



Istanbul Metropolitan Municipality
&
Japan International Cooperation Agency (JICA)



THE STUDY
ON
INTEGRATED URBAN TRANSPORTATION
MASTER PLAN
FOR
ISTANBUL METROPOLITAN AREA
IN THE REPUBLIC OF TURKEY

Summary Report

January 2009

ALMEC Corporation
Nippon Koei Co., Ltd

Exchange Rate used in the Report

(as of August 2008)

YTL 1.0 = US\$ 0.86

= EU 0.64

= JY 92

US\$1.0 = YTL 1.16

EU 1.0 = YTL 1.54

JY 1000 = YTL 10.9

PREFACE

In response to a request from the Government of the Republic of Turkey, the Government of Japan decided to conduct “The Study on Integrated Urban Transport Master Plan for the Istanbul Metropolitan Area” and entrusted to the study to Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Tetsuo Wakui of ALMEC Co., LTD. And consists of ALMEC Co., LTD. And NIPPON KOEI Co., LTD. between June, 2007 and October, 2008.

The team held discussions with the officials concerned of the Government of the Republic of Turkey and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studied and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Turkey for their close cooperation extended to the study.

January, 2009

EIJI HASHIMOTO,

Vice President

Japan International Cooperation Agency

January 2009

HASHIMOTO Eiji
Vice President
Japan International Cooperation Agency
Tokyo

Letter of Transmittal

Dear Sir,

We are pleased to formally submit herewith the final report of the Study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area In the Republic of Turkey.

This report compiles the result of the study which was undertaken both in Turkey and Japan from June 2007 to January 2009 by the Team comprising ALMEC Corporation and Nippon Koei Co., Ltd.

We owe a lot to many people for the accomplishment of this study. First we would like to express our sincere appreciation and deep gratitude to all those who extended their extensive assistance and cooperation to the Team, in particular the Steering Committee and composed by Istanbul Metropolitan Municipality.

We also acknowledge the officials of your agency, the JICA Advisory Committee, and the Embassy of Japan in Turkey to their support and valuable advise in the course of the Study.

We hope the report would contribute to the sustainable development of Istanbul.

Very truly yours,

WAKUI Tetsuo

Team Leader

Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area

**The Study on Integrated Urban Transportation Master Plan
for Istanbul Metropolitan Area
Summary**

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 Others: Study Team

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	Others :	Study Team

ABBREVIATIONS

BOT	Build-Operate-Transfer
CBD	Central Business District
IDO	Istanbul Deniz Otobusleri: Istanbul Sea Buses
IMM	Istanbul Metropolitan Municipality
IMP	Istanbul Metropolitan Planlama: Istanbul Metropolitan Planning Center
IRR	Internal Rate of Return: Economic- and Financial- IRR
IT	Information Technology
IUAP	Istanbul Ulasim Ana Planı: Istanbul Transportation Master Plan
JICA	Japan International Cooperation Agency
KGM	Karayollari Genel Mudurlugu: General Directorate of Highway
NOx	Nitrogen Oxides
NPV	Net Present Value
O&M	Operation and Maintenance
OD	Origin and Destination
ODA	Official Development Assistance
PFI	Private Financing Initiatives
PPP	Public Private Partnership
RO-LA	Rollande-Land Strasse: Piggy Back
RO-RO	Roll-on & Roll-off
SPM	Suspended Particulate Matters
TCDD	Turkiye Cumhuriyeti Devlet Demiryollari: Turkish State Railway
TDA	Transit Development Authority
TDAF	Transit Development Acceleration Fund
TDM	Transport Demand Management
TEM	Trans-European Motorway
TOD	Transit-oriented Development
V/C	Volume/Capacity
VGf	Viability Gap Fund
WIDEC	West Istanbul Urban Development Corporation

Executive Summary

1. Introduction

The economy of Turkey has been steadily expanding since the late 20th century. In the process, metropolitan Istanbul witnessed rapid population concentration and motorization. During peak hours, the entire built-up areas are now clogged with heavy traffic. The mitigation of chronic traffic congestion is one of the most pressing issues for the municipal government.

IMM has been allocating the largest part of its development budget to the transport sector, toward the improvement of roads, railways and shipping and parking spaces. The transport infrastructure, notably railway facilities, takes long time to develop, whereas urbanization inexorably evolves ahead rapidly to change the volume and the structure of traffic demand. It was thought necessary to formulate an integrated master plan for the transport sector which incorporates effective policy measures and investment planning consistent with the long-term metropolitan land use plan. IMM commenced in May 2006 the study for the integrated transport master plan, or IUAP as initialized from the Turkish study title, and soon JICA agreed to provide technical cooperation.

2. Environment for Planning

2.1 Land Use Plan

IMM completed in mid 2007 the land use plan for the target year of 2023. A new group of commissioned experts has been reviewing it since April of 2008. The salient features of the plan are outlined below, because it provides the basis for the present transport master plan.

2.2 Population

The rate of population growth has been slowly declining in Istanbul in the long term, but it is yet high at over 3% per annum. The recent annual increase ranged from 0.4 to 0.5 million. Assuming the estimated 12.53 million in 2007 with annual growth of 3%, the population of Istanbul would exceed 20 million in 2023. At a lower growth derived from the past trend, the population will reach 18 million. The planned target of 16 million presupposes substantially lowered growth. It is requisite to implement decisive policy instruments to curve further concentration.

2.3 Motorization

As of 2005, the registered automobiles in the metropolitan region totaled 1.33 million. With the expected economic growth, the number of motorized vehicles will increase rapidly by more than 3.14 times to 4.19 million in 2023.

Registered automobiles per thousand of population were 111 vehicles in 2005 and will increase to 245 by 2023. In 2005, 31% of the metropolitan households owned one passenger car and 4% two or more. The passenger car ownerships are estimated to increase to 67% of the households in 2023.

3. Environment for Planning

Figure 3.1 shows the distribution of OD trips within and without the study area. The percentage distribution of trips between the European and the Asian sides does not change much during 2006 -2023, and Bosphorus crossing trips increase 1.5 times, or as much as the growth of the total trips.

Trips between the study area and elsewhere outside and through trips increase 2 to 3 times over the period, totaling 3.3 million. This is equivalent to over 10% of the total trips within the study area in 2023. The trips between Silivri and Tekirdag show notably large increase.

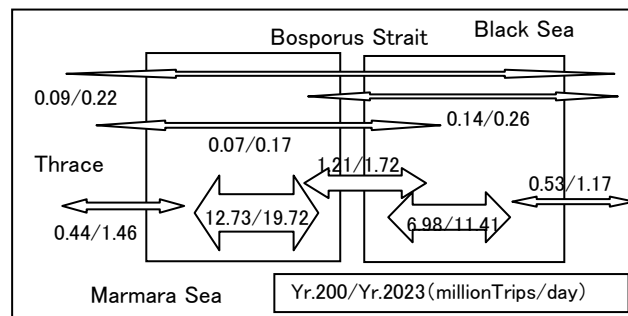


Figure 3.1 OD Trips Within and Without the Study Area

The forecast outcome of the “Do Nothing” case contains crucial implications for transport planning.

