THE INCREASING ROLE OF REGIONAL RAIL SYSTEM IN URBAN TRANSPORT: THE CASE OF IZBAN IN IZMIR

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ABSTRACT

THE INCREASING ROLE OF REGIONAL RAIL SYSTEM IN URBAN TRANSPORT: THE CASE OF IZBAN IN IZMIR

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The rapid increase in population and spatial growth of cities result in ever-increasing travel distances for urban transport. While urban rail systems, such as metro and LRT systems, are often considered to provide fast and effective service for metropolitan areas, regional rail systems, as a modernized version of commuter railways, appear to be the most effective way of providing fast services for the mobility needs of such long-distance daily travels in the world. In Turkey too spatial growth is a major challenge for most metropolitan cities as these results in higher distances to be travelled in urban transport. Regional rail systems become indispensable elements of urban transport. Consequently, there have been developments in these cities in Turkey too to invest and modernize existing commuter rail services into modern regional rail systems. Izmir, in particular, has become a leading city in modernizing its commuter railways since it was the first city in Turkey that launched a partnership project between Turkish State Railways agency and the local authority.

This research analysed the experience with regards to the partnership project of IZBAN that revealed that the local authorities should have a higher share of the responsibility in running urban transport projects on state railways infrastructure in order to have more successful projects.

Keywords: Regional Rail, Commuter Rail, Spatial Growth, Partnership Project Between State and Local Authority, Izmir, IZBAN

ÖZ

KENTSEL ULAŞIMDA BÖLGESEL DEMİRYOLU SİSTEMLERİNİN ARTAN ROLÜ: İZMİR IZBAN ÖRNEĞİ

Üçüncüoğlu, Cevat
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Kentlerin nüfus ve mekansal olarak hızlı büyümesi toplu taşımda seyahat mesafelerinin artması ile sonuçlanır. Metro ve hafif raylı sistemler metropellerde hızlı ve etkili hizmet sunarken, bölgesel trenler (modernize edilmiş banliyö sistemler olarak da kullanılır) uzun mesafelerde günlük en hızlı ve etkili hizmeti sunmaktadır. Türkiye'de çoğu metropollerde mekansal gelişim sonucunda uzun mesafelerde ulaşım ile karşı karşıya kalmıştır. Banliyö sistemler kentsel ulaşımın vazgeçilmez bir unsuru haline gelmiştir. Sonuç olarak, Türkiye'deki bu şehirlerde eski banliyö sistemlere yatırım yapılmış ve bu sistemler modernize edilerek bölgesel trenlere çevrilmiştir. İzmir banliyö sistemlerin modenizasyonu üzerine Türkiye'de TCDD ile yerel yönetim arasında bir ortaklık projesi oluşturan ilk şehirdir.

IZBAN üzerine yapılan bu araştırmada devlet demiryolları üzerinde çalıştırılan ve kentsel ulaşıma hizmet eden uygulamalarda daha başarılı projeler oluşturabilmek için yerel yönetimlerin daha geniş yetki ve sorumluluklara sahip olmaları gerektiği ortaya çıkmıştır.

Anahtar Kelimeler: Bölgesel Tren, Banliyö Tren, Mekansal Gelişim , Merkezi ve Yerel Yönetim Ortaklık Projesi, İzmir, IZBAN

Dedicated to The Lord of The Rings

"Three Rings for the Elven-kings under the sky,

Seven for the Dwarf-lords in their halls of stone,

Nine for Mortal Men doomed to die,

One for the Dark Lord on his dark throne

In the Land of Mordor where the Shadows lie.

One Ring to rule them all, One Ring to find them,

One Ring to bring them all and in the darkness bind them

In the Land of Mordor where the Shadows lie." (Tolkien,J.R.R., 1954)

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CHAPTER 1

INTRODUCTION

From the past to present, the rapid population increase in cities led to a need for space together with continuous spatial growth and spread in periphery. After the 1960's urban growth was experienced in many cities in the world and providing accessibility for ever-increasing travel distances became a major challenge, especially for metropolitan areas. This challenge increased further in the recent years as a result of city-region formation in many urban areas.

Urban spatial growth, city-region developments, and formation of new towns, office centres etc. at peripheral areas or out-of-town locations result in an increase in mobility needs and travel distances. While urban rail systems, such as metro and LRT systems, are often considered to provide fast and effective service for metropolitan areas, even they are not sufficient to offer the necessary level of service due to increasing distances in city-regions and similar urban structures. Regional rail systems, as a modernized version of commuter railways, appear to be the most effective way of providing fast services for the mobility needs of such long-distance daily travels. Many large-sized cities in the world and particularly those that show city-region characteristics invest in regional rail systems today to provide high-quality travel service over long distances.

In Turkey too spatial growth is a major challenge for most metropolitan cities as these results in higher distances to be travelled in urban transport. City structures especially in metropolitan cities show constant spatial growth, sometimes in the form of new sub-centres and settlements at peripheral locations. Istanbul, Ankara and Izmir are examples to such models of urban growth, where spatial growth and increased distances are being observed. Furthermore, Istanbul and Izmir also show city-region characteristics and suffer from ever-increasing travel distances. Regional rail systems become indispensable elements of urban transport in such cases since they can connect sub-centres and sub-settlements and serve city-regions efficiently.

Consequently, there have been developments in these cities in Turkey too to invest and modernize existing commuter rail services and transform them into modern regional rail systems.

Izmir, in particular, have become a leading city in transforming and modernizing its commuter railways since it was the first city in Turkey that launched a model to transfer the operation of the existing commuter line from the Turkish State Railways agency to a newly established partnership that also encompasses the local authority. The new structure features both the Izmir Greater Municipality and the Turkish State Railways as joint operators. This model was followed by Ankara and Istanbul too, where protocols were made although implementation has not yet taken place due to legal procedures and the annulment of protocols. Therefore, Izmir currently stands as the only case study for the modernization of commuter rail system and transformation of its operation from the central government railways agency to a new partnership involving the local authority. Izmir Greater Municipality also set up a subsidiary company as the operator of the system. Under these new operating conditions, the system received significant investment in terms of network extension, new modern cars and improved service frequency.

In spite of this restructuring, both in terms of the operator and the infrastructure, there has not been a comprehensive research that analyzed this experience and assessed the performance of the Izmir regional rail system, which is now known as IZBAN. This study examines this experience and aims at providing a better understanding of the localization of commuter services in Turkish metropolitan, i.e. partnership project of commuter rail operation between Turkish State Railways and local authority in Izmir. The analysis comprises system performance, service levels and passenger statistics before and after the transfer of the operation. In addition, interviews will be made with the general manager of IZBAN A.Ş and other planners and managers to provide information about the past, present and future plans of IZBAN as well as to understand achievements and challenges from operators' point of view.

Two main research questions are formulated:

1. How has the general performance of Izmir regional rail system changed after the partnership project between state and local authority?

1.1. Has the performance been improving since the local authority took part over the operation?

1.2. What factors have been effective in enhancing or hindering the performance of the system?

2. Have there been a better integration and coordination in planning and transport operations after the local authority took over the operation?

2.1 Have the urban planning and transport planning coordination been improved?

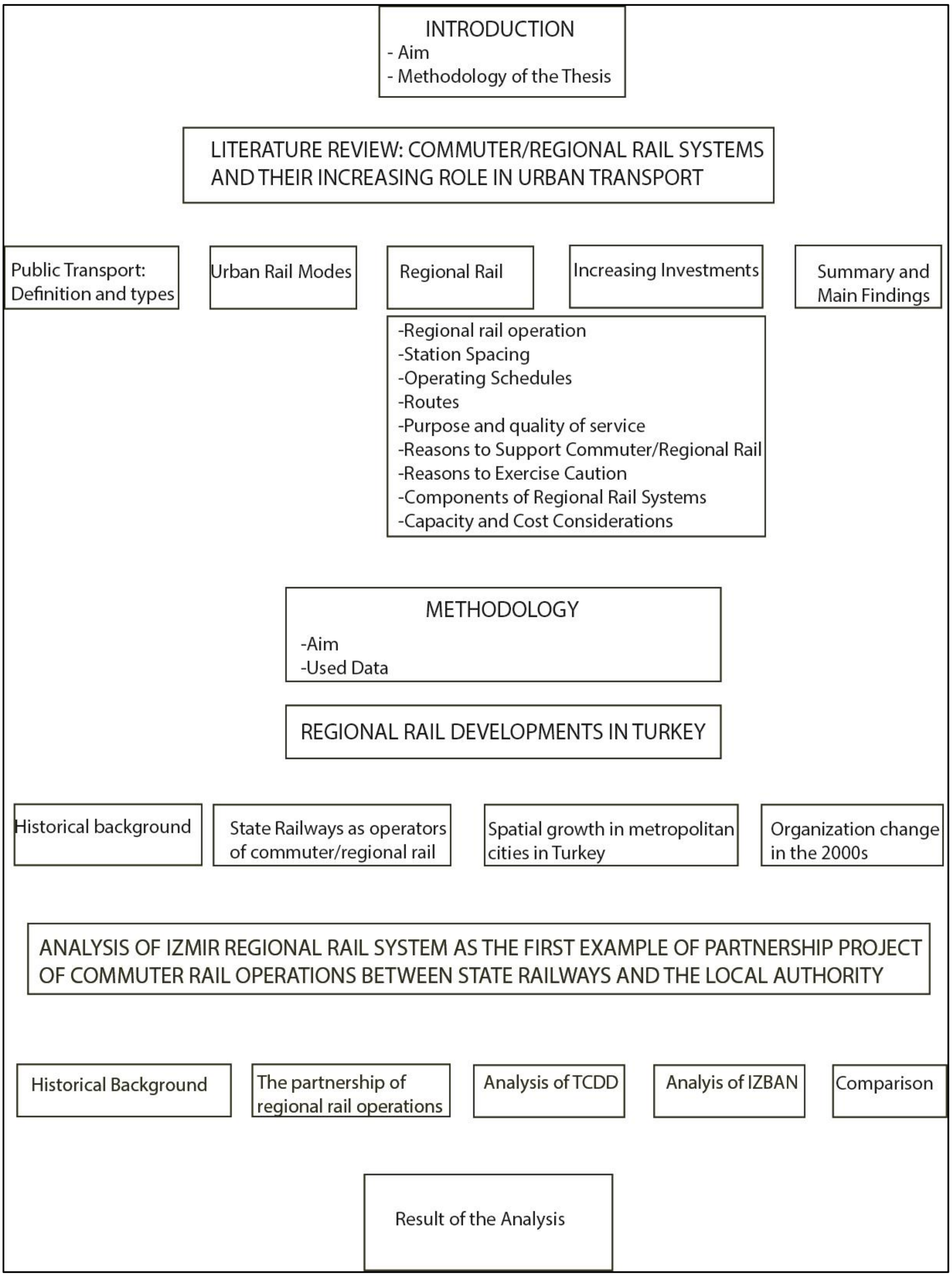
2.2 Has the integration between transport modes been improved in terms of both planning and operation?

In order to answer these questions, the study first reviews regional rail systems and their increasing role in urban transport in the next chapter, Chapter 2. This review highlights a number of characteristics and criteria for regional rail systems to be effective transport alternatives. These include, but are not limited to system length, station design, station spacing, service frequency and service hours. The best cases in the world are chosen from Caltrain,U.S.A, S-Bahn and Dublin commuter rail, Europe.In Chapter 3, the methodology of the study that is to be implemented for the case of IZBAN in Izmir is being analyzed.

The analysis consists of two parts; qualitative and quantitative research. In the qualitative part interviews are done with the experts in the institutions and organizations. In the quantitative part the data gathered from the research are analyzed to reveal if the partnership project is a success or not in Chapter 5. In Chapter 4, the development of regional rail systems in Turkey is explained and the transfer of regional rail operations from Turkish State Railways to partnerships with local authorities described. There are two more metropolitan cities in Turkey that have a commuter rail and the past, present and the future plans of these commuter lines are examined. In Chapter 5, the analysis is carried out on the İzmir regional rail system as the first example of the partnership project of commuter rail operations between state railways and local authority. Firstly, the history of İzmir and the transportation systems are described briefly. Secondly, the history of commuter systems is described and compared with the existing situations. In the last part of the chapter, main findings are presented with respect to the criteria that have been mentioned in Chapter 2.

Finally, Chapter 6 presents the main findings of the study. Based on the study carried out in İzmir, the achievements, shortcomings and challenges of the transfer of commuter rail operations from state railways to a local authority is discussed. Based on the experience of the Izmir IZBAN case, recommendations are made for such reorganization and operation of regional rail systems in other cities in Turkey. In the last part of this chapter further research proposals are made to lead other researchers to build on this subject and the findings of this study.

There have been two major constraints with regards to this research. Firstly, it was hard to find quantitative data about the operation of the system. The statistical data from the State Railways operation era was not all available or comparable with the current data. All the data was gathered from the Turkish State Railway Annual Statistics although these are not detailed enough. Secondly, an analysis of user perspective was also intended in this study with a view to finding the passenger satisfaction before and after the partnership project. Such a passenger survey has been carried out by a local university in Izmir; however, during the time of this thesis the survey results have not yet been published or made public, and they were not shared to be used for this thesis either. Therefore, the intended passenger satisfaction analysis had to be omitted.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CHAPTER 2

COMMUTER RAIL SYSTEMS AND THEIR INCREASING ROLE IN URBAN TRANSPORT

Spatial growth of cities results in ever-increasing travel distances in urban transport. To provide accessibility for these distances becomes a major challenge particularly in metropolitan cities. The distance as well as volume of travel requires relatively faster public transport systems to be offered to citizens and as a result, many cities opt for metro and light rail transit systems. However, in larger cities, such as those that show city-region characteristics and urban structures, even metro systems become inefficient to overcome the travel distances. Regional rail systems become effective solutions in such cases.

In this chapter, the increasing importance of regional rail systems in urban transport is presented in a historical context. In the first part public transport and types are described; in the second part, urban rail modes are presented; in the third part regional rail system are described in detail; in the fourth part increasing investment in regional rail systems and good-practice cases of regional rail systems in the world are presented; and in the last (fifth) part summary and main findings of the literature review are described briefly.

2.1.Public Transport: Definition and types

Public transport is a shared passenger transport service, which is for the utilization by the public. It is different from models such as hired buses, which are not used by strangers without private arrangement. In order for a transport service to be defined as ”public transport” it has to include the following characteristics:

- It must be non-exclusive, i.e. available for anyone to use (provided that they pay the fare)
- It must allow more than one journey to be conducted at the same time
- It must have fixed route
- It must have a fare system
- It must have predetermined stations and stops as access points to the system
- It must have a predetermined schedule of service (though flexible on some systems). (Suttcliffe, 2012)

According to Vuchic (2007), public transportation can be categorized with respect to three main characteristics: their right-of-way (ROW) category, technology and type of operation.

ROW categories:

There are three ROW categories that public transport systems can be classified under, Category A; Category B and Category C.

A-paths used exclusively by transit vehicles comprise the rapid transit mode or metro system. Its electric rail vehicles are operated in trains and provide the highest performance mode of urban transportation.

B-partially separated tracks/lanes, usually in street medians. Semi rapid transit, using mostly ROW B, requires higher investment and has a higher performance than street transit. It includes Light Rail Transit - LRT, as well as semi rapid bus, i.e. bus rapid transit (BRT).

C-urban streets with mixed traffic: Street transit modes include mostly buses, butalso trolleybuses and tramways/streetcars. (Vuchic, 2007)

ROW \ Technology	Highway Driver-Steered	Rubber-Tired Guided, Partially Guided	Rail	Specialized
C[a]	*Paratransit* *Shuttle bus* *Regular bus (on street)*	*Trolleybus*	*Streetcar/tramway* Cable car	*Ferryboat* *Hydrofoil*
B	*Bus rapid transit (BRT)*	*Guided bus*	*Light rail transit (LRT)*	(Cog railway)
A	Bus on busway only[b]	*Rubber-tired metro* *Rubber-tired monorail* *Automated guided transit (AGT)* PRT[b]	*Light rail rapid transit* *Rail rapid transit/metro* *Regional/commuter rail* *Monorail Schwebebahn*	Cog railway *Funicular* Aerial tramway

[a]Modes extensively used are shown in italic type.
[b]Modes that are not in operation.

Figure 1: Classification of urban public transportation modes by ROW category and technology
Source 1:Vuchic (2007), p 51

Technology

Technology of transit systems refers to the mechanical features of their vehicles and travel ways. The four most important features are:

- Support: rubber tires on roadways, steel wheels on rails, boats on the water, etc.

- Guidance: vehicles may be steered by the driver, or guided by the guideway; on rail, AGT and monorail systems drivers do not steer vehicles/trains, because they are mechanically guided.

- Propulsion: most common in transit systems are internal combustion engine – ICE (diesel or gasoline) and electric motor, but some special systems use magnetic forces (linear induction motor - LIM), cable traction from a stationary motor, propeller or rotor, and others.

- Control: the means of regulating travel of one or all vehicles in the system. The most important control is for longitudinal spacing of vehicles, which may be manual/visual by the driver, manual/signal by the driver assisted by signals, fully automatic with driver initiation and supervision, or without any driver at all. (Vuchic, 2007)

Type of Service

Type of service includes several classifications:

- By types of routes and trips served: Short-haul, City transit and Regional Transit.

- By stopping schedule: Local, Accelerated (Skip-stop, Zonal) and Express Service.

- By time of operation and purpose: All-day, regular service, Peak-hour service or commuter transit, and special service for irregular events (public meetings, sports events, etc.).

Transit system technology is often the most popular aspect of transit systems: people usually know what a bus system is, or what trolleybus, tramway, rapid transit, metro and regional rail are. Actually, among the three characteristics, i.e. ROW, technology, and type of service, the ROW is the most important element, because it determines the performance/cost relationship for the modes (Vuchic, 1981)

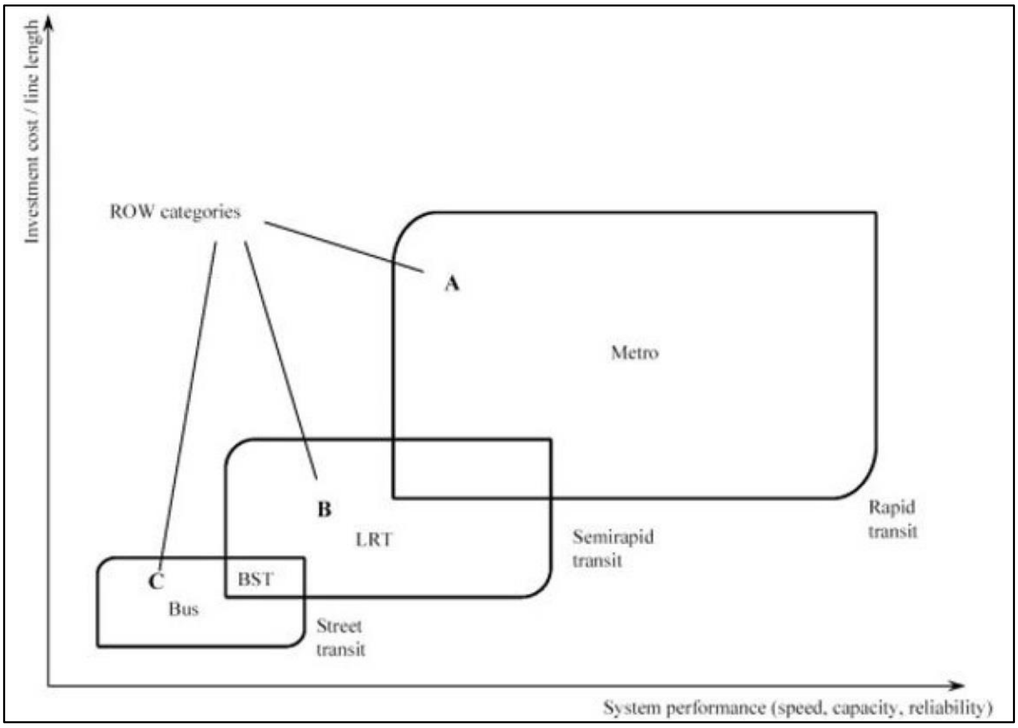


Figure 2: Right-of-way categories and generic classes of transit modes
Source 2: Vuchic, (1981)

The choice of public transport system for a city depends on a number of criteria, such as city size, urban form, population size, travel demand, etc. However, in cities where travel demand in certain corridors become very large and traffic congestion makes car travel and regular buses extremely slow, faster transport modes, such as urban rail systems, become inevitable to meet mobility needs. Spatial growth also results in increased travel distances, and particularly in cities where people start to live in outer glows of the city and work in the center, fast rail services become crucial. Urban city structures create residential areas far from the city; and metro and LRT systems offer solutions in such cases especially for medium distances. However, when distances increase significantly even metro systems become insufficient to provide fast services.

In addition, city-region growth trends in certain cities also necessitate fast transit services over long distances. Regional railways have become effective solutions for long distances. This is the reason for this study to focus on regional rail systems in particular. In the following sections, urban rail modes and regional rail systems are described.

2.2.Urban Rail Modes

Urban rail modes are classified in 4 main categories:

2.2.1. Streetcars/Tramways

One of the metropolitan rail systems, which have a suitable design regarding scale and traffic pattern is streetcars/trams. Its capacity may change from medium to high volume transportation depending on circumstances in a certain settlement area (Steiner & Butler, 2007, p. 178).

Figure 3: Example of a Streetcar
Source 3: https://thetransitpass.wordpress.com/tag/highways/

2.2.2. Light Rail Transit System

The term of light rail was started to be used by the U.S. Urban Mass Transportation Administration in 1972 (Verderber, 2012, p. 74). Following the operation of the first light rail system that had begun in 1978 in U.S., the usage of the system extended to Europe[1].

Light rail transit (LRT) is a system of electrically propelled passenger vehicles with steel wheels that are propelled along a track constructed with steel rails[2]. It is a sophisticated passenger transportation system, which varies system to system in terms of performance and capacity according to the necessities of a certain system in an area. Having versatility, it provides a lot of different solutions to transportation problems and fulfills forthcoming requirements in the future by increasing its capacity. It may be designed completely segregated from other modes of transportation; or alternatively it can share right of way with other transit modes.

[1]http://www.innovateus.net/transportation/what-light-rail
[2](Transportation Research Board, 2000)

Passengers can be boarded or discharged at low-level platforms, which take place in track or road (Steiner & Butler, 2007, p. 178).

Although light rail system's capacity and speed are lower than heavy rail, it has a higher speed and larger passenger capacity than street busses and tramways (Verderber, 2012, p. 74). Its transportation capacity is between 6000 and 20.000 individuals per hour. Maximum speed changes between the interval of 60 km/h and 120 km/h although actual operating speeds would be lower. It generally has more frequent stations in a line when compared to metro systems, i.e. heavy rail systems, and this is one of the reasons for its relatively lower speed.

Figure 4: Example of a LRT
Source 4: http://cooltownstudios.com/2008/06/03/transit-becoming-cooler-than-cars-whats-next/

2.2.3. Rapid Rail Transit System

These systems operate with single or multiple trains on fixed rails using high-speed and rapid-acceleration. RRT operates on an exclusive right-of-way, which is usually grade-separated in tunnels or elevated railways. High-platform loading is used, and these systems have a capacity for a heavy volume of traffic and sophisticated signaling systems are often in use. (Steiner & Butler, 2007, p. 177)

Figure 5: Example of a RRT
Source 5: http://cdn8.bigappled.com/wp-content/uploads/2012/12/73601683.jpg

2.2.4. Regional Rail Transit System

When compared to other urban rail systems described above, regional rail systems are faster, have less frequent stations and longer routes as they serve a larger region. The following figures show these main characteristics. Their carrying capacity may not be higher than rapid rail transit systems; what makes regional rail systems stand out from the rest of transit systems is the large distances between stations and the resulting service speed, as shown in the figure below.

The system is analyzed in more detail in the following section.

	Streetcar/Tramway	Light Rail Transit	Rapid Transit	Regional Rail
Vehicle/train characteristics				
Minimum operational unit	1	1 (4 to 10 axles)	1–3	1–3
Maximum train consist	3	2–4 (6 to 8 axles)	4–10	4–10
Vehicle length (m)	14–35	14–54	15–23	20–26
Floor height	Low/high	Low/high	High	High/low
Vehicle capacity (seats per vehicle)	22–40	25–80	32–84	80–175
Vehicle capacity (total spaces per vehicle)	100–250	110–350	140–280	140–210
Fixed facilities				
Exclusive ROW (% of length)	0–40	40–90	100	100
Vehicle control	Manual/visual	Manual/signal	Signal/ATC	Signal
Fare collection: self-service or:	On vehicle	On vehicle/at station	At station	At station/on vehicle
Power supply	Overhead	Overhead	Third rail/overhead	Overhead/third rail/diesel
Stations				
Platform height	Low	Low or high	High	High or low
Access control	None	None or full	Full	None or full
Operational characteristics				
Maximum speed (krn/h)	60–70	60–120	80–120	80–130
Operating speed (krn/h)	12–20	18–50	25–60	40–75
Maximum frequency				
Peak hour, joint section (TU/h)	60–120	40–90	20–40	10–30
Off-peak, single line (TU/h)	5–12	5–12	5–12	1–6
Capacity (prs/h)	4000–15,000	6000–20,000	10,000–60,000	8000–45,000
Reliability	Low-medium	High	Very high	Very high
System aspects				
Network and area coverage	Extensive, good coverage	Good CBD coverage, Branching common	Predominantly radial: good CBD coverage	Radial, limited CBD but good suburban coverage
Station spacing (m)	250–500	350–1600	500–2000	1200–7000
Average trip length	Short to medium	Medium to long	Medium to long	Long
Relationship to other modes in addition to walking	Can feed higher-capacity modes	P+R, K+R, Bus feeders	P+R, K+R, Bus & LRT feeders	Outlying: P+R, K+R, Bus feeders; center city: walk, bus, LRT, metro

Figure 6: Technical, operational and system characteristics of rail transit modes
Source 6: Vuchic, 2007. p:311

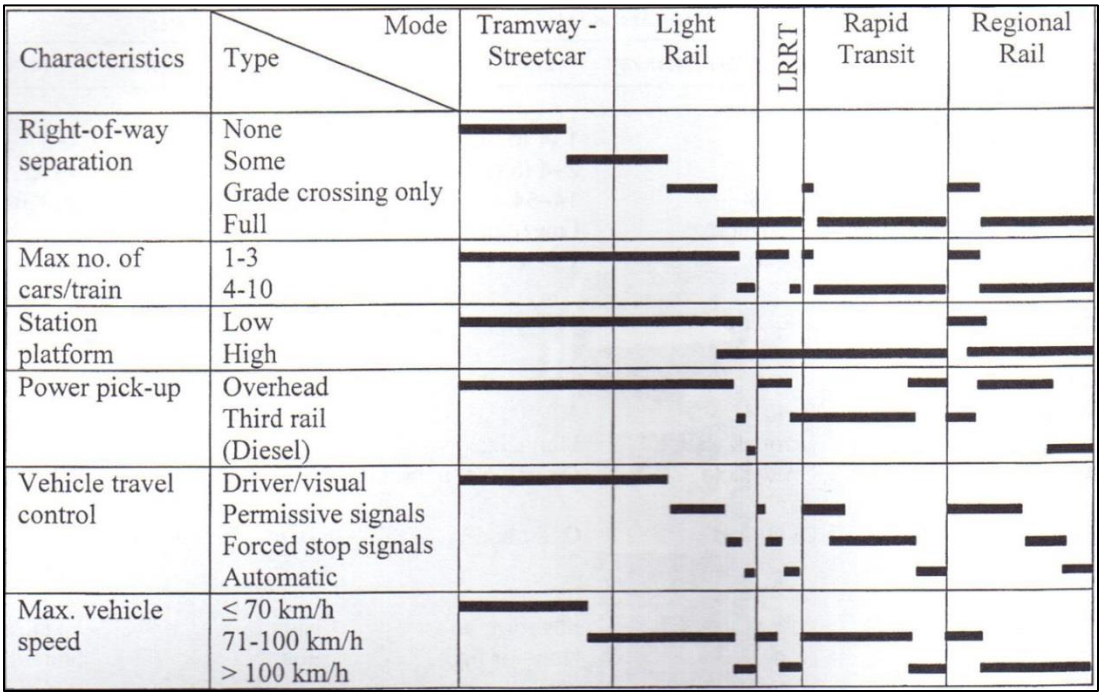


Figure 7: Basic characteristics of rail transit modes
Source 7:Vuchic, 2007. p:312

2.3.Regional Rail

Regional rail, which is also termed as suburban rail or commuter rail, provides service to peripheral districts. Carriage tracks or large tracks are allocated to commuter/regional rail service. In this service, diesel or electricity can be used to power conventional trains. By all manner of means, trains may contain locomotives or self-powered units. Commuter/regional rail is a public transit mode particularly attractive for longer distance trips – and has demonstrated an excellent ability to attract auto drivers out of their cars.

Figure 8: Example of a Commuter/Regional Rail
Source 8: http://www.transdevplc.co.uk/cmsUploads/expertise/images/mrb5.jpg

- Primarily serves passengers traveling between home and their place of work.
- Runs on existing track which has been upgraded for passenger service, usually shared with freight trains.
- Lines range in length, up to about 85 miles from city to terminal.
- Stations are spaced at intervals of one mile or more and speeds can reach 60 mph between stations and in some cases, up to 79 mph.
- Service is typically frequent during peak periods to accommodate large numbers of commuters.
- Trains consist of one or more cars and may be self-propelled or pushed/pulled by a diesel or electric locomotive. Commuter rail typically uses rail diesel cars (RDC's), new generation diesel multiple units (DMU's), single level locomotive hauled trains or double level locomotive hauled trains. Coaches are high capacity with limited personal space.
- Differs from light rail (LRT) in that it usually does not need new track infrastructure and uses equipment with different specifications, generally heavier in weight and more compatible with freight train traffic; it does not operate in mixed traffic with motor vehicles.
- Differs from intercity rail, which serves longer distance business and pleasure travel, and recreational rail services, such as the Portland-Astoria service that are nearly exclusively geared toward recreational travel. Intercity coaches have more comfort features and personal space.[3]

Figure 9: Characteristics of commuter/regional rail
Source 9: Oregon Transportatıon Plan Update, Commuter/Regional Rail in Oregon,pp 1.1-1.2

In the figure above, commuter rail system is described as a system that differs from other rail services by its speed, distance between stations, comfort and service hours. The regional rail systems of our day have some similarities to these characteristics but also they have service levels that differ from commuter services. Regional rail systems are often built on existing tracks too, but new infrastructure may also be necessary to ensure high-speed service. Modern vehicles today reach higher speeds than described in the table above. In most cases, they no longer can be described as services that are only frequent in peak hours for commuters as regional rail services today often run all day with reasonably high service frequency. In addition, in many cities regional rail systems represent modern long-distance rail services that run on exclusive rights of ways, ROW Category A. This makes them even faster than commuter rail services. Like the commuter rail services, they often have relatively higher distances between stations, which also ensure fast service.

2.3.1. Regional Rail Operation

Regional rail, usually operated by railroads, has high standards of alignment geometry. It utilizes the largest vehicles of all rail transit systems, which operate in trains, on longer routes, with fewer stations, at higher speeds than typical for RRT. Thus, RGR functionally represents a "large-scale RRT" which serves most efficiently regional and longer urban trips (Gray& Hoel,1979).

2.3.2. Station Spacing

The station for both commuter and regional trains need a bigger space compared to the stations of other rail modes. The station locations are mostly above ground meaning the nodes of the stations should be decided carefully. Another aspect is the integration of stations with other public transportation modes. The distance should not be far from the other transport modes (buses, LRTs, ferries etc.)

A principal issue at suburban stations is the means of access from the residential districts. Local feeder services have to be effective, for instance, buses, paratransit and taxis are essential, because walk-in patrons will be few at the home end. All of the feeders should physically contact the station as close as possible, with loading bays near the rail platform (Grava, 2002). Considering dropping of or picking up a rail passenger there should be convenient access lanes and some waiting space until the train arrives. In addition, there is often a demand for park-and-ride facilities at outer stations of commuter and regional rail services.

The station location is important by being accessible to all modes. If the access is not successful, private car owners will not use the public transportation (the importance of park-and-ride) the traffic and the city will be affected negatively.

2.3.3. Operating Schedules

The rail systems that serve large volumes citizens and other travelers besides commuters, will provide a service during the entire day.

There can be some differences about the service distinctions. Some express operations bypass stations (low volume stations) to decrease the total trip time for most passengers. (Cost-Allocation Methods For Commuter, Intercity, And Freight Rail Operations On Shared-Use Rail Systems And Corridors, 2007)

2.3.4. Routes

Most of the commuter systems and similarly regional rail lines are composed of disjointed routes that connect some of the denser and older suburbs to the central core. They are often planned to run on existing rail rights-of-way. In the case of commuter systems, there are examples where branching at the outside ends take place, although for higher-speed regional rail systems, where infrastructure and vehicles are modern and more costly, this may not be common.

Presence of freight traffic on the same track or within the same right-of-way is one of the major operational issues for commuter/regional rail service. It is common that different agencies are responsible for variants of traffic on the same right-of-way, and then clear operational procedures have to be followed. (Cost-Allocation Methods For Commuter, Intercity, And Freight Rail Operations On Shared-Use Rail Systems And Corridors, 2007)

One of the problems about the routes is that they become old. The lines and routes were built nearly a century ago and the time they are decided the cities were small and there were limited problems about the placement. In time cities developed and the routes remained inside the city. The residential areas are close to the routes, creating problems for the design of the new routes. In addition, there were not many problems with integration because there was not a multi-modal transport system in the past. (Rubin, 2008)

The commuter/regional rail affects the development of the city and its form. That is because its stations provide accessibility to places in long distances with a relatively high speed of journey. That can make the station areas attractive for development and hence the urban and regional form may shape accordingly.

The system mostly stays above ground that the routes are designed as exclusive right-of-way, i.e. in Category A.

2.3.5. Purpose and Quality of Service

Commuter/regional rail has a difference place among all kinds of public transportation. The commuter/regional rail system started as a suburban service for people living far from the city center, than in recent years with the transformation of these services into modern regional railways, it became popular rapidly for all people. Passengers using these services have an expectation of good quality and are willing to pay its price. Comfortable seats, air conditioning, proper ventilation, safety and lighting are expected and are provided. This is also a public policy that allows people to seek employment all over the city not just the center of the city. (Transit Capacity and Quality of Service Manual, 2nd Edition, 2003)

2.3.6. Reasons to Support Commuter/Regional Rail

In this and next section, the strengths and weaknesses of commuter/regional rail systems are assessed, particularly based on systems that utilize existing rail alignment.

