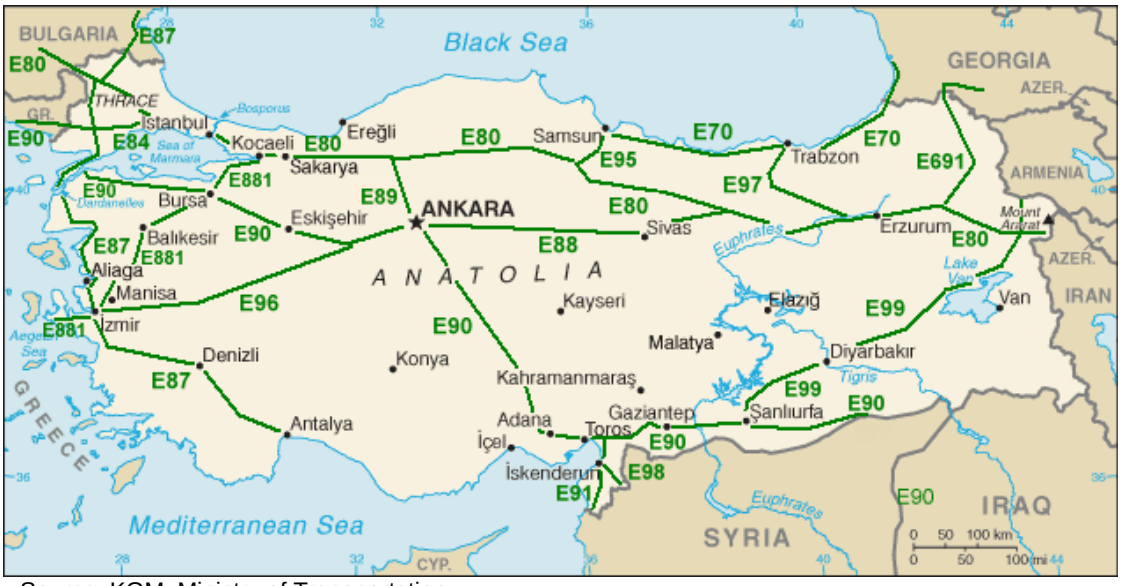
Chapter 3 Road Network and Traffic Volume

3.1 Road Network

3.1.1 Inter-regional Road Network

1) Existing Road

Turkey is situated at the transit corridor between South-east Europe and the Middle East. Since “The Declaration for The Construction of International Arteries” (AGR) prepared by the United Nations Economic Commission for Europe (UN/ECE) in 1950 in Geneva, Turkey has developed international corridors connecting it to Southern Europe, because the international road network of AGR included an extension to Turkey. According to the provisions of AGR, two arteries should reach Turkey as E-Road. These are E-80 entering from the Bulgarian border (Kapikule) and E-90 entering from the Greek border (Ipsala). These two main routes link the International Road Network of Europe with the Middle East and Asia at southern and eastern borders of Turkey via Anatolia.



Source: KGM, Ministry of Transportation

Figure 3.1.1 International Road Network through Turkey, 2007

In addition to the E-Roads, the Trans-European Motorway (TEM) project is ongoing and it covers the whole country as an expressway network.

The TEM highway network in Turkey starts from Edirne at the Bulgarian border and passes through Istanbul via the Fatih Sultan Mehmet Bridge and parts into two branches in Ankara going eastward and southward. Its eastern branch again parts into two branches in Askale. One of them reaches Trabzon in the Black Sea Region, and the other ends in Gurbulak at the Iranian border. The southern branch ends at the Syrian and Iraqi borders. Furthermore, it connects Istanbul to Izmir and Antalya.

Istanbul is situated at the most important connection point between South Europe and Asia, and at the same time, the connection point between the Black Sea and Marmara Sea, which are the entrance and exit points from the Aegean and the Mediterranean Sea.

Figure 3.1.2 shows the major interregional road network in the vicinity of Istanbul.

These roads are a part of the international road network mentioned above, linking Istanbul with the neighboring cities such as Kirklareli and Tekirdag in the west, and Izmit and Duzce in the east.

Source: *ibid.*

Figure 3.1.2 Interregional Road Network around Istanbul, 2007

2) Future Development

As an interregional road network, the following projects are planned by the Ministry of Transportation. Although they are not included entirely in the Study Area, these projects could influence the traffic flow in Istanbul.

- Gebze – Orhangazi Highway Project including Izmit Bay Bridge

  This project directly connects Gebze with Orhangazi through the construction of the Izmit Gulf Bridge, where currently vehicles cross the Gulf through ferries. It aims to develop the southern area of the Bridge as an industrial as well as a tourism sector. It also intends to reduce the travel time from Istanbul to Izmir by upgrading the Road from Bursa to Izmir.

- Kinali – Tekirdag – Malkara – Ipsala Road project

  This is to upgrade the existing road from Istanbul to Ipsala located at its border with Greece. It will contribute increasing the business relationship and the tourism development of both countries.

- Malkara – Canakkale Highway project including Canakkale Bridge

  This is to improve the highway link from Edirne near the Bulgarian Border to Canakkale and to construct of a bridge over the Dardanelle Strait. In the future, the road will be further extended to Izmit – Bursa – Izmir Highway.

The detailed design of the bridge project has already been completed and the next stage is obtaining the approval of the State Planning Organization (SPO).

The implementation of the above road projects means the completion of the circumferential highway around the Marmara Sea. At the same time, the interregional linkages between north and south, particularly between Istanbul and Izmir, the country's the third largest city, will be strengthened.

3.1.2 Road Network

1) Network Pattern

Istanbul's road network, as a whole, follows a ladder pattern rather than ring/radial form due to the long stretches of its urbanized areas spreading in an east-west direction. However, there are so-called two-ring roads that surround the "Old City area" and the CBD area of the newly developed area. The first ring road is formed by part of D-100 including Bosporus Bridge and Mevlana Topkapi Street. The second one is formed by TEM (Trans European Motorway) highway and the Airport Connection Road. These roads are half rings surrounding the central area with an interval of approximately 3 to 5km. As for the radial roads, there are several ones such as the extension of the TEM highway to the west and east, the extension of D-100 to the west and east, the old Edirne Road, Piyalepasa Blvd., Buyukdere Street, and Sile Road etc. Both TEM highway and D-100 were designed as motorways (expressway), therefore they have a high traffic capacity with either 8 or 6 lanes and all the intersections with other roads are grade separated.

Fig 3.1.3 shows the existing road network in the Study Area.

In the Central area inside the first ring road, the major roads are Ataturk Boulevard, Refik Saydam St, Tarlabasi St.,Cumhuriyet St, Piyale Boulevard, Barbaros Boulevard, Fevzi Pasa St. Edirne Kapi Rami St, Vatan St (Adnan Menderes Boulevard), and Kennedy Street. These roads are mostly 6-lane roads connecting the Central Area with the first ring road.

Outside the second ring road, the road network is shaped as a ladder pattern mainly formed by the freeway network consisting of TEM highway and D-100, and highways connecting them.


BLACK SEA
MARMARA SEA
SILE
BEYKOZ
UMRANIYE
PENDIK
TUZLA
SULTANBEYLI
KARTAL
MALTEPE
ADALAR
KADIKOY
USKUDAR
SARIYER
SISLI
BESIKTAS
KAGITHANE
BEYOGLU
EMINONU
FATIH
ZEYTINBURNU
BAYRAMPASA
GUNGOREN
BAHCELIEVLER
BAGCILAR
ESENLER
BAKIRKOY
EYUP
KUCUKCEKMECE
GAZIOSMANPASA
AVCILAR
CATALCA
BUYUKCEKMECE
SILIVRI
E 80
D 100
TEM
O - 2
Fatih Cad.
Yan Yol
Ahmediye-Mimar Sinan 1
Büyükdere Cad.
Tarabya Cad.
Kurtköy - Ömerli Yolu
Yakacık Cad.
Fatih Bulvarı
Road Classification
IMP
Legend:
Road Network
1 st Class
2 nd Class
3 rd Class
Freeway
N
0
3
6
Kilometers

Figure 3.1.4 Road Network in Urban Area of Istanbul

2) Organizations Responsible for Roads

The organizations responsible for the roads in the study area are the Municipality of Istanbul (IMM) and the Directorate General of Highways of the Ministry of Transportation (KGM). The former is responsible for all the roads, except for TEM highway and two Bridges over the Bosporus, which are under the responsibility of KGM.

The road network planning is mainly undertaken by the Directorate of Transport Planning of Department of Transportation of the IMM, in the case of municipal roads. The approval of the plan is made by the City Council and the actual implementation is done under the responsibility of the Directorate of Construction Affairs of the Department of Science Affairs in IMM.

Table 3.1.1 Organizations Responsible for Road Planning to Implementation

Work Item	Roads in Istanbul other than TEM highway / Two Bridges over Bosporus	TEM Highway / Two Bridges over Bosporus
Road Planning	Dept. of Transportation, IMM	Dept of Planning, KGM
Designing	Dept. of Transportation, IMM	Dept of Motorways, KGM
Construction	Dept. of Science Affairs, IMM	Dept of Motorways, KGM
Maintenance	Dept. of Transportation, IMM	Field Organization, KGM

Source: Dept. of Transportation, IMM & KGM

In the case of Motorway Projects, the planning is undertaken by the Department of Planning of KGM; design and construction is done by the Department of Motorways of KGM. The actual operation and maintenance are made by the 17th Division of the Field Organization of KGM. All the toll incomes are sent to the Central Government. The toll of motorways is applied only for inter-city traffic and free for intra-city traffic.

As for the bridges over the Bosporus, the toll is charged only for westward bound vehicles.

The toll rates are shown in Table 3.1.2. Toll increases in accordance with the distances for TEM highway.

Table 3.1.2 Toll Rate for the Bridges over the Bosporus

Class	Vehicle Type	Toll (YTL)
1	Automobile, Light Truck, Mini-bus, Motor cycle	3.75
2	Truck, Bus with 2 axles	3.75
3	Bus, Trailer truck with 3 axles	9.00
4	Bus, Trailer truck with 4 or 5 axles	25.00
5	Trailer Truck with 6 axles or more	30.00

Source: Dept. of Planning, KGM

At present, KGM is planning to entrust the operation and maintenance of TEM highway and the two Bridges over the Bosporus to the private sector based on the privatization policy.

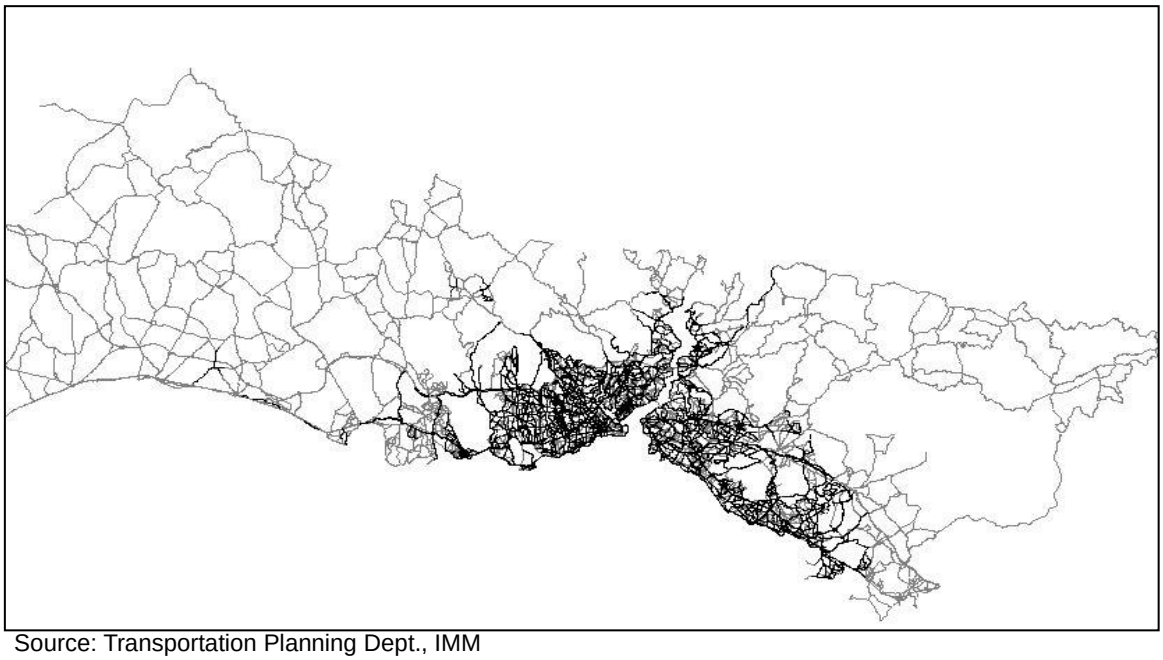
3) Road Classification

According to the Municipality of Istanbul, the total length of its road network as of 2007 is 26,853km, of which 63% or 16,800km is developed in the European side as shown in Table 3.1.3.

The road in Istanbul is classified into 3 categories: freeway, arterial road and other roads. In this classification, freeway is limited only for TEM highway of about 150km in total length, which is under the responsibility of KGM. Accordingly, other roads under the

responsibility of IMM are classified into just two categories; arterial road and others.

D-100 seems to be a freeway like TEM highway in terms of road structure such as wide carriageway, access control etc. However, it can also be grouped with other arterial roads in this classification. The arterial roads are illustrated in Figure 3.1.5.



Source: Transportation Planning Dept., IMM

Figure 3.1.5 Arterial Road Network defined by IMM

The Municipality of Istanbul is now under the process of re-classification of its road network due to the following reasons: (a) The recent urban expansion of new residential areas requires the review of its road network. (b) The improvement work of the roads also requires a review of the functions of each road. Therefore, the new classification will clarify road functions by introducing more detailed category such as arterial, semi-arterial, collector, etc.

Table 3.1.3 Total Road Length in Istanbul

(km)

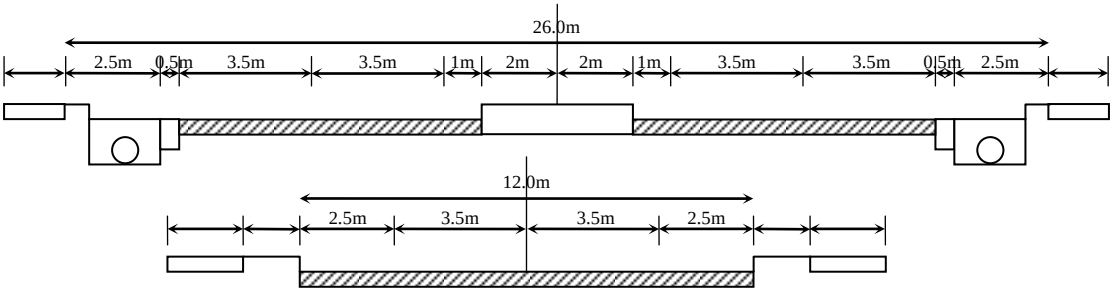
		2001	2004	2005	2007
Europe Side	Freeway(TEM)				151.1
	Arterial Road	872.8	959.8	1,673.7	2,349.3
	(D-100)				(incl. 100.5)
	Other Road				14,309.6
	Total				16,810.0
Asia Side	Freeway(TEM)				101.4
	Arterial Road	680.4	771.9	1,282.8	1,757.3
	(D-100)				(incl. 50.0)
	Other Road				8,184.3
	Total				10,043.0
Total	Freeway(TEM)				252.5
	Arterial Road	1,553.2	1,731.7	2,956.5	4,106.6
	(D-100)				(incl. 150.5)
	Other Road				22,493.9
	Total				26,853.0

Source: Transportation Dept. of Municipality

4) Design Standard

There is no specific design manual for urban roads. The design standard for inter-city roads prepared by KGM usually applies to urban roads as well. According to the standard, lane widths should be 3.5m per lane, and a median strip or central reservation is usually installed in case of multi-lane roads. Sidewalks, however, do not have defined standards.

The standard cross sections for a four-lane road and a two-lane road are shown in Figure 3.1.6.



Source: KGM

Figure 3.1.6 Standard Cross Section

5) Road Development Investment

Table 3.1.4 shows the distribution of the annual investment estimated by IMM for the years 2006 and 2007. The figures for 2005 and 2006 are approximately the actual expenditures while those for 2007 are the estimated sum of the project costs scheduled for this year.

Total investments, or development expenditures, fluctuates year by year due to various financial conditions and variables. It is expected to jump up from 1.8 billion YTL in 2006 to 4.3 billion YTL in 2007. Among the total expenditures, approximately 50% of the total has been spent for the transport sector.

Table 3.1.4 Annual Investment by Sector

Sector	2005		2006		2007	
	Amount (YTL/1000)	%	Amount (YTL/1000)	%	Amount (YTL/1000)	%
Infrastructure	134,300	3	26,600	1	84,550	2
Service	1,091,052	28	417,814	23	1,406,798	33
Recreation	474,332	12	175,357	10	267,526	6
Purchase	213,385	5	243,527	14	163,591	4
Sports	139,350	4	53,358	3	60,650	1
Transportation	1,901,056	48	884,858	49	2,280,148	53
Total	3,953,475	100	1,801,514	100	4,263,363	100

Source: Dept. of Transportation

Table 3.1.5 shows the breakdown of investments in the transport sector for the year 2005 and 2007 by directorate. The figures for 2006 are unfortunately not available. It was found that the share of each directorate also fluctuates depending on the year. In 2005, more than half, or about 1 billion YTL is allotted to the development of the rail system which includes the metro, light metro, tramway etc. In 2007, the allocation for the rail system has declined to about half of its amount in 2006, while the highest share, or about 1 billion YTL goes to the directorate of infrastructure services. This fluctuation may be related to the implementation stage of the main development projects. The investment of the Directorate

of Infrastructure Service is mainly used for the construction of roads, bridges and junctions. It should also be noted that a considerable amount of expenditure, about 10% to 20% of the investment of the transport sector, has been allocated to road maintenance.

As a consequence, the statistics indicate that rail as well as road network development has been prioritized among the public investment of the IMM at least until now.

Table 3.1.5 Distribution of the Investment to Transport Sector by Directorate

Directorate	2005		2007	
	Amount (YTL/1000)	%	Amount (YTL/1000)	%
Infrastructure Service	371,828	20	1,089,096	48
Rail System	1,038,250	55	535,363	23
Road Maintenance and Improvement	204,500	11	446,350	20
Transportation Planning	93,200	5	76,729	3
Traffic	38,429	2	73,900	3
Constructive Works	94,800	5	25,150	1
Transportation Coordination	11,400	1	24,500	1
Mass Transportation Service	17,900	1	5000	0
Marine Service	29,750	2	3250	0
Project	999	0	810	0
Total	1901,056	100	2,280,148	100

Source: *ibid.*

6) Road Network Characteristics

(1) Road Condition

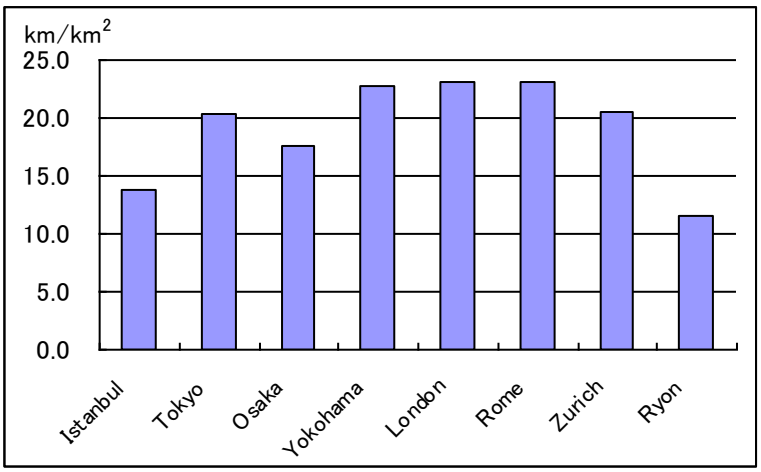
The roads in the study area are mostly paved with asphalt concrete or concrete/stone blocks though there are some local roads that are exceptionally left without pavement in the suburban areas. Although the statistical data by surface condition is not available, most of them seem to be well maintained.

Being a “City on the Seven Hills”, Istanbul’s urban area extends over its hilly and rolling geographical landscape, which is usually disadvantageous for road network building, however, this unfavorable condition is fully utilized as an advantage for making grade separations with crossing roads. Accordingly the numbers of interchanges that link the grade-separated roads have been developed in the urban area even at the intersections between non-freeway roads.

(2) Interval and Density of Roads

In the Central area (Beyoglu, Sisli districts), the average interval of the arterial roads is 1 to 2km in the northeast - southwest direction, while it is about 4 km in the northwest – southeast direction. This indicates that the density of the trunk road in the northwest – southeast direction is very low compared to northeast - southwest direction. In the neighboring areas (Bayrampasa, Gungoren, Bagcilar, Bahcelievler etc.) on the European side, the average interval of arterial roads is 1 to 2km in the north - south direction, whereas it becomes 4 to 5 km in the east - west direction. It also indicates the lower density of the arterial road in the east-west direction. These imbalances in the main road network can be observed on the Asian side as well. The interval of local road ranges from 20m to 100m depending on the district except for newly developed areas, where density is much lower.

Figure 3.1.7 presents a comparison of total road densities (the total length of all the roads including local roads per unit area) among a number of major cities in the world. The road density of Istanbul seems relatively low compared with other European as well as Japanese cities. Here, the city area is excludes forest, and water area.

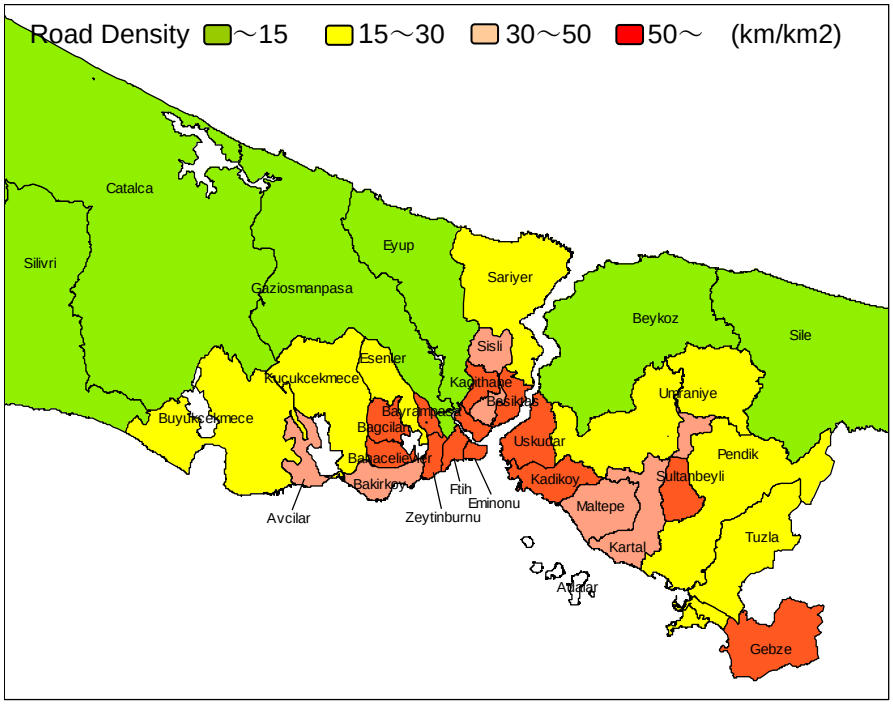


Source: World Cities Research 2005, Annual Statistics of Tokyo etc.

Figure 3.1.7 Comparison of Road Density for Selected Cities, 2005

Road density is also available by district of Istanbul. As shown in Figure 3.1.8, the central part of Istanbul in general has a comparatively higher road density, while the northern part has a lower density.

It is noted that there are suburban areas where road density is still low, in spite of the fact that they are already populated or the number of new residential development projects are being undertaken, such as in Esenler, Kucukcekmece ,Gaziomanpasa, Buyukcekmece etc. on the European side, and the Umraniye district on the Asian side.



Source: Elaborated by the Study Team based on IMM data

Figure 3.1.8 Road Density by District, 2007

(3) Number of Lanes

In case of motorways, including TEM highway and D-100, the number of lanes is mostly 8 or 6 as shown in Table 3.1.6, though the eastern section of the D-100 from Maltepe to Gebze on the Asian side still remains as a 4-lane road.

For arterial and semi-arterial roads, excluding motorways, the number of lanes varies depending on the section ranging from 2 lanes to 8 lanes. As shown in Table 3.1.7, in addition to motorways, there are arterial roads with multi-lanes (4 lanes or more) of over 1000km in total length, while more than 60% are 2-lane roads. The distribution of the number of lanes is illustrated in Figure 3.1.9.

Table 3.1.6 Number of Lanes of Motorway, 2007

No. of Lane	Length (km)		
	Europe	Asia	Total
8	151.1	101.4	252.5
6(incl.4)	100.5	50.0	150.5
Total	251.6	151.4	403.0

Source: Dept. of Transportation, IMM

Table 3.1.7 Number of Lanes of Arterial/Semi-arterial Road, 2007

No. of Lane	Length (km)			%
	Europe	Asia	Total	
8	9.6	5.1	14.7	0.5
6	99.4	45.1	144.5	5.0
4 incl 3	513.4	412.7	926.1	31.9
2	802.4	1018.8	1821.2	62.7
Total	1424.9	1481.6	2906.5	100.0

Source: *ibid.*

Source: Elaborated by the Study Team based on IMM data

Figure 3.1.9 Distribution of Number of Lanes, 2007

7) Existing Problems

(1) Network

The road network in Istanbul was developed in accordance with the expansion of urbanization. In general, its road network is well designed and formulated and well maintained despite its geographic conditions. Particularly, intersection points between main roads are grade-separated by fully utilizing its geographic conditions. Main arterial roads are also usually equipped with multi-lanes in each direction.

However, the rapid urbanization of areas and the high economic growth resulting in the growth of road traffic demands have resulted to urban transportation problems. These are, among others, traffic congestions and an insufficiently developed mass transit system. The main issues related to the existing road network may be explained by the following factors:

(i) Arterial/Semi-arterial roads

Firstly, arterial or semi-arterial roads are not adequately developed in some districts. For instance, there is no arterial linkage in the northwest – southeast direction in the new CBD area (Besiktas, Beyoglu, and Kagithane). This makes it difficult to disperse the traffic properly, leading to traffic congestion in the peak hours. Another example is the densely populated zones (Gungoren, Bagcilar districts) in between the two freeways of the European side, where arterial linkage in the east – west direction has not been well developed, therefore, the north-south roads that connect with the TEM highway or the D-100 are congested during peak hours.

In addition, the road network is not continuously developed. It is largely due to the geographical conditions. For instance, a wide street in a certain district which is used as an arterial or semi-arterial suddenly changes to a narrow street in the next district. This often tends to create traffic bottlenecks. (Refer to Figure 3.1.9)

(ii) Bosporus Crossing

Secondly, Istanbul is physically separated by the Bosporus and the Golden Horn. These crossings have historically been traffic bottlenecks. The most prominent is on the two bridges over the Bosporus and their approach roads. Heavy traffic congestions are observed during morning and evening peak hours everyday.

According to a survey conducted in 2005, queue lengths of more than 10km were observed at Anadolu highway in the morning and at Hasdal Viaduct in the evening. It also affects the connecting streets such as Barboros Blv./Buyukdere street etc.

(iii) Coordination among different transport modes

Istanbul has various transport modes, but coordination among them does not seem to function adequately. In relation to road transport, transfer facilities have not been sufficiently provided at the main terminal points for rails and ferries. At around the main stations of the mass transit system, in most cases buses and taxis use the whole road space due to the lack of special spaces provided for vehicles, thereby, causing further congestion problems. In addition, special consideration is not given to access roads to the main stations.

(iv) New development area

The development of road network has not been adequately followed up in the development of newly urbanized areas. This is partly caused by physical constraints like steep gradients and/or partly by financial constraints. For instance, a lot of residential development projects are progressing in Gaziosmanpasa, Halkali/Ikitelli or Kucukcekmece on the Europe side as well as Umraniye, Pendik on the Asian side, while the road network has yet to be sufficiently developed.

(v) Pedestrian Network

Another point is the inadequate pedestrian facilities. There are some roads where the sidewalk is not installed at all, like the CBD area shown in Figure 3.1.10. Even in cases where there are sidewalks, the sidewalks are often squeezed so narrow in order to accommodate vehicle carriageways. In addition they are sometimes occupied by parking vehicles or temporary walls and some materials for building construction. Therefore, pedestrian facilities do not function as a network; pedestrians are sometimes forced to walk along carriageways. Pedestrian crossings are also not sufficiently provided; therefore pedestrians have to take long detours or risk endangering themselves when they are forced to cross streets.

Source: *ibid*.

Figure 3.1.10 Distribution of Sidewalk in CBD Area, 2007

(2) Institutional Problems

(i) Financial Problem

As already mentioned in the development expenditure of IMM, the total budget for road development drastically varies year by year. The past record shows that more or less 70% of the revenue of IMM comes from the Central Government. Project implementation, whether or not they are realized on the budgeting plans, is rather uncertain due to the heavy dependence on the approval of the Central Government. Infrastructure development may sometimes require large amounts; therefore, projects are sometimes delayed or cancelled even in cases there are winning bidders because projects cannot be managed only by the municipality.

(ii) Lack of comprehensive development plan

There is no road development plan based on the Master Plan, therefore, road projects are currently not carried out in a systematic way but rather implemented as a symptomatic remedy.