- There is no way to cope with the expected tripling of automobile traffic. It is imperative to promote the demand shift to public transport means.
- East-west arterial routes must be strengthened in capacity.
- The congestion will chiefly occur in highways. It is essential to adopt policy instruments for dispersing the future motorized traffic to general roads.
- The transport capacity across Bosphorus Strait and across Golden Horn Bay falls seriously short of the demand forecast.
- The transport capacity both across K. Cekmece Lake and B. Cekmece is inadequate.

4. Network Planning

4.1 Master Plan Objectives of Network Development

The master plan network was identified by keeping in view the following objectives.

- The network must be reliable enough to support various economic activities and daily lives of the metropolitan population.
- The network must be securely disaster-prepared.
- The network development must be economically justifiable and financially feasible.
- The network must be environmentally sound.

4.2 Total Investment in Master Plan Projects

The total investment required for the master plan projects amounts to US\$24.2 billion (US\$ 11 billion for 52 road projects and US\$13.2 billion for 16 railway projects). The total cost of 10 projects scheduled for completion after 2023 is US\$5.5 billion, of which US\$0.8 billion will be spent before 2023 and must be added to the above total.

Figure 4.1 shows the required investment in roads and railways by period of completion. The amount of investment decreases from the short term to the long term, but in reality it will either stay on the same level or increase because new projects are likely to be added on the occasion of the master plan review at every five-year or ten-year interval.

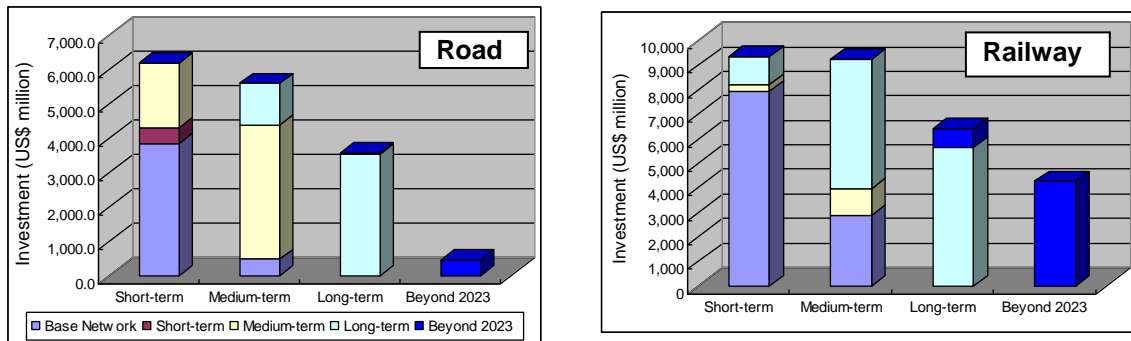


Figure 4.1 Investment in Master Plan Projects by Period of Completion

4.3 Bosphorus Crossing

When the Marmaray railway crossing and the road tunnel are completed, the total capacity for Bosphorus crossing will substantially increase. The capacity expansion will not, arguably, ease the pressure of demand for very long. The expected traffic on the new railway would probably consist of those passengers who otherwise travel by bus or ferry. The railway crossing would have only limited appeal to those who cross the Strait by car on the existing two bridges. The metro-bus route is now planned on the 1st Bridge, but this will not increase the capacity of the bridge. The daily passenger traffic across the Strait will again increase to 1.2 times the available capacity by 2023.

The present master plan proposes the completion by 2023 of the 3rd bridge as both railway and road links across the Strait. The new bridge is needed simply to meet the expected growth of demand. However, there are many arguments against the new bridge. Main points of contention are the problem of land acquisition and the adverse impact on natural environment and landscape. It is necessary to undertake careful studies over these issues and explain the circumstances of project formulation until a general consensus begins to emerge.

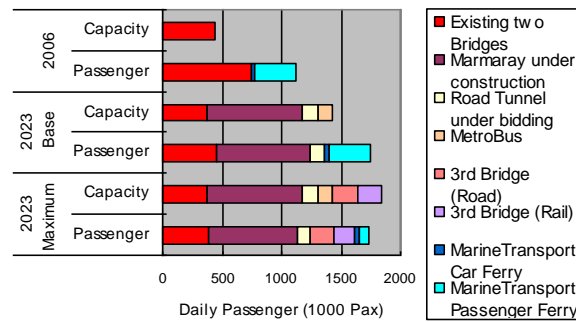


Figure 4.2 Bosphorus Crossing Capacity and Passenger Traffic

5. Road Plan

5.1 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.

Moreover, the present master plan proposes the 3rd Bosphorus crossing bridge as both railway and road links, which precludes the possibility of having the new expressway further north from the 2nd Bosphorus Bridge. Accordingly, the present study made the transport demand forecast on the route passing in-between the existing two bridges and evaluated the new expressway.

The traffic on the new east - west expressway in 2023 will be 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.

5.2 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 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.

5.3 Road Network Development in Newly Urbanizing Areas

The Marmara coastal area from Buyukcekmece to further west is at present sparsely populated with density ranging from 1 to 30 persons per km², 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 km² on the average, and reach 100 to 120 persons per km² in its urban subcenters. The area's requirement of arterial roads, at the density of 1.0km to 2km per km², would be simply enormous.

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.

6. Railway Plan

6.1 Railway Projects of Base Network

There are 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 6.1 shows the base network of railway 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 Yenikapı – Sirkeçi section by using the new underground rail leading to the Bosphorus crossing immersed tunnel and reaches the underground terminal at Uskudar 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.

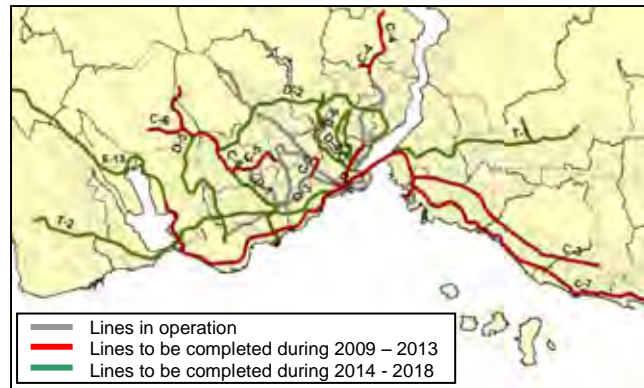


Figure 6.1 Base Network of Railway Projects

6.2 Master Plan Railway Projects

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

Twelve 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.

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.

6.3 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 270 million passenger km in metropolitan Istanbul. By 2023, 110 million passenger km will be serviced by the railways, an increase of 11 times (Figure 6.2). 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.

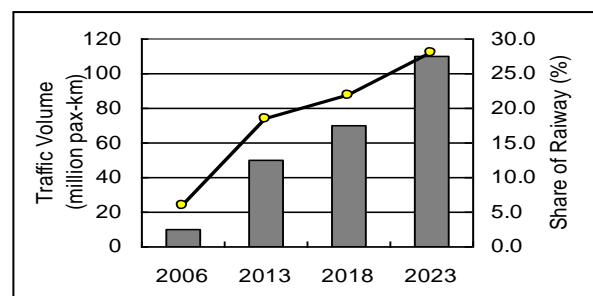


Figure 6.2 Growth of Demand for Railways

6.4 Bosphorus Crossing (Railway)

The Bosphorus 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 Sogutlucemesme – 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 6.3). 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.