As it is seen in the table below the commuter/regional rail CO2 emission is lower due to the most of the transport modes.

	BTUs	Pounds CO_2
Ferry Boats	10,744	1.73
Automated Guideways	10,661	1.36
Light Trucks	4,423	0.69
Motor Buses	4,365	0.71
Trolley Buses	3,923	0.28
All Automobiles	3,885	0.61
Light Rail	3,465	0.36
Passenger Cars	3,445	0.54
All Transit	3,444	0.47
Heavy Rail	2,600	0.25
Commuter Rail	2,558	0.29
Toyota Prius	1,659	0.26

Figure 10: Modal Energy Consumption and CO2 Emissions per Passenger Mile
Source 10: Randal,2005, p:4

The commuter rail industry has a strong safety record. The National Transportation Safety Board (NTSB), in its Safety Report for 2005, shows that of the 45,650 transportation fatalities that occurred in the United States in 2005, only 81 (or 0.18 percent) are attributed to commuter rail (Commuter Rail Safety Study,2006).

Owing to the fact that trains consume relatively less energy to operate, this situation brings operational efficiency for all of the rail based transport systems as long as cars are reasonably occupied.

The system could easily be modified because there are existing lines and does not require acquisition of property.

The commuter/regional rail network is both suitable for the transportation and public services such as pedestrian, bike trails, communication lines (Grava,2002).

Since the rail transportation is not a new mode, approval process is easy and as compared to other high capacity modes, service can be implemented easily.

2.3.7. Reasons to Exercise Caution

The commuter/regional rail investment cost is extremely high compared to the other modes of transport. A modernization of existing systems may be more affordable; however, operating costs may also be high.

One of the biggest problems in the system is there are too many players for the system (The governance, state, local actors). The policy of the governance is another important problem.

The systems are planned for a long time period and this affects the development of the city. These planning studies take a long time and the implementation of the project can wait for years.

An accommodation has to be made between the new and the current users of the channel and space struggle will exist if the alignment carries other types of traffic such as freight transport. In many cases, the right-of-way is held by private corporations that are wary about possible intrusions into and cutback of their freight operations. (Grava,2002)

The maintenance cost of the system is expensive and if the system was not planned carefully, the consequences can cause lots of problem for the economy. The existing lines, the types of the coaches, the units and the stations have to be studied carefully.

According to Rubin (2008), there may be real or perceived safety issues, especially if at-grade crossings are present and there are possibilities for persons, particularly children due to the right-of-way. Unauthorized trespassing is frequently a cause for concern. If the lines are electrified at high voltage and problems occur in the lines, this cannot be solved in a short period of time.

2.3.8. Components of Regional Rail Systems

2.3.8.1. Rolling Stock

According to Grava (2002), passenger oriented rail vehicles are classified in 4 groups;

1- Locomotives. Powered units with large traction capability able to pull or push trains, carrying no passengers themselves. Electric and diesel locomotives take place of the steams engines in time. The former may receive power from overhead wires or a third rail along the side of the track. Dual-mode locomotives can operate on both electrified and non-electrified tracks.

2- Coaches or Trailers. These are non-powered units that are pushed or towed by other powered units. Their aim is to give accommodation to passengers. As it is seen in the Figure 11, there are several variations like 2*2 or 2*3 (regular coaches) seating rows with a central aisle or two leveled accommodation seats (bi-level coaches). The latter are either of the "gallery" type, with elevated rows of seats or vehicles with two full floors and intermediate decks. The handicap of these large coaches are the space requirements because of their height, they can encounter problems in tunnels and underpasses

3-Powered Cars. Units having electric motors below the trucks and getting power directly from an overhead wire or below with a third rail. It has two types of units; single and multiple. In the single units all controls are in the vehicle and operate alone, in the multiple units also known as "emus'' (electric multiple units) operating units are controlled by a single driver or an engineer up front.

4-Railbus or Diesel Multiple Units (DMUs). The diesel engines operating on a regular truck for passenger carrying vehicles. They can tow one or more trailers and can run singly or consists. These units are not so popular in North America, but some systems are operating in Europe, South America and Asia. (Grava, 2002)

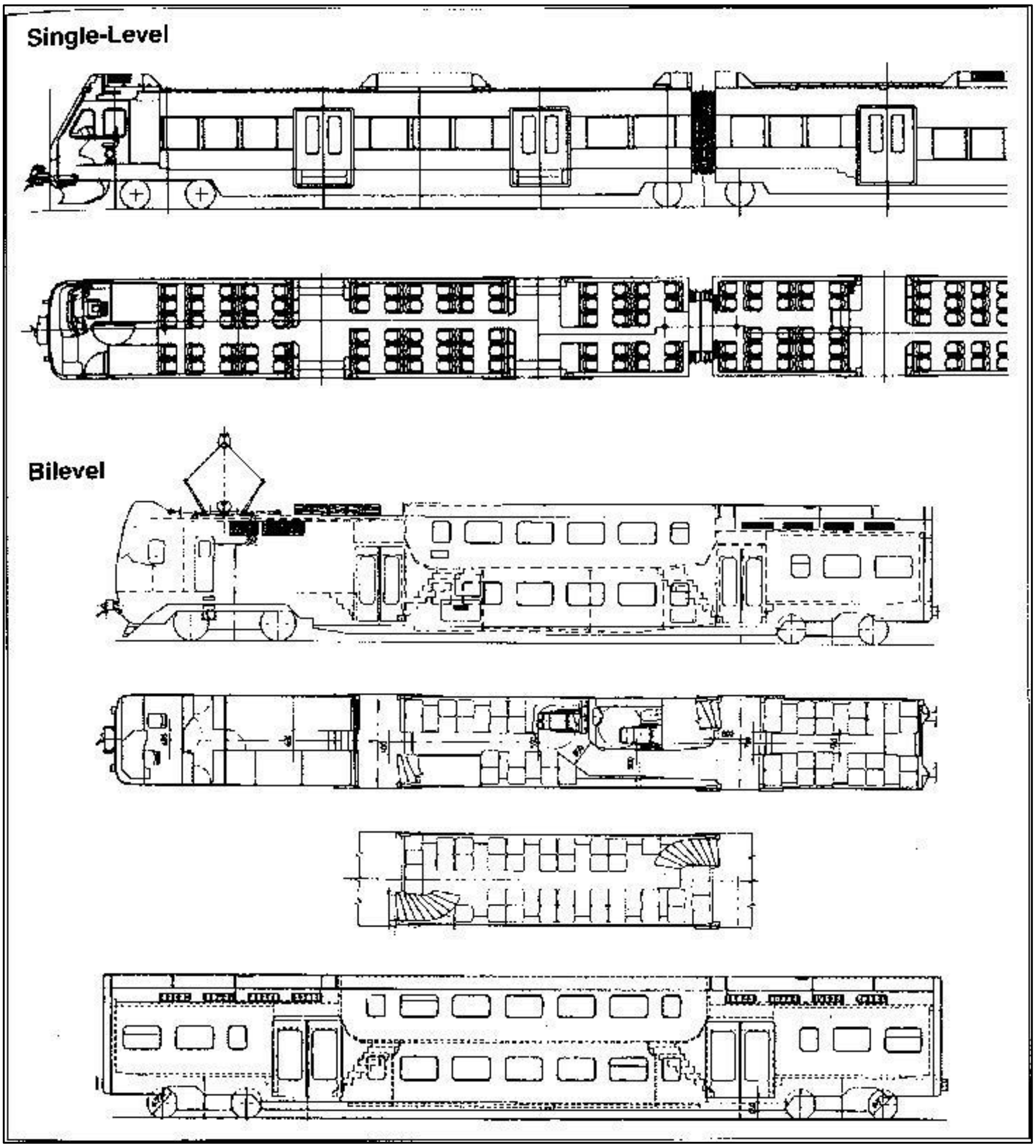


Figure 11: Examples of commuter/regional rail cars
Source 11: Grava,2002,p: 659

These are the main types of rolling stocks. There are different variations having similarity in most of the points such as “married pairs’’ that operate together because sharing of components and can be more than two (can be three cars). In classical commuter/regional coaches there are doors allowing passages between cars. The design of commuter/regional coaches are still in progress and in the future there can more than 4 groups explained above.

2.3.8.2. Right of Way and Track

The technology is developing fast and this affects the tracks of the commuter/regional rail system. The 2000s locomotives are heavy and fast and the most important thing in the systems is safety.

The system uses the right-of-way category A that segregates itself form vehicles and people. In the existing lines, the systems take a route inside the city center and it is not preferred to take the roads underground because of its expenses.

Commuter/regional trains use electric locomotives accompanying electrifications along the route if they are run in tunnel especially in some of the larger cities. Instead of electric locomotives, diesel-propelled systems with extensive tunnel ventilation can be designed.

2.3.8.3. Stations

Regional rail services are modernized commuter lines. Hence, some of the descriptions used in this study presents literature on how commuter rail systems are planned and operated. Commuter/regional rail routes, with few exceptions, start at the old established downtown railroad stations, run outward along old radial alignments and make stops at the old suburban stations.

There is an associated dimension to this situation that does not affect transportation system development as such, but is important in the culture of cities—the adaptive reuse of historical landmarks. Since a great many of the old stations are of that quality, and they were located deliberately on highly visible sites, this matter becomes an important component of planning and operation of these rail systems. (Carroll,1956;Grow,1977)

Accordingly, the buildings are protected but some conversions are required in these buildings. Today long-distance travelers who are in rush desire grand spaces that were designed to accommodate with much luggage and also with comfortable waiting rooms and restaurants.

Demands differentiate at the suburban ends of commuter/regional routes where the challenges are much alike. In cases where train services are provided at relatively long intervals, weather-bulwarked waiting space is indispensable, opportunities to buy newspaper and some rudimentary supplies are desirable, and purchase of tickets should be possible.

> "…There are splendidly restored and well-equipped old station houses, but there are also instances in which a prefabricated metal box and vending machines are expected to suffice. The latter may be the high-tech, efficient solution for the future, but it would seem that a sensible regard for human amenities is called for to attract and keep customers…" (Grava, S, 2002, pp 634)

There are important design principles of a station. These are to meet the basic requirements of the people such as waiting rooms, concourses, food sales, newsstands, information boards, ticketing facilities, rest rooms etc. The safety of people, access to the trains, integration of the rail system with other transport modes and the location analysis of the station are important principles. The design principles are shown in the figure below.

Functional	Fit for purpose, well planned and constructed with appropriate materials and technology.
Safe, Legible	Understandable, feels safe and secure, includes good visual link and strong passive surveillance. Signage is carefully considered as part of the project.
Seamless	A cohesive and linked network which is easy to understand and navigate; integrates different transport modes, providing direct connections and easy transitions.
Universally Inclusive	Main access routes are obvious and accessible to all members of the community, whether able bodied or mobility impaired, without barriers or discrimination.
Walkable	Supported pedestrian links across transport corridors, pathways and usable public space around major roads and railway reservations. This is to include access for people who use mobility aids (for example prams, wheelchairs, walking frames, and luggage).
Sustainable	Promote positive environmental, social, cultural and economic values; recurrent cost savings
Engaging	Reflect and respond to diverse community values and encourage positive interaction
Socially Responsive	Support and encourage communities, connecting nearby facilities, incorporating shops, art, recreation spaces
Site Responsive	Respond to specific local landscape, topography and orientation
Valuing Heritage	Respond to history, memory, understanding of and continuity with the past
Enduring	Relevant across life-spans of many generations; representative of its time and of a high quality
Enjoyable	Create a desire to experience the journey rather a just pass through
Durable	Easy to maintain and will age gracefully
Delightful	Authentic, sensitive and intelligent in design of form, space, proportion, craft and detail

Figure 12: Design principles of stations
Source 12: Victorian Rail Industry Operators Group Standards,p.9

As it is seen in the table, there are several principles when designing a station. An underlying principle is the sustainability of the system. Stations have to be designed taking into consideration future plans. Stations and routes have to be integrated with each other. Passengers have to reach the stations and rolling stocks immediately and safely. The design standards should include design principles for disabled people. The station has to be comfortable during the time that passengers wait for the train.

In the old designs of the stations, there were patrons crossing the tracks at grade but in contemporary operations this is not preferred. The new design of the tracks also causes new designs of stations. Disabled people should be considered during the design of the station, which should include elevators and gradient ramps in the landing. The security and safety of people should be considered by closed circuit TV monitoring.

According to the Victorian Rail Industry Operators Group Standards, Metropolitan and Regional stations are classified according to the extent of services, staff facilities and customer amenities they provide. The definition and characteristics of stations are mainly categorized in two and briefly explained in the tables below. (Victorian Rail Industry Operators Group Standards, 2011)

TYPE	DEFINITION
	METROPOLITAN STATIONS CATEGORY
Premium	▪ Station staffed at all train operating times. ▪ Modal hub location with significant modal interchange facilities. ▪ Number of staff facilities increased to cater for greater staff numbers (See Section 10.4 for station category specific facilities). ▪ Passenger amenities supplied (See Section 11.2 for station category specific amenities) with the quantity of amenities dependent upon patronage. ▪ Increased services and security measures. ▪ Enhanced smart card ticketing sales and smart card reading facilities provided. (See Section 12.4 for station category specific ticketing requirements; ▪ Heating/Ventilated enclosed waiting area/s provided which are supervised by CCTV and staff. ▪ On account of the focus on modal interchange, they will have low to medium volume car parks.
Host	▪ Station staffed during morning peak periods. ▪ Modal hub location with modal interchange facilities. ▪ Basic staff facilities provided See Section 10.4 for station category specific facilities). ▪ Passenger amenities supplied (See Section 11.2 for station category specific amenities) with the quantity of amenities dependent upon patronage. ▪ Services and security measures supplied. ▪ Smart card ticketing sales: CVM and smart card reading facilities: FPD provided. ▪ On account of the focus on modal interchange, they will have medium volume car parks.
Un-staffed	▪ Station un-staffed. ▪ Selected services and security measures required. ▪ CCTV provided but monitored from nearby control station. ▪ No ticket office, Smart card ticketing sales: CVM and smart card reading facilities: FPD provided. ▪ Associated modal transfers provided with a focus on local connections. ▪ High volume car park facilities where small or no modal interchange provided.
Terminal	Where a station is a terminating station, driver's facilities shall either be incorporated in the existing operational facilities or provided as separate facilities in addition to the general requirements of the station category.

Figure 13: Metropolitan Stations Category
Source 13: Victorian Rail Industry Operators Group Standards, p.15

	REGIONAL STATIONS CATEGORY
Premium	▪ Station staffed at all train operating times. ▪ Modal hub location with significant modal interchange facilities. ▪ Number of staff facilities increased to cater for greater staff numbers (See Section 10.4 for station category specific facilities). ▪ Passenger amenities supplied (See Section 11.2 for station category specific amenities) with the quantity of amenities dependent upon patronage. ▪ Increased services and security measures. ▪ Enhanced smart card ticketing sales and smart card reading facilities provided. (See Section 12.4 for station category specific ticketing requirements; ▪ Heating/Ventilated enclosed waiting area/s provided which is supervised by CCTV and staff. ▪ Medium to high volume car parking.
Modal Hub Station	▪ Station staffed to meet patronage peaks, which may be for the majority of the train operating times. ▪ Modal hub location with significant modal interchange facilities. ▪ Number of staff facilities provided dependant on staff numbers (See Section 10.4 for station category specific facilities). ▪ Passenger amenities supplied (See Section 11.2 for station category specific amenities) with the quantity of amenities dependent upon patronage. ▪ Increased services and security measures. ▪ Enhanced smart card ticketing sales and smart card reading facilities provided. (See Section 12.4 for station category specific ticketing requirements; ▪ On account of the focus on modal interchange, they will have medium volume car parks.
Commuter Station	▪ Station staffed during morning peak periods as a minimum. ▪ Associated modal transfers provided with a focus on local connections. ▪ Number of staff facilities provided dependant on staff numbers (See Section 10.4 for station category specific facilities). ▪ Passenger amenities supplied (See Section 11.2 for station category specific amenities) with the quantity of amenities dependent upon patronage. ▪ Increased services and security measures. ▪ Smart card ticketing sales: CVM and smart card reading facilities: FPD provided. ▪ High volume car park facilities.
Regional Station	▪ Unstaffed station. ▪ Associated modal transfers provided with a focus on local connections. ▪ No ticket office, Smart card ticketing sales: CVM and smart card reading facilities: FPD provided. ▪ Low volume car parks facilities, selected customer amenities, services and security measures required.
Crew/Other maintainers Facilities	▪ Premium, Modal hub and Commuter stations may have conductor and train crew facilities in addition to the station staff facilities already provided. Stabling, regional signalling facilities and rolling stock maintenance/provisioning facilities may also be located in the vicinity.

Figure 14: Station Categories Regional
Source 14: Victorian Rail Industry Operators Group Standards, p.16

Another aspect is the type of the platforms, which is high or low. In earlier practices, train platforms were low so that people had to use steps to reach the car floor. In new systems, this is not preferred and high platforms are popular.

2.3.8.4. Signaling and Control Systems

Commuter rail systems have often been developed over a long period of time, and operation frequency and the train number in the lines increased over time. The lines are often used by different types of rails and the system has started to become complex. The old lines have been electrified and the coaches use different types of controlling systems.

The signaling system has been developed rapidly and including automotive train protection, which prevents trains from passing red stop signals, by accident. One of the features of the new system is the capacity for bi-directional running which will enable trains to be run in both directions on either track, giving the operator more flexibility on the overall network.[3]

2.3.8.5. Fare Collection

Traditional practice requires passengers to obtain tickets or passes before boarding, which is then checked by a conductor. This still prevails in fare collection on old commuter/regional routes. In modernized operations, including most systems described as regional rail services, operators started to use electronic systems, which are integrated with the other transportation modes. The cards have a weekly, monthly, or annual basis. Automatic fare accumulation does reduce the requirement for staff at stations and on trains.

2.3.8.6. Yards

Yards are the main requirements of storage and maintenance of rolling stock for all railroad operations. Old freight yards can be used for commuter/regional rail usage too. These yards especially serve for holding equipment during the nights and

[3]http://www.kiwirail.co.nz/index.php?page=signalling-and-traction

days, for daily maintenance of the equipment, such as cleaning, repairing, painting and refurbishing which can be also done at the other sites in joint use (Grava, 2002).

As it is mentioned before the creation of these systems, need a big investment. One of the most expensive part of this system is the yards. The yards need a large space for construction and the location of the yard is important for the future plans. It is nearly impossible to build yards in the city center. The yard should be accessible for the existing and the future of the railway routes.

2.3.8.7. Power Supply

The old and the new locomotives use different kinds of power supply. The old locomotives use diesel power although the new locomotives mostly known as the Electric Multiple Units (EMUs) use the electricity.

“Besides diesel power, electric locomotives are frequently employed. The original systems depended on 11,000-V AC, 25-Hz current supplied by overhead catenaries. Modem power supply utilizes 25,000 V AC, 60 Hz. Some commuter/regional rail systems rely on metro-like arrangements—600 to 650 V DC drawn from a third rail.’’ (Electric Power Supply for Commuter Rail: Are Railroads Keeping Up)

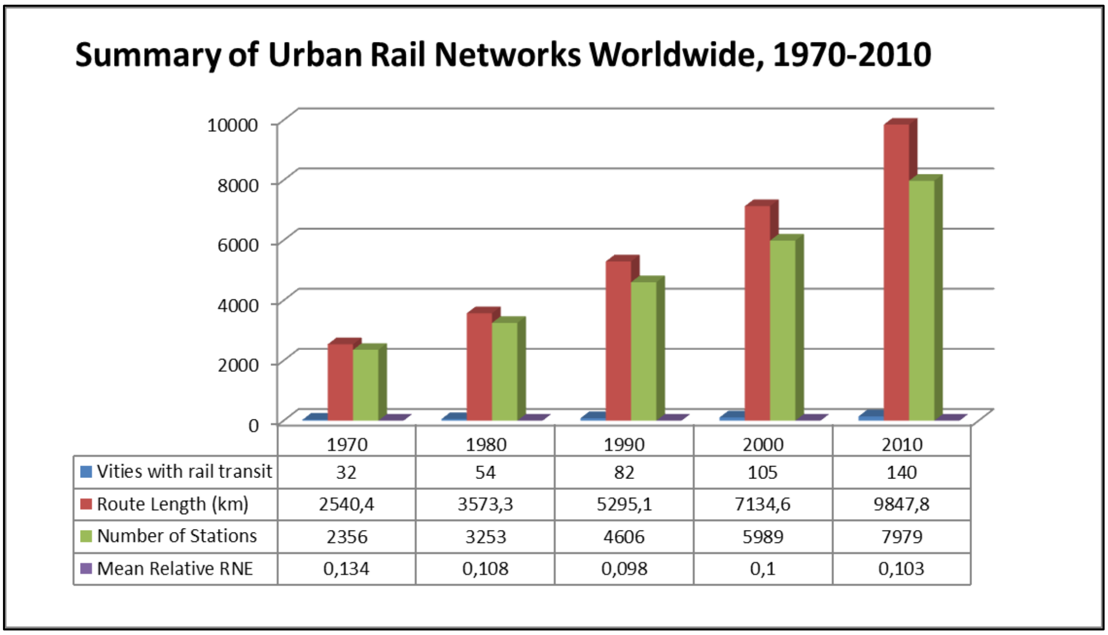
2.4.Increasing Investment in Regional Rail System

Investments in urban rail systems have increased all around the world in the past three decades. Due to the increase in travel distances and growth of inter-city regional economic interactions, as seen in city-region formations, regional rail services that provide longer distance travel for urban transport became also popular.

Year	Cities with rail transit	Route length (km)	Number of stations	Mean relative *RNE*	Cities with *ARC* = 4	Cities with *ARC* = 3	Cities with *ARC* = 2	Cities with *ARC* = 1	Cities with *ARC* = 0
1970	32	2540.4	2,356	0.134	0	1	4	13	14
1980	54	3573.3	3,253	0.108	0	1	9	22	22
1990	82	5295.1	4,606	0.098	0	3	16	26	36
2000	105	7134.6	5,989	0.100	1	9	23	24	48
2010	140	9847.8	7,979	0.103	4	17	37	11	71

Note: RNE = rail network exposure; *ARC* = airport rail connectivity.

Figure 15: Summary of Urban Rail Networks Worldwide, 1970-2010
Source 15: Niedzielski & Malecki (2011),p:1417



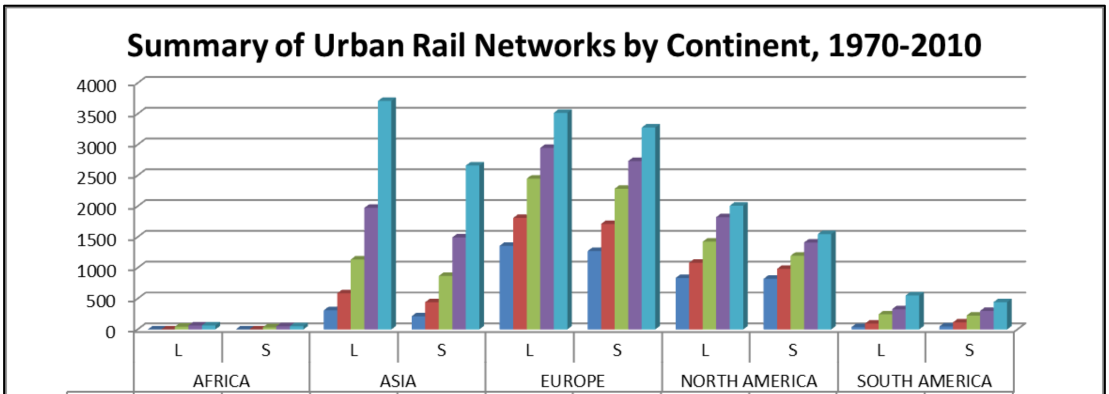
RNE=Rail Network Exposure; ARC=Airport Rail Connectivity
Graph 1: Summary of Urban Rail Networks Worldwide, 1970-2010

Table 5. Summary of urban rail networks by continent, 1970–2010

	Africa		Asia		Europe		North America		South America	
Year	*L*	*S*	*L*	*S*	*L*	*S*	*L*	*S*	*L*	*S*
1970	0	0	310.2	214	1,357.5	1,272	834.8	821	38.0	49
1980	0	0	587.1	442	1,809.6	1,713	1,082.0	983	94.6	115
1990	43.8	34	1,134.9	867	2,447.6	2,284	1,423.7	1,196	245.1	225
2000	63	51	1,973.4	1,494	2,946.2	2,733	1,823.2	1,411	328.8	300
2010	65.5	53	3,708.1	2,660	3,515.9	3,277	2,007.0	1,546	551.3	443

Note: L = route length in kilometers; *S* = number of stations.

Figure 16: Summary of Urban Rail Networks by Continent, 1970-2010
Source 16: Niedzielski & Malecki (2011), p:1418



	AFRICA L	AFRICA S	ASIA L	ASIA S	EUROPE L	EUROPE S	NORTH AMERICA L	NORTH AMERICA S	SOUTH AMERICA L	SOUTH AMERICA S
1970	0	0	310,2	214	1357,5	1272	834,8	821	38	49
1980	0	0	587,1	442	1809,6	1713	1082	983	94,6	115
1990	43,8	34	1134,9	867	2447,6	2284	1423,7	1196	245,1	225
2000	63	51	1973,4	1494	2946,2	2733	1823,2	1411	328,8	300
2010	65,5	53	3708,1	2660	3515,9	3277	2007	1546	551,3	443

L=Route Length in kilometers; S=Number of Stations

Graph 2: Summary of Urban Rail Networks by Continent, 1970-2010

Commuter Rail Practices from the World

1.SAN FRANCISCO, CALTRAIN

According to Duncan (2005), railroad system is one of the most common public transportation choice in San Francisco Peninsula. The railroad connection reaches out among San Francisco and San Jose, first capital city in California. San Francisco and San Jose Railroad Company constructed the rail system in the year 1864 and in 1870 South Pacific Railroads (SP) was integrated to ownership.

The commuter rail system in San Francisco is used not only by middle-income class but also upper class living in San Francisco. Furthermore, the residential and business areas were relocated through the rail line after Caltrain started to operate in 1991. (Tsai, 2014)

On 2012 July the first bullet train funding for the construction and electrification of Caltrain has been started. Therefore, the transformation from steam power to diesel was supported by government mandated positive train control system.

Accordingly, McGovern (2012), Caltrain and the Peninsula Commuter Services, The San Mateo County Transit District (Sam Trans), the Santa Clara Valley Transportation Authority (VTA) and the San Francisco Municipal Transportation Agency (SFMTA) are co-operators of JPB. 3 enrollees of each company in JPB's were empowered to over Caltrain system. Administrative and operation issues are conducted by Sam Trans. Furthermore, Transit America Services Company had a duty on train stuff together with maintenance of rolling stocks and right-of-way.

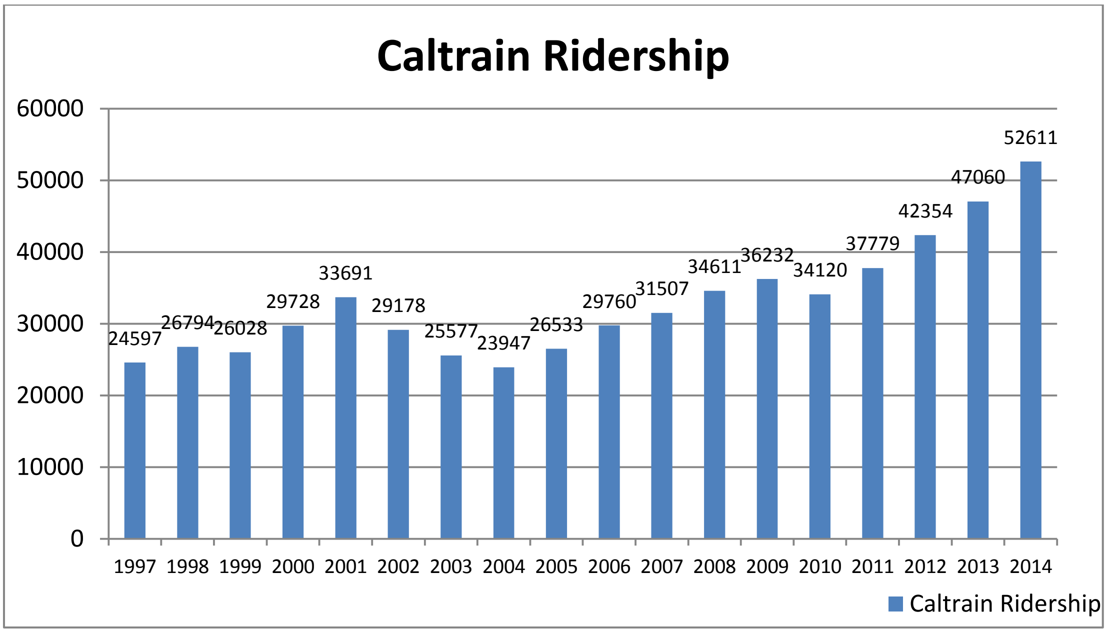
Caltrain had 98 headways in every weekday in 2008, however it was decreased to 86 headways on weekdays because of economic considerations. In 2012, the headways of Caltrain commuter rail system had been increased to 92 (http://www.caltrain.com/about/statsandreports.html).

Caltrain system had additional connections, which are the connections of urban development over the years. A direct connection to metro line was provided by Caltrain-Muni Metro station in 1998 and in 1999 the Light Rail System was extended from Santa Clara to Mountain View Caltrain Station and then the San Jose Diridon Station. A passenger attachment between Bay-Area Rapid Transit (BART) and Caltrain located close to San Francisco International Airport Millbrae Station. This intermodal station was supported by many Sam Tran vehicles. San Jose International Airport has also connections from Santa Clara Caltrain Station via free VTA shuttles.

Map 1: Caltrain System Map
Source 17: http://www.mobilemaplets.com/thumbnails/4299_thumbnail-1024.jpg

Caltrain Express Project was completed on 2004 June. The project includes some additional lines in Brisbane and Sunnyvale by a centralized traffic control system. Caltrain Express has 57 minutes travel time for 4 stations and 59 minutes for 5 stations in total. On the other hand, the traditional trains have 1 hour 30 minutes for all route.

Caltrain ridership diagram is located below. According to this diagram, the ridership increased because of Silicon Valley. Silicon Valley had led to very powerful reverse commuter traffic on Caltrain.



Graph 3: Caltrain Average Weekday Ridership Trend
Source 18: Caltrain Annual Passenger Counts, Final Report, 2014

According to ridership diagram, there was a steady increase in years 1997 to 2001- except 1999. The years between 2001-2004, Caltrain ridership was decreased because of the construction of Baby Bullet system and in 2005 improvement of the service. On the other hand, the ridership increased from 2005 to 2009 till 2010. Furthermore, the Baby Bullet System increased the ridership of Caltrain approximately 77%. Between the years 2010-2014 the ridership of Caltrain has increased steadily. (Tsai, 2014)

According to Rail Journal Online; Caltrain; the Californian commuter rail operator plans to make a modernization investment about the electrification of the San Francisco and San Jose route. Caltrain Modernization Programme includes a transformation of diesel locomotives to Electrified fleet until the year 2019. Because of the fact that, Caltrain policies include environmental issues, the offerings would be evaluated under clearance guidelines. For that reason, the project has not been signed by Caltrain Company.

2. DUBLIN, DART

Dublin city in Ireland has a strong and efficient railway network in progress. This network has 5 main lines which provide the significant part of public transportation in the city center. These lines are;

- Northern Commuter Service (from Dublin city center to Dundalk)
- Kildare Commuter Service (the west side, from Heuston station to Portlaoise)
- Maynooth Commuter Service (from Dublin city to Longford)
- Southern Commuter Service (from Gorey to Dublin city)
- DART (Dublin Area Rapid Transit) (from Greystones in County Wicklow to Howth and Malahide in northern County Dublin) (http://www.irishrail.ie/about-us/dart-commuter).

All lines are owned and operated by Iarnrod Eireann. The Northern Commuter line has 15 stations in progress. South Eastern Commuter, the least frequent line, has 14 stations on operation. The South Western Commuter line (Kildare Suburban), the newest Dublin/DART Commuter system, has 8 stations in total and started to operate in 1994. The Western commuter has two different branches. The city branch has 18 stations while Docklands branch has 10. This line started to operate in 1981 as a limited service until 1990. However, in 2001 a revision on that area led to improve the line from Clonsilla and Maynooth.

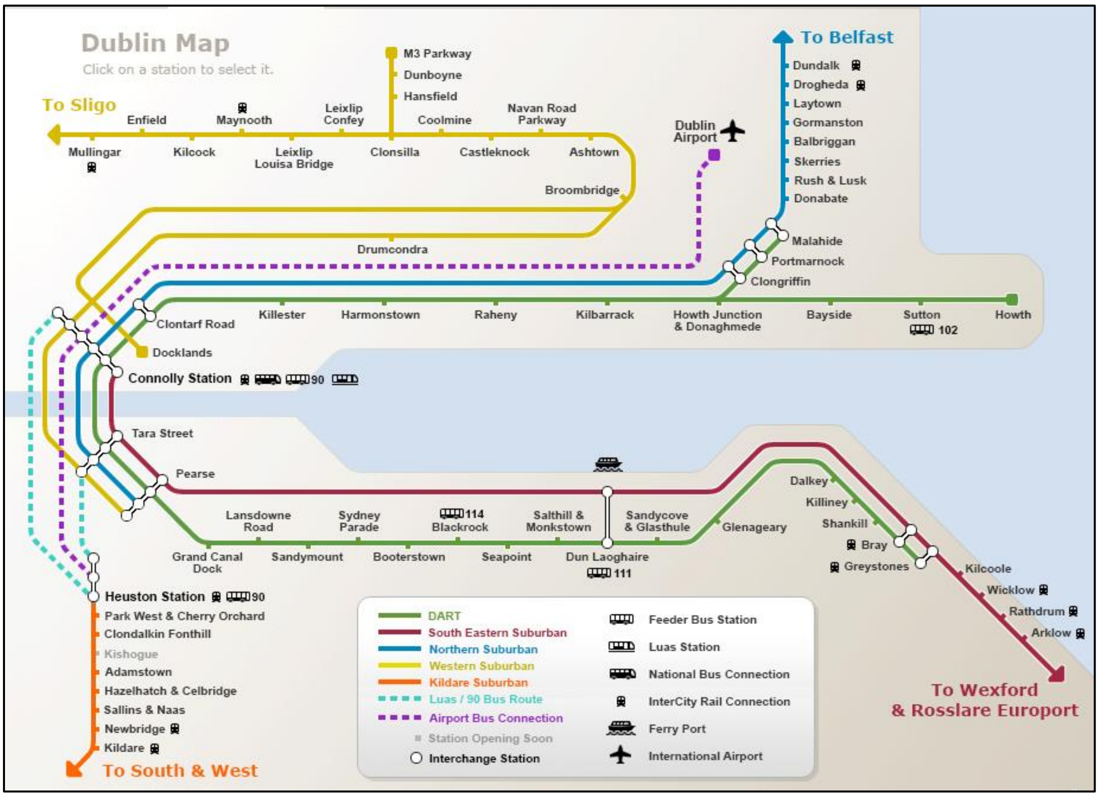
According to Railway Gazette, 2010, 5 stations from Northern Commuter lines and 5 stations for South Western Commuter line are planned to electrified by 2015 according to Transport 21 Plan. Furthermore, this plan also compromises of replacing of these lines with DART lines[4].

