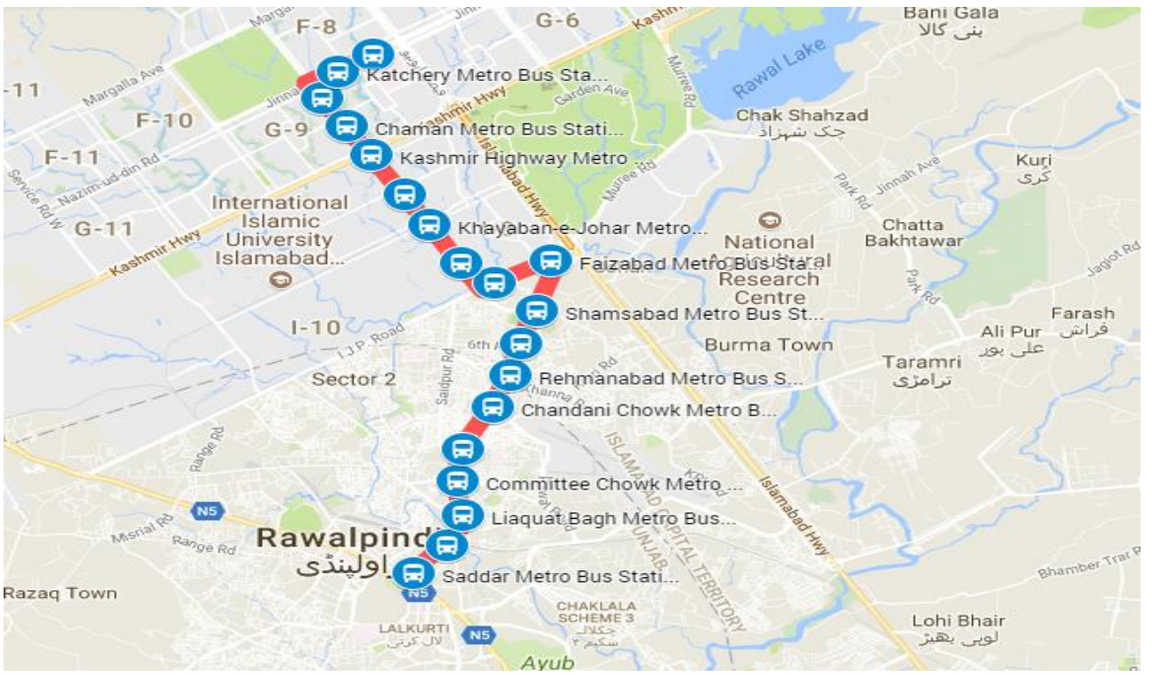

Figure 4.5: Route 5 (PIMS Station to Saddar Station)

For the whole week this route starts its service at 3:20 pm and ends at 5:40 pm. It performs 18 trips with a headway of 8 mins 15 seconds between each bus on working days. This route is not operated on weekends. Table 4.6 explains the route operational characteristics.

Table 4.6: Operational Characteristics of Route 5

Route No	5
Route Starting Point Route Ending Point	PIMS Saddar
Route Start Time	3:20 pm
Route End Time	5:40 pm
Journey Time	36 mins
Route Length	17 kms
Working days (Mon-Fri)	
No of Busses in use/day	18
No of Trips	18
Time Headway	8 minute 15 seconds

4.6.7 Line Capacity

The line capacity of bus represents the capacity of system under specific operational parameters like time, frequency, capacity of bus etc. In calculating line capacity, the bus overloading with design capacity was taken as 192 passengers. The peak hour frequency was taken as 21 trips per hour and off peak hour frequency was taken as 12 trips per hour. So by calculating line capacity of Rwp-Isl Metrobus Service, we get the following results.

Line Capacity = Frequency x Bus Capacity

Line Capacity (Peak Hour) = 4032 passengers/hr/direction

Line Capacity (Off Peak) = 2304 passengers/hr/direction

In Rwp-Isl MetroBus-Facts and Perspectives, an article published by Punjab Masstransit Authority on their website, it is stated that PMBS has a designed capacity of 24,480 passengers per hour per direction and its current demand is 4000 which is approximately the same as calculated by analysis of field data in this research.

4.2 ORIGIN DESTINATION SURVEY

The Origin Destination (OD) Survey was conducted to get information about the number of people travelling from one station to another. It was carried out by travelling on a sample of buses on each route. In this survey, surveyors boarded from starting node of the route and started counting number of passengers boarding and leaving on each bus station. By combining all this data, it gave information that how many people are travelling from station to station during the whole day.

The OD Survey was carried out for fifteen days and OD matrixes are attached in Appendix A. The analysis was divided in two portions based on working days which starts from Monday and ends at Friday while weekend starts from Saturday and ends at Sunday. This was done in order to understand travel pattern on working days as well as on weekends.

4.2.1 AVERAGE DAILY RIDERSHIP/BOARDINGS

Data collected from OD Survey was transformed in to OD matrix. These matrix were then combined to calculate average daily boarding on working days from different stations. The following bar chart in Figure 4.6 was obtained from data of OD Matrix.

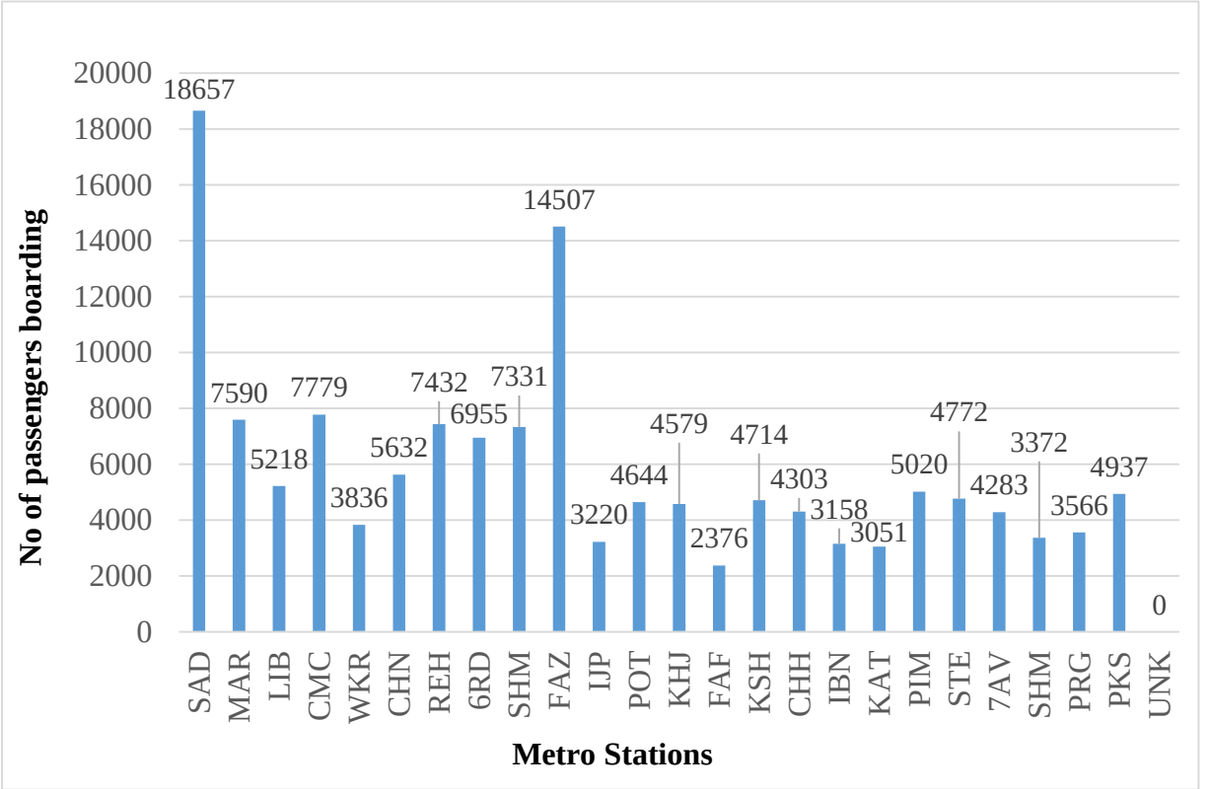

Figure 4.6: Average Daily Ridership of Stations (Mon-Fri)

In Fig 4.6, a bar chart is shown which indicates average daily ridership of different stations during working days (Mon-Fri). By visual analysis, two distinct peaks can be seen that gives the clear picture of travel pattern in twin cities of Rawalpindi and Islamabad. The highest peak can be seen at Saddar Station which shows that maximum number of people start their journey from Saddar Station. As Saddar is the Central Business District of Rawalpindi and number of people travel daily from Saddar Station to other stations for various purposes which mostly include work trips and educational trips that's why it shows the highest peak among all.

The second highest peak is seen at Faizabad Station which is located in vicinity of terminals of various intracity buses. So people travelling to and from other cities use Rwp-Isl Metrobus Service to travel within twin cities of Islamabad. Moreover Faizabad Station is also a junction of Rawalpindi and Islamabad that's why it attracts commuters to use this cheap and quality public transport service for travelling. Furthermore, while comparing Rawalpindi

Boardings and Islamabad Boardings, it was observed that number of people boarding from Rawalpindi are more as compared to people boarding from Islamabad. This is because most of Islamabad residents usually prefer to use their personal vehicle to travel rather than using public transport. That's why lower boarding from Islamabad is observed. The Average Daily Ridership for working day (Mon-Fri) is around 150,000.

Similar analysis was performed on OD matrix for weekends (Sat-Sun) to calculate average daily ridership of different stations on weekends.

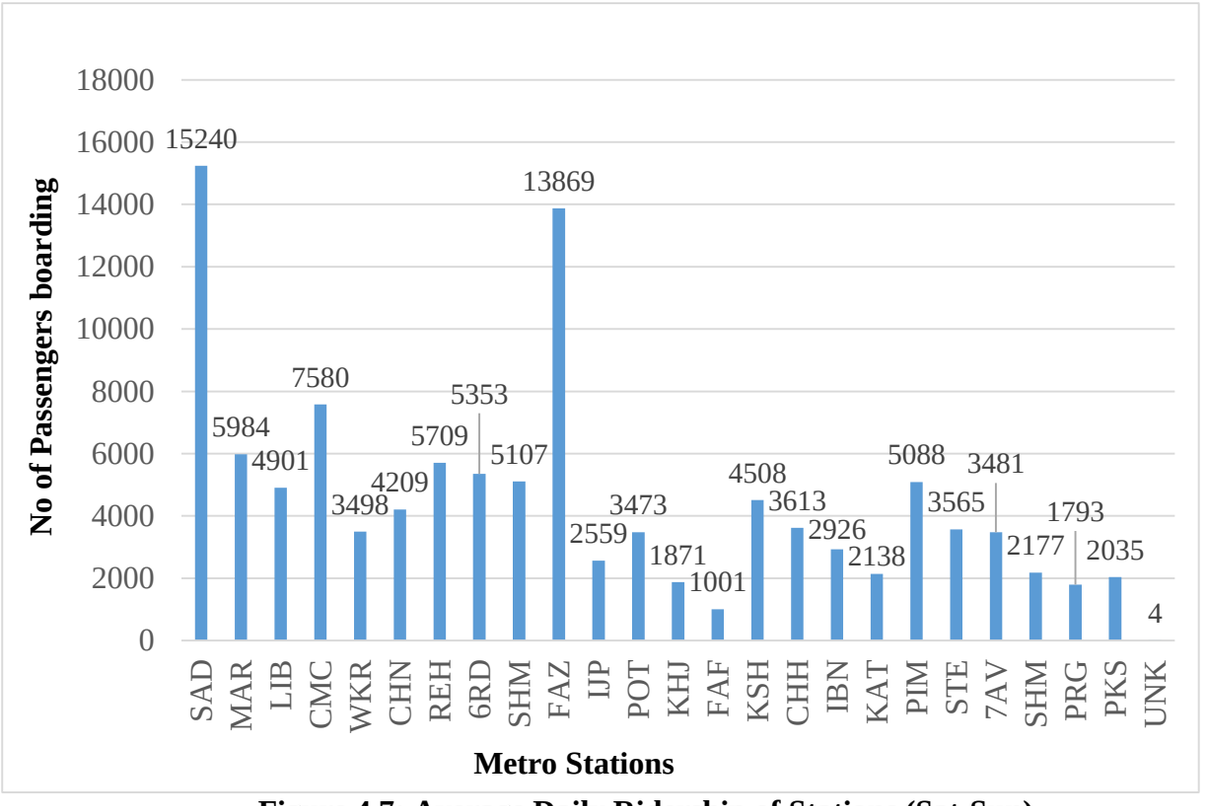

Figure 4.7: Average Daily Ridership of Stations (Sat-Sun)

In Fig 4.7 a bar chart is shown which indicate average daily boarding of different stations during weekends (Sat-Sun). It has two distinct peaks that are notable. The highest peak is still at Saddar Station which shows that maximum number of people start their journey from Saddar Station. The reason is same that Saddar is the Central Business District of Rawalpindi and many people travel on weekends from Saddar Station to other stations for shopping and other

purposes. It also shows that regardless of working days and weekends, Saddar Station is always the busiest station. Similar to what was observed in working day boardings, the next highest peak is seen at Faizabad Station. The reasons is same that Faizabad has numerous intracity bus stations that are used by people travelling to different cities.

To better understand the travel pattern on working day and weekdays, a comparison is drawn in Fig 4.8 between the average boarding of two time periods i.e. Working days and Weekend

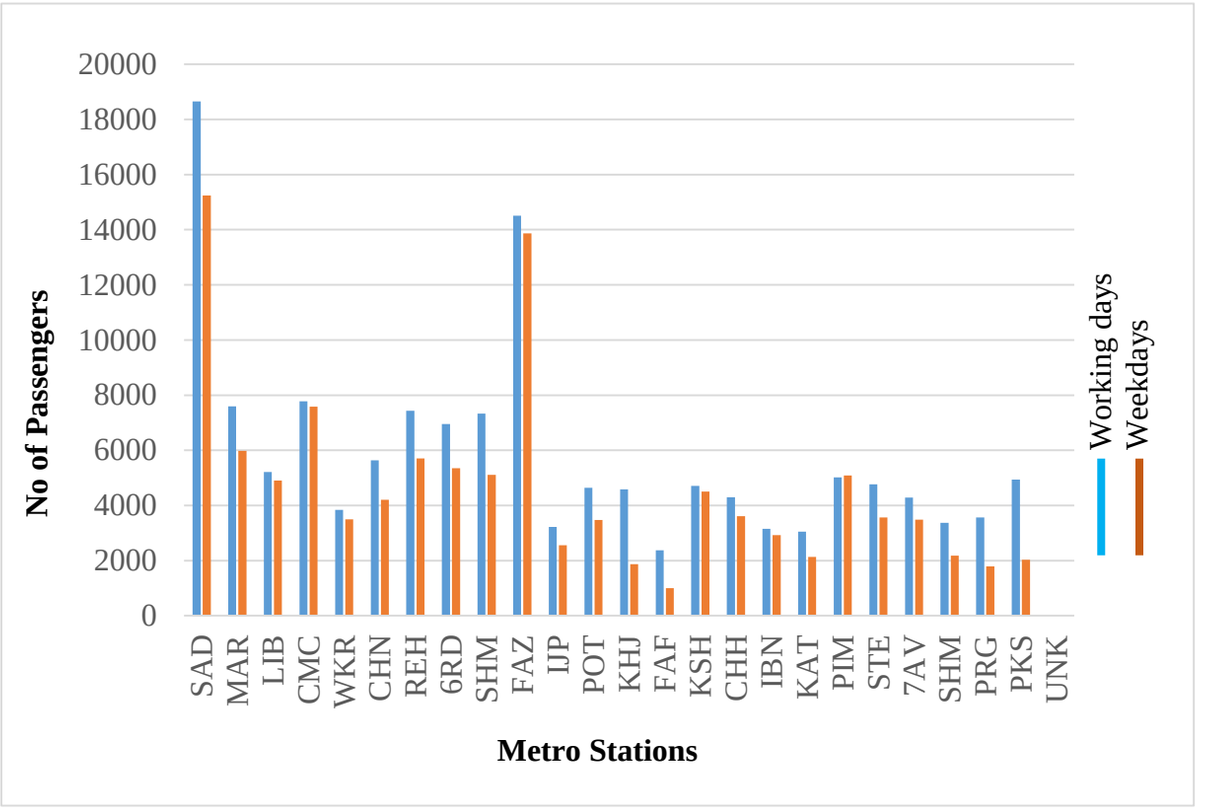

Figure: 4.8 Comparison of Stations Daily Ridership

This comparison shows the clear picture of the travel pattern of the twin cities. Almost similar pattern is observed between average ridership of working days and weekends. The only difference is the reduction in daily ridership from 149,932 to 111,682 which is due to change in travel pattern of people. In working days, travelling pattern is work/job oriented while in weekends travelling pattern changes to shopping etc. For instance if we compare average daily

ridership of Pak Secretariat Station between Working day and Weekday, we can clearly see that high peaks are observed on working day and low peaks are observed on weekends. These high peaks on working day is due to the travelling of people to Secretariat for their job while low peak is observed on weekends because Secretariat is closed on Saturday and Sunday. Furthermore there is nothing much reduction in ridership at Faizabad station on weekend. This is due to the fact that at Faizabad, intracity bus station remains functional throughout the week.

4.2.2 TRIP DISTRIBUTION

Trip Distribution means that how trips are distributed between the twin cities. The distribution of daily trips on working days is shown in Table 4.7 and pie chart showing percentage wise trip distribution is show in Fig 4.9

Table 4.7: Distribution of Trips on Working days (Mon-Fri)

Description	**Average Daily Trips**	**Percentage**
Trip within Rawalpindi	57,494	38%
Trips within Islamabad	25,488	17%
Trips between Rawalpindi and Islamabad	67,469	45%
Incomplete Trips	298	~0%
Total Trips	149,932	100%

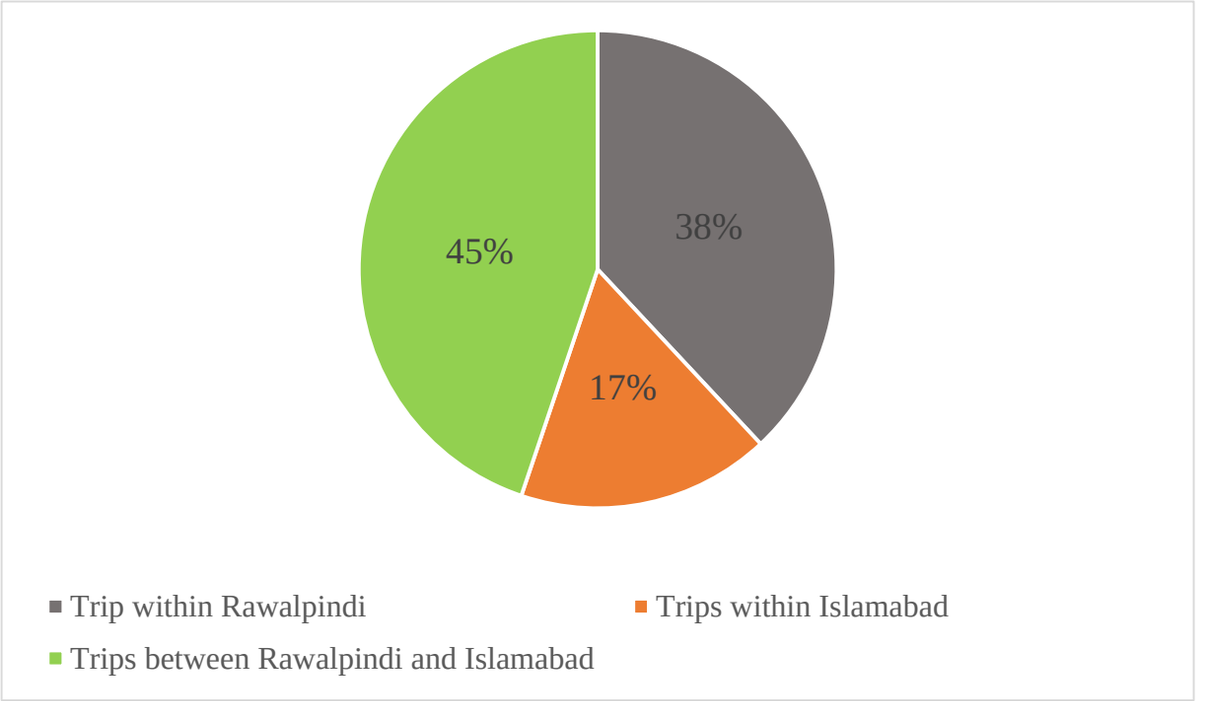

Figure 4.9: Distribution of Trips on Working days (Mon-Fri)

Fig 4.9 shows that 45% of people travel between Rawalpindi and Islamabad. This implies that large number of people travel between the two cities for various purposes. Beside this, the Rawalpindi area is congested and one experiences a lot of traffic jam while travelling between the twin cities. This traffic jam increases travel cost as well as journey time. So to avoid this problem, people usually prefer to travel on Rwp-Isl Metrobus Service between the twin cities to save cost and time. Fig 4.9 also shows that 38% of people travel within Rawalpindi while only 17% of people travel within Islamabad. The higher percentage of trips within Rawalpindi is because the Rwp-Isl Metrobus Service corridor that falls in Rawalpindi is along the busiest area with alot of shops, schools, hospitals, university surrounding it. Secondly the population around the Rwp-Isl Metrobus Service route of Rawalpindi is from poor to Middle Class. So they usually prefer to save time and money by travelling in Rwp-Isl Metrobus Service. On the other hand in Islamabad which has less than half percentage of trips than Rawalpindi is due to reason that in Islamabad, most of the population is Upper Middle Class to High Class.

The people of these Classes usually prefer to travel in their own personal vehicle rather than travelling using Rwp-Isl Metrobus Service.