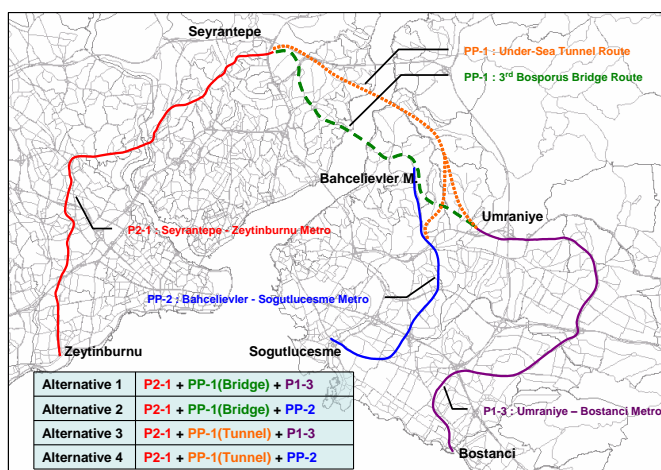


Figure 6.3 Four Alternatives for New Bosphorus Crossing

Table 6.1 Evaluation of Four Alternatives

Alternative	Cost (US\$ million)	Demand in 2023	Internal Rate of Return (%)	
			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

The results of comparative analysis are summarized in Table 6.1. 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.

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 built-up 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 Bosphorus crossing.

7. Road-based Public Transport Plan

7.1 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.

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.

7.2 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 7.1). 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 Bosphorus bridge to Sogutlucemesme near Kadikoy.

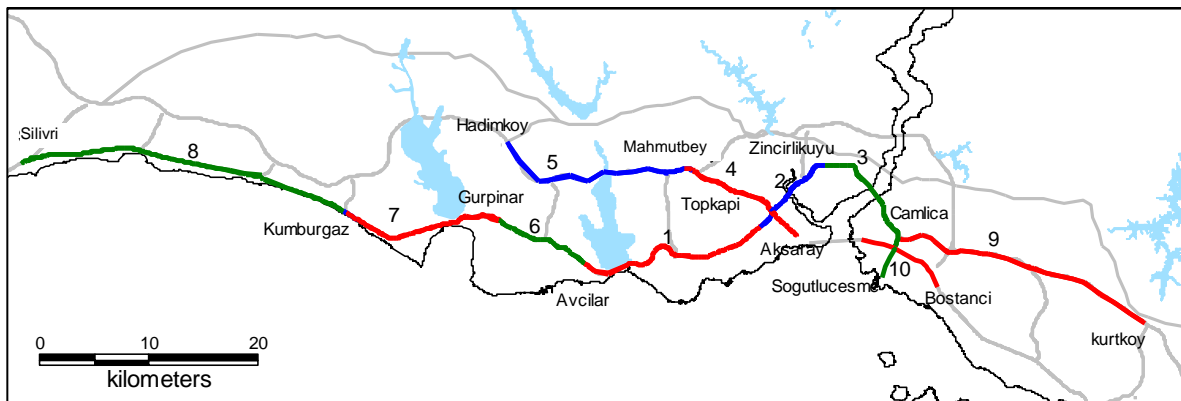


Figure 7.1 Expansion of Metro Bus Network

7.3 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.

The total number of daily passengers on the metro bus network is estimated to reach 2.22 million in 2023. 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.

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.

8. Traffic Management

8.1 The Worst 30 Traffic Jam Prone Areas

The worst 30 traffic jam prone areas have been identified 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 8.1 are implemented. Early planning and implementation are recommended.

At present, reversible lane is applied on the two (2) bridges across the Bosphorus. 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.

Table 8.1 Counter-measures against Existing Traffic Bottlenecks

No.	Name	Possible Solution
1	Kadikoy - Hasanpasa	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Extension of reversible lane to the nearest interchanges from the bridge on both sides (see the figure below).
3	Uskudar – Bulgurlu	<ul style="list-style-type: none"> Additional traffic sign to implement priority rule at roundabout.
6	Beykoz – Kavacik Koprusu	<ul style="list-style-type: none"> Extension of reversible lane to the nearest interchanges from the bridge on both sides
7	Besiktas – Levent Koprusu	<ul style="list-style-type: none"> Extension of reversible lane to the nearest interchanges from the bridge on both sides.
8	Beyoglu – Taksim Meydani	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Construction of median barrier. Prohibition and/or management of on-street parking.
15	D100 Basibuyuk Koprusu Maltepe Koprusu Arasi	<ul style="list-style-type: none"> Partial widening of D100 at uphill section.
16	D100 Bostanci Koprusu Yenisahra Arasi	<ul style="list-style-type: none"> Extension of merging lane. Prohibition of bus stop use except buses.
17	D100 Goztepe Koprusu Mevki	<ul style="list-style-type: none"> Extension of merging lane.
26	Hsim Iscan Gecidi Yusufpasa Arasi	<ul style="list-style-type: none"> Prohibition of on-street parking. Management of pedestrian movements. Improvement of signal control
27	Balat Yolu Eyup Sapagi Eminonu Arasi	<ul style="list-style-type: none"> Demand responsive signal at intersection connecting to O-1.

8.2 Transport Demand Management (TDM)

“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. 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.

9. Implementation Plan

9.1 Investment Plan

The total investment required for the master plan including other subsectors is shown in Table 9.1. The total investment accounts for USD68.6billion. This is comparable to the estimated amount of possible investment at USD68billion.

Table 9.1 Transportation Sector Investment Plan in 2009-202
(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

There are four (4) possible new sources, viz: a) Congestion charging, b) Transit Development Acceleration Fund, c) West Istanbul Urban Development Corporation (WIDEC) and d) Private sector participation. The former three (3) are supposed to be earmarked exclusively for transport development.

9.2 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.

9.3 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.

9.4 West Istanbul Urban Development Corporation (WIDEC)

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.

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.

10. Urgent Actions Program

The followings were recommended as action programs to be urgently implemented.

- 1) Countermeasures for Traffic Jam Prone Areas
- 2) Authorization as Official Master Plan
- 3) Surveys and Researches
 - a. Freight Movement Survey and Logistics Plan
 - b. Preparation and Update of Transport Network Inventory
 - c. Surveys and Plans for Traffic Safety
 - d. Policy Study on Land Use Guidance
 - e. Research on BOT/PPP
- 4) New Organizations and Institutions
 - a. Establishment of TDAF
 - b. Establishment of WIDEC

1. Introduction

1.1 Background and Purpose of the Study

The economy of Turkey has been steadily expanding since the late 20th century. In the process, metropolitan Istanbul witnessed rapid population concentration and motorization. During peak hours, the entire built-up areas are now clogged with heavy traffic. The mitigation of chronic traffic congestion is one of the most pressing issues for the municipal government.