According to the web site of Irish Rail, the service for these 4 lines starts at 05:30 to 00:42 from Monday to Saturday and 08:25 to 00:42 on Sundays. The

[4] http://www.railwaygazette.com/news/single-view/view/commuter-trains-return-to-dunboyne.html

frequencies of the lines vary to each other but when they compare to the DART, the trip numbers are quite less than DART[5].

The DART system started to operate in 1984 with a high-dense ridership in peak hours at that time. Therefore, in 2009, the capacity was increased 40% by Transport 21 Plans in order to reduce the density (Railway Safety Bill, 2001). Recently, the system runs at 53 km length with 2 different lines, 31 stations in total[6].



Map 2: Dublin Transportation Map
Source 19: http://www.irishrail.ie/media/dublinarea_large.jpg?v=ge3u1pa

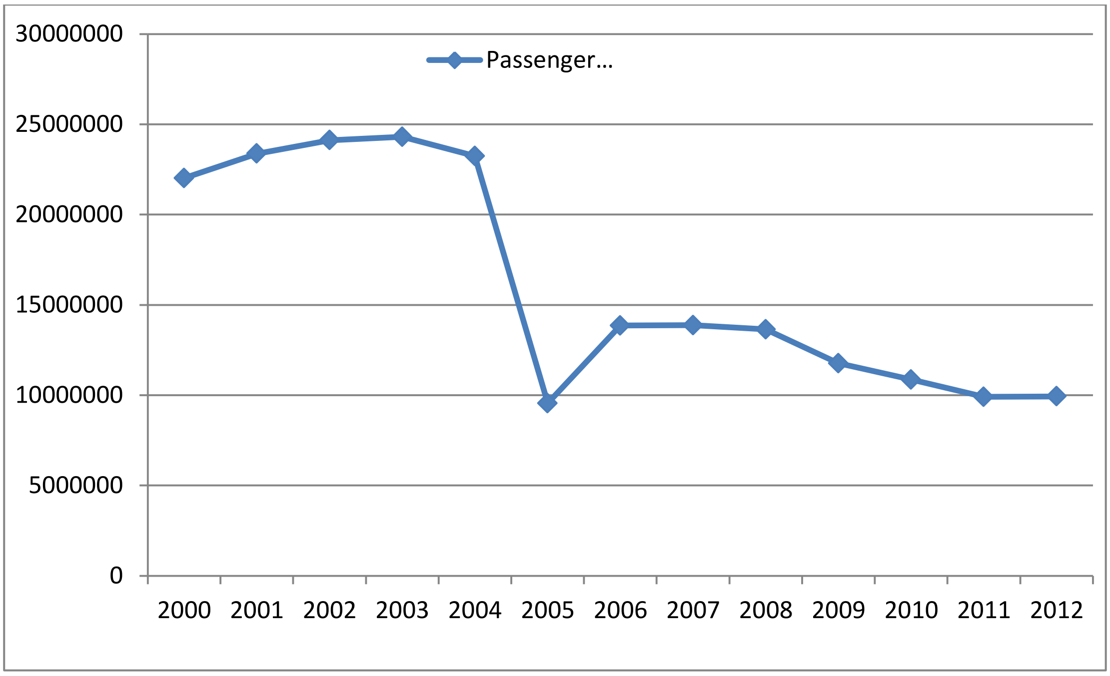
Table 1: Dublin suburban railway services passenger numbers by years

Years	Passenger Numbers
2000	22026000
2001	23373000
2002	24120000
2003	24302000
2004	23240000
2005	9556000
2006	13862000

[5] http://www.irishrail.ie/timetables/timetable-pdfs
[6] http://historical-debates.oireachtas.ie/D/0560/D.0560.200302060007.html

2007	13880000
2008	13645000
2009	11768000
2010	10861000
2011	9911000
2012	9934000

Source 20: http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?maintable=TCA01



Graph 4: Dublin suburban railway services passenger numbers by years

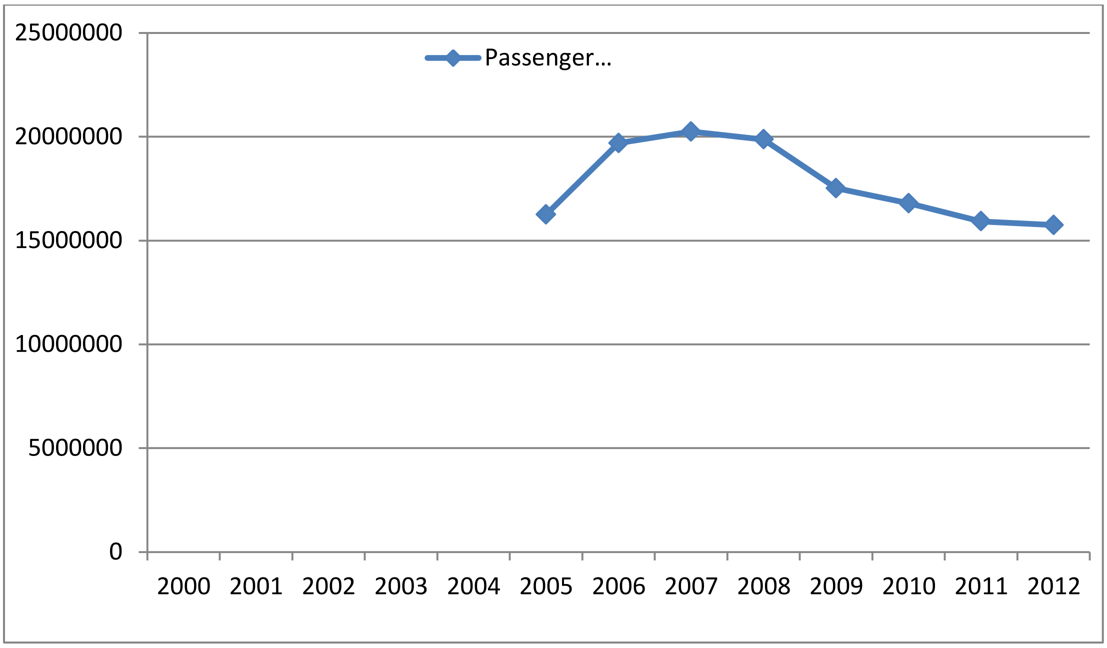
Table 2: DART passenger numbers by years

Years	**Passenger Numbers**
2000	-
2001	-
2002	-
2003	-
2004	-
2005	16256000
2006	19689000
2007	20244000
2008	19865000
2009	17520000
2010	16793000
2011	15924000
2012	15747000

Source 21: http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?maintable=TCA01

*Passenger data for DART was included in category Dublin suburban services prior to 2005.

After DART started to operate the ridership of commuter operations decreased.



Graph 5: DART passenger numbers by years

3.BERLIN, S-BAHN

Berlin, as most other cities, has two different separate railway lines which formed both the transportation network and pattern of urban development around the city. These 2 formative lines are U-Bahn for Untergrundbahn which is "underground railway" and S-Bahn for Stadtschnellbahn which is "city rapid railway". U-Bahn, as an underground railway system, has a network on inner city with high dense residential and commercial centers, while S-Bahn has much more wide and sprawl network from city center to commuter areas in Berlin as well as Bremen, Dresden, Hamburg, Hanover and more cities.

S-Bahn project was managed by Deutsche Stadteisenbahn-Baugesellschaft (DEBG) Company until it crashed in late 1870's. After that crash, the government decided to manage the S-Bahn project by public funding rather than private participations. The S-Bahn, which was called central Station of Berlin, was opened in 1882 with a total length of 12 km (Fabian, 2000). The main line was electrified in the year 1928. Central area focused S-Bahn line was elevated on 731 viaduct arches. These arches are the milestones of urban development in Berlin because they could not formed as any other transportation forms. Furthermore, these areas were functioned as commercial areas like, restaurants, malls, shops or markets. Therefore, S-Bahn line was an effective axis to shape the urban form.

Being established as a Capital city of Germany, Berlin was established after the unification of two different states in 1990. After demolishing the Berlin Wall in 1989, U-Bahn and S-Bahn had to be combined. The S-Bahn is a rapid-transit commuter system within both public transport and commuter rail networks. Therefore, the line reduces both the city centre and suburban traffic in the peak hours. (Fabian, 2000).

Public transport network [1] and stations

	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010	2012
Regional railway network (in km)	100.0	120.9	123.5	148.2	153.1 [4]	156.0 [4]	152.0 [4]	211.3	213.2	213.2	204.6
Regional stations	9	10	13	13	15	16	15	19	21	21	21
S-Bahn network (in km)	200.4	209.5	222.3	249.0	251.8	255.3	256.5	257.0	257.0	256.2	256.2
S-Bahn stations	97	115	117	128	130	131	131	131	132	132	132
U-Bahn network (in km) [2]	134.5	137.9	142.9	143.3	144.2	144.2	144.2	144.2	144.9	146.3	146.3
U-Bahn stations	160	162	167	169	170	170	170	170	170	173	173
Tram network (in km) [3]	178.3	176.8	179.8	181.6	187.7	187.7	187.7	189.4	189.7	189.7	191.2
Bus lanes per direction (in km)	67.1	67.1	93.3	94.4	99.8	101.5	101.9	101.7	101.4	101.4	101.1

1) Trafficable network
2) Line kilometres
3) Length of routes in operation
4) Estimated data, fluctuations in network length due to line changes resulting from building works

Figure 17: Public transport network and stations
Source 22: Berlin Traffic Data, Public Transport, 2013. p:49

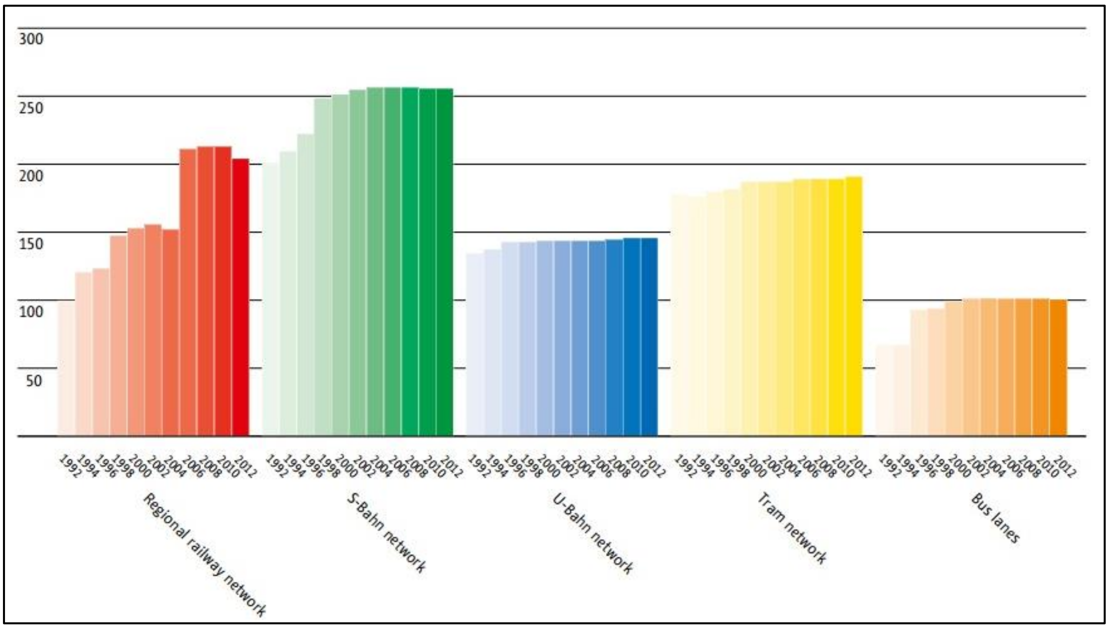
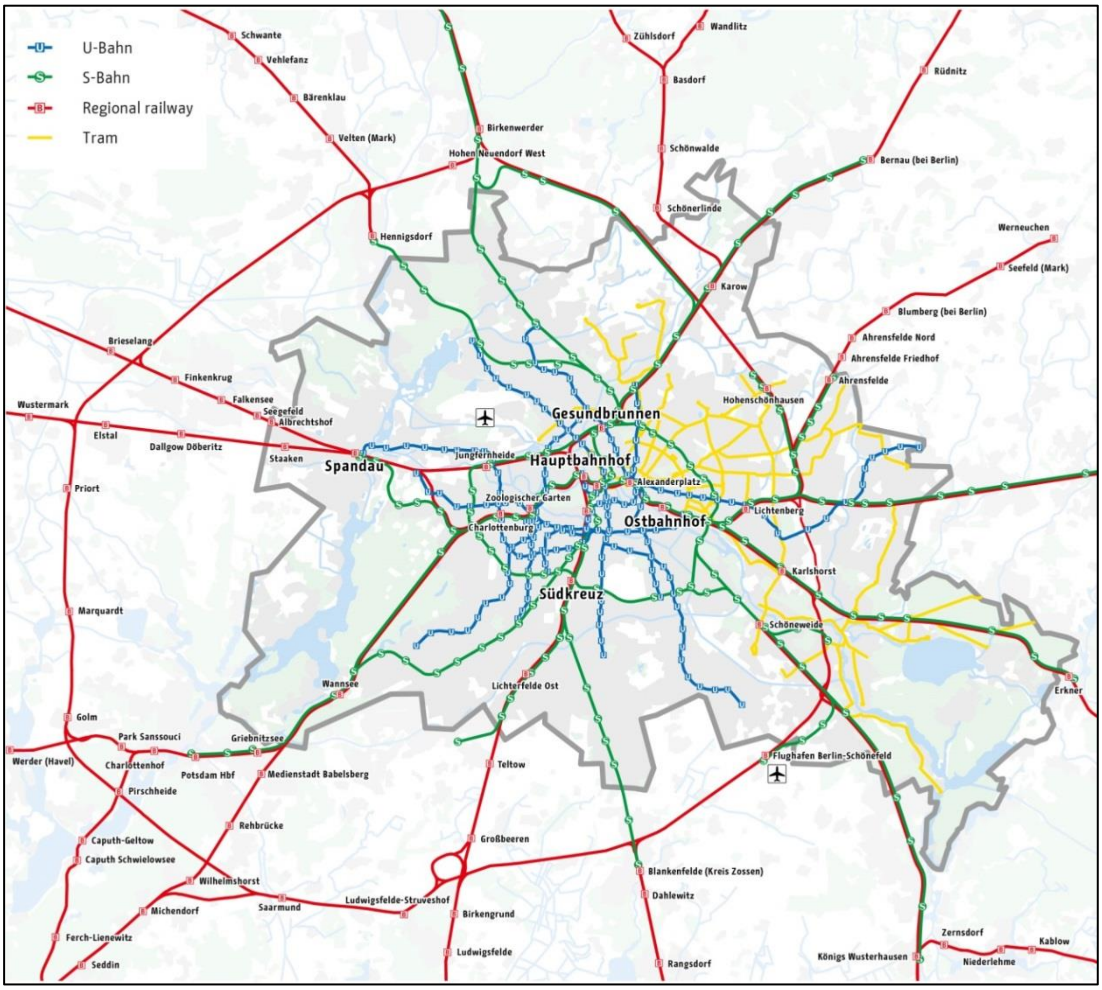


Figure 18: Length of routes in operation (in kilometers)
Source 23: Berlin Traffic Data, Public Transport, 2013. p:49

As it can be seen at figures above, S-Bahn railway system has sprawled among the city accordingly by the years 1992-2006 so as the stations in 1992-2012. Furthermore, S-Bahn system is the most used public transportation network.

S-Bahn line connects whole other rail transport units all around the city. Mostly elevated east-west line- the Stadbahn and the Ringbahn, a central underground north-south line- the Nord-Süd Tunnel are supported both by S-Bahn line.



Map 3: Integration Map of Berlin S-Bahn and Other Railways, 2013
Source 24: Berlin Traffic Data, Public Transport, 2013. p:50

Map 4: S-Bahn Map
Source 25: http://upload.wikimedia.org/wikipedia/commons/f/f9/S-Bahn_Rhein_Main_Map.png

	1995	1997	1999	2001	2003	2005	2007	2009	2011	2012 6)
Annual passenger volume, total (in millions)	1,146	1,085	1,107	1,137	1,253	1,307	1,324	1.351	1,375	1,386
Passengers BVG (U-Bahn, bus & tram) (in millions)	872	789	787	798	890 3)	907	904	925	937	937
Passengers S-Bahn (in millions)	245	264	280	296	315	357	371	371 5)	383	395
Passengers in regional transport (in millions)	29	32	40	43	48	43 4)	49	55	55	54
Local network passengers, total (in millions) 2)			1,038	1,136	1,185	1,227	1,237	1,260	1,281	1,291

1) Passenger volume S-Bahn and regional transport including Brandenburg
2) Local public transportation network passengers outside the city, and S-Bahn passengers of all transportation providers in Verkehrsbund Berlin-Brandenburg (VBB)
3) From 2003 new survey and projection
4) From 2005 new survey and projection
5) Stagnation in passenger volume as a result of the S-Bahn crisis
6) Figures for regional transportation and totals still provisional (later revision possible)

Figure 19: Public Transport Passenger Volume
Source 26: Berlin Traffic Data, Public Transport, 2013. p:53

According to Public Transport Passenger Volume table, S-Bahn has increased its ridership in years 1995-2012.

In Turkey too, there have been developments in modernizing existing commuter services to turn them into modern regional rail services, resulting in investments to extend their lines and improve service levels. This is parallel to spatial growth that metropolitan cities experienced, as well as some city-region developments as seen in Istanbul and Izmir. As a consequence of these spatial growth patterns, travel distances have increased for daily trips, including commuting, business or leisure trips.

The development of rail system in Turkey together with recent developments in commuter and regional rail systems will be presented in Chapter 4.

2.5.Summary and Main Findings

Spatial growth patterns in metropolitan cities and those with city-region characteristics result in increased travel distances. Regional rail systems provide a solution in such cases where meeting mobility demands for such long-distance daily travel become a challenge. Regional rail systems are often a modernized version of commuter rail services, which is a form of rail that transports commuters from suburban areas into cities, using the same tracks that intercity railway freight, and passenger trains use. In the case of regional rail systems in urban areas and city-regions, the connections are not limited to city centres and suburban neighborhoods however. Similarly, trips offered on regional rail systems are not limited to commuting but include also business and leisure trips. Regional rail systems, like the Commuter Rail Transit, usually travel at high speeds and with few stops and the trains are usually large and comfortable.

As mentioned before, a number of Turkish cities have also been experiencing significant spatial growth, transforming into city-region development. In order to provide public transport access that can accommodate travel demands in long distances with high-quality level of service, a number of cities in Turkey too started to invest in and modernize their commuter rail lines.

Izmir is the first city to do this as it launched a model partnership project for regional rail operations between Turkish State Railways and the local authority, i.e. the Greater Municipality of Izmir. Furthermore, the local authority invested in the line and vehicles to transform the service into a frequent urban/regional service with new large vehicles. The line has also been extending to provide access to new locations within the Izmir city-region.

The above literature provided information about the planning and operation of commuter and regional rail services, showing that the following issues are important and therefore should also be assessed for Izmir:

- Right of way
- Station spacing
- Station design; facilities and amenities at the stations; disabled access
- Platforms and boarding
- Yards and maintenance sites
- Fare collection
- Operating schedule; frequency, service hours
- Integration of the system with other transportation modes

The analysis of cases from the world also revealed the importance of system integration: the commuter rail systems should be well integrated into other urban transport systems, and intermodal stations are common to provide convenient and fast transfers between modes of transport. The world cases also support the above issues regarding service speed, station spacing and design.

In the following chapter, the methodology of the study will be introduced. Based on this, the chapters that follow will present railway developments in Turkey, the organizational change in commuter/regional rail services, and then the specific case of Izmir regional rail system.

CHAPTER 3

METHODOLOGY

3.1.Context

As it has been shown in the previous chapters of the study, the population and the car ownership is rapidly increasing in the globalized world. Today, this makes the urban transportation system more important than before. Among the public transportation modes, rail modes are preferred in large metropolitan areas because of their speed, capacity and being environment-friendly although the railway systems are highly expensive investments. There is a rapid increase in the urban rail investments in all over the world especially in the metropolitan areas. Among the urban rail systems, regional rail systems have also been gaining importance due to increasing distances and the consequent need for higher-speed services.

Regional rail systems indicate modern, fast regional rail lines, which are often a modernization and improvement of old commuter systems. There are two types of regional rail investment: the first and the most popular one is modernizing the old rail lines and the tracks because of its low cost, the second one is building new lines and creating new tracks which is not so preferred because of its high cost. Regional rail services are not the same as commuter services since the latter provided service limited to morning and evening commuting journeys. Commuter railways have been existing nearly all over the world including developing countries. The systems have been modernizing and taking new names such as regional rail, suburban rail, above ground etc.

There are three commuter/regional train systems in Turkey, Istanbul, Ankara and Izmir. All these commuter/regional lines were built more than 50 years ago and due the investment in commuter lines, the system was built to operate in the peak hours for the labors living in the residential areas. By the development of the cities, railways and stations used to be in the suburbs while few stations also took place in the inner city.

Turkey also followed the trend for the modernization of commuter rail lines, with Izmir as the leading example. In most metropolitan cities in Turkey, urban rail system investments have been increasing in the recent years. Until recently, existing commuter rail systems, which were being operated by the State Railways Agency, have not been popular among the urban rail systems as they offered limited services and operated with old vehicles on old tracks. This has changed with the project in Izmir, which transformed the commuter railways by both a modernization investment and the creation of a new operation model comprising a partnership between the State Railways and the local authority. This case is the main theme of this research.

3.2.Aims, Objectives, Research Questions

İzmir regional rail system, called IZBAN, is the only example of commuter railway modernization through a new partnership between the State and local government, although the two other cities with commuter lines, namely Ankara and Istanbul also followed suit and started similar projects. The latter cases did not complete the investment, nor did they start the operation yet. While Izmir IZBAN currently stands as the only example in Turkey, a performance analysis has not been made for this system. Since there are no similar projects in Turkey, it is impossible to compare it with other experiences in the country. Therefore, the analysis relies on a comparison of the planning and operation before and the after changes made due to this project.

According to the research, the partnership system is not being used elsewhere in Turkey yet or another country. The system is a new system and the effects of it will be seen more clearly in the future. The aim of this thesis is to show the achievements, shortcomings, and possible challenges regarding the partnership between the local and the state authority from the perspective of system performance and integrated planning and operation.

In order to make this assessment, the study introduces two main research questions;

1. How has the general performance of İzmir regional rail system changed after the partnership project between state and local authority?

1.1 Has the performance been improving since the local authority took part ofthe operation?

1.2. What factors have been effective in enhancing or hindering the performance of the system?

2. Has there been a better integration and coordination in planning and transport operations after the local authority took over the operation?

2.1 Has the urban planning and transport planning coordination been improved?

2.2 Has the integration between transport modes been improved in terms of both planning and operation?

The analysis of best- practice commuter/regional rail cases in the world, explained in the previous chapter, has already created the criteria standards of the system. In the İzmir case, the criteria explained above will be compared before and after the partnership project.

3.3.Case Study Selection

İzmir Metropolitan Area was chosen as the study case since it is the only example of commuter rail modernization project and the only case of a partnership between the local and the state authority. The project started to operate in 2010, and it is the only modernized regional rail system in Turkey. İzmir Greater Municipality and Turkish State Railways signed a protocol in 2005. After that in 2007 IZBAN has reached its corporate identity and in 2010 the systems started to operate.

3.4.Data

In the last part of the literature review, the world examples have been studied and a list of the measures for the planning and operation of regional rail systems was prepared. Right of way, station spacing, station design; facilities and amenities at the stations; disabled access, platforms and boarding, signaling systems, yards and maintenance sites, fare collection, operating schedule; frequency, service hours, and integration of the system with other transportation modes are covered in this list of measures and hence they will be examined for the case of Izmir.

The available quantitative data was gathered from İzmir Greater Municipality, İzmir Metro Inc., IZBAN Inc and Turkish State Railways (TCDD). The ridership of IZBAN and İzmir Metro do not include the free passes. Not only quantitative data but also qualitative data were gathered from the interviews made with the executive staff of these institutions. The interview questions are below.

INTERVIEW QUESTIONS

This was a semi-structured interview, and therefore rather than formulating exact questions, the following topics have been discussed and certain questions under those topics were addressed:

- General information about the management model
- Is there an existing model that the system adopted?
- Who is the decision- maker?
- How does the cooperation work between TCDD, İzmir Greater Municipality and IZBAN? Are there any problems with the coordination? (Both in terms of transport planning/operation and in terms of coordination between urban planning and transport planning)
- Do you find the coordination between these agencies successfully?
- What are the roles of TCDD, İzmir Greater Municipality and IZBAN
- Are there any problems with the distribution of tasks?
- How are the future extensions and new lines decided and planned? Are the future urban development strategies of Izmir Greater Municipality’s plans taken into

consideration? Who plans the extensions, who approves them? Is there a committee for planning decisions and control of the system?

- What were the steps of the project from beginning to now? (Modernization, feasibility analysis if prepared, etc.)

Information about urban transport and the integration of regional rail system with other modes

- Is there a park and ride system?
- Are there any problems with the parking issues?
- Can bicycle passenger use the system?
- Are there bike parks at stations?
- How does the system integrate with the other public transport modes? (Buses, ferries, metro etc.) (Physical integration issues; fare integration issues)
- Who decide the transfer stations and its locations?

Personal opinions of interviewees

What do you think about the partnership project in general?

Do you think the systems would be more successful if İzmir Greater Municipality operates the system on its own?

Ankara and İstanbul are also planning a modernization of their commuter systems; do you have any information about these projects or whether they are adopting the same partnership model? (To be asked particularly to TCDD experts and IZBAN managers)

Data requested from interviewees

Is there an analysis of workplaces and change in residential area development around stations?

Passenger satisfaction surveys, if there are any.

The before and after data regarding:

- The station spacing
- Frequency
- Ridership

- Platform type
- The organizational scheme
- The list of new lines and modernized lines
- Information on metro and IZBAN ridership
- Detailed information of ridership on IZBAN, with daily, weekly, monthly, annual and station-based statistics

The requested quantitative data cannot be taken from TCDD. The ridership data was found from Turkish State Railways Annual Statistics.

3.5.Methods of the Analysis

In the analysis, IZBAN commuter/regional rail will be analyzed based on a "before and after" approach, focusing on changes that took place after the partnership project. In order to make the analysis, on the 3rd week of October, 2014 a field trip was made. In the field trip each railway station was analyzed individually by visiting the station and observing its physical properties as well as facilities provided within the station site. In addition, interviews were made during the site visit with the executive staff of the main actors (İzmir Greater Municipality, İzmir Metro Inc., IZBAN Inc, Turkish State Railways) that have a role in the project.

This analyses carried out in 5 main topics:

- In the first part the historical development and urban transport system will be analyzed briefly.
- In the second part the commuter rail system will be analyzed under the operation of Turkish State Railways (TCDD).
- In the third part the commuter rail system will be analyzed under the partnership project operation.
- In the fourth part the before-and-after analysis will be made. There will be both a qualitative and a quantitative analysis. The criteria of the analyses are below.
  - Right of way
  - Station spacing

- Station design; facilities and amenities at the stations; disabled access
- Platforms and boarding
- Yards and maintenance sites
- Fare collection
- Operating schedule; frequency, service hours
- Integration and coordination between urban planning and regional rail system planning
- Integration of transport planning and operation
- Integration of the system with other transportation modes

The ridership of IZBAN and metro changes will be compared. The data taken from IZBAN Inc. has the ridership between August 2010 and October 2014. The data taken from İzmir Metro Inc. has the ridership January 2010 and September 2014. There are missing data in both of them. 2012 February ridership data and 2014 November and December data is missing in IZBAN. 2014 October, November and December ridership data is missing in İzmir Metro Inc. The comparisons are made with same data of the ridership of each rail system.

CHAPTER 4

REGIONAL RAIL DEVELOPMENTS IN TURKEY

4.1.Historical Background

According to the data taken from the Turkish State Railways Annual Statistics 2001-2005, when Turkish Republic was declared in 29.10.1923 approximately 4.000 km of railway lines that were built and operated by various foreign companies remained within the national borders of the new State. These lines were nationalized by Law No: 506, which came into effect on 24.05.1924 establishing also the "General Directorate of Anatolian-Baghdad Railways". Following Law No: 1042 that was passed on 31.05.1927 the name was changed to "General Administration of State Railways and Ports "in order to unite the railway construction and operational activities under one authority and to broaden the scope of functioning.

The Administration, which functioned as a supplementary budgeted public enterprise until 29.07.1953, was converted to a Public Economical Enterprise under the name "Republic of Turkey General Directorate of State Railways Administration (TCDD)" with a Government Decree No: 233 in Power of Law(Turkish State Railways Annual Statistics 2001-2005, p.3).

Republican Period

1923- 1940 period

In this period, the railways were nationalized and new lines were created. The initial 4559 km of railway in Anatolia has been extended to 8637 km in 1940. (Kamusen, Türkiye'de Demiryolunun Tarihi Gelişimi, 2009).

According to the 1st National Railway Congress Statement; 1st and 2nd Five-Year Industrialization Plans prepared in 1932 and 1936, emphasized railways to support iron and steel, coal and machinery industries since such massive loads are carried cheapest and safely by railways. As a result, railway investments in this period gained importance. In these plans, the railways were seen as crucial to strengthening potential production centers, provide access to natural resources, and support the economic development of the country, especially in the less developed regions. (1. Ulusal Demiryolu Bildirileri, Ankara, 1979).

1940-1960 period

Until the World War II, although the economy was not stable new lines had opened. However, after the war, the economic crisis all over the world affected Turkey too and there was a stagnation period. The 3208 m of railway lines that were completed until 1940 could only be increased to 3578 km between the 1923-1960 period. This period is also important due to a US Federal Government aid that was received to invest in the development of the road network. This resulted in a road-oriented transport investment programme for the next decades and railway infrastructure was neglected.

1960-2000 period

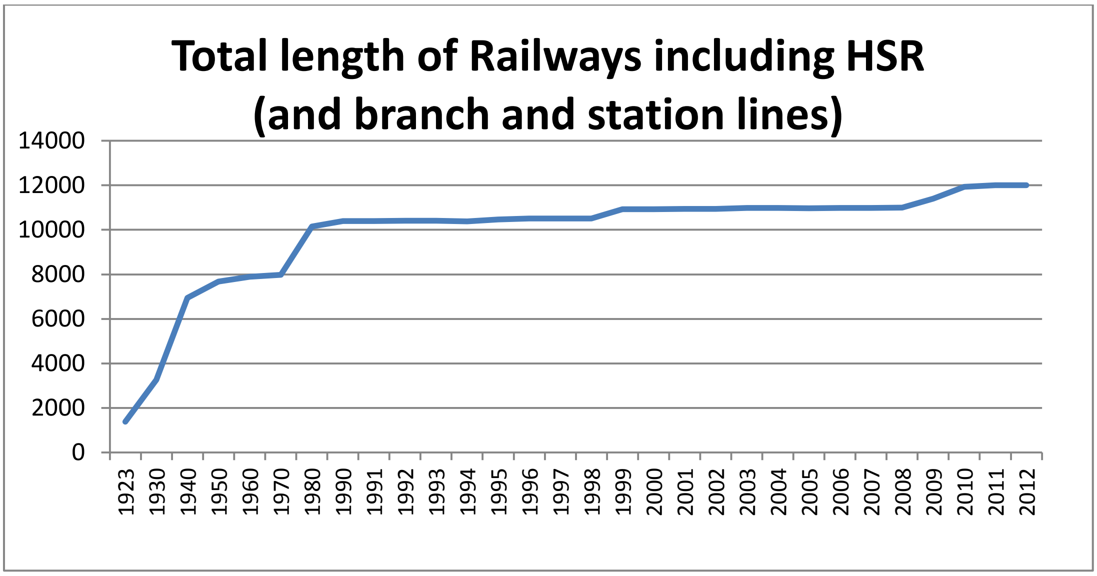
Under investment in railways continued after the 1950s. The main reason of this was the change of the main transportation policy of the state after the US aid as mentioned above. (1950'li Yıllarda Türk Ekonomisi Üzerine Amerikan Kalkınma Reçeteleri Hilts Raporu, Thomburg Raporu, Barker Raporu, Sami Güven, Ezgi Kitabevi Yayınları, Bursa-Eylül 1998). Although Five-Year Development Plans of the country since the 1960s have been emphasizing the need to develop railways and to prevent the growth of the transport sector being dominated by roads only, railway investments remained limited.