Similarly the distribution of daily trips on weekends is shown in Table 4.8 and pie chart showing percentage wise trip distribution is show in Fig 4.10

Table 4.8: Distribution of Trips on Weekends (Sat-Sun)

Description	**Average Daily Trips**	**Percentage**
Trip within Rawalpindi	46,632	42%
Trips within Islamabad	15,313	14%
Trips between Rawalpindi and Islamabad	49,429	44%
Incomplete Trips	308	~0%
Total Trips	111,682	100

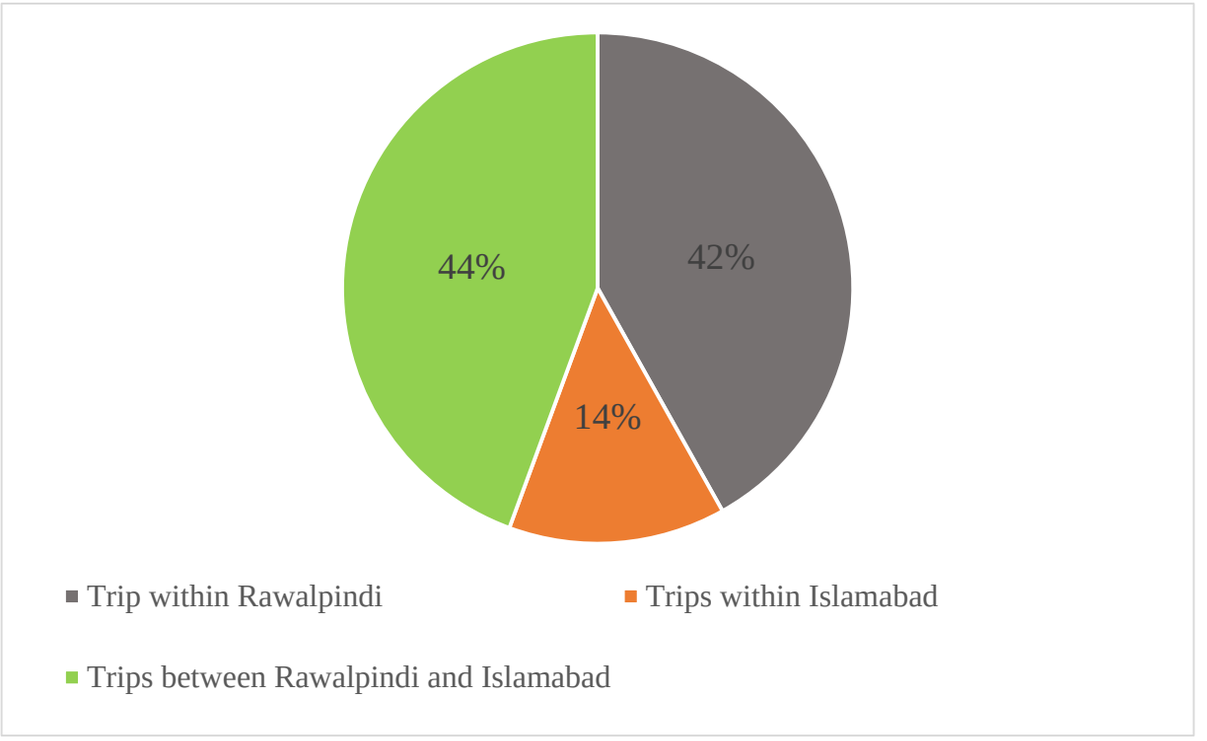

Figure 4.10: Distribution of Trips on Weekends (Sat-Sun)

Fig 4.10 shows that 44% of people travel between Rawalpindi and Islamabad while 42% of people travel within Rawalpindi and only 14% of people travel within Islamabad. The reason of the distribution of trips is same as stated above in case of working day analysis. The difference here is only trip type. On working days (Mon-Fri), mostly work trips are performed while on weekends mostly shopping trips are performed.

To better understand the trip distributions on working day and weekends, a comparison is drawn in Fig 4.11.

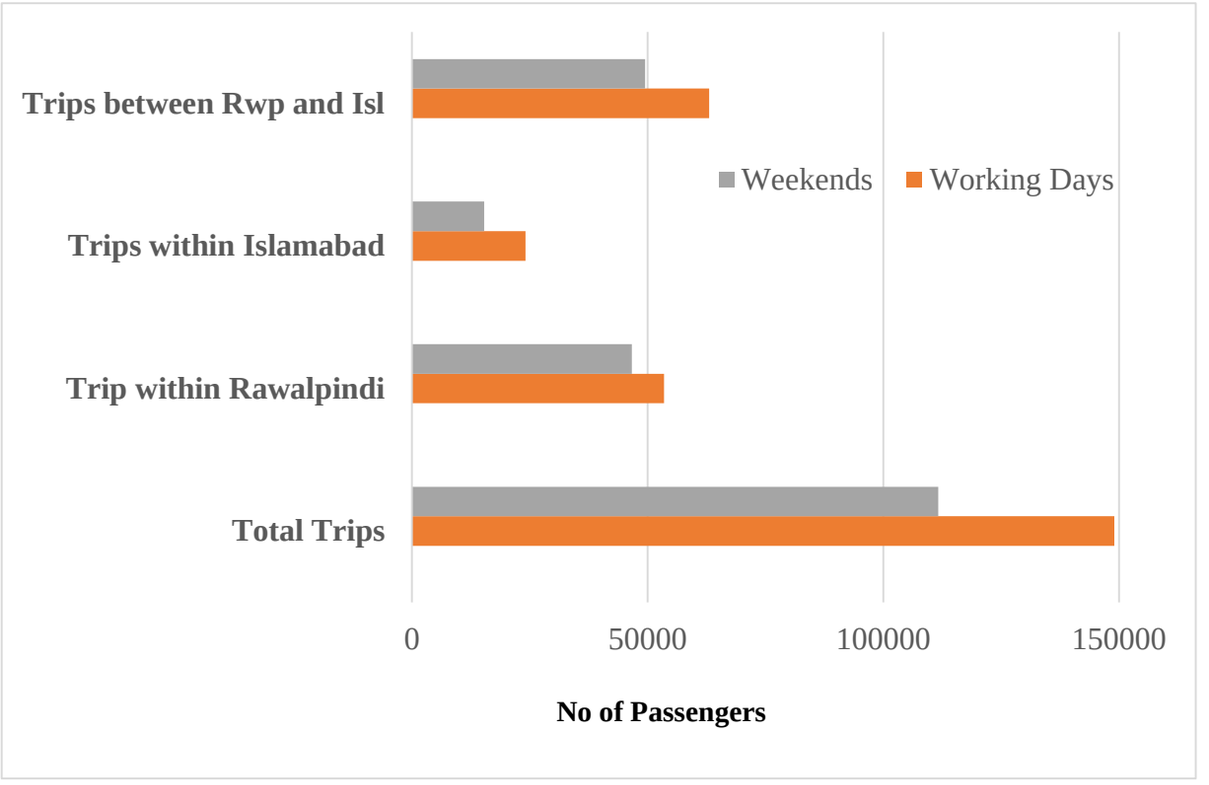

Figure 4.11: Comparison of Daily Ridership (Working days and Weekends)

From Fig 4.11, it can be concluded that maximum number of people travel between Rawalpindi and Islamabad. It also shows that number of people travelling on working days is always greater than people travelling on weekends.

4.2.3 WEEKLY VARIATION OF TRIPS

Weekly variation of daily trips shows how daily ridership vary throughout the week. Fig 4.12 shows a bar chart of the weekly variation of daily trips.

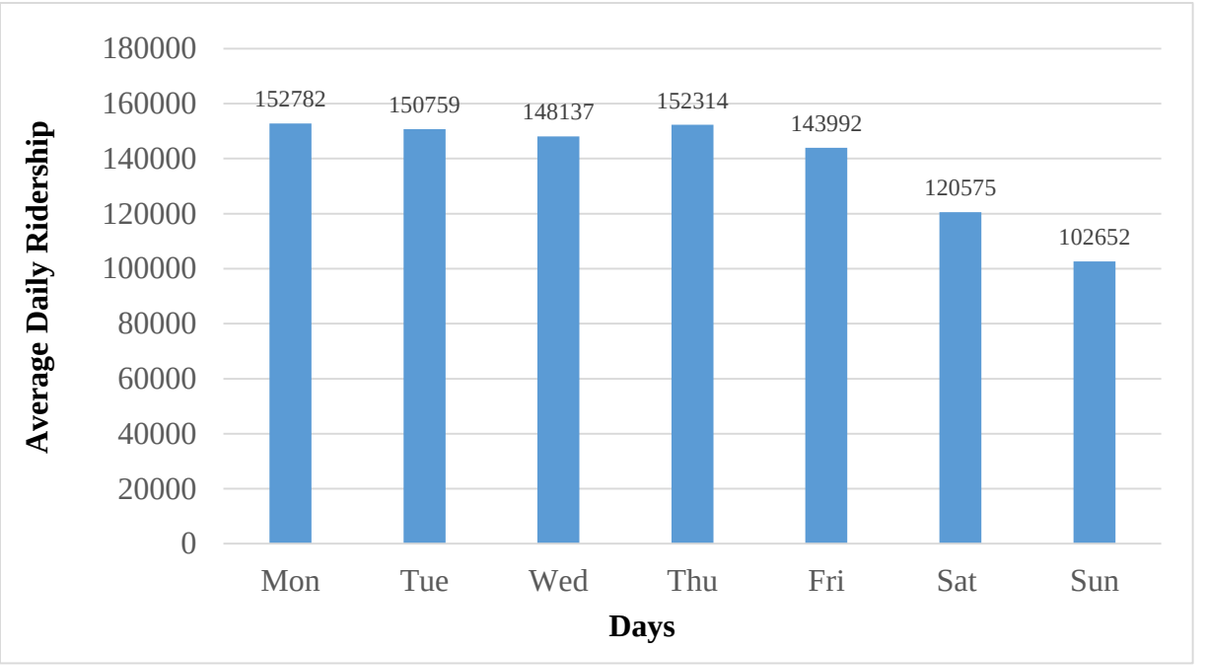

Figure 4.12: Weekly Variation of Daily Ridership

This bar chart in Fig 4.12 shows that Monday has the highest ridership as it is the first working day of the week and the average daily ridership of Rwp-Isl Metrobus Service remains approximately the same throughout the week but it starts to go down on weekends. It decreases to around 20%-30% from daily ridership of working days. The decrease of ridership on Saturday is because government institutes are mostly closed on Saturday however educational institutes and private companies/firms are open on Saturday. The further decrease in daily ridership on Sunday is due to the fact that every office/institute is closed on Sunday, so least ridership is observed on Sunday.

4.2.4 HOURLY VARIATION OF TRIPS

Hourly variation of daily trips shows how trips vary throughout the day. Fig 4.13 shows a bar chart of the hourly variation of daily trips.

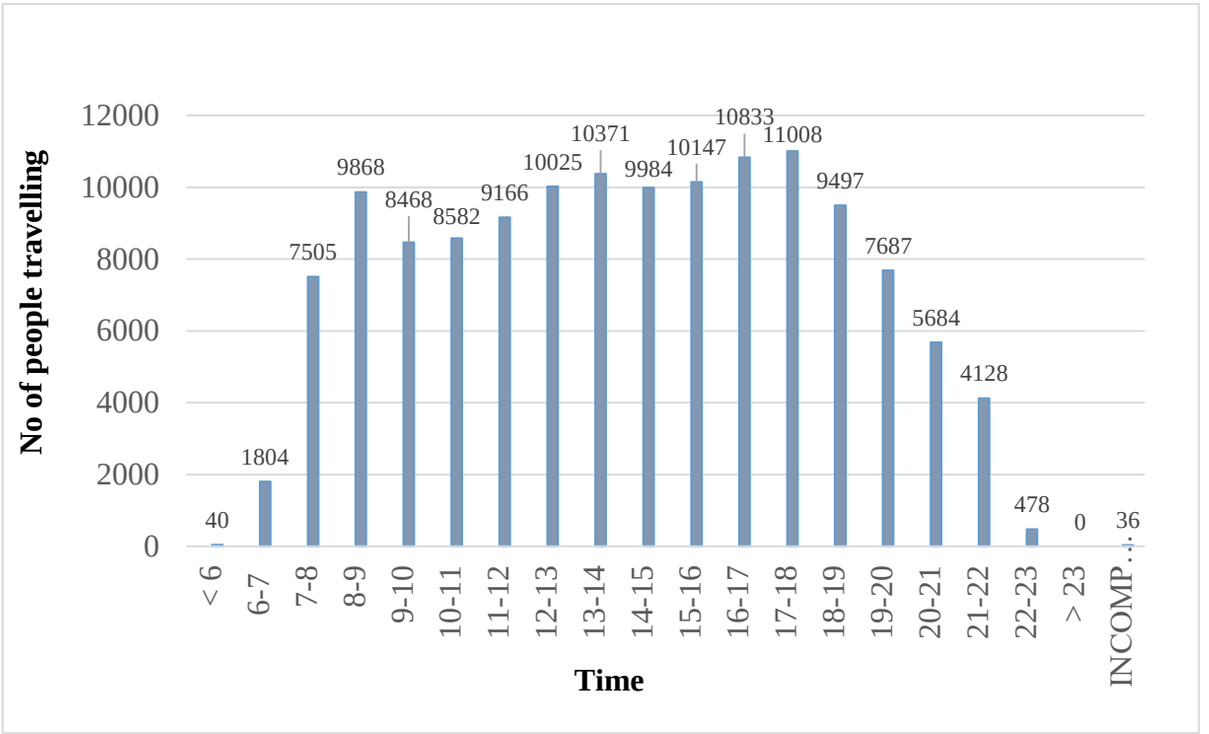

Figure 4.13: Daily Variation of Ridership on Working day

This bar chart in Fig 4.13 shows that average daily ridership of Rwp-Isl Metrobus Service fluctuates throughout the day. The peak time for morning starts from 8 am and ends at 11 am. The first significant peak can be seen between 8 am to 9 am as number of offices/educational institutes start at 9 am. The next significant peaks starts from 12 noon to 6 pm where the daily ridership reaches the highest value of as high as 11,000. This is because most of the office/educational institutes close from 1 am to 2 am and 4 pm to 5 pm. The peak time for evening is 3 pm to 6 pm.

Similarly the variation of daily trips on weekends is shown in Fig 4.14. It shows a bell shape curve similar to normal distribution. It shows that ridership steadily increases and reach

a highest value from 4 pm to 6 pm. So from this information it can be concluded that maximum number of people use Rwp-Isl MetroBus Service in the evening for shopping purposes.

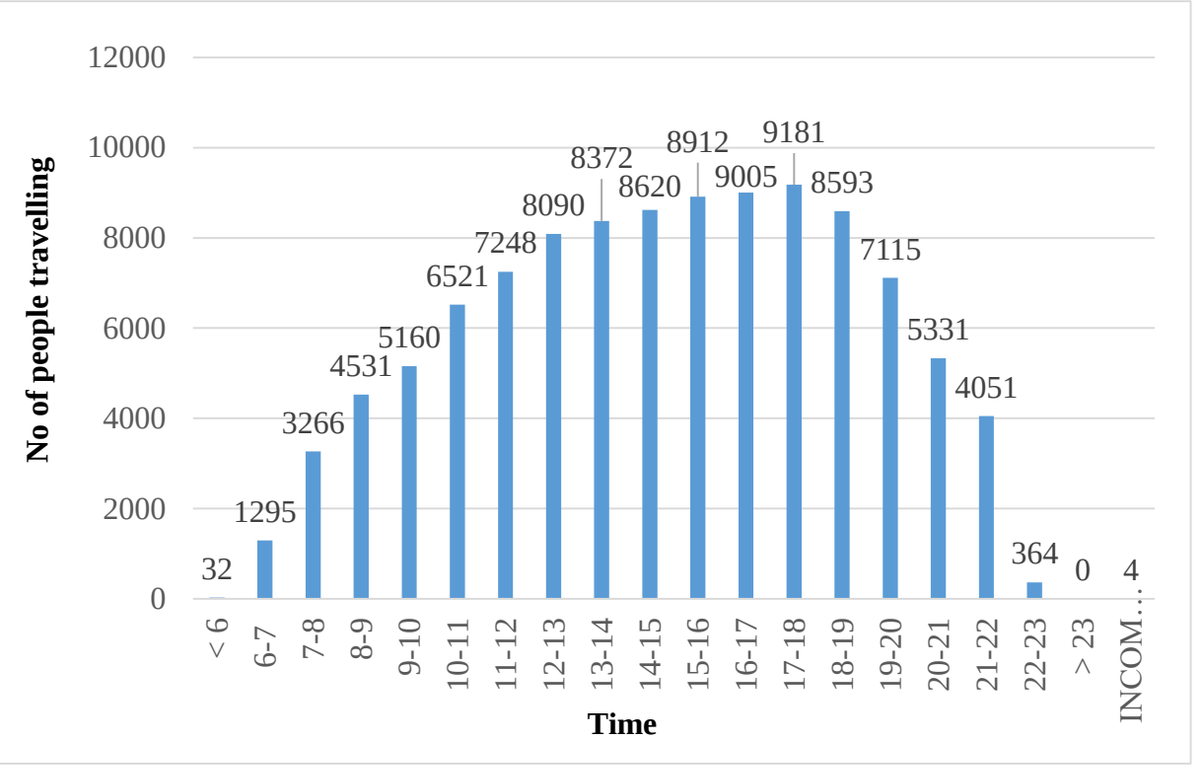

Figure 4.14: Daily Variation of Ridership on Weekends

4.3 TRAVEL LENGTH SURVEY

The travel length survey was carried out to know how much people travel in kilometers using Rwp-Isl Metrobus Service. The results of Travel Length Survey are attached in Appendix B. Table 4.9 shows the summary of results extracted from Travel Length Survey and Fig 4.15 shows the percentage wise average trip length for working days.

Table 4.9: Average Trip Length for Working days (Mon-Fri)

	FORWARD (SAD-PKS)	BACKWARD (PKS-SAD)	BOTH FORWARD AND BACKWARD	
Trip Length Band	**Frequency**	**Frequency**	**Frequency**	**Percentage**
< = 4	14663	15222	29885	22.27
4 - 8	22365	22369	44734	33.34
8 – 12	13675	14054	27729	20.66
12 - 16	9101	9185	18286	13.63
16 - 20	5093	5161	10254	7.64
20 - 24	1629	1678	3307	2.46
Average Trip Length	**8.32**			
Passenger Kms	**1,118,814**			

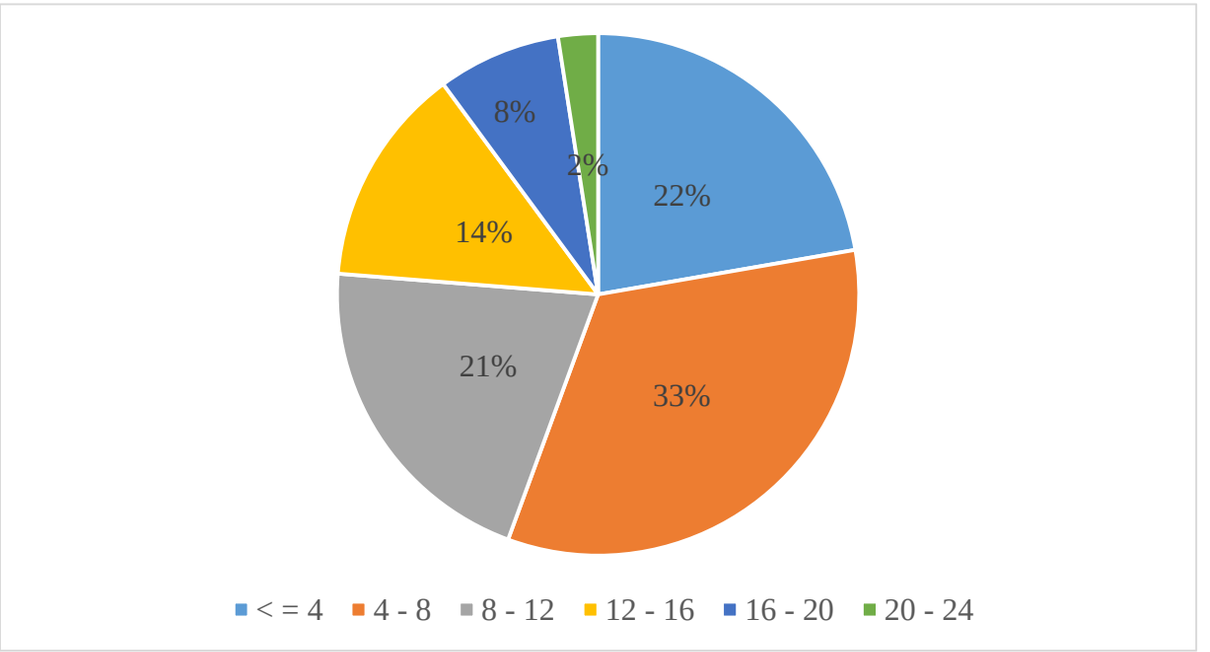

Figure 4.15: Percentage wise Average Trip Length for Working days (Mon-Fri)

From Fig 4.15, it can be deduced that 22% of people travel for < 4 kms, 33 % of passengers travel for 4-8 kilometers band and 21% of people travel for 8-12 km. It means that 76% of people travel for 12 km only while 24% travel for more than 12 km. This pie chart also shows that least number of people travel for the whole route and only those people travel for whole route who either work at Pakistan Secretariat or for some other purpose.

Similar analysis was performed to calculate travel length for weekends. Table 4.10 shows the summary of results extracted from Travel Length Survey and Fig 4.16 shows the percentage wise average trip length for working days. In Table 4.10, average trip length comes out to be 8.32 kms.