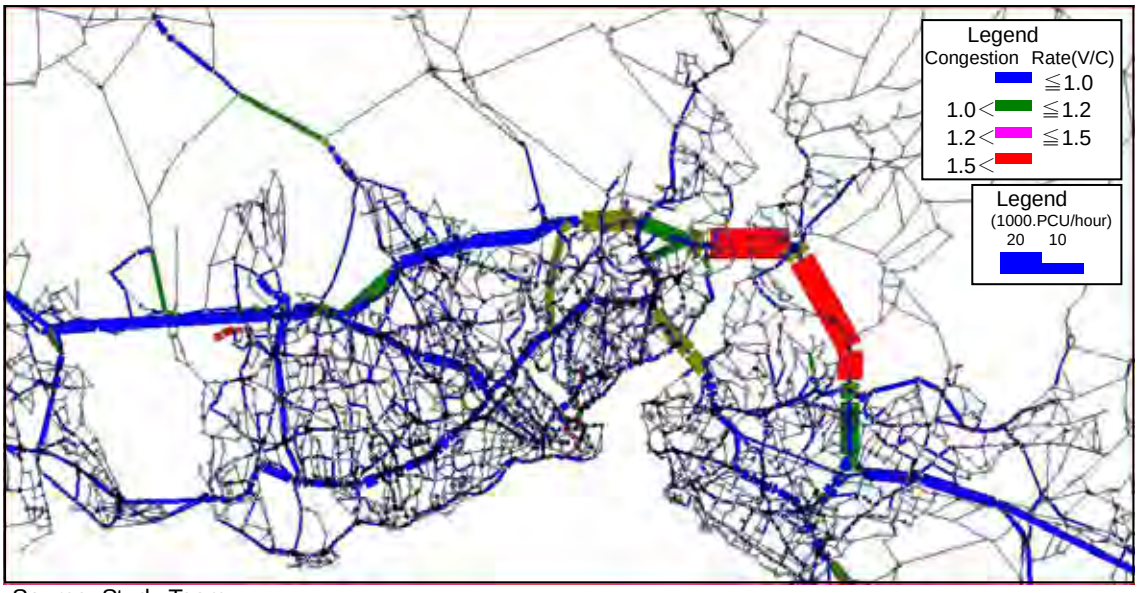
Therefore, it will be quite difficult to provide priorities among various projects, which may also result in the oversight of the relationship with other projects particularly in the other sectors. In other words, the road development plan is not adequately prepared to take into account the developments of traffic generating facilities, such as mass transit stations, commercial, residential facilities etc.

3.2 Road Traffic Volume on Roads

3.2.1 Road Traffic Volume at Peak Hour

Figure 3.2.1 shows road traffic volume on road in the morning peak hour during 7:00 a.m. to 8:00 a.m., estimated by traffic assignment under the present road network system and the peak hour OD tables. The road traffic volumes on the screen lines are replaced by the traffic counting data. In Figure 3.2.1, traffic volume on each road is drawn by a narrow band whose width is proportional to the assigned traffic volume. The yellow color shows a volume-capacity ratio of 1.0 or less, the red means a volume-capacity ratio of 1.5 or more which represents heavily congested segments on roads.

Roads with heavy traffic volume are Trans European Motorway (Outer Ring road), the D-100, and Basin Yolu Road. On the 1st and 2nd Bosporus Bridges, the volume-capacity ratio is over 1.0.



Source: Study Team

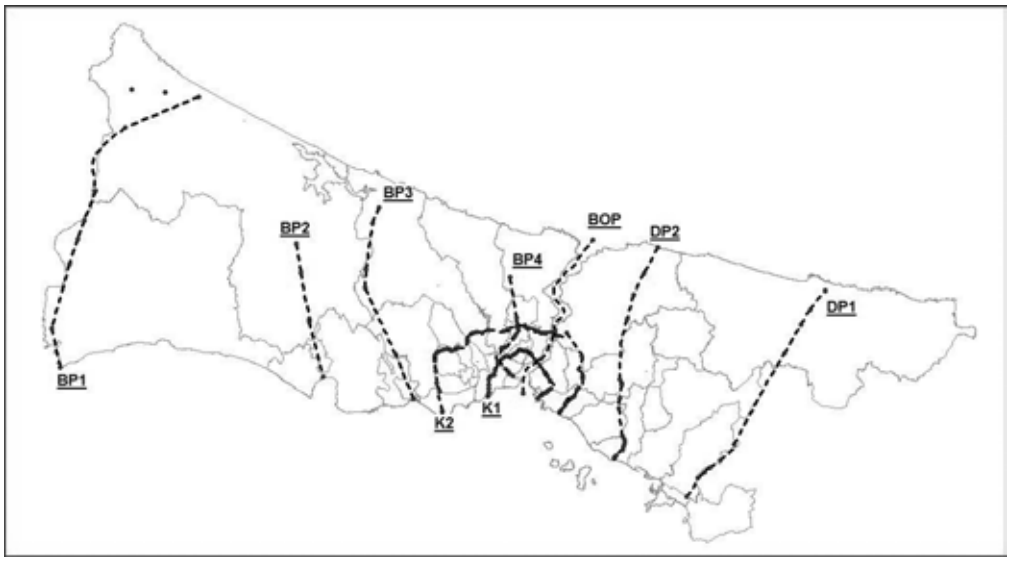
Figure 3.2.1 Peak Hour Traffic Volumes on Roads, 2006

3.2.2 Screen Line Traffic Volume

1) Introduction

This section finds road traffic conditions in Istanbul by analyzing road traffic count data on the screen lines. Figure 3.2.2 shows the screen line survey locations covering the whole study area in which 9 screen lines were set. Table 3.2.1 shows the summary of the screen line surveys. The survey duration was 3 hours from 7:00 a.m. to 10:00 a.m. in the morning period, 2 hours from 12:00 noon to 14:00 in the afternoon and 3 hours from 17:00 to 20:00 in the evening.

Classification of type of vehicles is shown in Table 3.2.2 vehicle types were counted together with passenger volumes. The counting survey was carried out from May 24 to June 14, 2006 at 351 stations.



Source: *ibid*.

Figure 3.2.2 Screen Line Locations, 2006

Table 3.2.1 Summary of Screen Lines Survey, 2006

Continent	Screen line	Screen line No.	Number of Counting Locations	Number of Lanes
Europe	Bati Son	BP1	16	22
	Buyukcekmece	BP2	10	14
	Kuçukcekmece	BP3	20	26
	Halic	BP4	30	64
Bosporus	Bosporus Screen Line	BoP	4	16
Asia	Kartal	DP2	39	58
	Dogu Son	DP1	18	24
Europe - Asia	1. Cevre Yolu Kordonu	K1	87	153
	2. Cevre Yolu Kordonu	K2	127	234
Total			351	611

Source: *ibid*.

Table 3.2.2 Type of Vehicles Counted, 2006

No.	Integrated Type of Vehicles	Type of Vehicles
1	Motorcycles	Motorcycles
2	Car	Cars
		Taxis
3	Public Transportation	IETT Public Transportation (with ticket)
		Private Public Transportation (with money)
		Private Public Transportation (2 floored IETT buses)
		Minibus/Dolmuş (minibus)
4	Service Buses	Bus (+50 people)
		Middle Size Bus (+30 people)
		Minibus (+15 people)
5	Commercial Vehicles	Light Truck
		Truck
		Van
		Mini Bus
6	Intercity buses	Bus (+50 people)
		Middle Size Bus (+30 people)

Source: *ibid*.

2) Traffic Volume on Screen Line

(1) Daily Traffic Volume

Table 3.2.3 shows summary of daily traffic volumes on the screen lines in inbound and outbound directions. The daily traffic was converted from the data of three time periods by supplementing with monitoring images of on-road cameras. The type of vehicles was integrated into 6 vehicle types (see Table 3.2.2).

The highest volume on the screen lines was observed on K1 and K2 screen lines. The highest volume was on K2 at approximately 1,170,000 vehicles/day in the inbound and 1,120,000 in the outbound directions. The K1 traffic volume was approximately 600,000 and 650,000 in the inbound and outbound directions, respectively. These screen locations

are closest to the CBD. Screen line traffic volumes decrease in proportion to the distance from CBD.

Table 3.2.3 Daily Traffic Volumes on Screen Lines by Direction, 2006

1) West and Inbound

Screen	BP1	BP2	BP3	BP4	BoP	DP2	DP1	K1	K2
Passenger Car	12,196	29,884	115,991	278,091	147,040	157,844	44,191	466,482	861,422
Public Transportation	469	2,864	6,267	13,676	4,511	8,624	1,278	37,316	33,611
Service Bus	504	4,438	15,107	22,349	13,593	15,538	6,431	30,253	67,513
Commercial Vehicles	6013	11,471	33,707	67,493	24,751	38,187	19,149	54,080	189,469
Intercity Buses	478	507	847	1,531	1,978	989	747	1,133	3,898
Motorcycles	224	180	860	4,042	2,804	1,393	369	8,324	10,111
Total	19,884	49,344	172,779	387,182	194,677	222,575	72,165	597,588	1,166,024

2) East and Outbound

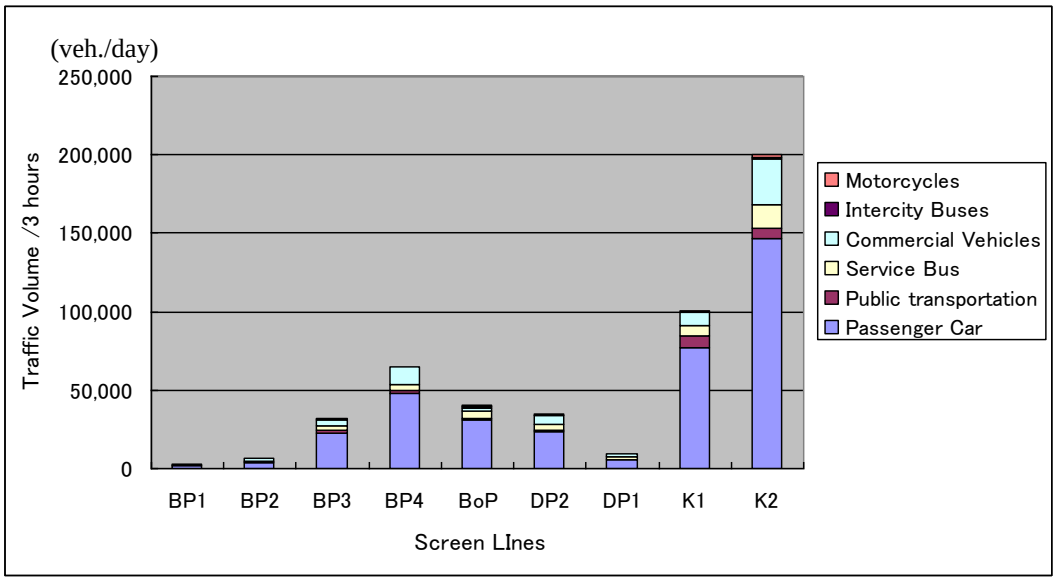
Screen	BP1	BP2	BP3	BP4	BoP	DP2	DP1	K1	K2
Passenger Car	10,596	18,327	115,907	237,909	146,593	172,796	50,731	500,013	812,138
Public Transportation	456	2,133	5,011	16,404	3,238	8,804	1,336	35,771	34,036
Service Bus	584	2,611	12,038	23,858	14,882	16,278	7,576	39,778	76,900
Commercial Vehicles	5,631	12,940	29,744	73,544	19,009	46,596	23,776	67,018	179,316
Intercity Buses	536	362	820	1,651	1,344	820	933	1,151	2,376
Motorcycles	178	162	1,004	4,253	1,984	1,458	380	8,918	11,271
Total	17,981	36,535	164,524	357,619	187,050	246,752	84,732	652,649	1,116,037

Source: *ibid*.

(2) Peak Hour Traffic Volume (7:00- 10:00)

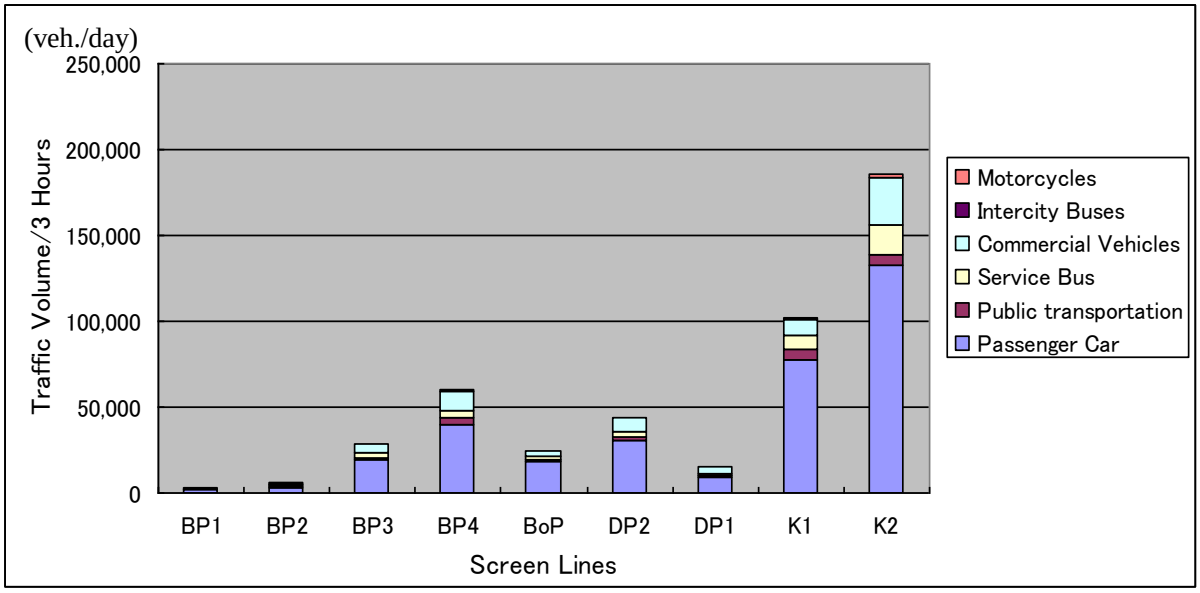
Figure 3.2.3 and Figure 3.2.4 show peak hour traffic volumes for 3 hours from 7:00 to 10:00 in the morning peak hours. The highest volume on the screen lines was counted again on K2 at approximately 200,000 vehicles in the inbound and 185,000 in the outbound directions. The K1 traffic volume was approximately 101,000 and 102,000 in the inbound and outbound directions, respectively.

Car share to the total is predominant at 60% to 75% in the morning peak hours (see Figure 3.2.5). Those ratios are similar in both directions, and decrease near the boundary of the study area.



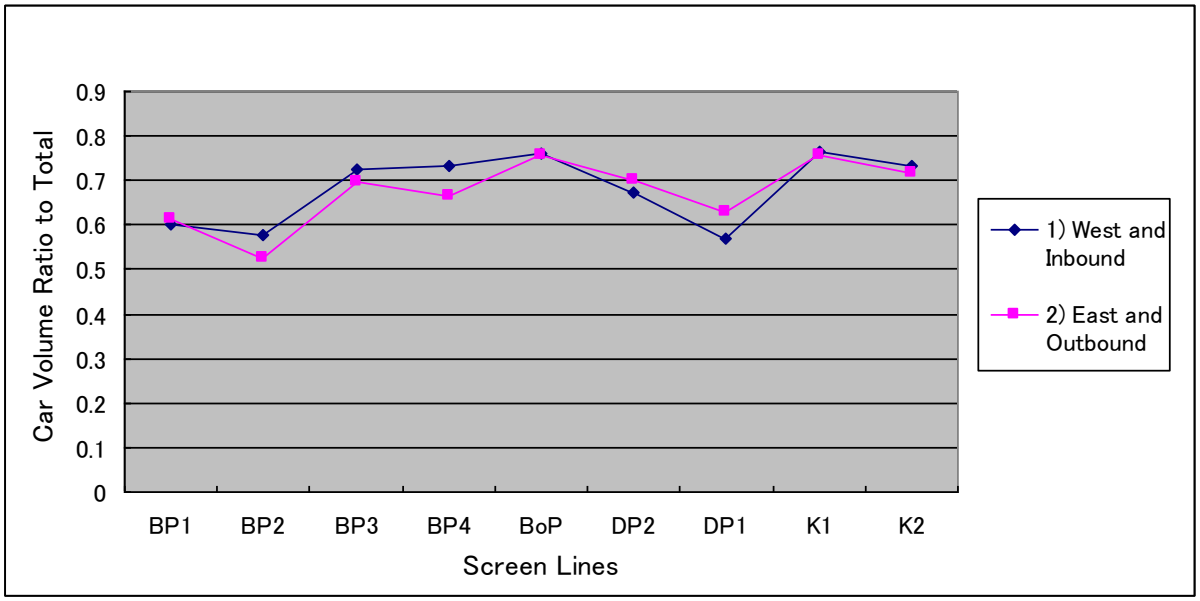
Source: *ibid*.

Figure 3.2.3 Traffic Volumes on Screen Lines by Type of Vehicles in the Morning Peak Hours (7:00-10:00, West and Inbound Direction), 2006



Source: *ibid*.

Figure 3.2.4 Traffic Volumes on Screen Lines by Type of Vehicles in the Morning Peak Hours (7:00-10:00, East and Outbound Direction), 2006

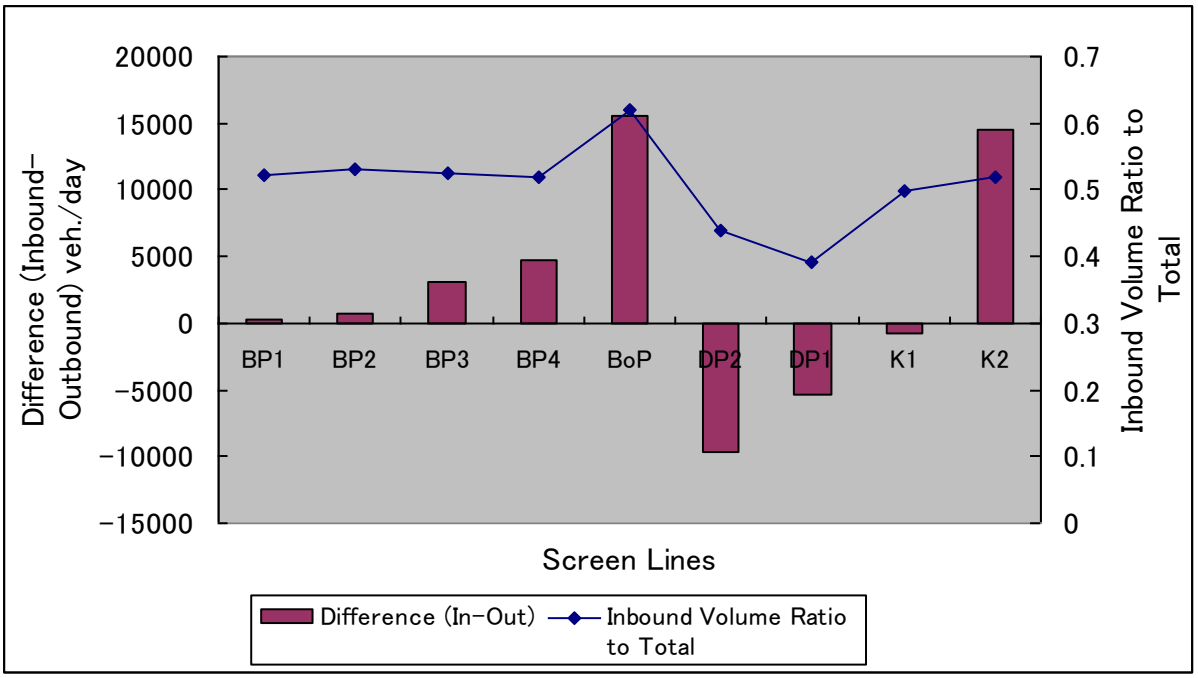


Source: *ibid*.

Figure 3.2.5 Vehicle Composition Ratio of Car in the Morning Peak Hours (7:00-10:00), 2006

(3) Directional Difference of Traffic Volumes in the Peak Hour

Generally, the inbound traffic volume is predominant in the morning peak hours. Figure 3.2.6 shows the difference in traffic volumes between inbound and outbound directions and its inbound ratio to the total. The screen lines K2 and BOP (Bosporus Crossing) show high volume in the inbound direction. The inflow ratio to the total volume is approximately 60%. On the other hand, outflow volumes on DP1 and DP2 on the Asian side are large outbound volumes. On other screen lines, the inflow and outflow traffic volumes are balanced in general.



Source: ibid.

Figure 3.2.6 Traffic Volume Difference between Inbound and Outbound Direction and Its Inbound Ratio (7:00-10:00), 2006

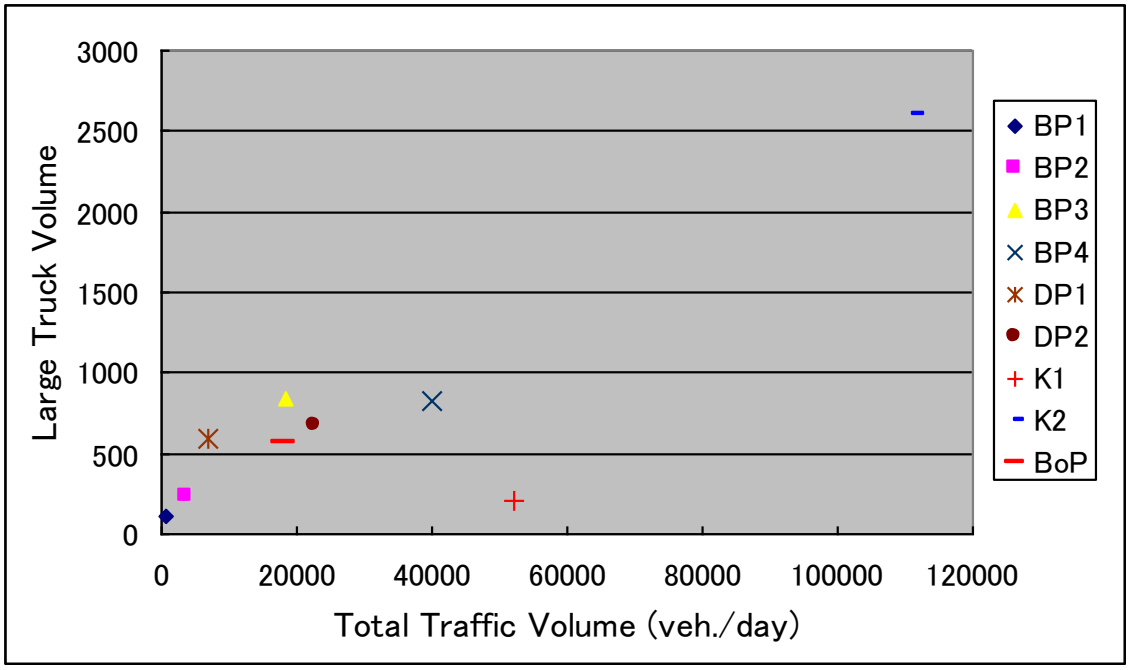
3) Cargo Transport on Screen Line

(1) Cargo Traffic Volumes in the Morning Peak Hour (7:00-8:00)

Cargo transport by heavy trucks, is restricted from entering the central business district in the morning from 6:00 to 10:00. Trucks entering the CBD must get permission. Thus, the cargo traffic volume during the morning peak hour is low.

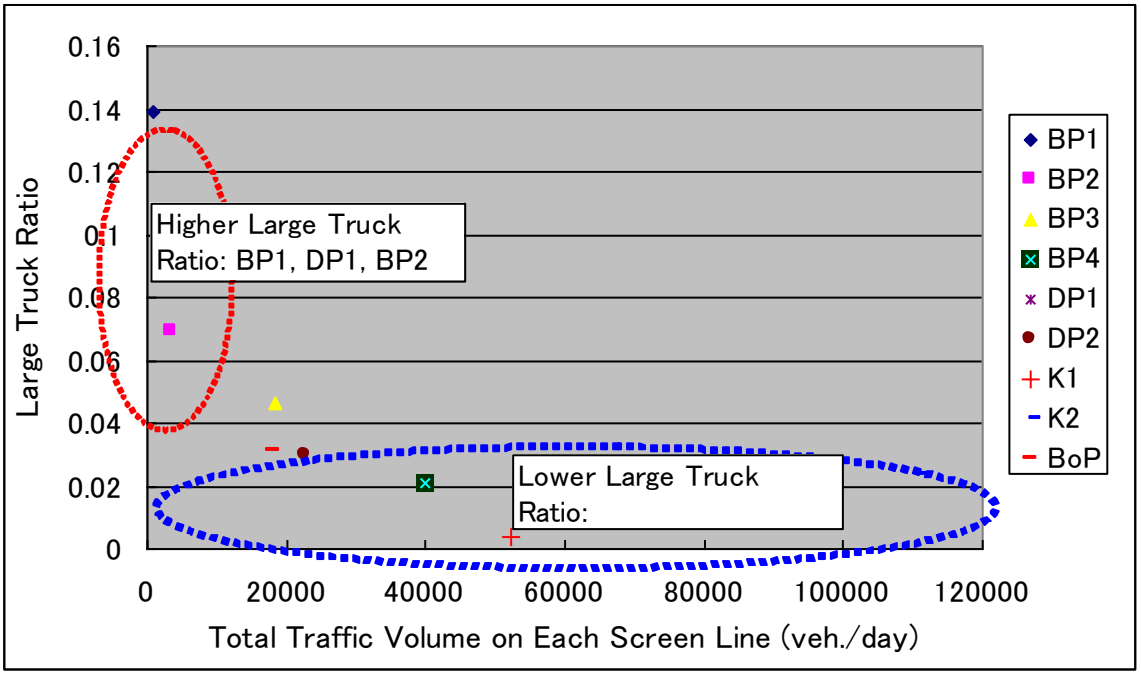
This section deals with cargo transport conditions in Istanbul by analyzing the road traffic count data on the screen lines. Figure 3.2.7 shows the relationship between total traffic volume and heavy truck volume on each screen line in the morning peak hour from 7:00 to 8:00. Figure 3.2.8 also shows the relationship between total traffic volumes and heavy truck volume ratios to the total.

The screen lines with higher heavy truck ratios are BP1, BP2 and DP1 located far from the CBD. These areas have no heavy truck restrictions. On the other hand, the screen lines of K1, K2, BOP, DP2 and BP4 have lower heavy truck ratios. These screen lines are located near the CBD where heavy truck entrance is restricted.



Source: *ibid*.

Figure 3.2.7 Heavy Truck Volumes on Screen Lines (7:00-8:00), 2006

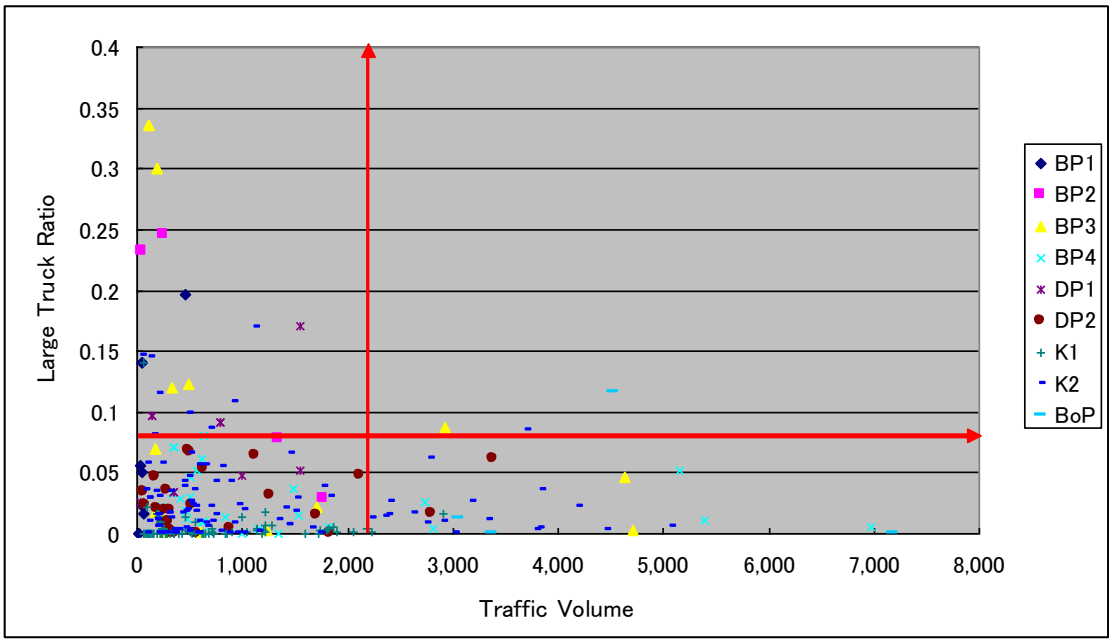


Source: *ibid*.

Figure 3.2.8 Heavy Truck Ratios on Screen Lines (7:00-8:00), 2006

Figure 3.2.9 also shows the relationship between the total traffic volume and heavy truck volume ratio to the total on roads counted on each station on the screen lines. The color of the plotted points represents one of the screen lines. The roads with higher heavy truck ratio (10% or more) and heavy traffic volumes (1,800 vehicle/hr or more) are few. The east-bound traffic on the 2nd Bosporus Bridge is one of the few samples. The higher ratios are seen on BP1, BP2 and BP3 although the traffic volumes are small.

In Istanbul, heavy truck does not have much effect on road traffic conditions.



Source: *ibid*.

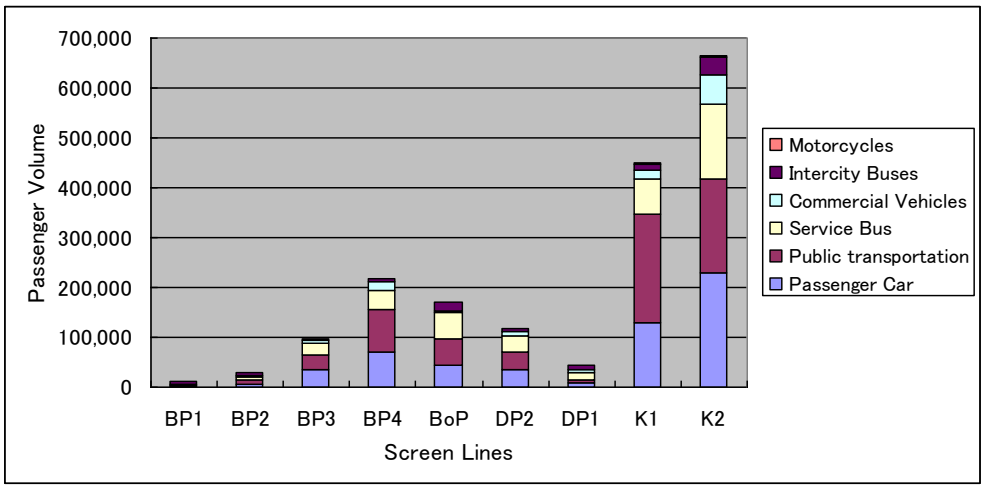
Figure 3.2.9 Traffic Volume and Heavy Truck Ratios by Road (7:00-8:00), 2006

4) Passenger Volume on Screen Line

(1) Peak Hour Passenger Volume (7:00- 10:00)

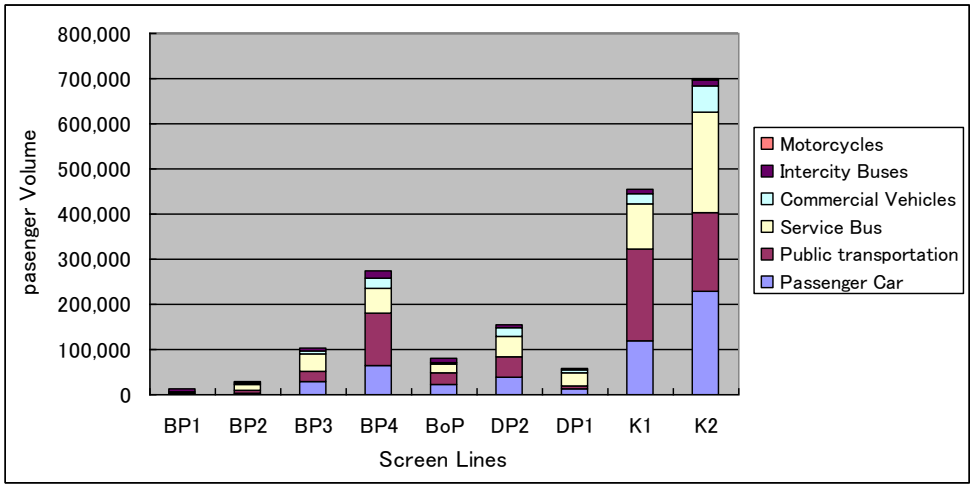
Figure 3.2.10 and Figure 3.2.11 show peak hour passenger volume for 3 hours from 7:00 to 10:00 in the morning. The highest passenger volume on the screen lines was, counted again, on K2 at approximately 670,000 passengers/day in the inbound and 700,000 in the outbound direction. The K1 passenger volume was approximately 450,000 and 455,000 in the inbound and outbound direction, respectively.

