6. Road Plan

6.1 Master Plan Road Projects

Based on the evaluation and prioritization of the maximum network projects, the following road projects were selected for completion during the master plan period. These projects are added to the base network to constitute the master plan network.

- Arterial road projects proposed by IMM, including the tunnel roads for the builtup area
- A new transversal expressway proposed by KGM
- Widening of certain sections o f the existing expressways
- New roads in the new urban subcenters in the western region such as Silivri and Tuzla
- New roads in the new residential zones about to be developed in Kucukcekmece and Buyukcekmece

6.2 Arterial Road Projects in the Builtup Areas

Figure 6.2.1 shows the committed road projects included in the base network. All of them are located in the builtup areas of metropolitan Istanbul, none in the suburbs. Major projects that call for sizable investment are as follows.

- Tunnel projects in and around the CBD
- The north – south arterial road between Istasyon Street and Kayabasi in Kucukcekmece (C33)
- The Bosporus road tunnel to connect Kennedy Street in Eminonu and D-100 in Uskudar on the Asian side of Istanbul. (B09)
- Rehabilitation of the approach roads to the Umraniye Junction of the Sile Highway
- Rehabilitation of the Zeytenbumu – Bakirkoy – Kennedy Street road. (D07)
- Improvement of the Harem – Kartal section of D-100.(D14)

In addition to the above projects, the improvement of intersections is proposed at 122 locations. 73 intersections were already approved at the municipal assembly and are part of the base network as committed projects. The improvement includes minor changes like lane additions, traffic guiding islands and structures for traffic channelization as well as substantial investments in grade separation.

Figure 6.2.2 shows the master plan projects that are located in the builtup areas. Major projects are as follows.

- A new transversal expressway (see 6.3)
- Umraniye tunnel road (see 6.4)

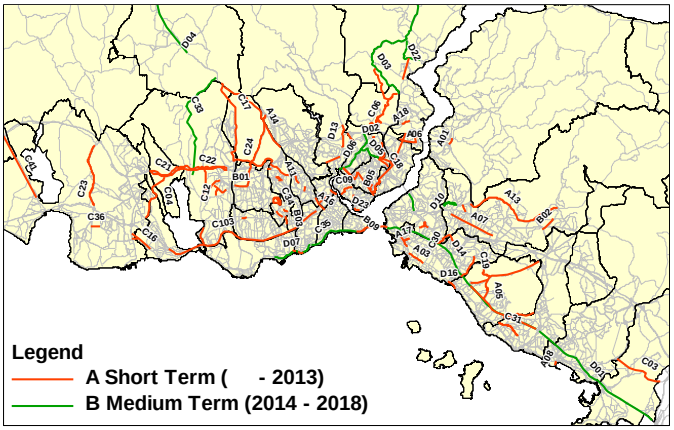


Figure 6.2.1 Base Network Road Projects

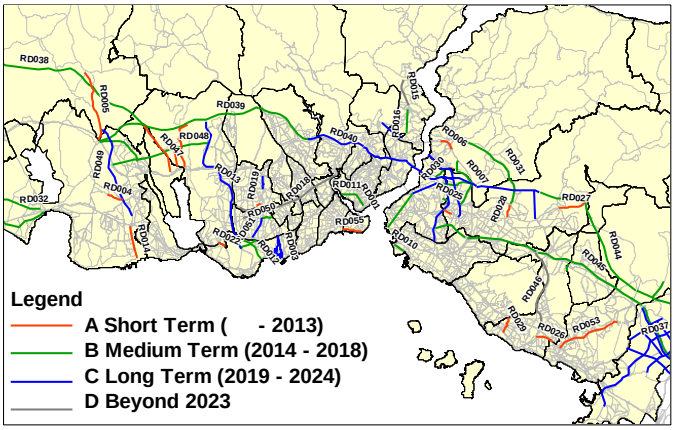


Figure 6.2.2 Master Plan Road Projects

- Road network development for the urban subcenter in Bahcesehir (see 6.5)
- The north – south arterial road for heavy duty vehicles in Buyukcekmece (RD049) that connects Ambarli Port and the logistic center nearby
- Widening of the Asian-side section of TEM from the current 6-lane road to the 10-lane width.

6.3 Transversal Expressways

Metropolitan Istanbul extends lineally eastward and westward. The transversal movement dominates the traffic flows in the city and is destined to do so in the future. The two existing east – west expressways, TEM and D-100, will not be able to service the growing traffic before long. The need of the third transversal thoroughfare has been variously argued with proposals and counterproposals. Figure 6.3.1 shows seven alternative routes proposed by KGM for the third expressway. According to the JBIC-commissioned study on the 3rd Bosporus Bridge in 2005 (JBIC, The Study for Construction of New Bosporus Crossing, May 2005), the Routes 2 and 5 were judged more promising than the other alternatives. After the detailed analysis of the two, the said study found that the Route 2, though superior in its estimated demand and financial and economic internal rates of return, would involve the heavy cost of land acquisition for the right of way. The study concluded thus that the Route 5 would be more feasible. One of the justifications offered was that the said route would contribute to the northern regional development.

The Route 5 has no possibility, however, now that the IMM land use plan bans any further development in the northern region (except some part of the Black Sea coast) for environmental conservation. Even if the route should ever be selected, it runs too north to service the daily metropolitan transversal traffic. Moreover, the present master plan proposes the 3rd Bosporus crossing bridge as both railway and road links, which precludes the possibility of having the new expressway further north from the 2nd Bosporus Bridge. Accordingly, the present study made the transport demand forecast on the Route 2 and evaluated the new expressway.

Figure 6.3.1 Alternative Routes for a New Transversal Expressway

Figure 6.3.2 shows the traffic forecast on three east - west expressways in 2023. The estimated daily transversal traffic assigned to the new expressway is in the range of 80,000 – 100,000pcu, very close to the capacity of a 6-lane expressway. The two existing expressways would suffer severe congestion unless the new thoroughfare should be provided.

The economic evaluation suggested high economic returns: namely, the IRR of 45% for the European side of the new expressway, 19% for the bridge crossing, 39% for the Asian side, and 38% for the entire distance from Silivri through Gebze. This evaluation assumed that the construction of the bridge would be equally allocated to the road and the railway link. If the entire cost of the bridge be part of the road construction, the IRR would be down to 15%, less feasible yet feasible enough.

The financial evaluation of the 3rd Bridge as a road link showed the IRR of 5% at the toll rate of US$2.00/passenger car one way, and 12% at US$4.00. This suggests that the bridge project can be implemented by the PPP scheme of financing. The actual toll rate across the bridge will have to be decided as part of the proposed TDM measure on the highway toll system.

The master plan assumes that the bridge section be completed during the period of 2019 – 2023 after the road and railway sections on the European and the Asian sides are both completed. The Bosporus Strait is one of the prides of Turkey for its world renowned scenic beauty. Any hint of a new Bosporus crossing raises hues and cries, about problems of land acquisition, adverse impacts on environment and scenery, policy implications for transport development and demand management and so forth. It is evidently necessary to undertake thorough studies over such issues and reflect the findings in the project formulation and design. Above all, the relevant information need be offered to any interested party for further discussion and review, in due time to foster a general consensus over the issue of the new Bosporus crossing.

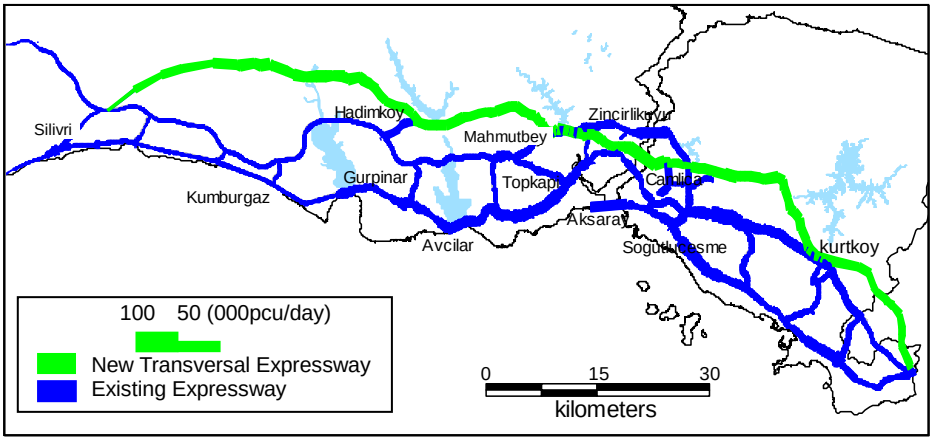


Figure 6.3.2 Demand Forecast for the New and Existing Transversal Expressways (in 2023)

6.4 Tunnel Roads in Builtup Areas

The construction of underground roads is one of the few alternatives available for the densely packed urban areas. The extreme difficulty of land acquisition in the builtup areas precludes any new road extension on the land. The construction of elevated roads is also becoming increasingly difficult to find enough space. Going underground is practically the only possibility left.

The cases of building underground or tunneled roads have been increasing in such large cities as Paris, Tokyo and Cairo. The idea of tunnel roads is a logical answer to metropolitan Istanbul that grew on the hilly terrains, where the valleys can be connected by passing tunnels through ridges and hills. There are 7 committed projects. The tunnel road of 1.4km extending from Piyalepasa to Dolmabahce (A09) is now under construction and four others (B04-B08) are in the process of bidding. Other two are under detailed designing (C26,C28). Tunnel roads will become more common before long in Istanbul. In addition, the BOT scheme is about to start the construction of the undersea tunnel across the Bosporus Strait connecting Kennedy Street on the European side and Harem on the Asian side (B09).