Table 4.10: Average Trip Length for Weekends (Sat-Sun)

	FORWARD (SAD-PKS)	**BACKWARD (PKS-SAD)**	**BOTH FORWARD AND BACKWARD**	
Trip Length Band	**Frequency**	**Frequency**	**Frequency**	**Percentage**
< = 4	11355	11748	23103	22.10
4 - 8	17373	17259	34632	33.13
8 - 12	10733	11195	21928	20.98
12 - 16	7292	7304	14596	13.96
16 - 20	4264	4279	8543	8.17
20 - 24	896	837	1733	1.66
Average Trip Length	**8.32**			
Passenger Kms	**869,511**			

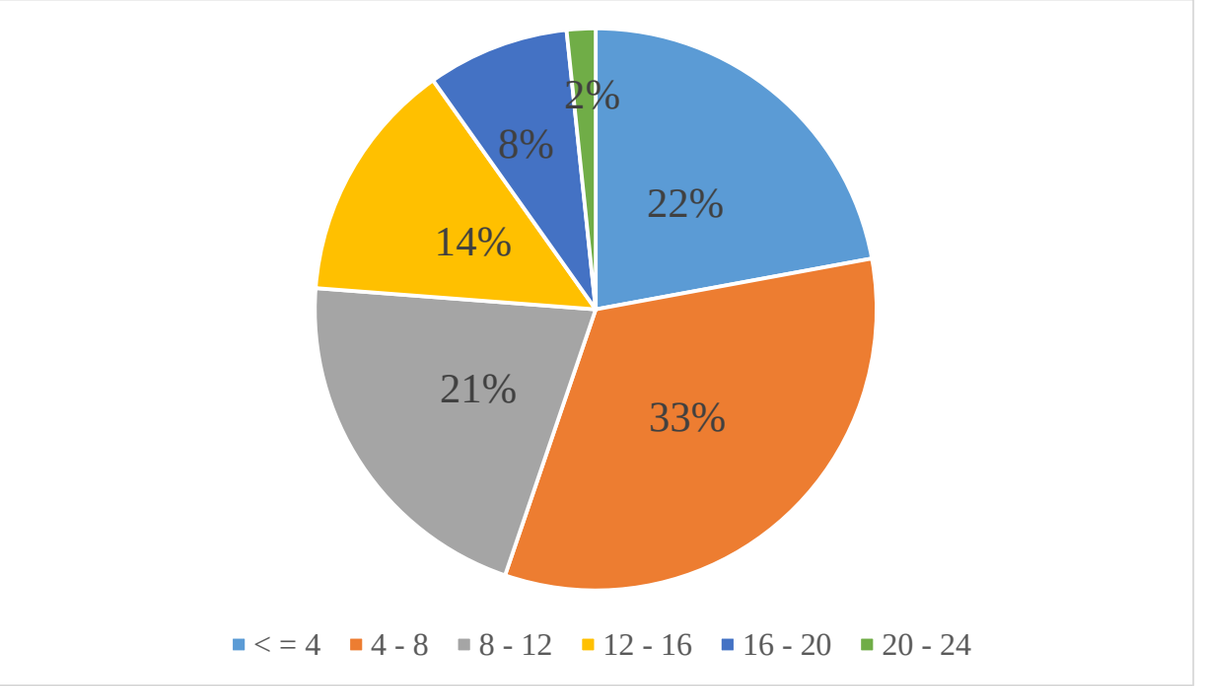

Figure 4.16: Percentage wise Average Trip Length for Weekends (Sat-Sun)

From Fig 4.16, it can be concluded that travel pattern on working day and weekend remains the same. i.e. 76% of passengers travel for <12 kms and 24% of people travel for >12kms. By comparing two time periods (Working day and Weekends), it is clear that average trip length remains the same regardless of any day of week.

4.4 TRAVEL TIME SURVEY

The Travel Time Survey was conducted to get information about the travel time of people travelling from one station to another. The results of Travel Time Survey are attached in Appendix C. The output of this survey is trip time as well as average trip time. The Table 4.11 shows the summarized results extracted from Travel Time Survey and shows that average trip time is 22.42 mins for every passenger. This average trip time corresponds with average trip length such that in previous analysis, the average trip length came out to be 12 km which is half of the whole trip length and average trip time comes out to be 22.42 mins which is also the half of trip time for the whole route.

Table 4.11: Average Trip Time for Working days (Mon-Fri)

	FORWARD		BACKWARD		BOTH	
Travel Time Band	**QTY**	**Percentage**	**QTY**	**Percentage**	**QTY**	**Percentage**
< 15 Min	22251	33.45	22375	33.07	44626	33.25
15 Min To 30 Min	27400	41.19	27878	41.20	55278	41.19
30 Min To 45 Min	12517	18.81	12993	19.20	25510	19.01
45 Min To 1 Hrs	3978	5.98	3947	5.83	7925	5.91
1 Hrs To 1.5 Hrs	358	0.538	452	0.668	810	0.604
1.5 Hrs To 2 Hrs	16	0.024	16	0.024	32	0.024
2 Hrs To 3 Hrs	7	0.011	8	0.012	15	0.011
Average Trip Time	**22.42**		**22.56**		**22.49**	

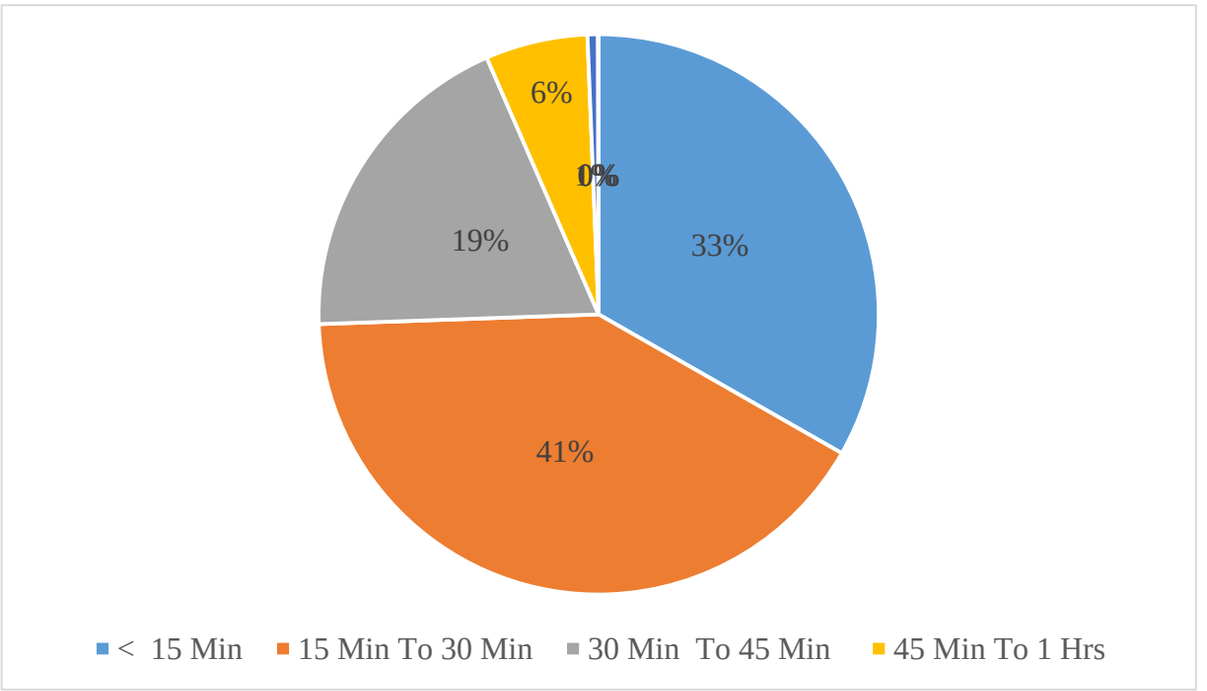

Figure 4.17: Percentage wise Average Trip Time for Working days (Mon-Fri)

Fig 4.17 shows average trip time for working days. Pie chart shows that 41% of passengers travel within 15-30 minutes while 33 % has average time of less than 15 minutes while 41% of people travel within 15-30 mins. So nearly 75% of people travel in 30 minutes which is a good travel time efficiency for Rwp-Isl Metrobus Service.

Similar analysis was performed to determine average trip time on weekends. The Table 4.12 shows the summarized results extracted from Travel Time Survey.

Table 4.12: Average Trip Time for Weekends (Sat-Sun)

	FORWARD		**BACKWARD**		**BOTH**	
Travel Time Band	**QTY**	**Percentage**	**QTY**	**Percentage**	**QTY**	**Percentage**
< 15 Min	16875	32.51	33913	32.44	50788	32.46
15 Min To 30 Min	21796	41.99	44309	42.39	66105	42.25
30 Min To 45 Min	10355	19.95	20817	19.91	31172	19.92
45 Min To 1 Hrs	2660	5.12	5031	4.81	7691	4.92
1 Hrs To 1.5 Hrs	205	0.395	425	0.407	630	0.403
1.5 Hrs To 2 Hrs	12	0.023	25	0.024	37	0.024
2 Hrs To 3 Hrs	10	0.019	14	0.013	24	0.015
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
Average Trip Time	**22.41**		**22.32**		**22.35**	

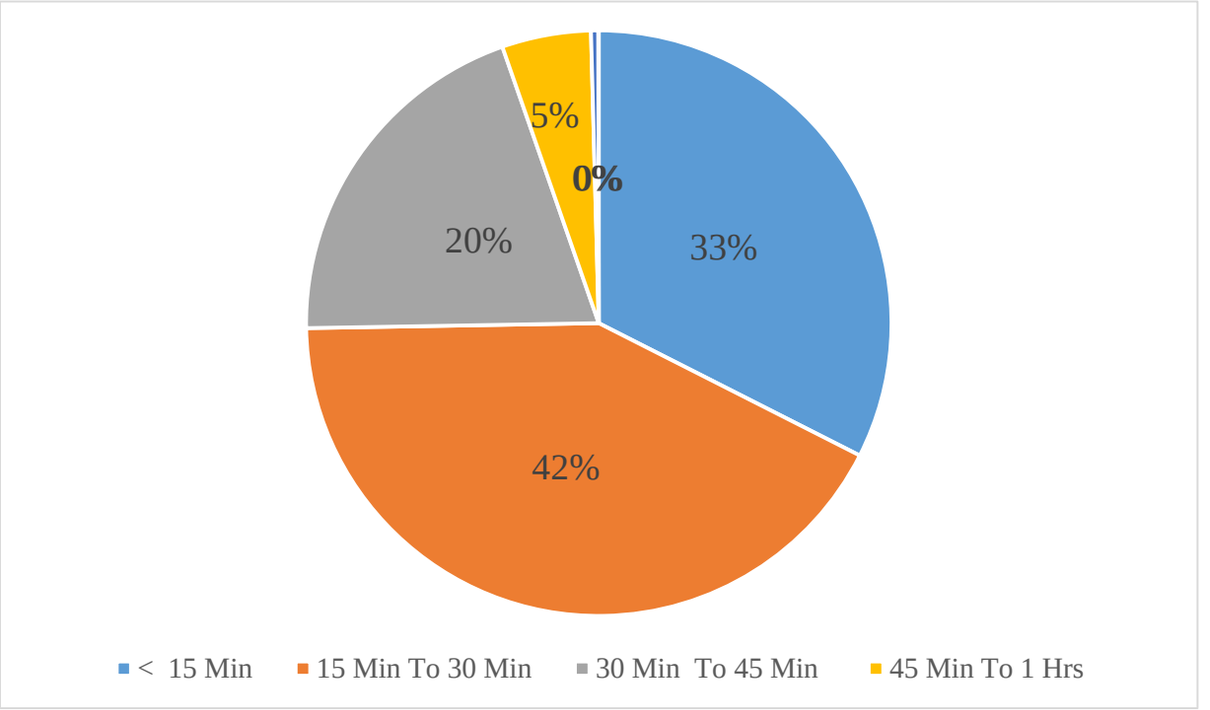

Figure 4.18: Percentage wise Average Trip Time for Weekends (Sat-Sun)

Fig 4.18 shows percentage average trip time for weekends. It has the same pattern as shown in average trip time of working day. This exhibits that travel pattern and average trip time remains the same irrespective of the day

4.5 AVERAGE HOURLY LOAD IN BUS

Working Days (Mon-Fri)

One of the most important findings is the average load per bus for the whole day while moving along the 22.5 long corridor. This information was extracted with the help of surveys that were conducted to know that how much passengers are travelling in bus at a given time. The Table 4.13 shows the Average Load per bus at a given time on working days while starting its journey from Saddar Station up to Pak Secretariat Station (Forward). This table is colored based on the different criteria of comfort, discomfort, overloading etc. By analyzing the average load per bus, we can extract that the morning peak rush starts from Committee Chowk Station to Faiz Ahmad Faiz Station between 8 am to 9 am. People start feeling discomfort from

Committee Chowk Station and after Rehmanabad Station the bus is overloaded within its design capacity. This overloading of passengers goes upto Potohar Station and after that average load per bus comes at discomfort level. After 6 am the average load per bus starts to decrease and it comes at comfortable level for passengers.

The Table 4.14 shows the Average Load per bus at a given time on working days while starting its journey from Pak Secretariat Station to Saddar Station (Backward). This table shows a comprehensive picture of what is going on when a bus is carrying passenger from points A to B with respect to time. It shows that from 6 am to 8 am between Faiz Ahmad Faiz Station and Waris Khan Station bus is at discomfort level for passengers. It also shows that from 12 noon to 2 pm and 4 pm to 6 pm, between Khyban-e-Johar and Committee Chowk Station, bus is at discomfort level and at some place overloaded with design capacity. After 6 pm the average load per bus starts to decrease and it comes at comfortable level for passengers.

Table 4.13: Average Load per bus (Forward) on Working Days (Mon-Fri)

HEADWAY	TIME	METRO STATIONS																							
		SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS
30	< 6	11	11	12	12	12	12	12	12	12	15	15	15	15	15	16	16	16	16	16	16	16	16	16	16
6	6-7	32	49	57	66	69	71	75	80	84	85	88	87	84	81	79	79	77	75	72	70	69	68	68	66
2.5	7-8	63	89	103	119	126	128	135	143	149	149	159	162	144	138	134	135	134	129	122	116	112	101	96	84
2.5	8-9	78	109	125	143	150	153	162	168	169	169	178	179	154	143	130	130	125	116	104	87	78	65	45	9
2.5	9-10	56	82	94	109	114	113	117	120	121	119	127	127	117	110	99	98	94	85	69	49	37	19	-1	-36
3.5	10-11	72	108	124	141	147	146	149	150	151	141	148	148	138	133	120	116	111	101	80	61	48	31	17	-16
3.5	11-12	71	105	121	138	142	143	143	144	144	126	130	128	121	117	107	101	96	87	68	52	42	28	17	-7
3.5	12-13	73	106	123	138	141	145	145	147	146	122	125	122	117	115	106	99	92	83	64	49	39	27	17	-1
3.5	13-14	75	105	121	137	140	145	148	151	147	118	119	115	110	107	98	90	84	74	57	43	33	21	11	-4
3.5	14-15	69	96	111	132	138	142	148	152	150	120	121	118	104	102	93	84	78	72	57	44	34	22	14	0
3.5	15-16	74	99	115	135	139	140	142	144	141	111	111	107	95	93	84	75	68	63	46	32	22	13	5	-7
3.5	16-17	75	101	116	135	138	140	141	142	137	105	104	101	98	97	92	81	74	67	51	38	28	18	11	0
3.5	17-18	77	101	115	135	138	140	141	141	134	103	102	98	97	95	91	79	72	66	50	37	26	17	9	-1
3.5	18-19	67	87	101	119	121	122	121	119	111	84	82	77	76	73	69	57	50	46	33	21	10	2	-5	-13
4	19-20	64	83	97	116	118	117	116	115	104	76	74	69	72	69	64	53	45	41	30	17	7	-2	-7	-17
4	20-21	49	62	73	88	90	89	89	87	78	58	56	51	50	47	44	35	30	27	19	9	0	-6	-9	-17
4	21-22	40	47	55	65	68	68	68	66	58	42	40	36	34	32	28	20	15	13	9	1	-5	-10	-12	-17
30	22-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	> 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

< 30% Capacity (48 Pax) - Under Load

> 30% < = 85% Capacity (48 -136 Pax) Comfortable

> 85% < = 100% Capacity (136 -160 Pax) - Discomfort

> 100% < = 120% Capacity (160 - 192 Pax) – Overloading Within Design Capacity

> 120% Capacity (> 192 Pax) – Overloading Exceeding Design Capacity

Table 4.14: Average Load per bus (Backward) on Working Days (Mon-Fri)

HEADWAY	TIME	Metro Station																							
		PKS	PRG	SHM	7AV	STE	PIM	KAT	IBN	CHH	KSH	FAF	KHJ	POT	IJP	FAZ	SHM	6RD	REH	CHN	WKR	CMC	LIB	MAR	SAD
30	< 6	0	1	1	1	1	1	1	1	1	1	1	1	2	2	7	7	7	7	7	7	7	7	7	7
6	6-7	9	11	14	19	23	25	27	29	31	32	34	35	36	37	51	54	56	57	57	57	56	54	49	36
6	7-8	8	14	23	38	49	53	60	73	89	95	96	91	100	106	137	149	151	150	146	149	143	136	110	54
6	8-9	10	18	28	44	55	61	67	80	99	105	103	96	102	111	150	158	158	161	157	160	149	130	93	1
3.5	9-10	7	13	20	27	33	38	43	49	57	61	62	62	65	68	96	100	98	97	92	93	85	76	56	6
3.5	10-11	11	19	28	36	42	51	57	64	72	77	80	83	86	88	120	125	122	124	121	120	106	95	76	17
3.5	11-12	16	26	37	48	56	70	77	85	94	101	106	114	117	117	144	149	148	147	146	145	126	113	90	23
3.5	12-13	26	38	52	63	74	91	101	108	116	125	133	148	149	146	165	170	167	167	167	163	139	122	98	18
3.5	13-14	22	36	52	63	75	93	101	109	115	122	131	152	151	146	161	166	161	159	159	154	129	110	84	-1
2.5	14-15	17	28	37	47	57	72	79	86	92	98	102	108	110	107	117	122	120	118	117	114	98	85	67	4
2.5	15-16	24	38	48	57	68	80	88	95	102	109	116	122	123	120	131	135	133	132	129	126	108	95	76	9
2.5	16-17	34	50	60	69	82	95	104	111	117	126	133	143	142	137	148	150	148	146	143	138	118	103	81	9
2.5	17-18	22	39	52	67	88	104	114	121	128	136	140	153	155	149	158	158	153	152	150	145	125	109	86	11
2.5	18-19	15	29	39	52	70	84	91	97	101	107	110	120	120	114	123	123	118	116	113	108	88	74	52	-25
2.5	19-20	9	16	24	33	46	58	64	68	73	80	82	96	97	92	100	98	93	88	86	82	66	54	37	-27
2.5	20-21	6	11	17	23	32	43	47	50	54	58	60	64	64	60	69	70	68	67	65	61	49	41	29	-17
4	21-22	7	13	20	28	42	56	61	64	69	72	73	76	75	70	78	74	73	71	69	64	49	39	25	-24
30	22-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	> 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

< 30% Capacity (48 Pax) - Under Load

> 30% < = 85% Capacity (48 -136 Pax) Comfortable

> 85% < = 100% Capacity (136 -160 Pax) - Discomfort

> 100% < = 120% Capacity (160 - 192 Pax) – Overloading Within Design Capacity

> 120% Capacity (> 192 Pax) – Overloading Exceeding Design Capacity

Weekends (Sat-Sun)

The Table 4.15 shows the Average Load per bus at a given time on weekends while starting its journey from Saddar Station up to Pak Secretariat Station (Forward). This table is colored based on the different criteria of comfort, discomfort, overloading etc. By analyzing the average load per bus, we can extract that the there is no morning peak rush on weekends. Mostly passenger feel comfortable throughout weekend except for few stations. For example the table 4.16 shows that from 1 pm to 6 pm between Chandani Chowk Station and Shamsabad Station there is a slight sense of discomfort in passengers travelling on the bus.

The Table 4.16 shows the Average Load per bus at a given time on working days while starting its journey from Pak Secretariat Station to Saddar Station (Backward). Similar pattern and trend can been that most of the time bus loading is at comfort level. But from 12 noon to 2 pm there is a sense of discomfort between Faizabad Station and Waris Khan Station.

In both cases one can observe that that passengers going to PIMS, Stock Exchange Station, 7th Avenue, Shaheed-e-Millat Station, Parade Ground Station and Pak Secretariat Station decreases considerably that bus is under load and everyone has a seat to sit. It also shows that ridership on weekends in considerably low such that busses are running under load.