IMM has been allocating the largest part of its development budget to the transport sector, toward the improvement of roads, railways and shipping and parking spaces. The transport infrastructure, notably railway facilities, takes long time to develop, whereas urbanization inexorably evolves ahead rapidly to change the volume and the structure of traffic demand. It was thought necessary to formulate an integrated master plan for the transport sector which incorporates effective policy measures and investment planning consistent with the long-term metropolitan land use plan.

IMM commenced in May 2006 the study for the integrated transport master plan, or IUAP as initialized from the Turkish study title, and soon JICA agreed to provide technical cooperation.

1.2 Implementation of the Study

In June 2007, the IMM project team embarked on the stated preference survey by visiting as many as 90,000 households sampled from the metropolitan population, together with associated field surveys on person trips. By May 2007, the team compiled the database from the survey findings and developed its model for demand forecast. The JICA team joined in the study in June 2007.

The important turns in the process of study implementation after the participation of the JICA team were as follows.

- June 2007 : Presentation of the inception report
- Aug. 2007 : 1st Steering Committee meeting · 1st Workshop
- Oct. 2007 : Presentation of the progress report
- Nov. 2007 : 2nd Workshop
- Mar. 2008 : Presentation of the interim report
- Mar. 2008 : 2nd Steering Committee meeting and 1st Seminar
- Aug. 2008 : 3rd Steering Committee meeting and 2nd Seminar
- Oct. 2008 : Presentation of the draft final report
- Jan. 2009 : Comments from IMM
- Jan. 2009 : Submission of the final report

1.3 Organizational Setup

The Transport Dept of IMM set up its own project team for the IUAP study, which acted as the counterpart team for the JICA experts. IMM appointed a consulting group of three university professors as advisors to the project team.

In addition, IMM organized a steering committee of representatives from those agencies and organizations that have some stake in the study formulation. The committee monitored the course of the study and critically reviewed the details of planning in progress. The figure below shows the organizational setup for study implementation.

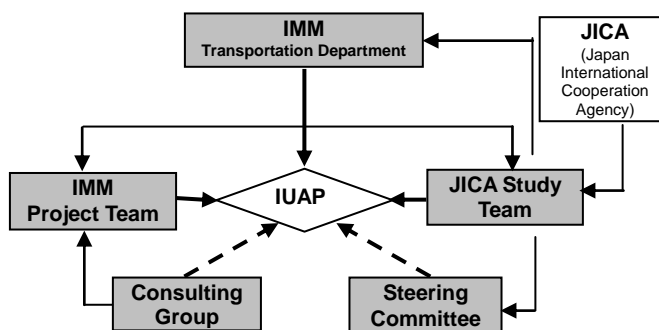


Figure 1.3.1 Organization for Study Implementation

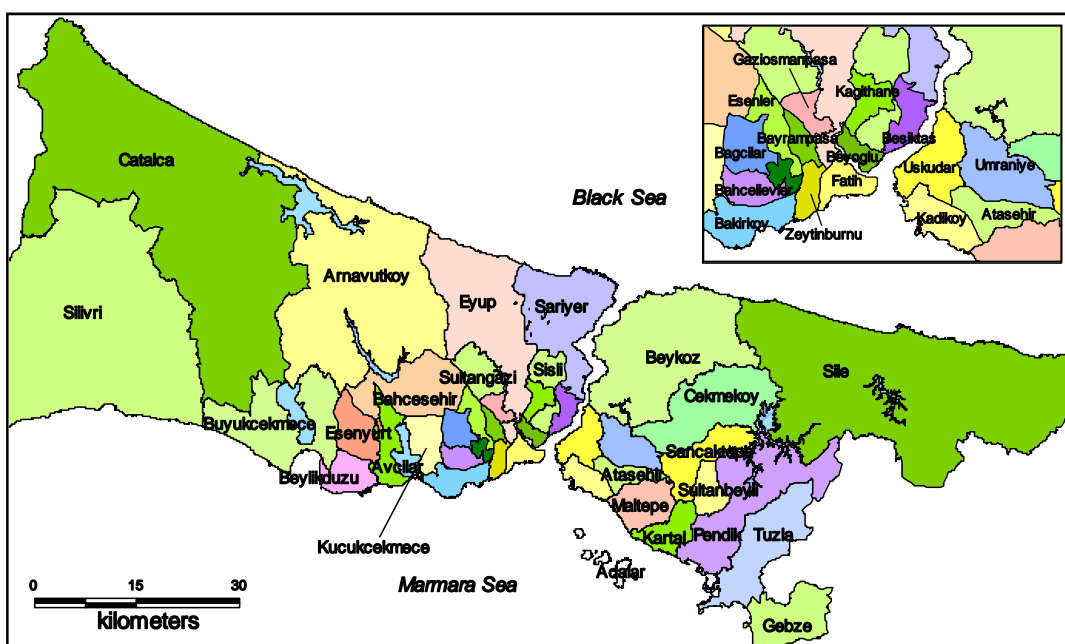


Figure 1.1.1 Study Area (Metropolitan Istanbul and Part of Gebze District)

2. Environment for Planning

2.1 Natural Conditions

As seen in the ancient designation of Istanbul as the City of Seven Hills, most of its administrative area is hilly, ranging from 100m to 300m in elevation. Flat land is limited to the littoral areas of Marmara and Black Seas. A plain of some size is found along the city's western coast of Marmara Sea between Silivri and Gumusyaka and another around Terkos Lake near Black Sea, both of which remain largely rural to this day.

The European side of the city is comparatively low in elevation, rising from southeast to northwest. As a result, most ravines cut the terrains toward Marmara Sea. On the Asian side, in contrast, the veins of river courses are largely oriented toward Black Sea. The valleys in the southern part of the city had long been used for agriculture but are now engulfed in rapid industrialization and urbanization. Many northern ravines serve as important catchment basins.

74% of the city area consists of variously eroded tablelands of low elevation with few mountainous formations. In Beyoglu Plateau hemmed by the Bosphorus Strait and Golden Horn Bay, the erosion first bored holes, which were then linked up into ravines. Along the ridges thus formed, the trunk route of Tunel – Toprbasi – Taksim – Sisli – Mecidiyekoy – Maslak Hill – Okemeydani has been opened up to serve the new CBD development.

The Bosphorus Strait was formed from the country's largest gorge which had collapsed at both northern and southern ends by erosion and later flooded up by the risen sea.

The Northern Anatolian Fault Zone is located close to the northern shore of Marmara Sea, complicating the geological constraints of Istanbul. One northern branch of the Fault Line partly passes Istanbul. It is predicted that another big earthquake will hit the city in the foreseeable future. IMM is currently implementing various projects to improve earthquake preparedness.

The flora of Turkey comprises some 8,600 species, of which 2,700 are reported as indigenous. Istanbul shares part of this biodiversity with some 2,000 species, including 270 rare species. 40 species are said to be in danger of extinction. The fauna is equally diverse and wild life conservation areas in the Istanbul Metropolitan Region add up to some 320 square kilometers. The area around Terkos Lake provides habitats for red-footed deer and many species of birds. Bosphorus Strait has been an important route for birds migrating to Africa, but it is now reported that the worsening air pollution is disrupting their passage.