Table 6.4.1 Tunnel Road Projects

	Code	Name
Base Network	A09	Kagithane - Piyalepasa - Dolmabahce (Inonu Stadium) Tunnel
	B04	Dolmabahce - Fulya Tunnel
	B05	Fulya - Levazim Sitesi Tunnel
	B06	Levazim Sitesi - Akatlar Tunnel
	B07	Sanyer Merkez -Cayirbasi Tunnel
	B08	Zinciridere - Levazim Tunnel
	B09	Bosporus Road Tunnel Crossing
	C26	Kagithane - Piyalepasa Tunnel Project
	C28	Eyup(Silahtaraga) - GOP cd. Tunnel,
Master Plan	RD001	Tophane - Iplikci Tunnel
	RD008	Beylerbeyi - Harem Tunnel
	RD009	Beylerbeyi - Hekimbasi Tunnel
	RD010	Kadikoy - Moda Tunnel
	RD011	Tophane - Haskoy Tunnel
	RD015	Derbent Haciosman Tunnel Project
	RD016	Armutlualti - Poligon Mah. Tunnel Project
	RD017	Armutlualti - Ayazaga Tunnel Project
	RD018	Kuyumcu Kent - Otogar - Eyup Tunnel Project
	RD049	New Truck Route for Ambarli Port - Logistic Center
	RD050	E-W Missing Linkage in Gungoren (tunnel)
	RD051	N-S Missing Link in Bahcelievler (tunnel)
	RD052	Connection Tunnel between Bosna Bulvari and Hatboyu St (tunnel)
	RD054	Connection Road between New Motorway and Uskudar Tunnel (50% tunnel)

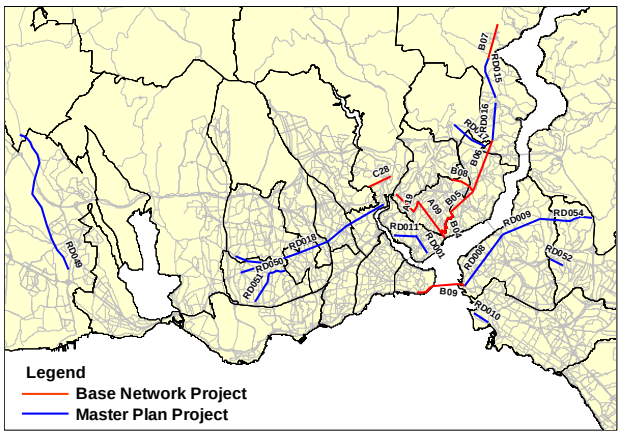


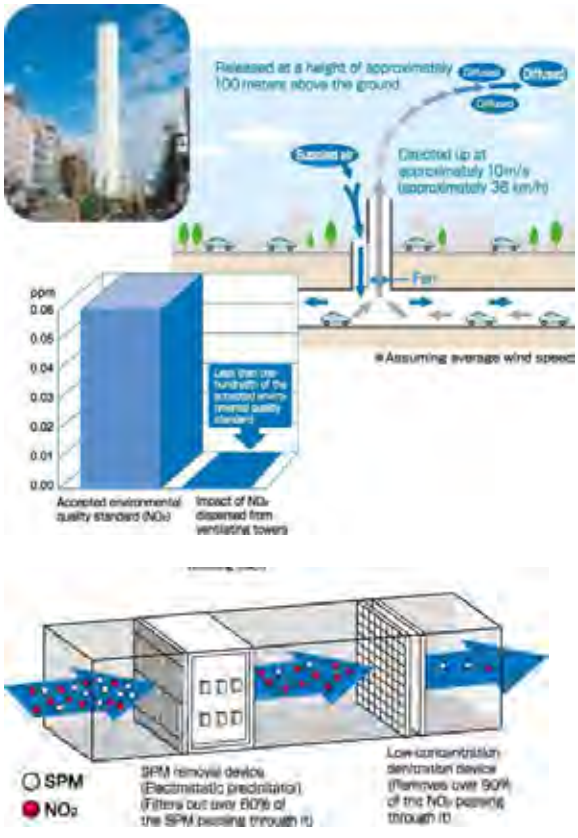
Figure 6.4.1 Distribution of Tunnel Road Projects

The master plan proposes 13 tunnel roads to be completed by 2023. The longest tunnel road proposed for the distance of Kuyumcu Kent – Otogar – Eyup (RD018) is estimated to cost as much as US$330 million and thus scheduled to be completed after 2023. Long distance tunnel roads in the urbanized areas require especially careful safety and security measures. Ventilators and shelter caves must be provided for emergencies like traffic accidents and fires inside, while the tunnel structures must be sufficiently earthquake resistant. It will take some time to acquire necessary technical expertise in designing, constructing and operating long-distance tunnels. It is also important to educate car drivers about the traffic rules in the tunnels and how to behave in cases of emergency. Accordingly, it is more appropriate to postpone the tunnel road projects of long distance until ordinary drivers get well acquainted with short tunnels and learn how to behave inside the tunnels.

Yamanote Tunnel in Tokyo

The western part of the metropolitan expressway ring was in the densely builtup area of Tokyo. The tunnel road of 30m underground was proposed because of the prohibitive cost of land acquisition. Of the total length of 11km, 7km is now in operation.

Ventilation towers as high as 45m above the ground level are provided at every 2km of the tunnel. The towers are equipped with air filters and powerful fans blow up the filtered air to the height of 100m above the ground. Reportedly, CO_2 of 60,000 tons, NOX of 700,000 tons and SMP of 40,000 tons are eliminated per annum by the ventilation filters.



Source: Tokyo Metropolitan Expressway Co.,Ltd

6.5 Road Network Development in Newly Urbanizing Areas

The density of arterial roads appropriate for builtup areas varies by the geographical configuration of urban space and the traffic volume. Generally speaking, the arterial roads are provided at intervals of 1.0km to 2.0km. Therefore, the density per square kilometer ranges from 1km to 3km. The density of arterial and general roads altogether would be from 10km to 20km per km^2.

The Marmara coastal area from Buyukcekmece to further west is at present sparsely populated with density ranging from 1 to 30 persons per km^2, and serviced by a paltry extension of arterial roads. This western area is expected to absorb a large population increase of 2.5 million by 2023. The density will then increase to 60 persons per km^2 on the average, and reach 100 to 120 persons per km^2 in its urban subcenters. The area's requirement of arterial roads, at the density of 1.0km to 2km per km^2, would be simply enormous.

Figure 6.5.1 illustrates possible networks of arterial roads in a number of urban subcenters that are likely to develop in the said western area. The network grids are drawn mainly by following the contours of the terrains. It would be better to carry out the actual network development in the manner tried for the special development zones in Istanbul by inviting proposals from the public.

For the purpose of project evaluation and scheduling, arterial roads are bundled into project packages for six subcenters. The aggregated length of these roads is 350km, with the estimated total cost of US$3.6 billion.

Table 6.5.1 Arterial Road Packages in Newly Urbanizing Areas

No.	Urbanizing Area	Length (km)	Cost (US$ million)
RD032	Buyukcekmece	40.46	495.6
RD033	East Silivri	66.30	842.0
RD034	Silivri center	74.57	827.2
RD035	West Silivri	91.85	844.6
RD037	Tuzla	58.51	477.7
RD047	Kucukcekmece	17.50	135.8
Total		349.19	3,622.9

The arterial roads in six urban subcenters need be constructed at the earliest possible opportunity. When the urbanization picks up its pace, it will become increasingly difficult to acquire land for these roads. It is essential to draw up a city plan for each subcenter as early as possible and thereby earmark the land for roads, railways, parks and other public facilities.

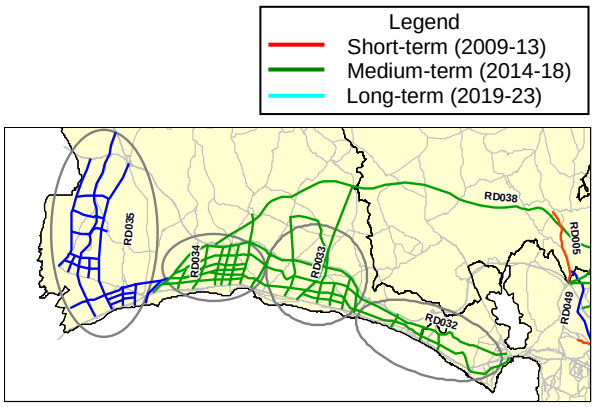
The arterial road network is urgently needed in the subcenter of Bahcesehir, where the multi-story housing development has been going on in earnest. The inflow of population will sharply increase when the on-going construction of the metro railway line of Bagcilar – Ikitelli – Olimpiyat Koyu is completed. As the residential population of this area is expected to increase to some 800,000, it is judged necessary to complete the new transversal expressway of the European side during the medium term period (2014 – 2018).

Although the arterial roads are urgently needed in all the newly urbanizing areas, it will be impossible to complete the entire350km during the short term period. Allowing a few years for drawing up city plans with appropriate institutional development, the implementation must begin during 2009 – 2013 in the other subcenters, targeting the completion sometime during the medium term period.

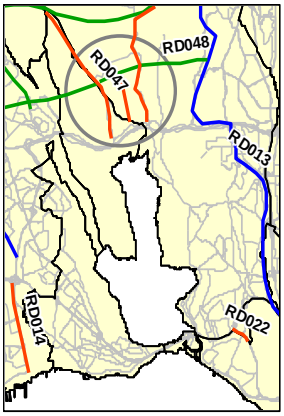
Apace with urbanization in the western Marmara coastal area, the land price will jump up to more than 25 times the present level. While the government revenue from taxes on fixed assets will increase as a result, the public expenditure on social welfare, education and health care also increase at the same time. There appears to be no reason to refuse out of hand the possibility of raising fund for infrastructural development from the expected land price boom.

IMM itself does not have the mandate to take direct advantage of the situation. Instead, the present study proposes the establishment of a non-profit third sector body that will undertake the land development and the construction of multi-story residential and office buildings to sell at market price. The proposed body, tentatively called "West Istanbul Urban Development Corporation (WIDEC)", will internalize the profits from real estate dealings to invest in local economic and social infrastructure.

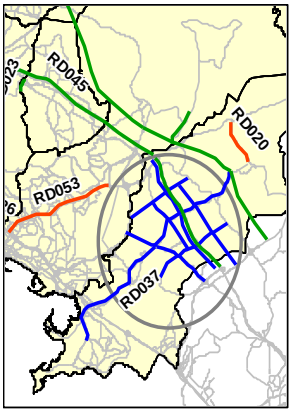
The proposed institutional development will partly solve the financial constraint on the master plan implementation. If the proposed organization needs the business acumen for real estate development and marketing, it is as well to head hunt appropriate persons from the private sector or to invite the participation of private capital. The said organization will probably require some legislation of limited duration, say about 20 years.



a) Buyukcekmece – Silivri – Gumusyaka



b) Bahcesehir Area



C) Tuzla Area

Figure 6.5.1 Arterial Road Networks for New Urban Subcenters

7. Railway Plan

7.1 Railway Projects of Base Network

Various railway lines totaling 138km are in operation in Istanbul as of August 2008: viz., one subway line (8.5km), one light metro line (19.3km), three tram lines (32km), two nostalgic tram lines (4.2km), two suburban lines (72km), two funicular lines (1.2km) and two telefeliks (0.7km). Only the subway and the LRT might be called large to medium volume transits that service the demand of morning peak hours. The rest are historic facilities servicing tourists and/ or localized passengers. The railways transport 4% – 5% of the total metropolitan traffic volume. The bus services are the mainstay of public transportation, carrying more than 50% of the total passenger traffic.