Table 4.15: Average Load per bus (Forward) on Weekends (Sat-Sun)

HEADWAY	TIME	Metro Stations																							
		SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS
30	< 6	7	7	7	7	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
6	6-7	18	27	33	39	40	42	44	47	49	49	51	50	48	47	45	45	43	42	41	39	38	37	37	36
2.5	7-8	25	37	43	48	51	51	52	52	54	48	51	50	48	48	45	45	44	41	37	33	31	26	25	22
2.5	8-9	32	50	57	65	68	69	71	72	76	70	74	72	66	64	56	54	51	46	38	32	28	23	18	13
2.5	9-10	35	54	60	69	72	71	71	73	75	66	69	68	64	62	54	51	47	43	31	23	17	11	5	-1
3.5	10-11	57	84	96	110	114	114	117	119	122	107	111	109	104	102	91	86	81	75	57	45	36	28	21	13
3.5	11-12	58	85	98	114	117	117	117	120	121	100	103	101	97	96	84	76	70	64	41	29	21	12	6	-4
3.5	12-13	67	94	110	126	130	133	133	135	135	113	116	113	110	109	97	90	83	75	51	39	30	22	17	10
3.5	13-14	71	96	112	132	136	139	143	146	143	119	121	118	115	114	103	94	86	78	51	38	27	19	14	5
3.5	14-15	66	88	106	129	133	136	140	143	141	111	112	110	107	106	93	83	75	69	43	30	20	11	6	-4
3.5	15-16	71	93	113	138	143	145	148	150	146	115	117	113	112	112	99	89	79	73	48	36	27	18	13	3
3.5	16-17	72	94	114	141	145	147	150	152	147	111	112	107	106	105	97	86	76	70	48	35	25	16	10	0
3.5	17-18	72	93	113	141	146	147	149	148	139	111	112	106	104	103	94	81	73	66	46	33	22	14	9	-1
3.5	18-19	66	87	103	130	133	133	134	132	124	96	95	89	87	86	82	69	59	53	35	21	8	0	-5	-13
4	19-20	64	83	100	126	128	128	126	125	114	93	92	86	84	82	76	62	53	48	35	20	8	-1	-6	-14
4	20-21	50	63	74	94	98	98	97	94	83	66	65	59	57	57	53	43	35	31	21	9	-1	-8	-12	-18
4	21-22	41	50	57	71	74	73	74	70	61	49	48	43	42	41	37	28	22	18	12	3	-5	-11	-13	-18
30	22-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	> 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

< 30% Capacity (48 Pax) - Under Load

> 30% < = 85% Capacity (48 -136 Pax) Comfortable

> 85% < = 100% Capacity (136 -160 Pax) – Discomfort

> 100% < = 120% Capacity (160 - 192 Pax) – Overloading Within Design Capacity

> 120% Capacity (> 192 Pax) – Overloading Exceeding Design Capacity

Table 4.16: Average Load per bus (Backward) on Weekends (Sat-Sun)

HEADWAY	TIME	Metro Stations																						
		PKS	PRG	SHM	7AV	STE	PIM	KAT	IBN	CHH	KSH	FAF	KHJ	POT	IJP	FAZ	SHM	6RD	REH	CHN	WKR	CMC	LIB	MAR	SAD
30	< 6	0	0	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	6	6	6	6	6	6
6	6-7	8	10	13	18	21	23	25	27	29	29	31	31	33	31	40	42	43	44	43	43	42	40	36	28
6	7-8	6	11	15	23	31	34	37	44	50	53	54	55	58	60	69	76	79	77	75	75	67	61	47	25
6	8-9	6	12	18	26	34	39	43	53	61	65	65	65	68	71	89	99	98	97	94	94	81	69	50	10
3.5	9-10	5	10	14	21	26	29	33	40	46	49	50	50	53	55	72	78	79	77	75	75	64	56	44	13
3.5	10-11	5	10	17	26	33	41	46	56	64	68	69	71	74	74	101	109	111	114	112	110	91	79	65	19
3.5	11-12	8	13	21	31	40	51	57	68	78	84	86	89	92	93	123	130	131	131	130	128	102	87	72	11
3.5	12-13	7	13	22	34	44	60	67	77	89	97	98	104	108	109	140	147	149	149	150	147	117	99	82	12
3.5	13-14	9	15	25	38	50	65	73	82	92	102	104	109	114	114	138	143	143	144	143	139	111	92	72	-2
2.5	14-15	7	13	20	30	41	55	61	68	76	83	85	88	91	90	107	110	109	109	108	107	89	77	63	9
2.5	15-16	8	13	19	29	42	55	61	69	77	84	86	92	95	93	107	111	111	111	110	108	89	77	62	1
2.5	16-17	8	13	19	30	41	59	66	72	80	88	90	94	98	96	111	112	112	111	110	107	91	79	62	1
2.5	17-18	7	14	22	33	47	67	75	83	90	98	101	105	109	106	122	122	119	118	118	114	98	86	71	8
2.5	18-19	7	14	21	31	42	63	68	77	84	95	96	99	102	98	114	113	109	106	104	100	83	72	55	-9
2.5	19-20	5	9	14	22	31	48	53	59	66	74	76	78	80	76	92	90	85	82	80	75	61	51	36	-19
2.5	20-21	3	6	10	16	22	36	38	41	45	52	54	57	57	55	66	64	60	59	57	54	44	37	26	-16
4	21-22	5	9	15	21	34	51	55	58	64	68	68	69	69	66	79	76	73	71	69	66	52	43	31	-13
30	22-23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	> 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

< 30% Capacity (48 Pax) - Under Load

> 30% < = 85% Capacity (48 -136 Pax) Comfortable

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4.6 EVALUATION AS PER INTERNATIONAL STANDARDS

This research will now shift its focus and compares Rwp-Isl Metrobus Service with the international best practices followed all around the world. Rwp-Isl Metrobus Service was evaluated according to the "BRT Standard 2016". These BRT Standards was developed to create a common definition of Bus Rapid transit and to recognize high quality BRT corridors around the world. BRT Standard 2016 is a tool that is used to asses and analyze BRT based on international best practices.

In order to evaluate Rwp-Isl Metrobus Service on the basis of BRT Standard 2016, extensive visits and trips were performed to observe the different elements of BRT currently operating in twin cities of Rawalpindi and Islamabad. Google maps were also utilized to quantify the length of the Rwp-Isl Metrobus Service corridor, distance between stations as well as other necessary data.

4.6.1 BRT BASICS

BRT basics are the element that are set forth for defining a corridor as BRT. Various factors are considered in BRT basics such as "dedicated right of way; busway alignment; off-board fare collection; intersections treatment and platform level boarding etc". A proposed BRT corridor must achieve atleast 4 points on both busway alignment and dedicated right of way and must achieve a minimum 20 points across all five categories to be identified as BRT. Rwp-Isl Metrobus Service achieved 38/38 points in BRT basics as it fulfilled all the criterias. These criterias are explained one by one in following paragraphs.

4.6.2 Dedicated right of way

Dedicated right of way are costly to build as but it helps to improve safety of bus operations within the assigned corridor. Rwp-Isl Metrobus Service has 22.5 long dedicated

corridor that is physically separated with other traffic and has no crossing of traffic or signal whatsoever. So Rwp-Isl Metrobus Service has scored 8/8 points in this criteria.

4.6.3 Bus-way alignment

Busway alignment plays and important role in minimizing conflicts with other traffic. The researchers have found out that if BRT corridor is located in middle of roadway, it has least chance to have conflict with other traffic plying on road. Rwp-Isl Metrobus Service operates in the middle of the Murree Road, 9th Avenue and Jinnah Avenue with two way median aligned bus-way. So Rwp-Isl Metrobus Service earned full points in this criteria.

4.6.4 Off-board fare collection

Off-board fare collection is usually used in transit systems in order to speed up boarding time. It also improves efficiency of system and improve passengers experience. Rwp-Isl Metrobus Service has all turnstile controlled stations. These stations are used to enforce one way traffic of people as well fare is deducted when a passenger pass through turnstile. Maximum points are awarded if BRT has all turnstile controlled stations. Rwp-Isl Metrobus Service earned 8/8 points as all 24 stations are turnstile controlled.

4.6.5 Platform-level boarding

Platform-level boarding is most important aspect as far as accessibility of public transport to disabled people is concerned. A platform level boarding provides accessibility to disabled people as well ensuring the safety of passengers during boarding and alighting at stations. It also minimizes the time of alighting and boarding of passengers. As per the standard, the distance between station and bus should be less than 4cm to be said as platform level boarding (BRT Standard 2016). Rwp-Isl Metrobus Service buses that are at platform level having 4 cm or less of vertical gap. So Rwp-Isl Metrobus Service earned 7/7 points in this criteria.

4.6.6 SERVICE PLANNING

Service Planning helps to ensure that the system is fulfilling the current demand as well as has the capacity to fulfill future demand as well. Service Planning criteria includes different components such as “multiple routes; express, limited and local services; control center; etc”. Rwp-Isl Metrobus Service achieved 10/19 points in this criteria. This score shows that Rwp-Isl Metrobus Service has performed poorly in service planning. The breakdown of service planning is given below.

4.6.7 Multiple routes

Multiple routes in a single corridor helps in reduction of door to door travel time. As Rwp-Isl Metrobus Service consists of a single corridor so it achieved 0/4 points in multiple routes criteria. In May, 2017 Govt started constructing another route of Rwp-Isl Metrobus Service that will start from Peshawar More, Islamabad and will go upto New Islamabad Airport near Fateh Jang. It is hoped that it will attract number of people that will eventually decrease the congestion on Kashmir Highway, Islamabad.

4.6.8 Express, limited-stop and local services

The prime objective of Mass Transit is to reduce travel time and it is provided by express and limited services. Rwp-Isl Metrobus Service is currently not operating with limited and express services. As discussed in operational analysis, buses are overcrowded during peak hour thus it would be difficult to serve future passenger demand and current design of Rwp-Isl Metrobus Service did not support express and multiple services, so no limited-stop or express services exist whatsoever. Rwp-Isl Metrobus Service achieved 0/3 points in this criteria.

4.6.9 Control center

Control center are essential for keeping an eye on vehicles which is tool to identify problems and respond quickly to a problem in BRT system. A Central Command and Control

Center helps to monitor the exact location of vehicles with GPS as well as recording different parameters of operations. Rwp-Isl Metrobus Service has full Command and Control Center located in Saddar, Rawalpindi which monitors overall bus operations. Rwp-Isl Metrobus Service achieved 3/3 points as it has state of the art control center.

4.6.10 BRT corridor in top ten corridors

A BRT system will only attract people if it exist on that route which has potential of attracting riders. Rwp-Isl Metrobus Service is located in top ten corridors that has highest ridership and demand. The whole route of Rwp-Isl Metrobus Service is among the busiest areas of Rawalpindi as well as Islamabad. That's why Rwp-Isl Metrobus Service earned 2/2 points in this criteria.

4.6.11 Demand profile

Maximum utilization and productivity can be achieved if the BRT is built along the highest demand of road. Rwp-Isl Metrobus Service is passing along the highest demand of the road. So Rwp-Isl Metrobus Service earned 3/3 points in criteria.

4.6.12 Hours of operation

Availability of BRT service throughout the day is a sign of good BRT system. But Rwp-Isl Metrobus Service is not available after 10 pm as it operates between 6:00 AM to 10:00 PM in seven days a week. Rwp-Isl Metrobus Service earned 1 point because it is not available till midnight.

4.6.13 Multi corridor network

Multiple corridor networks provides several travel options to passengers while moving through the city. They prefer to use BRT if gives access to different areas of city. A vast network of multiple corridors in a BRT system helps in increased ridership. Rwp-Isl Metrobus Service

operates on a single corridor. It achieved 1/2 points but it will improve as another corridor is under construction.

4.6.14 INFRASTRUCTURE

Good infrastructure plays a key role in increasing comfort of passengers during the journey and can accommodate passengers for longer time. Various things are considered in Infrastructure that includes “passing lanes at stations; minimizing bus emissions; stations set back from intersections” etc. Rwp-Isl Metrobus Service achieved 7/14 points in infrastructure. It shows that transportation authorities are totally neglecting this important constituent. The breakdown of this section is given below.

4.6.15 Passing lanes at station

Passing lanes at Station stops are necessary for express and limited services to operate. During visual survey it was found out that Rwp-Isl Metrobus Service does not have passing lanes at stations. It means that it is not viable to start express and limited services of BRT that is the key feature of an efficient system. Rwp-Isl Metrobus Service achieved 0/4 points because it has no passing lanes at stations. In case of breakdown at Station, Busses would have to use opposite side lane that will not only cause delays as well as it will compromise the safety of bus operations. This maneuver of passing will also compromise the safety of the system and chance of collision with opposite bus will increase.

4.6.16 Minimizing bus emissions

Environmental is a great concern nowadays due to increase in Global warming. The main source of Global warming is automobile pollution and industrious pollutions. BRT vehicles must be Euro VI and U.S. 2010 emissions standards as per international practice. Rwp-Isl Metrobus Service fleet consists of Euro III diesel vehicles and the available fuel is not good

for clean environment. BRT vehicles in Rwp-Isl Metrobus Service are using fuel of Euro II technology. It achieved 0/3 points because BRT vehicles are below Euro VI technology.

4.6.17 Stations set back from intersections

According to international standards, the least distance of stations from intersections should be 26 meters. An ideal distance should be 40 meters to avoid delays due to blockage at intersection. If stations are located just before an intersection, the traffic signal can keep buses from leaving the station and thus not allow other buses to pull in. The risk of conflict remains acute, particularly as frequency increases. Separating stations from intersections is a key way to mitigate these problems. This problem is not encountered as Rwp-Isl Metrobus Service has dedicated corridor with no intersection so it achieved 3/3 points in this criteria.

4.6.18 Center stations

Station design plays a key role in determine the construction cost as well as comfortable transfer of passenger. It always recommended to use centrally designed stations serving both directions of BRT. In Lahore BRT they have given stations sidewise i.e. Separate Station for each direction. Contrary to this, Rwp-Isl Metrobus Service stations are designed at center and has achieved 2/2 points.

4.6.19 Pavement quality

Good quality pavement ensures better service and operation and reduces the maintenance and rehabilitation cost of the road. Poor pavement quality will slow down the speed of vehicles as well as decreasing the discomfort of passengers as well. Rwp-Isl Metrobus Service has good quality of pavement as it is newly constructed. So Rwp-Isl Metrobus Service achieved 2/2 points in pavement quality.

4.6.20 STATIONS

A good and spacious designed station increases the level of satisfaction of passengers. It includes different criterias such as separation between station, safety and comfort of stations as well as number of docking bays and sub-stops and sliding doors in BRT stations. Rwp-Isl Metrobus Service earned 10/10 points in station design. It means that the station design of Rwp-Isl Metrobus Service is as per international practice. The detailed component analysis of station design is given below.

4.6.21 Distance between stations

According to BRT Standard 2016, the average distance between stations must be between 0.3 km to 0.8 km. The average distance between stations is 0.8 km of Rwp-Isl Metrobus Service. So this figure comes below the standards stated by BRT Standard 2016. So Rwp-Isl Metrobus Service achieved 2/2 points in this criteria.

4.6.22 Safe and comfortable stations

Stations should be safe and comfortable for passengers. Comfortable in terms of air quality, temperature of stations and with adequate facilities like a water dispenser, sitting area etc. A station must also be safe and protected from effect of atmospheric effects. The Rwp-Isl Metrobus Service are more than 3 meter wide and are safe and weather protected. So it achieved 3/3 points because it fulfilled all the criterias.

4.6.23 Number of doors in bus

An efficient mass transit system takes minimum time in boarding and alighting of passenger with help of multiple bus doors. Multiple door increases the safety of passengers in case of emergency. In the fleet of Rwp-Isl Metrobus Service, all buses have four doors which minimize the boarding and alighting time at stations. So it earned full points 3/3 as each bus has

four doors in which two doors are for female passengers while the last two doors are for male passengers only.

4.6.24 Docking bays and sub-stops

Docking bays helps to increase the station capacity but it also allows to provide multiple services. Two docking bays and one sub-stop should be atleast present in station. Rwp-Isl Metrobus Service achieved 1/1 point in this criteria as it has three docking bays at all stations.

4.6.25 Sliding doors at BRT stations

Sliding doors at BRT stations improves quality of station, environment as well as reducing the risk of accidents. Sliding doors also improve the quality of station and increase the aesthetics of station. Rwp-Isl Metrobus Service earned full points 1/1 as all the stations has sliding doors.

4.6.26 COMMUNICATIONS

Communications includes giving passengers required information about the routes of bus, locations of bus, necessary instructions etc. Rwp-Isl Metrobus Service achieved 5/5 points in communications. The detailed breakdown analysis is given below.

4.6.27 Branding

Branding plays a crucial role in public acceptance of BRT services as it can differentiate its services from conventional transport services. Rwp-Isl Metrobus Service includes vehicles of red color that represents one brand in general while the operating staff has different bands. Dedicated corridor and services of Rwp-Isl Metrobus Service and physical segregation from other public vehicles that makes in one brand service. Rwp-Isl Metrobus Service achieved 3/3 points in branding as it has unique color which is easily identifiable.

4.6.28 Passenger Information

Availability of real time data about the arrival and departure of bus at station will help in providing necessary information to passengers. All stations of Rwp-Isl Metrobus Service have state of the art LEDs that give upto date information about the departure and arrival of buses. Rwp-Isl Metrobus Service earned 2/2 points in this criteria.

4.6.29 ACCESS AND INTEGRATION

Access and Integration includes different criteria including “universal access; integration with other public transport network; pedestrian access; bicycle lanes etc”. Rwp-Isl Metrobus Service achieved 5/14 points in access and integration. This score shows that proper attention is not paid to integrate the Rwp-Isl Metrobus Service with public transport.

4.6.30 Universal access

All BRT stations should be highly accessible to all people especially to disabled and old people. Rwp-Isl Metrobus Service has physical accessibility to disabled people because stations have ramps, escalators as well as lifts that provides easy access to disabled people. It was also seen that in some stations, lifts were installed but were not functioning. So in this criteria, Rwp-Isl Metrobus Service achieved 2/3 points in universal access.

4.6.31 Integration with Other Public Transport Network

A well-integrated BRT System helps in increasing productivity and utilization of the system. The distance between transferring points as well as fare integration should be minimum in order to avoid delays. Rwp-Isl Metrobus Service is not integrated with city public transport system. So it earned 0/3 points in this criteria.

4.6.32 Pedestrian access

Safe and accessible pedestrian access is of prime importance in a BRT system. An unsafe BRT system cannot achieve its goals. All stations of Rwp-Isl Metrobus Service have safe access

for passengers. Most of stations are accessible through pedestrian bridges as Rwp-Isl Metrobus Service operates in the middle of the road. Rwp-Isl Metrobus Service achieved 3/3 points in this section.

4.6.33 Secure bicycle parking, bicycle lanes and bicycle sharing integration

Rwp-Isl Metrobus Service does not have bicycle lanes and bicycle sharing integration feature. It failed to provide any cycle/motorcycle/car stand for passengers. Rwp-Isl Metrobus Service earned 0/2 points in secure bicycle parking, 0/2 in bicycle lanes and 0/1 points in bicycle sharing integration.

4.6.34 OPERATIONS DEDUCTIONS

Points are deducted on poor performance and management of BRT. 7 points are deduced due to overcrowding and non-availability of traffic safety data. The detailed analysis of point deductions is given below.

4.6.35 Commercial speed

As per BRT Standard 2016 the minimum average commercial speed should be greater than 20 km/h. The minimum average commercial speed of Rwp-Isl Metrobus Service is more than 45 km/h.

4.6.36 Minimum peak passengers per hour per direction (pphpd)

No point is deducted because average ridership is greater than 1,000 passengers in peak hour in one direction.

4.6.37 Lack of enforcement of right-of-way

A BRT Corridor should be free from interference of other vehicles plying on road. Rwp-Isl Metrobus Service is physically segregated by means of fence from other traffic. Heavy fines are imposed in case of any violation by the users. So, no points are deducted.

4.6.38 Significant gap between bus floor & station platform

Full penalty (i.e.-5 points) should be imposed if there is large gap between bus and station platform. As there is no significant gap at point of docking at stations is observed during operation in Rwp-Isl Metrobus Service, so no penalty is imposed.

4.6.39 Overcrowding

Overcrowding decreases comfort and safety for passengers. Overcrowding shows that the system is failing to achieve its targets. Full penalty is imposed (i.e.-5 points) on Rwp-Isl Metrobus Service because overcrowding is observed during peak hours.

4.6.40 Poorly maintained busway, buses, stations and technology system

A well designed BRT system can collapse if not properly maintained. A corridor should be penalized if the bus-ways, busses and stations are poorly maintained. No penalty is imposed as Rwp-Isl Metrobus Service is in good condition.

4.6.41 Low Peak frequency

The average headway of buses during peak hour is an indicator that shows the quality of service. If all the routes have minimum of 8 buses per hour, no penalty is imposed. No point is deducted because Rwp-Isl Metrobus Service fulfills this proxy as each route has more than 8 buses per hour in peak time.

4.6.42 Low Off Peak frequency

The average headway of buses during off peak hour is an indicator that shows the quality of service. If all the routes have alteast 4 buses per hour, no penalty is imposed. In case of Rwp-Isl Metrobus Service, no penalty is imposed as it has more than 4 buses per hour in off-peak time on each route.

4.6.43 Permitting Unsafe Bicycle Use

Bicycle use in busways is generally not encourage, and is particularly dangerous in bus lanes with speed limits greater than 25 kilometers/per hour and bus lanes widths less than 3.8 meter. No deduction is made because Rwp-Isl Metrobus Service has no bicycle lane or usage.

4.6.44 Lack of Traffic Safety Data

Traffic safety data is vital to ensuring that transportation system operates safely and efforts to improve safety. All cities should collect traffic safety data and make this information public so that progress can be tracked and safety can be improved. Penalty is imposed as no traffic safety data is collect by Rwp-Isl Metrobus Service.

4.6.45 Buses Running Parallel To BRT Corridor

Bus corridors should be designed to capture as much of the public transport demand on a corridor to maximize the utility of dedicated transit infrastructures. A significant number of full-sized public busses operating outside of the busway results in difficult transfers, undermines the financial sustainability of the BRT corridor, and leads to less frequent service on the corridor. No penalty is imposed as no busses operate parallel to BRT corridor

4.6.46 Bus Bunching

Bus reliability is critical in improving BRT performance. Bus Bunching when the distance between buses become highly uneven, reduce reliability, increase wait time and contributes to crowding conditions, deteriorating quality and speed of service. No penalty is imposed as no bunch is observed on Rwp-Isl Metrobus Service and headway of buses are properly managed and maintained.