After 2000's

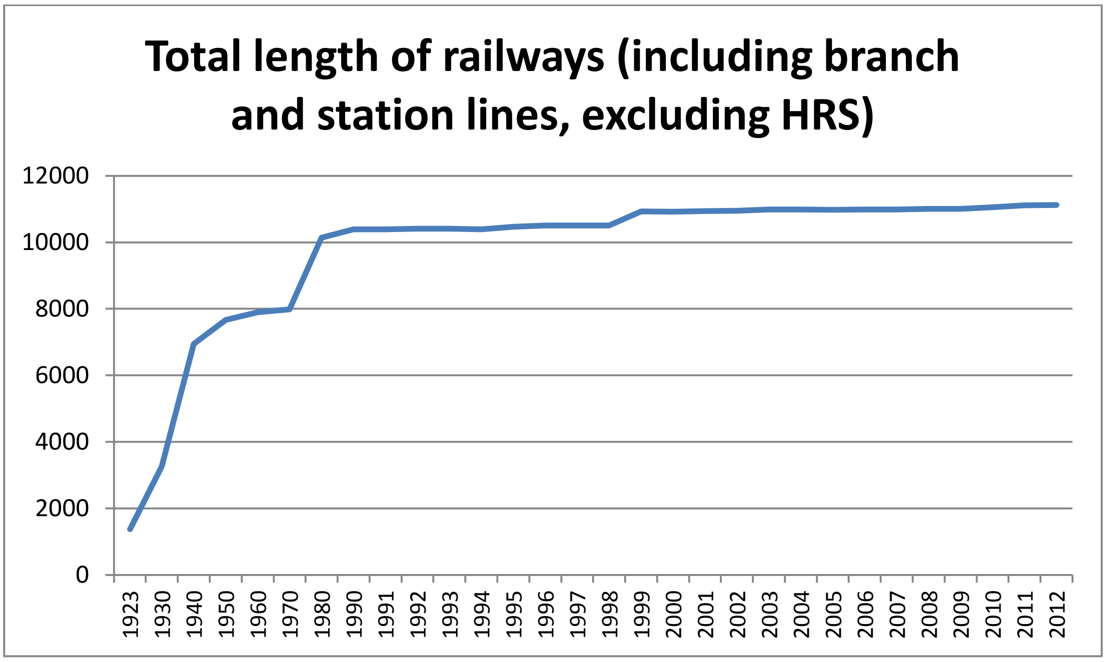
The Five-Year Development Plan prepared in 2001 also emphasized that it was crucial to develop railways, both to improve existing lines and to expand the network. Turkish State Railways aims at the renewal of existing lines; however, as seen in the figures below, building of new lines has remained limited. Nowadays, there is a significant policy priority to build high-speed rail systems; however, apart from these investment railway lines are not extended.

According to the website of TCDD, with the end of 2012 the active railway length is 12008 km; of these 11120 km is conventional lines and 888km is high-speed train lines(http://www.tcdd.gov.tr/home/detail/?id=266).

The historical development of railways in Turkey is seen in the two figures below. The first includes the high-speed lines and the second excludes these lines.



Graph 6: Total length of railways including HSR (and branch and station lines)
Source 27: Turkish State Railways Annual Statistics



Graph 7: Total length of railways (including branch and station lines, excluding HRS)
Source 28: Turkish State Railways Annual Statistics

4.2.State Railways as Operators of Commuter/Regional Rail

Commuter rail services in Turkey have been provided only in three cities, Ankara, İzmir and İstanbul. These railway operations locate in specific routes; Sincan-Kayaş in Ankara, Cumaovası-Aliağa in İzmir, Haydarpaşa-Gebze and Sirkeci-Halkalı in İstanbul. Ankara commuter rail system, which runs along Sincan-Kayaş, is 37 km length in total and has 26 stations. One trip takes 53 minutes from Sincan to Kayaş station in that line. İzmir Cumaovası-Aliağa line is 80 km in length and it has 31 stations in total. This line is planned to be extended to Torbalı. İstanbul Haydarpaşa-Gebze commuter rail system (45 km length) is composed of 27 stations and it takes 65 minutes from beginning to end. In addition, Sirkeci-Halkalı line is 28 km length and has 18 stations in total. In that line a trip from one end to the other takes approximately 48 minutes.

Sincan-Kayaş commuter rail system in Ankara was completed in 4 phases. The Variants of Esenkent-Sincan, the main component of Sincan-Kayaş line, the 1st phase (2.5 km) and the 2nd phase (2.4 km) were completed in 1957. The 3rd phase of the

Esenkent-Sincan Variant was established in 1963 while the 4th phase got opened in 1965. Sincan-Kayaş line, which is the whole system of commuter rail in Ankara city, started to operate in 1970 (TCDD Genel Müdürlüğü BYHİM Web ve İnteraktif Hizmetler Bürosu, 2010). Sincan-Kayaş destination has 154 trips in a day. The headway of the line is 10 minutes in peak hours and 15 minutes for other time periods. Total travel time for Sincan Kayaş line takes 53 minutes; Sincan-Ankara 31, Ankara-Kayaş 22 minutes separately.

İzmir Menemen-Aliağa line was completed in 1995 with a length of 26 km. In addition to that line Şirinyer-Cumaovası line started to operate in the year of 1996 with a length of 15 km (TCDD Genel Müdürlüğü BYHİM Web ve İnteraktif Hizmetler Bürosu, 2010).

Furthermore, 44 km length İstanbul Haydarpaşa-Gebze and 27 km length Sirkeci-Halkalı commuter rails were completed in the year of 1949 (TCDD Genel Müdürlüğü BYHİM Web ve İnteraktif Hizmetler Bürosu, 2010).

4.2.1. Commuter Rail Operations in Turkey's Metropolitan Cities

The commuter rail system information and details for the metropolitan cities; İstanbul and Ankara are explained below.

İstanbul commuter rail line is operated by international and long distance trains. The commuter rail line locates at the two sides of the Marmara Sea in İstanbul metropolitan area. The line operated by TCDD reaches out the destination Sirkeci – Halkalı and Haydarpaşa – Gebze locations (İstanbul Metropoliten Alanı Kentsel Ulaşım Ana Planı, (İUAP), Mayıs 2011)

İstanbul; Haydarpaşa-Gebze Line

Haydarpaşa-Gebze commuter rail provides the drop offs and pickups of passengers in every station at Anatolian side. The train stays roughly 30-35 seconds in each station and after stay 10-15 seconds the doors are closed. Station destinations for the line are approximately 2.5 minutes and the train from Gebze depart at 15.55 and arrive Pendik at 16.21. After 7 minutes waiting for passing the ‘Başkent Ekspresi’, the commuter rail moves at 16.28. In the same way, on the way back the train moving from Haydarpaşa station at 9.44 arrives to Kartal at 10.17 and after 6 minutes waiting for the passing of the ‘Başkent Ekspresi’, it moves at 10.23.

Haydarpaşa-Gebze line has 27 stations and one trip takes 65 minutes. The usual route for the line is listed in a row below.

Haydarpaşa-Söğütlüçeşme-Kızıltoprak-Feneryolu-Göztepe-Erenköy-Suadiye-Bostancı-Küçükyalı-İdealtepe-Süreyyaplajı-Maltepe-Cevizli-Atalar-Kartal-Yunus-Pendik-Kaynarca-Tersane-Güzelyalı-Aydıntepe-İçmeler-Tuzla-Çayırova-Fatih-Osmangazi-Gebze

Some of the stations on the line have been removed or cancelled for spatial reasons. For instance, Coşkunoğlu station is cancelled for being out of residential area district at that region. Besides, Çayırova station is limited for all trains because of being located out of residential districts.

The Haydarpaşa-Gebze commuter rail system focused serves major development focus areas in the central city. For instance, Söğütlüçeşme station is located at the intersection point of Şükrü Saraçoğlu Stadium, Salı Pazarı and Kadıköy. Furthermore, Suadiye station is close to Bağdat Street. Moreover, Gebze station is located at the road close to the Eskihisar-Topçular ferry. Bostancı station has a proximity to İDO pier and dolmuş stations. Erenköy, Bostancı, Maltepe, Kartal, Pendik, Tuzla and Gebze stations are considered to be among the largest stations.

However, in the current situation, the line is out of order for the modernization construction of high-speed train project. Operation has been halted since 19 June 2013. (TC Ulaştırma Denizcilik ve Haberleşme Bakanlığı 2006-2010 İstatistik Yıllığı)

<u>İstanbul; Sirkeci Halkalı Line</u>

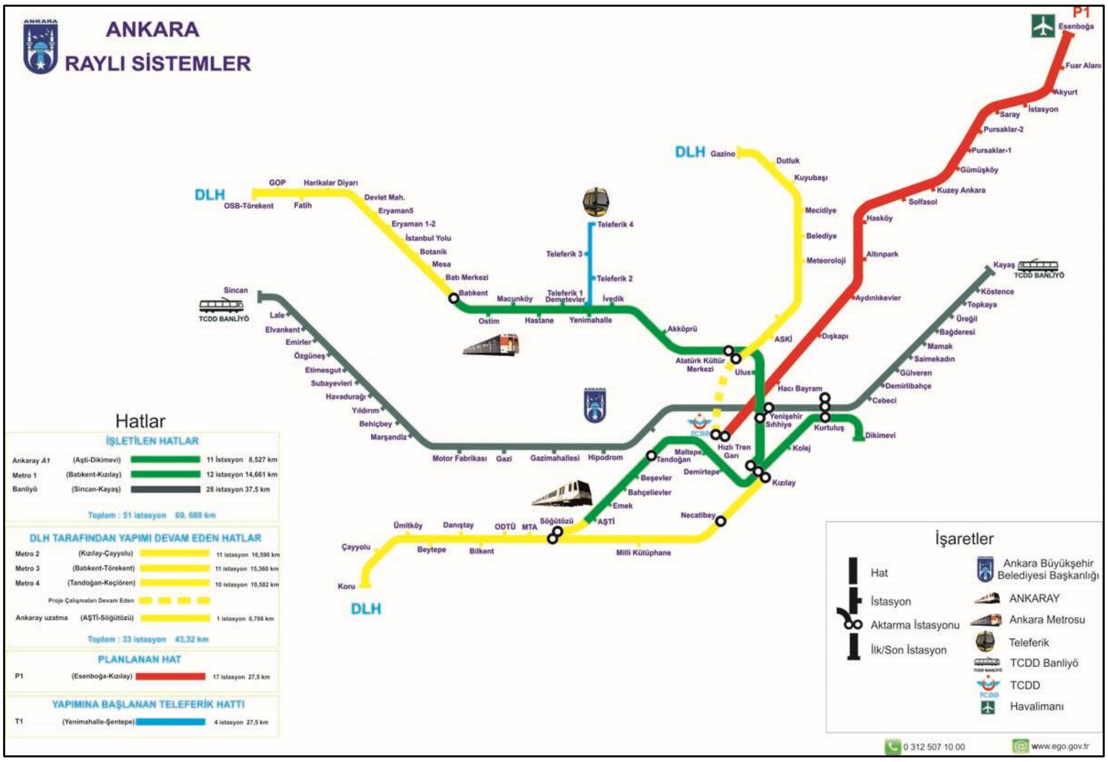
Sirkeci-Halkalı commuter rail line is at the European side and has 18 stations. Trip destination from Sirkeci to Halkalı takes 47 minutes. The route for that line goes along in a row, Cankurtaran, Kumkapı, Yenikapı, Kocamustafapaşa, Yedikule, Kazlıçeşme, Zeytinburnu, Yenimahalle, Bakırköy, Yeşilyurt, Yeşilköy, Florya, Menekşe, Küçükçekmece, Soğuksu, Kanarya and Halkalı stations.

İstanbul commuter rail line illustrations are located below.

Map 5: Commuter Lines in İstanbul
Source 29: http://upload.wikimedia.org/wikipedia/commons/3/30/Istanbul_Rapid_Transit_Map.png

Ankara; Sincan-Kayaş Line

Sincan-Kayaş commuter rail system operates along Sincan-Kayaş in Ankara and TCDD is the owner and operator of the line. This line started to operate in the year of 1929 and at 1972 electric trains were introduced for services. Railway line among Sincan and Ankara station was completed and started to operate in 1892. This line had rather less trains in terms of number and these trains were pulled by steam traction engine before TCDD management. In the current situation E14000 suburban train sets serve for the commuter rail line, which was electrified in 1972. Visual images for Sincan-Kayaş rail is located below.



Map 6: Commuter Line in Ankara
Source 30: http://www.rayhaber.com/wp-content/uploads/Ankara-Rayli-Sistem-Haritasi-1.jpg

Sincan-Kayaş line trips have been out of order since 1 August 2011 because of the construction of Ankara Metropolitan Municipality's Yeni Çiftlik Boulevard and transformation of grade crossings to interchanges. Afterwards, TCDD went out to tender in 25 April 2012 for 'Başkentray' Project concluding Sincan-Ankara-Kayaş line's reconstruction. The project could not be actualized because of the rejections for tender and legal processes. Finally, Public Procurement Authority reached a verdict to cancel Başkentray Project on 2011 May.

The passenger numbers of Ankara, İzmir and İstanbul commuter rail systems are given below by years. As seen in the table; operation and services stopped at Basmane and Alsancak stations in Izmir in 2007 due to modernization and IZBAN started to operate at August 2010. Ankara Sincan-Kayaş commuter rail line has been out of service since 2011 due to the cancellation of Başkentray Project.

Table 3: Passenger Numbers by Years

	Number of Passenger by Years (*1000)													
Types of Trains	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SUBURBAN														
Sirkeci	28274	25193	20345	18825	19652	21495	21442	21015	21943	22236	21105	22268	23736	24341
Haydarpaşa	24016	19931	17056	14946	14555	13792	16722	19196	22200	23829	25324	26409	28987	26020
Ankara	17752	14660	14158	14407	15088	15116	14118	13173	12162	9152	10824	11224	6703	
Basmane	1438	616	87	60	44	70	135	23						
Alsancak	1393	728	253	215	183	117	78	75						
TOTAL	**72873**	**61128**	**51899**	**48453**	**49522**	**50590**	**52495**	**53482**	**56305**	**55217**	**57253**	**59901**	**59426**	**50361**
Mainline														
Blue Train	893	1157	1044	906	1158	1221	1255	1516	1489	1377	1389	1024	1102	958
Express	21262	19928	20338	20926	23485	22241	20175	20442	21387	20502	18224	19240	21127	14552
Ordinary Passenger	3660	2909	2777	2526	2539	2464	2124	1670	1713	1692	1910	1719	1232	903
Sleeping cars	140	137	125	142	160	124	114	122	158	144	133	139	127	36
High Speed Train											942	1890	2557	3350
Total	**25955**	**24131**	**25284**	**24500**	**27342**	**26050**	**23668**	**23750**	**24747**	**23715**	**22598**	**24012**	**26145**	**19799**
International	103	84	139	135	129	116	143	182	208	255	241	260	181	124
Grand Total	**98931**	**85343**	**76322**	**73088**	**76993**	**76756**	**76306**	**77414**	**81260**	**79187**	**80092**	**84173**	**85752**	**70284**
IZBAN Suburban												2647	35438	50361

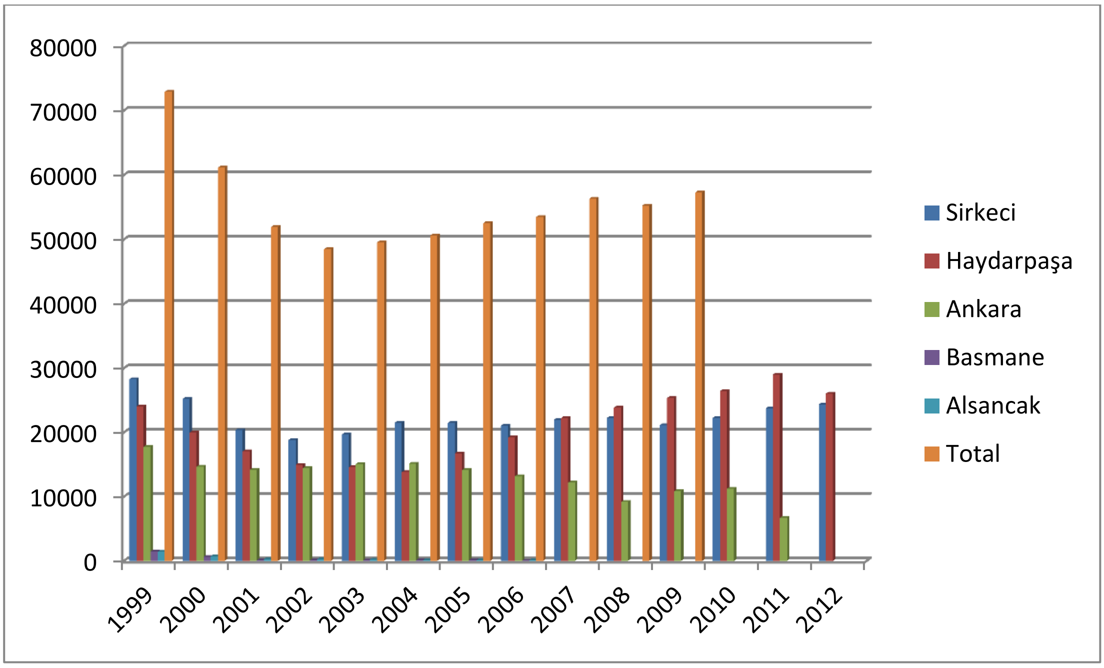
Source 31: Turkish State Railways Annual Statistics

Table 4: Passenger Kilometers by Years

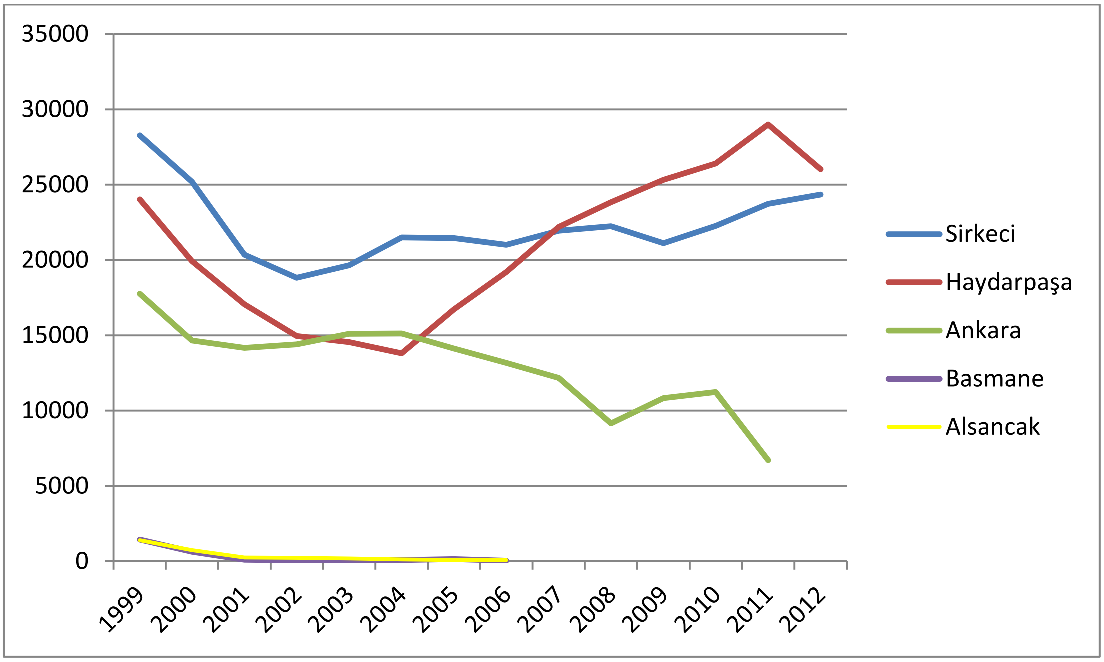
	Passenger-Kilometers by Years (*1000000)													
Types of Trains	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SUBURBAN														
Sirkeci	792	705	570	527	550	602	600	588	614	622	591	624	665	681
Haydarpaşa	600	498	426	374	364	345	418	480	555	596	886	924	1015	911
Ankara	444	367	354	360	377	378	353	329	304	229	325	337	200	
Basmane	26	11	1	1	1	1	3	1						
Alsancak	21	11	4	3	3	2	1	1						
TOTAL	**1883**	**1592**	**1355**	**1265**	**1295**	**1328**	**1375**	**1399**	**1473**	**1447**	**1802**	**1885**	**1880**	**1592**
Mainline														
Blue Train	414	531	472	390	511	517	532	622	616	551	550	413	444	398

Express	3225	3139	3101	2982	3555	2901	2690	2786	2867	2704	2355	2349	2611	1520
Ordinary Passenger	503	458	496	408	355	338	302	310	405	195	234	162	115	90
Sleeping cars	91	87	80	89	101	87	78	84	111	102	93	93	87	27
High Speed Train											237	476	665	914
Total	**4233**	**4215**	**4149**	**3869**	**4522**	**3843**	**3602**	**3802**	**3999**	**3552**	**3469**	**3493**	**3922**	**2949**
International	60	25	64	70	61	65	59	76	81	98	103	113	80	57
Grand Total	**6146**	**5832**	**5568**	**5204**	**5878**	**5236**	**5036**	**5277**	**5553**	**5097**	**5374**	**5491**	**5882**	**4598**

Source 32: Turkish State Railways Annual Statistics



Graph 8: Number of Passenger by Years (*1000)
Source 33: Turkish State Railways Annual Statistics



Graph 9: Number of Passenger by Years (*1000)
Source 34: Turkish State Railways Annual Statistics
*Alsancak and Basmane stations closed in 2007
*Ankara (Sincan-Kayaş) closed in 2012

According to the statistics given above the commuter rail system in metropolitan systems, there are various fluctuations. Some of these may be related to the economy as well as construction works. The recent increase in ridership in Istanbul commuter rail lines may also be due to the spatial growth of the city, increasing problems of traffic congestion, and improvements in public transport services and integration. In contrast both in Ankara and Izmir commuter rail ridership levels have been decreasing. This changed in Izmir after the modernization and organizational changes. The İzmir case will be analyzed in the following sections below.

CHAPTER 5

ANALYSIS OF IZMIR REGIONAL RAIL SYSTEM AS THE FIRST EXAMPLE OF THE PARTNERSHIP PROJECT OF REGIONAL RAIL OPERATIONS BETWEEN STATE RAILWAYS AND A LOCAL AUTHORITY

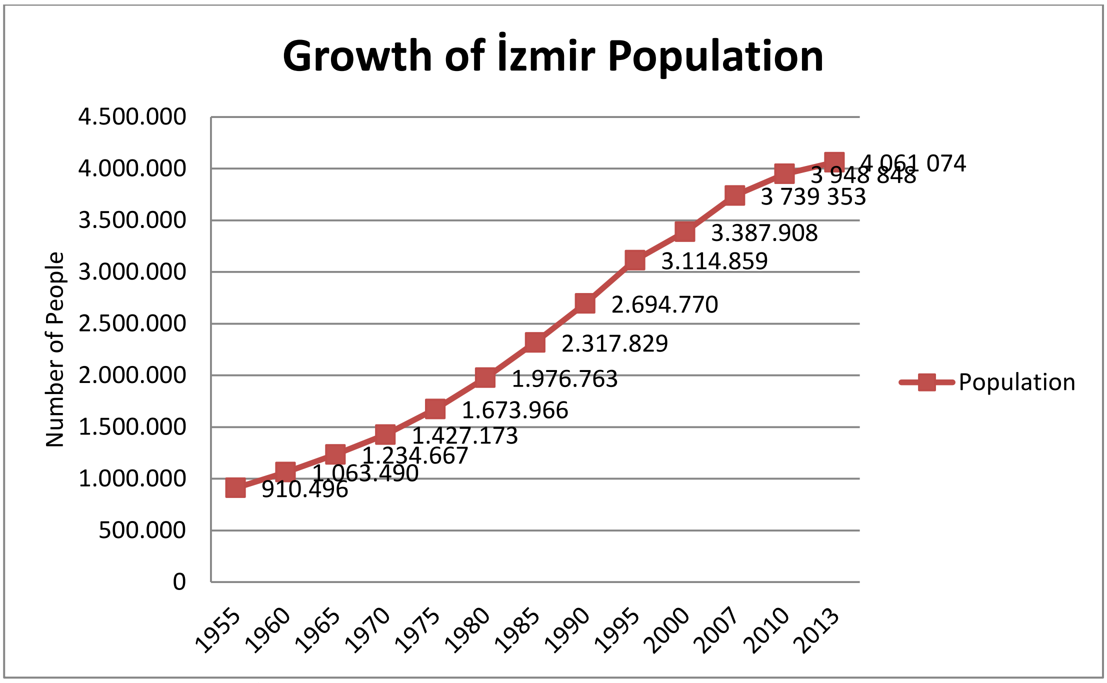
5.1.Historical Background

Izmir is home to 5.2% of Turkey's total population, with 4.061.074 inhabitants according TUİK 2013 Census results. It is the third largest city of Turkey after Istanbul and Ankara.

Table 5: Growth of İzmir Population

Year	Population
1955	910.496
1960	1.063.490
1965	1.234.667
1970	1.427.173
1975	1.673.966
1980	1.976.763
1985	2.317.829
1990	2.694.770
1995	3.114.859
2000	3.387.908
2007	3 739 353
2010	3 948 848
2013	4 061 074

Source 35: TUİK



Graph 10: Growth of İzmir Population
Source 36: TÜİK

Table 6: Socio-Economic Development Ranking of Cities (2010)

Rank	City	Index	Rank	City	Index
1	İstanbul	17.1245	42	Nevşehir	-0.2616
2	Ankara	13.3247	43	Kastamonu	-0.3892
3	İzmir	9.2423	44	Afyonkarahisar	-0.3938
4	Kocaeli	8.5219	45	Sivas	-0.4488
5	Bursa	5.7950	46	Elazığ	-0.8997
6	Eskişehir	5.4807	47	Malatya	-0.9008
7	Antalya	5.1158	48	Çankırı	-0.9061
8	Muğla	3.6780	49	Sinop	-1.1215
9	Bolu	3.6312	50	Çorum	-1.1268
10	Tekirdağ	3.5553	51	Osmaniye	-1.1892
11	Denizli	3.4636	52	Erzincan	-1.2898
12	Isparta	3.0835	53	Bartın	-1.4700
13	Kırklareli	3.0434	54	Aksaray	-1.4828
14	Edirne	2.9301	55	Niğde	-1.5252
15	Bilecik	2.7733	56	Giresun	-1.6070
16	Çanakkale	2.6545	57	Kahramanmaraş	-1.7012
17	Yalova	2.6408	58	Tokat	-1.8371
18	Adana	2.6245	59	Kilis	-2.4608
19	Kayseri	2.4042	60	Ordu	-2.4979
20	Aydın	2.2610	61	Erzurum	-2.5724
21	Burdur	2.2574	62	Yozgat	-2.7304
22	Mersin	2.1565	63	Tunceli	-2.8327
23	Balıkesir	2.1406	64	Gümüşhane	-2.8523
24	Konya	2.0486	65	Bayburt	-3.0414
25	Manisa	1.8884	66	Diyarbakır	-3.7639
26	Sakarya	1.7031	67	Adıyaman	-3.8313
27	Zonguldak	1.4035	68	Batman	-4.1247
28	Karabük	1.3401	69	Şanlıurfa	-4.6074
29	Uşak	1.1997	70	Ardahan	-4.7460
30	Karaman	0.9203	71	Iğdır	-4.8515
31	Kırıkkale	0.7540	72	Kars	-4.9092
32	Samsun	0.5417	73	Siirt	-5.1654
33	Gaziantep	0.4191	74	Mardin	-5.3043
34	Kütahya	0.3115	75	Bingöl	-5.7479
35	Hatay	0.2870	76	Van	-5.8239
36	Trabzon	0.1402	77	Bitlis	-5.9739
37	Rize	0.1379	78	Şırnak	-6.3983
38	Amasya	0.0346	79	Hakkari	-6.4263
39	Düzce	-0.1387	80	Ağrı	-6.5364
40	Artvin	-0.2353	81	Muş	-6.6496
41	Kırşehir	-0.2598			

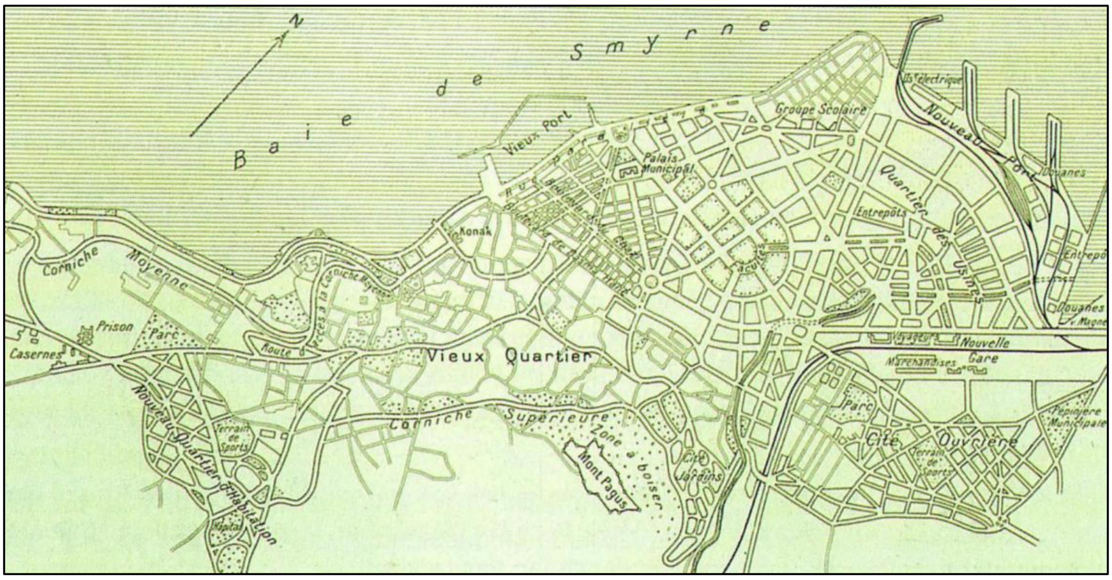
Source 37: Türkiye'de İllerin Sosyo-Ekonomik Gelişmişlik Sıralaması (2010)

According to the research of Socio-Economic Development Ranking in Turkey, İzmir has the 3rd ranking.

5.1.1. Urban Development: Past And Present Urban Plans and Urban Development Trends in Izmir

Izmir has always been one of the largest cities in Turkey. Various planning studies have been carried out for Izmir since the early days of the Republic. These are described briefly below.

1.The plan of Danger and Prost (approved in 1925 and revised by the municipality staff in 1933)

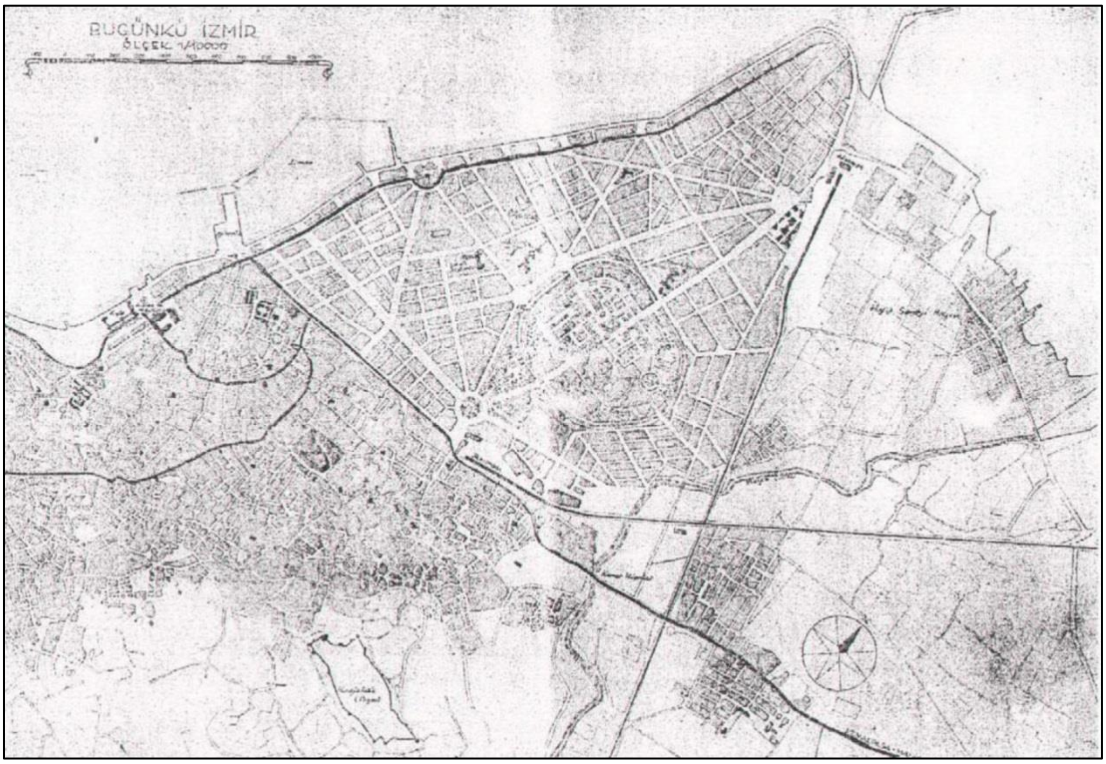


Map 7: The plan of Danger and Prost
Source 38: İzmir Metropolitan Municipality Archives

After the 1st World War, the Turkish Republic was established in 1923 and the first city plan for Izmir was produced shortly after. This plan was prepared in 2 steps. In 1925, the master plan was prepared and in 1933 the plan was revised. According to Bilsel (1996), the main goals of the plan in 1925 were mainly:

- To combine the two railway stations
- To relocate the port complex and create a new port
- To develop new residential areas
- To build new town on destroyed areas (Bilsel, 17)

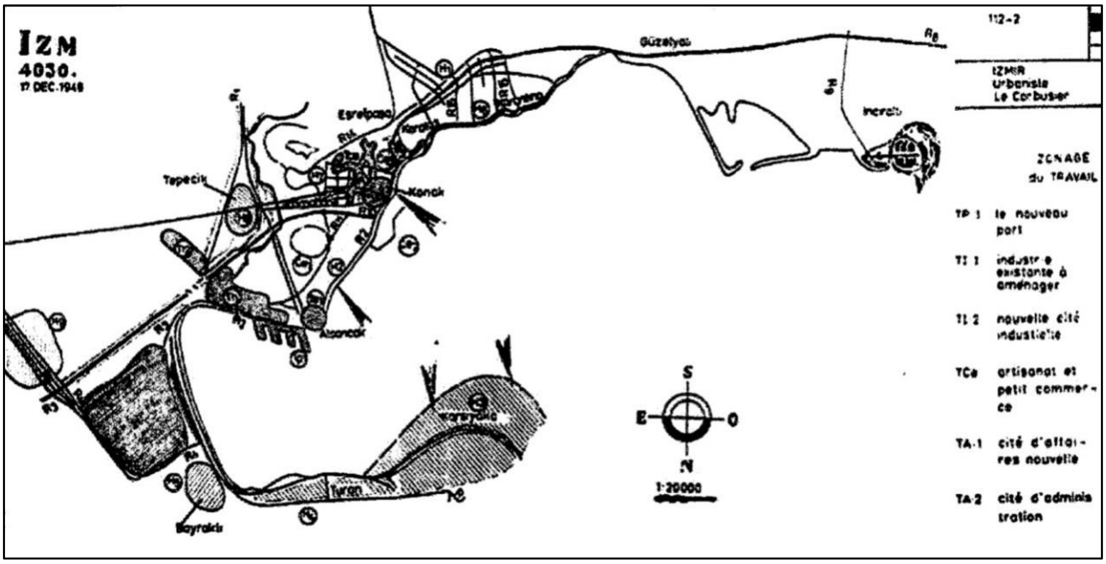
After the World Economic Depression in 1929, the economy of the country was affected negatively and government prepared a five-year development plan. According to this, the plan of Danger and Prost has been revised.In the revision plan, a large park was created in Alsancak (in time the park was enlarged and surrounded by residential areas).