There and 16 committed railway projects, including those under construction, and all of them will be in operation around 2015. The urban railways of Istanbul will soon outgrow the cradle stage and begin to mature. Figure 7.1.1 shows the base network of railways lines. The red lines will be completed by 2013 and blue ones by 2018.

The Marmaray suburban line (C-7) is the biggest committed project. It runs on the rail extension of the Turkish National Railways (TCDD), but shortcuts the Yenicapi – Sirkechi section by using the new underground rail leading to the Bosporus crossing immersed tunnel and reaches the underground terminal at Uskdar on the Asian side. It is the first railway line that connects the European and the Asian side. The line is scheduled to be in operation in 2013.

Table 7.1.1 Committed Railway Projects

Code	Railway Type	Length (km)	Start of Operation	Total Cost (US$ million)
C-1	Metro	5.2	2013	330
C-2	Tram	3.0	2008	12
C-3	Metro	21.7	2013	787
C-4	Metro	8.0	2013	267
C-5	Light Metro	5.6	2010	87
C-6	Metro	15.9	2010	194
C-7	Suburban Railway	76.5	2013	3,000
C-8	Light Metro	0.7	2013	30
T-1	Light Metro	19.0	2015	1,195
T-2	Light Metro	25.0	2016	1,325
D-1	Metro	9.0	2015	548
D-2	Metro	25.0	2019	1,790
D-3	Metro	7.0	2017	481
D-4	Tram	9.6	2015	243
D-5	Metro	14.3	2018	1,130
D-6	Monorail	5.8	2015	250
Total		251.3	-	11,669

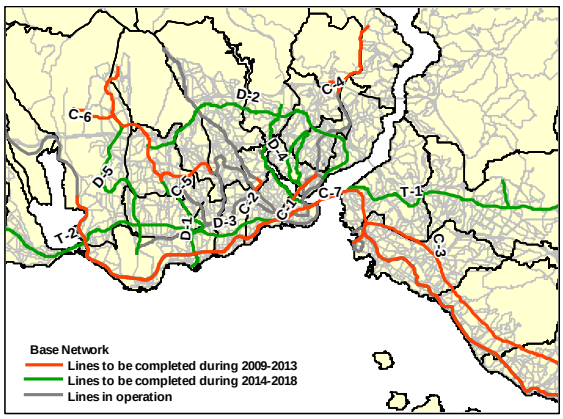


Figure 7.1.1 Base Network of Railway Projects

7.2 Master Plan Railway Projects

The master plan examined and proposed 21 projects to be added to the base network (Table 7.2.1and Figure 5.5.1). The aggregated extension is a little over 300km, a total increase of 551km combined with the committed projects.

12 projects are proposed for metro railways, with aggregated extension of 178km costing US$12.5 billion. These metro projects require large investment, accounting for two thirds of the total projects both in number and cost. Two light metro projects will extend the existing airport line. Three suburban railway projects are extensions of the Marmaray line, including its branch line. Three monorail projects will service the localized short-distance demand.

Regarding two metro lines, RL-010 and RL-013, where the expected demand would be not as large as in the others, the master plan proposes a medium volume transit system with lower operational cost, either the automated guided transit system (AGT) or the linear motor system. These lines run from Marmara Sea to Black Sea along the European and the Asian coast, respectively, of the Bosporus Strait. Their priority is relatively low and scheduled to be completed after the master plan period. The development of the future railway technology might offer a new transit system other than the present suggestion.

Three metro lines of RL-005, RL-017 and RL-018 will constitute the second railway line to connect the European and the Asian side. The start of their operation is scheduled in 2021 and 2022. The preparation must start in 2011 to begin the construction works in 2013.

Table 7.2.1 Master Plan Railway Projects

Code	Railway Type	Length (km)	Start of Operation	Total Cost (US$ million)
RL-001	Light Metro	7.5	2018	494
RL-002	Metro	12.0	2022	1,197
RL-003	Metro	14.0	2022	1,225
RL-004	Metro	18.1	2022	1,261
RL-005	Metro	19.5	2022	1,187
RL-006	Monorail	3.0	2021	94
RL-007	Monorail	7.7	2023	242
RL-008	Metro	2.7	2019	193
RL-009	Monorail	8.6	2030	248
RL-010	AGT/LIM Metro	14.1	2030	787
RL-011	Metro	16.7	2030	1,197
RL-012-1	Suburban Railway	15.8	2019	791
RL-012-2	Suburban Railway	10.0	2023	528
RL-013	AGT/LIM Metro	15.0	2030	881
RL-014	Metro	13.0	2030	932
RL-015	Suburban Railway	2.5	2028	160
RL-017	Metro	9.8	2021	816
RL-018	Metro	8.6	2021	776
RL-019	Metro	36.8	2024	2,365
RL-020	Light Metro	1.0	2019	66
RL-021-1	Metro	18.9	2023	796
RL-021-2	Metro	30.0	2029	1,404
RL-022	Suburban Railway	20.4	2021	536
Total		299.5	-	18,176

7.3 Passenger Demand for Railway Services

Passengers increase in acceleration as railways extend their lines. The railways now account for a mere 5% of the total daily demand of 170 million passenger km in metropolitan Istanbul. By 2023, 110 million passenger km will be serviced by the railways, an increase of 11 times (Figure 7.3.1). The share will expand to 28%. However, most of this increase will come from the shift of passengers from public bus services. Passengers on private bus services provided by schools and companies will also shift to the railways. The shift from private automobile users will not amount to much, a mere few percent of the railway passengers. In other words, the expansion of the railway network does not by itself induce an appreciable decrease of the automobile traffic. Such a shift requires a number of specific policy measures.

Figure 7.3.2 shows the flows of railway passengers in 2018 and 2023, respectively the last year of the medium and the long term plan period. The flow bands of passengers extend their reach in each five year period in the western suburbs of the European side and the entire area of the Asian side. The most remarkable growth of demand is seen in the western area beyond Kucukcekmese, where the extension of the Marmaray line and the construction of the Silivri line will take place. The daily railway passengers in the western area, both inland and coastal, are estimated to reach 600,000 – 800,000.

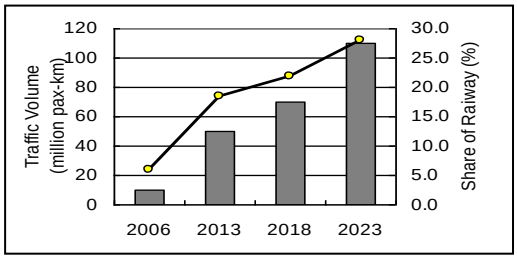


Figure 7.3.1 Growth of Demand for Railways

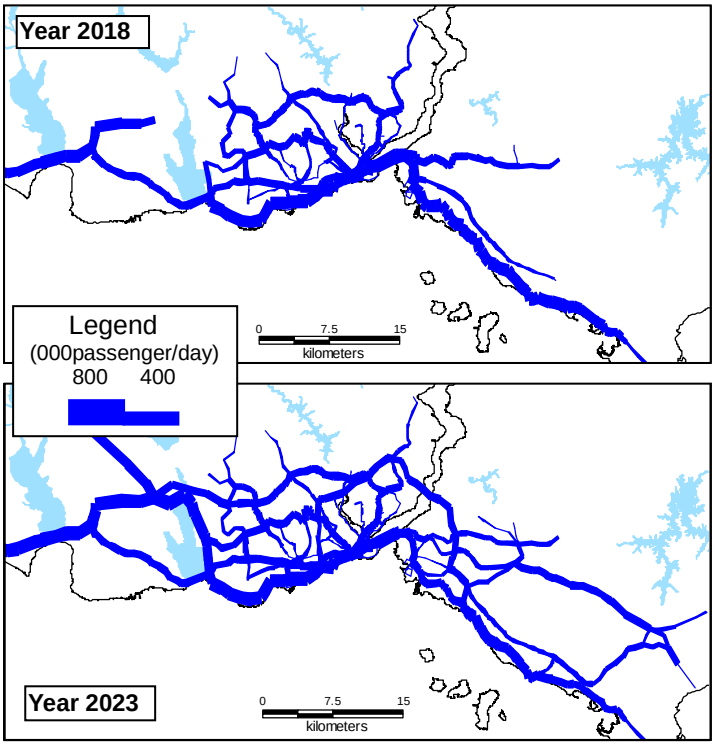


Figure 7.3.2 Passenger Flows on Master Plan Railway Network

7.4 Prioritization and Investment Scheduling

When the public sector invests in the railways, the primary purpose is “the public service”, or the social benefit. The proposed railway projects were evaluated for their economic IRRs to assign priority in accordance. The social benefit of a given project can be paraphrased as its impact in serving the twin purposes of reducing the operational cost of all the transport means available and reducing the travel time of all the passengers on the available transport means.

Figure 7.4.1 shows the cumulative cost curve of the evaluated projects in the ascending order of E-IRRs from left to right. If the social benefit of project implementation should be more important than other criteria, the project selection for the master plan would begin from the left -hand end of the graph and move rightward up to the point where the cumulative cost reaches the limit of the available financial envelope. This was the first step of project prioritization.

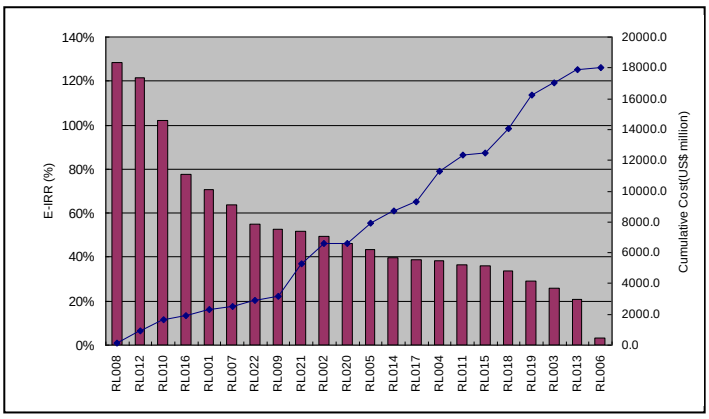


Figure 7.4.1 E-IRRs and Cumulative Project Cost

In addition, the projects were evaluated on the following aspects of implementation.

- Contribution to the alleviation of congestion
- Contribution to the improvement of transport capacity
- Financial viability
- Environmental impact
- Other idiosyncratic circumstances of each project

The scores were aggregated per project and used to review, and reorder when deemed necessary, the prioritization by E-IRRs. The projects were then assigned to three time periods of short and medium and long terms (see Annex C)

Because two projects were divided into two phases for implementation, the total number of railway projects increased from 21 to 23. In sum, 4 projects are scheduled during the medium term, 12 during the long term and the remaining 7 after the master plan period.