4.6.47 SUMMARY

The summary of this evaluation is shown in Table 4.17

Table 4.17: Rwp-Isl Metrobus Service Achieved Points

"BRT STANDARDS	**BRT Standards 2016**	**Rwp-Isl Metro Bus Achieved Points**
BRT Basics - Minimum score of 20 points needed	38	38
Dedicated right-of-way - Minimum 4 points	8	8
Busway alignment - Minimum 4 points	8	8
Off-board fare collection	8	8
Intersection treatments	7	7
Platform-level boarding	7	7
Service Planning	19	10
Multiple routes	4	0
Express, limited, and local services	3	0
Control center	3	3
Located In top ten corridors	2	2
Demand Profile	3	3
Hours of operations	2	1
Multi-corridor network	2	1
Infrastructure	13	7
Passing lanes at stations	3	0
Minimizing bus emissions	3	0
Stations set back from intersections	3	3
Center stations	2	2
Pavement quality	2	2
Stations	10	10
Distances between stations	2	2
Safe and comfortable stations	3	3
Number of doors on bus	3	3
Docking bays and sub-stops	1	1
Sliding doors in BRT stations	1	1
Communications	5	5
Branding	3	3
Passenger information	2	2
Access and Integration	15	5
Universal access	3	2
Integration with other public transport	3	0
Pedestrian access	4	3
Secure bicycle parking	2	0
Bicycle lanes	2	0
Bicycle-sharing integration	1	0
TOTAL	100	75

“BRT STANDARDS	**BRT Standards 2016**	**Rwp-Isl Metro Bus Achieved Points**
Point Deductions	-	-7
Commercial Speeds	-10	
Peak Passengers per hour per director below 1,000	-5	
Lack of Enforcement Right of Way	-5	
Significant Gap between Bus Floor and Station Platform	-5	
Overcrowding	-5	-5
Poorly Maintained Infrastructure	-14	
Low Peak Frequency	-3	
Low Off Peak Frequency	-2	
Permitting Unsafe Bicycle Use	-2	
Lack of Traffic Safety Data	-2	-2
Busses running parallel to BRT Corridor	-6	
Bus Bunching	-4	
Total Score	100	68
Rwp-Isl Metrobus Service Classification	Gold, Silver, Bronze	Bronze”

The graphical representation of comparison of Rwp-Isl Metrobus Service with BRT Standard 2016 is shown in figure 4.19

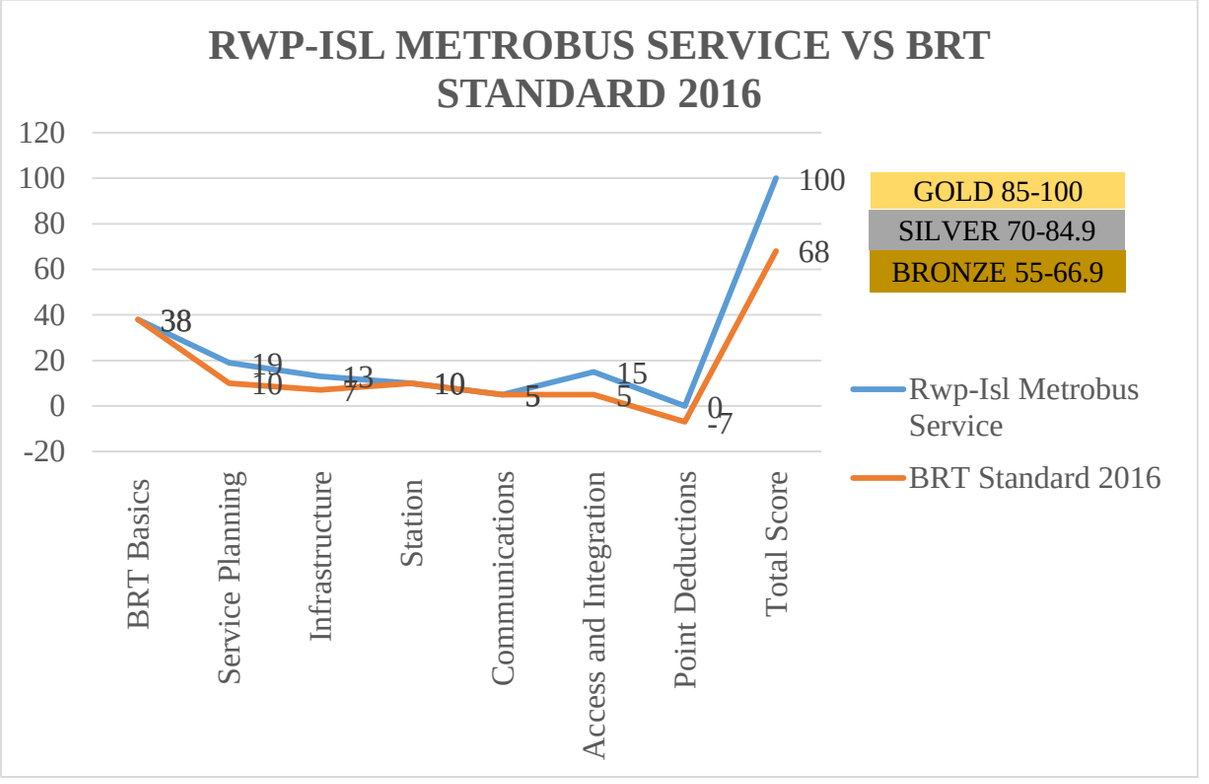

Figure 4.19: Comparison of Rwp-Isl Metrobus Service with BRT Standard 2016

According to BRT Criteria if BRT system scores 85-100 points, Gold standard is awarded, if scores 70-84 points silver standard is awarded and bronze standard is awarded if a BRT system scores 55-69 points. Rwp-Isl Metrobus Service has achieved “Bronze BRT” status as it has scored 68 numbers out of total of 100 as shown in Figure 4.19.

Summarizing the above analysis it is clear that Rwl-Isl Metro Bus Service fulfills the criteria for Bronze BRT. It has scored low in Service Planning, Infrastructure and access and integration as well. Rathore and Ali (2015) performed a similar analysis on Lahore Metro Bus. They used BRT Standards 2014 to evaluate the Lahore Bus Rapid Transit system. In their analysis, the Lahore BRT scored 47 achieving the level of “Basic BRT” and failed to achieve gold, silver or bronze standard. It means that Lahore BRT only fulfills the minimum criteria for a BRT system. Similar to Rwp-Isl Metrobus Service, the Lahore BRT also scored low in Service Planning, Infrastructure and access and integration. Although much improvement can be seen in construction of Rwp-Isl Metrobus Service but still number of key things were not considered like service planning, infrastructure and access and integration. This shows that ignoring standards of BRT and deviation from proposed transport policies is one of the factors that can lead towards failure of urban transport system in Rawalpindi-Islamabad.

4.7 ECONOMIC SUSTAINABILITY

Rwp-Isl Metrobus Service has been completed with a cost of Rs 44 billion. Since the start of Rwp-Isl Metrobus Service, a lot of questions were being asked by political and economists regarding economic feasibility and sustainability of this system. To assess that whether the fare of Rs. 20 per trip is justified and how much government is subsidizing the Metro Bus system, an economic analysis was performed.

In this analysis average daily ridership was taken as 138,000 and passenger fare cost per trips is taken as Rs 20. So total daily collected revenue comes out to be Rs, 2,76,000. Similar

calculations was performed and total daily agency cost comes out to be Rs 4,291,200. So the daily economic deficit comes out to be Rs 1,531,200 or Rs 11/trip. From this we can concluded that the actual operating cost of Rwp-Isl Metrobus Service is Rs 31/ trip. It means that this Rwp-Isl Metrobus Service is not sustainable and is not recovering its cost from the revenue it is generating. The details of calculations are shown below.

Table 4.18: Economic Analysis Case 1

CASE 1: CURRENT SCENARIO	
Description	**Analysis**
Average Daily Ridership (1)	138,000
Passenger Fare Cost per trip (2)	Rs 20
Daily Revenue received from passengers(3)	Rs 2,760,000 (1 x 2)
Total Trips by busses (4)	596
Trip Length for each bus (5)	22.5 km
Total Trip-Length (6)	13410 km (4 x 5)
Agency Cost per kilometer (7)	Rs 320
Daily Cost given to Agency (8)	Rs 4,291,200 (6 x 7)
Subsidy/Loss to Government per day(9)	Rs 1,531,200 (Rs 1.53 million) (8 - 3)
Subsidy/Loss to Government per year(10)	Rs 558,888,000 (Rs 0.55 billion)
Subsidy by Government per trip(11)	Rs 11
Actual Operating Cost per trip (12)	Rs 31

In Table 4.18 “Case 2”, an analysis was performed such that passenger fare is charged according to trip type. i.e. Passenger Fare for travelling within city is set at Rs 30/- per trip while

Passenger Fare for travelling between twin cities is set at Rs 40/- per trip. This analysis showed that it will take approximately 399 years to recover the construction cost of Rwp-Isl Metro Bus Service.

Table 4.19 Economic Analysis Case 2

CASE 2: IF PASSENGER FARE IS CHARGED ACCORDING TO TRIP TYPE	
Description	**Analysis**
Passenger Fare Cost per trip within Rwp (1)	Rs 30
Average Trips within Rawalpindi (2)	51940
Daily Revenue received from passengers(3)	Rs. 1,558,208 (1 x 2)
Passenger Fare Cost per trip within Isl (4)	Rs 30
Average Trips within Islamabad(5)	21789
Daily Revenue received from passengers(6)	Rs. 653,666 (4 x 5)
Passenger Fare Cost between Rwp and Isl (7)	Rs 40
Average Trips between Rwp and Isl (8)	59531
Daily Revenue received from passengers(9)	Rs. 2,381,253 (7 x 8)
Total Money Received (10)	Rs 4,593,125 (3+6+9)
Daily Cost given to Agency (11)	Rs 4,291,200
Savings to Government per day(12)	Rs 301,925 (Rs 0.30 million) (10 - 11)
Savings to Government per year(13)	Rs 110,202,625 (Rs 0.11 billion)
Cost of Construction(14)	Rs 44,000,000,000 (Rs 44 billion)
Breakeven Time (15)	399 years (Approx) (14/13)

In Table 4.19 “Case 3”, an analysis was performed such that passenger fare is increased to Rs 35/- per trip. This analysis showed that it will take approximately 223 years to recover the construction cost of Rwp-Isl Metro Bus Service

Table 4.20 Economic Analysis Case 3

CASE 3: IF PASSENGER FARE IS INCREASE TO RS 35/TRIP	
Description	**Analysis**
Average Daily Ridership (1)	138,000
Passenger Fare Cost per trip (2)	Rs 35
Daily Cost received from passengers(3)	Rs 4,830,000 (1 x 2)
Total Trips by busses (4)	596
Trip Length for each bus (5)	22.5 km
Total Trip-Length (6)	13410 km (4 x 5)
Agency Cost per kilometer (7)	Rs 320
Daily Cost given to Agency (8)	Rs 4,291,200 (6 x 7)
Savings to Government per day(9)	Rs 538,800 (Rs 0.538 million) (3 - 8)
Savings to Government per year(10)	Rs 196,662,000 (Rs 0.196 billion)
Cost of Construction(11)	Rs 44,000,000,000 (Rs 44 billion)
Breakeven Time (12)	223 years (Approx) (11/10)

In Table 4.20 “Case 4”, an analysis was performed such that passenger fare is increased to Rs 40/- per trip. This analysis showed that it will take approximately 98 years to recover the construction cost of Rwp-Isl Metro Bus Service

Table 4.21 Economic Analysis Case 4

CASE 4: IF PASSENGER FARE IS INCREASE TO RS 40/TRIP	
Description	**Analysis**
Average Daily Ridership (1)	138,000
Passenger Fare Cost per trip (2)	Rs 40
Daily Cost received from passengers(3)	Rs 5,520,000 (1 x 2)
Total Trips by busses (4)	596
Trip Length for each bus (5)	22.5 km
Total Trip-Length (6)	13410 km (4 x 5)
Agency Cost per kilometer (7)	Rs 320
Daily Cost given to Agency (8)	Rs 4,291,200 (6 x 7)
Savings to Government per day(9)	Rs 1,228,800 (Rs 1.22 million) (3 - 8)
Savings to Government per year(10)	Rs 448,512,000 (Rs 0.44 billion)
Cost of Construction(11)	Rs 44,000,000,000 (Rs 44 billion)
Breakeven Time (12)	98 years (Approx) (11/10)

In Table 4.21 “Case 5”, an analysis was performed such that passenger fare is increased to Rs 40/- per trip and ridership is also increased to 150,000. This analysis showed that it will take approximately 70 years to recover the construction cost of Rwp-Isl Metro Bus Service

Table 4.22 Economic Analysis Case 5

CASE 5: IF DAILY RIDERSHIP INCREASES TO 150,000 AND FARE INCREASE TO RS 40/TRIP	
Description	**Analysis**
Average Daily Ridership (1)	150,000
Passenger Fare Cost per trip (2)	Rs 40
Daily Cost received from passengers(3)	Rs 6,000,000 (1 x 2)
Total Trips by busses (4)	596
Trip Length for each bus (5)	22.5 km
Total Trip-Length (6)	13410 km (4 x 5)
Agency Cost per kilometer (7)	Rs 320
Daily Cost given to Agency (8)	Rs 4,291,200 (6 x 7)
Savings to Government per day(9)	Rs 1,708,800 (Rs 1.7 million) (8 - 3)
Savings to Government per year(10)	Rs 623,712,000 (Rs 0.62 billion)
Cost of Construction(11)	Rs 44,000,000,000 (Rs 44 billion)
Breakeven Time	70 years (Approx) (11/10)

By analysis all the cases, it can be concluded that Rwp-Isl MetroBus Service has been costly built and at the present fare per trip, of Rs 20, it is giving Rs 500 million lost per year to government. A comparison is drawn in Table 4.23 between the construction cost and trip cost of similar BRTs around the world.

Table 4.23 Comparison of System Elements with other BRTs

Location	System Length	Construction Cost (US$ Million per km)	Trip Fare (US$)	Daily Demand of Passengers
Guangzhou, China	22.9	4.400	0.30	850,000
Bhopal, India	24.0	2.460	0.43	70,000
Lagos, Nigeria	22.0	1.700	0.97	200,000
Eugene, UK	18.8	3.490	1.75	10,000
Rwp-Isl, Rwp-Isl	22.5	20.00	0.19	150,000

It can be clearly seen for the table that Rwp-Isl Metrobus Service has the lowest construction cost but the trip fare is also the lowest. The lowest trip fare is the prime reason behind the poor economic sustainability of the system.

By assuming several cases and comparing it with BRTs around the world, it can be confidently concluded that Rwp-Isl Metrobus Service is a burden on economy of country. If proper steps are not taken like increasing ridership and trip fare then this project will be on the verge of collapse.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY

This study was carried to evaluate performance of Rawalpindi-Islamabad Metro Bus by conducting different types of survey as well as comparing Rwp-Isl Metrobus Service with international practices. These surveys included General Survey, Route Survey, Origin Destination Survey/Ridership Survey, Travel Time Survey, Travel Length Survey, Hourly Load Survey, and Average Load per Bus Survey etc. Survey data was divided in to two categories i.e. Working days (Mon-Fri) and Weekends (Sat-Sun). Number of parameters were taken under consideration while performing analysis. The research gives a brief overview of various features of Rwp-Isl Metro Bus. It was then followed by route survey which was conducted to get an idea of existing routes, number of buses plying on each route as well as number of trips completed on each route. Origin Destination Survey was conducted to know the travel pattern of passengers from different stations along the route. With the help of OD Matrix, daily ridership of each station was quantified along with daily ridership for the whole day as well as weekly and hourly variation was analyzed. Travel Time was survey was conducted to get information about how many people travel for a specific period of time. Travel Length Survey was conducted to get information is how much kilometer people travel in Metro Bus. Hourly Load Survey was conducted to know that how much passengers are currently present in different stations of the Metro Bus Service. Average Load per bus Survey was carried out to get information about the number of passengers boarding on bus at a particular time. This survey helped in analyzing the time and the Metro Bus stations where the overloading of buses starts. These survey showed that PMS is operating five (05) routes which are serving on average 138,000 people daily. On

average 150,000 people have been served daily on each working day (Mon-Fri) while around 110,000 people are served on weekends. Saddar and Faizabad are the stations which have highest ridership. From Committee Chowk to Faizabad, bus is overloaded with its design capacity. Morning Peak Starts from 8 am to 11 am while evening peak starts from 3 pm to 6 pm. Maximum number of people travel between Rawalpindi and Islamabad and 76% of people travel 12 km daily and has average trip time of 22 mins and average trip length of 8.32 kms. It was then followed by economic sustainability analysis of Rwp-Isl Metrobus Service which aimed at computing operating cost per trip. In the end Rwp-Isl Metrobus Service was compared with international standards such as BRT Standard 2016. In a nutshell this was a comprehensive research which involved a painstaking work of organizing, managing and presenting data.

5.2 CONCLUSIONS

The conclusion drawn from the analysis of data as mentioned in Chapter 4 are classified as follows

- Performance of Rwp-Isl MetroBus Service based on various performance elements is found satisfactory but number of improvements can be made to fully utilize the potential of the system.
- Rwp-Isl Metrobus Service achieved level of Bronze BRT while evaluating it on BRT Standard 2016. This level of achievement is good as compared to Lahore BRT but still a long way to go to compete with the BRT systems around the world
- Rwp-Isl Metrobus Service is burden on economy of country as operating Cost of Rwp-Isl Metrobus Service is Rs 31/trip and only Rs 20/trip is charged from passengers which means that government is giving additional Rs 11/trip as a subsidy. At this rate it is impossible to recover its cost from its generated revenue. Increasing the ridership on weekends as well as increasing cost per trip to at least Rs 31/trip will earn revenues for government.

5.3 RECOMENDATIONS

- Feeder Bus Service must be introduced to increase the model share of Rwp-Isl MetroBus Service. The introduction of a feeder route network in the twin cities will ensure that maximum productivity of PMS can be achieved. It is also recommended that steps should be taken to increase daily ridership on weekends to around 150,000.
- Buses should be optimized for Rawalpindi area to reduce the average load per bus. This will not only increase the comfort of passengers but it will also enhance the safety of passengers.
- The subsidized fare of Rs 20 for Metro Bus Service should be increased to atleast Rs 31/trip. With the increase in ridership and trip fare, it is anticipated that it will increase the sustainability of project and will generate revenues for the government of Pakistan.
- Due to absence of coherent and focused policy regarding Transportation systems the performance of the public transport system is greatly affected. Policy makers should make sound policy for transportation network and must perform an analysis on the supply and demand of public transport system.

5.4 FUTURE RESEARCH

- An analysis of Multan Metro Bus Service
- Analysis of Metro Bus Service using Performance Indicators
- Comparative studies of Pakistan Metro Bus Systems with other Countries

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APPENDICIES

Table A1: ORIGIN DESTINATION MATRIX of 1st March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	363	71	330	762	460	853	831	694	770	2076	248	358	167	1269	0	0	0	0	0	0	0	0	0	0	23	9275
MAR	71	227	34	193	257	372	314	318	304	819	102	145	70	527	0	0	0	0	0	0	0	0	0	0	10	3763
LIB	364	31	256	45	94	175	227	252	205	750	71	92	52	379	0	0	0	0	0	0	0	0	0	0	4	2997
CMC	900	167	42	265	39	243	377	373	451	971	82	156	66	573	0	0	0	0	0	0	0	0	0	0	3	4708
WKR	520	203	113	54	279	34	135	122	151	379	24	54	19	164	0	0	0	0	0	0	0	0	0	0	3	2254
CHN	963	265	173	242	35	295	23	70	144	482	42	74	43	331	0	0	0	1	0	0	0	0	0	0	5	3188
REH	969	258	219	410	83	24	275	35	106	470	76	182	75	415	1	0	0	0	0	0	0	0	0	0	6	3604
6RD	741	254	235	397	104	84	36	267	66	508	77	163	61	363	0	0	0	0	0	0	0	0	0	0	7	3363
SHM	874	278	239	461	134	131	100	50	323	260	41	124	65	382	0	0	0	0	0	0	0	0	0	0	8	3470
FAZ	2358	685	651	972	314	562	473	557	283	820	47	195	107	873	0	0	0	0	0	0	0	0	0	0	41	8938
IJP	299	115	80	114	37	59	93	99	51	72	241	18	32	248	1	0	0	0	0	0	0	0	0	0	5	1564
POT	396	142	128	169	58	106	180	185	163	152	16	284	15	149	0	0	0	0	0	0	0	0	0	0	5	2148
KHJ	223	97	69	81	21	35	83	63	65	107	30	19	202	31	0	0	0	0	0	0	0	0	0	0	1	1127
FAF	668	177	187	279	78	127	156	149	145	292	85	41	9	317	0	0	0	0	0	0	0	0	0	0	5	2715
KSH	0	0	0	0	0	0	0	0	0	0	0	1	0	0	364	0	0	0	0	0	0	0	0	0	0	365
CHH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	137	0	0	0	0	0	0	0	0	0	137
IBN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	12
KAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	0	0	0	0	0	0	55
PIM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	12
STE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	0	0	0	0	0	73
7AV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	316	0	0	0	0	316
SHM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	0	0	0	46
PRG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162	0	1	163
PKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	0	76
UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
∑	9709	2970	2756	4444	1993	3100	3303	3234	3227	8158	1182	1906	983	6021	366	137	12	56	12	73	316	46	162	76	127	54369

Table A2: ORIGIN DESTINATION MATRIX of 2nd March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	343	108	498	1042	671	1256	1548	1307	1536	3094	288	608	825	344	677	673	525	560	1041	954	622	618	589	898	67	20692
MAR	116	284	46	370	357	727	750	691	636	1203	123	277	312	150	300	240	216	201	380	235	177	173	159	261	13	8397
LIB	578	47	262	52	154	292	381	403	464	963	92	158	207	82	176	176	154	107	327	223	163	154	98	186	25	5924
CMC	1146	310	44	283	78	357	591	564	622	1470	114	215	238	79	269	322	209	141	399	276	231	214	206	225	24	8627
WKR	817	305	172	89	225	66	228	219	246	536	36	95	103	40	99	112	79	74	126	124	100	89	68	110	5	4163
CHN	1463	407	287	371	67	339	56	126	236	776	66	155	183	54	139	150	118	123	300	214	135	136	124	160	20	6205
REH	1850	565	416	671	236	64	260	51	264	994	127	236	462	80	227	264	169	179	262	292	166	172	195	239	12	8453
6RD	1455	487	405	666	187	148	45	241	116	872	108	289	469	86	225	286	126	174	250	231	198	185	157	185	13	7604
SHM	1668	513	469	621	237	244	220	141	264	502	63	276	332	110	259	243	176	122	269	248	172	190	123	190	12	7664
FAZ	3211	968	819	1344	424	867	887	940	474	706	50	296	511	273	569	428	356	322	452	417	290	255	205	440	33	15537
IJP	287	156	90	118	36	105	149	173	102	65	240	18	103	44	136	58	70	153	280	278	142	208	155	257	2	3425
POT	591	257	177	250	100	161	240	306	261	246	29	247	74	27	120	89	80	150	334	287	180	314	165	372	6	5063
KHJ	753	253	198	255	90	181	432	471	309	502	138	98	216	8	143	117	74	88	161	217	131	131	73	115	7	5161
FAF	358	135	96	126	45	84	126	96	109	290	85	50	11	189	27	53	47	56	72	164	64	75	53	120	1	2532
KSH	617	223	169	273	94	139	215	241	247	500	176	148	173	21	644	23	30	73	119	210	111	112	120	231	16	4925
CHH	713	249	201	348	99	192	251	259	269	527	93	117	112	31	13	276	8	57	106	211	155	221	148	320	10	4986
IBN	564	244	176	231	97	152	173	149	204	426	123	104	79	37	23	8	189	21	42	88	58	136	99	190	3	3616
KAT	576	199	118	219	83	118	155	201	139	327	181	205	85	34	80	62	28	211	21	75	79	120	101	121	3	3541
PIM	1051	282	290	363	125	273	256	266	252	502	312	306	129	38	106	102	40	25	213	91	112	151	115	182	22	5604
STE	821	264	222	313	118	203	260	261	192	498	295	308	142	111	182	196	73	62	99	254	67	109	129	264	9	5452
7AV	674	189	156	264	83	128	149	203	207	378	199	243	118	56	139	147	78	87	126	72	609	50	85	244	12	4696
SHM	515	179	134	227	102	117	149	180	174	222	196	275	106	61	123	181	120	120	161	113	43	259	20	115	9	3901
PRG	650	210	133	230	67	130	216	192	134	324	209	256	66	57	124	175	97	81	161	171	78	8	223	97	9	4098
PKS	815	284	180	289	107	186	213	172	190	441	265	416	100	62	248	267	176	94	193	237	216	112	100	284	10	5657
UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
∑	21632	7118	5758	9015	3882	6529	7950	7853	7647	16364	3608	5396	5156	2074	5048	4648	3238	3281	5894	5682	4299	4192	3511	5806	343	15924