The climate is Mediterranean, with relatively low annual precipitation of 700 – 800mm. The summer is very hot and dry with low rainfall, while the winter is cold and rainier.

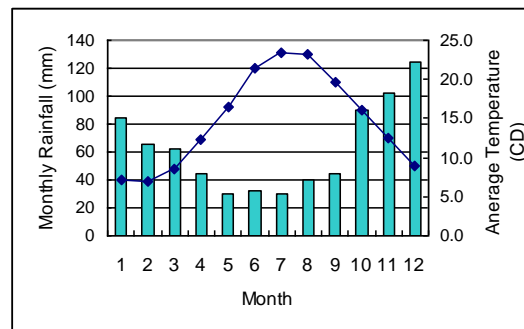


Figure 2.1.2 Average Monthly Temperature and Rainfall in Istanbul

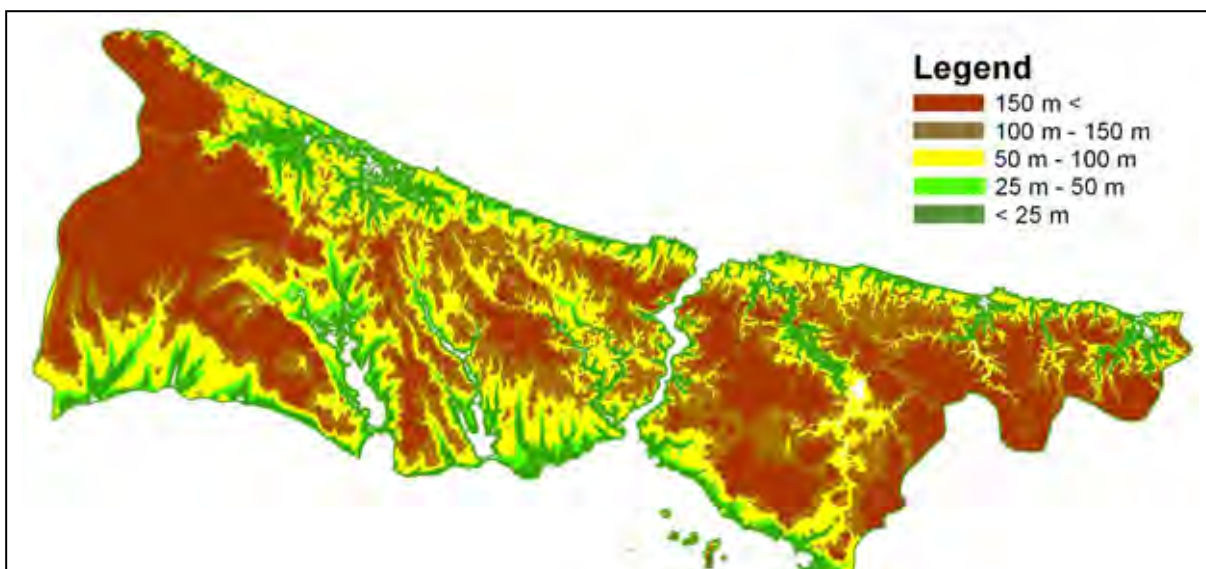


Figure 2.1.1 Topography of Istanbul Metropolitan Area

2.2 Land Use Plan

IMM completed in mid 2007 the land use plan for the target year of 2023. A new group of commissioned experts has been reviewing it since April of 2008. The salient features of the plan are outlined below, because it provides the basis for the present transport master plan.

(1) Basic Assumption

Past rapid economic development brought about an excessive concentration of population and economic functions in Istanbul. Too fast an expansion of urbanization caused various environmental hazards, while compounding the economic disadvantage of agglomeration and harming the competitiveness of the city vis-à-vis other great cities in the world. In order to arrest this adverse trend and to ensure sustainable urban growth in the future, it is essential to adopt a suitable policy for dispersing urban functions and thereby reshape the metropolitan structure.

(2) Directions and Capacity for Urban Growth

The northern part of the Istanbul Metropolitan Region largely consists of forests and thin shrubs which provide natural habitats for wild life and plants. It also contains reservoirs for vital water supply. It is imperative to conserve such areas and check any further urban sprawls from the south. Therefore, the future urbanization must be encouraged along the east-west axis.

If the urban growth expands east and west, the unipolar structure of concentration, such as it is, is untenable for the future intensification of economic activities, because its disadvantage in transportation will be amplified. It is necessary to foster a multipolar structure of dispersed urban functions by appropriately adding new CBDs.

In this approach, it is important as well to conserve good farmland. The future urbanization need be expedited only on the south of Trans-European Motorway (TEM). Based on these assumptions, the future Istanbul Metropolitan Region is estimated to accommodate a population of 16 million.

The estimate suggests the need of taking every feasible policy measure to control the population growth not to exceed 16 million in the year 2023. IMM/IMP has announced its policy of developing the outlying areas beyond the Metropolitan Region to arrest the pressure of further population concentration in Istanbul. It will not be easy to check the inflow of population as long as regional disparities in productivity and income persist in the country.

In order to realize the land use as planned, it is necessary to monitor closely the trend of urban growth in the Metropolitan Region and introduce and implement with perseverance effective policies for guiding population distribution.