7.5 Costs of Transit Vehicles and Operation and Maintenance

(1) Train Formation

The size of transit vehicle and the train formation vary widely by railway system. However, the present master plan study used the following standards.

Table 7.5.1 Train Formation and Capacity

System	Vehicle Length	Passenger Capacity per Vehicle	No. of Vehicles per Train	Passenger Capacity per Train
Suburban	20	220	4-10	880-2200
Metro	20	220	4-10	880-2200
Light Metro	20	220	4-6	880-1320
Tram	30	340	2-3	680-1020
Monorail (regular)	15	170	4	680
Monorail (small)	10	70	4	280

(2) Vehicle Cost

The total cost of the proposed railway projects amounts to US$33.8 billion, of which US$5.2 billion is spent on transit vehicles. After the start of operation, the fleet of vehicles will have to be increased, upgraded and replaced regularly. The unit cost of vehicles is set at US$1.7 million for metro, light metro, tram and suburban lines, and US$1.5 million for AGT and monorails. Table 7.5.2 shows the vehicle cost per five year period.

Table 7.5.2 Necessary Vehicles and Investment

Period	No. of Vehicles	Cost (US$ million)
Short Term (2009-13)	807	1,363
Medium Term (2014-18)	974	1,655
Long Term (2019-23)	1,274	2,155
Total	3,055	5,173

(3) O&M Cost

The cost of operation and maintenance was divided into labor cost and other expenses and the estimation was simplified by the following formula.

$$\text{Labor cost} = \text{no. of employees x average salary}$$

- Employment = Sg x length of line + Ss x no. of stations + So x (daily 1000 vehicle km)
- Other expenses = E x operated vehicle km

where, E = costs other than labor per vehicle km

Sg, Ss, So: unit number of clerical staff, station staff and other workers

Table 7.5.3 O&M Unit Cost and Unit

System	Units of Labor			Other Expenses
	Clerical Staff	Station Staff	Other Workers	
	Per line km	Per station	Per 1000 vehicle km	Per vehicle km
Metro	3.0	10.0	6.7	3.34
Tram	3.0	8.3	25.0	13.6
Suburban	3.0	9.9	3.4	2.07
Monorail	3.0	3.4	7.2	2.85

The annual O&M cost estimated for 2023 is US$1.7 billion, of which 23% is paid to the employees of nearly 13,000.

7.6 Operating Schedules and Transfer Stations

(1) Operating Schedules

The headway of train service is assumed to be 4 to 5 minutes during peak hours and 7.5 to 15 minutes during off-peak hours. The Marmaray line will have to be operated at the headway of 2minutes before long. The operation of intra-city railways would be at the scheduled speed of 30 to 40km per hour with station intervals of 0.8 to 1.5km. The express service on the Marmaray line should be run at the scheduled speed of 45km/h, reaching 50km/h in the Silivri suburbs.

(2) Inter-System Service

One of the important issues would be how quickly to transport the passengers from Silivri and Buyukcekmece into the CBD of Istanbul. The inter-system service is effective for this purpose. For example, the express trains from Silivri of the Marmaray suburban system might be able to run on the Sisli line up to Kabatas in the CBD. Likewise, the inter-system through service could be provided between Silivri and Bakirkoy.

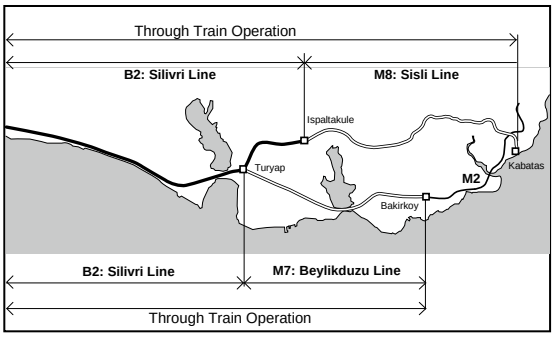


Figure 7.6.1 Inter-system Through Service from Silivri to CBD

(3) Development of Transfer Stations

In order to induce the shift to the railway travel, it is important to reduce the transfer resistance between two railway systems. The definitive answer is the inter-system through service with shared use of tickets. If that is not possible easily, the next best alternative is to improve the ease and convenience of the inter-system transfer. Figure 7.6.2 shows important transfer stations in the future railway network. The larger the red circles, the needier the appropriate development.

Figure 7.6.2 Transfer Stations

7.7 Bosporus Crossing

The Bosporus crossing will be provided soon by the Marmaray railway line and the undersea tunnel road in addition to the existing two bridges. Even then, however, the demand will exceed the available capacity in 2023. Many passengers, many more than at the present moment, would be forced to cross the Strait by ferries. The present study accordingly examined the possibility of the 2nd railway crossing. The location was sought between the existing two bridges, with two alternatives of a bridge and an undersea tunnel. On the European side of the Strait, the metro line of Seyrantepe – Kazilcesme (P2-1) is available, while two metro lines, Umraniye – Bostanci (P1-3) and Sogutlucesme – Bahcelievler (PP-2), are in accessible distance on the Asian side. Consequently, the alternatives were increased to four by adding the choice over the Asian-side lines (Figure 7.7.1). Alternatives 1 and 2 involve a new bridge, while Alternative 3 and 4 a new undersea tunnel. Alternatives 1 and 3 rely on P1-3, while the other two on PP-2.

The prospective tunnel must be 110m deep from the sea surface level (the estimated maximum depth in the Strait being 90m) and accordingly, its location must be moved up further north from the proposed bridge location. Moreover, the distance of 19km across the Strait could not be provided with any station because of the depth.

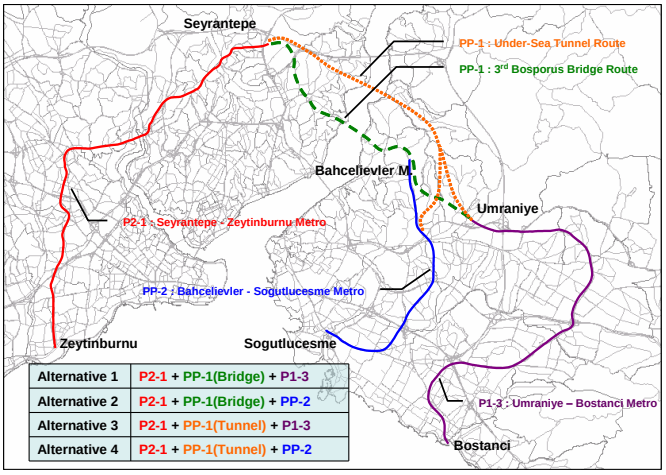


Figure 7.7.1 Four Alternatives for New Bosporus Crossing

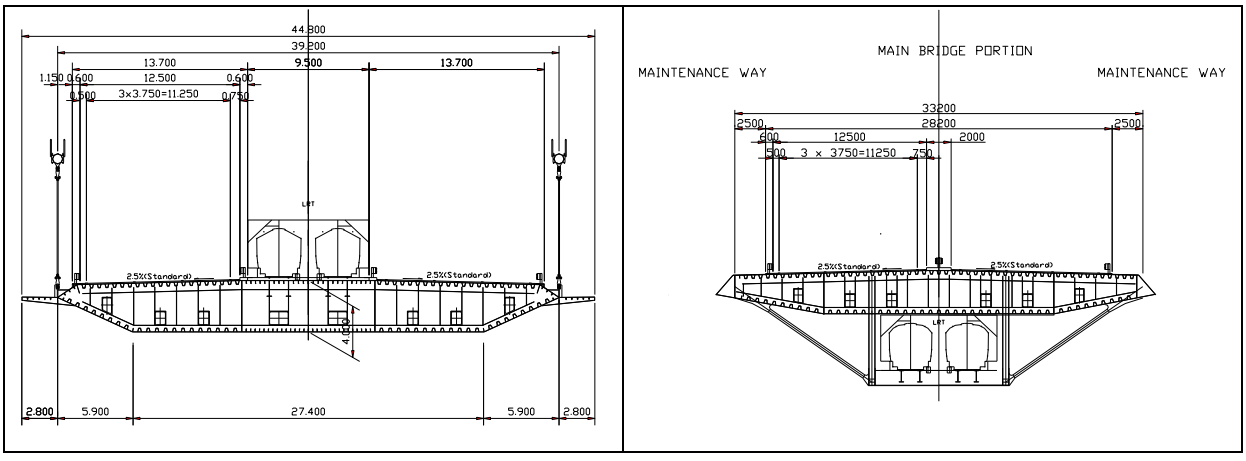
The results of comparative analysis are summarized in Table 7.7.1. The costing was only on the crossing section. The bridge is assumed to serve both railway and road, and the estimated cost is thus halved in the two bridge alternatives. Even halved, the cost of the bridge is on a par with the tunnel. The estimated demand on the bridge would be larger by 20% than the tunnel, because it is possible to provide stations close to the abutment.

Table 7.7.1 Evaluation of Four Alternatives

Alternative	Cost (US$ million)	Demand	Internal Rate of Return (%)	
		in 2023	Economic	Financial
Alt-1	3.44	13,580	16.3	11.9
Alt-2	2.78	10,849	24.7	12.7
Alt-3	3.30	11,135	12.0	11.3
Alt-4	2.69	8,896	19.7	11.6

On the Asian side, Alternative 1 using P1-3 would have the transport demand 25% larger than Alternative 2 on PP-2, but the investment cost for the former is also higher by 23% than the latter. The same applies between Alternatives 3 and 4. The PP-2 line operates in the already builtup areas, whereas the P1-3 line runs through the areas yet to grow in population. Therefore, the economic benefit and the revenue immediately expected after the start of operation would be higher in Alternatives 2 and 4 on PP-2, as duly reflected in the higher IRRs. Alternative 2 is higher in both economic and financial feasibility than the others, its E-IRR being especially remarkable. The master plan thus proposes Alternative 2 (the bridge and PP-2) for Bosporus crossing.

The road & railway bridge has a large cross sectional dimension and some people strongly insist that its bulky shape will become an eye sore in the beautiful landscape. Figure 7.7.2 shows two possibilities of cross sectional design for the bridge. Many examples of road & railway bridges exist in the world and they will offer useful pointers on what to do and what not to do. It will be possible to give the proposed bridge a design that not only pleases the eye but enhances the beauty of the surrounding landscape.