Table A3: ORIGIN DESTINATION MATRIX of 3rd March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	355	98	359	824	479	1057	1247	1094	1246	3203	265	469	707	292	737	577	503	469	1112	816	605	574	541	824	54	18507
MAR	98	258	51	297	280	561	613	536	572	1252	141	216	262	122	320	227	187	170	419	255	140	162	142	207	24	7512
LIB	449	29	231	45	116	259	286	305	380	787	68	139	155	65	181	135	127	93	332	195	117	107	100	186	31	4918
CMC	962	247	57	258	67	335	473	511	551	1173	111	214	191	72	286	246	129	175	421	238	200	179	130	205	19	7450
WKR	638	253	107	84	243	47	142	154	183	447	20	82	83	35	153	90	59	70	210	116	89	78	57	93	13	3546
CHN	1240	382	272	289	64	323	35	117	244	770	52	109	165	52	225	127	73	105	332	200	115	112	98	140	23	5664
REH	1707	510	373	572	183	30	301	43	259	893	88	200	396	64	322	198	140	115	285	250	125	156	192	197	19	7618
6RD	1332	452	368	539	154	135	53	267	113	868	126	232	407	69	285	211	138	116	241	216	156	173	144	178	15	6988
SHM	1435	503	367	536	172	247	205	125	284	592	62	233	285	112	357	241	169	135	273	254	171	169	138	226	10	7301
FAZ	3179	885	711	1069	397	758	672	868	449	799	49	287	467	221	723	393	279	229	546	405	243	197	191	420	50	14487
IJP	260	141	55	116	29	80	136	155	84	66	212	22	112	44	202	67	72	138	265	262	141	191	122	220	8	3200
POT	488	242	133	187	72	115	167	249	224	321	20	273	66	32	224	93	65	156	256	242	199	251	148	332	8	4563
KHJ	633	241	145	213	63	133	359	354	242	454	137	71	219	8	181	99	56	77	142	206	121	125	58	117	4	4458
FAF	352	125	79	87	47	66	86	97	129	334	53	44	11	222	25	49	32	41	66	118	48	58	42	54	6	2271
KSH	674	257	164	291	136	178	259	277	294	843	226	268	182	26	673	76	83	134	210	287	207	200	183	225	16	6369
CHH	600	261	137	233	90	130	190	258	237	561	102	98	98	30	65	262	5	48	100	201	124	184	129	240	6	4389
IBN	562	221	169	191	76	107	147	140	165	556	121	75	59	32	81	7	216	21	44	62	69	110	73	140	4	3448
KAT	554	212	126	195	47	112	113	145	116	415	194	170	77	21	164	58	18	211	15	60	95	115	95	92	11	3431
PIM	1087	362	286	427	172	277	260	297	299	608	275	241	112	31	267	109	40	8	205	110	134	121	103	139	23	5993
STE	788	268	179	248	106	186	196	190	215	506	297	265	128	89	307	174	63	50	117	219	59	97	116	226	11	5100
7AV	599	170	126	221	98	113	134	196	183	375	227	234	120	51	266	146	67	89	172	61	641	28	72	246	6	4641
SHM	460	168	103	175	77	117	150	133	133	298	206	283	102	54	219	205	104	101	142	115	41	260	24	130	4	3804
PRG	601	202	116	201	67	115	203	170	136	322	178	192	69	33	173	156	77	76	146	138	76	15	215	83	7	3767
PKS	790	235	169	261	96	119	166	159	173	655	305	395	90	39	368	275	161	70	144	205	208	107	81	262	10	5543
UNK	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	6
∑	19844	6722	4883	7559	3331	5600	6593	6840	6911	17099	3535	4812	4563	1816	6804	4221	2863	2901	6195	5231	4124	3769	3194	5182	382	144974

Table A4: ORIGIN DESTINATION MATRIX of 4th March, 2017 (Weekend-Sat)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	330	79	440	961	617	1076	1194	1145	1001	2807	217	523	363	112	442	628	439	429	1286	670	554	448	324	452	63	16600
MAR	101	245	41	322	332	584	593	591	379	1103	103	214	153	53	176	206	180	172	395	180	164	124	107	103	15	6636
LIB	602	35	212	72	174	329	340	397	377	934	79	145	85	37	169	210	148	114	283	167	117	126	67	81	9	5309
CMC	1093	251	62	224	96	383	575	582	581	1477	111	231	115	42	219	344	227	151	335	284	290	160	131	87	18	8069
WKR	781	285	182	96	248	91	220	207	202	551	30	82	43	6	70	148	91	49	180	111	72	103	45	37	7	3937
CHN	1200	380	243	350	60	257	23	95	186	714	66	116	81	23	98	80	101	92	340	152	91	99	60	63	13	4983
REH	1514	425	371	588	192	24	220	34	167	844	114	277	135	42	162	294	155	97	325	233	175	132	96	66	16	6698
6RD	1374	415	383	639	193	117	39	252	90	823	104	261	146	35	178	228	140	147	317	193	138	136	79	71	4	6502
SHM	1112	346	363	564	188	178	158	83	257	373	50	146	110	42	126	166	127	87	255	175	125	121	59	74	10	5295
FAZ	3052	881	830	1623	487	753	735	887	314	709	30	269	232	88	382	356	303	193	531	350	205	172	102	215	27	13726
IJP	249	134	86	153	33	81	111	137	49	54	183	24	59	9	97	65	52	111	344	212	128	148	58	78	2	2657
POT	543	210	130	265	65	116	262	222	157	278	23	264	32	21	48	75	63	96	273	169	165	191	86	129	3	3886
KHJ	399	141	93	154	43	86	132	138	97	228	58	25	217	1	48	52	30	31	108	97	45	56	43	21	6	2349
FAF	122	53	45	49	12	31	46	51	42	125	32	15	2	188	8	10	8	12	49	45	21	18	6	10	0	1000
KSH	366	135	126	231	64	102	150	164	104	369	99	102	53	12	647	21	26	39	102	123	64	79	41	46	12	3277
CHH	634	243	212	381	101	122	249	234	201	454	78	71	48	12	13	273	4	44	88	158	110	129	75	88	12	4034
IBN	538	187	197	263	87	116	179	133	158	431	99	53	31	7	17	5	201	7	52	62	40	80	47	62	6	3058
KAT	443	160	134	172	55	100	101	159	72	262	140	113	34	13	38	37	15	196	14	33	39	69	49	30	4	2482
PIM	1195	303	259	400	171	300	302	288	248	562	293	289	91	23	110	98	31	14	248	102	113	121	68	77	18	5724
STE	667	178	181	290	89	134	201	191	172	446	232	207	68	37	140	118	72	34	73	273	26	65	53	73	19	4039
7AV	615	155	153	328	79	130	163	149	154	326	187	188	44	14	83	110	40	45	111	44	606	16	22	69	7	3838
SHM	431	102	118	173	79	111	127	125	93	251	143	177	45	18	65	137	60	57	128	49	22	224	3	14	5	2757
PRG	368	127	89	159	56	70	111	92	78	177	92	91	20	5	44	72	62	26	67	68	36	5	220	12	6	2153
PKS	397	101	104	137	42	38	86	72	52	242	104	90	12	6	74	77	36	24	73	36	36	29	15	240	8	2131
UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	7	0	0	0	0	0	10
∑	18126	5571	5054	8594	3563	5329	6317	6428	5231	14540	2667	3973	2219	846	3454	3810	2611	2270	5977	3993	3382	2851	1856	2198	290	121150

Table A5: ORIGIN DESTINATION MATRIX of 5th March, 2017 (Weekend-Sun)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	361	65	348	697	458	668	751	659	900	2768	219	402	221	103	743	485	429	250	1024	506	453	303	174	426	86	13499
MAR	78	246	35	280	255	311	367	347	346	1099	79	162	104	53	237	165	167	95	285	156	130	107	64	107	17	5292
LIB	419	32	205	58	112	172	258	236	255	870	82	90	59	46	199	174	118	68	276	133	126	77	64	90	7	4226
CMC	872	233	38	213	79	198	408	386	563	1370	116	212	90	37	355	279	190	102	298	243	182	155	63	115	29	6826
WKR	605	196	126	71	208	20	104	119	177	504	20	66	33	19	167	118	49	57	173	74	81	34	29	28	6	3084
CHN	774	192	152	187	30	220	15	68	128	437	35	71	39	21	170	103	69	51	248	119	65	52	26	62	9	3343
REH	895	234	270	416	97	13	220	22	101	602	50	160	69	32	249	190	143	59	270	122	72	43	31	54	10	4424
6RD	743	234	232	447	94	64	24	240	41	542	64	205	71	39	313	199	90	72	241	88	91	60	37	55	11	4297
SHM	962	280	238	542	126	134	115	48	203	326	30	136	42	28	293	142	128	50	234	111	87	79	43	94	16	4487
FAZ	3395	750	819	1448	437	541	622	748	430	704	29	273	197	129	837	408	414	240	563	312	179	135	102	288	29	14029
IJP	262	92	73	128	21	57	93	103	47	48	205	17	41	19	203	51	67	104	233	170	97	89	49	92	2	2363
POT	390	131	101	224	63	95	156	156	125	199	11	243	19	18	236	59	50	53	179	121	112	91	35	64	4	2935
KHJ	221	103	69	102	19	50	73	54	55	193	35	24	170	1	106	27	21	11	45	37	31	9	9	11	1	1477
FAF	104	52	48	41	17	27	44	32	40	124	23	15	0	181	13	12	17	13	17	28	9	22	6	10	3	898
KSH	598	188	206	360	133	152	263	293	273	779	209	254	96	25	682	60	83	134	182	270	164	127	70	141	13	5755
CHH	495	140	168	301	90	103	164	216	173	345	64	67	22	15	58	235	9	25	83	83	82	74	48	69	5	3134
IBN	442	178	152	240	68	88	148	131	119	326	65	49	14	4	86	1	203	7	35	35	26	25	20	37	6	2505
KAT	232	114	86	136	51	59	64	72	36	198	119	42	12	13	129	21	7	182	5	16	29	41	21	26	0	1711
PIM	855	228	239	313	140	179	206	220	219	482	189	152	29	19	235	66	15	8	264	29	46	41	34	47	16	4271
STE	493	120	138	229	100	94	125	91	90	280	185	119	25	16	250	77	26	22	47	232	9	25	33	36	13	2875
7AV	499	148	130	265	68	84	119	95	122	254	99	110	19	15	218	60	28	20	62	26	567	9	11	43	7	3078
SHM	214	71	63	155	57	60	46	50	52	120	67	63	8	20	148	61	31	25	73	23	8	243	0	12	1	1671
PRG	251	70	39	109	27	59	53	42	53	125	60	48	17	6	81	50	26	27	69	35	12	1	197	9	26	1492
PKS	311	79	76	125	25	47	48	49	74	203	52	57	13	6	125	57	40	15	81	48	32	16	9	250	12	1850
UNK	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
∑	14471	4177	4051	7087	2775	3495	4486	4477	4622	12898	2107	3037	1410	865	6133	3100	2421	1690	4987	3017	2690	1858	1175	2166	329	99524

Table A6: ORIGIN DESTINATION MATRIX of 6th March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	291	134	444	1087	630	1376	1576	1344	1592	3067	303	709	794	326	701	710	506	594	1036	866	628	621	585	901	56	20877
MAR	111	282	41	379	351	708	777	727	659	1064	152	267	329	122	315	265	225	211	363	276	179	214	169	209	21	8416
LIB	564	28	237	54	166	291	400	407	441	849	81	162	198	88	194	213	121	105	279	174	121	129	91	182	8	5583
CMC	1229	309	63	263	88	375	572	511	620	1291	122	231	232	76	305	310	166	152	325	283	203	203	174	192	10	8305
WKR	755	320	194	97	249	69	232	207	299	477	50	100	82	34	120	114	71	63	130	129	94	68	62	101	11	4128
CHN	1454	469	296	371	80	290	62	144	265	841	67	144	178	49	186	150	122	124	302	194	108	106	88	132	16	6238
REH	1816	526	421	681	204	57	234	65	280	940	127	228	420	74	268	251	146	157	279	275	150	171	204	204	16	8194
6RD	1419	479	421	635	210	168	53	251	118	852	130	283	403	75	258	232	117	168	291	261	161	174	156	182	16	7513
SHM	1696	533	477	631	291	280	262	130	258	516	83	267	427	108	307	277	185	143	340	233	189	185	153	193	17	8181
FAZ	3554	937	808	1329	452	992	1058	1197	635	745	63	393	593	266	635	524	440	360	551	472	294	315	260	502	45	17420
IJP	339	161	88	135	43	118	179	204	112	67	229	18	111	38	161	75	91	181	300	314	159	190	164	312	2	3791
POT	684	254	171	236	94	173	234	335	271	295	27	294	81	35	131	100	66	161	233	291	185	253	156	375	8	5143
KHJ	766	271	197	254	81	170	420	444	426	448	143	91	189	9	128	122	66	95	176	173	135	120	90	107	4	5125
FAF	367	125	92	99	49	53	108	99	122	273	72	50	10	202	30	52	47	61	82	101	64	63	62	66	3	2352
KSH	604	241	203	285	106	191	244	247	293	492	214	175	165	44	624	32	41	75	118	204	137	155	127	245	15	5277
CHH	663	263	228	298	94	165	235	268	287	503	101	133	128	30	19	231	7	67	91	196	157	251	193	381	6	4995
IBN	550	224	174	201	84	136	166	166	189	404	110	97	89	31	29	4	206	19	40	86	69	140	75	196	5	3490
KAT	552	174	126	195	70	119	135	212	124	292	177	187	89	47	74	61	18	170	13	65	106	122	87	118	6	3339
PIM	1028	341	289	371	120	236	261	275	309	475	295	236	124	58	114	108	29	7	239	101	114	145	98	167	12	5552
STE	752	249	224	336	97	198	218	253	240	457	285	276	134	76	177	189	77	59	73	212	63	112	111	246	4	5118
7AV	617	192	149	252	80	156	168	182	185	338	206	205	129	48	119	168	61	83	155	90	669	37	80	248	13	4630
SHM	521	150	110	238	90	116	165	163	161	274	186	241	102	58	141	180	114	110	135	127	41	300	26	139	4	3892
PRG	643	210	103	205	71	121	220	184	161	273	183	228	65	49	131	190	95	85	126	157	87	21	281	115	19	4023
PKS	808	227	154	251	110	146	217	177	195	383	281	401	89	53	217	253	153	79	144	206	234	108	92	288	12	5278
UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
∑	21783	7099	5710	8883	3910	6704	8196	8192	8242	15616	3687	5416	5161	1996	5384	4811	3170	3329	5821	5486	4347	4203	3585	5801	329	156861

Table A7: ORIGIN DESTINATION MATRIX of 7th March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	312	86	459	977	617	1234	1454	1249	1473	2917	285	586	761	311	679	639	502	541	1141	911	635	537	599	795	53	19753
MAR	97	263	31	310	372	646	668	665	656	1096	138	275	308	127	312	228	167	199	352	245	168	189	161	226	21	7920
LIB	583	31	218	63	126	305	361	394	416	834	88	166	211	71	193	171	132	140	297	207	117	96	112	183	13	5528
CMC	1103	279	62	282	83	355	542	528	615	1269	91	206	262	71	290	276	149	153	296	229	204	203	161	218	16	7943
WKR	748	307	167	74	210	57	249	203	265	491	28	94	110	31	163	100	73	69	141	129	90	82	55	103	4	4043
CHN	1358	440	279	357	53	264	51	125	252	653	58	142	162	51	167	172	112	124	274	186	125	143	109	138	11	5806
REH	1743	509	393	603	204	45	239	50	211	789	102	256	463	62	285	224	150	164	279	250	167	159	225	205	12	7789
6RD	1359	489	410	556	189	141	45	256	115	850	129	296	442	68	257	248	155	184	264	237	178	172	149	192	8	7389
SHM	1665	536	410	629	261	245	208	127	261	434	72	251	331	104	315	291	151	147	276	233	184	175	163	192	14	7675
FAZ	3136	872	804	1214	386	798	819	979	473	646	37	280	519	205	654	395	328	300	426	398	287	223	219	466	37	14901
IJP	287	168	105	120	32	95	130	173	89	64	234	23	116	49	162	68	68	175	292	257	153	183	166	277	4	3490
POT	616	265	169	234	98	182	244	305	254	275	23	266	80	37	170	85	67	130	232	293	183	267	198	366	6	5045
KHJ	735	274	182	301	98	178	429	448	286	424	181	92	221	6	160	108	70	87	128	186	136	138	79	148	6	5101
FAF	326	148	83	100	37	58	100	80	124	210	66	57	10	183	30	34	34	58	83	117	62	76	68	67	2	2213
KSH	601	196	180	301	157	166	243	242	273	656	194	215	163	33	676	52	63	92	168	300	206	182	161	229	13	5762
CHH	618	273	193	284	106	169	234	253	313	447	83	94	130	33	58	227	1	54	113	183	146	188	169	316	8	4693
IBN	577	213	146	201	70	151	162	180	184	362	108	85	76	31	65	8	170	19	50	87	67	129	81	163	5	3390
KAT	556	237	134	164	62	125	154	184	147	288	200	153	69	34	113	53	7	185	6	66	86	108	96	88	5	3320
PIM	1044	348	283	333	156	281	242	267	271	500	295	250	100	49	195	97	28	12	226	94	123	128	96	176	21	5615
STE	842	250	180	240	115	174	236	236	212	452	299	267	141	95	296	200	97	63	140	221	67	102	126	259	11	5321
7AV	649	192	129	254	56	117	164	196	189	329	183	211	106	58	221	136	73	95	138	84	625	45	80	248	7	4585
SHM	476	150	112	222	96	132	149	170	158	241	186	248	100	55	237	167	113	105	116	108	37	284	19	134	8	3823
PRG	621	211	138	197	81	132	213	174	160	205	195	244	73	40	178	181	100	75	137	134	88	18	227	81	9	3912
PKS	770	259	179	281	109	130	202	194	188	462	263	413	108	63	310	238	168	98	180	230	229	112	93	306	9	5594
UNK	0	0	0	0	1	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5
∑	20822	6996	5446	8297	3775	6181	7538	7678	7586	14894	3539	5170	5062	1867	6187	4398	2978	3269	5755	5385	4363	3939	3612	5576	303	150616

Table A8: ORIGIN DESTINATION MATRIX of 8th March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	325	110	501	993	604	1208	1464	1216	1510	2883	262	545	811	288	577	655	527	506	970	787	616	623	599	821	54	19455
MAR	104	285	34	343	380	696	688	683	628	1057	123	230	282	131	269	277	200	220	389	277	147	164	155	197	16	7975
LIB	558	47	237	52	168	308	352	360	430	905	86	150	225	80	161	176	138	104	270	203	110	119	125	169	7	5540
CMC	1095	283	58	261	99	321	569	593	635	1331	90	220	263	68	231	295	120	132	333	260	210	204	180	201	13	8065
WKR	737	317	179	99	238	76	228	248	255	482	33	100	83	38	72	103	77	82	134	130	85	94	59	93	9	4051
CHN	1331	482	282	310	63	284	44	118	248	687	70	145	194	44	130	150	106	111	280	212	120	129	122	159	23	5844
REH	1707	460	403	605	195	50	236	46	250	917	127	258	485	75	269	278	131	194	277	289	163	144	228	200	13	8000
6RD	1351	516	416	598	213	155	32	250	115	854	108	313	456	69	201	258	115	167	297	234	166	212	155	174	16	7441
SHM	1698	467	406	655	221	265	227	114	273	438	69	237	346	118	233	272	176	147	285	244	186	165	170	215	12	7639
FAZ	3027	893	805	1316	413	837	865	970	463	638	54	277	474	204	454	382	316	309	484	383	249	211	185	397	27	14633
IJP	258	156	98	120	43	96	136	164	73	60	204	22	111	47	118	80	64	153	264	257	149	208	165	264	8	3318
POT	605	245	150	244	105	156	252	288	254	246	30	307	68	37	102	76	70	149	205	255	187	241	165	363	5	4805
KHJ	728	267	205	281	94	191	426	422	302	452	181	98	206	14	126	121	51	90	167	181	134	115	86	140	4	5082
FAF	344	147	97	86	38	81	108	120	121	230	68	43	10	193	25	61	25	44	82	98	59	83	50	85	2	2300
KSH	444	218	138	231	67	111	221	198	199	452	158	154	144	33	584	20	28	63	98	131	103	135	114	167	5	4216
CHH	623	256	196	327	80	169	266	272	265	447	91	131	142	30	21	252	1	49	95	175	142	189	163	282	15	4679
IBN	605	229	146	182	68	145	154	154	185	406	96	98	73	25	22	6	189	20	30	74	59	141	83	169	3	3362
KAT	503	206	122	178	65	102	150	187	144	314	174	184	94	36	64	48	14	176	16	60	75	129	90	126	3	3260
PIM	1037	325	255	363	118	271	263	264	257	495	271	231	131	44	89	99	28	8	304	94	103	130	107	168	10	5465
STE	784	244	181	257	143	187	267	244	248	444	269	276	130	60	136	146	58	63	116	227	71	83	133	250	4	5021
7AV	659	223	126	245	94	165	168	222	209	321	198	215	105	52	99	148	62	71	131	79	678	60	77	245	2	4654
SHM	473	156	123	211	93	125	154	192	160	220	188	223	105	59	132	213	126	90	114	96	39	279	18	130	4	3723
PRG	652	214	128	206	69	126	216	186	162	291	203	229	51	45	127	199	99	79	150	176	65	20	234	83	6	4016
PKS	802	248	158	290	96	162	194	179	185	420	252	414	97	54	196	251	162	97	165	234	206	118	56	237	5	5278
UNK	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	5
∑	20450	6995	5444	8453	3767	6287	7680	7692	7571	14990	3405	5100	5086	1844	4438	4566	2883	3125	5656	5156	4122	3996	3519	5336	266	147827