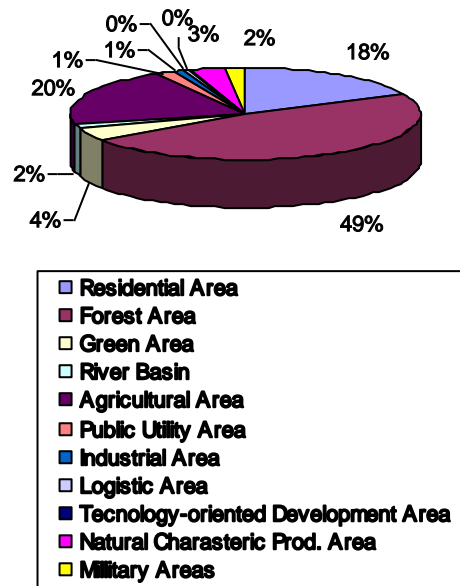


Figure 2.2.2 Planned Land Use

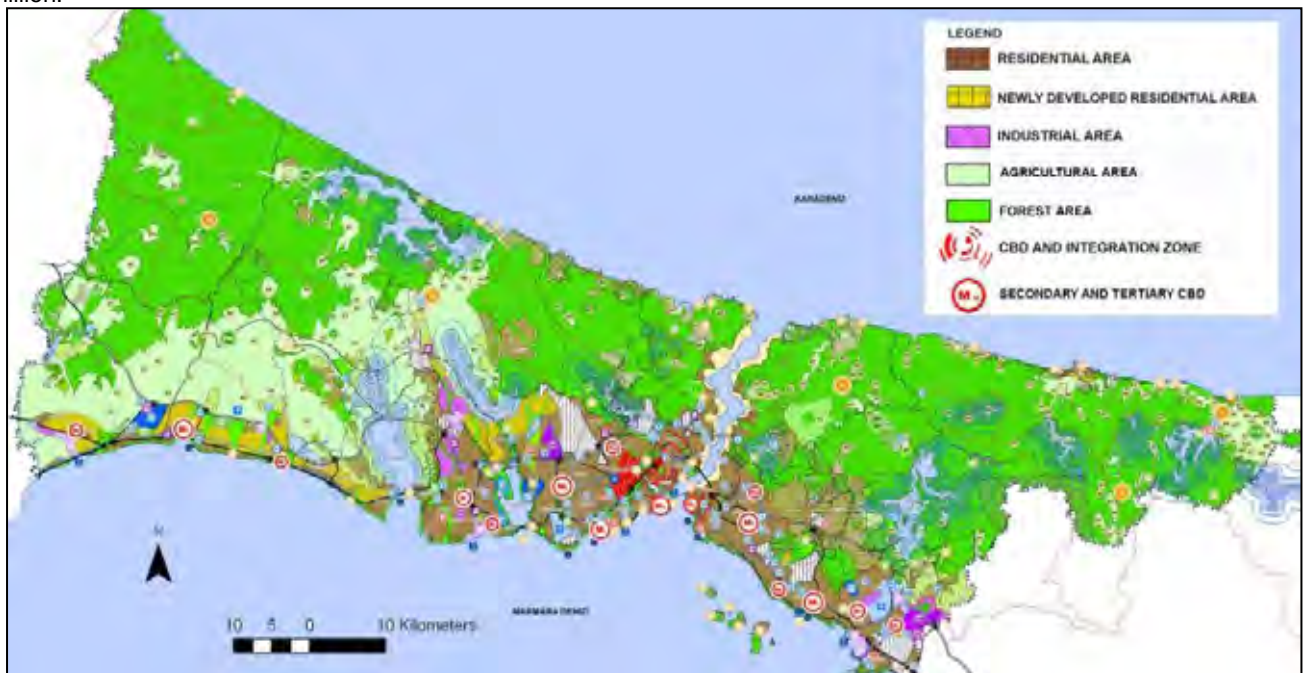


Figure 2.2.1 Land Use Master Plan (2007-2023) as of Sept. 2008

2.3 Wider Regional Development Planning

The economic sphere of Istanbul is much wider than the administrative area. Therefore, it is necessary to plan the future transport network from the wider regional perspective and requirement. The aforementioned Land Use Plan for the metropolitan region, especially the socioeconomic frame defined for land use planning, assumes the introduction and implementation of the policy commitment that aims at easing the population pressure on Istanbul by developing the outlying regions. This makes it all the more important to consider the existing plans of wider regional implications.

(1) Marmara Regional Development

The outlying areas of the Metropolitan Region consist of those provinces surrounding Marmara Sea, collectively known as the Marmara Region. Three most important provinces are Kocaeli immediately to the east, Trakya (Thrace) in the west and Bursa on the opposite shore of the sea.

The regional planning group of IMP made public the perspective plan for Marmara regional development in June 2006. The plan aims to relocate industries out of Istanbul as well as promote new industrial investments in the wider Marmara Region. The envisioned transport network proposes the strengthening of the east-west axis that crosses Istanbul, another east-west axis of Badirna – Bursa – Bozuyuk on the opposite shore and the axis of Bilecik – Bozuyuk that connects the two (Figure 2.3.1).

(2) Trakya Regional Development

The same IMP group formulated this plan with Silivri as the future urban growth pole in Trakya regional development. The existing industrial agglomerations in Corlu and Cerkezkoy found along the axis from Silivri toward Europe will be integrated into the regional development.

Major proposed transport infrastructures are the international port and the associated logistic center at Gumusyaka, with the airport at Corlu also contributing to international traffic.

(3) Wider Istanbul Logistics Development

Major development proposals by the logistics planning group of IMP are as follows.

- Application of the Ro-La system that carries trucks on railways
- Utilization of Ro-Ro ships that ply Marmara Sea (Ambarli - Bandirma/Mudanya and Tekirda - Bandirma)
- Development of logistic facilities at Hadimkoy (similar to the logistic center in Paris or Barcelona)
- Pipeline for petroleum products
- Improvement of container cargo handling efficiency at ports (the increase from 1.1 million TEU in 2005 to 2.5 - 4.0 million by 2015), development of a container depot behind Ambarli Port and transshipment of container cargo at Bahcesehir to the Halkali - Edirne railway
- Relocation of the cargo terminal at Ataturk Airport
- Construction of two emergency landing logistic terminals



Figure 2.3.2 Wider Istanbul Logistics development



Figure 2.3.1 Perspective Plan of Marmara Regional Development

2.4 Social Conditions

The following description is largely based on the socioeconomic frame defined by the IMM/IMP group for land use planning.

(1) Population

The rate of population growth has been slowly declining in Istanbul in the long term, but it is yet high at over 3% per annum. The recent annual increase ranged from 0.4 to 0.5 million.

Assuming the estimated 12.53 million in 2007 with annual growth of 3%, the population of Istanbul would exceed 20 million in 2023 (high estimate in the figure below). At a lower growth derived from the past trend, the population will reach 18 million (low estimate in the figure). The planned target of 16 million presupposes substantially lowered growth. It is requisite to implement decisive policy instruments to curve further concentration.

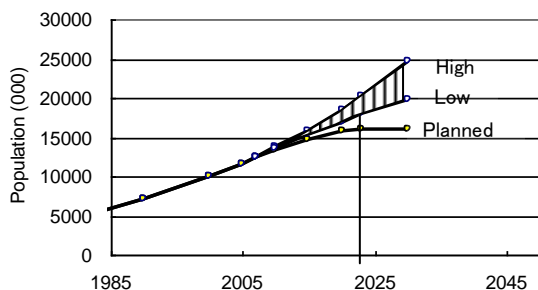


Figure 2.4.1 Population Forecasts and the Planned Target for 2023

With Gebze added, the metropolitan population is 12.7 million in 2007 and will reach 17.1 million in 2023 according to the plan. The net increase of 100 million will mostly reside in the present suburbs and exurbs of Istanbul. Growth will be high in K. Cekmece and other districts further west on the European side, with Silivri notably absorbing 1.5 million. On the Asian side, growth will be high in Pendik and Gebze, and together with Tuzla in between, three districts will absorb 1.3 million.