Map 8: The revision of the Danger and Prost Plan in 1933
Source 39: İzmir Metropolitan Municipality Archives

2.The Plan of Le Corbusier (completed in 1949 but not approved)

The Plan of Le Corbusier was prepared in 1949. This was a schematic proposal prepared at 1/20000 scale as shown in the figure below.



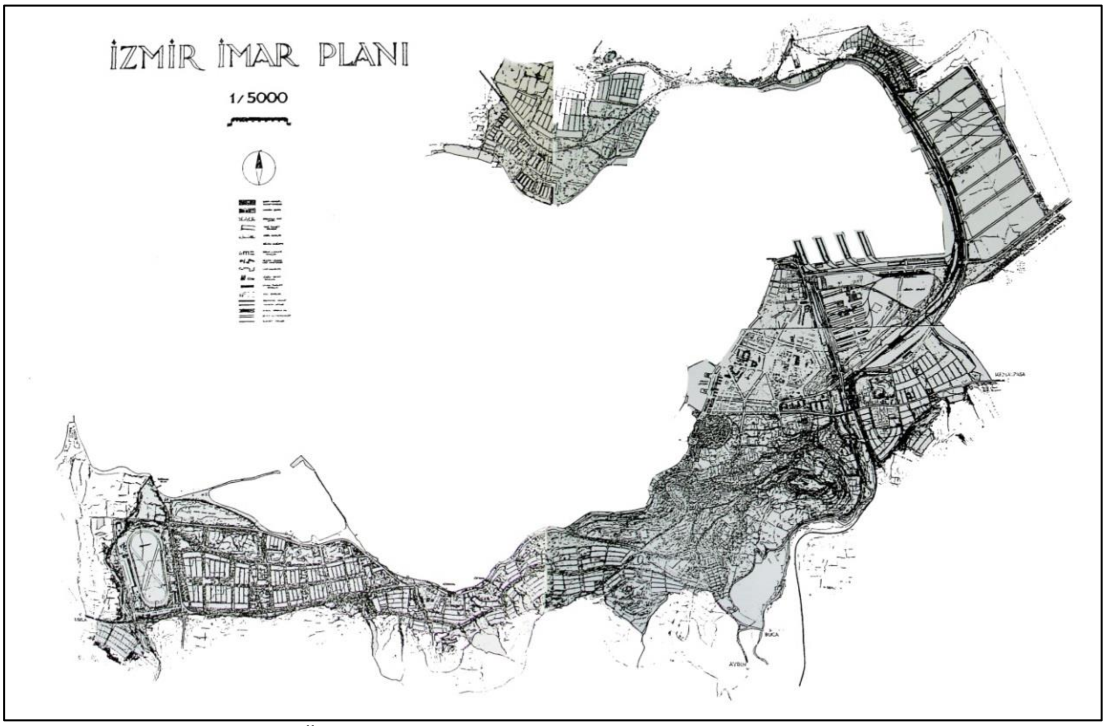
Map 9: The schematic plan of Le Corbusier
Source 40: İzmir Metropolitan Municipality Archives

The population has grown since the last plan and the city needed a new plan to meet the needs for spatial growth. According to Kaya (2005), the main decisions of the plan were mainly;

- To propose new land use decisions
- To accept some of the decisions in the first plan (combination of railway stations and expansion of the port)
- To propose new residential areas
- To make a connection between the industrial zones and railroads and motorways

The municipality however did not implement the plan because the plan was prepared before the world war. Since the implementation of the plan was about to start the existing structure was not suitable for plan and the plan was no longer feasible.

3.The Plan of Aru, Özdeş and Canpolat (prepared as a competition project in 1952, improved by the planning office of the Municipality of İzmir with the collaboration of Aru and approved in 1955)

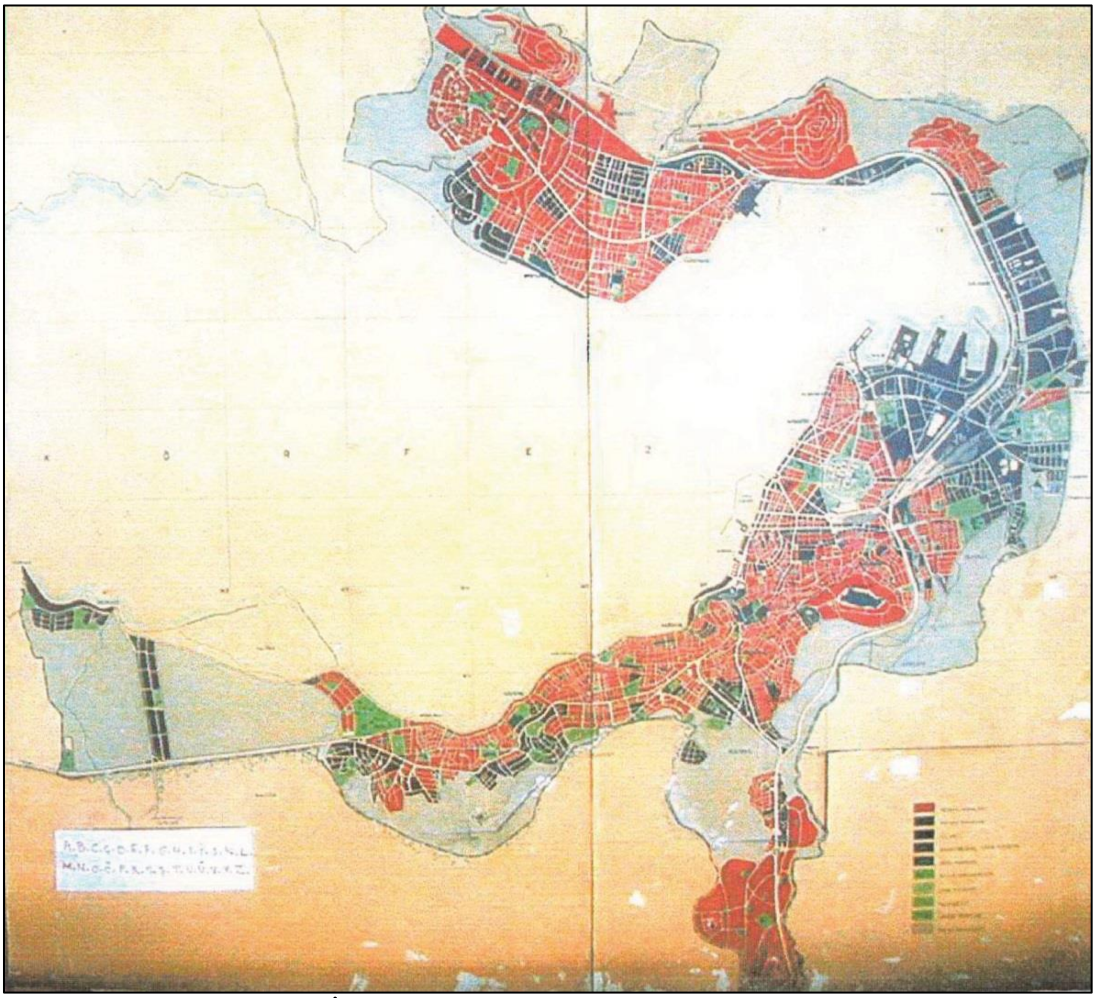


Map 10: The plan of Aru, Özdeş and Canpolat
Source 41: Master Plan Competition Report

The plan of Le Corbusier has not been implemented and the city still needed a plan. Government chose a different method and announced a competition for the plan of İzmir. K.Ahmet Aru, Emin Canpolat and Gündüz Özdeş won the competition. On of the most important criteria in the competition was about the implementation of the plan. There were several problems about the implementation of the plans prepared before.

The planning decisions were mainly;

- To improve Alsancak port as a freight and trade port
- To propose a new industrial zone
- To propose new residential areas
- To make connections between railway and motorways



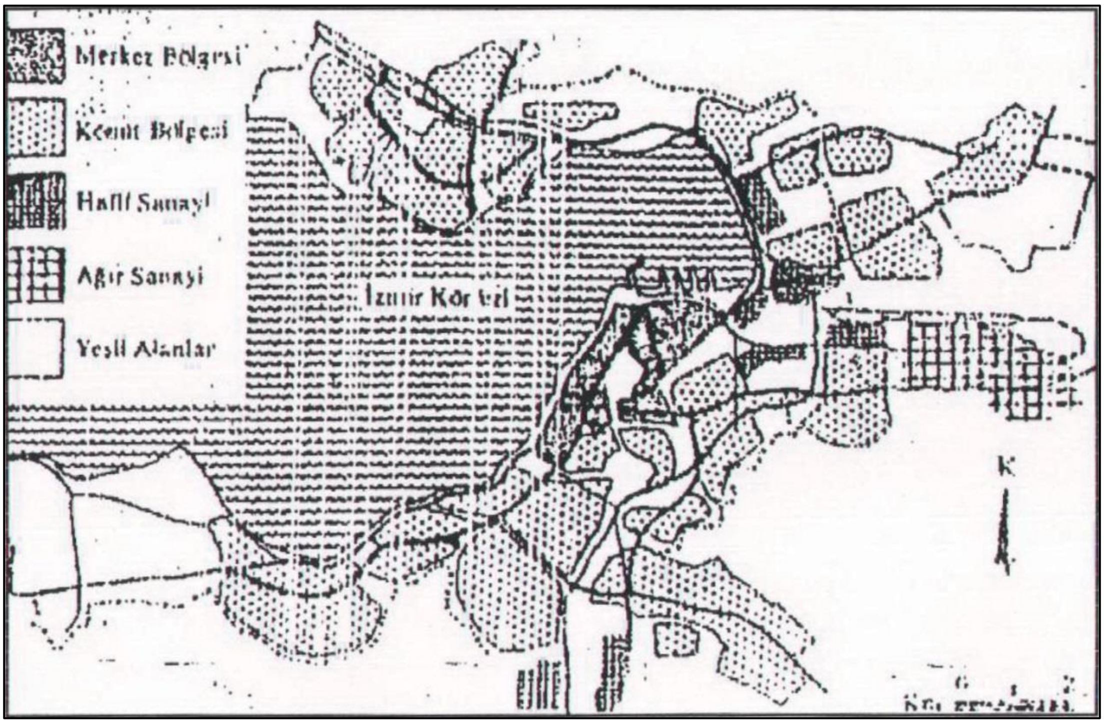
Map 11: The Master Plan of İzmir,1955
Source 42: İzmir Metropolitan Municipality Archives

4.The Plan of Albert Bodmer (completed and examined by the Ministry of Development and Settlement in 1960 but not approved)

After the plan of Aru,Özdeş and Canpolat, there had been too many plan alterations and meanwhile the development of İzmir was far beyond the predictions. The existing plan was not sufficient to meet the needs of İzmir, so a new plan was prepared. The decisions of the plan were mainly;

- A new road was accepted to make a connection between the north and south parts of İzmir for heavy industry
- New residential areas were proposed
- Heavy industry zones were proposed
- The port was accepted as a central district

The ministry did not approve the plan and the plan was not implemented.



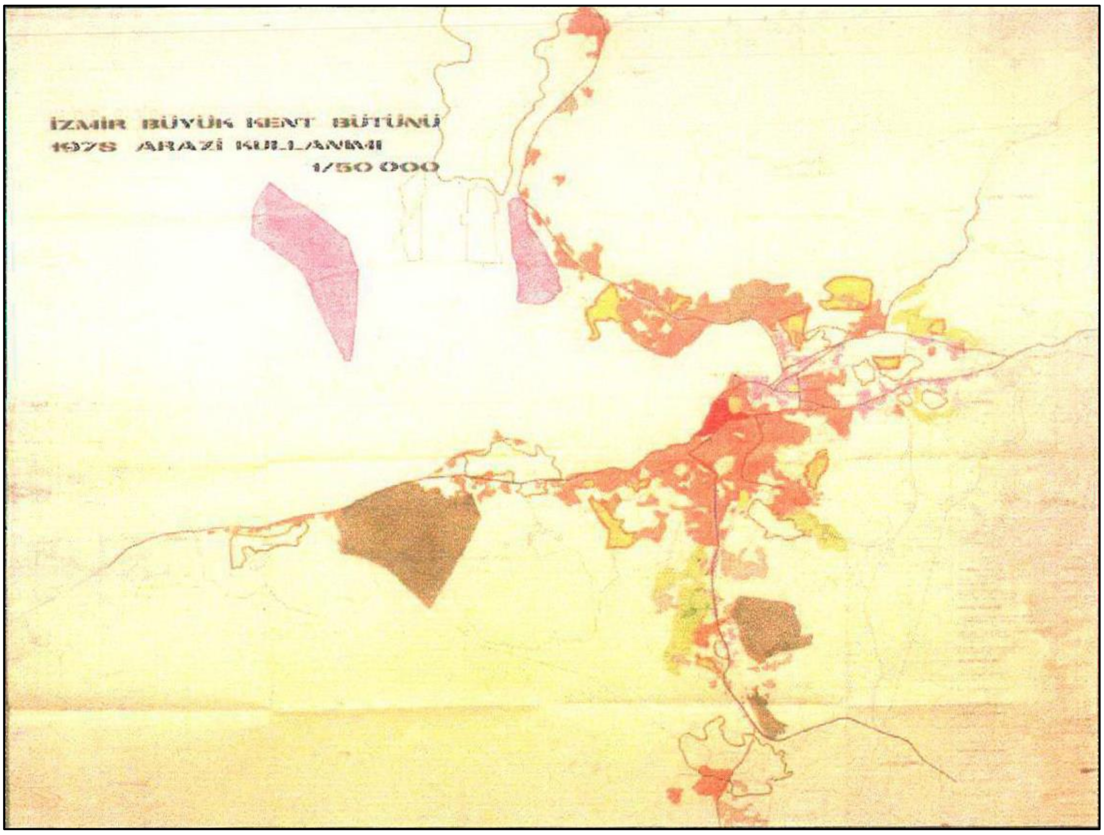
Map 12: The plan of Albert Bodmer
Source 43: İzmir Metropolitan Municipality Archives

5.The Plan of Metropolitan Planning Office (completed in 1972, approved in 1973, revised in 1978)

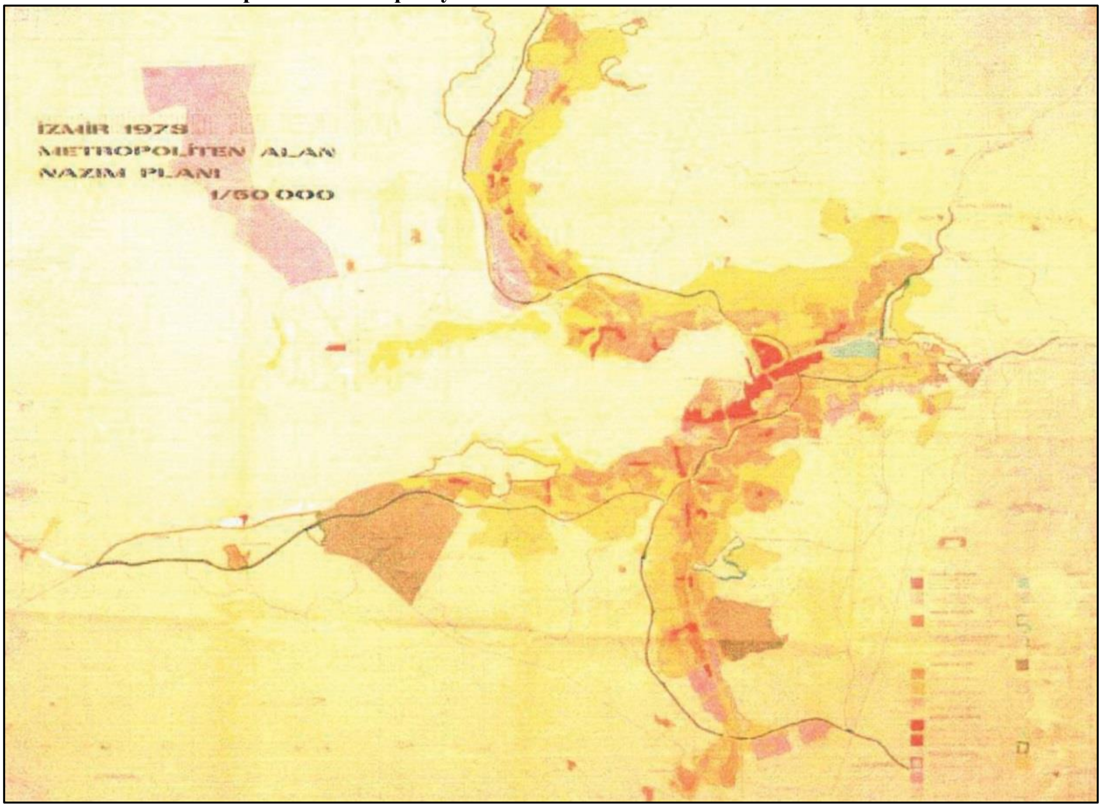
The fifth master plan of İzmir was prepared by the İzmir Metropolitan Planning Office. İzmir has become a metropolitan city and most important problems were traffic congestion, water scarcity, pollution of the bay and expansion of the squatters. The decisions of the plan were mainly;

- Tourism centers were created
- Satellite centers were created
- Agricultural and rural areas were protected
- Heavy industry were developed
- The suburban rail lines were developed (electrified) (Master Plan Report,1972,91-95)

A major planning decision was to reinforce a linear form for the city (Izmir Greater Municipality Plan Report 2012). This was to be attained on the north-south axis; however, considering that growth trends were already very strong in the south, the aim was to strengthen the northern growth corridor in particular.



Map 13: Existing Land Use Map, 1978
Source 44: İzmir Metropolitan Municipality Archives

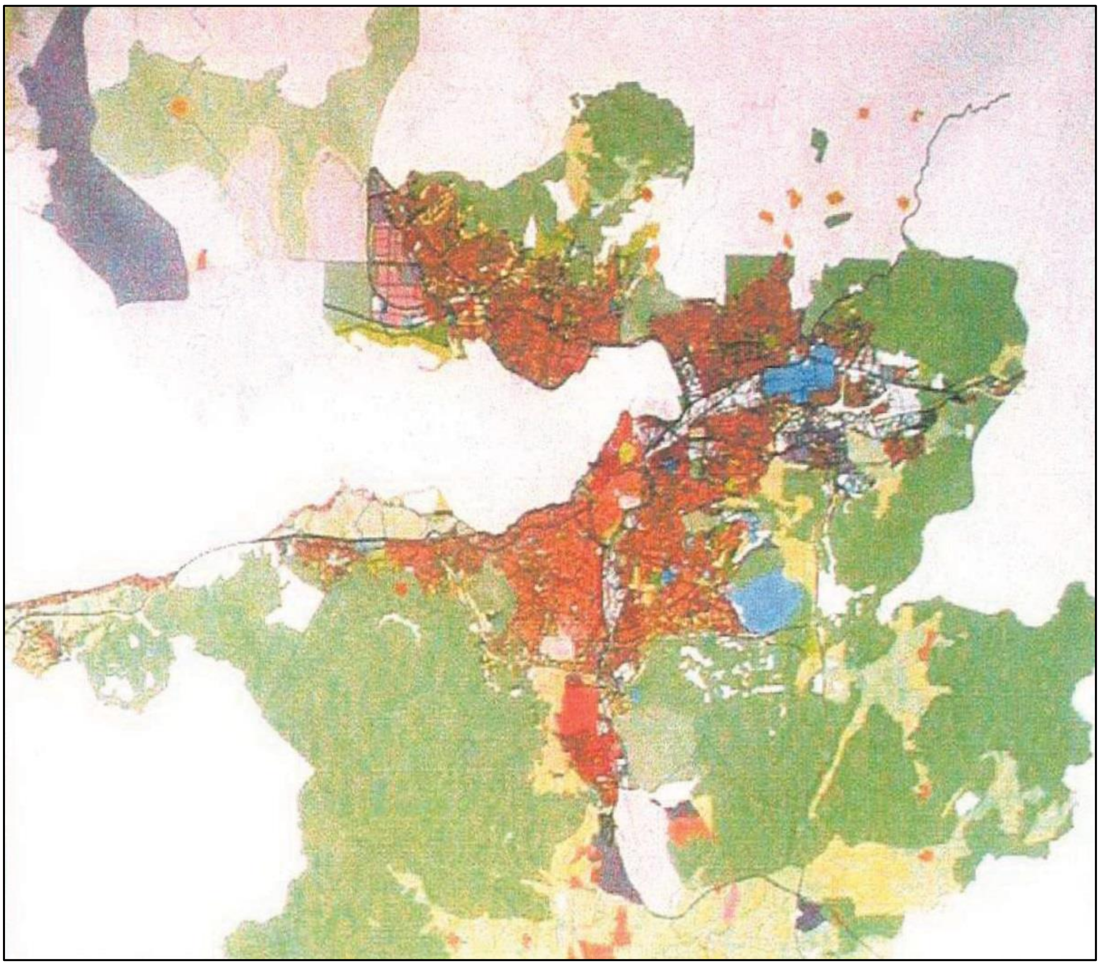


Map 14: The Plan of Metropolitan Planning Office, 1978
Source 45: İzmir Metropolitan Municipality Archives

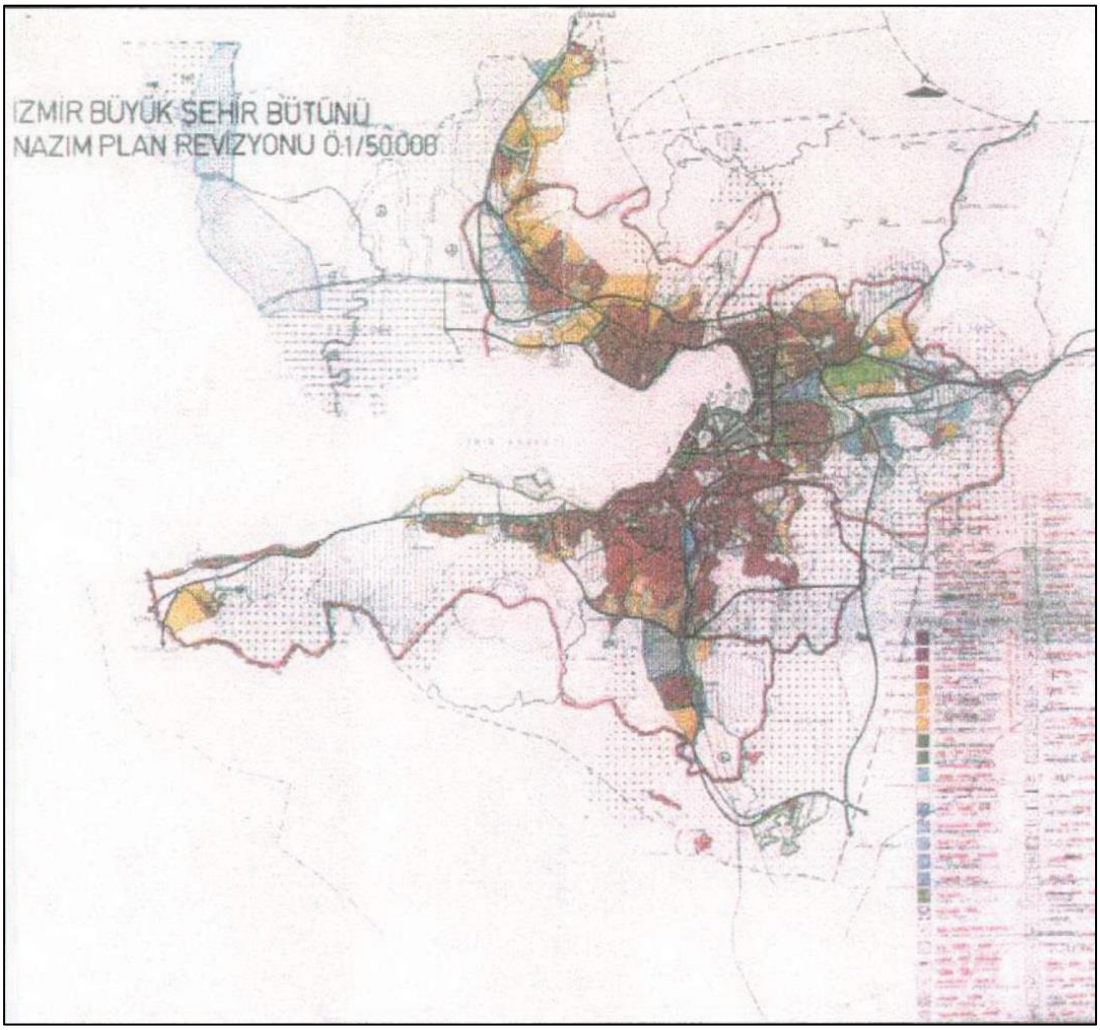
6.The Plan of Metropolitan Municipality approved in 1989

The sixth plan of İzmir was a revision plan. The decisions were mainly:

- South axis development was limited
- New residential areas were proposed
- Green areas were preserved
- Free-trade zone and airport located in Gaziemir
- Alterations were made to accept the existing unauthorized buildings



Map 15: Combination of the Implementation Plans, 1978-1987
Source 46: İzmir Metropolitan Municipality Archives



Map 16: The Master Plan of Metropolitan Municipality, 1989
Source 47: İzmir Metropolitan Municipality Archives

1 / 25.000 Scale İzmir Metropolitan City Land Use Plan Revision entered to implementation in 1989 based on 1973 Plan. This plan was cancelled in 2002 according to a justification that Great Municipalities had no longer power to make 1 / 25.000 scaled plans. On the other hand, İzmir Urban Area has 4 Environment Plans approved on different dates one of them still prevails. The first plan Tahtalı Dam Environment Plan was approved in 1996 and revised in 2002 by Ministry of Public Works and Settlement. After some revisions on plan decisions and redefining of borders and construction provisions on Tahtalı Environment Plan, the new plan; 1 / 25.000 Scaled Tahtalı Dam Environment Plan 2nd Revision was approved in 2003 by Ministry of Public Works and Settlement. The other Environment Plans are; Seferihisar-Dilek Peninsula Coastal Region and Çeşme-Karaburun Plans.

Furthermore, the last and in progress Environment Plan for İzmir City is İzmir-Manisa Planning Region Environment Plan concluding both 1 / 100.000 and 1 / 25.000 scales. 1 / 25.000 scaled plan differs by some revisions on defined areas. The first revision for the mentioned plan on İzmir Metropolitan whole city was approved in 29/08/2013 and again in 14/11/2013 (Ministry of Environment and Urbanization, Spatial Planning General Management). Secondly, İzmir-Çeşme-Altınkum Tourism Center 1 / 25.000 Environment Plan Revision was approved in 04/09/2013 (Ministry of Environment and Urbanization, Spatial Planning General Management). İzmir-Manisa Planning Region 1 / 100.000 Scale Environment Plan was approved in 23/06/2014 by approval of the Ministry (Ministry of Environment and Urbanization, Spatial Planning General Management). Therefore, Environment Plans are mostly the significant parts of İzmir city planning history.

8.Izmir Environment Plan (2012)

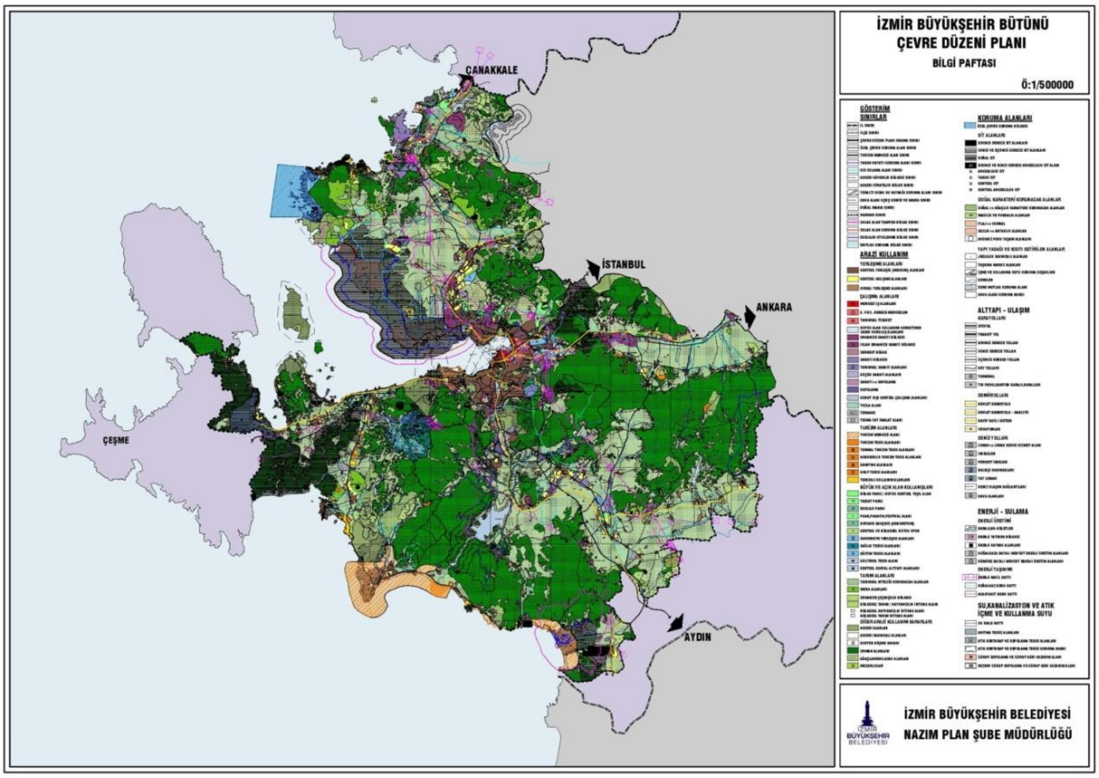
The main objective of the plan is described as making existing settlements more sustainable and livable. In terms of pattern of development, this plan also emphasizes linear growth in the northern corridor since this is the dominant industrial axis and hence encouraging residential developments along here strengthens the corridor. Throughout the city-region, sub-centres are defined to make existing settlements self-sustained and to reduce the pressure on the CBD. Hence, a linear corridor with a polycentric urban structure is supported.

The south axis is planned as a green belt and the agricultural areas are protected. In order to protect the agricultural areas in the south, the east axis is planned as low-density residential areas.

There is a north-south and east-west development due to the geographical conditions. In the plan, the city center is defined by the towns; Konak, Karabağlar, Karşıyaka, Çiğli, Bayraklı, Bornova, Buca, Gaziemir, Balçova, Narlıdere, Güzelbahçe,

- In the west axis; towns of Seferihisar, Urla, Menderes, Selçuk,
- In the north axis; the towns of Menemen, Foça, Aliağa,

- In the south axis, the towns of Torbalı, Bayındır,
- In the east axis; the town of Kemalpaşa has been planned as development areas.



Map 17: 2012 İzmir Greater Municipality Plan
Source 48: İzmir Greater Municipality Plan Report

5.1.2. Transportation: Past And Present Transport Master Plans, Investment and Current Transport Trends in İzmir

Public transportation in İzmir started in 19th century at the Ottoman period. The first public transport system was a commuter rail service, and then tramways and trolleybuses started to operate in time.

In 1855, commuter railway services started on Izmir-Manisa line between Çiğli and between Basmane and Bornova. In 1870 commuter railway services started on Buca line. In 1876, commuter railway services started on Gaziemir-Seydiköy line.

The bus transit in İzmir is operated by two operators; ESHOT and İZULAŞ. ESHOT, which was established in 1943, was responsible of the İzmir's electricity, water, gas and public transport system. During time, all the responsibilities were transferred into different institutions and today ESHOT is responsible for only bus transport in İzmir (http://www.eshot.gov.tr/Hakkimizda.aspx?MID=82).

The second operator İZULAŞ was established in 1990 to support ESHOT in bus services. İzulaş is a private company that some share of it belongs to İzmir Greater Municipality. The difference of İZULAŞ from ESHOT is the chance to give fast decisions with less procedures. (http://www.izulas.com.tr/Pages/Single.aspx?id=17).

Another public transportation service dolmuş has started to operate in early years in İzmir. Dolmuş usually serves where the municipality does not give service. Dolmuş also give service in the same routes with the municipality especially in central places.

The Turkish Maritime Administration (TDİ) was operating the maritime transportation until 1996. A private company started to operate in 1996 until İZDENİZ established in 1999. İZDENİZ is also the same as İZULAŞ municipality oriented company that operates the maritime transport in İzmir.

The functional role of the railways in the transportation sector in Turkey is limited. In 1980 Turkish State Railways prepared a project called "Aegean Coast Railways Master Plan". In the plan the main station was built in Halkapınar and along the rail line to Ankara it was planned to separate the passenger and freight lines from each other. The pre-project was completed in 1980; however, no improvements were made (İzmir Transportation Plan Report, 2009)

After the 1990's there has been a particular emphasis on developing and improving public transportation services. In the late 1990s, the Greater Municipality of Izmir introduced a project named "Transformation in Transportation", which had integrated transport at its core and resulted in a major reorganization of public transport services as well as the introduction of a metro system.

The change was a big impact for the city as all the public transport modes (buses, ferries, metro and then later the commuter/regional rail) were reorganized, service frequencies increased and all services integrated with each other both physically and in terms of fares. The timelines of the "Transformation in Transportation" project is presented in the figure below.