Table A9: ORIGIN DESTINATION MATRIX of 9th March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	336	109	457	956	585	1283	1409	1200	1478	2938	281	588	781	257	575	676	460	515	967	875	623	579	593	831	63	19415
MAR	85	267	40	332	382	740	703	623	631	1178	129	255	304	128	259	230	198	196	363	243	184	164	171	201	12	8018
LIB	548	36	265	64	140	297	350	358	389	866	93	173	227	72	153	180	126	135	258	219	132	124	119	169	18	5511
CMC	1116	296	55	287	96	333	535	560	598	1409	124	245	248	83	244	340	154	155	373	299	219	182	183	184	24	8342
WKR	727	342	198	75	217	63	213	213	262	539	37	90	91	38	89	100	80	83	148	146	114	69	58	100	7	4099
CHN	1454	453	283	347	70	265	40	119	258	802	78	118	172	46	134	152	108	99	302	187	120	121	128	131	13	6000
REH	1710	496	374	602	189	55	225	59	261	932	104	263	460	91	225	248	169	158	254	253	174	164	207	190	13	7876
6RD	1373	449	354	623	203	128	52	249	136	905	91	277	441	87	214	231	167	144	256	269	171	211	152	195	15	7393
SHM	1575	594	408	633	262	254	215	146	256	553	97	254	324	121	234	284	173	134	328	262	190	174	161	184	15	7831
FAZ	2954	864	786	1263	453	851	798	915	477	752	59	308	475	208	433	424	319	318	415	411	288	208	222	415	25	14641
IJP	271	142	85	148	30	110	122	156	92	76	175	15	114	40	102	77	74	175	251	258	127	181	160	245	2	3228
POT	667	247	186	251	105	147	263	322	242	286	21	263	70	34	101	82	65	148	219	284	195	255	167	362	7	4989
KHJ	693	318	194	295	81	167	390	479	265	451	168	88	209	13	125	135	63	105	166	205	130	115	62	131	2	5050
FAF	323	142	94	103	41	76	122	114	121	279	73	48	7	221	32	43	33	57	112	103	61	73	46	49	2	2375
KSH	454	190	120	259	95	112	197	194	221	459	157	140	151	29	673	28	21	40	85	145	105	132	102	169	18	4296
CHH	641	274	221	344	103	177	235	249	298	481	102	136	128	29	19	230	4	60	114	176	151	166	156	255	8	4757
IBN	538	248	149	212	83	130	209	156	200	397	121	75	79	39	22	6	222	16	34	70	62	115	102	173	5	3463
KAT	517	208	145	177	65	118	136	174	142	349	181	190	88	39	51	65	15	224	8	70	68	108	88	96	5	3327
PIM	942	278	258	344	133	304	242	252	262	523	268	238	126	33	85	117	28	19	206	83	103	138	96	134	13	5225
STE	850	231	187	346	120	206	258	267	257	467	288	318	144	87	140	183	76	61	91	247	73	108	105	210	11	5331
7AV	679	215	117	248	117	141	181	188	208	392	181	205	109	45	96	147	70	62	111	87	780	44	62	275	12	4772
SHM	445	160	102	194	95	139	150	193	143	246	168	242	103	46	138	156	107	93	137	124	38	224	7	128	5	3583
PRG	629	200	135	247	82	144	210	165	150	275	205	227	60	37	92	164	103	80	133	155	73	13	222	90	6	3897
PKS	792	249	177	233	105	136	195	201	187	417	253	379	118	52	202	258	142	80	158	241	217	123	79	282	7	5283
UNK	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
∑=	20319	7008	5390	8583	3852	6376	7450	7552	7534	15973	3454	5135	5029	1875	4438	4556	2977	3157	5489	5412	4398	3791	3448	5199	308	148703

Table A10: ORIGIN DESTINATION MATRIX of 10th March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	315	81	342	842	509	1097	1129	984	1422	2975	302	536	707	303	702	632	492	441	1119	805	579	545	560	747	59	18225
MAR	80	243	38	283	329	595	542	548	621	1204	130	249	277	117	278	221	201	164	381	275	193	152	167	208	25	7521
LIB	444	32	205	56	139	250	263	317	335	748	60	137	150	66	174	163	101	96	315	213	89	117	95	135	14	4714
CMC	1047	263	54	300	79	294	506	464	551	1180	94	169	224	81	318	228	142	136	412	216	216	200	176	195	25	7570
WKR	643	241	130	87	232	48	169	169	217	468	31	78	86	54	152	82	62	55	205	108	96	82	51	120	10	3676
CHN	1220	364	206	305	46	252	33	107	224	750	38	113	140	46	144	146	85	106	331	199	123	101	96	123	15	5313
REH	1374	431	295	541	153	44	213	36	189	836	98	220	421	71	312	189	136	137	232	266	146	153	185	172	16	6866
6RD	1223	457	311	452	164	120	34	242	117	918	96	273	409	74	245	255	99	132	263	293	172	144	155	153	6	6807
SHM	1643	473	367	551	192	218	192	90	272	654	67	257	286	106	311	258	139	127	344	262	165	163	137	212	9	7495
FAZ	3126	933	687	1093	440	739	708	825	442	667	54	335	420	222	661	422	293	267	524	414	285	233	182	353	36	14361
IJP	276	152	67	118	40	86	120	134	90	66	233	30	111	28	155	83	68	149	248	283	163	172	164	259	4	3299
POT	580	224	132	172	87	117	211	283	235	316	22	310	81	48	222	96	76	131	259	256	145	226	171	307	2	4709
KHJ	639	240	130	201	62	117	342	369	254	486	128	61	201	10	156	110	75	62	174	188	119	123	68	121	8	4444
FAF	374	126	85	96	45	65	117	96	103	347	69	55	12	227	44	36	25	34	62	91	60	76	45	54	3	2347
KSH	616	238	168	309	157	169	287	258	273	805	190	263	184	29	679	51	87	118	169	280	174	146	162	215	15	6042
CHH	590	226	174	251	58	141	221	264	268	614	108	97	123	31	77	247	4	41	97	177	133	170	134	287	9	4542
IBN	545	215	126	162	73	131	130	152	159	551	122	76	85	27	89	13	237	16	30	68	59	92	76	159	6	3399
KAT	442	179	100	172	68	105	118	147	108	405	173	153	61	23	132	49	13	203	12	72	82	107	75	88	0	3087
PIM	1007	308	275	378	193	263	231	254	301	479	284	254	103	29	248	86	21	10	240	105	111	117	112	175	17	5601
STE	775	241	174	239	100	160	232	240	214	562	333	305	150	79	316	208	61	60	113	258	63	114	102	227	6	5332
7AV	662	201	141	227	90	139	143	172	191	422	179	210	96	55	227	156	61	68	167	66	607	28	64	215	9	4596
SHM	486	145	101	190	70	115	149	133	144	269	196	208	111	60	180	184	99	74	125	132	24	274	18	131	4	3622
PRG	655	182	114	218	69	119	176	193	127	321	223	197	42	30	168	144	87	67	112	130	82	10	254	114	3	3837
PKS	768	239	139	245	90	127	155	147	190	644	349	378	99	48	332	304	160	84	208	223	186	127	85	269	7	5603
UNK	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2
∑=	19530	6434	4561	7488	3485	5511	6421	6624	7047	16687	3579	4965	4579	1864	6322	4363	2824	2778	6142	5380	4072	3672	3334	5040	308	143010

Table A11: ORIGIN DESTINATION MATRIX of 11th March, 2017 (Weekend-Sat)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	316	94	481	973	610	1126	1267	1082	1027	2741	272	513	347	115	437	632	492	368	1214	653	545	412	365	396	75	16553
MAR	110	254	53	330	377	593	576	541	374	1095	132	224	128	62	168	246	170	166	378	170	164	159	81	133	7	6691
LIB	625	37	229	81	183	247	341	404	358	1027	90	150	99	45	129	221	116	93	307	178	158	119	89	99	14	5439
CMC	1133	275	49	285	86	324	525	569	591	1504	127	244	133	27	162	333	226	167	387	281	240	226	106	108	23	8131
WKR	766	285	196	79	212	64	212	162	206	489	37	92	69	6	73	110	69	57	155	140	103	82	35	41	7	3747
CHN	1195	369	272	342	48	254	35	110	201	640	64	123	66	28	106	140	85	61	297	154	89	107	64	67	20	4937
REH	1508	400	357	552	174	38	230	36	164	792	109	269	126	47	142	299	163	121	416	220	146	126	105	80	17	6637
6RD	1164	394	372	540	164	119	33	251	80	873	75	239	135	42	121	241	131	99	316	209	151	110	80	87	3	6029
SHM	1196	356	354	583	196	189	156	89	279	389	46	189	105	40	151	179	147	82	309	185	136	115	66	81	12	5630
FAZ	2784	779	892	1529	518	635	712	880	344	635	39	308	190	111	422	355	299	244	542	322	266	164	125	218	32	13345
IJP	275	141	98	102	38	94	121	123	56	55	214	15	72	14	75	63	56	113	301	201	135	136	72	86	3	2659
POT	570	211	164	260	98	104	244	266	143	271	24	279	26	16	75	85	70	103	306	207	129	141	85	97	4	3978
KHJ	313	157	90	150	54	88	118	132	76	203	57	35	176	2	58	42	31	37	123	76	57	47	26	26	2	2176
FAF	131	72	53	38	15	38	46	57	48	139	33	19	2	190	13	20	8	8	31	37	10	22	16	9	0	1055
KSH	358	136	119	179	71	88	113	122	125	406	117	96	46	19	661	20	15	21	84	97	77	69	35	53	10	3137
CHH	586	216	239	327	119	151	273	244	169	464	72	78	48	14	16	230	12	25	92	129	112	87	95	69	6	3873
IBN	537	196	151	248	71	103	166	154	162	399	68	86	37	10	18	7	224	10	36	69	53	74	49	63	5	2996
KAT	425	165	118	179	70	92	119	149	88	299	119	106	21	7	22	25	11	206	15	37	51	47	36	24	4	2435
PIM	1125	288	279	444	141	246	367	305	258	578	248	279	108	27	96	113	31	21	235	66	109	121	81	68	12	5646
STE	694	186	153	294	103	150	220	202	197	442	243	220	69	28	130	152	38	37	71	249	19	42	62	60	9	4070
7AV	552	197	173	319	89	131	149	160	157	367	145	172	50	19	84	105	53	54	128	30	638	6	25	55	14	3872
SHM	384	101	101	243	90	92	110	93	91	206	136	147	36	13	45	116	56	56	118	46	10	277	3	17	3	2590
PRG	400	107	91	135	46	87	127	75	66	166	91	116	22	12	47	78	51	32	89	67	33	4	198	12	5	2157
PKS	378	90	81	153	43	60	72	66	81	233	100	78	18	10	72	73	58	30	97	59	40	19	14	284	5	2214
UNK	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
∑	17525	5507	5165	8366	3616	5113	6332	6272	5341	14413	2658	4077	2129	904	3323	3885	2612	2211	6047	3882	3471	2712	1913	2233	292	119999

Table A12: ORIGIN DESTINATION MATRIX of 12th March, 2017 (Weekend-Sun)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	298	87	377	816	480	733	910	746	992	2821	237	436	206	104	638	544	486	337	1079	548	491	266	178	435	61	14306
MAR	81	223	38	259	247	343	381	364	307	992	85	132	107	57	251	192	186	114	396	148	122	96	44	124	13	5302
LIB	475	22	245	51	118	198	284	237	317	944	89	152	93	26	209	186	163	87	259	139	83	66	50	97	21	4611
CMC	964	185	52	255	70	269	449	453	574	1485	111	250	67	37	325	304	216	147	326	215	197	154	53	105	25	7288
WKR	600	188	119	74	209	47	130	120	170	544	38	84	29	27	135	87	92	39	195	75	78	50	39	37	3	3209
CHN	843	210	159	195	34	242	9	49	129	494	24	74	49	24	181	109	115	61	260	96	73	42	35	43	12	3562
REH	1074	248	234	520	98	24	203	28	100	676	74	200	69	30	332	216	121	77	260	149	110	79	46	78	11	5057
6RD	786	256	250	480	109	76	28	220	52	630	69	199	66	34	297	149	144	76	251	125	59	60	57	94	7	4574
SHM	1036	246	346	622	192	118	123	48	262	357	34	128	43	35	329	157	149	63	287	132	89	56	46	95	14	5007
FAZ	3128	830	881	1501	501	547	716	867	468	667	49	271	201	129	810	393	434	303	446	374	247	173	100	289	38	14363
IJP	271	102	70	147	25	55	106	95	74	64	214	15	29	34	185	76	91	67	298	162	118	88	53	101	8	2548
POT	376	127	132	249	72	77	202	172	115	221	16	273	15	18	235	63	59	56	181	144	77	74	51	64	7	3076
KHJ	201	88	76	102	22	49	54	68	70	168	54	15	196	2	78	39	24	10	51	33	27	13	21	9	0	1470
FAF	140	87	37	50	34	27	47	37	38	148	37	15	0	173	20	9	13	13	25	32	18	17	3	10	0	1030
KSH	545	217	223	344	152	162	275	292	305	743	246	297	77	20	601	63	94	151	248	276	200	104	78	126	11	5850
CHH	512	185	191	333	100	116	194	150	190	421	74	61	25	12	58	230	13	22	98	91	84	70	72	98	3	3403
IBN	589	212	159	277	86	128	155	161	145	440	104	69	21	8	123	6	220	3	34	32	50	30	27	55	8	3142
KAT	328	103	90	164	40	57	80	84	73	248	77	62	20	10	153	18	6	158	15	27	33	29	13	20	5	1913
PIM	931	261	240	352	166	194	248	218	277	415	209	189	45	16	260	73	37	16	214	87	65	81	38	60	13	4705
STE	602	133	135	273	69	110	130	122	124	332	186	125	30	25	290	82	34	20	81	243	12	20	21	57	6	3262
7AV	515	115	108	261	87	100	114	89	108	294	102	88	36	14	211	73	42	29	118	20	542	3	11	52	3	3135
SHM	311	57	55	153	57	49	58	58	59	115	84	67	15	12	116	51	24	28	54	22	6	204	0	7	11	1673
PRG	199	48	46	109	43	42	58	43	39	89	69	61	10	7	104	70	27	18	49	32	11	1	169	10	2	1356
PKS	366	82	64	83	35	45	49	86	72	242	82	51	8	7	148	64	23	12	73	45	44	7	13	230	6	1937
UNK	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
∑	15171	4312	4328	7670	3046	3808	5003	4807	5060	13550	2364	3314	1457	861	6089	3254	2813	1907	5298	3247	2836	1783	1218	2296	288	105780

Table A13: ORIGIN DESTINATION MATRIX of 13th March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	336	109	457	956	585	1283	1409	1200	1478	2938	281	588	781	257	575	676	460	515	967	875	623	579	593	831	63	19415
MAR	85	267	40	332	382	740	703	623	631	1178	129	255	304	128	259	230	198	196	363	243	184	164	171	201	12	8018
LIB	548	36	265	64	140	297	350	358	389	866	93	173	227	72	153	180	126	135	258	219	132	124	119	169	18	5511
CMC	1116	296	55	287	96	333	535	560	598	1409	124	245	248	83	244	340	154	155	373	299	219	182	183	184	24	8342
WKR	727	342	198	75	217	63	213	213	262	539	37	90	91	38	89	100	80	83	148	146	114	69	58	100	7	4099
CHN	1454	453	283	347	70	265	40	119	258	802	78	118	172	46	134	152	108	99	302	187	120	121	128	131	13	6000
REH	1710	496	374	602	189	55	225	59	261	932	104	263	460	91	225	248	169	158	254	253	174	164	207	190	13	7876
6RD	1373	449	354	623	203	128	52	249	136	905	91	277	441	87	214	231	167	144	256	269	171	211	152	195	15	7393
SHM	1575	594	408	633	262	254	215	146	256	553	97	254	324	121	234	284	173	134	328	262	190	174	161	184	15	7831
FAZ	2954	864	786	1263	453	851	798	915	477	752	59	308	475	208	433	424	319	318	415	411	288	208	222	415	25	14641
IJP	271	142	85	148	30	110	122	156	92	76	175	15	114	40	102	77	74	175	251	258	127	181	160	245	2	3228
POT	667	247	186	251	105	147	263	322	242	286	21	263	70	34	101	82	65	148	219	284	195	255	167	362	7	4989
KHJ	693	318	194	295	81	167	390	479	265	451	168	88	209	13	125	135	63	105	166	205	130	115	62	131	2	5050
FAF	323	142	94	103	41	76	122	114	121	279	73	48	7	221	32	43	33	57	112	103	61	73	46	49	2	2375
KSH	454	190	120	259	95	112	197	194	221	459	157	140	151	29	673	28	21	40	85	145	105	132	102	169	18	4296
CHH	641	274	221	344	103	177	235	249	298	481	102	136	128	29	19	230	4	60	114	176	151	166	156	255	8	4757
IBN	538	248	149	212	83	130	209	156	200	397	121	75	79	39	22	6	222	16	34	70	62	115	102	173	5	3463
KAT	517	208	145	177	65	118	136	174	142	349	181	190	88	39	51	65	15	224	8	70	68	108	88	96	5	3327
PIM	942	278	258	344	133	304	242	252	262	523	268	238	126	33	85	117	28	19	206	83	103	138	96	134	13	5225
STE	850	231	187	346	120	206	258	267	257	467	288	318	144	87	140	183	76	61	91	247	73	108	105	210	11	5331
7AV	679	215	117	248	117	141	181	188	208	392	181	205	109	45	96	147	70	62	111	87	780	44	62	275	12	4772
SHM	445	160	102	194	95	139	150	193	143	246	168	242	103	46	138	156	107	93	137	124	38	224	7	128	5	3583
PRG	629	200	135	247	82	144	210	165	150	275	205	227	60	37	92	164	103	80	133	155	73	13	222	90	6	3897
PKS	792	249	177	233	105	136	195	201	187	417	253	379	118	52	202	258	142	80	158	241	217	123	79	282	7	5283
UNK	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
∑	20319	7008	5390	8583	3852	6376	7450	7552	7534	15973	3454	5135	5029	1875	4438	4556	2977	3157	5489	5412	4398	3791	3448	5199	308	148703

Table A14: ORIGIN DESTINATION MATRIX of 14th March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	306	94	518	955	574	1181	1412	1268	1544	2896	322	596	748	340	679	672	520	521	989	885	599	618	578	786	61	19662
MAR	111	278	44	335	352	662	684	627	685	1101	134	246	305	115	342	240	159	208	415	267	148	160	159	225	16	8018
LIB	613	47	212	54	152	280	376	386	392	864	102	157	212	67	225	205	127	116	276	211	106	138	103	165	9	5595
CMC	1126	268	50	243	72	337	557	574	645	1232	116	220	218	94	343	265	160	156	315	259	215	173	167	210	21	8036
WKR	760	297	173	80	224	76	192	191	291	508	27	80	89	42	163	94	75	70	132	126	80	68	66	102	16	4022
CHN	1376	437	254	347	56	261	37	128	254	769	73	132	161	43	190	131	92	122	298	202	118	120	113	127	8	5849
REH	1729	559	429	598	177	55	235	54	248	841	121	241	434	91	280	212	149	148	302	280	150	137	195	180	18	7863
6RD	1446	462	390	589	178	148	46	254	99	782	122	259	434	79	256	237	130	151	281	259	146	161	145	187	9	7250
SHM	1595	572	410	720	264	271	240	117	236	478	61	297	335	116	318	278	183	124	316	245	181	172	150	181	8	7868
FAZ	3127	944	786	1177	410	803	778	1020	471	684	59	273	486	212	680	437	361	317	490	423	290	236	189	457	36	15146
IJP	333	151	98	130	39	96	146	140	89	62	230	14	98	43	166	77	74	183	266	283	149	182	166	261	3	3479
POT	593	294	185	231	81	132	260	309	299	222	18	275	56	39	175	94	64	174	224	273	178	240	135	353	13	4917
KHJ	685	272	172	231	79	156	404	398	295	373	153	72	245	12	182	113	65	80	171	198	124	118	76	121	9	4804
FAF	358	120	97	130	41	68	114	129	120	266	71	47	12	211	30	42	39	40	83	84	72	64	50	68	4	2360
KSH	565	253	213	310	145	151	257	261	304	690	212	188	146	41	725	67	102	109	181	268	224	205	190	233	16	6056
CHH	666	265	213	303	85	167	254	242	265	465	93	85	97	29	59	221	13	48	114	197	157	162	145	325	3	4673
IBN	574	224	175	225	69	141	183	146	220	402	131	103	72	28	116	9	201	19	40	85	64	118	68	152	5	3570
KAT	513	219	101	183	65	138	168	178	131	320	181	214	89	34	143	59	19	194	18	91	75	110	91	99	3	3436
PIM	963	290	260	345	128	288	270	255	286	467	260	266	113	61	225	107	41	16	224	76	116	126	117	172	21	5493
STE	826	260	228	277	113	191	239	254	224	377	281	296	127	78	297	189	76	79	88	215	60	95	114	274	6	5264
7AV	633	189	153	244	75	148	183	162	210	387	197	213	127	58	230	161	75	85	121	72	651	41	65	230	4	4714
SHM	505	149	110	192	88	107	135	158	149	228	164	208	101	55	215	149	97	105	137	135	46	260	16	115	9	3633
PRG	632	169	126	193	78	129	200	143	173	257	179	196	61	37	191	151	97	88	142	128	56	11	233	74	8	3752
PKS	825	238	160	281	99	153	203	171	175	408	274	391	86	57	313	270	159	93	197	220	208	92	80	274	12	5439
UNK	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
∑	20861	7051	5557	8373	3644	6139	7573	7565	7805	15079	3581	5069	4852	1982	6543	4480	3078	3246	5821	5482	4213	3807	3411	5371	318	150901

Table A15: ORIGIN DESTINATION MATRIX of 15th March, 2017 (Working Day)