The public transport passenger share is high at 60% to 75% in the morning peak hours (see Figure 3.2.12). In this figure, public transport is the total of bus, service and inter-city bus. These ratios are similar in both directions.



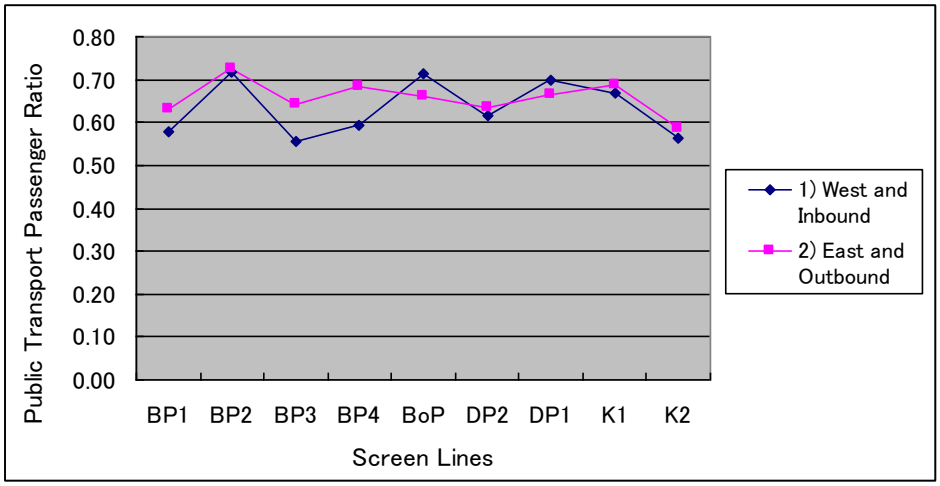
Source: *ibid*.

Figure 3.2.10 Passenger Volumes on Screen Lines by Type of Vehicles in the Morning Peak Hours (7:00-10:00), West and Inbound Direction, 2006



Source: *ibid*.

Figure 3.2.11 Passenger Volumes on Screen Lines by Type of Vehicles in the Morning Peak Hours (7:00-10:00), East and Outbound Direction, 2006

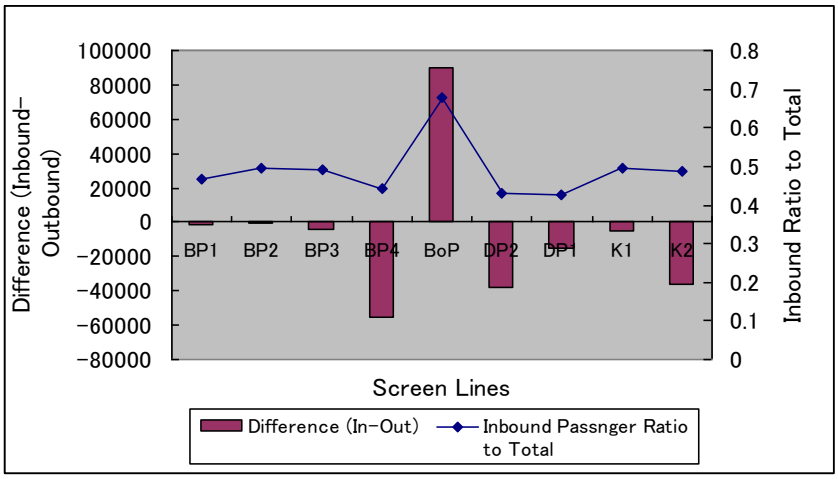


Source: *ibid*.

Figure 3.2.12 Passenger Composition Ratio of Public Transport in the Morning Peak Hours (7:00-10:00), 2006

(2) Directional Difference of Passenger Volumes in the Peak Hour (7:00-10:00)

Generally, the inbound passenger volume is predominant in the morning peak hour. Figure 3.2.13 shows difference in passenger volumes between inbound and outbound direction and its inbound ratio to the total. The difference of passenger volume on the screen line is remarkable on the Bosporus Crossing (BOP). The inflow ratio to the total volume is mostly 40-50%. On the other hand, only the BOP shows a very high inflow passenger volume and its ratio.



Source: *ibid*.

Figure 3.2.13 Passenger Volume Difference between Inbound and Outbound Direction and Its Inbound Ratio, in the Morning Peak Hours (700-10:00), 2006

5) Occupancy on Screen Line

Table 3.2.4 shows the average occupancy for 3 hours from 7:00 to 10:00 in the morning for inbound and outbound directions. The occupancy is defined as the number of passengers divided by the number of vehicles on each screen line. The occupancy of bus on BP4 and BOP are high at 42 and 45 passengers/vehicle respectively in both directions.

Service bus has an occupancy of approximately 10 passengers/vehicle in both directions.

Table 3.2.4 Average Occupancy on the Screen Lines, 2006

1) West and Inbound

Screen	BP1	BP2	BP3	BP4	BoP	DP2	DP1	K1	K2
Passenger Car	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.7	1.6
Public Transportation	17.8	15.4	22.1	42.4	44.5	21.1	22.6	30.4	28.0
Service Bus	14.1	12.3	8.5	9.4	11.7	9.6	11.9	10.7	10.3
Commercial Vehicles	2.0	1.7	1.6	1.7	1.4	1.6	1.9	2.2	2.0
Intercity Buses	39.9	34.4	26.3	34.7	28.7	35.3	60.7	50.7	38.5
Motorcycles	2.1	2.5	1.9	1.8	1.2	1.2	2.3	2.3	2.1
Total	3.5	4.4	3.1	3.4	4.3	3.4	4.5	4.5	3.3

2) East and Outbound

Screen	BP1	BP2	BP3	BP4	BoP	DP2	DP1	K1	K2
Passenger Car	1.7	1.5	1.5	1.6	1.2	1.3	1.4	1.6	1.7
Public Transportation	19.5	28.7	25.5	35.9	43.6	28.4	21.9	31.1	28.2
Service Bus	16.2	18.1	12.9	11.2	7.9	13.7	14.1	12.9	13.2
Commercial Vehicles	2.0	2.0	1.6	1.9	1.5	2.2	2.0	2.2	2.1
Intercity Buses	45.3	47.5	23.7	40.8	34.5	53.1	56.3	52.1	34.0
Motorcycles	2.1	2.2	1.7	1.8	1.2	1.2	2.6	2.2	2.1
Total	4.4	5.1	3.6	4.5	3.3	3.5	3.9	4.5	3.8

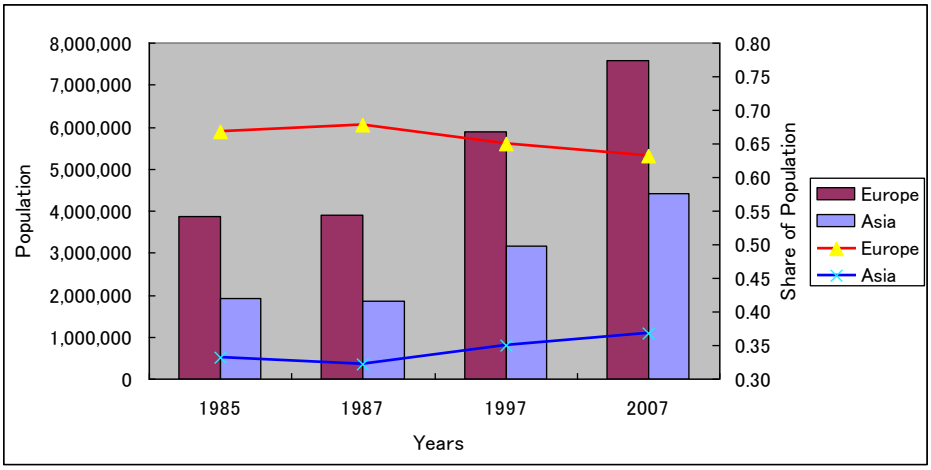
Source: *ibid*.

6) Bosporus Crossing

Istanbul is divided into the European and the Asian side by the Bosporus Strait. The travel between both sides is done, aside from ferries, through the 1st and 2nd Bridges where heavy traffic congestion occurs during the peak hours. The travel across the two bridges is not easy. Therefore, this section focuses on the travel conditions of the bridges.

7) Population on the European and Asian Sides

Figure 3.2.14 shows the population growth and its share in European and Asian sides by year. The population in European and Asian sides is 7,600,000 and 4,400,000 in 2007, respectively. The population share in European side is 63% to the total, in contrast to 67% in 1985. The share of the European side slightly decreases year by year.

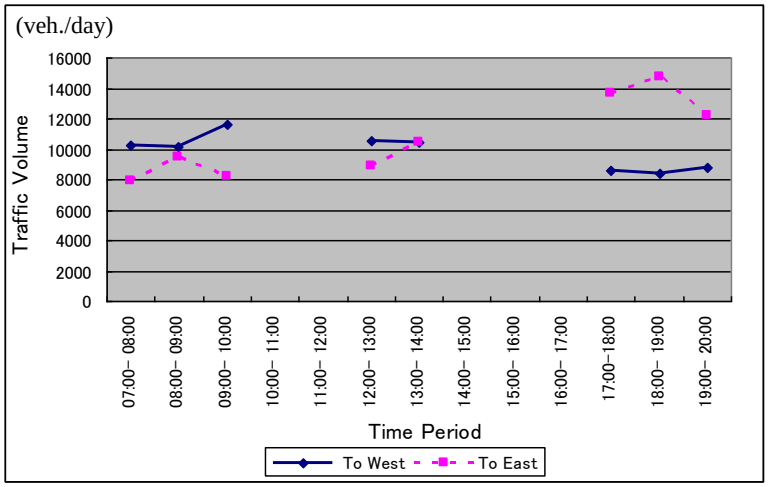


Source: Census Data

Figure 3.2.14 Population Growth in European and Asian Sides

8) Traffic Volume on Bosporus Crossing

Figure 3.2.15 shows hourly traffic volume by direction on the Bosporus Crossing in 2006 as the total traffic of the both Bridges. In the morning peak hour, the inbound direction (to west) is dominant in traffic volume, and it is reversed in the evening. This is because in the morning, the commuters, who reside in the Asian side, travel to European side across the strait, and return to their houses during the evening peak hours.



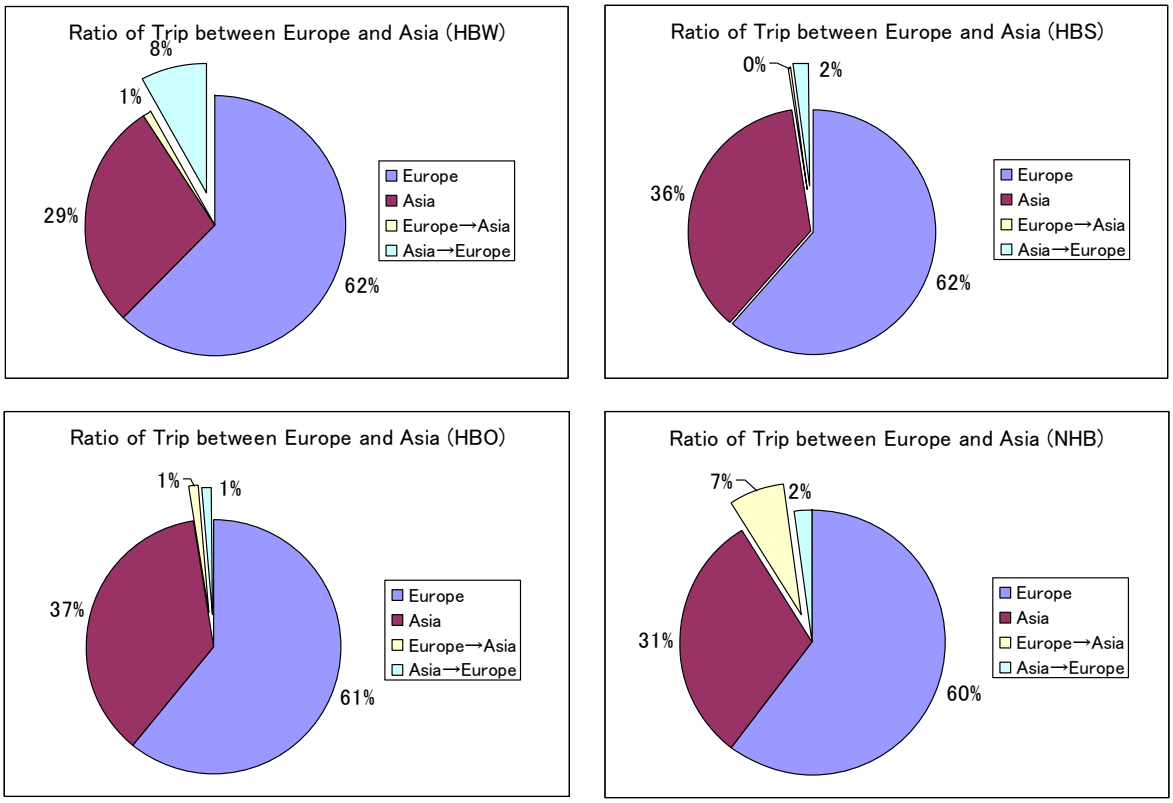
Source: Study Team

Figure 3.2.15 Hourly Traffic Volume by Direction on Bosporus Crossing, 2006

9) Trips between European and Asian Sides

Figure 3.2.16 shows shares of trips between the European and Asian sides by trip purpose, in which trip OD tables integrated into 4 blocks; inside Europe, inside Asia, Europe to Asia, and Asia to Europe. Ratio of HBW trips inside the European and Asian side is 62% and 29%, respectively. Inter-continental trips are few at 8% for Europe to Asia, and 1% for Asia to Europe.

For other trip purposes, similar ratios are observed. Especially, the share of inter-continental HBS and HBO trips is low and both sides seem to be independent from each other. Among the 4 purposes, HBW and NHB somewhat have higher dependence on each other. In HBW trips the movement from Asia to Europe is predominant, while it is from Europe to Asia in the NHB. This is because business and commercial areas are mostly located in the European side and the residential areas are in Asian side.

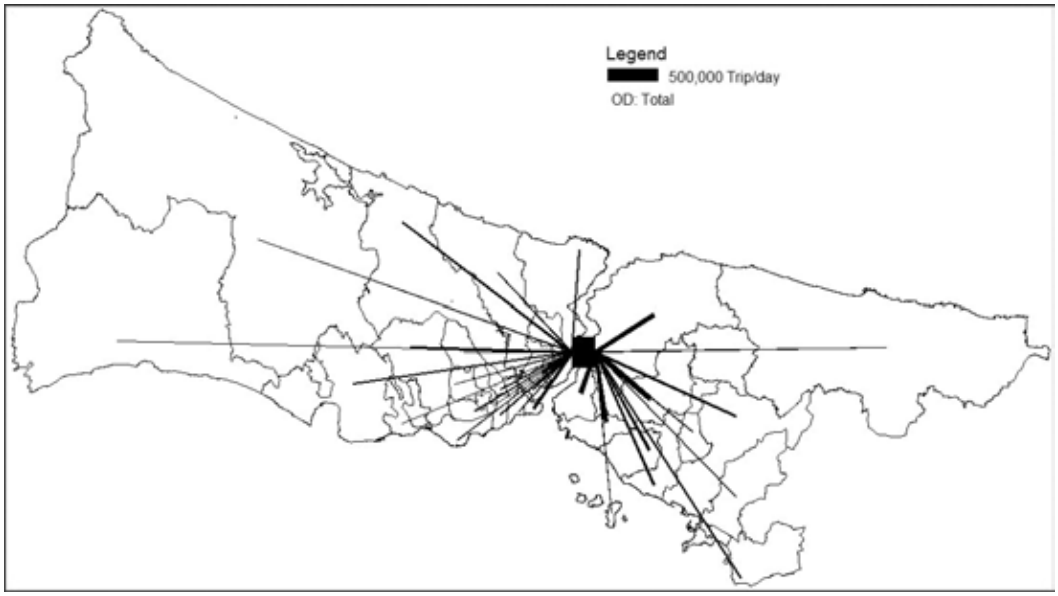


Source: *ibid.*

Figure 3.2.16 Share of Trips between Europe and Asia, 2006

10) Trip Distribution

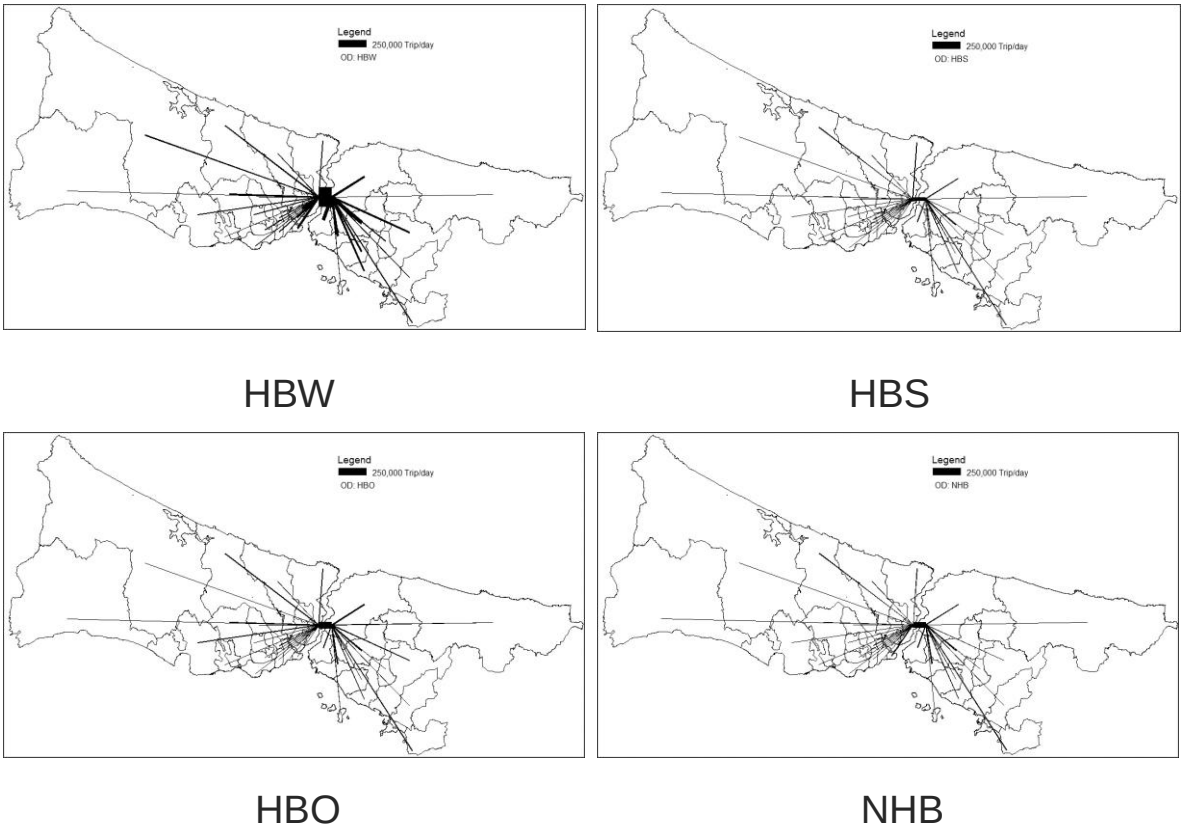
Figure 3.2.17 shows daily distribution of trips passing through the Bosporus. Most of these trips are short-distance, connecting area adjacent to the Bosporus. The trip end is close to the crossing.



Source: *ibid.*

Figure 3.2.17 Daily Trip Distribution Passing Bosporus Crossing (All Trip Purpose), 2006

Figure 3.2.18 shows daily trip distribution passing the Bosporus by purpose. Among the 4 trip purposes, HBW is somewhat heavy in volume. Heavy traffic is seen also near the Bosporus where business and commercial centers are located in the European side, and residential areas.



Source: *ibid.*

Figure 3.2.18 Daily Trip Distribution Passing Bosporus Crossing by Trip Purpose, 2006

3.2.3 Cordon Line (Boundary of the Study Area) Traffic Volume

1) Introduction

The traffic volume and ODs to/from the study area from/to the external area can be found from the cordon line survey data. The cordon line survey was carried out simultaneously with the screen line survey. The cordon line survey consisted of roadside interviews and traffic volume counts which were conducted simultaneously at the cordon line survey stations. The roadside interview was done to obtain OD data of vehicles and passengers, including those not residing inside the study area but traveling to the study area. The cordon line survey was carried out at the locations covering the whole boundary of the study area consisting of three cordon lines (see Figure 3.2.19). Table 3.2.5 shows the number of stations on the cordon lines.

Source: *ibid.*

Figure 3.2.19 Location of Cordon Line Surveys, 2006

Table 3.2.5 Summary Interview Locations on Cordon Line, 2006

Cordon Lines		Location
1)	Europe	4
2)	Anatolia	2
3)	Ferry Boat	4
		4

Source: *ibid.*

2) Traffic Volume

Traffic volumes on the cordon line are summarized in Table 3.2.6 and Figure 3.2.20. Both the European and Asian sides show similar volume. These figures are 70,000-75,000 vehicles/day, with an exception of the inbound direction in the European side (42,000). As for arrival and departures from/to the ferry boat in the Yenikapi ports, the vehicle and passenger volumes are 5,600-7,600 vehicles/day and 8,500-9,700 persons/day, respectively.

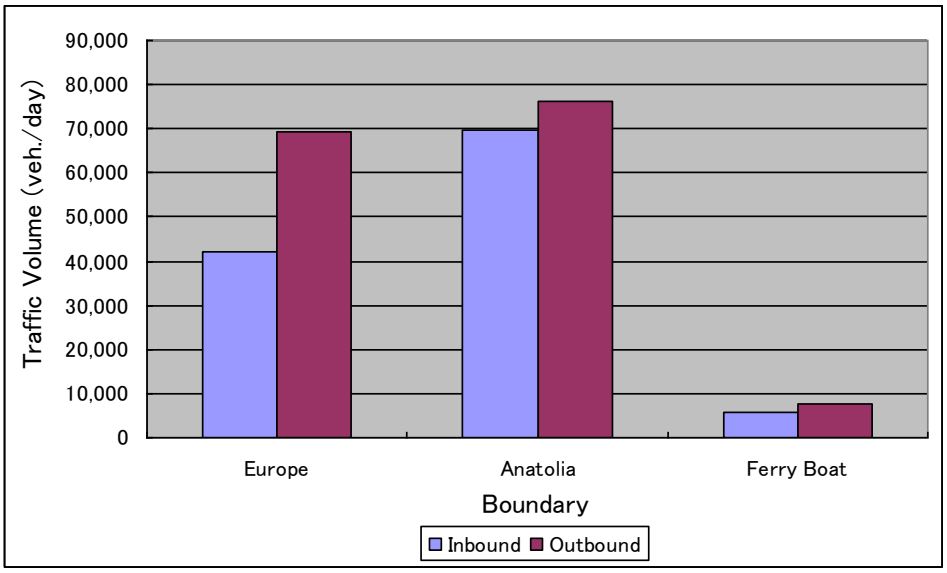
Figure 3.2.21 and 3.2.22 show daily vehicle composition ratio to the total volumes in both inbound and outbound directions. The ratio of car in the inbound direction from the Anatolia side is high at 56%, in contrast to 44% at European boundary. On the other hand, the ratio of commercial vehicle (truck) from European boundary is high at 40%.

The outbound traffic of car is remarkable at the Anatolia boundary and the European boundary shows a high percentage of service vehicles.

Table 3.2.6 Daily Traffic Volumes on Cordon Line by Direction, 2006

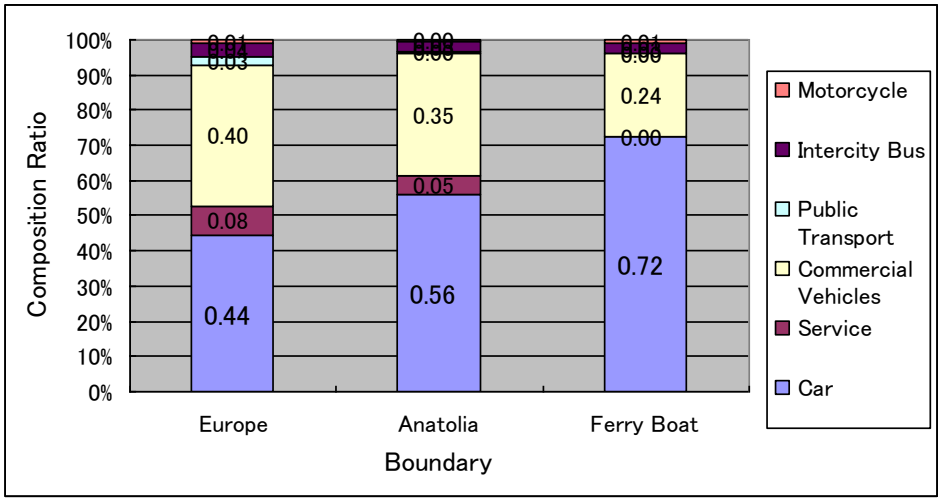
Cordon Lines	Unit/day	Inbound	Outbound
Europe	vehicle	42,311	69,173
Anatolia	vehicle	69,689	76,393
Ferry Boat	vehicle	5,582	7,653
	person	25,000	

Source: *bid.*



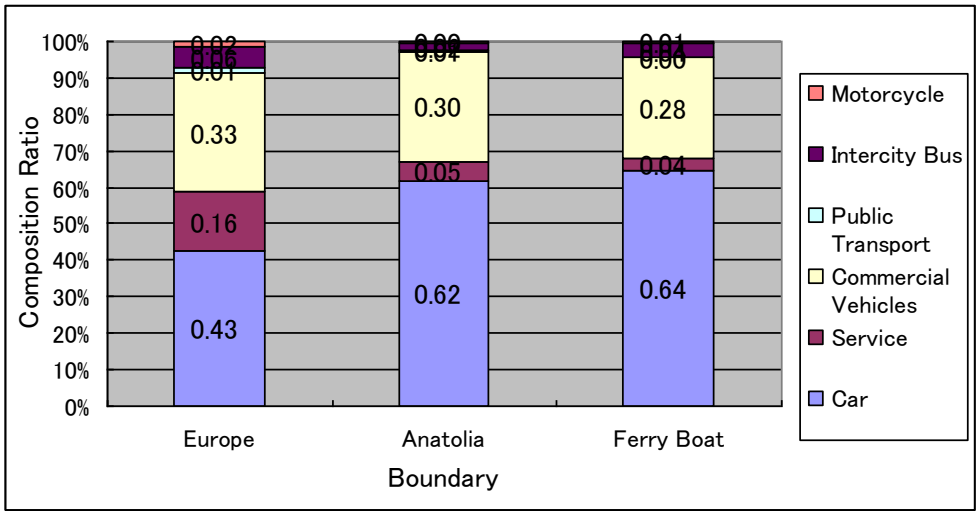
Source: Study Team

Figure 3.2.20 Inbound and Outbound Traffic Volumes on Cordon Line, 2006



Source: *ibid.*

Figure 3.2.21 Daily Vehicle Composition Ratio in Inbound Direction, 2006



Source: *ibid.*

Figure 3.2.22 Daily Vehicle Composition Ratio in Outbound Direction, 2006

3) Trip Distribution outside the Study Area

Traffic flows from the outside of the study area were counted through the cordon line survey. On the other hand, information on traffic flows within the study area were collected from the person trip survey. Table 3.2.7 and Table 3.2.8 show car and bus trips in the study area and outside the study area in terms of PCU/day. The trip data within the study area was obtained from the person trip survey, while travel data related to the external area was obtained from the cordon line survey. As for bus data in Table 3.2.8, since the unit of the city bus is passenger trips, the average occupancy of the city bus (30.4) was used to calculate the traffic volume in terms of PCU.

The total car trips related to the study area accounted for approximately 2,300,000 PCUs/day, of which 2,160,000 PCUs/day move within the study area and the balance moves between the study area and the external areas. Approximately 94% to total car trips are within the study area. Since trips within the study area have a high share, the study area is deemed to be closed from the viewpoint of traffic.

Bus trips also have a high percentage in the trips within the study area. they occupy approximately 96% in terms of PCUs/day. The share of external trips passing through the study area is as low as 0.2%.