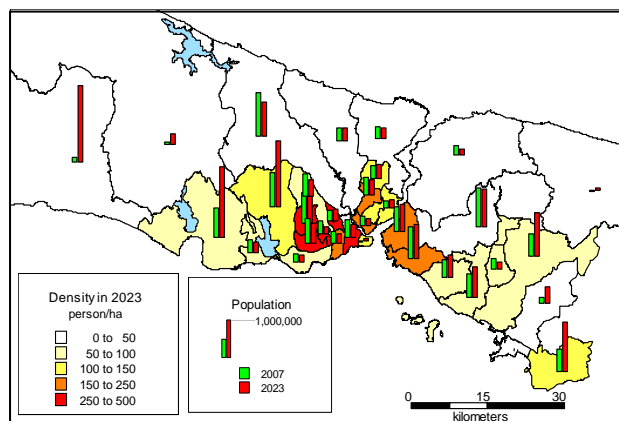


Figure 2.4.2 Future Distribution and Density of Population

(2) Employment

The distribution of employment is one of the most important factors that determine the pattern of traffic demand. The figure below shows the distribution of employment estimated for 2023. Blue bars indicate the residential distribution of workers and red bars that of their work places. This will enable the estimation of commuter traffic.

In the center of Istanbul and other CBDs, the red bar exceeds, as normally expected, the blue bar (supply surplus), while it is the opposite in the suburbs (demand surplus). Commuter traffic is generated in suburbs and attracted to CBDs. Catalca and Tuzla, largely suburban, show the red bar much longer than the blue because of their industrial agglomerations.

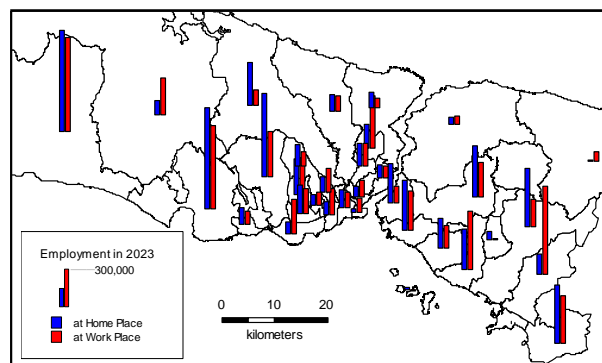


Figure 2.4.3 Future Distribution of Employment

(3) Economy

Metropolitan Istanbul always pulled the national economic growth, but its concentrated investment is now increasingly perceived in the negative light, as causing such urban hazards as high costs of living, extreme population density and environmental deterioration, while widening the economic disparity with other regions.

IMM/IMP proposed a number of economic policies for the future: (a) strengthening of commerce and service industries toward such advanced specialization as finance, corporate management and IP industries; (b) increased investment in social infrastructure (education and culture, medicine, sports); (c) wider regional dispersal of manufacturing; (d) industrial relocation; and (e) promotion and invitation of high-tech industries.

Assuming the annual GRDP growth of 5.2%, per capita GRDP will grow at 3.2% and increase 160% by 2023. The resultant growth of per capita income will accelerate the pace of motorization.

(4) Motorization

As of 2005, the registered automobiles in the metropolitan region totaled 1.33 million. With the expected economic growth, the number of motorized vehicles will increase rapidly by more than 3.14 times to 4.19 million in 2023.

Registered automobiles per thousand of population were 111 vehicles in 2005 and will increase to 245 by 2023. In 2005, 31% of the metropolitan households owned one passenger car and 4% two or more. The passenger car ownerships are estimated to increase to 67% of the households in 2023.

3 Future Traffic Demand

3.1 Forecasting Method

The traffic demand was forecast in four stages as commonly practiced in this field. A most commonly used model was selected for each stage. 451 zones within the study area and 9 external zones were identified in OD matrix.

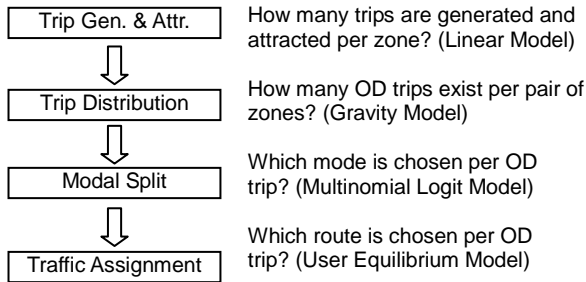


Figure 3.1.1 Four Stages of Demand Forecast

3.2 Traffic Generation and Attraction

The total daily traffic volume in the study area is 20.92 million trips, or 1.74 per resident. Because 27% of the population stays at home, the figure comes up to 2.4 trips per person who travels. About 50% of the trips are on foot. Trips out of the study area to external zones and vice versa are 1.27 million, which is equivalent to 6% of the total trips made within the study area.

The daily traffic inside the study area will rise to 32.85 million trips in 2023, and the trips to and from external zones will amount to 3.26 million. The estimated growth rate of OD trips is higher than that of population because increased automobile ownerships are likely to stimulate higher mobility among people.

Table 3.2.1 Growth of Daily Traffic

Trip Purpose		2006	2023	Increase
Home-Based Trips	Work	6,748	10,790	1.60
	School	4,506	6,983	1.54
	Others	7,798	10,645	1.36
Non Home-Based Trips		1,893	2,391	1.20
Total		20,948	30,810	1.47

(1000 trips)

Growth of trip generation is notably large in those suburban zones which are likely to absorb sizable population growth.

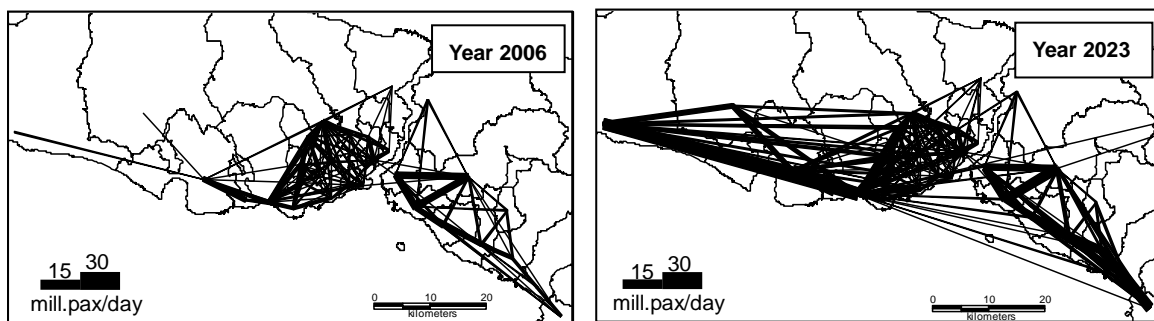


Figure 3.3.2 Daily OD Trips on Desired Line Network (all purposes)

3.3 Traffic Distribution

Figure 3.3.1 shows the distribution of OD trips within and without the study area. The percentage distribution of trips between the European and the Asian sides does not change much during 2006 -2023, and Bosphorus crossing trips increase 1.5 times, or as much as the growth of the total trips.

Trips between the study area and elsewhere outside and through trips increase 2 to 3 times over the period, totaling 3.3 million. This is equivalent to over 10% of the total trips within the study area in 2023. The trips between Silivri and Tekirdag show notably large increase.