	SAD	MAR	LIB	CMC	WKR	CHN	REH	6RD	SHM	FAZ	IJP	POT	KHJ	FAF	KSH	CHH	IBN	KAT	PIM	STE	7AV	SHM	PRG	PKS	UNK	∑
SAD	373	116	458	1000	677	1142	1379	1289	1555	3018	301	598	796	307	565	717	578	538	1060	856	628	626	519	791	58	19945
MAR	114	230	36	351	352	687	630	726	673	1131	138	241	308	114	280	247	181	198	364	233	154	174	149	205	11	7927
LIB	593	45	227	69	154	309	399	388	418	818	82	164	198	66	186	203	130	115	264	224	117	123	107	187	18	5604
CMC	1133	305	77	281	106	347	523	551	659	1313	109	197	245	93	239	298	190	142	331	293	212	196	158	170	25	8193
WKR	802	312	208	99	237	70	203	219	290	480	33	89	108	38	87	105	75	81	121	131	89	87	66	104	1	4135
CHN	1378	481	278	373	75	255	39	107	244	664	60	160	158	46	135	141	109	131	294	179	146	127	112	128	15	5835
REH	1694	487	414	616	205	27	220	39	201	747	121	264	482	87	212	222	152	168	283	274	159	165	184	195	9	7627
6RD	1447	451	389	630	188	126	32	271	131	805	93	289	459	65	238	222	163	175	300	248	161	145	130	191	8	7357
SHM	1696	540	408	658	286	243	222	123	259	497	61	247	346	112	259	258	194	130	253	220	196	162	126	204	6	7706
FAZ	3189	857	734	1299	429	764	694	1066	536	648	40	327	513	234	463	448	370	276	461	382	273	245	187	415	26	14876
IJP	317	193	95	122	30	92	136	173	86	63	229	27	112	39	98	63	77	175	246	311	124	174	153	263	4	3402
POT	543	255	164	239	98	160	259	325	243	260	26	296	66	30	118	75	60	142	254	272	183	200	122	319	8	4717
KHJ	738	255	174	254	97	169	415	458	312	395	152	61	197	9	123	136	72	81	169	188	139	127	86	148	5	4960
FAF	318	152	101	110	47	72	103	97	119	251	89	52	8	160	32	36	46	47	106	84	75	64	52	73	0	2294
KSH	463	202	156	197	77	133	175	166	210	446	170	146	162	35	640	22	16	53	91	158	121	124	103	191	16	4273
CHH	725	253	211	313	99	158	238	253	254	509	96	96	129	32	16	247	3	53	109	183	137	160	154	298	7	4733
IBN	639	233	162	252	64	141	183	166	204	407	111	95	90	36	25	6	193	13	45	81	60	90	65	162	8	3531
KAT	591	200	117	165	78	113	138	223	132	314	188	179	76	46	64	50	17	207	8	90	68	133	104	128	10	3439
PIM	1016	302	239	330	123	261	281	264	268	500	279	282	98	61	88	89	37	9	232	106	121	129	121	169	7	5412
STE	808	229	212	328	115	181	237	220	216	447	275	334	129	76	182	195	84	63	101	262	70	93	80	223	17	5177
7AV	617	200	148	324	91	137	167	191	208	346	165	182	115	56	124	148	74	86	152	79	694	50	70	257	6	4687
SHM	502	179	123	189	81	130	127	171	141	205	169	202	102	57	109	149	86	111	142	117	35	253	13	96	1	3490
PRG	652	181	146	217	82	127	217	172	141	247	191	186	78	40	123	130	109	60	145	111	79	14	282	129	8	3867
PKS	794	243	176	232	105	137	183	178	182	436	257	394	100	45	220	271	157	95	189	204	215	111	66	263	6	5259
UNK	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
∑	21143	6901	5453	8648	3896	5981	7200	7836	7682	14947	3435	5108	5075	1884	4626	4478	3173	3149	5720	5286	4256	3772	3209	5309	280	148447

Table B1: Trip Length of 1st March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	7819	30.67	7765	33.64	15584	32.08
4 - 8	11387	44.66	10018	43.41	21405	44.07
8 - 12	5020	19.69	4629	20.06	9649	19.86
12 - 16	1269	4.98	668	2.89	1937	3.99
16 - 20	0	0.00	0	0.00	0	0.00
20 - 24	0	0.00	0	0.00	0	0.00
AVERAGE TRIP LENGTH	**5.96**		**5.69**		**5.83**	
PASSENGER KMs	**151,926**		**131,280**		**283,206**	

Table B2: Trip Length of 2nd March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	15945	21.64	16401	21.98	32346	21.81
4 - 8	24658	33.46	24499	32.83	49157	33.14
8 - 12	14933	20.26	15384	20.62	30317	20.44
12 - 16	10288	13.96	10401	13.94	20689	13.95
16 - 20	5936	8.05	6011	8.05	11947	8.05
20 - 24	1934	2.62	1929	2.58	3863	2.60
AVERAGE TRIP LENGTH	**8.45**		**8.44**		**8.44**	
PASSENGER KMs	**622,596**		**629,886**		**1,252,482**	

Table B3: Trip Length of 3rd March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	14576	21.68	14894	21.29	29470	21.48
4 - 8	21881	32.55	22892	32.72	44773	32.64
8 - 12	13928	20.72	14694	21.00	28622	20.87
12 - 16	9665	14.38	10215	14.60	19880	14.49
16 - 20	5409	8.05	5470	7.82	10879	7.93
20 - 24	1758	2.62	1795	2.57	3553	2.59
AVERAGE TRIP LENGTH	**8.50**		**8.51**		**8.50**	
PASSENGER KMs	**571,066**		**595,040**		**1,166,106**	

Table B4: Trip Length of 4th March, 2017 (Weekend-Sat)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	12848	22.87	12927	22.39	25775	22.63
4 - 8	18353	32.67	18784	32.53	37137	32.60
8 - 12	11445	20.37	12112	20.98	23557	20.68
12 - 16	7746	13.79	8018	13.89	15764	13.84
16 - 20	4825	8.59	4928	8.53	9753	8.56
20 - 24	960	1.71	970	1.68	1930	1.69
AVERAGE TRIP LENGTH	**8.31**		**8.35**		**8.33**	
PASSENGER KMs	**466,678**		**481,974**		**948,652**	

Table B5: Trip Length of 5th March, 2017 (Weekend-Sun)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	9510	20.58	10239	22.10	19749	21.35
4 - 8	15800	34.20	15207	32.83	31007	33.51
8 - 12	9856	21.33	10261	22.15	20117	21.74
12 - 16	6504	14.08	6336	13.68	12840	13.88
16 - 20	3732	8.08	3560	7.69	7292	7.88
20 - 24	797	1.73	717	1.55	1514	1.64
AVERAGE TRIP LENGTH	**8.40**		**8.27**		**8.33**	
PASSENGER KMs	**388,146**		**382,888**		**771,034**	

Table B6: Trip Length of 6th March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	16312	21.96	17502	23.33	33814	22.65
4 - 8	24805	33.39	24197	32.26	49002	32.82
8 - 12	15416	20.75	15616	20.82	31032	20.79
12 - 16	10213	13.75	10197	13.60	20410	13.67
16 - 20	5669	7.63	5661	7.55	11330	7.59
20 - 24	1877	2.53	1832	2.44	3709	2.48
AVERAGE TRIP LENGTH	**8.37**		**8.28**		**8.33**	
PASSENGER KMs	**621,932**		**621,306**		**1,243,238**	

Table B7: Trip Length of 7th March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	15160	21.40	16032	22.12	31192	21.77
4 - 8	23714	33.48	23743	32.76	47457	33.12
8 - 12	14618	20.64	15213	20.99	29831	20.82
12 - 16	9864	13.92	9884	13.64	19748	13.78
16 - 20	5681	8.02	5765	7.96	11446	7.99
20 - 24	1803	2.55	1829	2.52	3632	2.53
AVERAGE TRIP LENGTH	**8.45**		**8.40**		**8.43**	
PASSENGER KMs	**598,804**		**609,036**		**1,207,840**	

Table B8: Trip Length of 8th March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	15179	21.82	15671	22.11	30850	21.96
4 - 8	23182	33.32	23154	32.66	46336	32.99
8 - 12	14163	20.36	14548	20.52	28711	20.44
12 - 16	9771	14.04	9919	13.99	19690	14.02
16 - 20	5493	7.90	5733	8.09	11226	7.99
20 - 24	1786	2.57	1860	2.62	3646	2.60
AVERAGE TRIP LENGTH	**8.42**		**8.45**		**8.43**	
PASSENGER KMs	**586,040**		**598,726**		**1,184,766**	

Table B9: Trip Length of 9th March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	15345	21.95	15722	22.08	31067	22.02
4 - 8	23178	33.16	23190	32.57	46368	32.86
8 - 12	14289	20.44	14877	20.89	29166	20.67
12 - 16	9793	14.01	9954	13.98	19747	14.00
16 - 20	5497	7.86	5611	7.88	11108	7.87
20 - 24	1794	2.57	1847	2.59	3641	2.58
AVERAGE TRIP LENGTH	8.41		8.43		8.42	
PASSENGER KMs	588,164		600,342		1,188,506	

Table B10: Trip Length of 10th March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	14443	21.67	14491	21.04	28934	21.35
4 - 8	21605	32.41	22686	32.94	44291	32.68
8 - 12	14047	21.07	14615	21.22	28662	21.15
12 - 16	9437	14.16	9828	14.27	19265	14.22
16 - 20	5471	8.21	5446	7.91	10917	8.06
20 - 24	1650	2.48	1801	2.62	3451	2.55
AVERAGE TRIP LENGTH	8.49		8.52		8.50	
PASSENGER KMs	565,882		586,490		1,152,372	

Table B11: Trip Length of 11th March, 2017 (Weekend-Sat)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	12581	22.48	12688	22.37	25269	22.42
4 - 8	18474	33.00	18473	32.57	36947	32.78
8 - 12	11310	20.21	11841	20.88	23151	20.54
12 - 16	7869	14.06	7900	13.93	15769	13.99
16 - 20	4749	8.48	4872	8.59	9621	8.54
20 - 24	993	1.77	949	1.67	1942	1.72
AVERAGE TRIP LENGTH	8.34		8.35		8.34	
PASSENGER KMs	466,600		473,798		940,398	

Table B12: Trip Length of 12th March, 2017 (Weekend-Sun)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	10479	21.26	11136	22.41	21615	21.83
4 - 8	16866	34.21	16572	33.34	33438	33.78
8 - 12	10320	20.93	10565	21.26	20885	21.10
12 - 16	7049	14.30	6963	14.01	14012	14.15
16 - 20	3749	7.60	3756	7.56	7505	7.58
20 - 24	834	1.69	711	1.43	1545	1.56
AVERAGE TRIP LENGTH	8.31		8.21		8.26	
PASSENGER KMs	409,870		408,086		817,956	

Table B13: Trip Length of 13th March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	16079	21.86	17036	22.91	33115	22.39
4 - 8	24571	33.41	24292	32.67	48863	33.04
8 - 12	15076	20.50	15366	20.67	30442	20.58
12 - 16	10118	13.76	10050	13.52	20168	13.64
16 - 20	5849	7.95	5764	7.75	11613	7.85
20 - 24	1859	2.53	1849	2.49	3708	2.51
AVERAGE TRIP LENGTH	8.40		8.32		8.36	
PASSENGER KMs	618,176		618,614		1,236,790	

Table B14: Trip Length of 14th March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	15407	21.72	15978	22.02	31385	21.87
4 - 8	23830	33.60	24184	33.33	48014	33.46
8 - 12	14583	20.56	15003	20.68	29586	20.62
12 - 16	9874	13.92	9927	13.68	19801	13.80
16 - 20	5480	7.73	5614	7.74	11094	7.73
20 - 24	1754	2.47	1855	2.56	3609	2.52
AVERAGE TRIP LENGTH	8.39		8.38		8.38	
PASSENGER KMs	595,088		607,930		1,203,018	

Table B15: Trip Length of 15th March, 2017 (Working Day)

	Forward		Backward		Both	
Trip Length Band	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< = 4	15029	21.58	15949	22.35	30978	21.97
4 - 8	23207	33.32	23200	32.51	46407	32.91
8 - 12	14354	20.61	14651	20.53	29005	20.57
12 - 16	9815	14.09	9996	14.01	19811	14.05
16 - 20	5543	7.96	5699	7.99	11242	7.97
20 - 24	1702	2.44	1865	2.61	3567	2.53
AVERAGE TRIP LENGTH	8.43		8.42		8.43	
PASSENGER KMs	587,468		601,164		1,188,632	

Table C1: Trip Time of 1st March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	10334	40.53	10014	43.39	20348	41.89
15 Min To 30 Min	13054	51.20	11703	50.71	24757	50.97
30 Min To 45 Min	1837	7.21	1201	5.20	3038	6.25
45 Min To 1 Hrs	196	0.77	121	0.52	317	0.65
1 Hrs To 1.5 Hrs	66	0.259	36	0.156	102	0.210
1.5 Hrs To 2 Hrs	6	0.024	2	0.009	8	0.016
2 Hrs To 3 Hrs	2	0.008	3	0.013	5	0.010
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	17.90		17.04		17.49	

Table C2: Trip Time of 2nd March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	23994	32.56	23724	31.79	47718	32.17
15 Min To 30 Min	30398	41.25	30794	41.26	61192	41.26
30 Min To 45 Min	14041	19.05	15064	20.19	29105	19.62
45 Min To 1 Hrs	4749	6.44	4583	6.14	9332	6.29
1 Hrs To 1.5 Hrs	490	0.665	438	0.587	928	0.626
1.5 Hrs To 2 Hrs	15	0.020	14	0.019	29	0.020
2 Hrs To 3 Hrs	7	0.009	8	0.011	15	0.010
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.79		22.94		22.87	

Table C3: Trip Time of 3rd March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	22032	32.78	22050	31.52	44082	32.14
15 Min To 30 Min	27198	40.46	28569	40.84	55767	40.65
30 Min To 45 Min	13397	19.93	14303	20.44	27700	20.19
45 Min To 1 Hrs	4227	6.29	4480	6.40	8707	6.35
1 Hrs To 1.5 Hrs	342	0.509	533	0.762	875	0.638
1.5 Hrs To 2 Hrs	15	0.022	6	0.009	21	0.015
2 Hrs To 3 Hrs	6	0.009	19	0.027	25	0.018
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.76		23.21		22.99	

Table C4: Trip Time of 4th March, 2017 (Weekend-Sat)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	18773	33.42	18432	31.92	37205	32.66
15 Min To 30 Min	23023	40.98	24477	42.39	47500	41.70
30 Min To 45 Min	11225	19.98	11670	20.21	22895	20.10
45 Min To 1 Hrs	2902	5.17	2899	5.02	5801	5.09
1 Hrs To 1.5 Hrs	225	0.401	247	0.428	472	0.414
1.5 Hrs To 2 Hrs	17	0.030	6	0.010	23	0.020
2 Hrs To 3 Hrs	12	0.021	8	0.014	20	0.018
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.30		22.50		22.41	

Table C5: Trip Time of 5th March, 2017 (Weekend-Sun)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	14493	31.37	14994	32.37	29487	31.87
15 Min To 30 Min	20006	43.30	20253	43.72	40259	43.51
30 Min To 45 Min	9120	19.74	9002	19.43	18122	19.59
45 Min To 1 Hrs	2369	5.13	1896	4.09	4265	4.61
1 Hrs To 1.5 Hrs	199	0.431	162	0.350	361	0.390
1.5 Hrs To 2 Hrs	5	0.011	10	0.022	15	0.016
2 Hrs To 3 Hrs	7	0.015	3	0.006	10	0.011
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.55		22.00		22.28	

Table C6: Trip Time of 6th March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	24509	32.99	25161	33.55	49670	33.27
15 Min To 30 Min	30669	41.28	30575	40.76	61244	41.02
30 Min To 45 Min	14060	18.93	14481	19.31	28541	19.12
45 Min To 1 Hrs	4629	6.23	4301	5.73	8930	5.98
1 Hrs To 1.5 Hrs	403	0.542	469	0.625	872	0.584
1.5 Hrs To 2 Hrs	13	0.017	14	0.019	27	0.018
2 Hrs To 3 Hrs	9	0.012	4	0.005	13	0.009
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.58		22.44		22.51	

Table C7: Trip Time of 7th March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	23351	32.96	23998	33.12	47349	33.04
15 Min To 30 Min	28862	40.74	29761	41.07	58623	40.91
30 Min To 45 Min	13833	19.53	13935	19.23	27768	19.38
45 Min To 1 Hrs	4341	6.13	4257	5.87	8598	6.00
1 Hrs To 1.5 Hrs	427	0.603	491	0.678	918	0.641
1.5 Hrs To 2 Hrs	21	0.030	21	0.029	42	0.029
2 Hrs To 3 Hrs	5	0.007	3	0.004	8	0.006
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.68		22.57		22.62	

Table C8: Trip Time of 8th March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	23469	33.73	23216	32.75	46685	33.24
15 Min To 30 Min	28051	40.32	28522	40.24	56573	40.28
30 Min To 45 Min	13372	19.22	14039	19.81	27411	19.52
45 Min To 1 Hrs	4233	6.08	4469	6.30	8702	6.20
1 Hrs To 1.5 Hrs	422	0.607	610	0.861	1032	0.735
1.5 Hrs To 2 Hrs	22	0.032	19	0.027	41	0.029
2 Hrs To 3 Hrs	5	0.007	10	0.014	15	0.011
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.50		22.95		22.73	

Table C9: Trip Time of 9th March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	23463	33.57	23651	33.22	47114	33.39
15 Min To 30 Min	28427	40.67	28896	40.58	57323	40.63
30 Min To 45 Min	13270	18.99	13835	19.43	27105	19.21
45 Min To 1 Hrs	4320	6.18	4269	6.00	8589	6.09
1 Hrs To 1.5 Hrs	402	0.575	521	0.732	923	0.654
1.5 Hrs To 2 Hrs	9	0.013	18	0.025	27	0.019
2 Hrs To 3 Hrs	5	0.007	11	0.015	16	0.011
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.49		22.66		22.58	

Table C10: Trip Time of 10th March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	22331	33.50	22013	31.96	44344	32.72
15 Min To 30 Min	27106	40.67	28487	41.37	55593	41.02
30 Min To 45 Min	12976	19.47	13796	20.03	26772	19.76
45 Min To 1 Hrs	3906	5.86	4053	5.89	7959	5.87
1 Hrs To 1.5 Hrs	308	0.462	483	0.701	791	0.584
1.5 Hrs To 2 Hrs	21	0.032	25	0.036	46	0.034
2 Hrs To 3 Hrs	5	0.008	10	0.015	15	0.011
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.43		22.90		22.67	

Table C11: Trip Time of 11th March, 2017 (Weekend-Sat)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	18581	33.19	18429	32.49	37010	32.84
15 Min To 30 Min	22918	40.94	23910	42.15	46828	41.55
30 Min To 45 Min	11263	20.12	11430	20.15	22693	20.14
45 Min To 1 Hrs	2958	5.28	2637	4.65	5595	4.96
1 Hrs To 1.5 Hrs	228	0.407	294	0.518	522	0.463
1.5 Hrs To 2 Hrs	14	0.025	19	0.033	33	0.029
2 Hrs To 3 Hrs	14	0.025	4	0.007	18	0.016
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.40		22.35		22.38	

Table C12: Trip Time of 12th March, 2017 (Weekend-Sun)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	18581	33.19	18429	32.49	37010	32.84
15 Min To 30 Min	22918	40.94	23910	42.15	46828	41.55
30 Min To 45 Min	11263	20.12	11430	20.15	22693	20.14
45 Min To 1 Hrs	2958	5.28	2637	4.65	5595	4.96
1 Hrs To 1.5 Hrs	228	0.407	294	0.518	522	0.463
1.5 Hrs To 2 Hrs	14	0.025	19	0.033	33	0.029
2 Hrs To 3 Hrs	14	0.025	4	0.007	18	0.016
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.40		22.35		22.38	

Table C13: Trip Time of 13th March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	24337	33.09	24647	33.15	48984	33.12
15 Min To 30 Min	30161	41.01	30490	41.00	60651	41.01
30 Min To 45 Min	14030	19.07	14405	19.37	28435	19.22
45 Min To 1 Hrs	4608	6.26	4343	5.84	8951	6.05
1 Hrs To 1.5 Hrs	382	0.519	448	0.602	830	0.561
1.5 Hrs To 2 Hrs	24	0.033	18	0.024	42	0.028
2 Hrs To 3 Hrs	10	0.014	6	0.008	16	0.011
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.60		22.54		22.57	

Table C14: Trip Time of 14th March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	23832	33.60	24142	33.27	47974	33.43
15 Min To 30 Min	29001	40.89	29761	41.02	58762	40.95
30 Min To 45 Min	13449	18.96	13855	19.09	27304	19.03
45 Min To 1 Hrs	4254	6.00	4284	5.90	8538	5.95
1 Hrs To 1.5 Hrs	370	0.522	494	0.681	864	0.602
1.5 Hrs To 2 Hrs	14	0.020	23	0.032	37	0.026
2 Hrs To 3 Hrs	8	0.011	2	0.003	10	0.007
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.41		22.53		22.47	

Table C15: Trip Time of 15th March, 2017 (Working Day)

	FORWARD		BACKWARD		BOTH	
Trip Time	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**	**Frequency**	**Percentage %**
< 15 Min	23111	33.18	23510	32.95	46621	33.06
15 Min To 30 Min	28470	40.88	29096	40.77	57566	40.82
30 Min To 45 Min	13423	19.27	14013	19.64	27436	19.46
45 Min To 1 Hrs	4300	6.17	4256	5.96	8556	6.07
1 Hrs To 1.5 Hrs	321	0.461	454	0.636	775	0.550
1.5 Hrs To 2 Hrs	14	0.020	20	0.028	34	0.024
2 Hrs To 3 Hrs	11	0.016	11	0.015	22	0.016
3 Hrs To 6 Hrs	0	0.000	0	0.000	0	0.000
6 Hrs To 12 Hrs	0	0.000	0	0.000	0	0.000
> 12 Hrs	0	0.000	0	0.000	0	0.000
AVERAGE TRIP TIME	22.55		22.67		22.61	