Table 3.2.7 Car Trips between the Study Area and the Outside, 2006

(Unit: PCU/day)

Car	Study Area	Outside of Study Area	Total
Study Area	2,159,267	78,363	2,237,630
Outside of Study Area	57,284	3,883	61,167
Total	2,216,551	82,246	2,298,797

Source: *ibid.*

(Unit: Ratio to Total)

Car	Study Area (%)	Outside of Study Area (%)	Total (5%)
Study Area	93.9	3.4	97.3
Outside of Study Area	2.5	0.2	2.7
Total	96.4	3.6	100.0

Source: Study Team

Table 3.2.8 Bus Trips between the Study Area and the Outside, 2006

(Unit: PCU/day)

Bus	Study Area	Outside of Study Area	Total
Study Area *)	486,132	10,868	497,000
Outside of Study Area **)	8,008	1,036	9,044
Total	494,140	11,904	506,044

Note: * City Bus, ** Intercity Bus

Source: IETT

(Unit: Ratio to Total)

Bus	Study Area (%)	Outside of Study Area (%)	Total (%)
Study Area *)	96.1	2.1	98.2
Outside of Study Area **)	1.6	0.2	1.8
Total	97.6	2.4	100.0

Note: * City Bus, ** Intercity Bus

Source: Study Team

Chapter 4 Rail Transit System

4.1 Present Railway System

4.1.1 Railway Network

Istanbul has a metro (15.7km), a light metro (19.3km), three tramways (34.7km), two funiculars (1.2km), two nostalgic tramways (4.2km), two suburban railways (72km), and two teleferiks (0.7km) with a total length of 148km. The standard gauge of 1435mm is applied for all lines of the metro, the light metro, and the tramways. Table 4.1.1 shows the list of the existing railways. Ulasm A.S. is the major operator of the urban rail in Istanbul.

Table 4.1.1 List of the Existing Railways

(As of October, 2008)

Project Code*1	Line Code*2	Route Name	Operator	Type	Length (km)	No. of station
E-1	M2	Sishane-Taksim - 4.Levent Metro	Ulasim A.S.	Metro	15.6	6
E-2	M1	Aksaray - Airport Light Metro	Ulasim A.S.	Light Metro	19.3	18
E-3	T1	Zeytinburnu - Kabatas Tramway	Ulasim A.S.	Tramway	14.1	24
E-4	T2	Zeytinburnu - Bagcilar Tramway	Ulasim A.S.	LRT (Tramway)	5.1	9
E-5	-	İstiklal Street Nostalgic Tram	IETT	Nostalgic Tram	1.6	5
E-6	-	Tunel	IETT	Funicular	0.6	2
E-7	-	Taksim - Macka Teleferik	Ulasim A.S.	Ropeway	0.3	2
E-8	T3	Kadikoy - Moda Nostalgic Tram	Ulasim A.S.	Nostalgic Tram	2.6	10
E-9	F1	Taksim - Kabatas Funicular	Ulasim A.S.	Funicular	0.64	2
E-10	-	Eyup - Piyer Loti Teleferik	Ulasim A.S.	Ropeway	0.42	2
E-11	-	Sirkeci - Halkali Suburban Rail	TCDD	Suburban Rail	30	18
	-	Haydarpasa - Gebze Suburban	TCDD	Suburban Rail	42	25
E-12	T4	Topkapi-Edirnekapi – Sultanciftligi Tramway	Ulasim A.S.	LRT (Tramway)	15.5	18
		Total			147.8	

*1: Project code is the line name defined by Study Team

*2: Line code is the line name defined by Ulasim A.S.

Source: IMM, Ulasim A.S.

Source: Study Team

Figure 4.1.1 Route Map of the Existing Railway System

Brief history and operating status at present of each line are summarized as follows:

E-1: Taksim - 4.Levent Metro (M2)

Its construction began in 1992, and the section between Taksim and 4-Levent was opened on September 16, 2000. The route length is 15.6km with 6 underground stations: Taksim, Osmanbey, Sisli, Gayrettepe, Levent and 4.Levent. The travel time between Taksim and 4.Levent is about 12 minutes with five-minute headway during peak hours. The power supply system is DC 750V third rail. The number of cars per train under operation is four, but the platform length is enough to operate trains with eight cars. The operation is not in full capability, because the depot for maintenance of trains is not yet constructed and 4.Levent station is temporarily used as the depot of this line.

E-2: Aksaray – Airport Light Metro (M1)

The first section of the light metro was opened in 1989 between Aksaray and Kartaltepe with a length of 8.5km. The extension of the line was completed in 2002 with a total length of 19.3 km between Aksaray and Ataturk International Airport. It has 18 stations (6 underground, 9 at grade and 3 elevated). The travel time between Aksaray and Atatulk International Airport is 32 minutes with five-minute headway during peak hours. The power supply system is DC 750V Catenary. The line is segregated from road traffic.

E-3: Zeytinburnu- Kabatas Tramway (T1)

This modern, low-step tramway began its operation in 1992 between Sirkeci and Topkapi. The two sections of Topkapi - Zeytinburnu and Sirkeci - Eminonu were opened in 1994 and 1996, respectively. The line was extended from Eminonu to Findikli in 2005, crossing the Golden Horn on the Garata Bridge. The total section up to Kabatas was opened in June 2006. The total route length is 13.2 km with 24 at grade stations, and the travel time between the end terminals is 50 minutes with three-minute headway during peak hours. The power supply system is DC 750V Catenary.

E-4: Zeytinburnu - Bagcilar Tramway (T2)

This line was put in service in September 2006, with a total length of 5.1 km. The train type on this line is the same as that of Aksaray - Airport Light Metro (M1). Although the term of tramway is used for the name of this line, the train type and platform height are different from those of Zeytinburnu - Kabatas Tramway. It has 9 at grade stations, and the travel time of between the end terminals is 18 minutes with five-minute headway. The power supply system is DC 750V Catenary. This line is connected to M1 and T1 at Zeytinburnu Station.

E-5: Istiklal Street Nostalgic Tram

This tram line was closed in 1961 but reopened in 1990 with a length of 1.6km along Istiklal Street. Its capacity is very small and the frequency is not enough to satisfy passenger demand. However, this line is convenient for the connection between Taksim Square and Tunnel, and it has become a tourism attraction.

E-6: Tunel

Tunel is an underground funicular which connects Tunel Square (the end of Istiklal Street) and Karakoy at the altitude difference of 60m, carrying 10,000 passengers per day. The

end station at Karakoy is not directly connected with Zeytinburnu - Kabatas Tramway (T1). Traction is by cable with pneumatic tire suspension and rack rail for emergency stop.

E-7: Taksim – Macka Teleferik

This teleferik provides a shortcut over the valley of the park in the east of the Military Museum with a distance of 334m. This is a local transport system carrying less than 1,000 passengers per day.

E-8: Kadikoy - Moda Nostalgic Tram (T3)

This tram was reopened in 2003. It has 10 stations with a length of 2.6km, which forms a ring with a clockwise one-way operation. The track is not separated from road traffic. This nostalgic tram carries about 1,500 passengers per day.

E-9: Taksim – Kabatas Funicular (F1)

This is a new funicular which connects Taksim - 4.Levent Metro (M2) at Taksim Station and Zeytinburnu - Kabatas Tramway (T1) at Kabatas Station, carrying about 17,000 passengers per day. The transfer of this line with T1 and the ferries at Kabatas Staiton is well designed and convenient. Its operation started in 2006.

E-10: Eyup - Piyer Loti Teleferik

This teleferik connects Eyup along Golden Horn and Piyer Loti at the top of the hill. It was opened in 2005. This is a convenient transport mode for residents and tourists. It carries about 2,000 passengers per day.

E-11: TCDD Suburban Railway

International and long-distance trains are operated on the TCDD railway lines. TCDD operates two commuter trains in Istanbul metropolitan area which are running along the Sea of Marmaray on both sides of the city called Sirkeci - Halkali section and Haydarpasa - Gebze section. The Sirkeci - Halkali section is 30 km long with 18 stations, and Haydarpasa - Gebze section is 42 km long with 25 stations. The travel time is 48 and 65 minutes respectively. The power supply system is AC 25kV 50Hz Catenary.

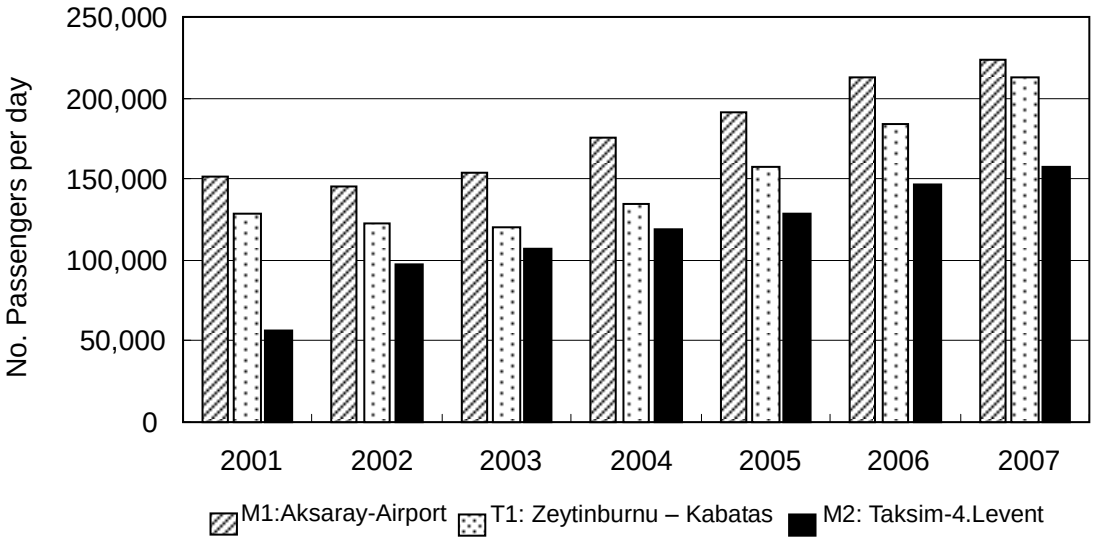
E-12: Edirnekapi - Sultanciftligi Tramway (T4)

This line was opened in September 2007. The route length is 12.4 km with 18 stations (6 underground and 12 at grade). The travel time is 35 minutes with a ten-minute headway at peak hours. The extension of this line from Edirnekapi to Topkapi is under construction. Train type of this line is the same as that of Aksaray - Airport Light Metro (M1). The power supply system is DC 750V Catenary. This line has level crossings with road traffic at some places.

4.1.2 Passenger Traffic

The number of passengers carried by Ulasim A.S. has been increasing yearly. Ulasim A.S. carried 123 million passengers in 2001, and the number increased by 83 million in five years from 2001, reaching 206 million in 2006. The average increase rate during this period is calculated as 10.8% a year. The number of passengers of Aksaray - Airport Light Metro (M1), Zeytinburnu – Kabatas Tramway (T1), and Taksim- 4.Levent Metro (M2) is 213,000 passengers per day, 184,000, and 147,000, respectively. The total

number of passengers is 595,000 (daily average in 2006). In addition, IETT carries 13,000 passengers per day and TCDD carries 95,000 on suburban lines. In total, the daily number of railway passengers is 711,000 as of 2006.



Source: Study Team, Data - www.istanbul-ulasim.com.tr

Figure 4.1.2 No. of Railway Passengers per Day

Table 4.1.2 No. of Passengers of Rail System per Day

Name of Rail System	2003	2004	2005	2006	2007*
Taksim – 4.Levent Metro(M2)	106,402	118,880	128,182	146,786	157,476
Aksaray-Airport Light Metro(M1)	154,400	175,115	191,047	212,664	223,963
Zeytinburnu – Kabatas Tramway(T1)	119,949	134,389	157,707	184,312	212,210
Zeytinburnu-Bagcilar Tramway(T2)	–	–	–	30,225[b)]	35,008
Takism – Kabatas Funicular(F1)	–	–	–	17,080[c)]	20,933
Tunnel (IETT)	8,968	9,878	9,979	10,782	N.A.
Kadikoy - Moda Nostalgic Tramway(T3)	1,014[a)]	1,419	1,547	1,568	1,716
İstiklal Street Nostalgic Tramway (IETT)	1,757	1,605	1,416	530[d)]	N.A.
Ropeway	739	679	656	2,490	3,886
Total	393,229	441,965	490,534	606,436	655,192

*: January – August, 2007 (IETT excluded)

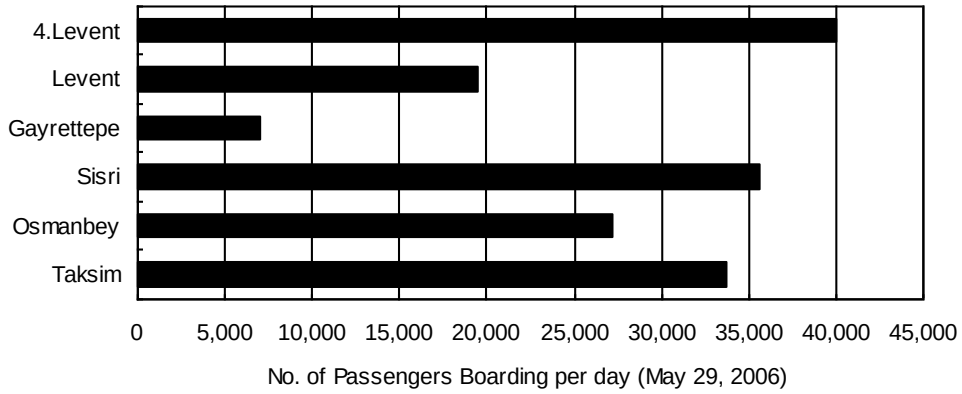
a) November and December, 2003/ b) July – December, 2006/ c) October – December, 2006

d) Passenger volume was small in 2006 due to rehabilitation work

Source: www.iett.gov.tr, www.istanbul-ulasim.com.tr (calculated from the original data)

Figure 4.1.3 shows the number of passengers of Taksim - 4.Levent Metro (M2). Although the total number of passengers on Taksim - 4.Levent Metro (M2) is smaller than that of the Light Metro and the Tramway, the passenger volume at stations of the Metro is high compared to that of the Light Metro and the Tramway. The number of passengers boarding at 4.Levent is 40,000 per day, which is the largest of all railway stations. It is more than 35,000 at Sisri, and more than 33,000 at Taksim.

The number of passengers boarding at Aksaray of the Light Metro is about 35,000 per day. The second largest volume on the Light Metro is 23,000 at Atakoy, and the third is 19,000 at Zeytinburnu.



Source: Study Team

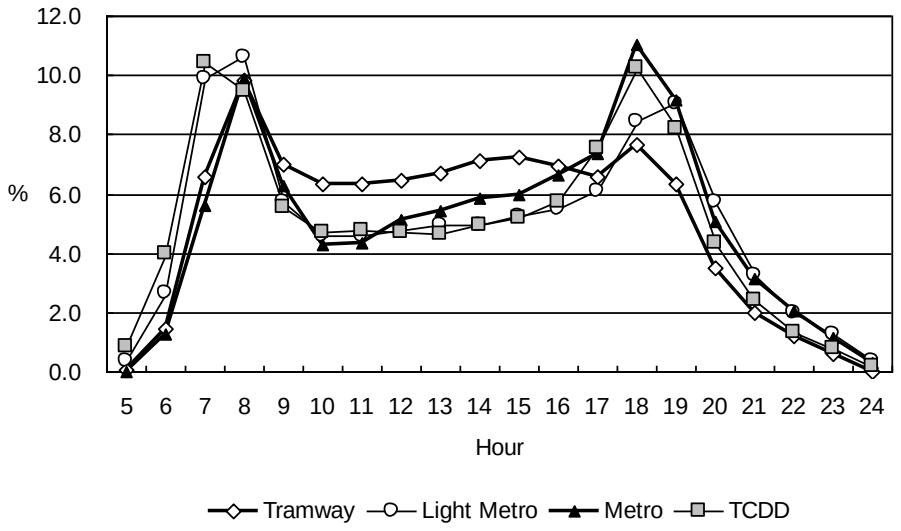
Figure 4.1.3 No of Passenger Boarding on Metro (M2),2006

The number of passengers boarding at the tramway stations ranges from 2,000 to 20,000 per day. It is 22,000 at Zeytinburnu, 18,000 at Sirkeci, 17,000 at Beyazit, and 16,000 at Eminonu.

The number of passengers boarding at Hydarapasa and Sirkesi is 7,500 and 11,400, respectively. Other major stations of the suburban rail are Bakirkoy (8,500), K.Cekmece (7,300), and Pendik (5,000).

The number of passengers boarding at each station can be obtained from ticket information, while the number of passengers between stations can not be obtained directly from the current ticket system. Although the number is not available, Aksaray - Airport Light Metro (M1), Taksim - 4.Levent Metro (M2), and Zeytinburnu - Kabatas Tramway (T1) are congested in the peak hours of weekdays. Especially, T1 is already oversaturated.

The peak ratio (no. of passengers boarding in a peak hour/ no. of daily passengers) of railways in Istanbul is approximately 10% as shown in Figure 4.1.4. Among the railway systems, the tramway carries more passengers during daytime than others.



Source: IMM

Figure 4.1.4 Distribution of Hourly Passenger Boarding on Railways

4.1.3 Operation

1) Frequency

The urban railways of Ulasim A.S. are operated according to the train schedule. The service frequency of the railways is sufficient; the headway in the peak hour ranges from four to five minutes, while it is about seven minutes in the off-peak hours and 10 to 15 minutes in the early morning and in the late night. The operational features of the main railway systems in Istanbul are shown as below:

Table 4.1.3 Frequency and Travel Time, 2006

	Taksim - 4.Levent Metro	Aksaray – Airport Light Metro	Kabatas – Zeytinburnu Tramway	Zeytinburnu – Bagcilar Tramway
Line Code	M2	M1	T1	T2
Operational length	8.5 km	19.6 km	13.2 km	5.2 km
No. of stations	6	18	24	9
No. of trains per day	M-F: 193 Sat: 177 Sun: 136	M-F: 177 Sat: 163 Sun: 134	M-F: 180 Sat: 180 Sun: 134	M-F: 148 Sat: 122 Sun: 110
No. of trains at peak hour	14	12	12	10
Shortest headway	4 min.	5 min.	5 min.	6 min.
Travel time	12 min.	32 min.	50 min.	18 min.
No. of passenger per day	185,000 passengers	240,000 passengers	245,000 passengers	40,000 passengers

	Edirnekapi – Sultanciftligi Tramway	Sirkeci – Halkali (TCDD)	Haydarpasa – Gebze (TCDD)
Line Code	T4	-	-
Operational length	12.4 km	30 km	42 km
No. of stations	18	18	25
No. of trains per day	112	116	110
No. of trains at peak hour	N.A.	6	6
Shortest headway	7.5 min.	10 min.	10 min.
Travel time	35 min.	48 min.	65 min.
No. of passenger per day	40,000 passengers	75,000 passengers	90,000 passengers

Note: M-F: Week days from Monday to Friday
Sat: Saturday
Sun: Sunday

Source: www.istanbul-ulasim.com.tr and www.tcdd.gov.tr

2) Fare System

There are two types of tickets - jeton (token) and Akbil (electric pass). In case of using jeton, a flat fare of 1.3 YTL is applied in each ride of the railway system as well as each bus ride, except for the express trains of TCDD. Within Istanbul, the fare of local trains of TCDD has the same flat fare of 1.3 YTL for Sirkeci – Halkali and Haiderapasa - Gebze. On the other hand, a discount fare of 1.25 YTL is applied for Akbil users. Akbil users are able to transfer from a line to another line at a discounted rate for a one-time ride up to 5 transfers. The fare system was revised in October 22, 2007 and the following system was introduced.

Table 4.1.4 Change of Railway Fare Structure, 2007

	Old System	New System
Maximum transfer time	90 minutes	120 minutes
Maximum no. of transfers	1	5
Extra charge	0	0.62 YTL
Transfer in the same line	Not allowed	Allowed

Source: IMM

With various transport modes, a trip in Istanbul usually involves a few transfers among different modes such as rail, bus and ferry. It is inconvenient if passengers buy all tickets or jetons for every transfer in a trip, while it would be convenient for passengers if the fare is defined on the condition that all the transport modes are operated as an integrated system. Ticket integration was introduced on 1st April 2006 among IETT, IDO, and Ulasim A.S. Soon after, TCDD and private bus and ferry companies joined the ticket integration.

4.1.4 Infrastructure and Equipment

E-1: Taksim – 4.Levent Metro（M2）

The Metro is fully equipped with electric and electronic systems and runs by an automatic train operation, and the operation control center operates the trains automatically. The driver on the train handles only opening and closing of the doors. The Metro temporarily operates from Taksim to 4th Levent, and one line of the platform of 4th Levent is used for passenger service and one other line is temporarily used as a rolling stock maintenance depot.

E-2: Aksaray – Airport Light Metro（M1）

The Light Metro is on a dedicated track with railway signals.

E-3: Zeytinburnu- Kabatas Tramway (T1)

The Tramway has no railway signal and is operated manually by a driver who follows road traffic signals. Passing of the tram car at road crossings is given the highest priority over road traffic signals.

E-4: Zeytinburnu – Bagcilar (T2) & E-12: Edirnekapi - Sultanciftligi Tramway (T4)

Although this system is called a “tramway”, it can be categorized as a Light Rail system. The train is operated manually according to road traffic conditions, and it is not equipped with a railway signal.

E-11: Sirkeci - Halkali & Haydarpasa - Gebze Suburban Railway (TCDD)

These commuter lines were first built as suburban rail service by TCDD. It shares the tracks and stations with long-distance trains.

The track gauge of the main railway systems is common at 1,435mm. The traction system of Metro, Light Metro and Tramways are 750 V DC, but the electric power for the Light Metro and Tramway is supplied by a catenary system while the Metro is supplied by the 3rd rail. Traction system of suburban lines are 25 kV AC 50Hz with catenary.

The technical specification of the existing railways is shown below.

Table 4.1.5 Technical Specification of Existing Railway Lines, 2006

	Metro (M2)	Light Metro (M1) / Tramway (T2&T4)	Tramway (T1)	Suburban (TCDD)
Type of railway	Subway (MRT)	LRT/Tramway	Tramway	Suburban
No. of cars per train	4	4 / 2	2	6
Track gauge	1,435 mm	1,435 mm	1,435 mm	1,435 mm
Design axle load	14 ton	8.2 ton	11 ton	18 ton
Height of platform	1,030 mm	910 mm	310 mm	N.A.
Traction system	750 V DC/ 3rd rail	750 V DC/ Catenary	750 V DC/ Catenary	25 kV AC 50 Hz/ Catenary
Signal system	Cabin signal	No information	No railway signal	No information
Telecommunication system	No information	No information	No information	No information
Operation system	Automatic train operation	Manual operation	Manual operation	Automatic train Stop

Source: www.istanbul-ulasim.com.tr and www.tcdd.gov.tr

4.1.5 Rolling Stock

There are three types of trains operated in the railway system in Istanbul. One type is larger car size with 3rd rail electricity collector manufactured by Alstom for the Metro. The rolling stock of the Light Metro and LRT is similar in type with the catenary electricity collector manufactured by ABB (before merged to Bombardier), and the rolling stock of the Tramway is another type with a low floor for low platforms and is manufactured by Bombardier. Rolling stock for suburban railway operated by TCDD is of E14000 type of Electrical Multiple Unit (EMU) manufactured by Alstom.

Ulasim A.S. has assembled four prototypes of trains in preparation of domestic production.

Table 4.1.6 Specification of Rolling Stocks

	Metro (M2)	Light Metro and Tramway(T2&T4)	Tramway (T1)	Suburban (TCDD)
Manufacturer	Alstom	ABB	Bombardier	Alstom
Length (m)	21.600/21.360	23.200	29.650	22.000
Width (m)	3.050	2.650	2.650	-
Height (m)	3.519	3.360	3.700	-
Wight (ton)	32.117(MC)/ 22.295(T)/ 31.650(M)	30.000	38.500	118.000 (1MC+1T+1TC)
No. of bogies	2	3	3	2
Maximum speed	80 km/h	80 km/h	70 km/h	120 km/h
Acceleration	1.03 m/s2	0.7 m/s2	1.1 m/s2	-
No. of pas./car (6 pas./m2) (Seating+standing)	54+174(MC)/ 60+180(M & T)	32+225	68+272	147+226+172 (1MC+1T+1TC)
Power control system	GTO/DC motor	GTO/DC motor	IGBT/AC motor	GTO/DC motor
No. of cars	32	105	55	69
Total vehicle power	1824 kW per train	330 kW per car	440 kW per car	1029 kW per unit

Source: www.istanbul-ulasim.com.tr and www.tcdd.gov.tr

Inspection, maintenance and repair of the rolling stock of Light Metro and LRT (T2&T4) are done in the depot at Esenler Station. Repair work of Tramway (T1) and the bogies including heavy maintenance of Metro is also carried out there.

The depot is arranged and restored well and the maintenance technique is on a high level to keep the rolling stock functioning in their original state.

4.1.6 Administration and Organization

1) Public Transport Authorities

Istanbul Metropolitan Municipality (IMM) is responsible for the urban transportation service in Istanbul. The level of the passenger fare, routes, and schedules are controlled by IMM. UKOME (Transportation Coordination Center) is the responsible authority under IMM for the decision of the passenger fares and others. IETT (Istanbul Electric Tramway and Tunnel) is responsible for the management of private buses. Department of Transportation in IMM is responsible for the planning of the public transportation in Istanbul and the construction of railway system.

The role of the central government in the urban railway system is minor. The suburban railway in Istanbul is operated by Turkish State Railways (TCDD) under the Ministry of Transportation and Communication. The Marmaray Project is being implemented by General Directorate of Railways, Harbors and Airports Construction (DLH).

2) Railway Operators

Railways in Istanbul are operated by TCDD (Turkish State Railway), IETT (Istanbul Electric Tramway and Tunnel), and Ulasim A.S. (Istanbul Transportation Corporation). IETT and Ulasim A.S. use the railway system owned by IMM. UKOME (Transportation Coordination Center) is responsible for the coordination among the operators, and the decisions of fare, route, and schedule.

(1) IETT (Istanbul Electric Tramway and Tunnel)

IETT is the public operator for bus transport in Istanbul. IMM conferred the right to use the existing railway infrastructure and rolling stock for 40 years to IETT in 2002 without royalty. However, IETT leases the railway system to Ulasim A.S. for the operations except for the Tunel and the Nostalgic Tramway along Istiklar Street. Distribution of passenger revenues from the integrated ticket system is one of the tasks of IETT. In addition, IETT is constructing the following railway lines for IMM:

1) Sultanciftligi – Edirnekapi (Light Metro)
2) Otogar – Bagcilar (Light Metro)
3) Bagcilar – Ikitelli – Olimpiyatkoy (Metro)
4) Kadikyoy – Kartal (Metro)

IETT will be given the right to use these lines, and lease them to Ulasim A.S. for their operation. After these projects, IETT will not construct new railway lines.

Financial Structure

Financial information of IETT is described in “Activity Report 2006”, which is available from IETT Web page.

Its total income in 2006 was 691 million YTL in which passenger revenue accounted for 53%. The other major revenues are subsidies from IMM (19%), rail access charges from Ulasim A.S. (9%), and the disposal of properties such as buses and buildings (5%). Its total income without subsidies was 559 million YTL.

Its total expenditure in 2006 was 730 million YTL of which personnel costs and other

operating costs accounted for 37% and 56%, respectively. Depreciation is not included in the total expenditure. Without subsidies, its operating losses in 2006 amounted to 173 million YTL. In addition to the expenditure, its capital investment, including new railway lines and purchase of bus fleets, was equivalent to 342 million YTL.

(2) Ulasim A.S. (Istanbul Transportation Corporation)

Ulasim A.S. is the public operating company for Akusaray - Airport Light Metro (M1), Taksim - 4.Levent Metro (M2), Zeytinburnu - Kabatas Tramway (T1), Zeytinburnu - Bagcilar Tramway (T2), Edirnekapi - Sultanciftligi Tramway (T4), Kadikoy - Moda Nostalgic Tramway (T3), and two ropeways, with a total length of 66.2km. Ulasim A.S. rents the railway systems from IETT for operation. Ticket sales of these railways are the major revenues of Ulasim A.S., while the company pays 12% of the revenue to IETT as the charge for the railway system. At the moment, Ulasim A.S. monopolizes the operation of railway system in Istanbul. It is not decided weather IMM will commission the operation of new railway lines to other private companies or not.

Ulasim A.S. was established in 1988 to undertake the operation and maintenance of the railway system in Istanbul as a subsidiary of IMM. IMM is the major stockholder of the corporation with 99% share of the total stocks. The number of personnel is around 900.

Financial Structure

With steady increase of passengers and opening of new lines, passenger revenue is remarkably increasing. Ulasim A.S. earned fare revenue of 148.1 million YTL in 2006 when Zeytinburnu - Bagcilar Tramway (T2) and Taksim - Kabatas Funicular (F1) were put in service. The total of expenses was 100.1 million YTL and Ulasm A.S. made sale profit of 48 million YTL in 2006.

The ratio of personnel expense to passenger revenue constantly accounts for approximately 25%. For comparison, the ratios in Japanese metros vary from 22% to 36%. On the other hand, personnel expense per passenger is increasing yearly, from 0.39YTL/passenger in 2002 to 0.72 in 2006, and this trend will continue due to the increase of labor cost in Turkey. Personnel expense per passenger of Japanese metros indicates approximately 0.4 to 0.6 YTL, reflecting the large number of passengers.

Table 4.1.7 Financial Statement of Ulasim A.S.

Million YTL

	2002	2003	2004	2005	2006
No. of Passengers (Million Passengers)	133.7	139.3	157.6	175.0	204.9
Passenger Income	52.4	80.1	94.4	116.4	148.1
Expenses	60.8	74.5	110.2	123.2	100.1
Personnel Expenses	10.7	22.1	26.1	30.6	38.2
% (d/c*100)	17.6	29.7	23.7	24.8	38.2
% (d/b*100)	20.5	27.6	27.6	26.3	25.8
Other Expenses	50.1	52.4	84.1	92.6	61.9
% (e/c*100)	82.4	70.3	76.3	75.2	61.8
Sales Profit	-8.4	5.6	15.8	-6.9	48.0
Administrative Expenses	9.8	11.5	12.8	13.8	19.9
Core Activity Profit	-18.3	-5.9	-28.6	-20.6	28.2
Other income & expenses	3.0	-3.8	11.7	-6.8	-12.8
Activity Profit	-15.2	-9.8	-16.9	-27.4	15.3
Unusual items	0.6	0.6	0.5	-3.0	0.9
Net Profit	-14.7	-9.1	-16.4	-30.4	16.2
Unit labor expenses (d/a)	0.39	0.58	0.60	0.66	0.72
Unit other expenses (e/c)	0.96	0.65	0.89	0.80	0.42

Source: Ulasim A.S.