(1) Single-Deck Girder (2) Double-Deck Girder

Figure 7.7.2 Two Alternative Cross Sectional Designs for the Road & Railway Bridge

8. Road-based Public Transport Plan

8.1 Reorganization of Bus Services

Bus services in metropolitan Istanbul are provided along some 1,000 regular bus routes and 500 mini bus routes. One can, in principle, go from any one place to his or her destination by making one or two transfers (using two to three different bus routes). However, the waiting time involved in such trips is tediously long, while it is hard to get a clear picture of how all these bus routes are laid down.

When Istanbul enters the age of mass rapid transits as undoubtedly it will do before long, bus services will be forced to change. They will not be able to compete with the rapid transit service along the same route. The presumption is sufficiently substantiated by the recent experience in which the opening of a metro bus route drove more than 100 conventional bus routes out of service along the way.

Regular bus services have two options for the future: namely, (1) to give up long distance travels and specialize in short distance feeder services for transit stations, and (2) to diversify into specialized niches, such as premium all-seated bus rides and late night services. Most of the existing bus services will eventually follow the first option.

Figure 8.1.1 illustrates the evolution of public transportation by bus. Istanbul, now between (a) and (b), will soon reach the stage where transit systems and metro bus routes are the arteries of public transportation.

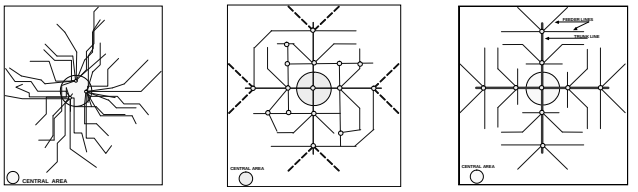


Figure 8.1.1 Evolution of Bus Service Network

8.2 Expansion of Metro Bus Network

IETT began in Sept. 2007 the operation of its first metro bus route of 19.5km from Avcilar to Topukapi (the section numbered 1 on Figure 8.2.1). The route of 10.5km from Topukapi to Zincirlikuyu (the section numbered 2) was added in Sept. 2008. IETT is now developing the third route going further east, across the 1st Bosporus bridge to Sogutlucesme near Kadikoy.

The on-going metro bus project involves the widening of D-100 from the present 6 lanes to 8 lanes, and provides the two central lanes exclusively for articulated double-body buses (instead of initially proposed triple-body buses). Figure 8.2.2 shows two types of the metro bus currently in service, the newly introduced vehicle on the right and the old type on the left.

Figure 8.2.2 Metro Buses in Action

D-100 and TEM are the most important twin transversal expressways in Istanbul, and both are heavily congested during peak hours. The metro bus that runs unimpeded by the traffic congestion on D-100 had a strong appeal. The daily passengers ranged between 60,000 and 70,000 immediately after the first route came into operation, but jumped to some 250,000 after one year.

The metro bus with capacity of some 200 passengers runs the route at the headway of 30 seconds during peak hours. The cross-section transport capacity of the metro bus service is 120,000 passengers per hour one way. This is equivalent to the LRT. Because the project utilizes the available road space on D-100, the construction works cost about US$8 million per km, worth only 15% of the subway construction per km or 20% of the elevated rails per km for LRT. The project is thus assured of high economic returns.

The Istanbul metropolitan area consists of hilly terrains other than its limited coastal area. The construction of railways has to cope with the problem of varying slopes, but metro buses are much less constrained by the terrains.

The serious problem concerns bus stops provided in the median of the heavily trafficked expressway. Their location makes the passenger access difficult and dangerous. The bottleneck of the future will emerge in the location of bus stops rather than in the lane capacity. In addition, metro bus stops are provided in isolation from other modes of travel and thus inconvenient for passengers to make a transfer.

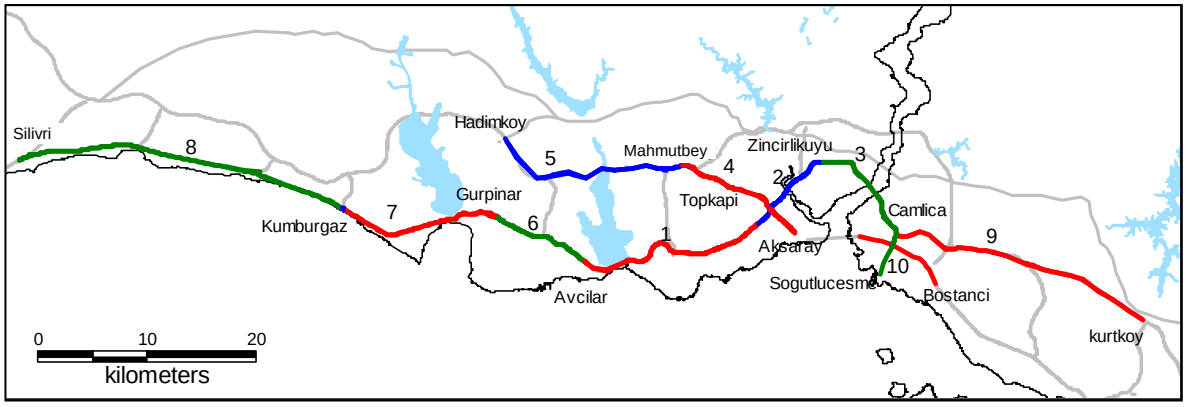


Figure 8.2.1 Expansion of Metro Bus Network

8.3 Feasibility of Metro Bus Extension

The well-developed transit network is the goal for public transportation in Istanbul, but it takes long time to achieve this goal. The metro bus service can be viewed as a most suitable transitional provider of public transportation. It will take, for example, more than 10 years from now to complete the extension of the suburban railway to Silivri. In the meantime, the metro bus transports the passenger traffic between the western area and CBD. When the rapid transit comes in to replace the metro bus, two exclusive bus lanes will be released for the automobile traffic. This improves the economic and financial viability of the transit operation as well as alleviates the congestion on the expressway.

As shown in Figure 8.2.1, the routes from 1 to 3 are committed projects. The present master plan added seven routes from 4 to 10 and the preliminary feasibility study was undertaken over them.

(1) Estimated Passengers

The total number of daily passengers on the metro bus network is estimated to reach 2.22 million in 2023. A passenger who rides through more than one route in the network is counted at the first bus stop where he boards and at the last bus stop he alighted. Assuming the uniform rate of fare, the total revenue from the network is obtained by multiplying the total daily passengers by the fare rate, and then distributed to seven routes in proportion to their shares in the total network passenger kilometers.

(2) Project Cost

The construction cost of the routes 1 to 3 was given as US$8 million per km. Because the additional routes are proposed on the expressways, the cost of construction will not vary much from this amount. Seven new routes totaling 125km will require the investment of US$1 billion.

(3) Economic Evaluation

The internal rate of return and the net present value were calculated on the seven proposed routes. The social benefit is the savings realized by the reduced cost of vehicle operation and the reduced travel time, while the economic cost is the entire expenditure on goods and labor for the project implementation.

As shown in Table 8.3.1, the new routes collectively have the E-IRR of a little over 100% and the net present value of US$8.41 billion. Their very high economic feasibility derives partly from the fact that they can provide the same level of service as the transit system at a much lower cost of operation. Another reason lies in the assumption made for economic analysis. The “without project” case assumes that no new project be implemented after the completion of the committed projects in the base network. If there is no extension in the metro bus network, the congestion will naturally get worse on the expressways and elsewhere.

(4) Financial Evaluation

The financial analysis was done over the cost of construction and O&M and the total fare revenue. Except for the route 4 (Aksaray – Mamutbey), the collective and individual financial IRRs are over 12%, indicating reasonable feasibility.

However, it must be noted that the passengers on the metro bus service are mostly those who shift from the conventional bus services. The gain to the metro bus means the loss to the conventional bus companies. Taking the IETT mandate as whole, seven new routes are judged financially not viable.

(5) Environmental Impact

It is judged that the proposed metro bus routes have no negative impact on natural and social environment, both during the construction and in operation. According to the environment-related laws in Turkey, metro bus projects belong to the category requiring no IEE.

It might be pointed out that the route 3 across the Strait will not provide the exclusive lanes for the metro bus. This implies a possible confusion in the traffic flow at both ends of the route and the more difficult access to the bus stops for passengers.

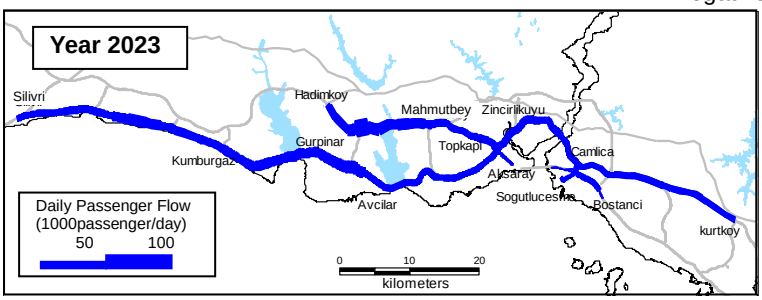


Figure 8.3.1 Estimated Passenger Traffic Flows on Metro Bus Network

Table 8.3.1 Summary Evaluation Table of Metro Bus Extension

No	Route			Length (km)	Cost (US$ million)	Passengers (000 per day)	Economic Evaluation		Financial Evaluation	
							IRR (%)	NPV	IRR (%)	NPV
1	Avcilar	–	Topkapi	19.5	150.0	147	–	–	–	–
2	Topkapi	–	Zincirlikuyu	10.5	100.0	72				
3	Zincirlikuyu	–	Sogutlucesme	9.5	80.0	371				
4	Aksaray	–	Mamutbey	21.9	175.2	96	85.5	4,009.3	1.2	−98.8
5	Mamutbey	–	Hadimkoy	17.1	136.8	466			17.4	52.1
6	Avcilar	–	Gurpinar	10.7	85.6	152	140.5	6,043.2	14.2	12.9
7	Gurpinar	–	Kumburgaz	17.6	140.8	171			14.4	21.5
8	Kumburgaz	–	Silivri	27.8	222.4	321			14.0	30.2
9	Camlica	–	Kurtkoy	22.7	181.6	210	40.3	1,987.2	13.3	14.7
10	Harem	–	Bostanci	8.6	68.8	210	31.0	116.0	37.3	137.6
11	Total			165.9	1341.2	2,216	100.8	8,412.2	12.5	32.6

9. Marine Transport Plan

9.1 Future Prospects

Marmara Sea and Bosporus Strait played an important role in the history of Turkey. Since the late 20th century, the passengers on ferries have rapidly increased to cross the Strait. The primary cause was that the capacity of two Bosporus crossing bridges fell increasingly short of the growing demand. When the Marmaray transit line, the undersea tunnel road and the 3rd bridge come into operation one by one in the future and strengthen the transport linkage between the European and the Asian side, the ferry service will surely lose its present demand and be forced to change.