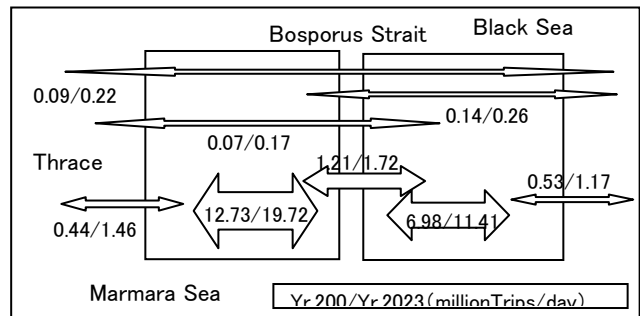


Figure 3.3.1 OD Trips Within and Without the Study Area

Figure 3.3.2 shows the desired-line trip distribution after integrating the OD matrix zones into 33 district-wise zones. The desired line network is roughly identical in its pattern and traffic volume between the already urbanized zone pairs. The flow from suburban zones to these areas, however, surges tremendously. Concomitantly, average trip distance lengthens from 12.1km in 2006 to 17.1km in 2023. Although the total trips increase 1.6 times over the period, the traffic volume expressed in person kilometers increases 2.6 times from 154 million to 404 million. This implies an intense pressure on the transport network.

Because the future urbanization will spread further along the east-west axis, longer trip length would be inevitable. Nonetheless, it is necessary to develop new CBDs and shopping malls in appropriate locations and thereby mitigate inordinate lengthening of person trips.

3.4 Modal Split

Modal selection depends upon the relative quality and quantity of available transport services, or varying conditions of the transport network. Supposing that the present network remains unchanged through 2023 (“Do Nothing” case), the modal shares will change as indicated in Figure 3.4.1. The notable factor in this change is the increased use of passenger cars. When total trips increase 1.5 times, those by passenger car triple over the period, with their share approximately doubling.

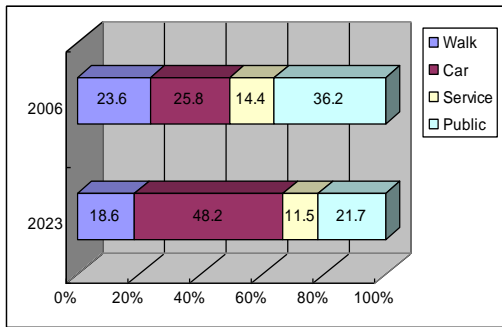


Figure 3.4.1 Change of Modal Shares

3.5 Traffic Assignment

Figure 3.5.1 shows the network of traffic flows forecast for 2023 in the case of “Do Nothing”. All east-west arterial routes are colored red, indicating the traffic volume/capacity ratio of 1.5 or above. The congestion of this level is roughly equivalent to the AASHTO service level F, the state of chronic congestion that forces automobiles to creep in inches. The yellow color corresponds to the service level E, the green to D and the blue to A, B, or C.

The forecast outcome of the “Do Nothing” case contains crucial implications for transport planning.

- There is no way to cope with the expected tripling of automobile traffic. It is imperative to promote the demand shift to public transport means.
- East-west arterial routes must be strengthened in capacity.
- The congestion will chiefly occur in highways. It is essential to adopt policy instruments for dispersing the future motorized traffic to general roads.
- The transport capacity across Bosphorus Strait and across Golden Horn Bay falls seriously short of the demand forecast.
- The transport capacity both across K. Cekmece Lake and across B. Cekmece is inadequate.

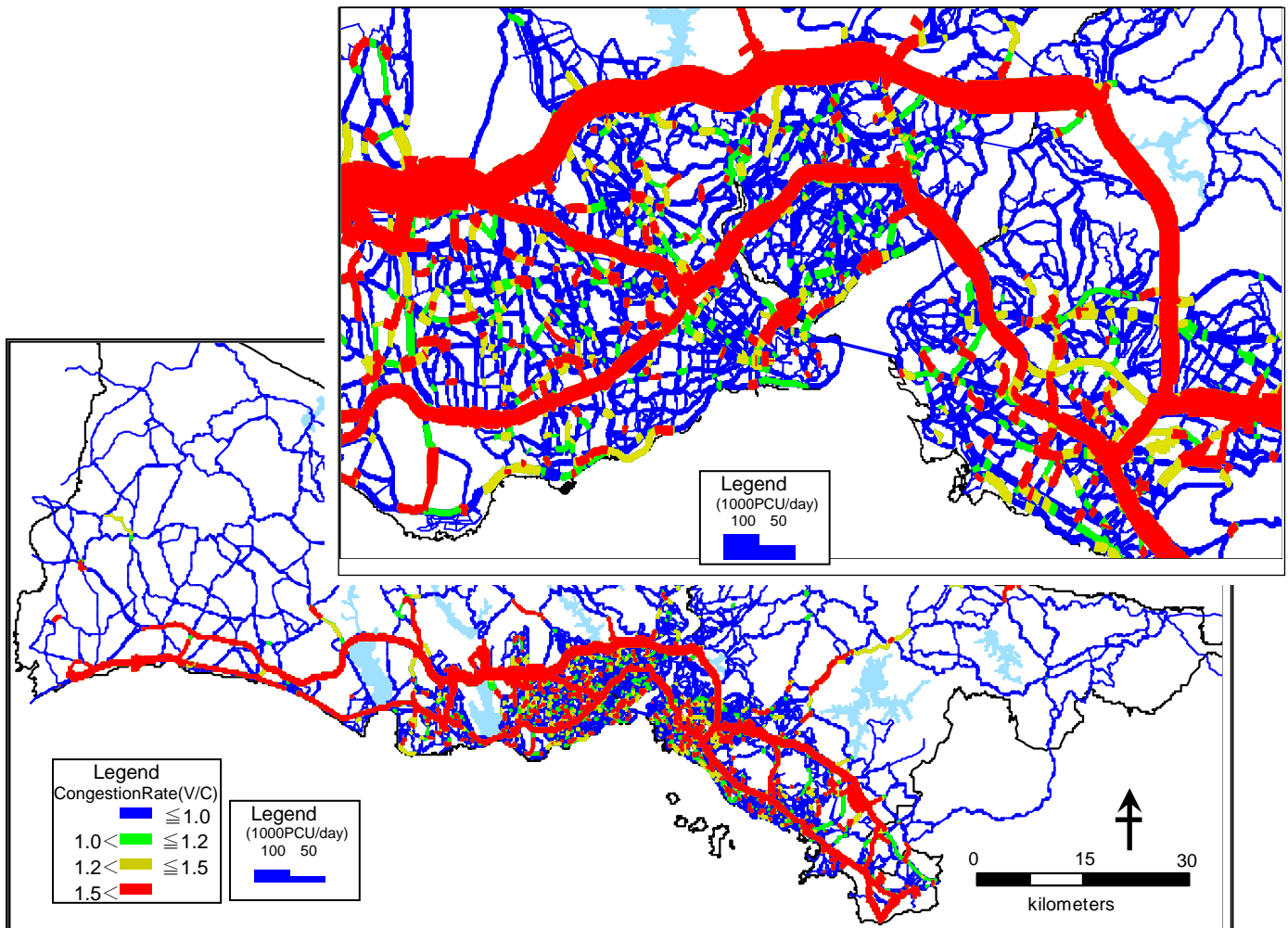


Figure 3.5.1 Traffic Demand Forecast on the Present Transport Network (Do Nothing Case)