(3) TCDD (Turkish State Railways)

TCDD is a State Economic Enterprise (SEE) under Ministry of Transportation and Communications (MoTC), operating passenger and freight railway services in Turkish. In Istanbul, TCDD operates two suburban railways from Sirkezi station to the west in the European side and from Hyderapasa station to the east in the Asian side. The two lines will be connected by the Marmary Project. TCDD also operates Hyderapasa Port.

The responsible organization in the construction of the state railway is DLH (the General Directorate of Railways, Harbors and Airports Construction).

4.2 Railway Projects

Many railway projects are currently in various stages of preparation or implementation in Istanbul. Those projects are already under construction, being tendered or ready for tender, or being studied or formulated. Thus, the study team is classified and identified these projects by using project codes. The status of each project shall be defined by the use of single letter code as follows:

Project Code

- E-xx : Existing Railways
- C-xx : Projects Under Construction
- T-xx : Tender Stage Projects
- D-xx : Projects Under Designing Stage

4.2.1 Projects Under Construction

Presently, construction work for new lines and extension of the existing lines are underway. The total length of the projects under construction is 136.5km of which 76.5km is the section length of the Marmaray Project. The Marmaray project is expected to be completed in 2012, while the other construction projects are scheduled to be completed in 2009 or 2010.

Extension of Taksim-4.Levent Metro (C-1&C-4): The construction of the underground railway is underway for both sides of the existing metro, from Taksim to Yenikapi (C-1, 5.2km) and 4.Levent to Haciosman (C-4, 8.0km). The section of Taksim - Yenikapi will be an alternative route of Zeytinburnu - Kabatas Tramway (E-3) with higher speeds and more convenient access to Taksim Square. This section will connect the metro to the Marmaray Commuter at Yenikapi. In the section between Taksim and Sishene with length of 1.65 km, construction work has been completed except for E&M systems installation such as power supply, signal, and telecommunication.

The section of 4.Levent - Haciosman (C-4) connects Sariyer District to the center of Istanbul, running through the new industrial area and Istanbul Technical University. Tunneling work for the section has been completed in February, 2008.

Topkapi-Edirnekapi-Sultanciftligi Tramway (C-2): Construction began in 2002 and the section between Sehitlik Station and Selam Station was completed and opened in September, 2007. Remaining section between Sehitlik and Topkapi is under construction and is expected to be completed in 2008. Passengers can transfer at either Ulubatli Station of Aksaray - Airport Light Metro (E-2) or Topkapi Station of Zeytinburnu - Kabatas Tramway (E-3) when the extension section is completed.

Kadikoy-Kartal Metro (C-3): This is a parallel route of the Marmaray Commuter. Both routes are connected at Ibrahimaga Station but Kadikoy-Kartal Metro will not go through the tunnel of the Marmaray Project. The total length of Kadikoy – Kartal Metro is 21.7 km with 16 stations. This route is expected to be in service between 2011 and 2013. The metro system is not the same as the existing Taksim - 4.Levent Metro (E-1). Power supply system is 1500V DC with overhead catenary (rigid catenary).

Otogar - Bagcilar (Kirazli) Light Metro (C-5): This is an extension of the branch line of Aksaray- Airport Light Metro (E-2) with a total length of 5.4km. Most section is underground. The construction started in 2005 and is expected to be completed in 2008. The location of Bagcilar Station is about 400m away from Bagcilar Station of Zeytinburnu - Bagcilar Tramway (E-4). The route runs through the high density residential area of Bagcilar District.

Bagcilar - Ikitelli - Olimpiyat Koyu Metro (C-6): This metro will be connected to Otogar - Bagcilar Light Metro (C-5) at Bagcilar Bati Kirazli 1 Station, providing mass transit access to the new industrial area in Gaziosmanpasa District. The total length of this line is 15.9 km with 11 underground stations. This metro is a different type from the existing Taksim - 4.Levent Metro (E-1). Power supply system will be 1500V DC with overhead catenary or rigid catenary. 68 rolling stocks for this line have been purchased from Alstom. This line will extend to Bakirkoy station of Aksaray - Airport Light Metro (E-2).

Marmaray Project (C-7): The Marmaray Project consists of three components: Bosporus crossing, commuter rail upgrading, and procurement of the rolling stocks. The total project cost is estimated as 3 billion USD.

The Bosporus Crossing Project will connect European and Asian sides through a 1.4 km immersed tube tunnel under the Bosporus Straight. The deepest point of the tunnel will be approximately 56 meters under the water surface level. This tube tunnel will be accessed by bored tunnels from Kazlicesme on the European side and Ayrilikcesme on

the Asian side. New underground stations will be built by cut-and-cover method at Yenikapi, Sirkeci, and Uskudar. , and other 37 at-grade stations along the line will be rebuilt or refurbished.

The project will upgrade the TCDD existing line as the commuter rail line. The existing two tracks will be fully upgraded to three tracks up to Halkali in European side and up to Gebze in Asian side. The entire upgraded and new railway system will be 76.3 km long of which 13.6 km are underground.

Bid for the procurement of rolling stock was done in February, 2008. New rolling stock purchased for this project is 440 vehicles in total; 280 in 2009, 40 in 2010, and 120 in 2011 with a total budget of approximately 750 million Euro.

Aksaray – Yenikapi (C-8): This is the extension of Aksaray- Airport Light Metro (E-2) with a length of 700m, connecting the Light Metro to the Marmaray Commuter at Yenikapi Station. This section is expected to be in service by 2010.

Table 4.2.1 Railway Systems under Construction

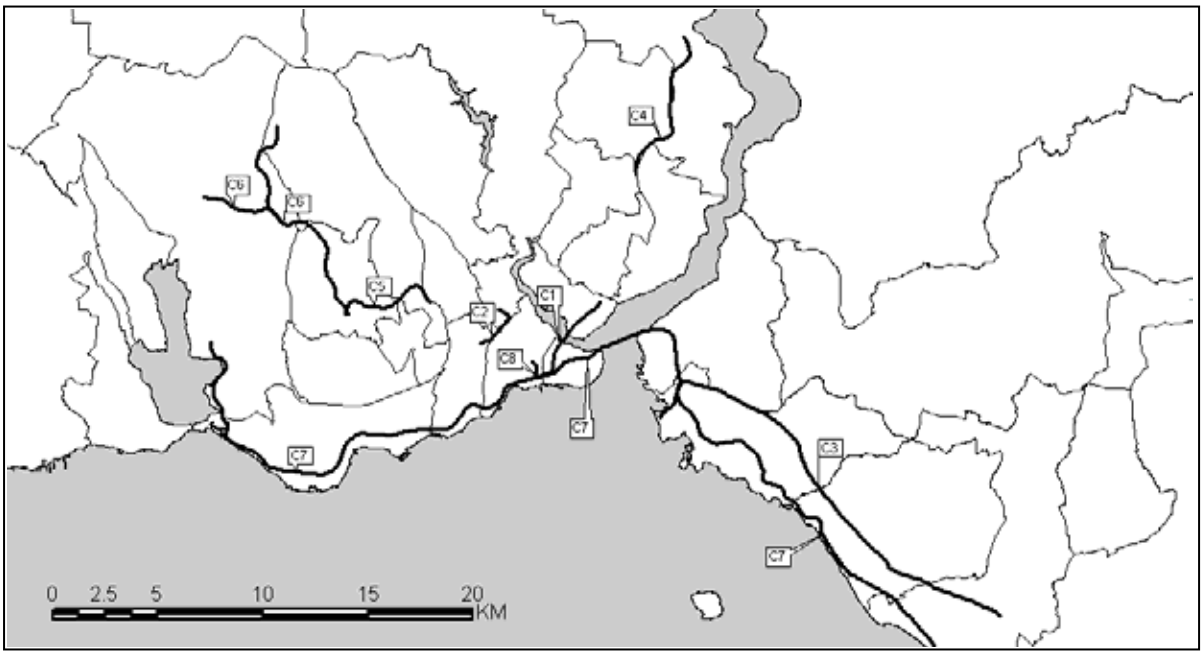
(As of October, 2008)

Project Code	Project Section	Type	Length (km)	No. of Stations	Operation Year
C-1	Taksim - Yenikapi (Extension of Taksim - 4.Levent Metro:E-1)	Metro	5.2	4*	2010
C-2	Topkapi- Edirnekapi (Extension of Edirnekapi-Sultanciftligi Tramway:E-12)	Tram	3.1	2*	2008
C-3	Kadikoy-Kartal (New Line)	Metro	21.7	16	2011-2013
C-4	4. levent - Ayazaga – Haciosman (Extension of Taksim-4.Levent Metro:E-1)	Metro	8.0	5*	Mar-2009
C-5	Otogar – Bagcilar (Kirazli) (Extension of Aksaray-Airport Light Metro:E-2)	Light Metro	5.4	4*	Dec-2008
C-6	Bagcilar - Ikitelli Olimpiyat koyu (New line)	Metro	15.9	11	Dec-2008
C-7	Marmaray project	Suburban Railway	76.5	45	Mar-2012
C-8	Aksaray – Yenikapi (Extension of Aksaray – Airport Light Metro:E-2)	Litght Metro	0.7	1*	2010
	Total		132.5		

Source: Study Team

*: No. of stations excludes the exiting station.

*: Total Cost of whole section



Source: Study Team

Figure 4.2.1 Location of Under Construction Projects

4.2.2 Tender Stage Projects

There are two light metro projects under tender stage: Uskudar - Cekmekoy Light Metro (T-1) in the Asian side and Bakirkoy - Beylikduzu Light Metro (T-2) in the European side.

Uskudar – Dudullu Light Metro (T-1): This route runs east and west through high density residential areas of Uskudar District and Umraniye District in Asian side. The total length is 19. 0 km with 17 stations. The system will be a light metro with six cars for each train. The terminal station at Uskudar will connect this route to the commuter railway of the Marmaray Project.

Bakirkoy - Beylikduzu Light Metro (T-2): This route will connect the west area of Kucukcekmece Lake and Bakirkoy, running along the D100 and the north of Ataturk International Airport. The route will be connected to the existing Aksaray - Airport Light Metro (E-2) at Bakirkoy Station. The total length is 24.1km with 19 stations. The route is overlapped with the Metrobus route.

Table 4.2.2 List of Tender Stage Projects

(As of October, 2008)

Project Code	Route Name	TYPE	Length (km)	No. of Stations	Operation Year
T-1	Uskudar – Dudullu Light Metro	Light Metro	19.0	17	2012
T-2	Bakirkoy - Beylikduzu Light Metro	Light Metro	24.1	19	2012
	Total		43.1		

Source: Study Team

Source: Study Team

Figure 4.2.2 Route of T-1 (Uskudar - Altunizade - Umraniye - Dudullu Light Metro)

Source: Study Team

Figure 4.2.3 Route of T-2 (Bakirkoy - Beylikduzu Light Metro)

4.2.3 Projects under Design Stage

There are five railway projects (four metros and one tramway) under design stage, with a total length of 74.4 km. In addition, Shishane – Kulaksiz – Cemal – Kamaci Guzergahi Monorail Project is listed in the IMM 2008 Investment Plan (2008-2010). Therefore, this monorail project is also included in this category.

Bakirkoy-Bahcelievler-Bagcilar (D-1): This is the southern extension of Bagcilar - Ikitelli Olimpiyat Koyo Metro (C-6) from Bagcilar to Bakirkoy port, running parallel to Zeytinburnu - Bagcilar Tramway (E-4) between Bagcilar and Bahcelievler. This route will be connected to another design-stage project of Yenikapi - Bakirkoy (D-3) at Bakirkoy, which is one of the transfer stations of Marmaray Commuter. The total length is 9km with 8 stations. This route and C-6 will form a north-south route between the industrial area around Ikitelli and the commercial and residential area in Bakirkoy District.

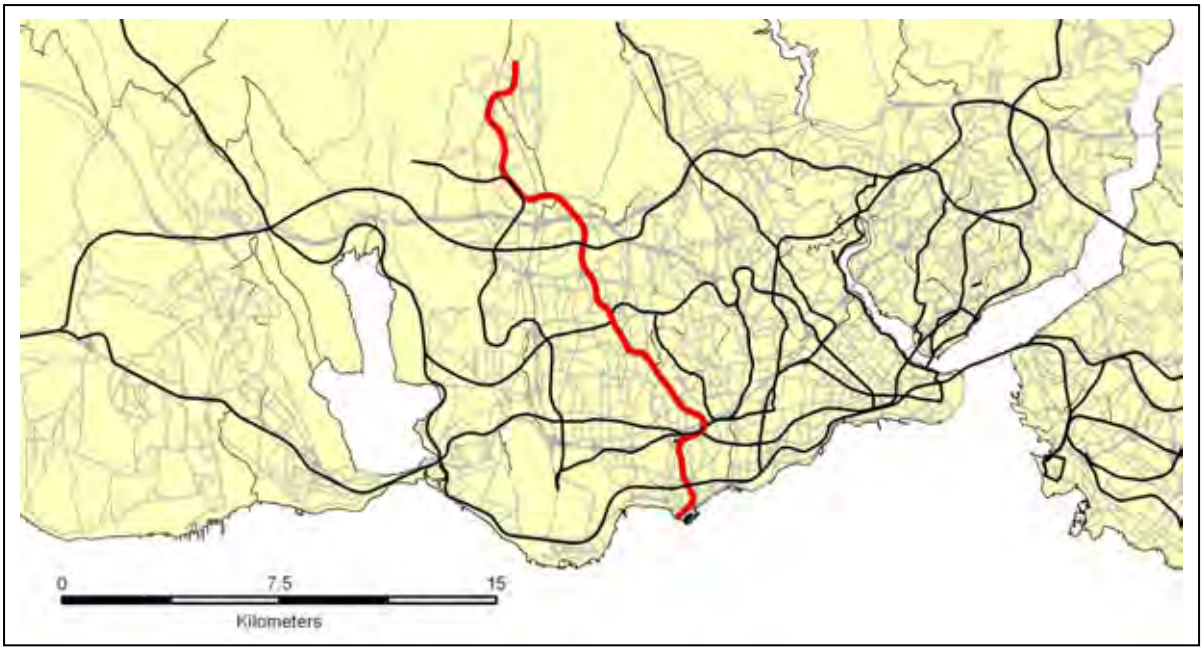
Kabatas - Besiktas - Sisli - Giyimkent – Bagcilar (D-2): This line goes along the expressway E-80 in European side, starting from Kabatas to a Bagcilar - Ikitelli Olimpiyat Koyo Metro (C-6) station in Bagcilar District. The total length is 25.0 km with 18 stations. There are some transfer stations with other rail lines such as Kabatas with Zeytinburnu - Kabatas Tramway (E-3), Sisli with Taksim - 4.Levent Metro (E-1), Alibekoy with Halic Surround Tramway (D-4), Metris with Topkapi - Edirnekapi - Sultanciftligi Tramway (C-2), and Mahmutbey with C-6.

Yenikapi – Bakirkoy (D-3): This is a metro which connect Yenikapi and Bakirkoy through high density commercial and residential area between Zeytinburnu - Kabatas Tramway (E-3) and the commuter railway of the Marmaray Commuter. This route will adopt the same system as the existing Taksim - 4.Levent Metro (E-1), which will form a north-south rail corridor between Sariyer District and Bakirkoy District.

Halic Surround Tramway (D-4): Halic surround (Golden Horn) is planned as a culture valley. This route runs along Golden Horn connecting educational institutions.

Yesilkoy - Ataturk Airport – Ikitelli (D-5): This route will connect the industrial area around Ikitelli and Ataturk Airport north to south. The alignment of the route is on the east side of Basin Expressway in the southern section, while it is on the west side in the northern section.

Shishane – Kulaksiz – Cemal – Kamaci Guzergahi Monorail (D-6): This is the loop line of monorail in the Beyoglu area and will be connected with Sishane Station of Taksim - 4.Levent Metro (E-1). The route is still under study and not finalized yet. Expected route length will be 5.8 km.

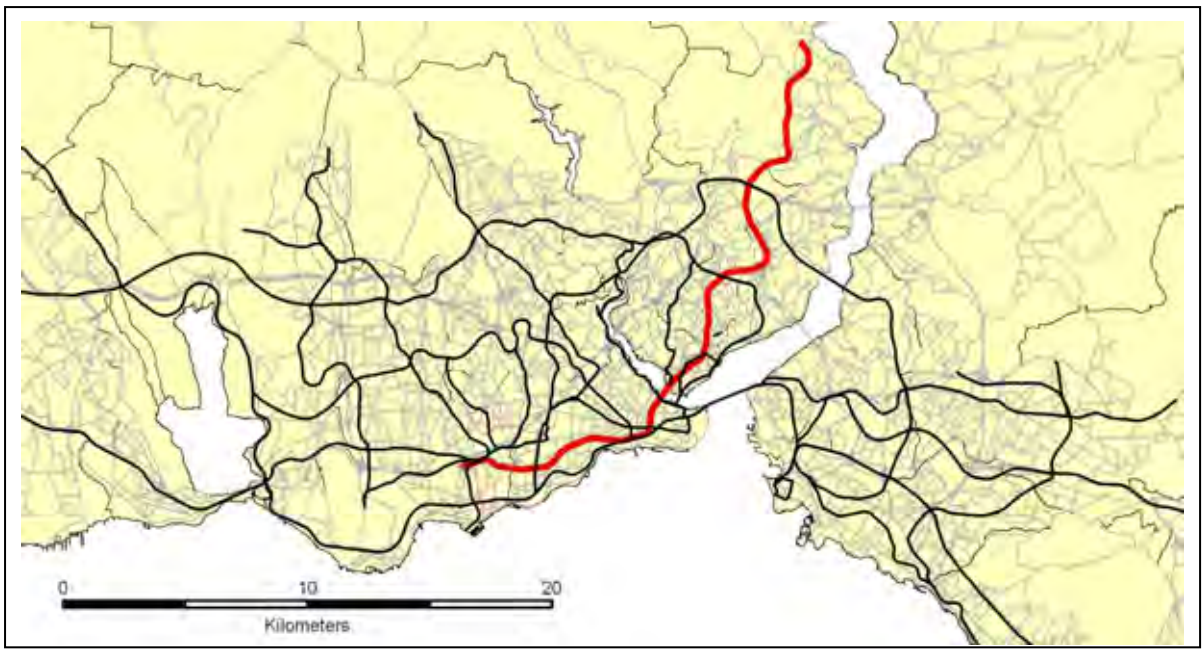


Source: Study Team

Figure 4.2.4 Route of Bakirkoy-Bahcelievler-Bagcilar Metro (D-1)

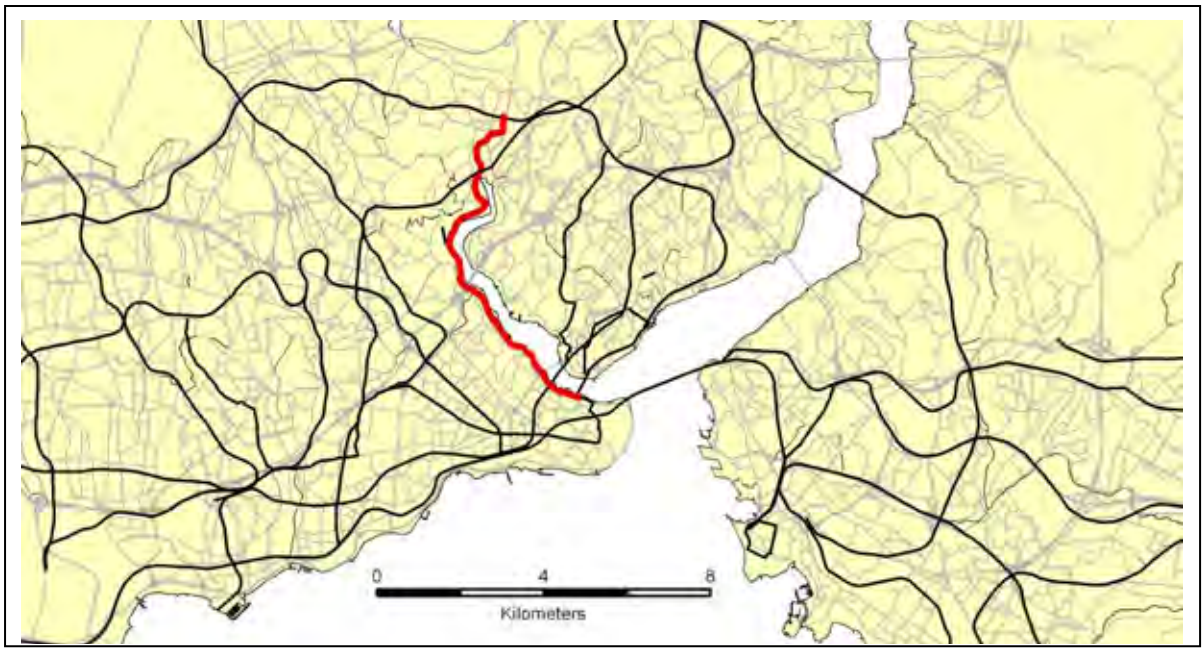
Source: Study Team

Figure 4.2.5 Route of Kabatas - Besiktas - Sisli - Giyimkent – Bagcilar (D-2)



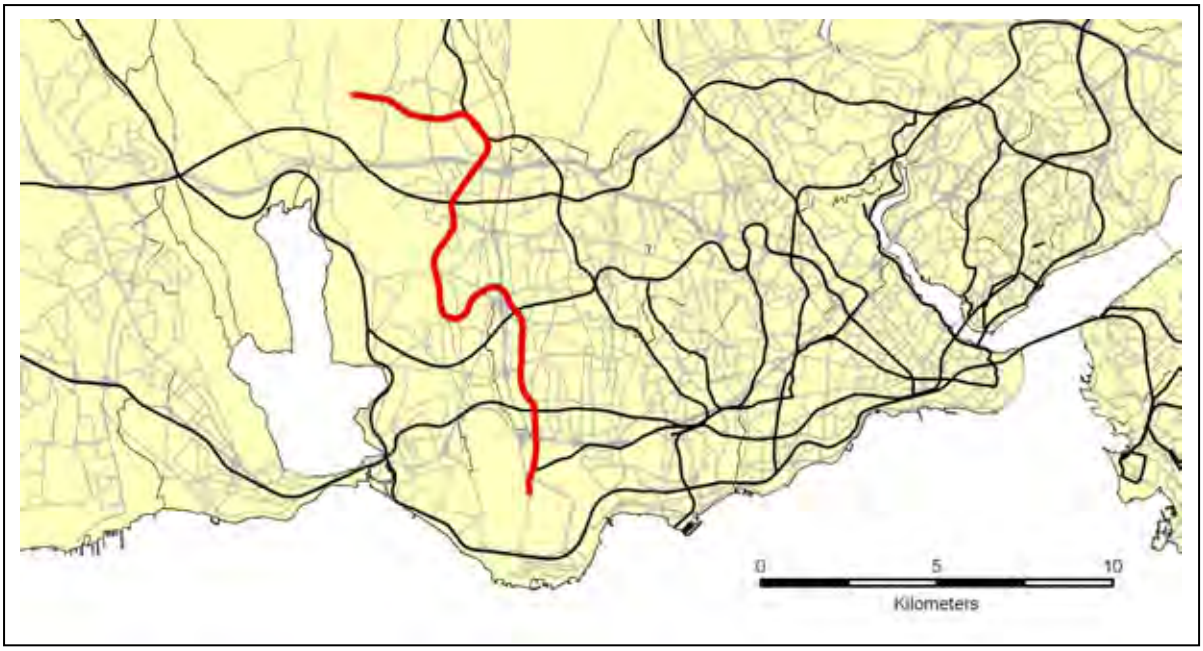
Source: Study Team

Figure 4.2.6 Route of Yenikapi – Bakirkoy (D-3)



Source: Study Team

Figure 4.2.7 Route of Halic and Its Surround Tramway (D-4)



Source: Study Team

Figure 4.2.8 Route of Yesilkoy - Ataturk Airport - Bahcelievler – Ikitelli (D-5)

Table 4.2.3 List of Under Design Stage Projects

(As of October, 2008)

Project Code	Route Name	TYPE	Length (km)	No. of Stations	Operation Year
D-1	Bakirkoy - Bahcelievler Bagacilar (Extension of C-6 Line to the South)	Metro	9	9	2012
D-2	Kabatas - Besiktas - Sisli - Giyimkent - Bagcilar	Metro	25.0	20	2012
D-3	Yanikapi - Bakirkoy (Extension of E-1 Line to the West)	Metro	7	7	2012
D-4	Halic Surround Tramway	Tramway	9.6	13	-
D-5	Yesilkoy - Ataturk Airport - Ikitelli Metro	Metro	14.3	10	-
D-6	Shishane - Kulaksiz - Cemal Kamaci Guzergahi Monorail	Monorail	5.8	10	2010
	Total		70.4		

Source: Study Team

Chapter 5 Road and Sea Based

5.1 Road Based Public Transport

5.1.1 Types of Service

Table 5.1.1 shows the types of services of road-based public transport available in Istanbul at present.

Table 5.1.1 Types of Road-based Public Transport in Istanbul, 2007

	Operator	
	Public	**Private**
Bus	• IETT Bus − Ordinary − Intercontinental − Express − Intercontinental Express − Double Decker (no standee) − Discounted	• Private Bus − Standard Bus − Doble Decker • Havas (Airport service)
BRT	• IETT Metrobus	
Minibus		• Minibus
Dolmus		• Dolmus
Taxi		• Taxi

Source : Study Team

IETT BUS (1)

IETT BUS (2)

METROBUS

Private BUS (Standard)

Private BUS (Double Decker)

HAVAS

TAXI

DOLMUS

MINIBUS

Public transport of Istanbul is shouldered by both public and private sector. The major part of bus service is operated by IETT, a public organization established by the law enacted in 1939, while some private companies are allowed to operate buses under the same fare system as IETT. Havas is a privately operated airport service/shuttle connecting airports and various terminals. Note that there are several types of services with different fare systems.

BRT (Metrobus) is a new mode of public transport developed vigorously at present. Its capacity is 193 passengers per unit. In September 2007, the first route was opened for service on D10 between Avcilar Istanbul University and Cevizlibag. The BRT system is scheduled to expand its service area over the expressway network. (See 5.1.5)

Minibus, with a capacity of 24 passengers, covers almost the same area as the bus. However, the coverage is scarce in the CBD such as Sisli, Beyoglu and Eminonu, and the route length is generally shorter. Minibus stops everywhere on passenger's request.

Dolmus, with a typical capacity of 5-9 passengers, serves mainly on busy arteries around the CBD. Although it has fixed stops on fixed routes, its operation is terminal-based, and it departs when it becomes full at terminals.

5.1.2 Administration

Table 5.1.2 presents the responsibility allocation regarding road-based public transport of Istanbul. As to bus and Metrobus, IETT has the dominant role in overall operation from planning, franchising, day-to-day operation and control. Private bus companies operate buses under the supervision of IETT. Regarding Metrobus, UKOME (Transport Coordination Committee) is partially responsible for the use of expressway infrastructure.

IETT and UKOME are both public organizations controlled directly by the mayor of IMM. They are rather independent from the line departments of the city and economic enterprises.

Havas was formerly a public organization, but was privatized recently. Since Havas operates bus services basing strategic airports, it is rather to link with the central government (Ministry of Transport).

Minibus, dolmus and taxi are all operated privately under the control of IMM (Department of Transportation).

In addition, the traffic police shares the responsibility of monitoring, controlling and enforcement in the public transport operation.

Table 5.1.2 Allocation of Responsibilities Relating to Road-based Pubic Transport, 2007

	Responsible Agency	Body	Planning	Permission		
				Route	Vehicle Unit	Monitoring /Control
IETT Bus	IETT	Public	IETT	IETT	IETT	IETT + Traffic Police
Private Bus	IETT	Private	IETT	IETT	IETT	IETT + Traffic Police
Metrobus	IETT	Public	IETT	IETT	UKOME + IETT	IETT + Traffic Police
Havas]	Havas	Private	Havas	Havas	Havas	IETT + Traffic Police
Minibus	IMM (Transportation)	Private	IMM	IMM (Transportation)	IMM	IETT + Traffic Police
Dolmus	IMM (Transportation)	Private	IMM	IMM (Transportation	IMM	IETT + Traffic Police
Taxi	IMM (Transportation)	Private	UKOME	IMM (Transportation)	IMM	IETT + Traffic Police

Note: 1) IMM: Responsible department for public transportation in IMM directly related also to UKOME.
2) HAVAS: Havas is directly connected to the central government.
3) UKOME: UKOME determines the total number of private buses while IETT is allowed to allocate buses to the lines by itself.

Source: Hearing from each Agency

5.1.3 Operation

Table 5.1.3 summarizes the operation of road-based public transport in Istanbul. The following characteristics are pointed out:

- In terms of number of passengers, bus (IETT bus plus private bus) carries 44 % of road public transport users, followed by minibus (32 %) and dolmus (23 %).
- Most of IETT bus passengers use Akbil. Metrobus also adopts the Akbil system, but it is not yet common for private bus. Havas, minibus and dolmus are outside the Akbil system so far.