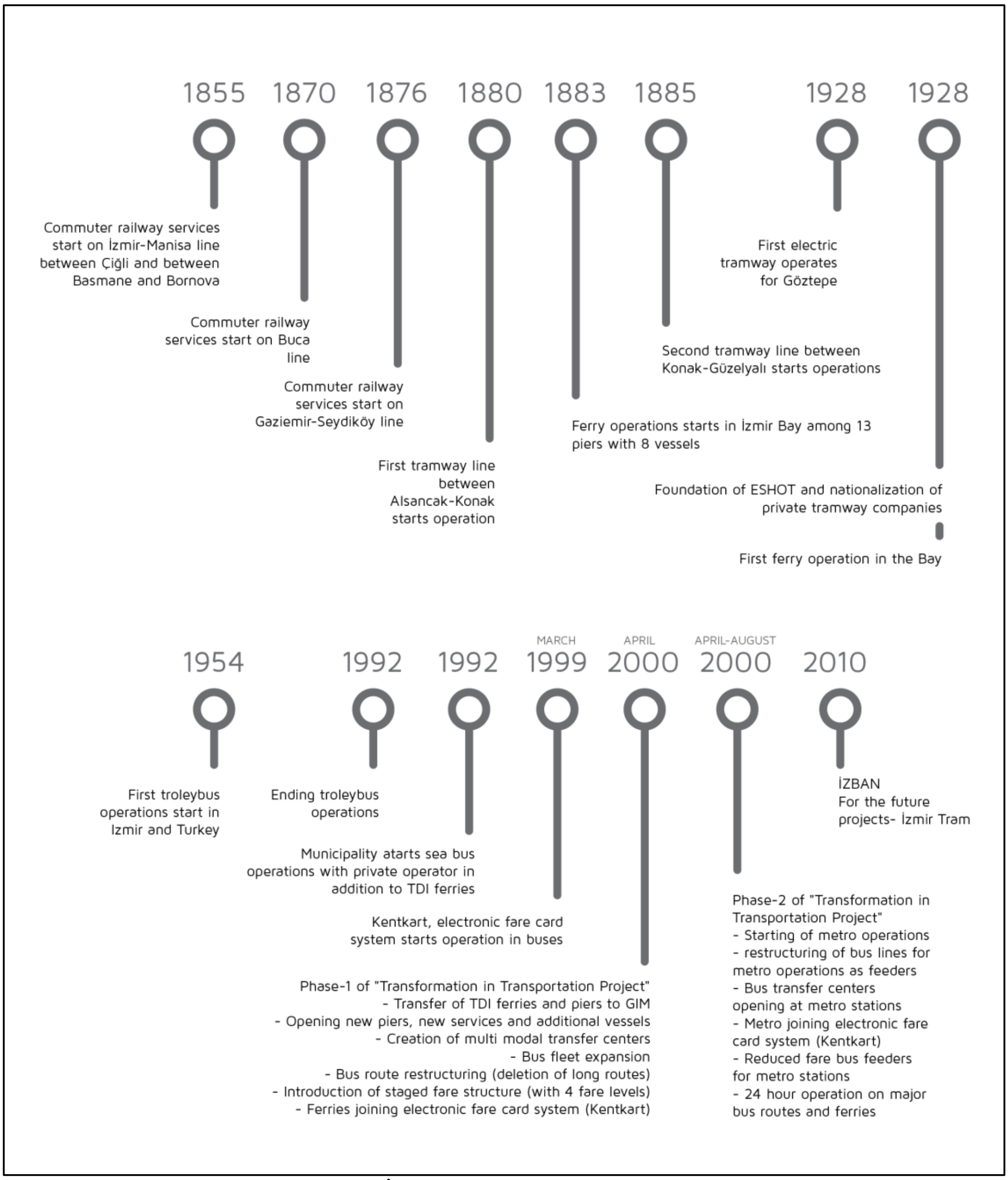
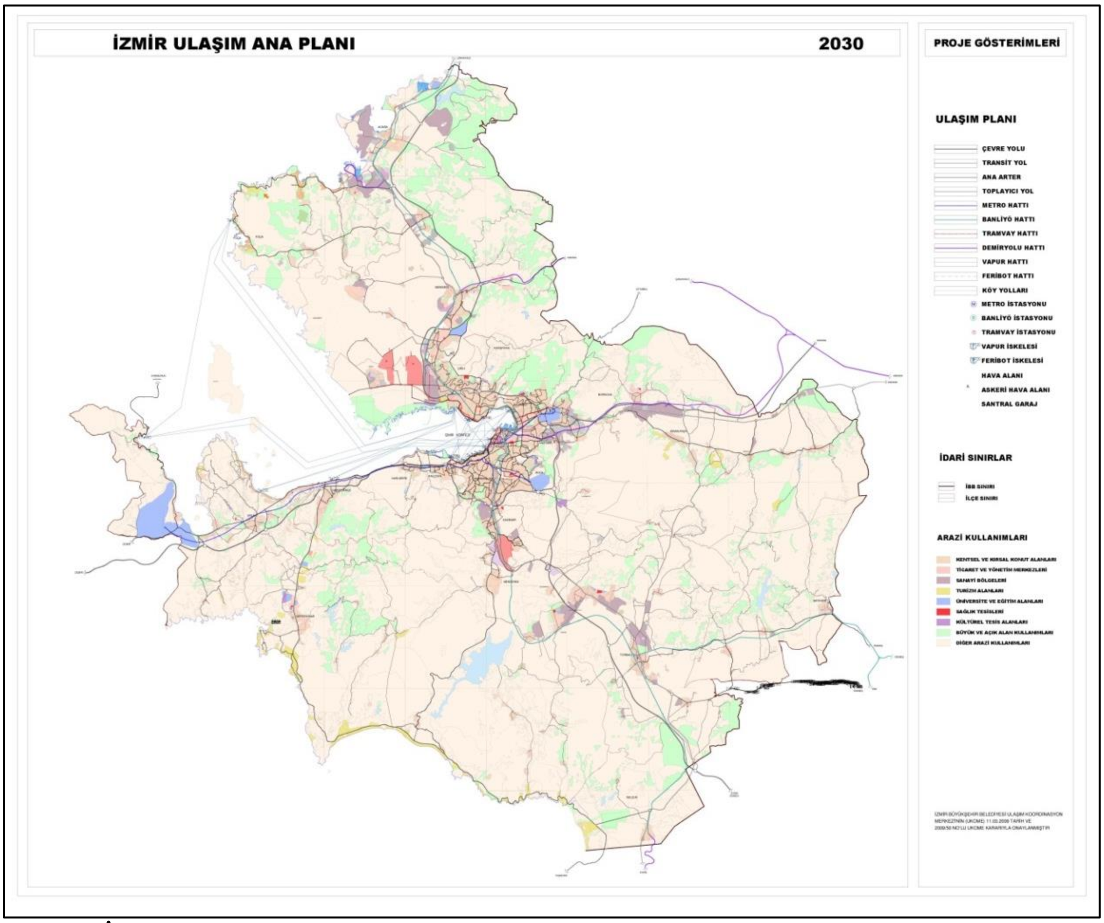


Figure 20: Transport Chronology of İzmir
Source 49: Updated from Öncü (2007), p.59

Electronic fare collection system, Kentkart started to operate in İzmir on 15th March 1999. The system was firstly used in ESHOT and İZULAŞ and in time other transportation modes were integrated (İZDENİZ, Metro, IZBAN) There are 4.5

million “Kentkart” users in İzmir. (http://www.kentkart.com/TR/yurtici-projelerimiz/). Kentkart was one of the most important innovation in “Transformation in Transport Project”. The 90 minutes of transfer time during the trips increased all public transportation modes in İzmir.

İzmir Transportation Master Plan (2009)



Map 18: İzmir Transportation Master Plan
Source 50: İzmir Metropolitan Municipality Archives

According to the İzmir Transportation Master Plan;

- Public transport should be given priority; primarily trams, light rail (metro) and commuter/regional rail projects should be implemented,
- Commuter/regional rail is important for the passengers traveling to the industry from long distances

- The public transport in the main and arterial roads will be increased, and railway investments will be made.
- Main stations will be built in Bornova and Aliağa to decrease the use of road dependency for freight and passenger transport and these stations will be integrated with the regional and metro systems to ease the inner city traffic
- The regional rail system will be used effectively like the metro (İzmir Transportation Master Plan Report,2009)

In order to revise the plan, tenders were carried out twice; however, the process has not been finalized and completed. In the first quarter of 2015, it is planned to go for a tender again.

5.2.The Modernization of The Commuter Rail Services: Partnership Between State Railways and Izmir Greater Municipality

İzmir Banliyö Sistemi Taşımacılığı Anonim Şirketi (IZBAN)- İzmir Regional Rail Transportation System Incorporated Company, is a transportation operator company that manage the regional rail line from the north side of İzmir, the settlement of Aliağa to the south side Cumaovası. The service is defined as a rail system that provides service with the standards of a metro system. IZBAN is a subsidiary company setup by the Izmir Metropolitan Municipality. Together with the İzmir Metropolitan Municipality, Turkish State Railways (TCDD) are partners of the company in running the regional rail system.

IZBAN was founded by a protocol, which was signed between TCDD and İzmir Metropolitan Municipality in June 2005. The company reached its corporate identity in January 2007 and started to operate with passengers on 30 August 2010. The whole system between the stations Alsancak – Cumaovası was put into operation on 29 October 2010, and was integrated with bus + metro + railway system to provide passenger transportation in 29 October 2010. The entire line was launched on 6 March 2011 with public and administrative participation.

The most significant innovative features of IZBAN are being a collaboration of central government and local administration. This partnership, which brought a different administration and financing model, created a synergy in the city and led to further projects, such as cleaning of the İzmir Gulf. Furthermore, it set the precedence to operations in other cities, such as Ankara commuter services and GAZİRAY project in Gaziantep.

IZBAN project belongs to both the Turkish State Railways, a central government agency, and İzmir Metropolitan Municipality, the local administration. İzmir metro is also involved in partnership for transferring its experience of 13 years of urban rail operation in Izmir.

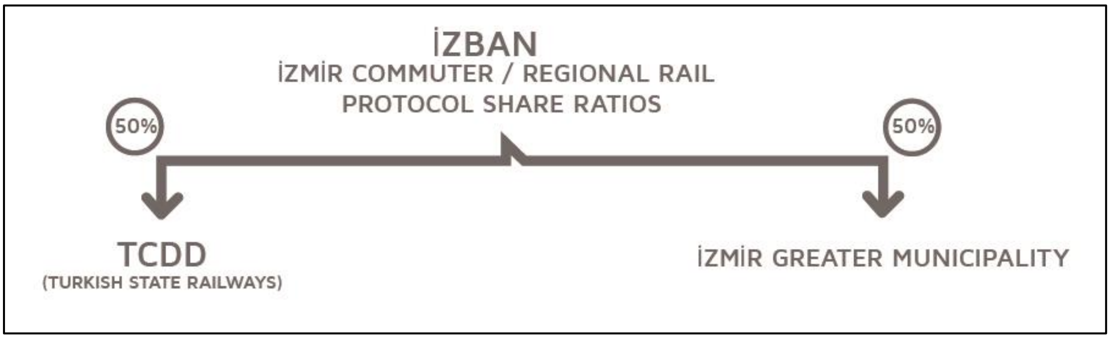


Figure 21: The split of ownership of IZBAN

The split of ownership, according to this protocol, is 50% State Railways and 50% İzmir Greater Municipality. The General Manager of the whole operation is one year from the State Railways and one year from İzmir Greater Municipality. The local district municipalities have no authority in the management and operation of the system. The distribution of the tasks is explained in the table below.

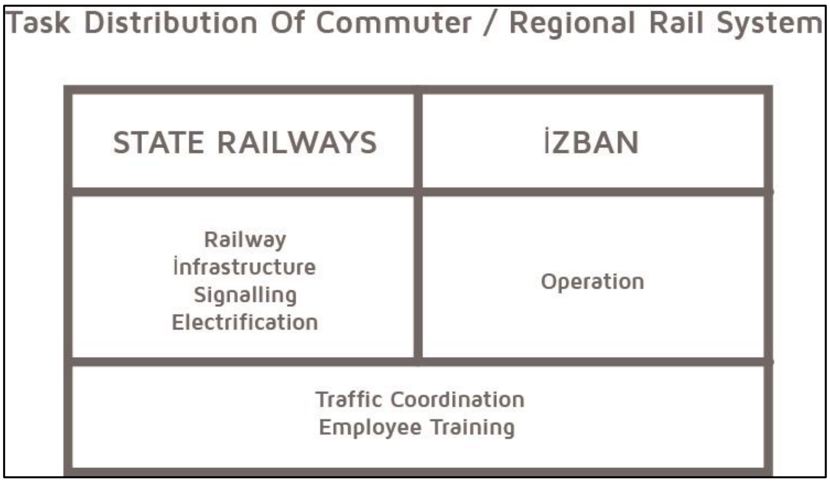


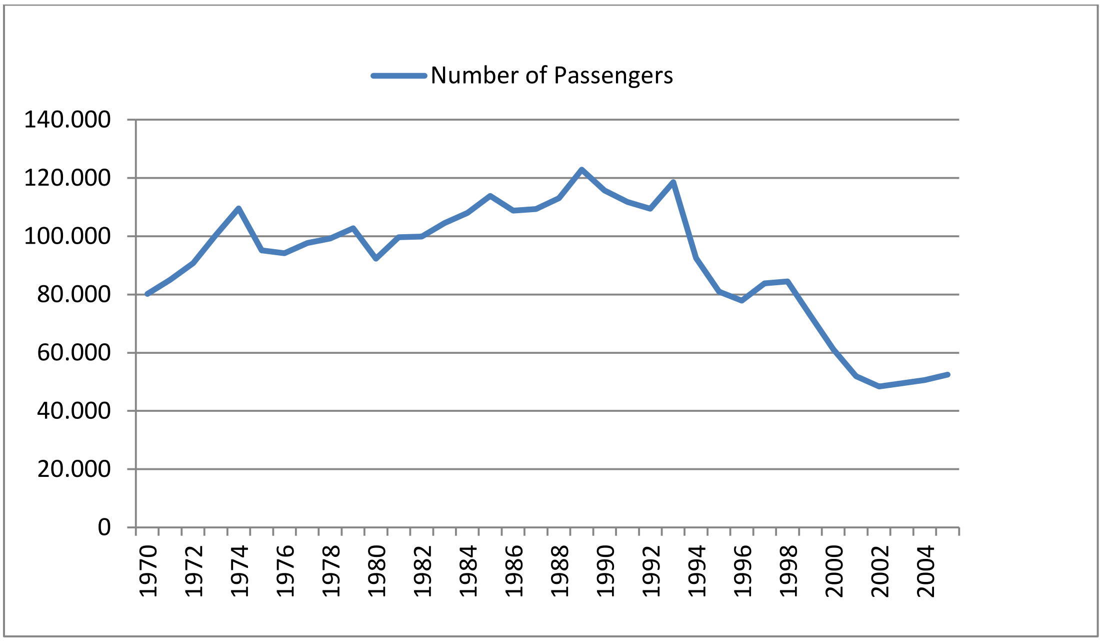
Figure 22: Task Distribution of Commuter/Regional Rail System

The system is using the infrastructure of TCDD so all the implementations about the railways (railway, electrification, signaling etc.) are done by TCDD. The maintenance of the tracks and carrying out the operation are done by IZBAN. The traffic coordination and the employee training are done by both TCDD and IZBAN.

İzmir Greater Municipality has a Rail Systems and Investments Department and under the department there is a directorate of commuter systems. All the planning decisions are taken in the municipality in this directorate. The Development and City Planning Department is not involved with the rail systems. The department and its directorates only make changes or revision in the existing plan.

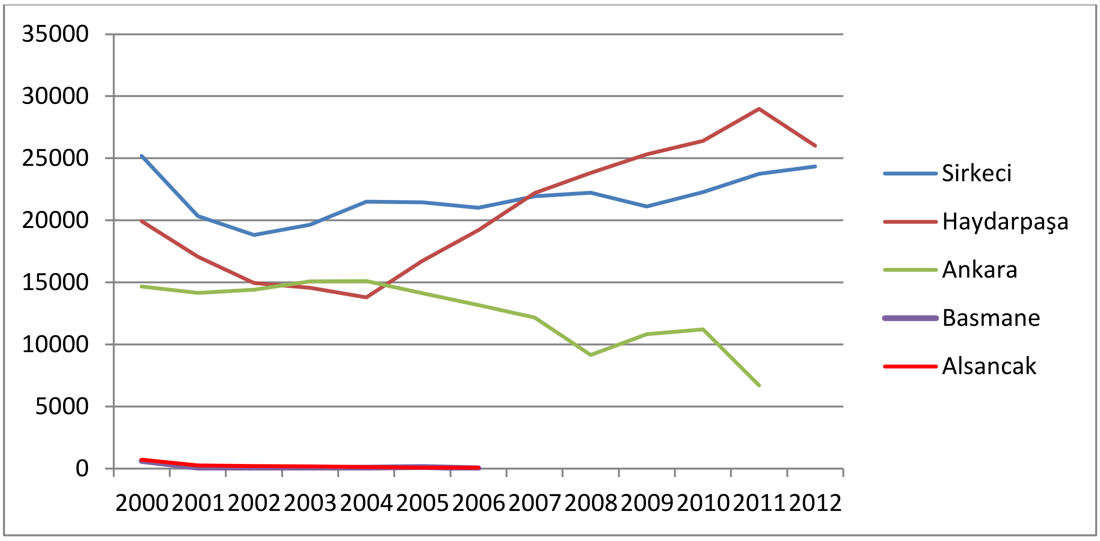
5.3. Analysis of the Commuter/Regional Rail System and Operation Under TCDD

According to the research made on the commuter rail operation of State railways in İzmir, it is found that until 1999, the data was collected in country level. After 1999, the data was collected in each commuter line and listed. The commuter rail services were relatively more popular between the years 1970 and 2000.Then there is a rapid decrease in the ridership. This is seen in the graphics below.



Graph 11: Annual Ridership of Commuter Rail between 1970-2004 (*1000)
Source 51: Turkish State Railways Annual Statistics

According to the ridership, it is seen that İzmir commuter/regional rail system had the poorest performance among the other metropolitan cities in terms of passengers carried.

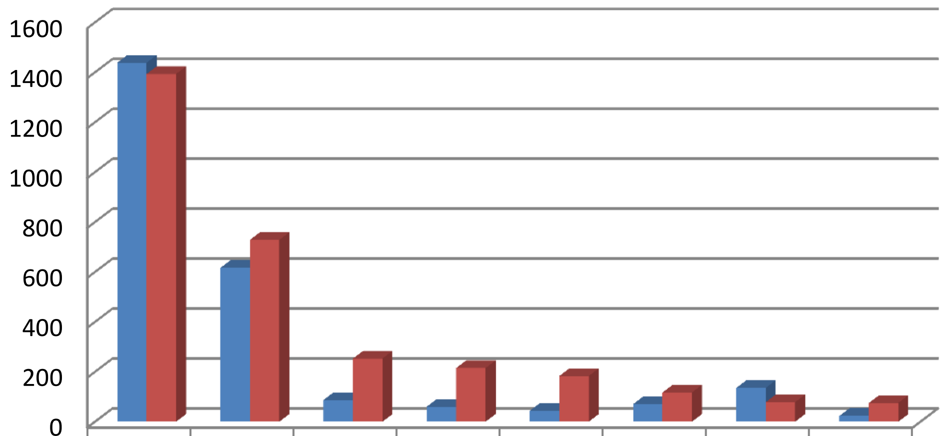


Graph 12: Annual Ridership of commuter rail system in Turkey (*1000)
Source 52: Turkish State Railways Annual Statistics

In İzmir the commuter rail system had an importance for the workers commuting between their homes and the industrial areas. The commuter rail system was running every hour. There were no travel card or smartcard systems for the fare. The tickets were bought in ticket offices in the stations and then went to the train.

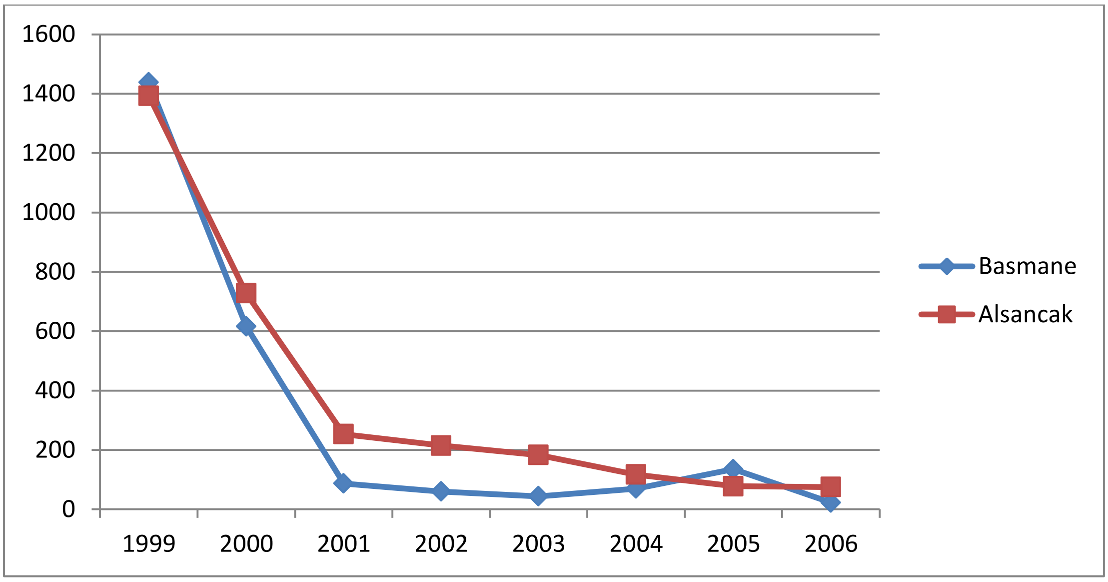
10 of the stations were grade crossing and it affected the city traffic in a negative way. These stations were Şirinyer, Kemer, Bayraklı, Turan, Alaybey, Karşıyaka, Nergiz, Naldöken, Demirköprü and Çiğli.

The commuter rail included 57 km-long North Section between Aliağa and Alsancak; 22 km-long South Section between Alsancak and Cumaovası. The ridership of İzmir commuter rail system is seen in the graphics below.



	1999	2000	2001	2002	2003	2004	2005	2006
Basmane	1438	616	87	60	44	70	135	23
Alsancak	1393	728	253	215	183	117	78	75

Graph 13: Number of Commuter Ridership in İzmir by Years (*1000)
Source 53: Turkish State Railways Annual Statistics



Graph 14: Number of Commuter Ridership in İzmir by Years (*1000)
Source 54: Turkish State Railways Annual Statistics

5.4.Analyis of the Commuter/Regional Rail System and Operation Under The Partnership Project

IZBAN is located on the first rail line (80 km) in Anatolia. Furthermore, IZBAN is the first and largest regional rail system connected to an airport.

The system has been operating with 32 stations, 4 of which are underground, 16 hubs, 2 yards, 43 train sets in 5.2 km length tunnels. Set number will be increased to 73 in 2016.

IZBAN line locates at the center of north-south high-density residential regions. The 156-year-old former rail line for that route had served for 3.000 people per day despite its strategic location. IZBAN project raised the passenger number to 200.000 per day on that line. Total number of public transportation users in İzmir city increased to 1,5 million from 1 million in this process. In other words, IZBAN enhanced its share in public transportation system on one hand while helped increase the share of total public transportation system in urban transport. IZBAN led to a substantial increase on ESHOT, İZULAŞ and İZMİR METRO passenger numbers rather than a decrease, which could have been the case because of passenger shifts.

The whole transportation company's passenger numbers increased from 393 million to 452 million in the year 2012.

In Turkey, like in many countries, residential areas have extended along railroads (where railroads existed) and the railroads generally pass through the centers of these areas. However, almost all of these railroads are idle and mostly used for freight transportation.

İzmir Commuter/Regional Rail System Stations

İzmir Regional Railway has 32 stations in total. Four of these stations, Şirinyer, Alaybey, Karşıyaka and Nergiz, are underground and the remaining stations are at-grade. These stations include 14 "bay platform" and 18 "side platform" stations. Hilal Transfer Station, opened in 04.08.2013, is an at-grade station. Station platforms are designed to serve in a length with triple sets in İzmir regional railway system (210 m).

In order to ease the access to the stations, 107 escalators and 101 elevators were built for disabled access located at all 32 stations.

Station platforms are 210 m in length and standard to allow the operation of triple sets. Stations are designed according to the station forms and passenger capacity. A smartcard ticket, Kentkart, which is used in all public transportation systems in Izmir, is valid for İzmir Regional Railway. Kentkart allows free transfer to all public transport modes within 90 minutes after the first boarding.

In order to cope with the problems such as departure layovers and slow transactions "*Yüklematik*" cards are in operation since 2010 and allow automatic ticket loads. These cards are included in all stations and have 4-5 second processing time period.

Explanatory guidance and warning signs are included in stations in order to guide people within the stations and platforms. Digital information boards show the remaining minutes for the next arriving train to that station.

Information boards display train times while kiosks allow the delivery of complaints, suggestions or views.

İzmir Regional Railway includes Station Operator, Teller and Security Guards at all times. All stations include security cameras (CCTV). Furthermore, medical teams are located at all stations allowing an immediate access via Traffic Operation Center to the nearest fire station, police and hospital. Traffic Operation Center makes automatic and manual announcements in stations for emergent situations.

In order to provide a secure train operation system the telecommunication between Traffic Operation Center and the other employees is ensured by transmitters, phones and emergency call stations. All train stations include fire detection systems and fire extinction systems.

Figure 23: Zone 1 Station photos from the Field Analysis

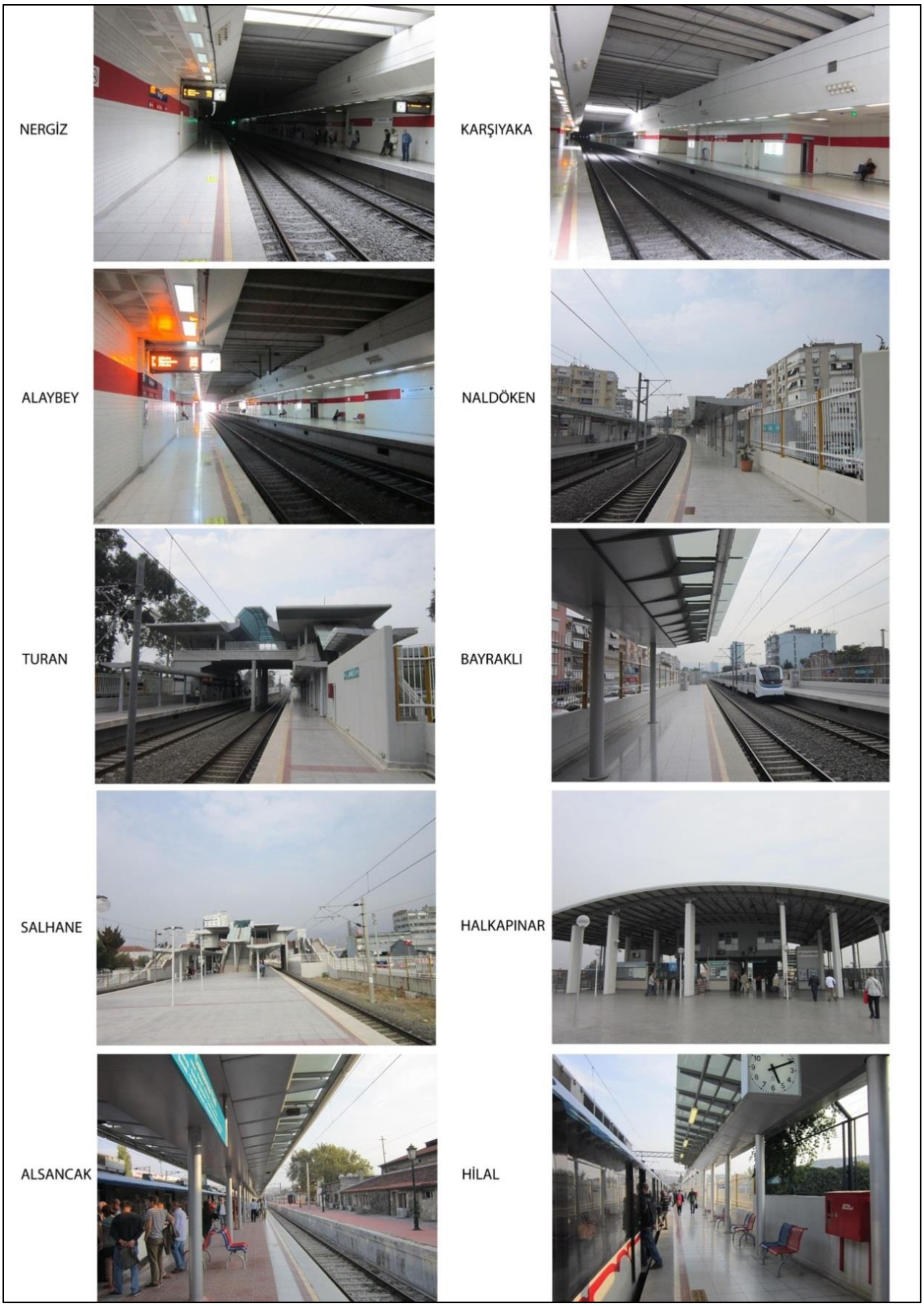


Figure 24: Zone 2 Station photos from the Field Analysis

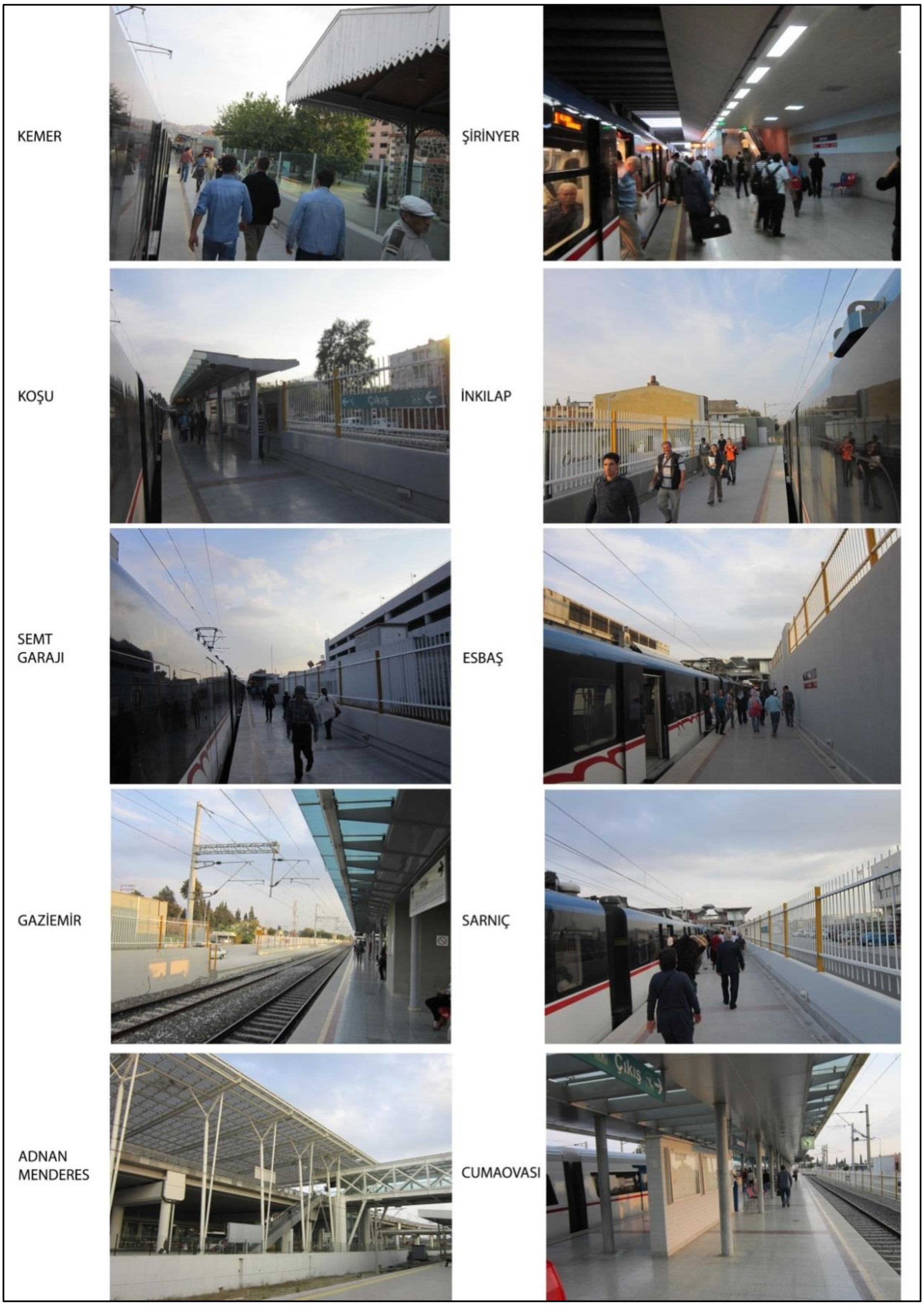


Figure 25: Zone 3 Station photos from the Field Analysis

Table 7: Travel time and station spacing

Departure Station	Arrival Station	Distance (m)	Arrival-time (sec)	Waiting period (sec)	Travel time (sec)
Cumaovası	**Havalimanı**	3426	215	25	240
Havalimanı	**Sarnıç**	2427	155	25	180
Sarnıç	**Gaziemir**	1553	95	25	120
Gaziemir	**Esbaş**	1234	95	25	120
Esbaş	**Semt Garajı**	2216	155	25	180
Semt Garajı	**İnkılap**	1469	95	25	120
İnkılap	**Koşu**	1650	95	25	120
Koşu	**Şirinyer**	972	95	25	120
Şirinyer	**Kemer**	4184	215	25	240
Kemer	**Hilal**	645	155	25	180
Hilal	**Alsancak**	1256	155	25	180
Alsancak	**Halkapınar**	2386	335	25	360
Halkapınar	**Salhane**	1806	155	25	180
Salhane	**Bayraklı**	1602	95	25	120
Bayraklı	**Turan**	1597	95	25	120
Turan	**Naldöken**	1844	95	25	120
Naldöken	**Alaybey**	748	35	25	60
Alaybey	**Karşıyaka**	629	35	25	60
Karşıyaka	**Nergiz**	968	95	25	120
Nergiz	**Demirköprü**	1215	95	25	120
Demirköprü	**Şemikler**	951	95	25	120
Şemikler	**Mavişehir**	994	95	25	120
Mavişehir	**Çiğli**	2007	155	25	180
Çiğli	**Atasanayi**	1217	95	25	120
Atasanayi	**Egekent**	1116	215	25	240

Egekent	**Ulukent**	4976	215	25	240
Ulukent	**Egekent 2**	1593	95	25	120
Egekent 2	**Menemen**	5653	275	25	300
Menemen	**Hatundere**	12065	515	25	540
Hatundere	**Biçerova**	8301	335	25	360
Biçerova	**Aliağa**	5205	335	25	360

As seen in the table, the distance between stations is typical to commuter and regional rail systems. There are some stations that are quite close to each, i.e. station spacing is below 1 km. There are also stations that are quite distant from each other, helping to keep the speed of the system at a certain level. Overall when the total length of the system is divided by total number of stations, the average station spacing is 2435 m. As a comparison, it should be noted that the İzmir Metro has 17 stations and the line is 20 km. Therefore, the average station spacing of İzmir metro is 1176 m. As it was explained in Chapter 2, the high station spacing affects the speed of the system and the IZBAN system is faster than Metro.