Figure 9.1.1 shows the present network of the IDO ferry service. The full operation of the Marmaray railway line will force the ferry routes quickly out of business between Eminonu and Karakoy on the European side and Uskudar, Harem and Kadikoy on the Asian side.

The future role for the country's marine transport is summarized as follows.

- To service tourism routes, like the present cruise trips in the Strait or to the Princess Islands
- To ferry long-distance trips of passengers and cars across Marmara Sea, instead of servicing the intra-city short trips
- To transport container cargo between regions
- To serve as logistic centers in times of emergency (see 9.2)
- To connect the places on both sides of the Strait that are unreachable by any land transport mode

The marine taxi service that has begun recently can be noted as another possibility of diversification.

Figure 9.1.1 Network of IDO Ferry Service

9.2 Emergency Marine Transport

The great earthquake of 1999 caused serious damages and many casualties in Kocaeli and elsewhere in the country. The probability of a big earthquake is high in metropolitan Istanbul. The city is inadequately serviced by transversal thoroughfares partly because of the physiographical limitations. Once the two existing expressways, TEM and D-100, are cut off in various places by an earthquake, there is no way to reach the affected inland areas other than the massive airlifts. Delivery of relief supplies and personnel has to rely on marine transportation.

Ports have an important role to play in earthquake emergencies, by providing logistic bases for relief supplies and shelters against tsunamis. However, the existing port facilities are not exactly earthquake-resistant. It has been reported that most of the ports would be totally destroyed by liquefaction.

It is urgently necessary to identify and implement projects which will improve the earthquake preparedness in metropolitan Istanbul. The suggested strategy is to consider the following issues.

- To select a number of ports as emergency logistics bases and upgrade the earthquake resistance of their wharves, access roads and port-front storage facilities.
- To equip the selected ports with emergency generators, helipads and other life line support installations.
- To develop an effective system of emergency communication on disaster information

Figure 9.2.1 illustrates a possible system for emergency response, with a few wider area logistics centers and a number of selected ports as marine shipping bases. Figure 9.2.2 indicates key ports suitable for developing such a system.

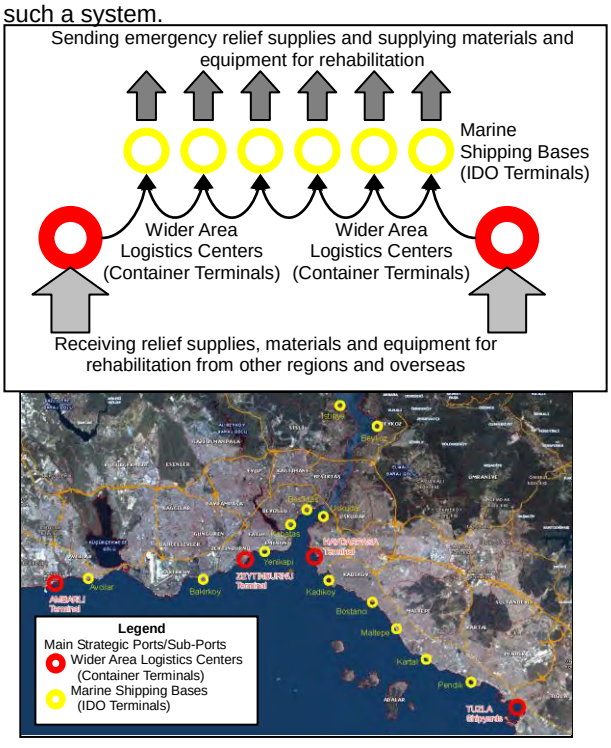


Figure 9.2.2 Development of Key Ports in Emergencies

10. Traffic Management

10.1 Traffic Management Plan

(1) The Worst 30 Traffic Jam Prone Areas

The worst 30 traffic jam prone areas have been identified as presented in Figure 10.1.1 based on the information from the Traffic Control Center of the City and selected taxi companies. Out of these 30, 13 are specific sites while the remaining 17 are sections of expressways or trunk roads.

The traffic jam frequently seen at these areas can be attributed to either of the three (3) reasons; traffic merging, poor-standard structure and roadside activity.

12 sites out of the 30 have been judged to improve if the countermeasures listed in Table 10.1.1 are implemented. Early planning and implementation are recommended.

Figure 10.1.1 Congestion Prone Spot/Section

Table 10.1.1 Traffic Management measures to Alleviate Congestion

No.	Name	Possible Solution
1	Kadikoy - Hasanpasa	• Limit on-street parking along Sogutlu Cesme Cad. to delivery service with time limit of 15 – 30 minutes. • Strict enforcement of the above. • Widening and improvement of sidewalk. • Provision of shuttle bus service connecting parking site and the harbor.
2	Uskudar - Altunizade	• Extension of reversible lane to the nearest interchanges from the bridge on both sides (see the figure below).
3	Uskudar – Bulgurlu	• Additional traffic sign to implement priority rule at roundabout.
6	Beykoz – Kavacik Koprusu	• Extension of reversible lane to the nearest interchanges from the bridge on both sides
7	Besiktas – Levent Koprusu	• Extension of reversible lane to the nearest interchanges from the bridge on both sides.
8	Beyoglu – Taksim Meydani	• Enforcement of illegal parking • Provision of taxi stand. • Strict enforcement of no parking / standing. • Construction of pedestrian barrier to prevent jaywalking.
14	Maltepe Minibus Caddesi	• Construction of median barrier. • Prohibition and/or management of on-street parking.
15	D100 Basibuyuk Koprusu Maltepe Koprusu Arasi	• Partial widening of D100 at uphill section.
16	D100 Bostanci Koprusu Yenisahra Arasi	• Extension of merging lane. • Prohibition of bus stop use except buses.
17	D100 Goztepe Koprusu Mevki	• Extension of merging lane.
26	Hsim Iscan Gecidi Yusufpasa Arasi	• Prohibition of on-street parking. • Management of pedestrian movements. • Improvement of signal control
27	Balat Yolu Eyup Sapagi Eminonu Arasi	• Demand responsive signal at intersection connecting to O-1.

At present, reversible lane is applied on the two (2) bridges across the Bosporus. Since traffic jam occurs at the end of these reversible lanes where traffic is merged into the original lane, extension of these reversible lanes beyond the off-ramp is effective to alleviate the traffic congestion at these points.

(2) Recommendations as to Traffic Management

- Improvement of Traffic Signal System

About 800 signals are linked with the Traffic Control Center at present. However, the control system itself is independent, and the effectiveness is low. It is advisable to convert this system so that the signals are controlled real time by the central computer. For congested intersections, vehicle detectors should be installed and linked to the center by exclusive communication lines.

- Strengthening of Traffic Information System
- Strict Enforcement on Illegal Parking
- Improvement of Pedestrian Environment
- Installation of Left Turn Only Lanes

(3) Parking Control

Parking control should be strengthened through clearer policies on parking development and designation of roadside parking, stricter enforcement on illegal parking, modification of building permit as to obligatory parking provision, etc. This can be considered as an integral part of TDM proposed hereafter.

(4) Traffic Safety

Although the National Traffic Safety Program was implemented in 1996-2001 with World Bank's assistance, review of this program scheduled in 2006 was not conducted. In the light of this experience, an urban traffic safety program should be established in Istanbul covering the following aspects:

- Setting of goals and objectives
- Cooperation of both public and private sector
- Compilation of traffic accident database and its effective use
- Identification of accident prone areas and countermeasures in this regard
- Traffic safety education and campaign for students and general public

10.2 Transport Demand Management (TDM)

(1) Rationale

"*Road development never catches up the increase of traffic demand of motor vehicles*" – This is a bitter lesson learned not only by Istanbul but by most large cities in the world. Although one of the major targets of this master plan is the modal shift from private to public, it is never realized merely by developing railway network.

Thus a demand-side approach that leads the traffic demand to the intended direction of infrastructure development becomes necessary. Carrot-and-stick policies may be considered for this purpose. However, the stick policy is never welcome by the people. Hence careful preparation including education and campaign becomes essential if a TDM policy is to be introduced.

If 20% of peak-hour car users shift to public transport, the average volume/capacity ratio in the CBD will be lowered to 0.51 from 0.60 in 2023. Congestion will be mitigated drastically and its economic benefit will be enormous.

By reviewing the TDM measures implemented at present in the world, applicable policies should be introduced to Istanbul. In this master plan, congestion charging, park & ride, parking control and traffic cell for improved environment of historic areas have been dealt with.

(2) Congestion Charging

Since congestion is produced by car users, external diseconomy of congestion is due to car users themselves. This is the reason behind congestion charging which penalizes peak-hour car users by imposing a tax. Congestion charging aims at a modal shift from private to public, and at raising a fund for transport infrastructure.

At present, expressways in the CBD Istanbul are toll-free. However, TEM, D-100 and their connecting road are currently the most congested roads, and cannot be excluded if congestion charging is to be launched judging from the effectiveness and implementability.

Figure 10.2.1 shows the interrelationship between charge rate and degree of congestion as well as revenue from congestion charging. Even if the charge rate is high at YTL1.0/km, traffic volume will decrease only by 20% while the revenue becomes huge. At a charge rate of YTL0.5/km, the total revenue for 15 years would be about YTL15billion (USD13billion), amounting to about 30% of the total cost required for the implementation of this master plan.

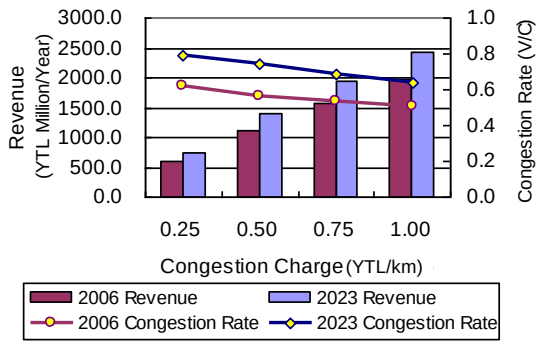


Figure 10.2.1 Effect and Revenue by Congestion Charging

It is noted, however, that high-level public transport system should be simultaneously provided for public use before strong policies such as congestion charging are adopted. According to the development progress of railway and metro-bus, congestion charging should be promoted carefully.

(3) Park & Ride

As a measure to accelerate the modal shift, park & ride should be promoted when arterial public transport system such as railway and expressway bus is extended to the suburbs. The key issue for this exercise is to provide convenient and low-fee parking near the stations/stops in the suburbs.