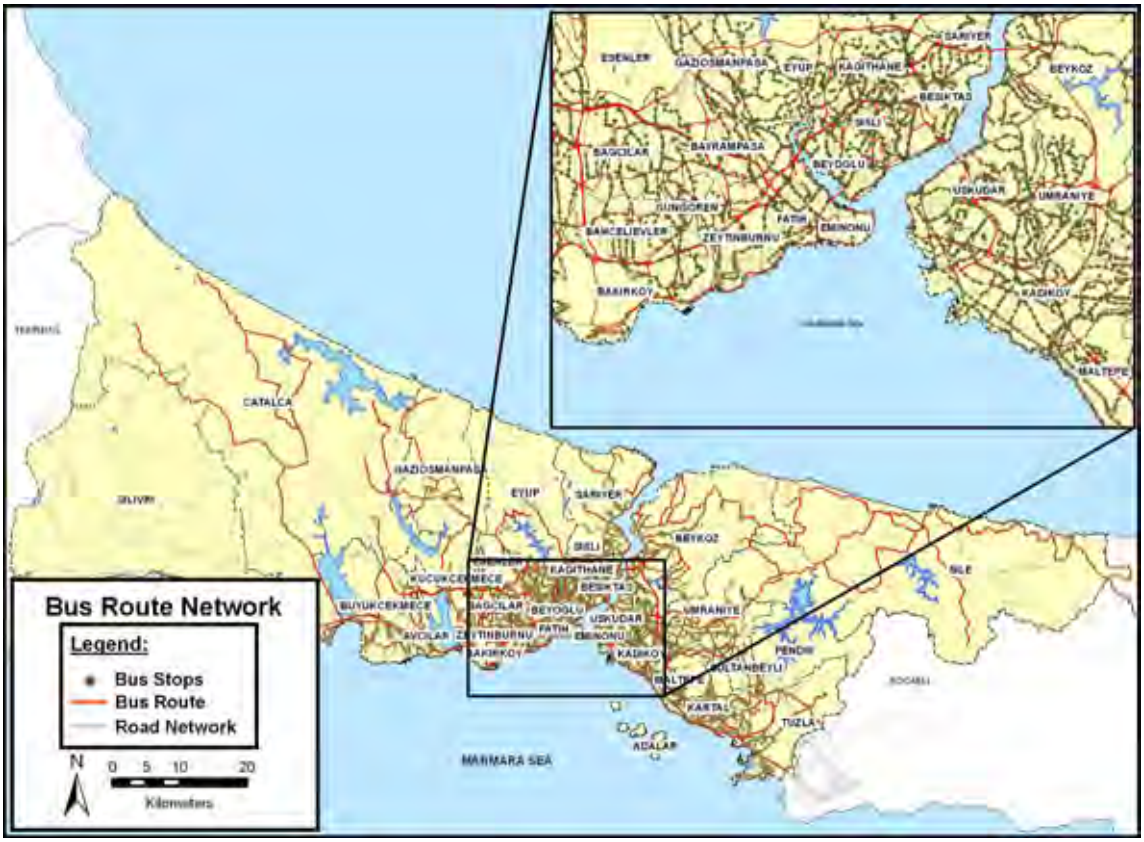
Table 5.1.3 Operation Outline of Road-based Public Transport, 2006

	Average Capacity	No. of Routes	Average Route Length (km)	No. of Units Allocated	No. of Passengers per Day (000)		
					Ticket/ Others	Akbil	Total
IETT Bus	107	449[2)]	16.5	2,824	250	1,264	1,514
Private Bus	99	257[2)]	21.3	1,374	658	283	941
Metrobus [1)]	193	1	37.6	75	-	6	6
Havas	17~46	8	Not .available	31	18~20	-	18~20
Minibus	24	293[3)]	13.7	5,813	1,750	-	1,750
Dolmus	9	21[3)]	15.4	568	1,270	-	1,270
Taxi	4	-	-	17,840	19	-	19
Total		-	-	28,525	3,965~3,967	1,553	5,518~5,520

Note: 1) As of October 2007 (tentative)
2) Including 167 routes jointly operated by IETT and private company.
3) As of May 2005

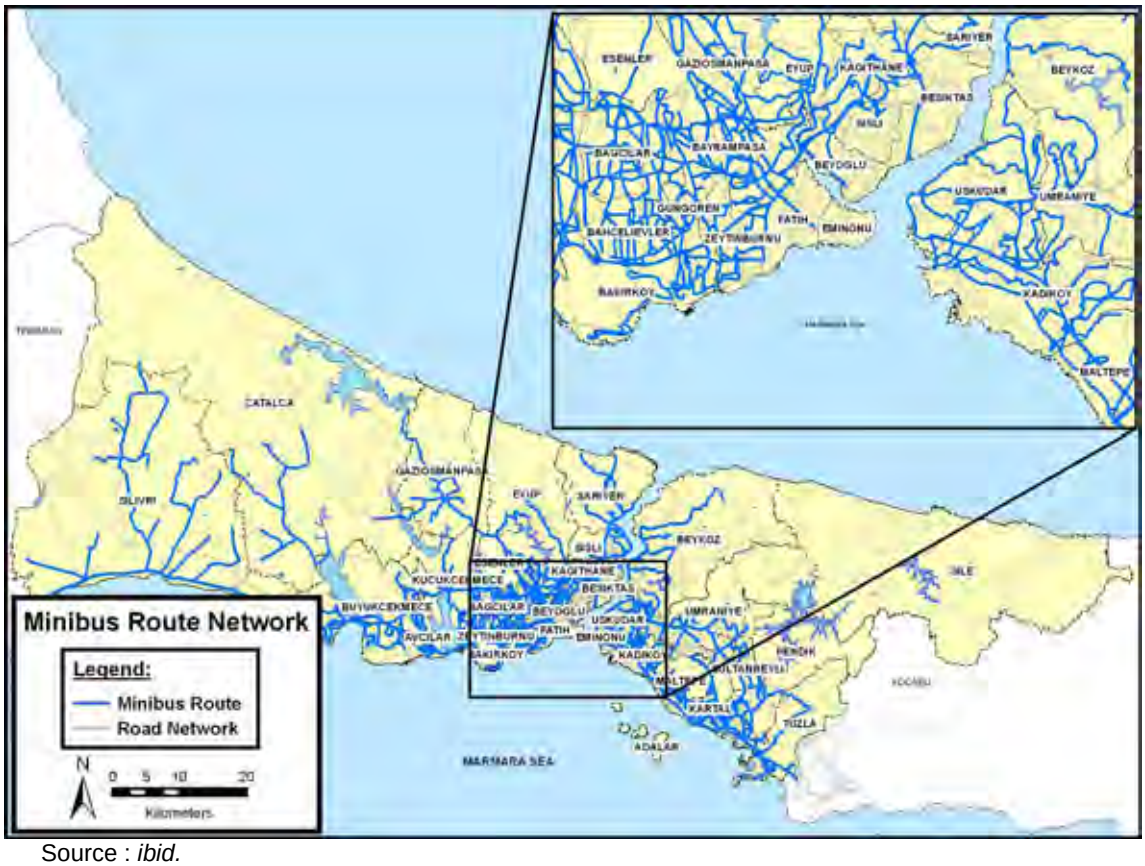
Source : *ibid.*

Figure 5.1.1~Figure 5.1.3 illustrate the service coverage of bus, minibus and dolmus.



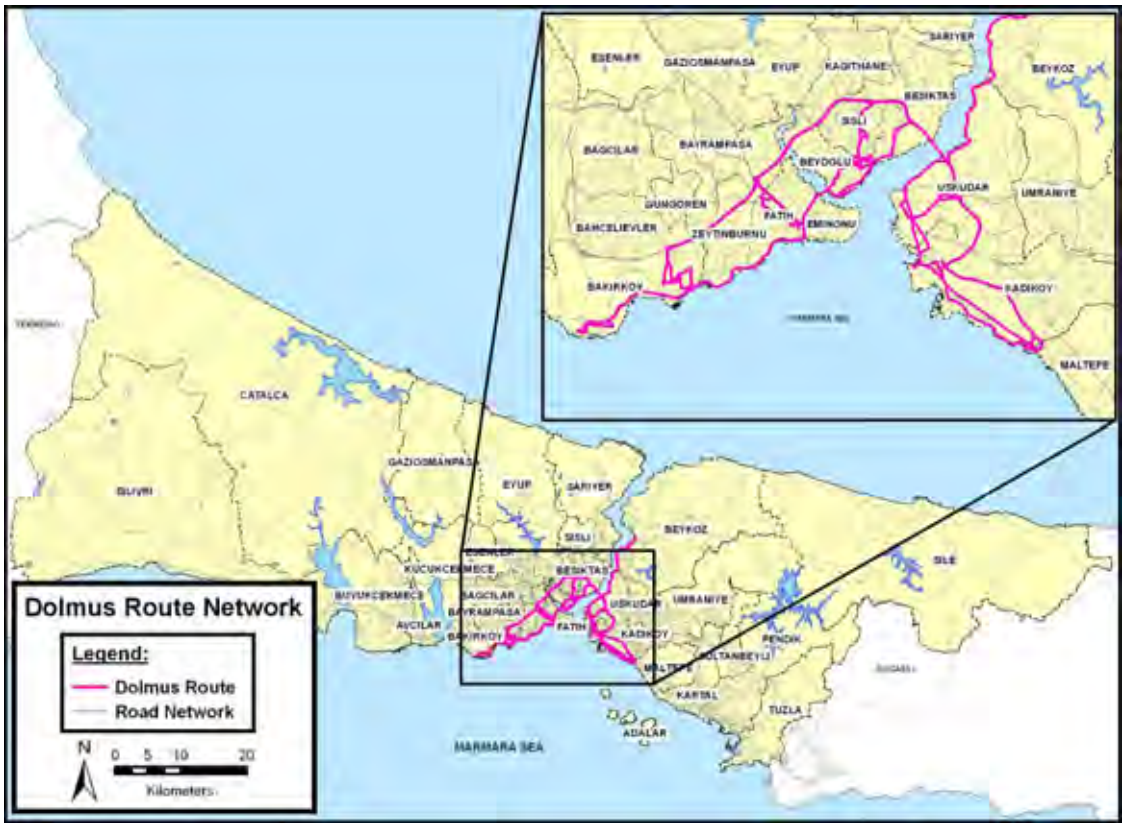
Source : Transportation Dept., IMM

Figure 5.1.1 Service Coverage of Bus, 2007



Source : *ibid.*

Figure 5.1.2 Service Coverage of Minibus, 2007



Source : *ibid.*

Figure 5.1.3 Service Coverage of Dolmus, 2007

5.1.4 Fare System

The fare system of public transport in Istanbul is complicated. It differs not only by service type but by payment method (ticket/jeton or akbil) and also by type of premium services. Various discounts are applied; time ticket is available (e.g. blue akbil) and discounted rates are applied to students, teachers, etc. in the case of bus.

Table 5.1.4 Typical Fare System of Road-based Public Transport, as of November, 2007

	Ticket/Jeton		Akbil			
			Full		Reduced Rate	
	Normal	Discounted[1)]	Initial	Following Trips[2)]	Initial	Following Trips[2)]
IETT Bus[5)]	1.30	0.80	1.25	0.62	0.80	0.40
Private Bus	1.30	0.80	1.25	0.62	0.80	0.40
Metrobus[3)]	-	-	0.65	0.32	0.40	0.20
Havas	3.50~15.00	-	-	-	-	-
Minibus	0.85~3.50	-[4)]	-	-	-	-
Dolmus	0.75~5.30	-	-	-	-	-
Taxi	1.60+	-	-	-	-	-

Source : Hearing from related agency

Note: [1)] Discount is applied to students, teachers, handicapped, etc.

[2)] Up to 5 transfers in 120 minutes (per-trip rate).

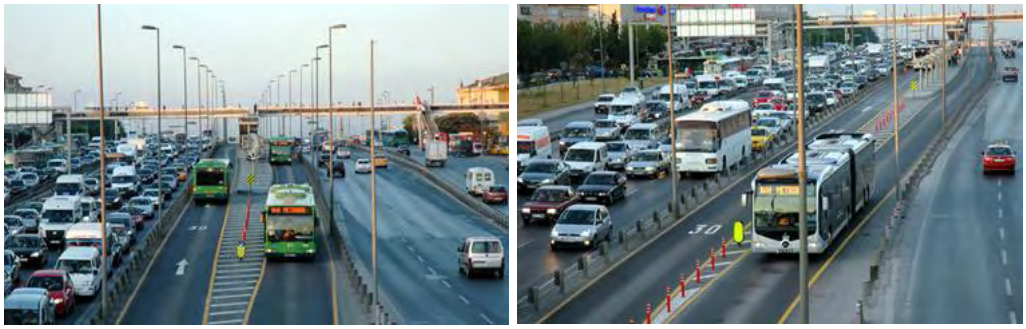
[3)] Tentative promotion rate valid up to the end-2007.

[4)] Some minibuses apply voluntarily discounted rates to students, handicapped, etc.

[5)]There are some premium services such as express, intercontinental, double Decker (no standee), etc. They charge higher rates (2~3 times).

5.1.5 Metrobus

The IETT started a test-operation of Metrobus for the first 18.6km section of Avcilar to Topkapi in January 2007 and a regular operation in September of the same year. The Metrobusses are operated exclusively in the central two lanes of the D-100 expressway, running the said section with 14 stops in 30 minutes. For this, most part of D-100 was widened into one lane for Metrobus, three lanes for expressway and two lanes for service road in one direction. Daily passengers using the service of the first section are about 300,000.



Source : Study Team

Figure 5.1.4 Metrobuses Operated on D-100

Table 5.1.5 Number of Passengers of Metrobus

Month/ Year	Operation days	Monthly Passengers	Average Daily Passengers
October,2007	31	2,036,463	65,692
November, 2007	30	3,284,578	109,486
December, 2007	31	5,100,881	164,545
January, 2008	31	6,210,470	200,338
February, 2008	29	6,558,319	226,149
March, 2008	31	7,542,067	243,292

Source : Metrobus Dept,. IETT

Source: IETT

Figure 5.1.5 Location of Metrobus Line 01

Following the first section, the second section (10.4 km) of Topkapi – Zincirlikuyu was open on 9th of September, 2008. By this, Metrobus was extended 28km, reaching the new CBD around Mecideyekoy. Trip time from Avcilar to the CBD was significantly reduced from more than 90 minutes by car in peak time, to 45 minutes by Metrobus. By this improvement of public transport service, some volume of modal shift from car to Metrobus is expected. In order to encourage this modal shift, further improvement of accessibility to bus stops and convenience at terminals will be needed.

Source : *ibid.*

Figure 5.1.6 Location of Metrobus Line 02

Further extension westward from Avcilar to Beylikduzu (10.4km) and eastward from Zincirlikuyu to Sogutlucesme (11.0 km) are already planned by IETT. After completion of these extensions, total operation of Metrobus will be 49.7 km with 41 bus stops. At the stage, 1.17 million daily passengers are expected by IETT.

5.2 Sea Transport

5.2.1 Types of Service and Administration

Sea public transport of Istanbul is operated by both private and public sector, as shown in Table 5.2.1.

Table 5.2.1 Allocation of Responsibilities Relating to Sea Public Transport

Operating Body	Responsible Agency	Planning	Permission		Monitoring/ Control
			Route	Vehicle Unit	
Private (Turyol/Dentur)	IMM	IMM	IMM (Transportation)	IMM	IMM
Public (IDO)	IMM	IDO	IDO + IMM (Transportation)	IMM	IMM

Source :IDO

Turyol and Dentur, two private companies, are specialized in passenger transport with small- to medium-sized boats.

IDO, one of the public economic enterprises under the control of IMM, has the following services:

- Fast ferry
- Sea bus
- Intercity passenger ship
- Intercity car ship
- Mavi Marmara passenger ship

"Fast ferry" carries both passengers and cars at a relatively high speed, while "Sea bus", "Intercity passenger ship" and "Mavi Marmara passenger ship" carries only passengers, and "Intercity car ship" is specialized to carry vehicles.

Fast Ferry / IDO

Sea Bus / IDO

Intercity Passenger Ship / IDO

Intercity Car Ship / IDO

Mavi Marmara Passenger Ship

Private

5.2.2 Operation

Table 5.2.2 summarizes the outline of operation of sea public transport in Istanbul. Its service coverage is presented in Figure 5.2.1. In addition, Figure 5.2.2 shows the major sea routes with number of passengers carried. These major routes carry about 2/3 of the total number of sea passengers.

IDO carries almost 3/4 of the total passengers due to its modern large vessels acquired recently.

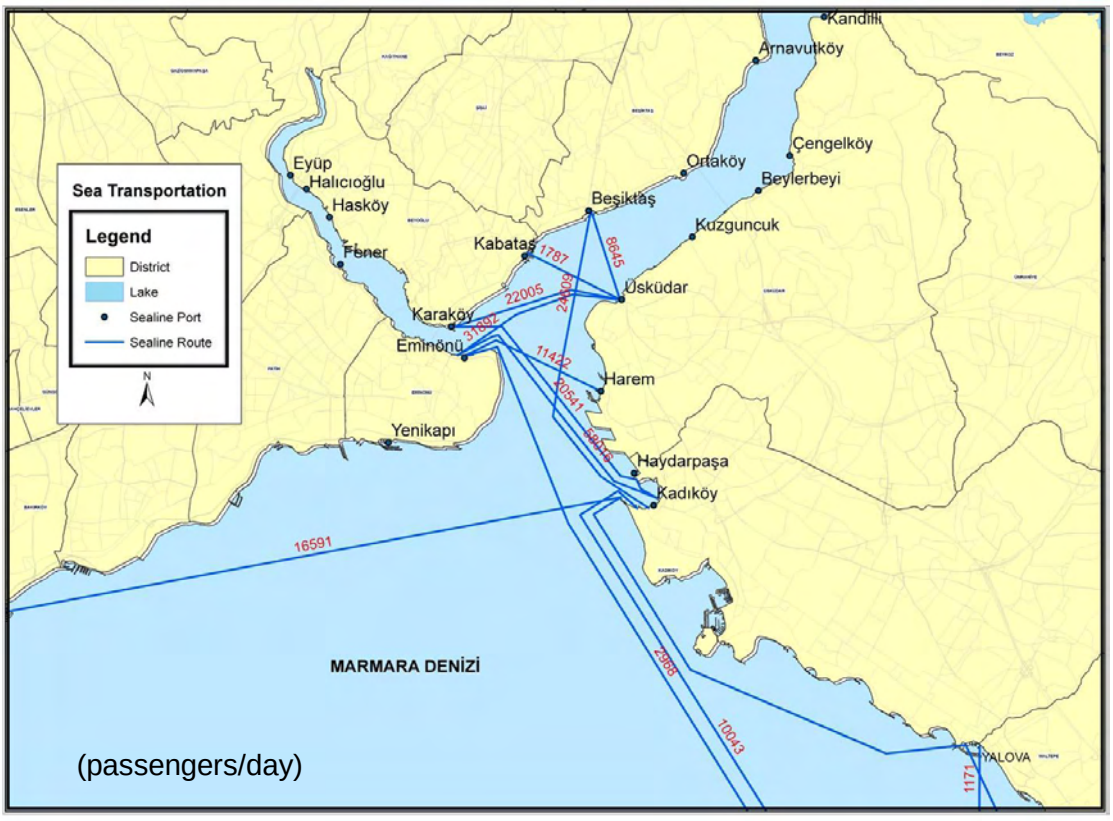
Table 5.2.2 Operational Characteristics of Sea Public Transport, 2007

	Fleet Size	No. of Passengers Carried per Day (000)			
		Ticket	(Token)Jeton	Akbil	Total
Private (Turyol/Dentur)	104	82	-	-	82
Public (IDO)	81	-	87	156	243
Total	185	82	87	156	325

Source : *ibid.*

Source : *ibid.*

Figure 5.2.1 Service Coverage of Sea Public Transport, 2007



Source : *ibid.*

Figure 5.2.2 Major Sea Routes and Number of Passengers Carried, 2006

5.2.3 Fare System

The fare system of sea public transportation is almost the same as IETT buses. Although tickets and jetons (tokens) are still used, the use of akbil is vigorously pursued toward an integrated public transportation for entire Istanbul.

Table 5.2.3 Typical Fare System of Sea Public Transport, 2007

	Ticket/Jeton		Akbil			
	Normal	Discounted[1)]	Full		Reduced Rate	
			Initial	Following Trips[2)]	Initial	Following Trips[2)]
Private (Turyol/Dentur)	1.30	0.80	1.25	0.62	0.80	0.40
Public (IDO)[3)]	1.30	0.80	1.25	0.62	0.80	0.40

Note: [1)] Discount is applied to students, teachers, handicapped, etc.
[2)] Up to 5 transfers in 120 minutes (per-trip rate).
[3)] There are premium services with higher charges.
Source : *ibid.*

5.3 Opinions on Public Transport Services

5.3.1 General

To grasp the current situation of people's opinion on public transport services and to get the active data regarding modal choice, a Stated Preference (SP) survey had been conducted under the study. In this interview survey, the respondents (public transport users and private car users) are asked a set of questions to tell how they rate the services of various transport modes in terms of satisfaction. The factual aspects of transportation problems are rated in such terminology as uneconomical, inconvenient, uncomfortable and dangerous, whereas the institutional and organizational aspects are categorized as uneconomic, inefficient and so on.

5.3.2 Preparation of the Survey

1) Survey Questionnaire and Pretest

The survey was targeted at the public transport users and private car users. Therefore, the survey questionnaire was prepared for both, and included questions regarding to 1) Attributes of Interviewee, 2) Stated Preference (SP), 3) Traffic Congestion, 4) Traffic Safety, 5) Public Transport and 6) Transport Policy Measures. Almost all questions were set the same for both but some questions were specialized regarding each characteristic. (Refer to Appendix)

Besides the survey questionnaire, a survey manual was also prepared explaining the notice of how to conduct the survey. The forms were then translated into Turkish.

About 20 survey forms were prepared at first, and sent to surveyors to make a pretest. The results of the pretest were then collected and reflected to some revisions of the questionnaire.

Then, final forms were printed and delivered to the surveyors, survey manual was introduced and supervisor was trained about the method of the survey. Surveyors were informed about the importance of the randomness of the survey according to gender, employment, age and social diversities.

2) Survey Size and Method

The target public transportation modes were first selected and the volume of questionnaire to be collected was determined for each mode. The number of questionnaires by public transportation services is shown in Table 5.3.1 and the number of questionnaire becomes 1,000 in total.

Table 5.3.1 No. of Samples Targeted by Mode

Target	Size
Metro	100
LRT	150
Tram	100
Bus/Minibus	200
Dolmus	100
Ferry/Seabus	100
Private Car	250

Source : Study Team

The survey was conducted by a direct interview by the surveyors to the respondents, and the surveyors filled up the questionnaire themselves, instead of the respondents. The surveyors took the target transportation mode to find the respondents and ask the questions on board.

3) Survey Location / Route

Survey area is the extent of Istanbul Metropolitan Municipality (IMM), and the location and the routes of the target public transportation services were selected as shown in the following maps considering the volume of the passengers and frequency.

Source : *ibid.*

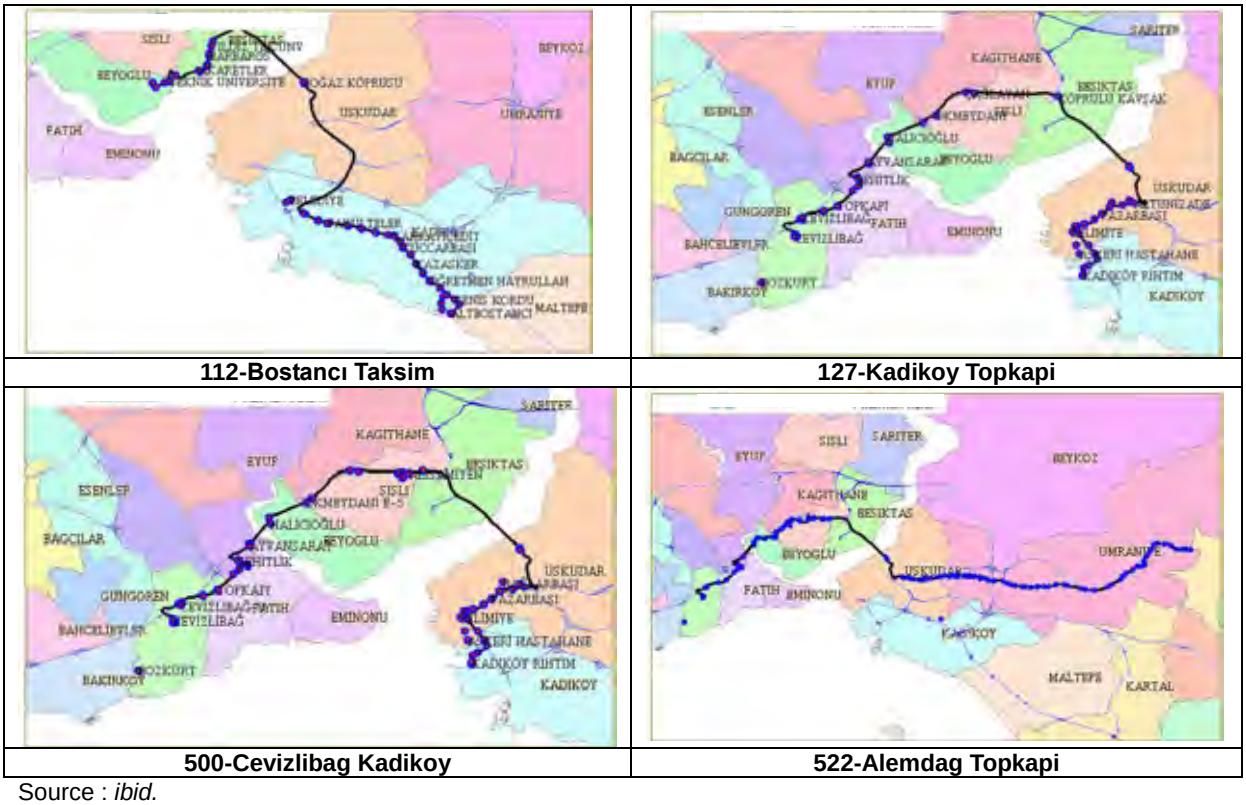
Figure 5.3.1 Survey Location and Roads of Private Car

Source : *ibid.*

Figure 5.3.2 Survey Locations of Dolmus & Minibus in Asian Side

Source : *ibid.*

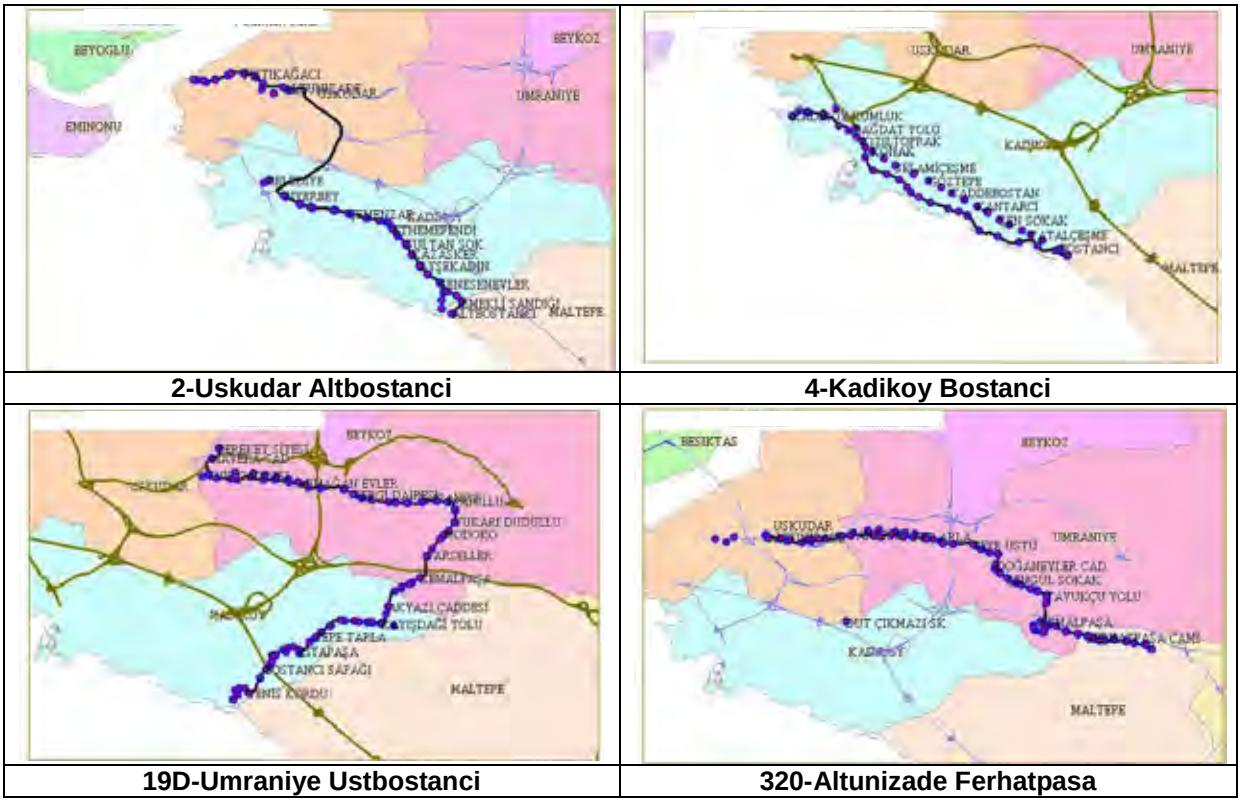
Figure 5.3.3 Survey Locations of Dolmus & Minibus in European Side



112-Bostancı Taksim	127-Kadikoy Topkapi
500-Cevizlibag Kadikoy	**522-Alemdag Topkapi**

Source : *ibid.*

Figure 5.3.4 Survey Routes of Bus Crossing 1st Bosporus Bridge



2-Uskudar Altbostanci	4-Kadikoy Bostanci
19D-Umraniye Ustbostanci	**320-Altunizade Ferhatpasa**

Source : *ibid.*

Figure 5.3.5 Survey Routes of Bus in Asian Side

36V-Vezneciler Gop

40-Sariyer Taksim

69A-Yenikapi Mecidiyekoy

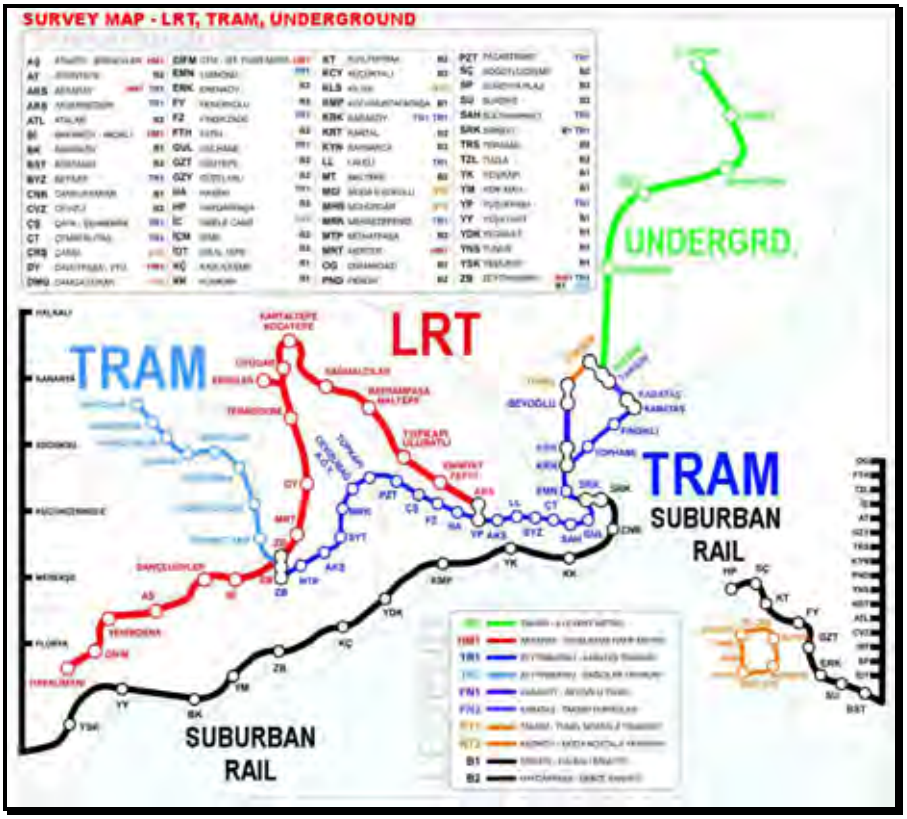
61B-Taksim Beyazit

73-Yenibosna Taksim

46C-Caglayan Eminonu

Source : *ibid.*

Figure 5.3.6 Survey Routes of Bus in European Side



Source : Ulasim, IMM

Figure 5.3.7 Survey Routes of LRT, Tram and Metro

Seabus	Ferry

Source : Study Team

Figure 5.3.8 Survey Routes of Seabus and Ferry

5.3.3 Implementation of the Survey

The field survey was successfully conducted from 14th September 2007 to 23rd September 2007. This period was selected as being the beginning of the school semester after summer vacation.