Table 8: General Information about the Stations

STATION NAME	**Building Type**	**No. of lines**	**Walking stairway**	**Escalator**	**Platform**	**Ticket office**	**Turnstile (Ent/ Ex)**
Cumaovası	Ground level	2	4	4	1 (bay)	1	2 / 2
Havalimanı	Ground level	2	2	1	1 (bay)	1	2 / 2
Sarnıç	Ground level	2	4	4	2 (side)	1	3 / 1
Gaziemir	Ground level	2	3	3	1 (bay)	1	2 / 2
Esbaş	Ground level	2	4	2	2 (side)	2	9 / 6
Semt Garajı	Ground level	2	4	4	2 (side)	1	4 / 2
İnkılap	Ground level	2	4	4	2 (side)	1	4 / 4
Koşu	Ground level	2	4	4	2 (side)	1	4 / 2
Şirinyer	Open-Close	2	4	2	2 (side)	2	6 / 6
Kemer	Ground	2	4	5	2 (side)	1	4 / 4

	level						
Hilal	Ground level	2	4	4	2 (side)	2	4 / 4
Alsancak	Ground level	2	-	-	2 (bay)	1	5 / 6
Halkapınar	Ground level	2	4	3	1 (bay)	1	8 / 8
Salhane	Ground level	2	3	3	1 (bay)	2	7 / 5
Bayraklı	Ground level	2	5	4	2 (side)	2	7 / 5
Turan	Ground level	2	2	3	2 (side)	1	2 / 2
Naldöken	Ground level	2	4	4	2 (side)	1	4 / 2
Alaybey	Open-Close	2	3	2	2 (side)	2	6 / 6
Karşıyaka	Open-Close	2	4	2	2 (side)	2	8 / 4
Nergiz	Open-Close	2	4	2	2 (side)	2	8 / 5
Demirköprü	Ground level	2	3	3	1 (bay)	1	3 / 3
Şemikler	Ground level	2	4	4	2 (side)	2	8 / 8
Mavişehir	Ground level	2	6	4	2 (side)	2	4 / 3
Çiğli	Ground level	2	5	8	1 (bay)	2	6 / 6
Atasanayi	Ground level	2	2	4	2 (side)	1	2 / 2
Egekent	Ground level	2	3	3	1 (bay)	1	3 / 3
Ulukent	Ground level	2	4	3	1 (bay)	1	3 / 2
Egekent2	Ground level	2	2	3	1 (bay)	1	2 / 2
Menemen	Ground level	2	2	3	1 (bay)	1	3 / 3
Hatundere	Ground level		2	2	2 (side)	1	2 / 1
Biçerova	Ground level		2	2	1 (bay)	1	2 / 0
Aliağa	Ground level		2	2	1 (bay)	1	4 / 1
TOTAL	32		**107**	**101**	**51**	**43**	**141 / 112**

IZBAN TRACKS

The first 33 pieces of train sets of IZBAN, which were designed to be used in suburban railway lines, were procured from the Spanish company CAF. Each train set is an "articulated" unit that is a combination of three wagons and six bogies of 12 axles. There is a total of 99 wagons; 66 units of (M) wagon with driver's cab and 33 units (N) wagon without driver cabin located in the middle. Each train set has the carrying capacity of 587 passengers.

Every vehicle has the system equipped with passenger information announcing the desired direction, station reached and the next station by LCD screens and car audios.

Air conditioning units in IZBAN vehicles are designed to meet the requirements of European Union standard "EN 14750-1 Railway applications - urban and suburban railway transport ventilation - Comfort parameters". Accepted and implemented standards in Europe are applied. Also in the driver's cab heating-cooling units are installed, to ensure the safety of driving in the most severe conditions. There are air-conditioning systems in all vehicles.

In August 2011 to meet the needs of the expanding transport network, a set of 10 pieces from Turkish State Railways were rented. These were trains procured from the Hyundai-Rotem company and are almost the same as CAF trains with some conceptual differences.

Due to the fact that new routes will be added to the transport network and in order to serve to higher passenger capacity 40 pieces of train sets belonging to Hyundai Rotem will join the fleet in the near future.

IZBAN’s Objectives, Obligations, Tasks

IZBAN Inc., in the province of Izmir, has been established to operate regional rail public transport services, and to let others with the aim of contributing to such services. In order to achieve this objective all obligations contained in the articles of the association (raw materials, semi-finished products, finished products, machinery, equipment, services, personnel recruiting, etc. ..) are the be undertaken by the company to fulfill these duties.

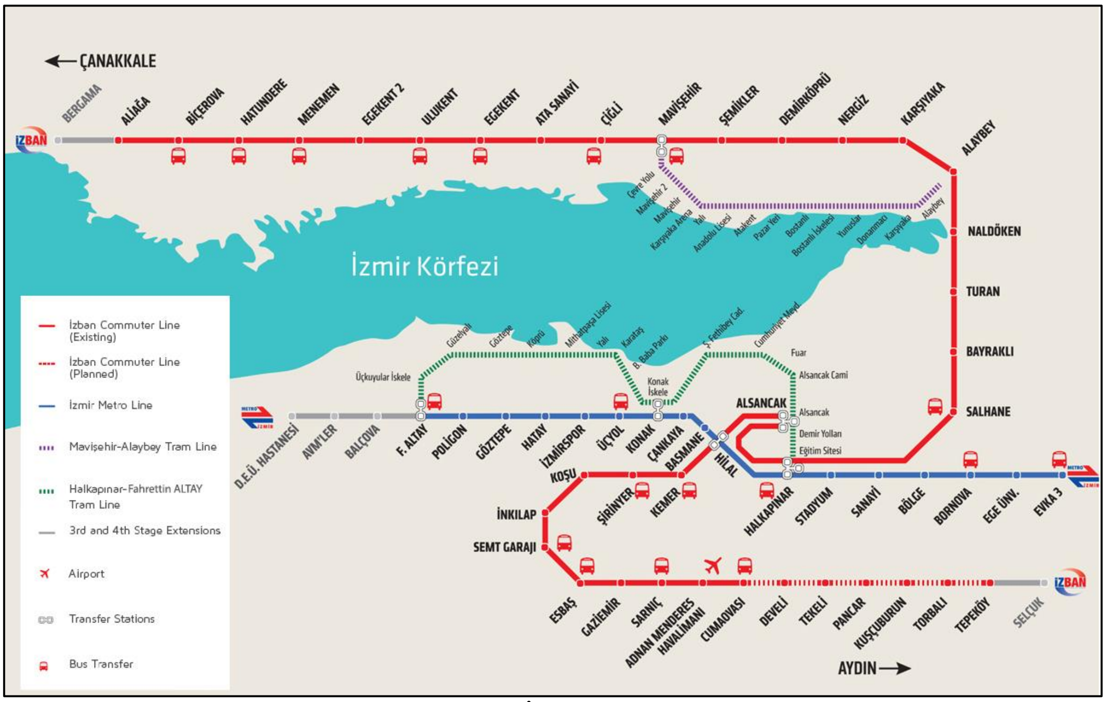
Policies of IZBAN

IZBAN Regional Rail System Company follows the policies given below:

- To meet the demand by serving economical, comfort, safe, fast, clean, easy and reliable trips,
- To reduce wastes to a minimum level and protect potential pollution at the source and decrease the direct or indirect negative effects on the environment,
- To prevent occupational accidents by making risk analysis on work-health and safety issues,
- To increase the productivity and provide savings on energy and natural resources,
- To meet the requirements of whole legal necessities and operate adaptation studies of related standards
- To provide continuous education for employees about quality, environment, work-health and safety rules to develop labor consciousness,
- To attain targets and sustainable growth policies by periodic revisions

Current Status and Future Projects

The system starting from Aliağa and up to Menemen, Karsiyaka, Alsancak, Adnan Menderes Airport and Cumaovası is an 80 km long double line belonging to the Turkish State Railways, composed of tunnels made and modernized by the Izmir Metropolitan Municipality. It has 32 stations, 16 transfer centers, and 2 yards. IZBAN Inc operates rail transport services between Aliağa and Cumaovasi in the existing Stage 1 on a route of 80 km with 43 trains.



Map 19: The schmatic railway system map of İzmir

The IZBAN regional line has 32 stations. It's hard to see all the developments in one graph so it's divided into three zones. In the following sections, these will be mentioned as 1st,2nd and 3rd Zone.

1st Zone

The first zone includes Aliağa, Biçerova, Hatundere, Menemen, Egekent-2, Ulukent, Egekent, Ata Sanayi, Çiğli, Mavişehir, Şemikler and Demirköprü stations.

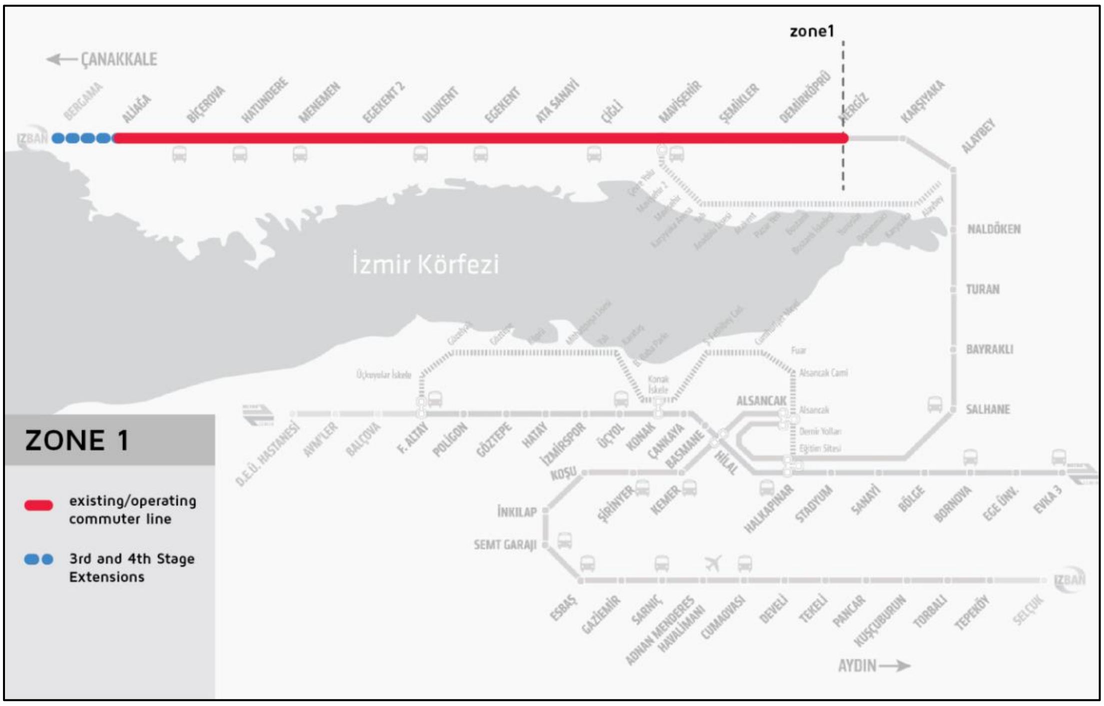


Figure 26: 1st Zone Map of IZBAN

2nd Zone

The Second Zone includes Nergiz, Karşıyaka, Alaybey, Naldöken, Turan, Bayraklı, Salhane, Halkapınar, Alsancak and Hilal stations.

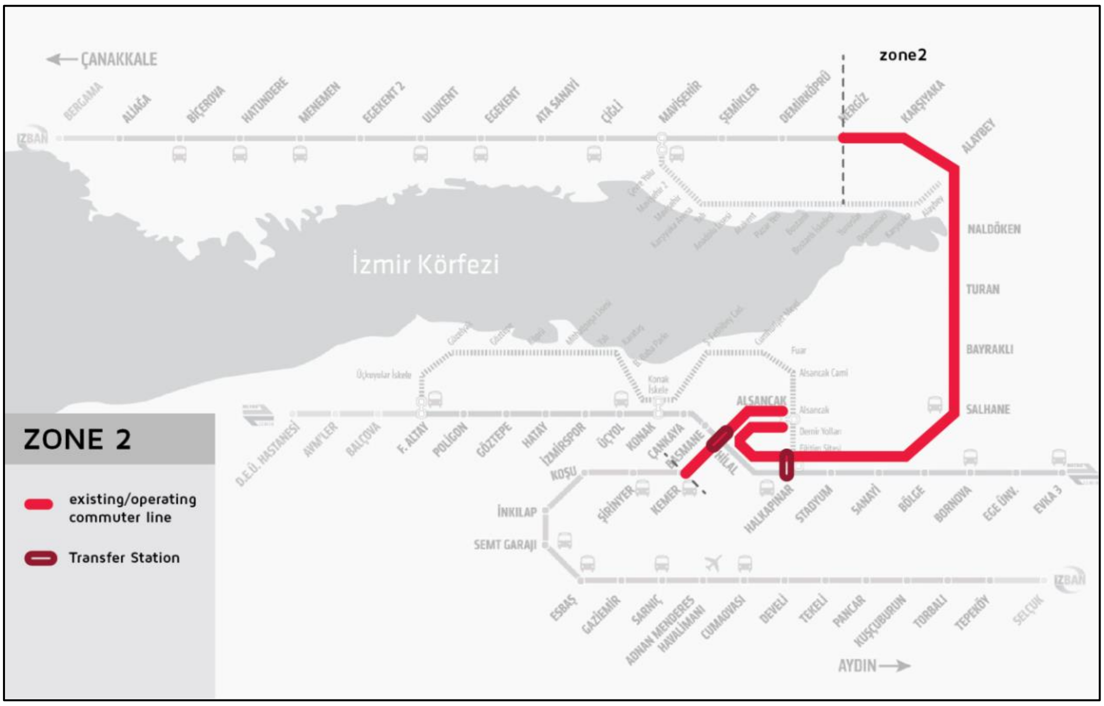


Figure 27: 2nd Zone Map of IZBAN

3rd Zone

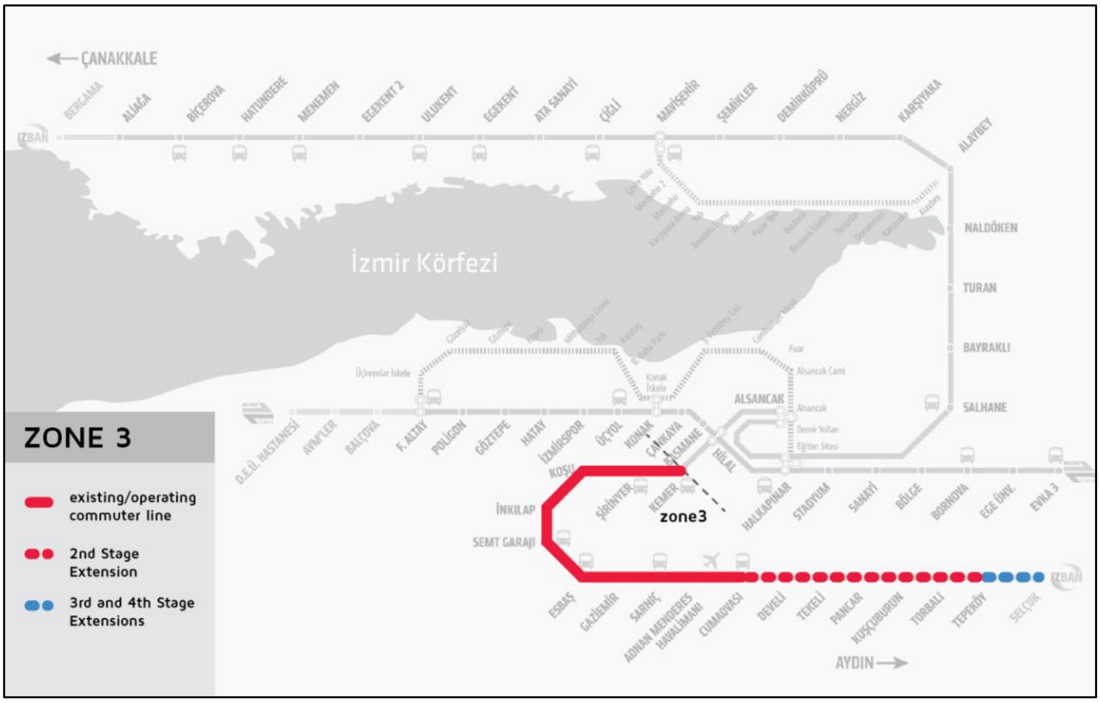


Figure 28: 3rd Zone Map of IZBAN

The third zone includes Kemer, Şirinyer, Koşu, İnkılap, Semt Garajı, Esbaş, Gaziemir, Sarnıç, Adnan Menderes Havalimanı and Cumaovası stations.

2nd Stage Extensions

A further 32 km extension is planned from Cumaovası to Tepeköy. Turkish State Railways and the İzmir Metropolitan Municipality signed a mutual protocol on 03.14.2011. When the system is activated 80km regional rail line will be increased to 112 km. The tasks to be carried out by the Turkish State Railways under the Protocol include adding new lines to the existing railway line between Cumaovasi - Torbalı (Tepeköy) stations, realization of the surrounding wall, bottom line and upper structure, construction of signaling and electrification. The tasks for the Izmir Metropolitan Municipality include renewing of the stations on the route to make them compatible with the stations built between Aliağa - Cumaovasi (Devel, Tekel, Beet, Kuşcubur's Bag, Tepekoy); realization of telecommunications system and building overpass or underpasses on the new route enabling vehicle and pedestrian crossings.

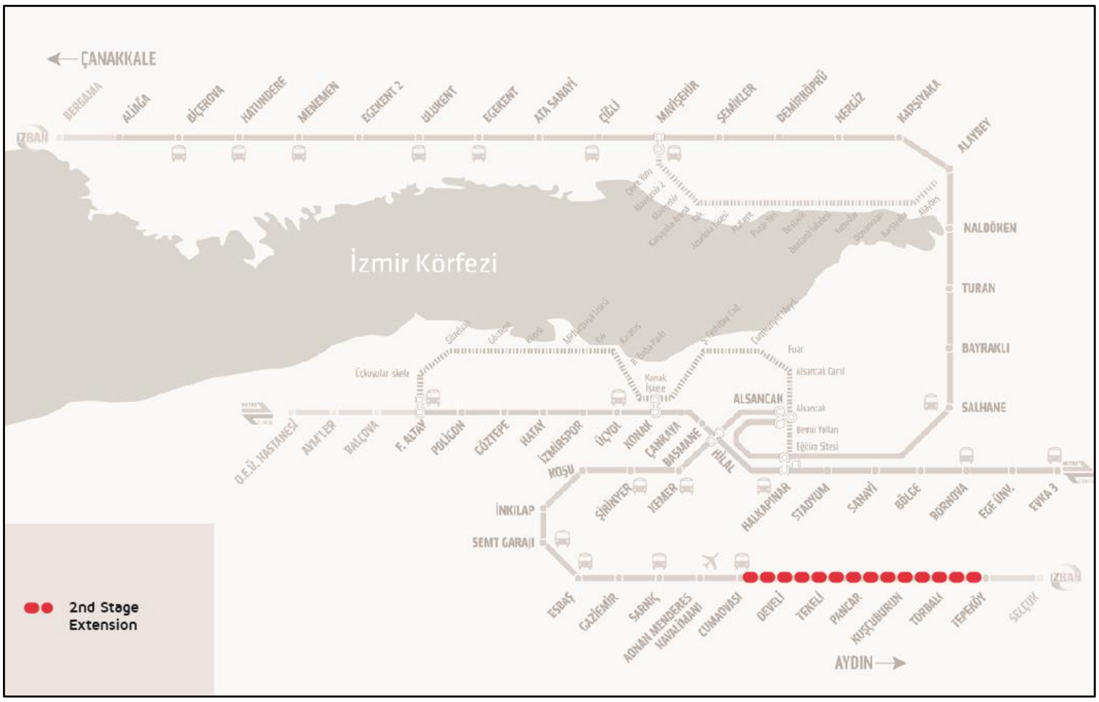


Figure 29: 2nd Stage Extensions of IZBAN

3rd and 4th Stage Extensions

- Tepeköy-Selçuk (26 km) destination is planned to be converted to dual-in-line. The project for this transformation was completed and construction tender for the project to contract was launched in 2013.

- Aliağa – Bergama (50 km) destinations dual-in-line railway construction projects are about to be completed.

When these extensions are completed, the system will become 188 km in length.

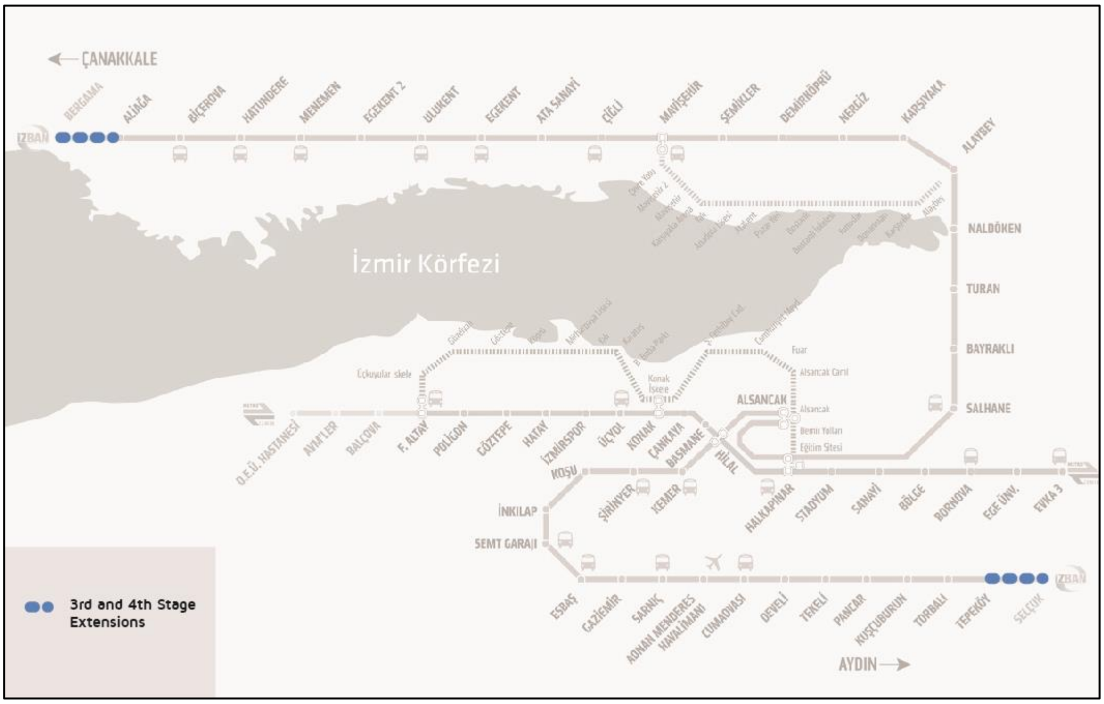


Figure 30: 3rd and 4th Stage Extensions of IZBAN

Buying of New EMU Train Set

IZBAN put in a tender for new trains according to extensions on lines and increase in passenger numbers and a contract is signed to buy 40 train sets with Hyundai-Rotem company from South Korea and all arrangements will be done in 2016 (IZBAN General Information Report, 2013).

5.5. Performance Analysis Comparison of the Regional rail system under TCDD and Local Authority

5.5.1. Performance Analysis: Passenger Statistics, Service Levels, etc.

As described in Chapter 1, two main research questions were formulated. In this and the following sections, analysis is carried out in line with these questions. The first question was "How has the general performance of İzmir regional rail system changed after the partnership project between state and local authority?

In order to answer the question the before and after operation is analyzed in this section. The statistics of TCDD were explained in section 5.3. Firstly, the progress in IZBAN will be explained than in the end TCDD and IZBAN will be compared. The analysis aims to answer the following two sub-questions:

1.1. Has the performance been improving since the local authority took part over the operation?

1.2. What factors have been effective in enhancing or hindering the performance of the system?

Table 9: IZBAN Passenger Statistics

	2010	**2011**	**2012**	**2013**
Total Passenger	2604648	35515414	50361383	61038918
Round Trip	16107	62181	66286	69191
Passenger by trip	161	571	759	882

Source 55: IZBAN A.Ş. Genel Bilgilendirme Raporu

IZBAN started to operate on 30th August 2010. The ridership of the regional system was 2604648 in 2010 and 61038918 in 2013. On the first 9 month of the 2014 the ridership was 60752844.

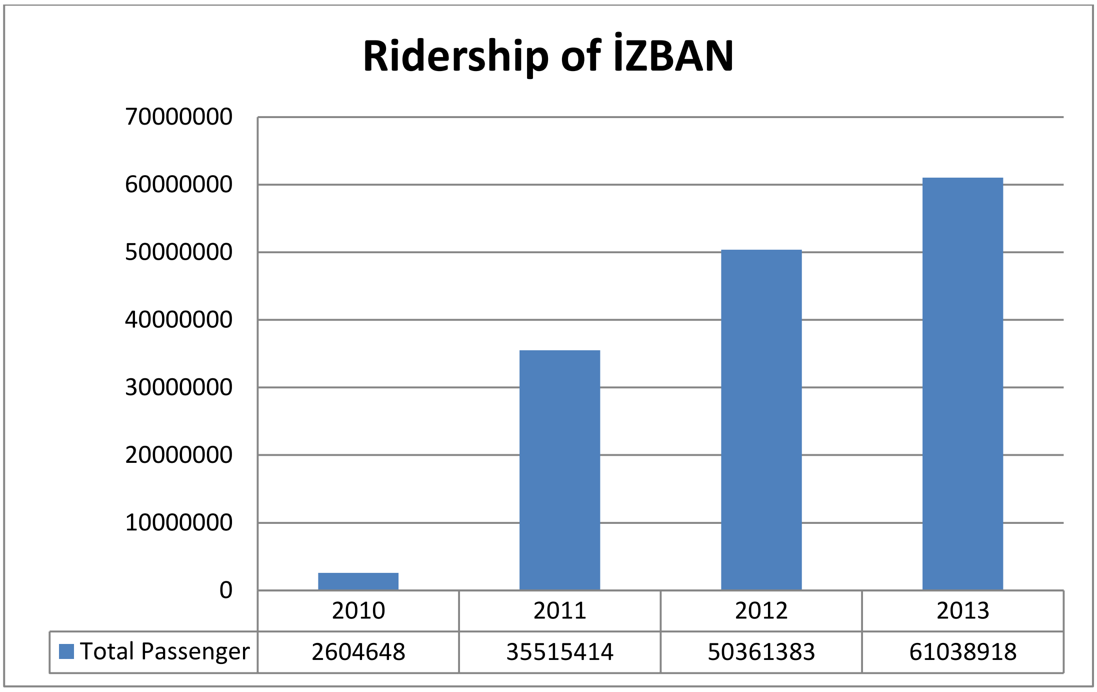


Figure 31: IZBAN Annual Ridership between 2010-2013

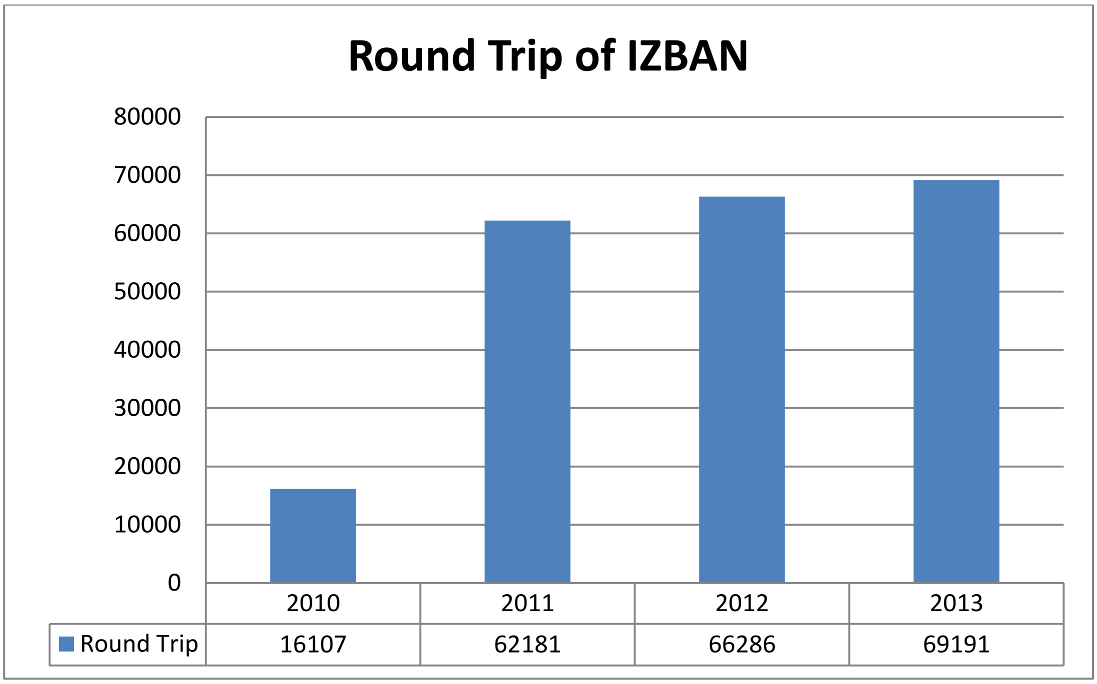


Figure 32: IZBAN Round Trip between 2010-2013

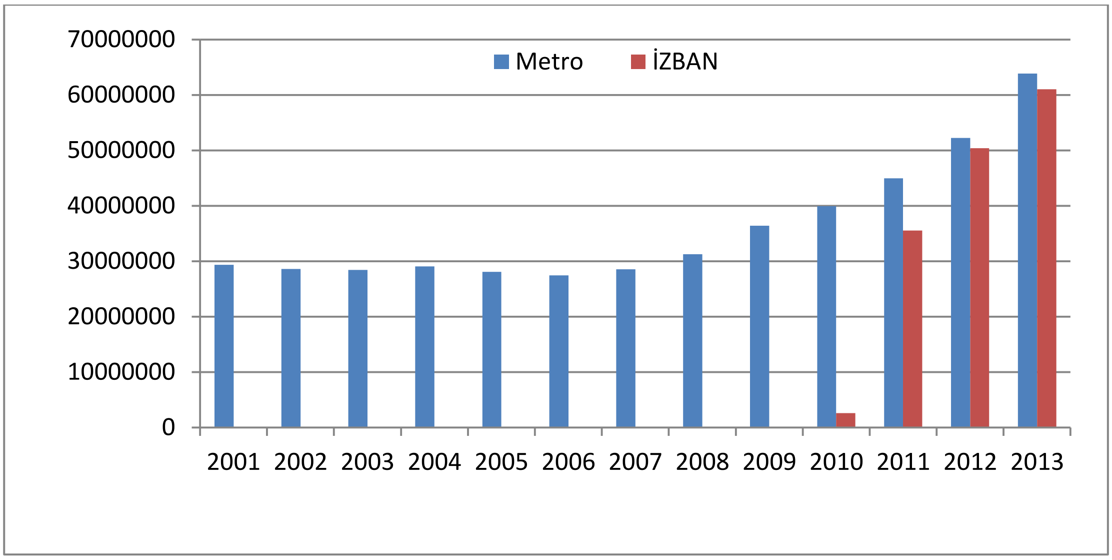
Different rail systems in an urban area are usually planned to operate in integration with each other. In this case İzmir Metro and IZBAN has two transfer stations; Halkapınar and Hilal. Halkapınar transfer station has been the transfer station since IZBAN started to operate. Then in 4th August 2013 Hilal station has opened. The ridership of İzmir metro and IZBAN and their relation with each other is seen the graphics below.

Izmir Metro Inc.

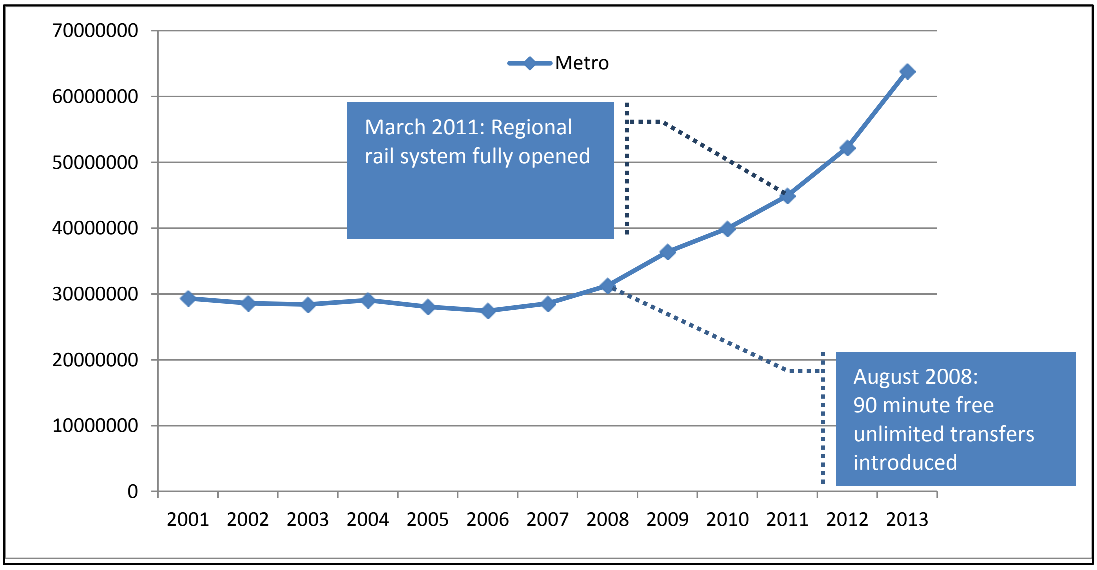
Table 10: Metro Annual Ridership between 2010-2014

	2010	2011	2012	2013	2014
JANUARY	2.681.401	3.631.256	3.905.814	4.920.007	5.945.030
FEBRUARY	2.611.800	3.516.510	3.901.593	4.595.571	5.422.528
MARCH	3.137.337	4.262.891	4.648.856	5.636.624	6.429.804
APRIL	3.036.369	4.212.559	4.615.471	5.541.599	6.108.418
MAY	3.007.224	4.106.634	4.688.166	5.647.413	6.073.859
JUNE	2.694.875	3.739.195	4.146.786	4.892.012	5.321.437
JULY	2.480.989	3.277.241	3.629.424	4.223.963	5.223.618
AUGUST	2.400.261	3.096.984	3.571.680	4.235.955	6.901.209
SEPTEMBER	2.876.547	3.890.071	4.533.984	5.556.275	8.102.008
OCTOBER	3.341.258	4.361.539	4.773.664	5.936.205	
NOVEMBER	3.302.978	3.930.538	4.898.317	6.238.805	
DECEMBER	3.898.581	2.897.517	4.929.594	6.430.832	

The data of the last three month of 2014 is missing because of that the 9-month-ridership is seen below. It is clearly seen that the ridership of the IZBAN system has been increasing every year since its opening. The ridership of Metro has increased in 2014. One of the main reason was that Fahrettin Altay and Poligon stations have opened and the metro line reached to Üçkuyular.