According to the interview survey conducted in one of the pilot projects "Park & Ride for Metro-bus", more than 80% of metro-bus users appreciate speed and quickness. As the route length of the metro-bus is still short at present, park & ride users were limited to those who had destinations around the alighting stop. Important lessons obtained from the survey were:

a) The influence radius of park & ride parking is 4km at most,

b) Parking should be within a 150m radius from the stop, and

c) Information service should be provided by internet on parking availability and road congestion.

Parking Facilities for Park & Ride

The photographs below show parking facilities for park & ride in USA and Australia. Free or low-fee parking are developed by the public sector around the stations and stops in the suburbs. The example of Washington is ideal; expressway bus comes directly up to the parking.

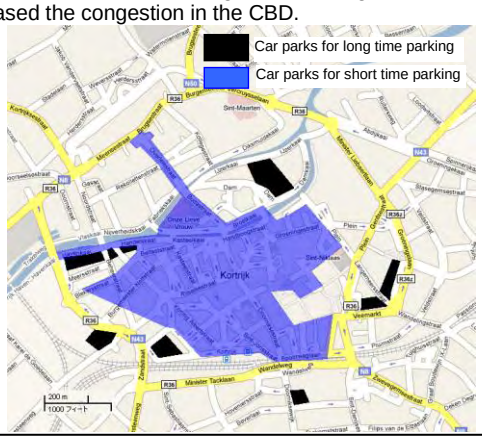
(4) Inducement by Parking Controls

Automobile traffic in the CBD can be reduced and made manageable by a variety of parking controls over the metropolitan area in such ways as: (a) promotion of fringe parking, (b) restriction of parking capacity expansion within the CBD and (c) crackdown on illegal roadside parking in the CBD.

The Study proposes the control over parking fees in the CBD. The increased parking cost will serve to discourage automobile commuters into the CBD, while the increased revenue can be partly diverted to the construction of public car parks. Specifically, curb-side parking longer than 2 hours is prohibited and long time off-street parking exceeding 6 hours is heavily charged.

Parking Control in Kortrijk, Belgium

One useful example is found in Kortrijk of Belgium. The parking control in Kortrijk consisted of raising the rate for long time parking higher than short time parking within the CBD. Car parks were then increased outside the ring road around the CBD to encourage long time fringe parking at a lower rate, while only short-time parking was tolerably possible within the CBD. The control succeeded in reducing the incoming automobile traffic and eased the congestion in the CBD.



(5) Traffic Cells in the Historic Area

Many historic edifices and structures are found in such neighborhoods as Fatih and Eminonu in the old town of Istanbul and collectively constitute the UNESCO World Heritage Site for conservation. Their on-going deterioration is evident, however, because of the constant exposure to the high congestion and the worsening air pollution of the CBD.

The Study proposes a set of TDM measures which will be able to cope with both the motorized and the pedestrian traffic, while contributing to the conservation of historic sites for continued growth of tourism and local economic activities. The proposed measures set up traffic cells in the historic conservation area and regulate and guide the flows of pedestrians and motorized vehicles into and out of these cells.

The roads inside the historic conservation area are classified into six different categories shown in the figure below, with varying entry restrictions by vehicle type.

a) Full malls: Accessible only by pedestrians all day.
b) Transit malls: Accessible only by buses and taxis during day time (7:00 through 20:00) on weekdays. Delivery vehicles are allowed entry during 7:00 – 10:00 and 14:30 – 17:30 on weekdays.
c) Access roads 1: Accessible all day only by local residents and service vehicles.
d) Access roads 2: Accessible only by local residents and service vehicles during day time (7:00 – 20:00) on weekdays.
e) Main roads 1: Accessible only by buses, taxis, delivery vehicles and local residents during peak hours (7:00 – 10:00 and 14:30 – 17:30) on weekdays. Parking is restricted to 30 minutes or less.
f) Main roads 2: These roads are arterials in the CBD with no vehicle type access restriction. In fact, the historic conservation area does not contain this road category.

Table 10.2.1 Access Restrictions in Traffic Cell

Mode / Mall/Road	Private Vehicles	Commercial Vehicles	Vehicles of Local Residents	Public Transport Vehicles	Taxis	Delivery Vehicles	Government Vehicles	Pedestrians
Full Pedestrian Malls								○
Transit Malls				○			○	○
Access Roads 1			○	○			○	○
Access Roads 2	○	○	○	○	○		○	○
Main Roads 1	○	○	○	○	○	○	○	○
Main Roads 2	○	○	○	○	○	○	○	○

The historic heritage sites in the CBD will require some integrated implementation of other measures in addition to the proposed TDM.

a) Parking spaces for local residents in the area
b) Promotion of fringe parking outside the congested area of metropolitan Istanbul
c) More frequent and area- intensive mini bus services
d) Provision of spaces for fringe parking serving the automobile traffic on two arterial highways
e) Prohibition of roadside parking in the area
f) Early development of transit malls in the neighborhoods with especially important historic monuments (e.g., the area from Sirkecj to Grand Bazaar)

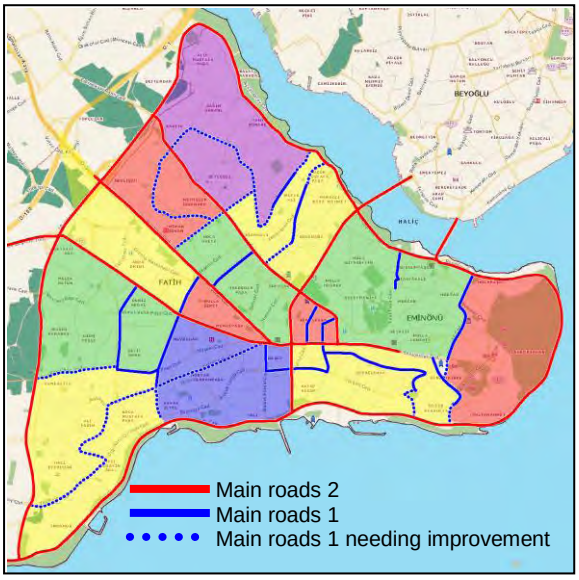


Figure 10.2.2 Traffic Cells for the Historic Conservation Area

11. Implementation Plan

11.1 Investment Plan

(1) Investment Framework

The proposed investment for road and railway subsector is presented in the Appendix. The total investment required for the master plan including other subsectors is shown in Table 11.1.1. The total investment accounts for USD68.6billion. This is comparable to the estimated amount of possible investment at USD68billion.

Table11.1.1 Transportation Sector Investment Plan in 2009-2023

(US$ billion)

Sub-Sector	Short	Medium	Long	Total
Road & Bridge	6.2	5.6	3.6	15.4
Railway	10.2	9.3	6.5	26.0
Maintenance & Improvement	4.3	5.5	7.1	17.0
Other Subsectors	2.6	3.3	4.3	10.2
Total	23.4	23.8	21.5	68.6

(2) Fund Sources

The financial condition of Istanbul is sound at present. Development expenditure is in principle covered by general revenue, and debt repayment and interest payment do not affect the city's budget.

However, the required investment at USD68.6billion, which accounts for 2.7% of future GRDP, surpasses the past investment of 1.8% by 0.9%. Namely, 1/3 of the investment needs new fund sources.

There are four (4) possible new sources, viz:

a) Congestion charging (refer to Chapter 10)
b) Transit Development Acceleration Fund (TDAF, refer to Chapter 12)
c) West Istanbul Urban Development Corporation (WIDEC)
d) Private sector participation (with b and c above)

The former three (3) are supposed to be earmarked for transport development.

11.2 Transit Development Acceleration Fund (TDAF)

(1) Railway Profitability

The profitability (financial feasibility) of railway is not high at an assumed fare rate of YTL0.2/km with some exceptions. The FIRR (financial internal rate of return) ranges 3-12%.

Excluding three (3) lines of poor profitability, the overall FIRR for the remaining lines is 10.3%. To raise this to a 15% level, which may be acceptable for the private sector, the cost must be curtailed by 37%. If this portion is subsidized by the government, a PPP (Public-Private Partnership) scheme may become feasible with an FIRR of 15% for the private sector.

(2) Possibility of PFI

The PFI (Private Financing Initiative), particularly the BOT scheme with 100% private funding, is difficult for the railway projects, because capital recovery period is long despite the large investment amount, railway fare tends to be controlled low and, above all, the risk is high. There is almost no example successfully implemented.

The sector that needs the largest investment is railway in the master plan. Without a mechanism to involve the private sector in the railway development, the master plan is hardly implemented. Individual negotiation with the private proponent project by project is time and cost consuming given the long list of proposed projects. A new and comprehensive mechanism is thus required.

(3) Establishment of TDAF

Establishment of a strong organization is proposed. This organization, controls all the railway PPP projects with its fund TDAF. Transit Development Authority (TDA) should be established under IMM. TDA plans, invites tender and grants permission with a selected private entity. For non-profitable lines, it provides VGF (Viability Gap Funding) from TDAF. The concessionaire secures fund, constructs and leases facilities to TDA for the concession period. In one word, the BLT scheme is applied.

The railway operation is done by an operation company with a contract with TDA. Fare revenue goes to TDA, and the operation company receives contracted amount from TDA.

Thus, all the risks can be concentrated to TDA. These risks are finally undertaken by IMM and/or the central government, and the concessionaire is guaranteed for the payment of lease and the operation company, the operation cost.

The administration of TDA needs high-level expertise. At the initial stage, world-class experts should be invited from overseas countries. For TDAF, government funds and low-interest development funds including ODA loans should be provided. Its scale would be USD1billio

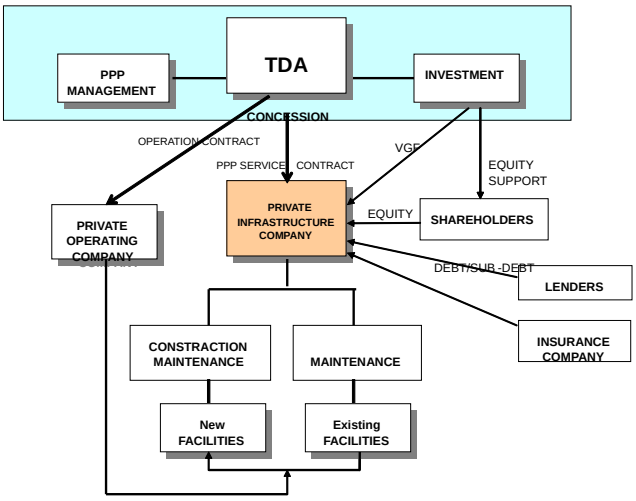


Figure 11.2.1 Organizational Scheme of TDA

11.3 West Istanbul Urban Development Corporation (WIDEC)

The land use master plan of Istanbul intends to realize scattered urban cores eliminating over-concentration of urban activities. This is ideal, and, if materialized, this plan will largely contribute to alleviate the current traffic congestion in the CBD area. One of the key factors of this plan is if it is possible to slowdown the population influx to built-up areas by promoting urban development in the west Istanbul such as Silivri.