After the field survey, result of the survey was checked and entered into excel form.

5.3.4 Review of the Result

The result of the survey was briefly analyzed regarding the difference between the public transport users and the private car users as follows:

1) Respondent's Attribute

The majority of the respondents were male and 20~39 years old. Almost 90 % of the public transport users don't have a car. In addition, more than 10 % of the private car users have two or more cars.

Table 5.3.2 Attribute of the Respondents

(%)

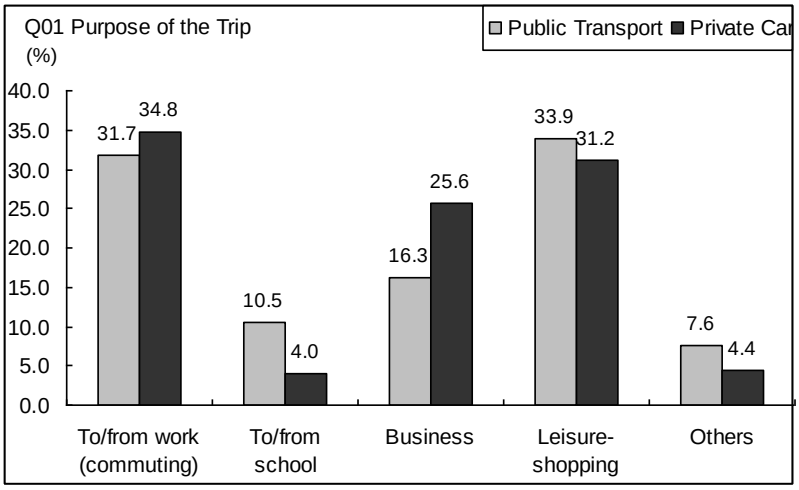
	Sex		Age						Car Ownership			Total Number
	Male	Female	-19	20-29	30-39	40-49	50-59	60-69	None	One	Two or more	
Public Transport	58.4	41.6	10.4	37.5	29.6	14.4	6.1	2.0	88.4	11.1	0.5	750
Metro	51.0	49.0	14.0	32.0	32.0	15.0	7.0	0.0	83.0	17.0	0.0	100
LRT	66.7	33.3	10.0	42.7	27.3	12.7	5.3	2.0	90.0	9.3	0.7	150
Tram	53.0	47.0	10.0	34.0	40.0	12.0	3.0	1.0	91.0	8.0	1.0	100
Bus/Minibus	59.0	41.0	10.0	45.0	25.5	12.0	5.0	2.5	89.5	9.5	1.0	200
Dolmus	68.0	32.0	10.0	38.0	28.0	17.0	6.0	1.0	87.0	13.0	0.0	100
Ferry/Seabus	48.0	52.0	9.0	23.0	30.0	21.0	12.0	5.0	88.0	12.0	0.0	100
Car	60.4	39.6	3.6	30.0	34.4	17.2	9.6	5.2	8.4	81.2	10.4	250

Source : *ibid.*

2) Stated Preference

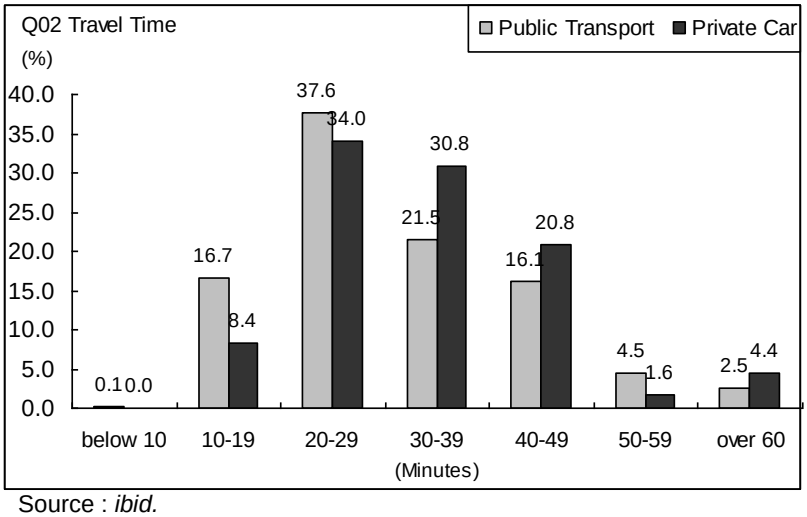
(1) Trip Characteristics

- The purpose of the trip is mainly for commuting and leisure-shopping which account more than 30 % of both public transport users and private car users. (refer to Figure 5.3.9)
- Business purpose trip of the private car users is higher than that of the public transport users. (refer to Figure 5.3.9)
- Average travel time of the public transport users is 28 minutes and is 3 minutes shorter than the private car users. In addition, the maximum and the minimum of travel time of public transport users are shorter than the private car users. (refer to Figure 5.3.10)
- Majority of the travel time of both are categorized into 20~39 minutes. (refer to Figure 5.3.10)



Source : *ibid.*

Figure 5.3.9 Purpose of the Trip



Source : *ibid.*

Unit: Minutes

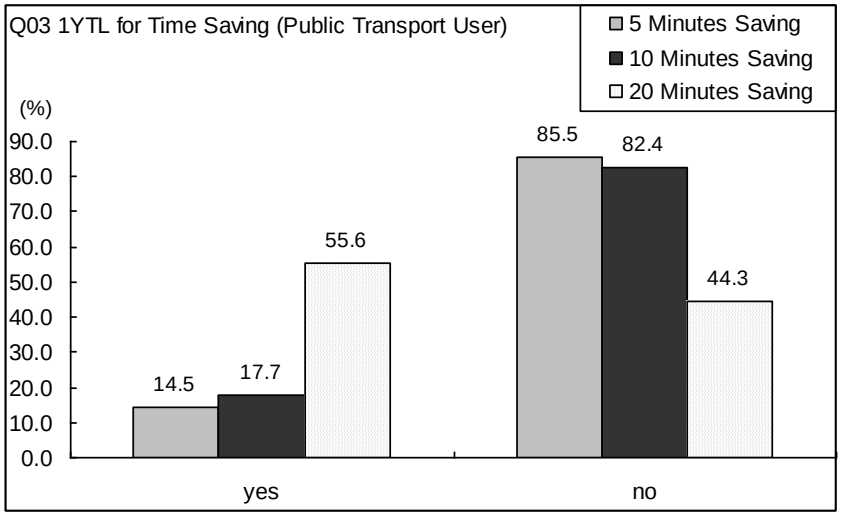
	Public Transport	Private Car
Average Travel Time	28	31
Maximum	90	150
Minimum Travel Coat	5	10

Source : *ibid.*

Figure 5.3.10 Travel Time

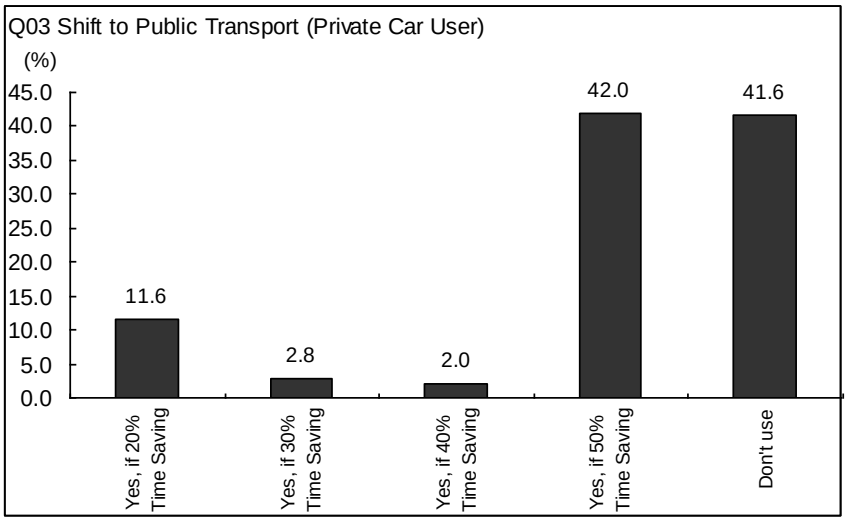
(2) Cost for Time Saving

- If the public transport users can save 5 minutes, 14.5 % of them are willing to pay 1 YTL. Likewise, for 10 minutes saving, 17.7 % and for 20 minutes saving, more than half of them (55.6%) are willing to pay 1YTL. (refer to Figure 5.3.11)
- On the other hand, most of the private car users don't want to shift to the public transport if the travel time saving is less than 40 %. In contrast, 42.0% of the private car users will shift to public transport with 50 % of time saving. (refer to Figure 5.3.12)
- Figure 5.3.13 shows the cost for 20 minutes time saving. The answers to this question were gained as free mentioning. Most of the respondents of both are willing to pay 1 YTL to 2.9 YTL.



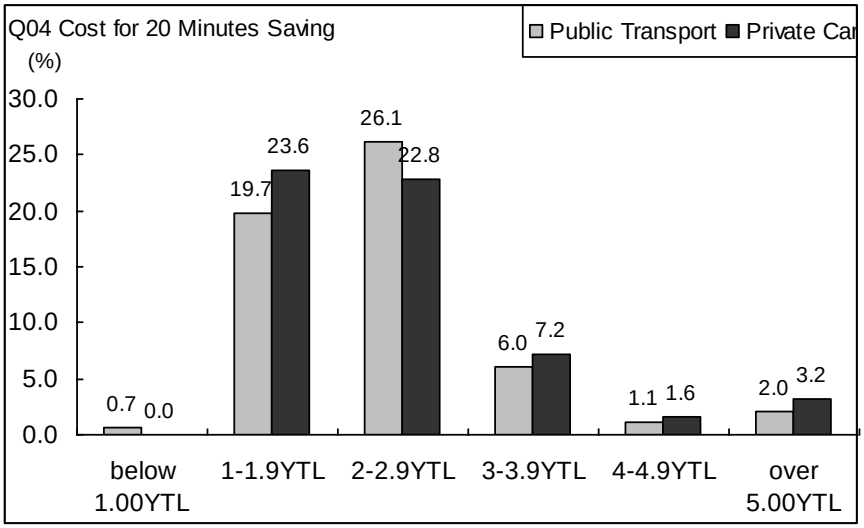
Source : *ibid.*

Figure 5.3.11 1 YTL for Time Saving (Public transport user)



Source : *ibid.*

Figure 5.3.12 Shift to Public Transport According to Time Saving (Private Car User)



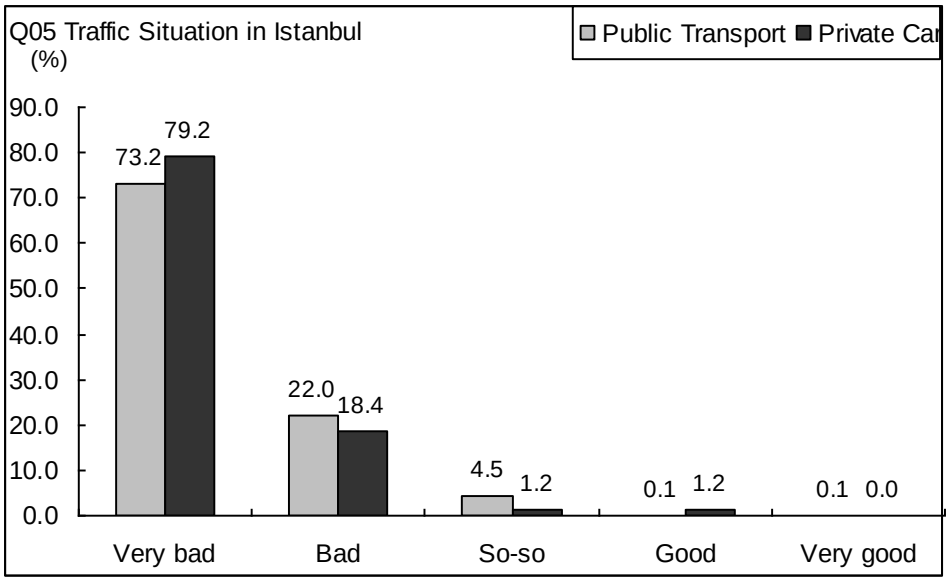
Source : *ibid.*

Figure 5.3.13 Cost for 20 Minutes Saving

3) Traffic Congestion

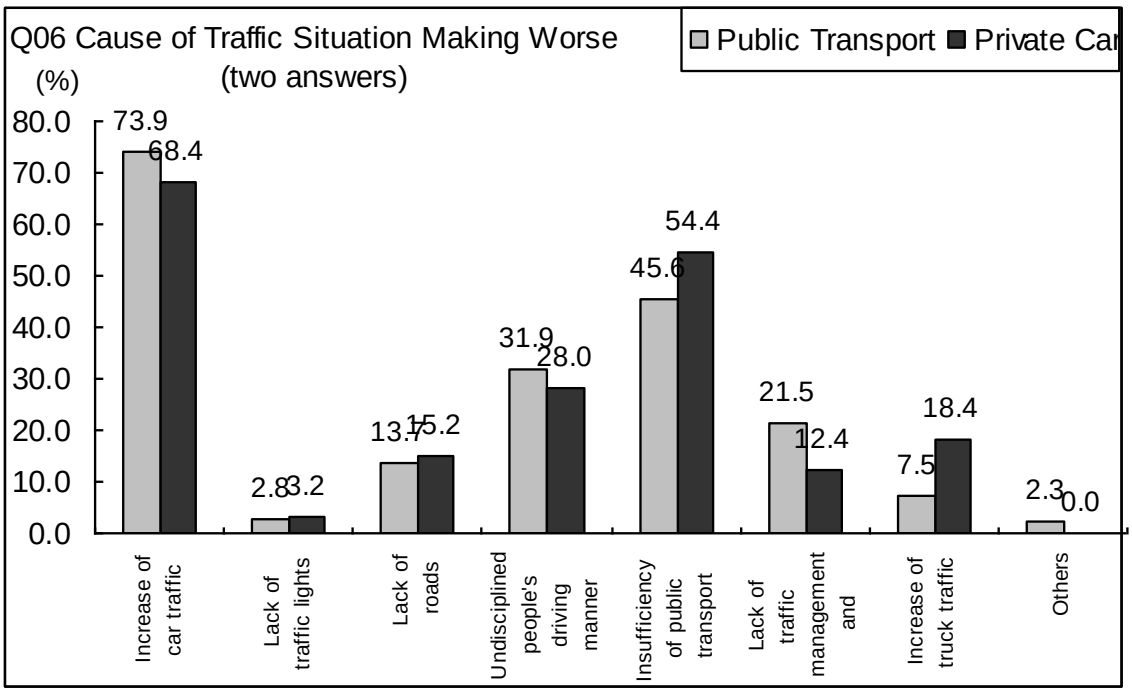
(1) Traffic Situation in Istanbul

- More than 70% of the respondents assess the traffic situation in Istanbul as “very bad”. (refer to Figure 5.3.14)
- Most of the respondents pointed out that the cause of making the traffic situation worsen is the “Increase of Car Traffic”. Another important problem is the “Insufficiency of Public Transport” and the private car users account, this point is more than the public transport users. (refer to Figure 5.3.15)



Source : *ibid.*

Figure 5.3.14 Traffic Situation in Istanbul



Source : *ibid.*

Figure 5.3.15 Cause of Traffic Situation Making Worse

(2) Traffic Situation compared to 5 Years Ago

A: Congestion

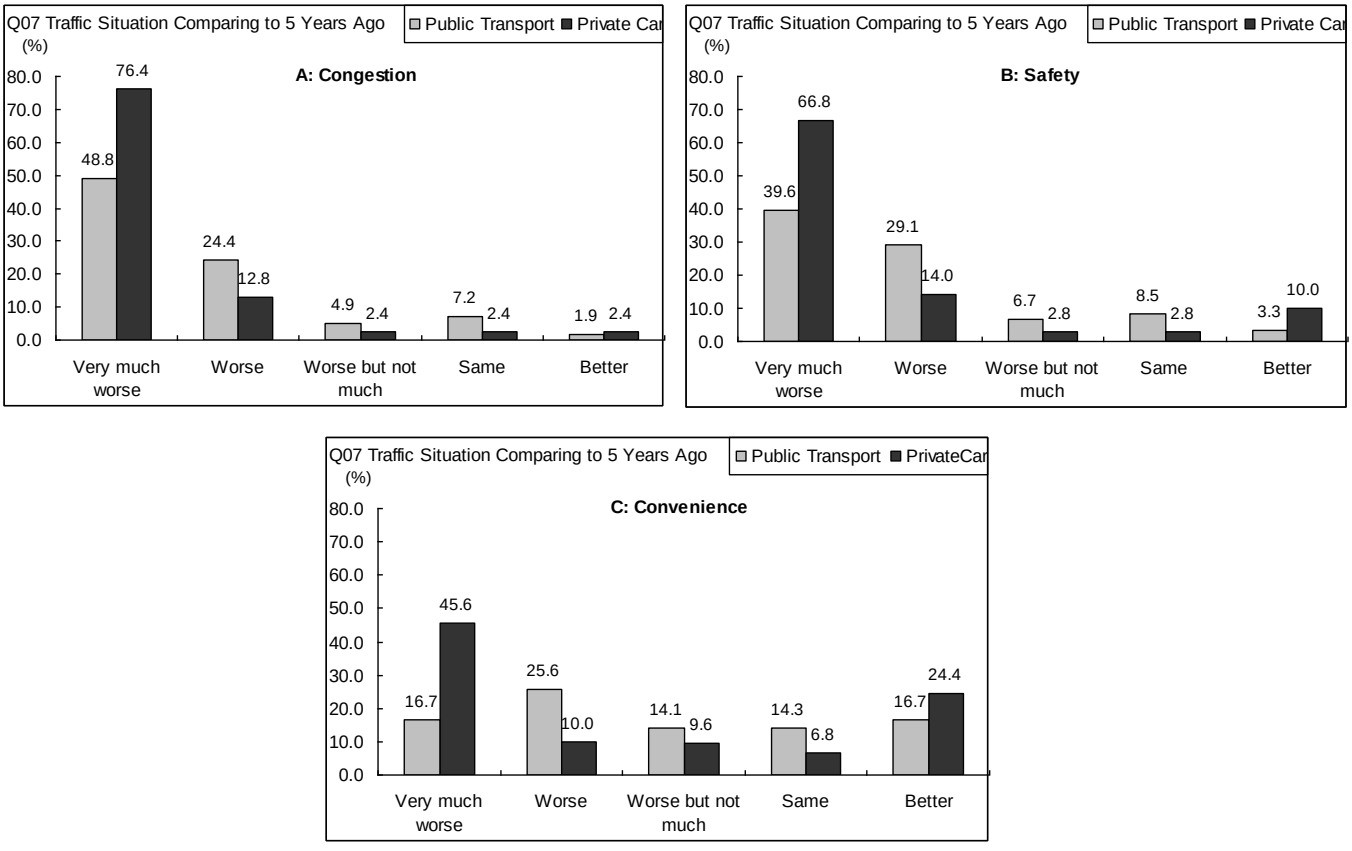
- Regarding the traffic congestion, most of the respondents, especially the private car users (1.5 times of the public transport users), assess the situation is “Very much worse” comparing to 5 years ago. (refer to Figure 5.3.16)

B: Safety

- Regarding the traffic safety, 66.8% of the private car users assess the situation as “Very much worse” which is 1.7 times of the public transport users. On contrary, 10.0% of the private car users assess as “Better”.

C: Convenience

- Regarding the convenience, the assessment by the public transport users is disparate; the ratio of “Very much worse” and “Better” is the same, which is 16.7%. On the other hand, 45.6% of the private car users assess as “Very much worse”, on the contrary, 24.4% of them assess as “Better”.



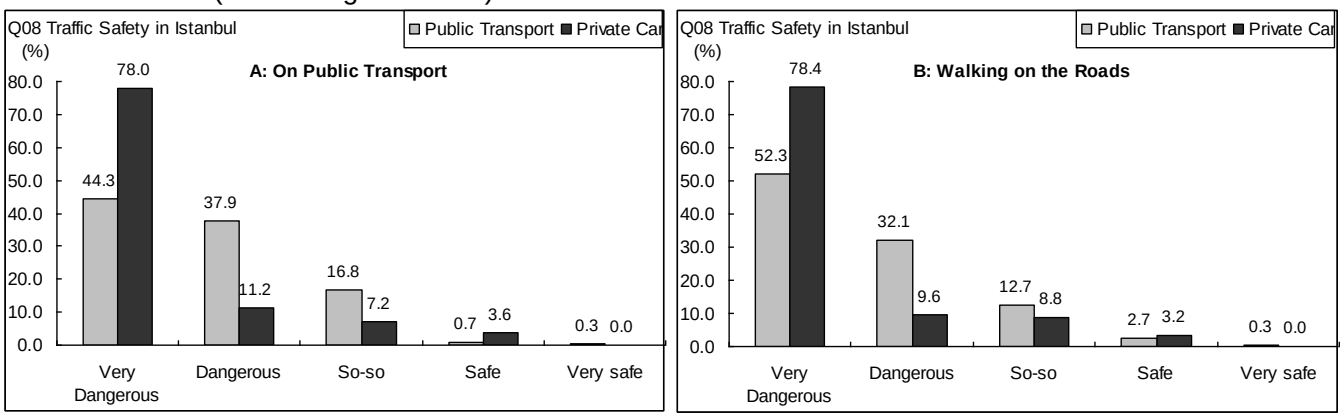
Source : *ibid.*

Figure 5.3.16 Traffic Situation Comparing to 5 Years Ago

4) Traffic Safety

(1) Traffic Safety in Istanbul

- The private car users tend to assess the traffic safety on “A: public transport” and “B: Walk across the roads” more dangerous than the public transport users. More than 78% of the respondents of the private car users assess as “Very dangerous”. (refer to Figure 5.3.17)

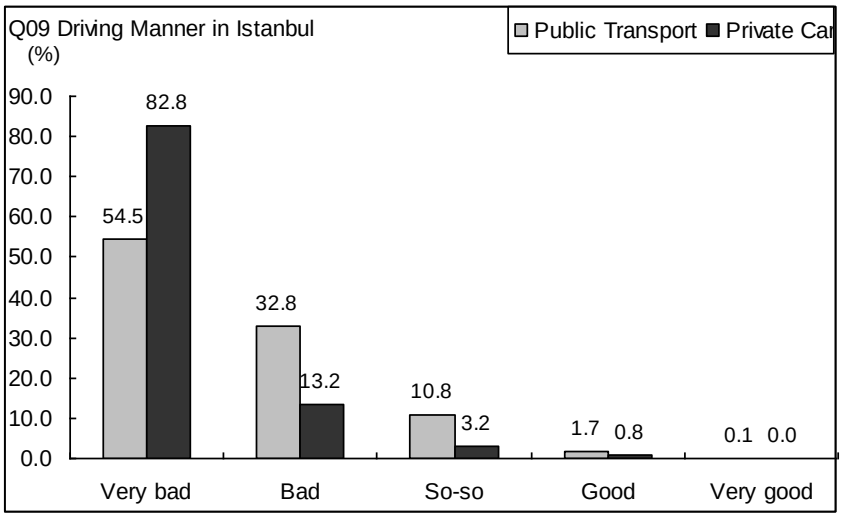


Source : *ibid.*

Figure 5.3.17 Traffic Safety in Istanbul

(2) Driving Manner in Istanbul

- Most of the respondents assess the driving manner in Istanbul as “Very bad”, especially the rate of the private car user’s accounts for 82.8 %. (refer to Figure 5.3.18)



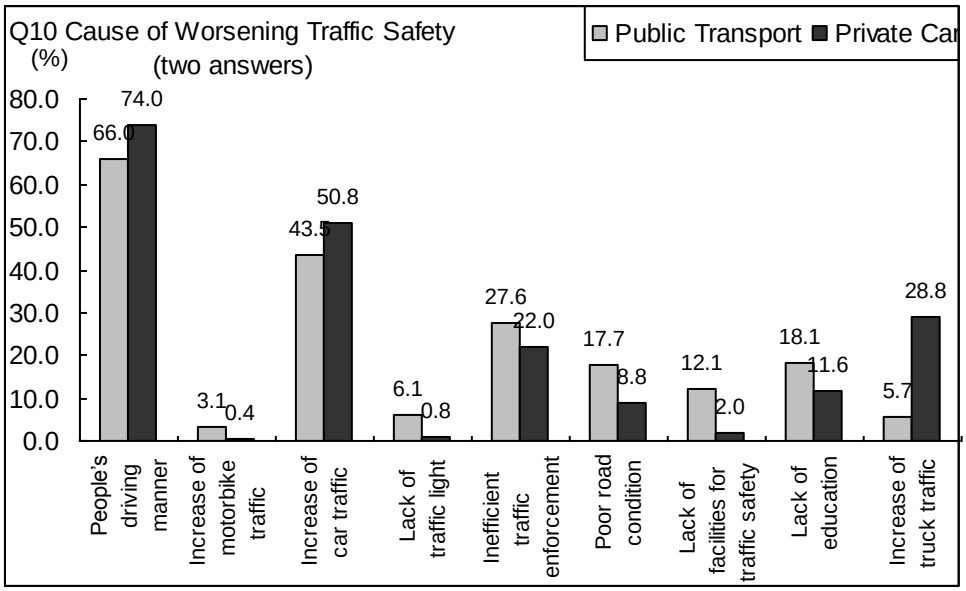
Source : *ibid.*

Figure 5.3.18 Driving Manner in Istanbul

(3) Cause of Worsening Traffic Safety

- The two most favored opinions on the cause of worsening traffic safety are “People’s driving manner” and “Increase of car traffic” according to both the public transport users and the private car users. (refer to Figure 5.3.19)
- The third most favored opinion for each mode is different from each other. For the

public transport users, it is “Insufficient traffic enforcement”, and for the private car users, it is “Increase of truck traffic”. (refer to Figure 5.3.19)

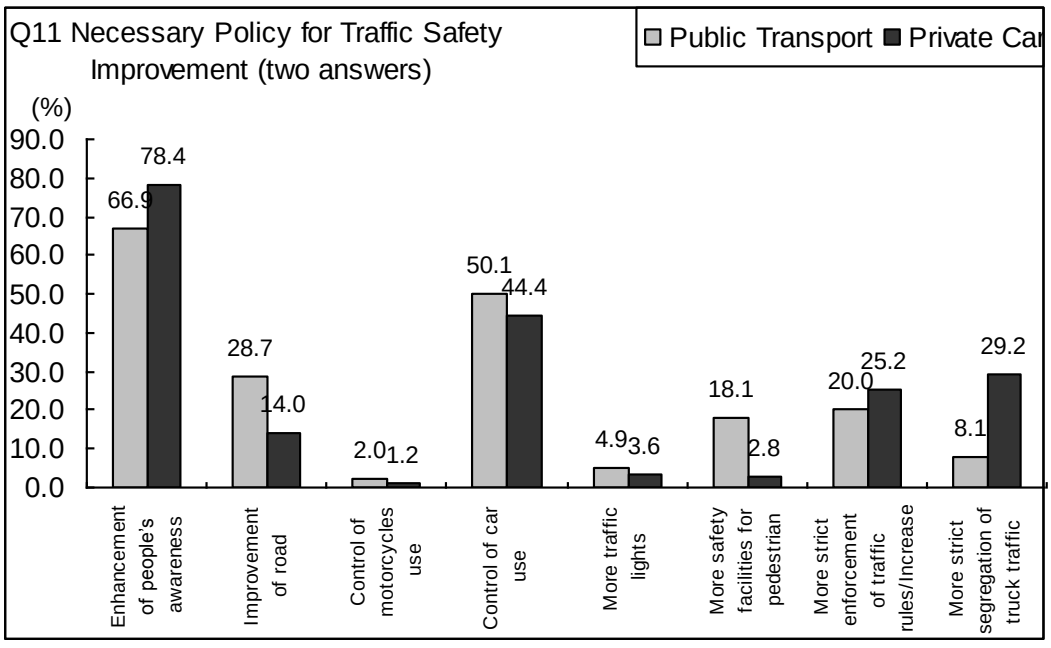


Source : *ibid.*

Figure 5.3.19 Cause of Worsening Traffic Safety

(4) Necessary Policy for Traffic Safety Improvement

- The two most favored opinions on the necessary policy for the traffic safety improvement are “Enhancement of people’s awareness” and “Control of car use” according to both the public transport users and the private car users. (refer to Figure 5.3.20)
- The third most favored opinion of the public transport users is “Improvement of road”, and that of the private car users’ is “More strict segregation of truck traffic”. (refer to Figure 5.3.20)



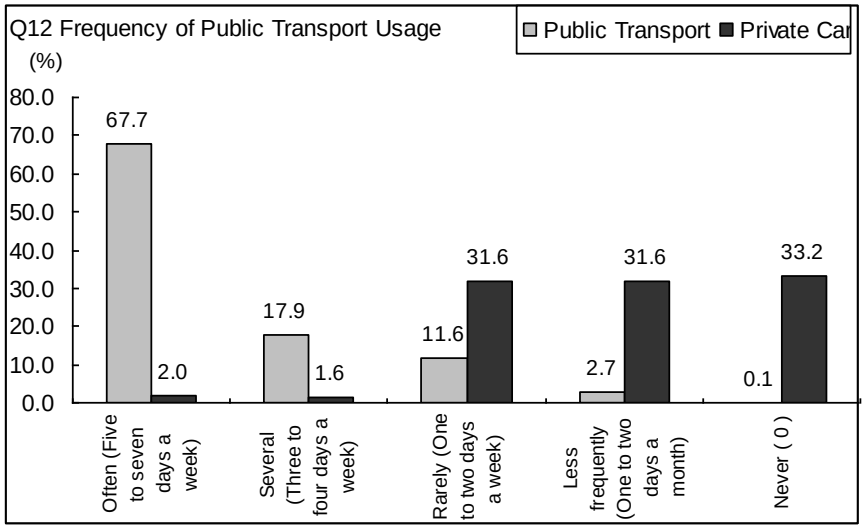
Source : *ibid.*

Figure 5.3.20 Necessary Policy for Traffic Safety Improvement

5) Public Transport

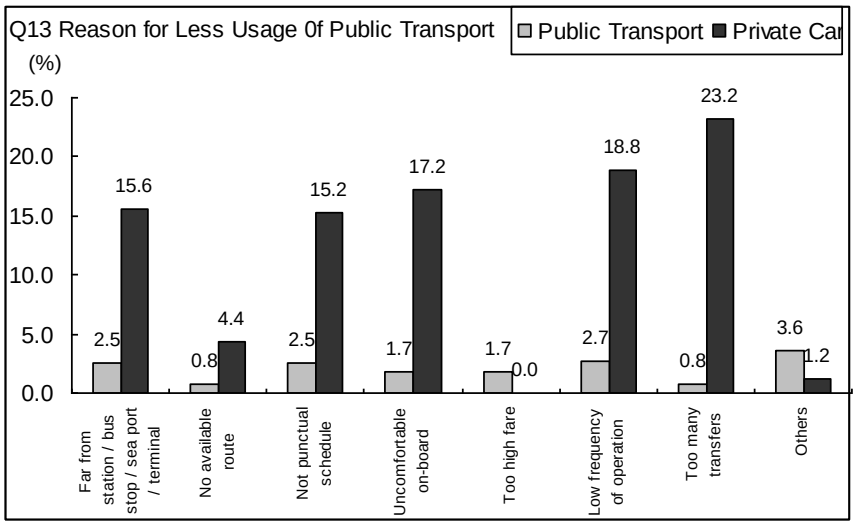
(1) Frequency of Public Transportation Usage

- Most of the public transport users use the public transport “Often (five to seven days a week)”. (refer to Figure 5.3.21
- Most of the private car users use the public transport “Rarely” (one to two days a week) and the ratio of “Never” is around 33.2 %. (refer to Figure 5.3.21)
- The reasons for less usage of public transport are not so much different than the alternatives in the questionnaire. The opinions included in “Others” are less necessity of trip, car usage instead of public transport, etc. (refer to Figure5.3.22)
- The opinions of the private car users on the reason for less usage of public transport vary such as “Far from station/bus stop/sea port/terminal”, “Not punctual schedule”, “Uncomfortable on-board”, “Low frequency of operation”, and “Too many transfers”. (refer to Figure 5.3.22)



Source : *ibid.*

Figure 5.3.21 Frequency of Public Transport Usage

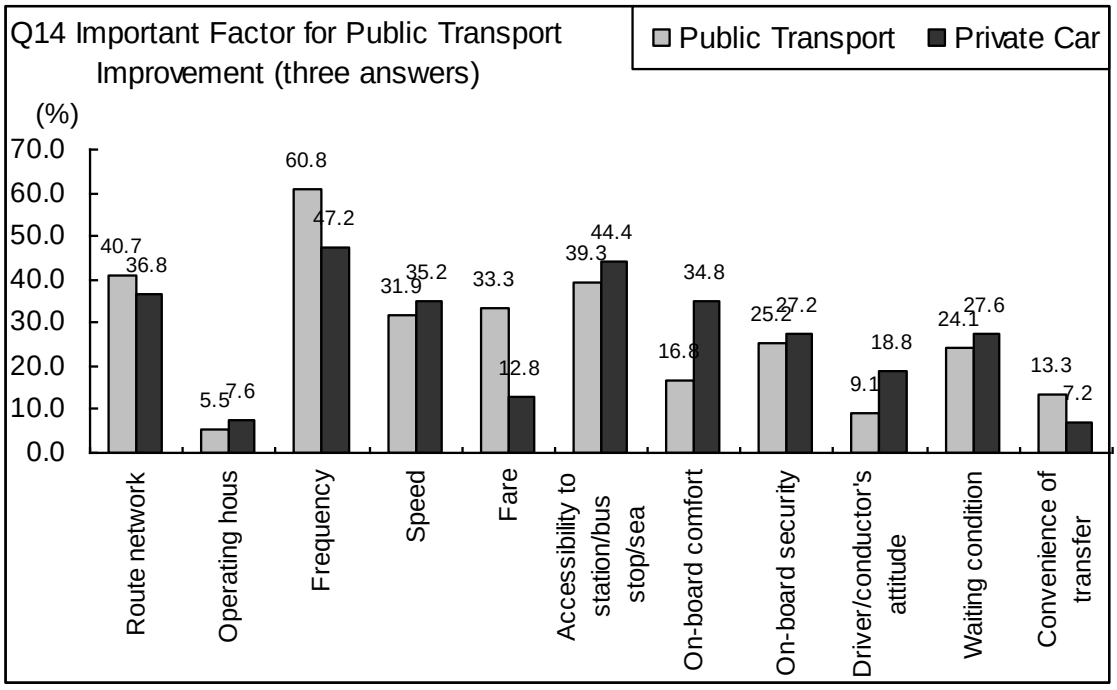


Source : *ibid.*

Figure 5.3.22 Reason for Less Usage of Public Transport

(2) Important Factor for Public Transport Improvement

- Three most favored opinions on the important factor for public transport improvement are almost the same, unless the order and the weight, according to the public transport users and the private car users which are “Frequency”, “Route network” and “Accessibility to station/bus stop/sea port/terminal”. (refer to Figure 5.3.23)
- Except those three, “Speed” and “Fare” are selected by the public transport users, and “Speed” and “On-board comfort” are selected by the private car users. (refer to Figure 5.3.23)

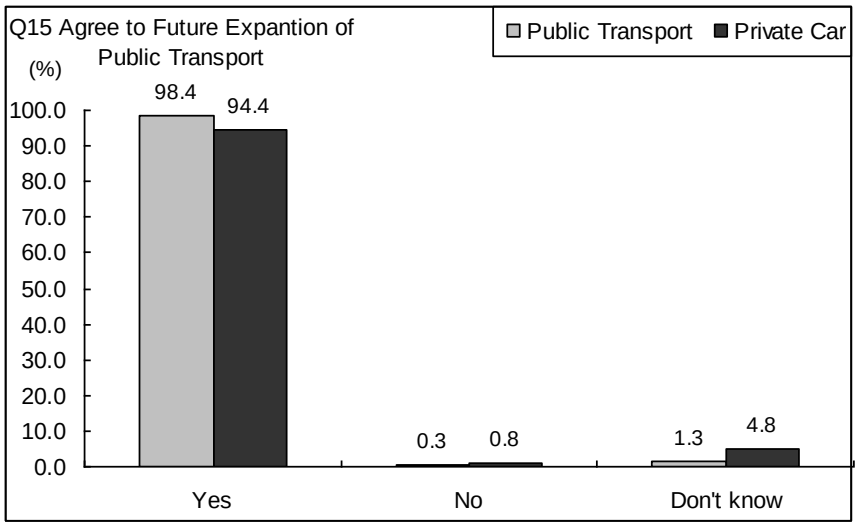


Source : *ibid.*

Figure 5.3.23 Important Factor for Public Transport Improvement

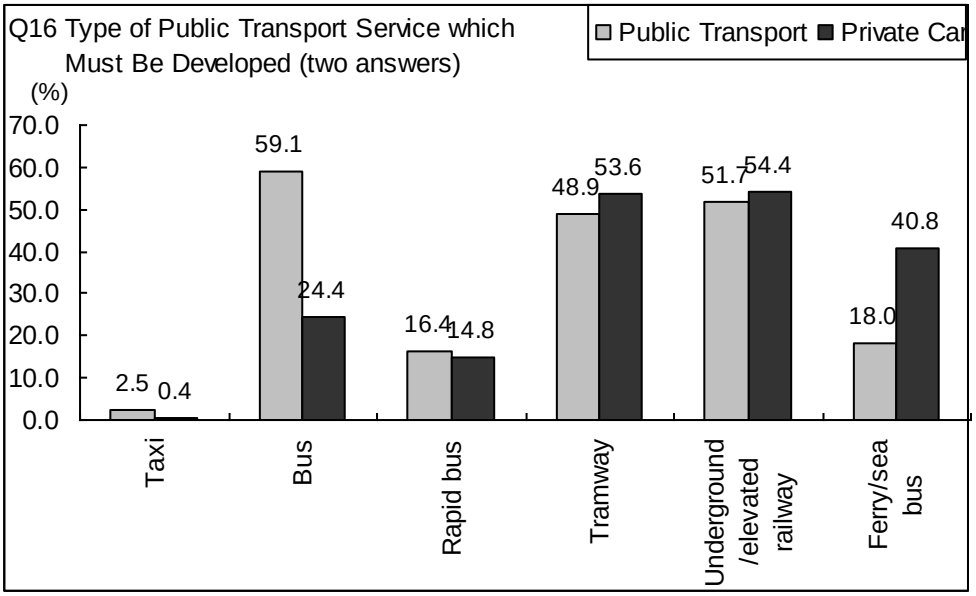
(3) Future Expansion of Public Transport

- Almost all of the respondents agree the future expansion of the public transportation. (refer to Figure 5.3.24)
- The types of the public transport services which need to be developed are “Bus”, “Underground/elevated railway” and “Tramway” according to the public transport users, and “Underground/elevated railway”, “Tramway” and “Ferry/seabus” according to the private car users. (refer to Figure 5.3.25)



Source : *ibid.*

Figure 5.3.24 Agree to Future Expansion of Public Transport



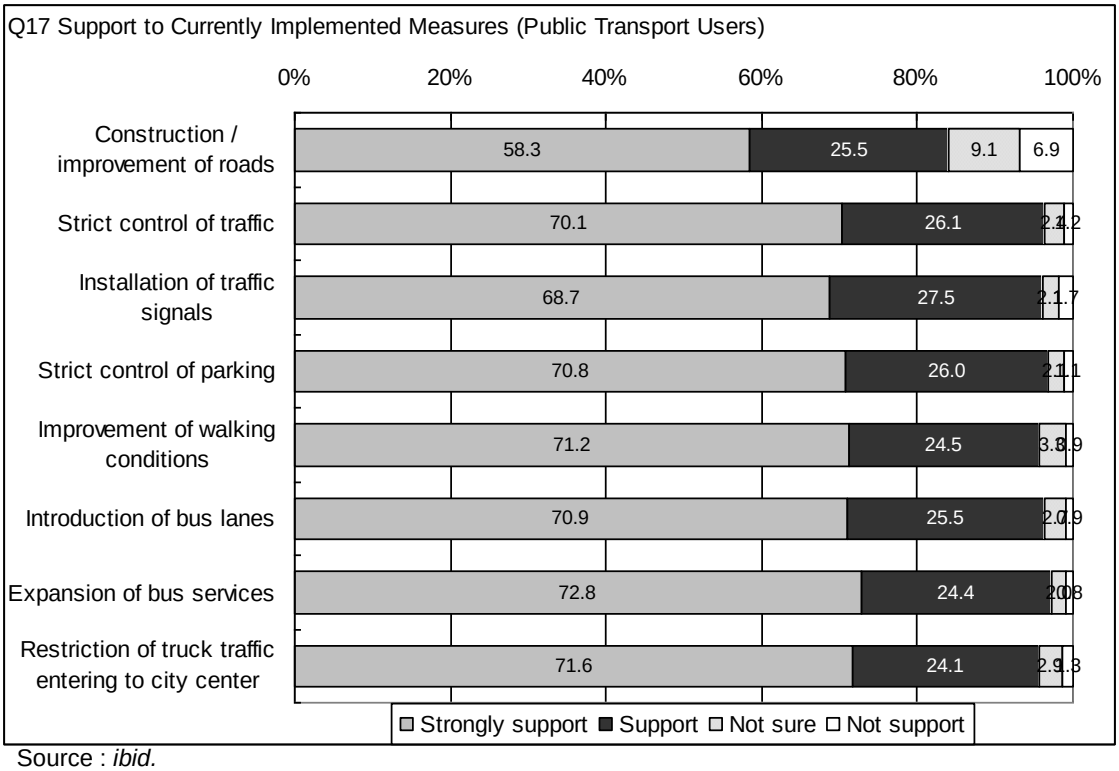
Source : *ibid.*

Figure 5.3.25 Type of Public Transport Service which Must Be Developed

6) Transport Measures

(1) Assessment to Currently Implemented Transport Measures

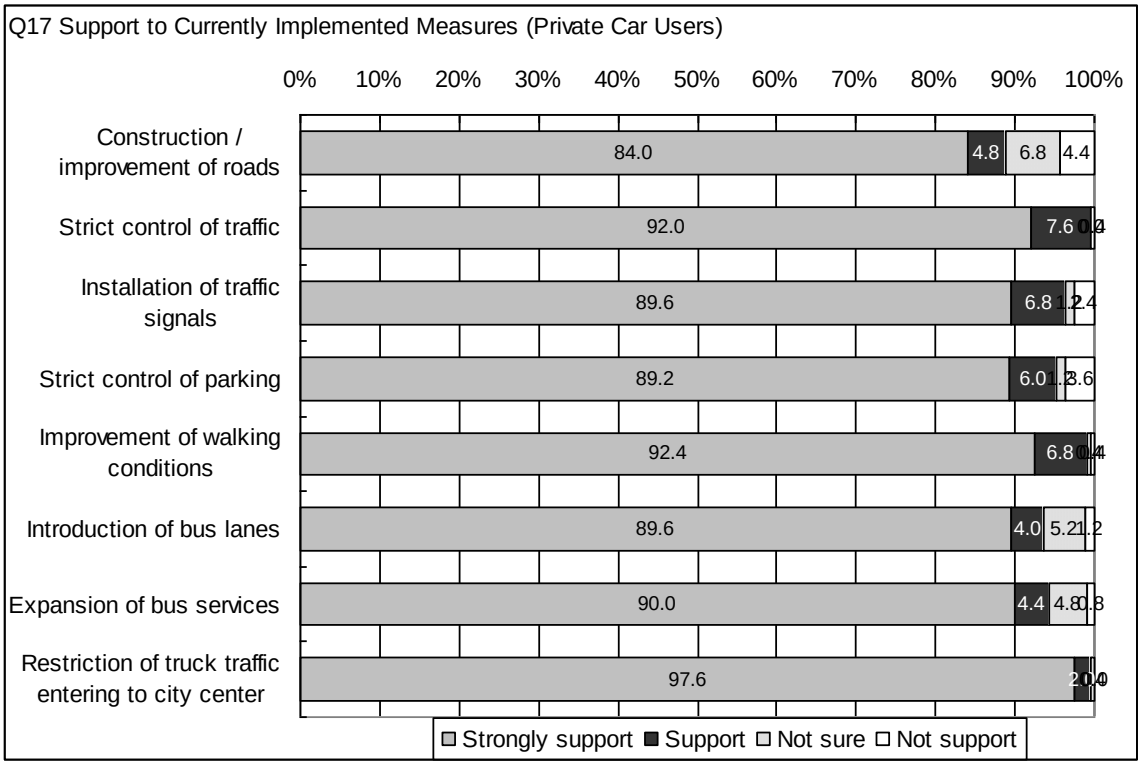
- The public transport users assess the transport measures which is currently implemented mostly “strongly support”, but not so positive, since “support” accounts for around 25 %. (refer to Figure 5.3.26)
- The transport measure which is supported the least by the public transport users is “Construction/improvement of roads”. (refer to Figure 5.3.26)



Source : *ibid.*

Figure 5.3.26 Support to Currently Implemented Transport Measures (Public Transport Users)

- Instead most of the private car users support the transport measures which is currently implemented, but in contrast ”Construction/improvement of roads” and “Strict control of traffic” were remarkably not supported. (refer to Figure 5.3.27)

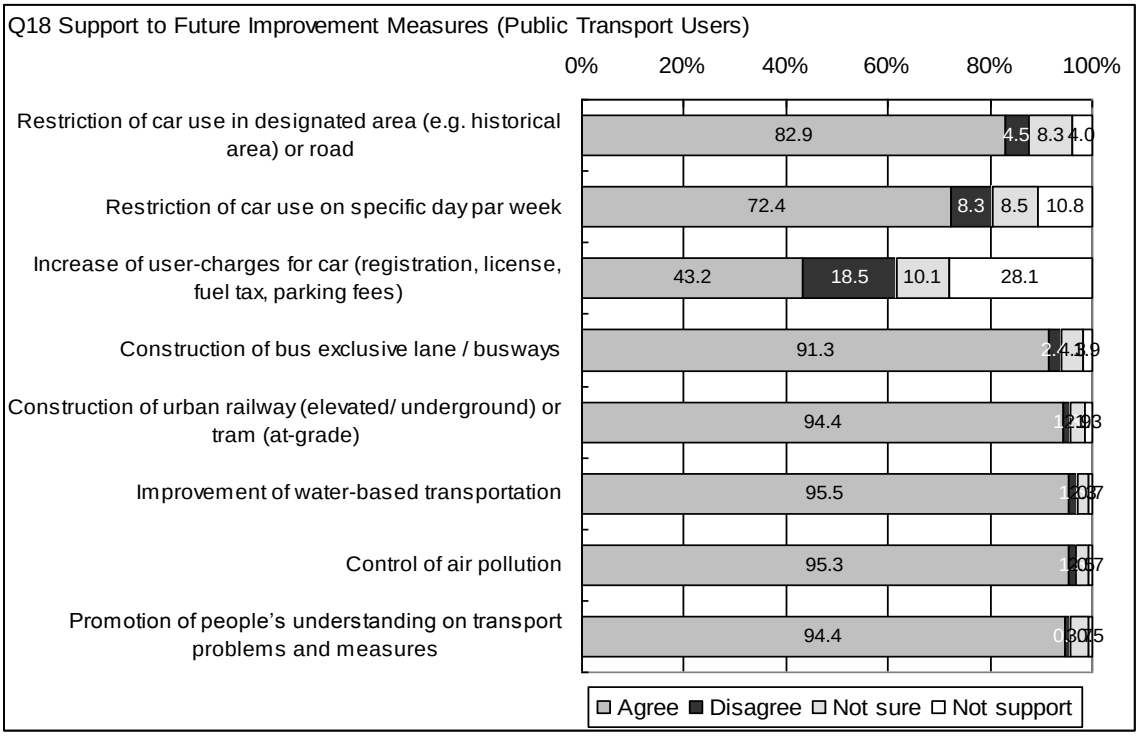


Source : *ibid.*

Figure 5.3.27 Support to Currently Implemented Transport Measures (Private Car Users)

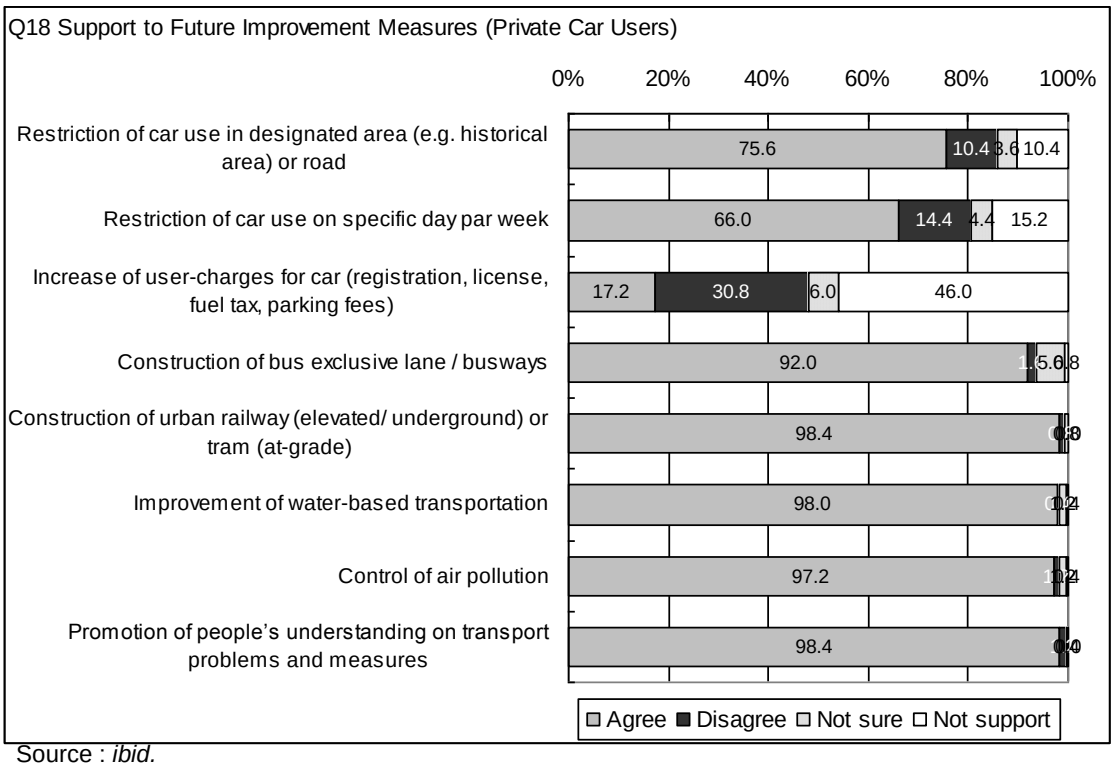
(2) Future Improvement of the Transport Measures

- Instead most of the public transport users support the future improvement of the transport measures on newly construction or improvement of infrastructure, nearly 30 % of the public transport users don't support "Increase of user-charges for car (registration, license, fuel tax, parking fees)" and more than 10 % of them don't support "Restriction of car use on specific day par week". (refer to Figure 5.3.28)
- Likewise, the private car users don't support the measures which restrict the usage of the private car. (Figure 5.3.29)



Source : *ibid.*

Figure 5.3.28 Support to Transport Improvement Measures in the Future (Public Transport Users)



Source : *ibid.*

Figure 5.3.29 Support to Transport Improvement Measures in the Future (Private Car Users)

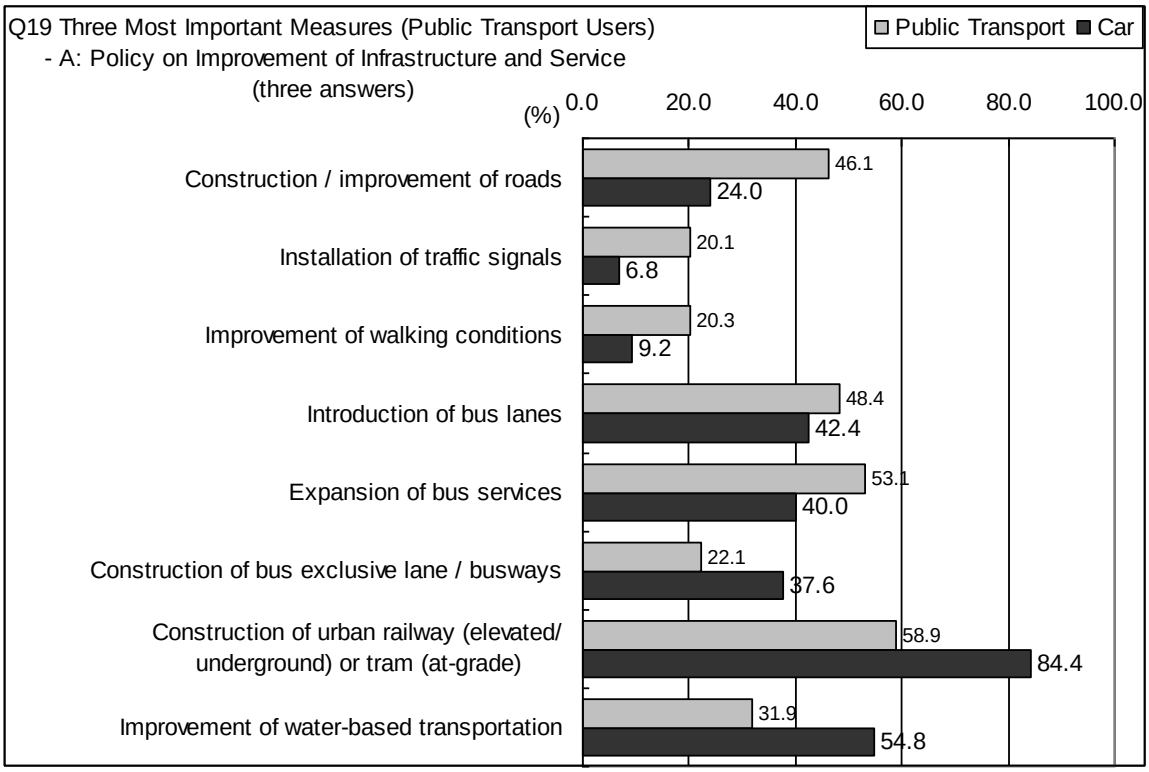
(3) Important Measures in the Future

The transport measures are re-categorized into "A: Policy on improvement of infrastructure and service" and "B: Policy on regulation and restriction" and the respondents can select three answers for each category.

A: Policy on improvement of infrastructure and service

01. Construction / improvement of roads
03. Installation of traffic signals
05. Improvement of walking conditions
06. Introduction of bus lanes
07. Expansion of bus services
12. Construction of bus exclusive lane / busways
13. Construction of urban railway (elevated / underground) or tram (at-grade)
14. Improvement of water-based transportation

- "Construction of urban railway (elevated/underground) or tram (at-grade)" is supported the most by both the public transport users and the private car users. (refer to Figure 5.3.30)
- The second highest of the public transport users are "Expansion of bus services", "Introduction of bus lanes" and "Construction/improvement of roads". In the contrary, the private car users support "Improvement of water-based transportation" as the second favored opinion. (refer to Figure 5.3.30)
- In addition, the private car users support the measures which are related to the improvement of bus services. (refer to Figure 5.3.30)



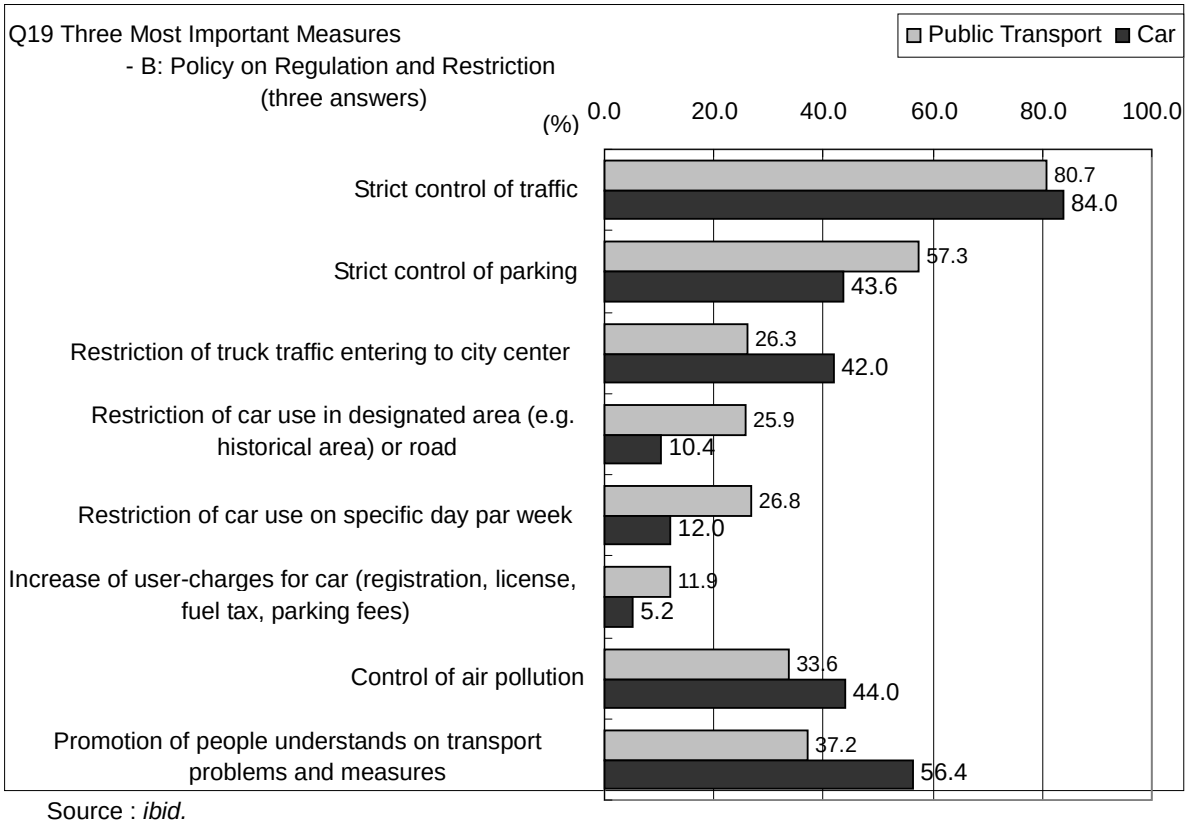
Source : *ibid.*

Figure 5.3.30 Most Important Measures on Improvement of Infrastructure and Service

B: Policy on regulation and restriction

02. Strict control of traffic
04. Strict control of parking
08. Restriction of truck traffic entering to city center
09. Restriction of car use in designated area (e.g. historical area) or road
10. Restriction of car use on specific day par week
11. Increase of user-charges for car (registration, license, fuel tax, parking fees)
15. Control of air pollution
16. Promotion of people understanding on transport problems and measures

- "Strict control of traffic" is supported more than 80 % by both the public transport users and the private car users". (refer to Figure 5.3.31)
- The public transportation users support "Strict control of parking" as the second favored opinion, and the private car users support "Promotion of people's understanding on transport problems and measures" as the second highest. (refer to Figure 5.3.31)



Source : *ibid.*

Figure 5.3.31 Most Important Measures on Regulation and Restriction

Other opinions mentioned on the future improvement measures as the free answers are related to reduction of the fare of the public transport, reduction of car number, increase of traffic lights, installment of safety barriers, etc.