Efficient high-speed railway or expressway is essential to deviate the population pressure to the outer directions. On the other hand, however, a vast investment in the suburbs needs a guarantee for the land use plan to be realized. This is a chicken-and-egg problem.

Suburban housing development may be possible by constructing roads and railways under the initiatives of the private sector. However, the creation of urban cores requires government intervention. The JICA Study Team proposes to establish a public organization that promotes urban development (hereafter West Istanbul Urban Development Corporation :WIDEC). Profit-oriented mind and know-how of the private sector should be incorporated into this organization together with its financial capability. The legal basis of this organization could be a law in force only for 30 years.

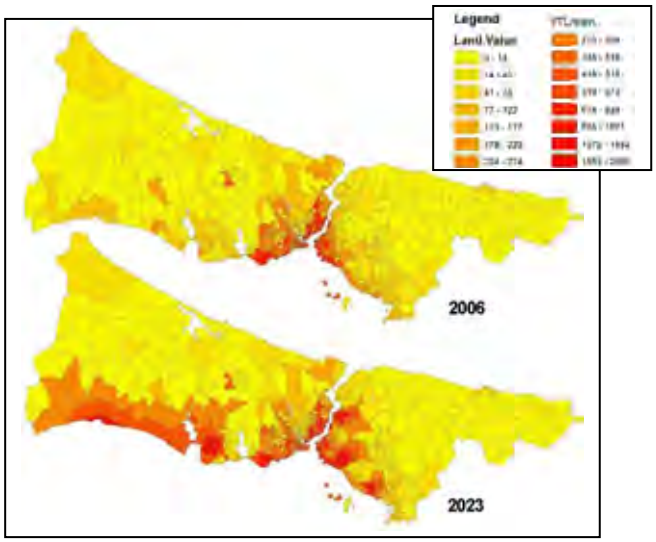


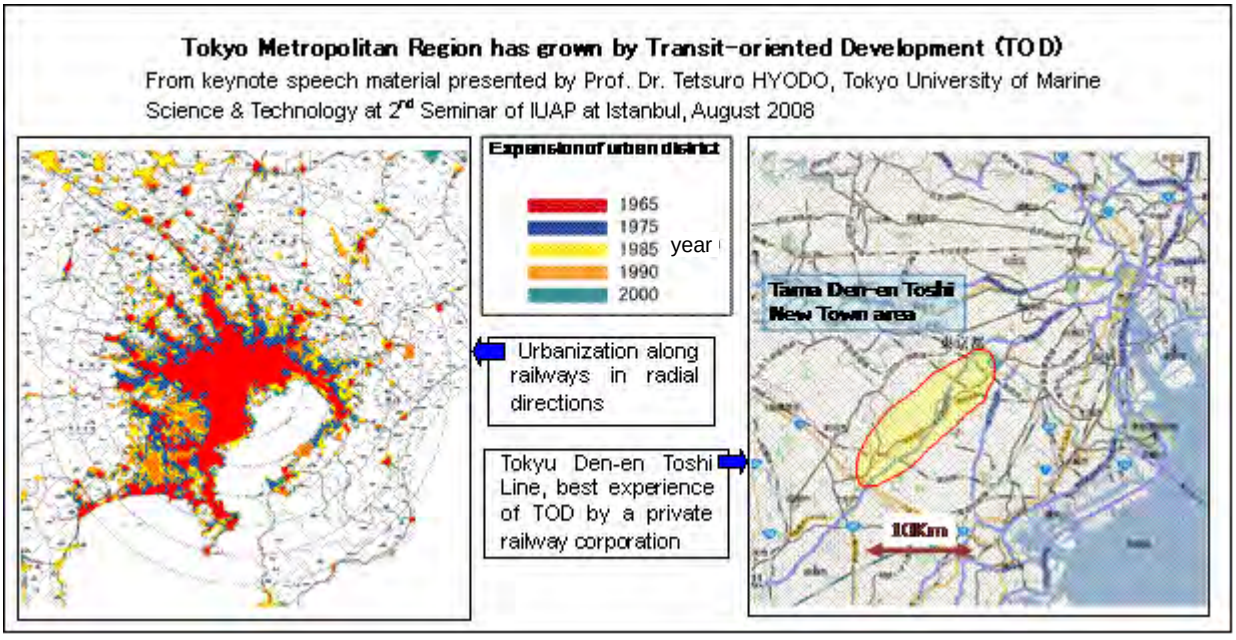
Figure 11.3.1 Urbanization and Land Value

WIDEC promotes urban development in cooperation with government agencies and the private sector, such as urban core, transport infrastructure, housing, power, water, school, park and other facilities.

The fund used for these projects is produced from its own projects. Figure 11.3.1 compares the land prices of Istanbul between 2006 and 2023. The land prices in the west Istanbul will jump at least to 25 times in 2023 after the planned urbanization. The total amount will increase from the present YTL14billion (taxation basis) to YTL350billion. The city's revenue from the real property tax (0.6%/year) will be important, but this should be spent for public services that will soar as well.

Development fund should basically be produced by the "capital gain" of urban development projects. The organization of WIDEC should be so designed that it can do both the profit-generating projects and public services projects. The profit-generating functions such as land transaction, housing and business/commercial development, and the public service functions such as development of transport infrastructure, parks and other public facilities should be balanced according to the pre-determined criteria. As a whole, WIDEC will be a non-profit organization.

The new idea that transfers a part of development benefit to the provision of infrastructure is in fact old. Concept is easy but realization is difficult, because the government responsible for infrastructure development is often prohibited from profit-seeking activities. This is why WIDEC is proposed as a third sector that is a mixture of the public and private sector. This proposal may be effective only at this stage of urban development of Istanbul.



12. Urgent Actions Program

12.1 Countermeasures for Traffic Jam Prone Areas

In Section 10.1 “Traffic Management Plan”, the 30 worst areas of traffic jam were identified, and traffic management measures have been proposed for 12 areas selected out of the 30. These measures do not require large cost nor long time for implementation.

It is thus recommended to start implementation in the earliest time possible after due perusal by responsible agencies, such as survey, design and construction, including post-monitoring. The proposed measures can all be applied to the places with similar characteristics if surveys are carefully done both for pre- and post-implementation conditions.

12.2 Authorization as Official Master Plan

This master plan study was conducted jointly by the JICA Study Team and IMM Study Team where key personnel of IMM and professors of some universities were involved. When opinions differed from each other, the JICA Study Team paid the maximum regard to the consensus within the Turkish side.

Nevertheless, this report is basically a JICA report, stating decisively some aspects that could not be pointed out clearly from the political standpoint of IMM. This report also deals mainly with major issues and tends to neglect minor aspects which should have been covered if this is an all-round official plan. The JICA Study Team undertakes the final responsibility of this report.

One of the most important actions that IMM should urgently take is to formulate the official transport master plan of IMM taking advantage of this report and the accumulated information among the counterpart staff. This must be done quickly before information becomes scattered and obsolete, and while this report is “alive”. The IMM plan thus formulated becomes official by the approval of the City Council.

12.3 Surveys and Researches

The JICA Study Team identified the necessity to conduct various surveys and to improve organizations and institutions during the course of the study, among others:

(1) Freight Movement Survey and Logistics Plan

The master plan described here was prepared based on a person-trip survey by household interviews, and therefore focuses on passenger transport without in-depth analysis on freight transport. Meanwhile IMM/IMP launched a study on “Trip and Cargo Generation by Land Use”. Using the result of this study, projects regarding goods flow and logistics should be planned, and incorporated in the transport master plan.

(2) Preparation and Update of Transport Network Inventory

The transport network prepared and used in this study would be the latest in Turkey so far. This, however, should be maintained by continuous updating for the frequent needs of transport planning. Otherwise, it will soon become obsolete and unusable. This is, in other words, to have always the latest inventory of all transport modes in Istanbul. Responsible agency for this task should be assigned together with funding, and all the information on projects and damage/loss should be accumulated there.

(3) Surveys and Plans for Traffic Safety

As mentioned earlier in Section 10.1 traffic accident statistics is not available in Istanbul in the form that could be used in transport planning. To create and maintain such a database is one of the urgent issues. This is also related to the organization responsible for collection and maintenance of the database. It is recommended to conduct a traffic safety master plan study when the database becomes available.

(4) Policy Study on Land Use Guidance

The land use plan of IMM on which this master plan is based is ideal and ambitious. It is advisable to establish a function in IMM to monitor the change of land use year by year and to assess the possible gap between the plan and the actual trend. It is recommended to organize a group that plans policy measures to orientate the direction of land use change towards the plan.

(5) Research on BOT/PPP

Private sector funding is indispensable for the implementation of the master plan. IMM however lacks the expertise of BOT/PPP, and the central government also tends to take these matters easily. It is essential to foster and train the experts who understand the mechanism of BOT/PPP as well as its difficulty and world examples. As a first step, setting up of a workshop is advisable.

12.4 New Organizations and Institutions

(1) Establishment of TDAF

In order to secure enough public funding to promote PPP, establishment of “Transit Development Acceleration Fund (TDAF)” was proposed. This would be of a nationwide mechanism with a fund scale of more than USD2billion. While careful preparation is required, it is recommended as initial actions to form a core group inside IMM, and to hold seminars/workshops with outside experts as well as to prepare the implementation plan.

(2) Establishment of WIDEC

The urban development in the Western Istanbul will be drastic and remarkable. The present suburban area with a population of only 300 thousand will be a metropolis populated by more than 3 million people. Land price is estimated to jump by more than 25 times. If a part of this benefit goes to infrastructure, the development of road, railway, etc, will be quite easy.

However, the government is prohibited to seek for a commercial profit. Therefore it is proposed to establish the “West Istanbul Urban Development Corporation (WIDEC)” under the initiatives of IMM. This WIDEC acts as a developer both for housing and infrastructure. Private sector may be invited on a competition basis to absorb the know-how accumulated in the private sector. The key requirement for this organization is that it is allowed to obtain profit from housing and to spend it on infrastructure. In other words, WIDEC is basically a non-profit public organization with an internal cross-subsidy system. The recommendation of the JICA Study Team is to start a study to look into the possibility to establish such organization legally, politically, institutionally and socially.