Graph 15: Annual Ridership of IZBAN and METRO



Graph 16: Annual Ridership of Metro

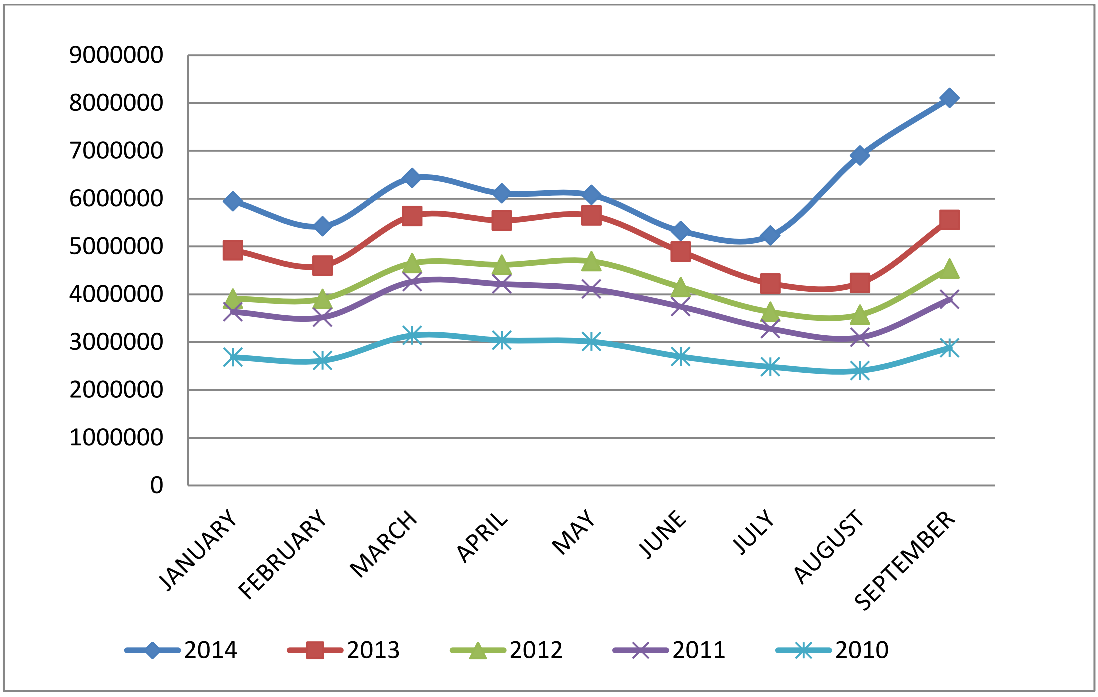


Figure 33: Metro Annual Ridership between 2010-2014

According to the data taken from the institutions and organizations the relationship of transfer stations of IZBAN and İzmir Metro can be seen in the table below. It is analyzed that with the Hilal transfer station opening on 4th August 2013, the ridership of both rail systems have increased.

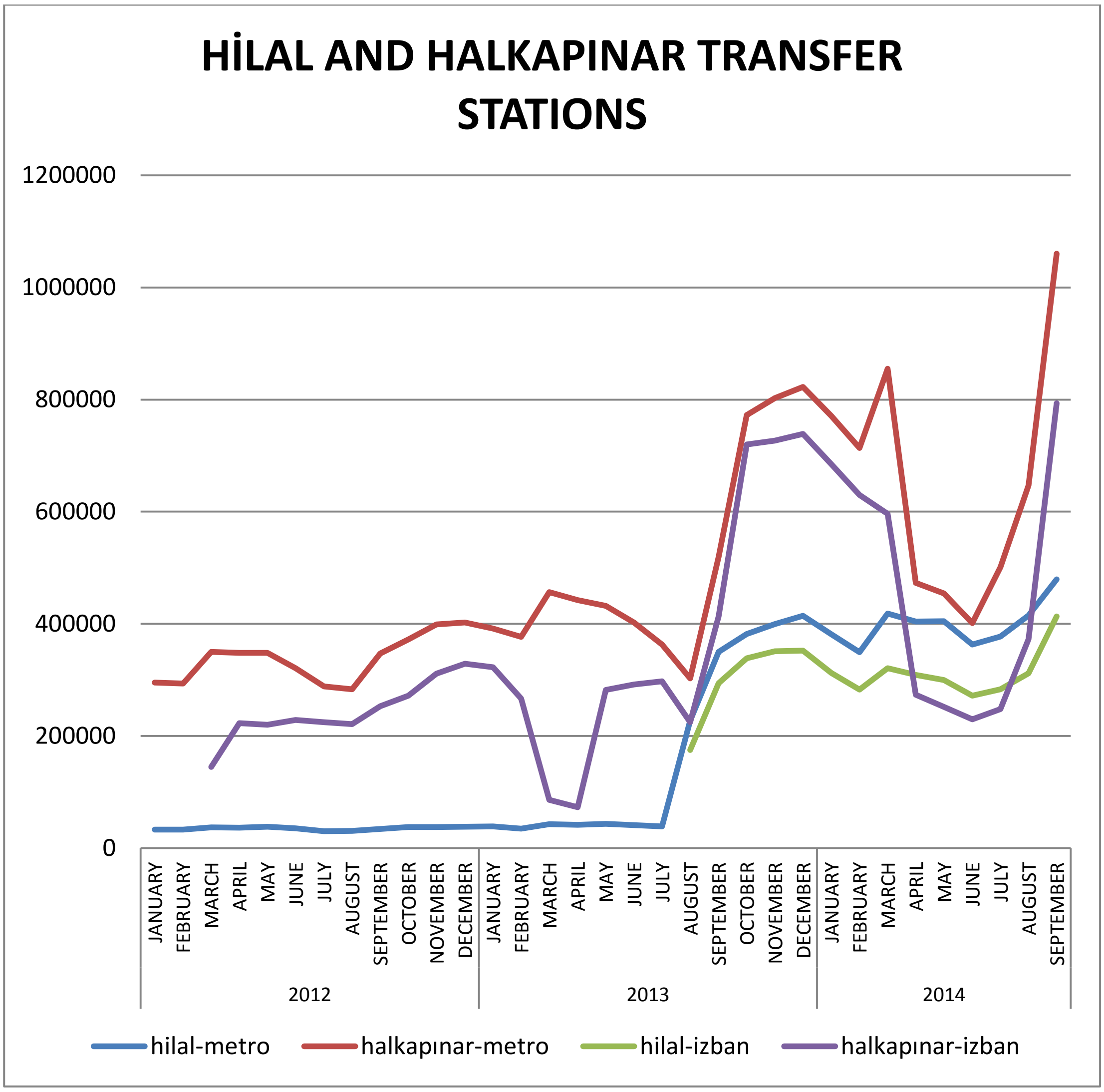
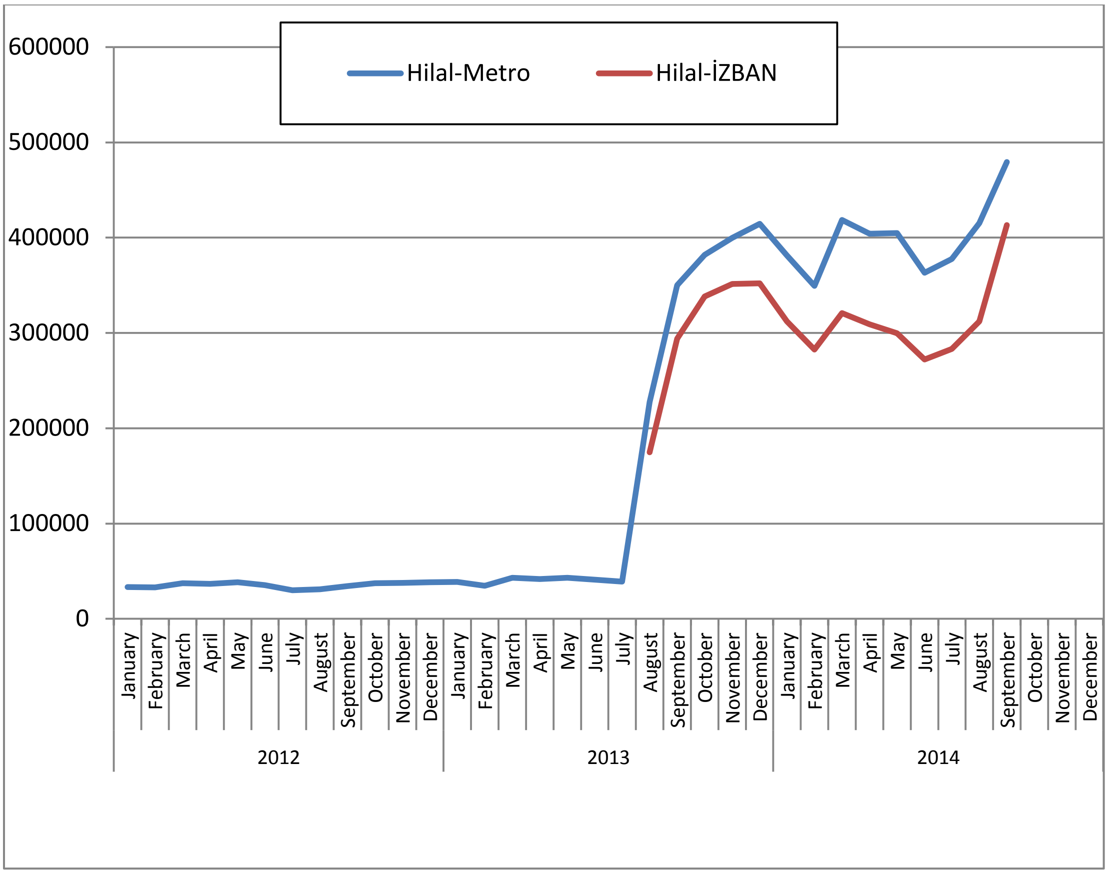


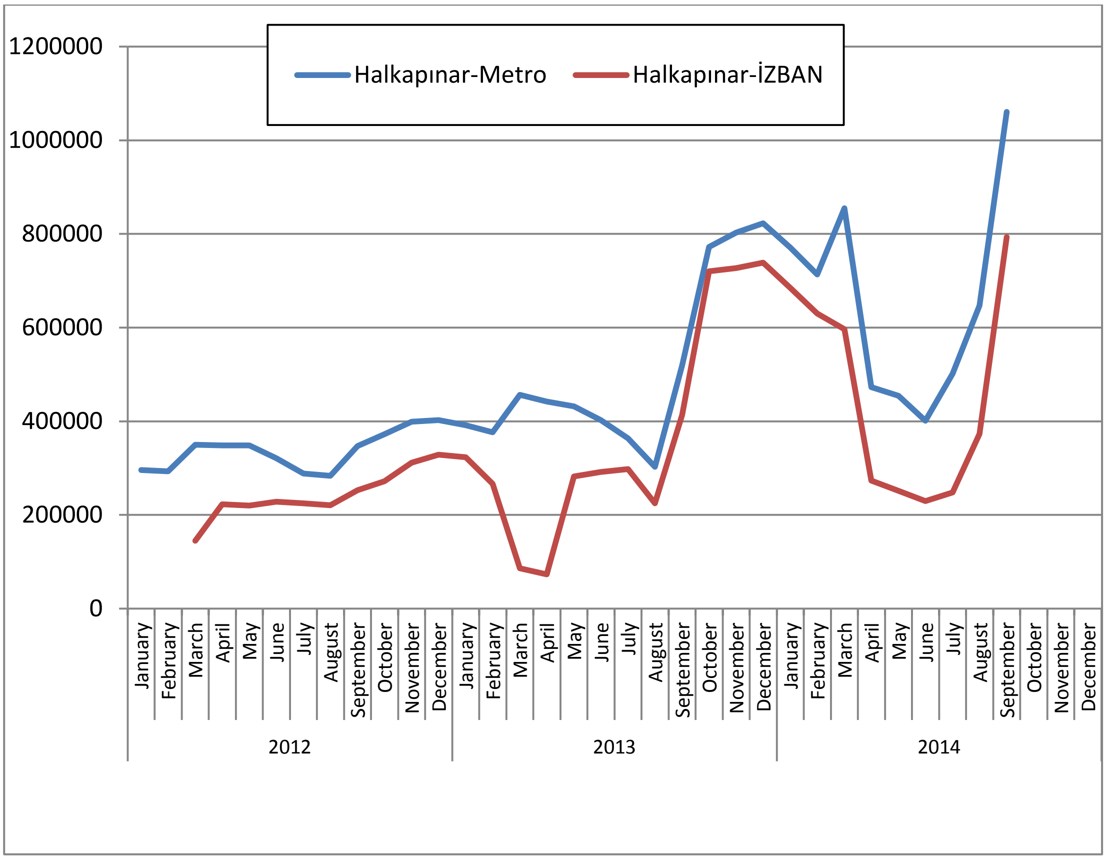
Figure 34: The annual and monthly ridership of Hilal and Halkapınar transfer stations
*The data of February 2012 IZBAN ridership is missing.
*Hilal transfer station opened on August 2013

The same transfer stations of IZBAN and İzmir Metro are below.

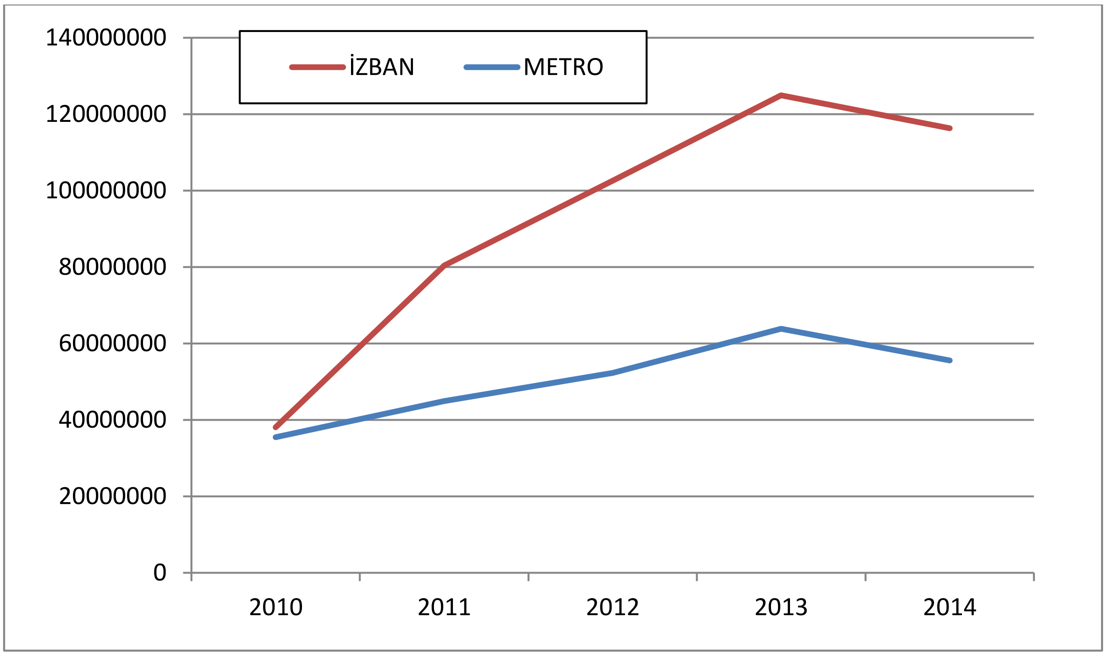


Graph 17: Annual and monthly Ridership of Hilal Transfer Stations

The ridership shows that after the opening of IZBAN both of the railway system increased their ridership especially after opening the transfer stations.



Graph 18: Annual and monthly Ridership of Halkapınar Transfer Stations



Graph 19: Annual Ridership of Metro and IZBAN
(*The ridership data of November and October is missing in 2014)

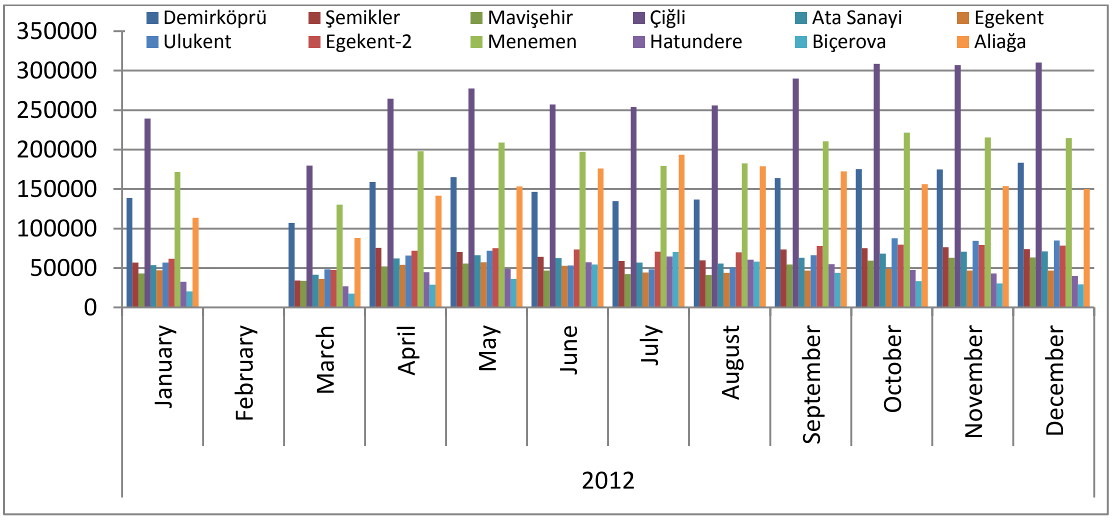
IZBAN can be considered a more comfortable transportation mode compared to the Metro. It is larger in size andthere are places for luggages.

Figure 35: Photos of IZBAN from inside

As mentioned in the section above there are too many stations and it is hard to see all of them in one graphic. In order to create a better visual understanding IZBAN regional rail was divided into 3 zones. The ridership of the stations due to month and year are below.

ZONE 1

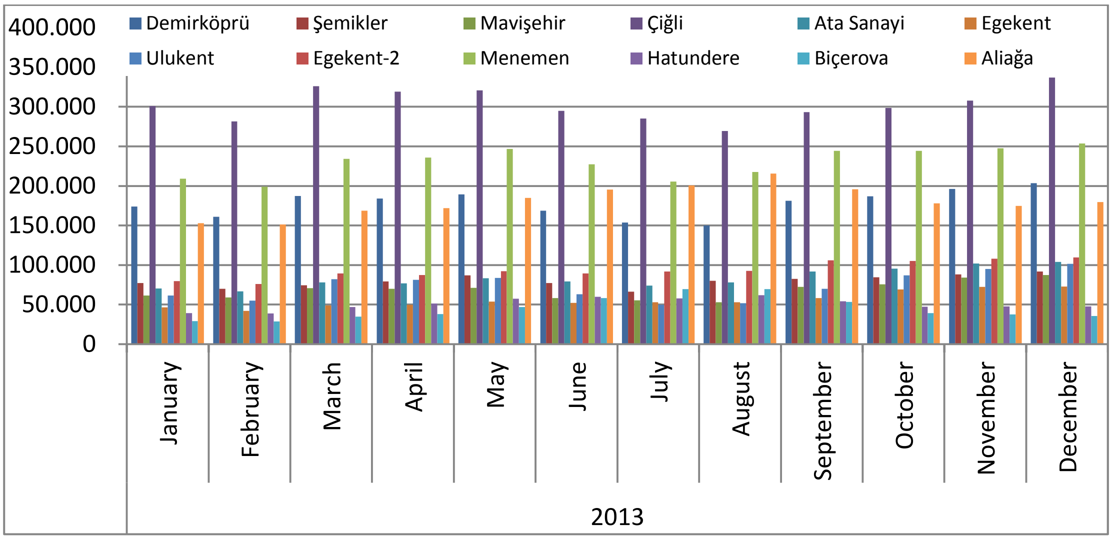
As it seen in the table above and its graph below in Zone 1, Çiğli, Menemen, Demirköprü are the stations with high ridership.



Graph 20: Monthly Ridership of Zone 1 in 2012

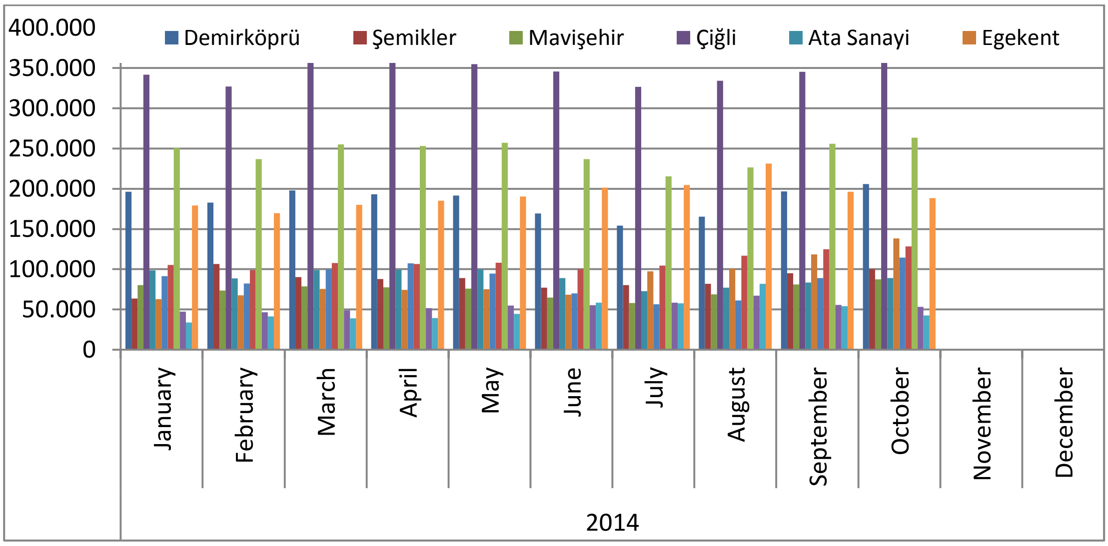
*The February ridership data is missing

All the stations increased their ridership in 2013 and the busy stations Çiğli, Menemen, Demirköprü stand the same.



Graph 21: Monthly Ridership of Zone 1 in 2013

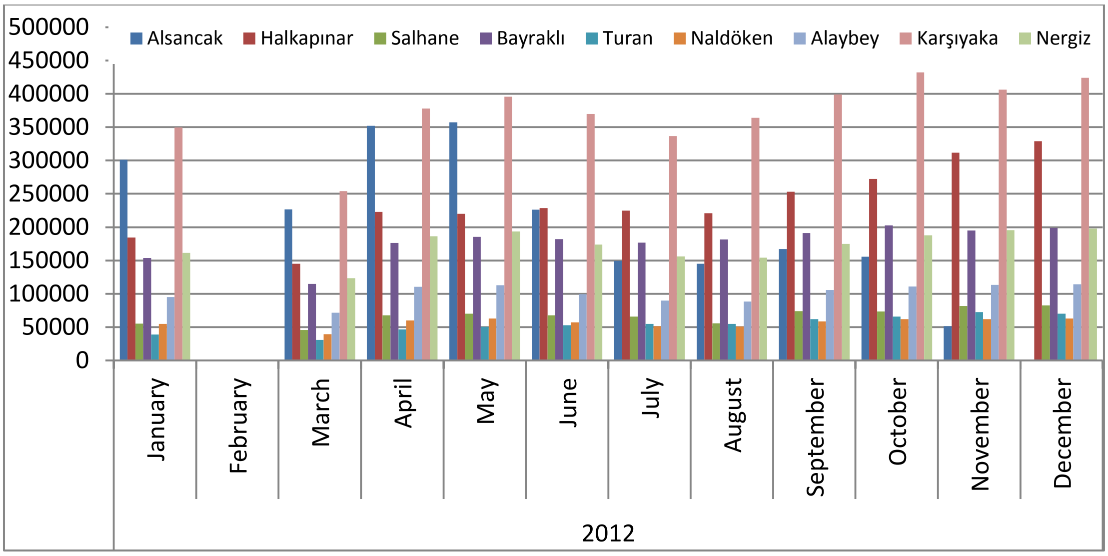
According to the data in 2014 the ridership continued to increase.



Graph 22: Monthly Ridership of Zone 1 in 2014

ZONE 2

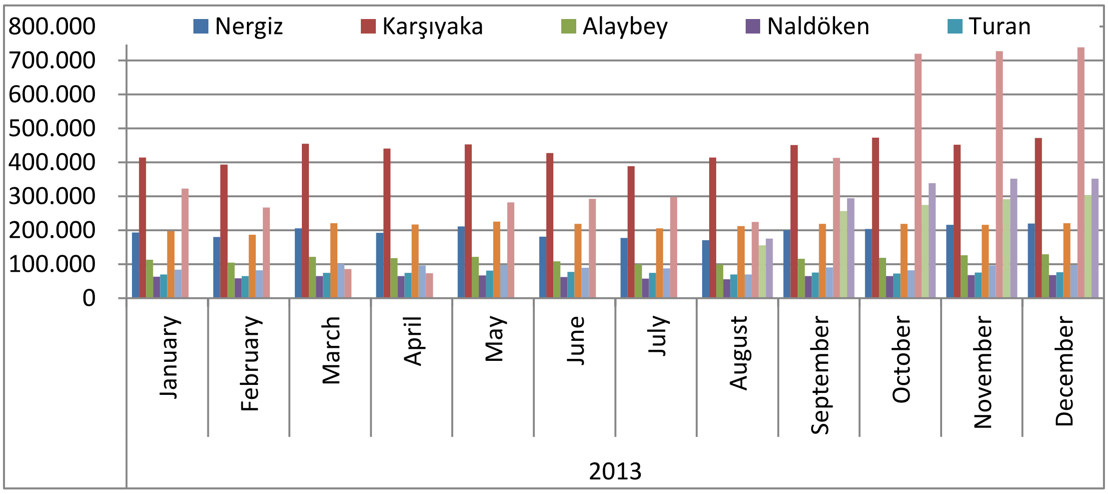
Alsancak station was closed because of the construction in Hilal transfer station in the mids of November. Karşıyaka, Halkapınar transfer station and Alsancak (not including the construction phase) are the stations with the high ridership.



Graph 23: Monthly Ridership of Zone 2 in 2012

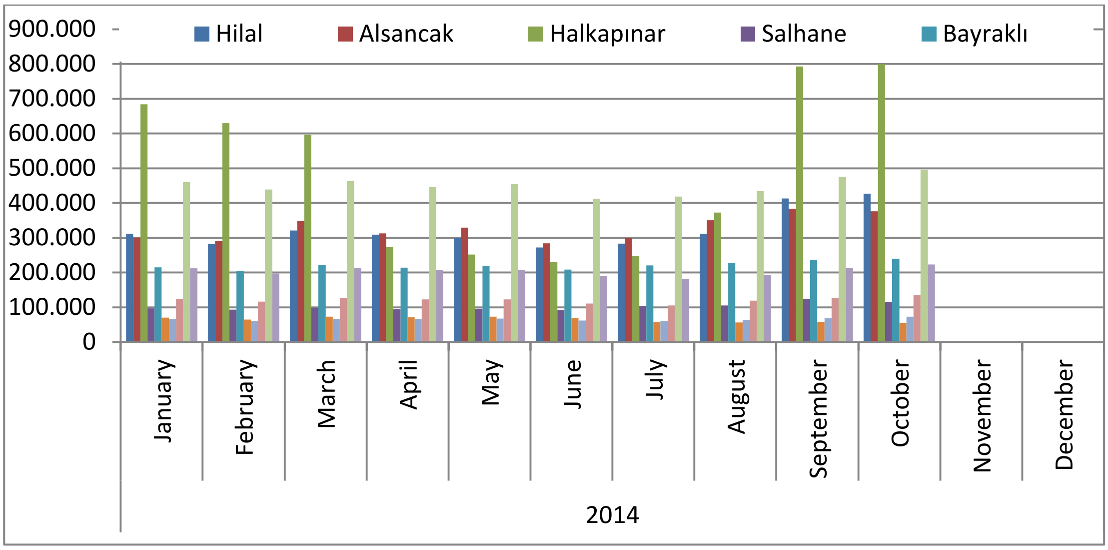
*The February ridership data is missing

In 2013 the second transfer station Hilal has opened and also Alsancak station started to operate again. After the opening of Hilal station there has been a big jump in Halkapınar station. Alsancak started to operate its old ridership approximately in the end of the year.



Graph 24: Monthly Ridership of Zone 2 in 2013

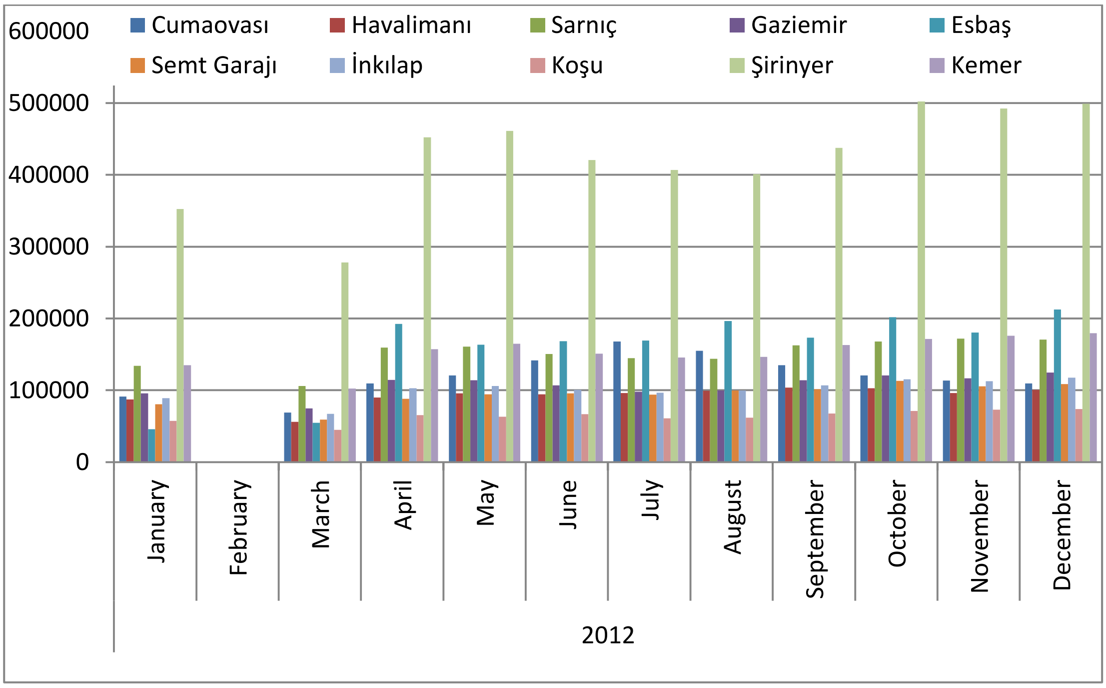
In 2014 Halkapınar, Karşıyaka and Hilal are the stations with the high ridership. The Zone 2 includes the stations in the center that is the reason of the high ridership in most of the stations.



Graph 25: Monthly Ridership of Zone 2 in 2014

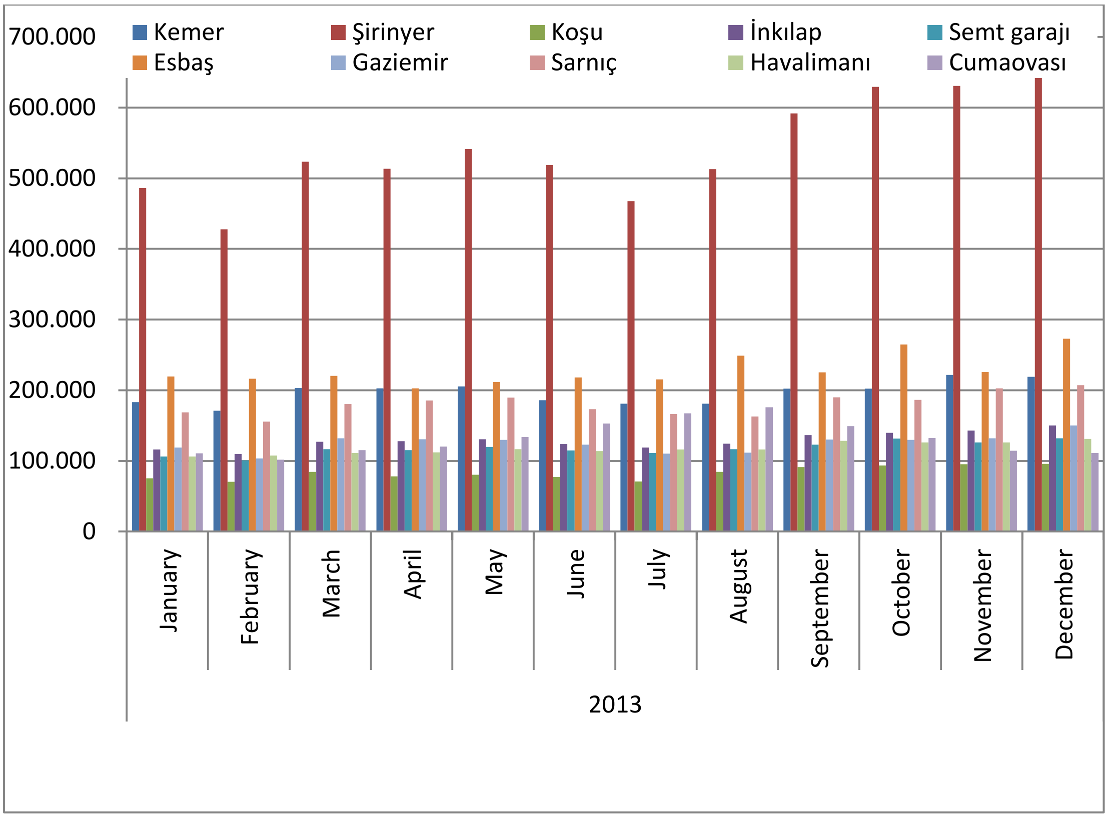
ZONE 3

As it seen in the graph below in Zone 3, Şirinyer has a higher ridership than other stations and another important station is the Airport station.



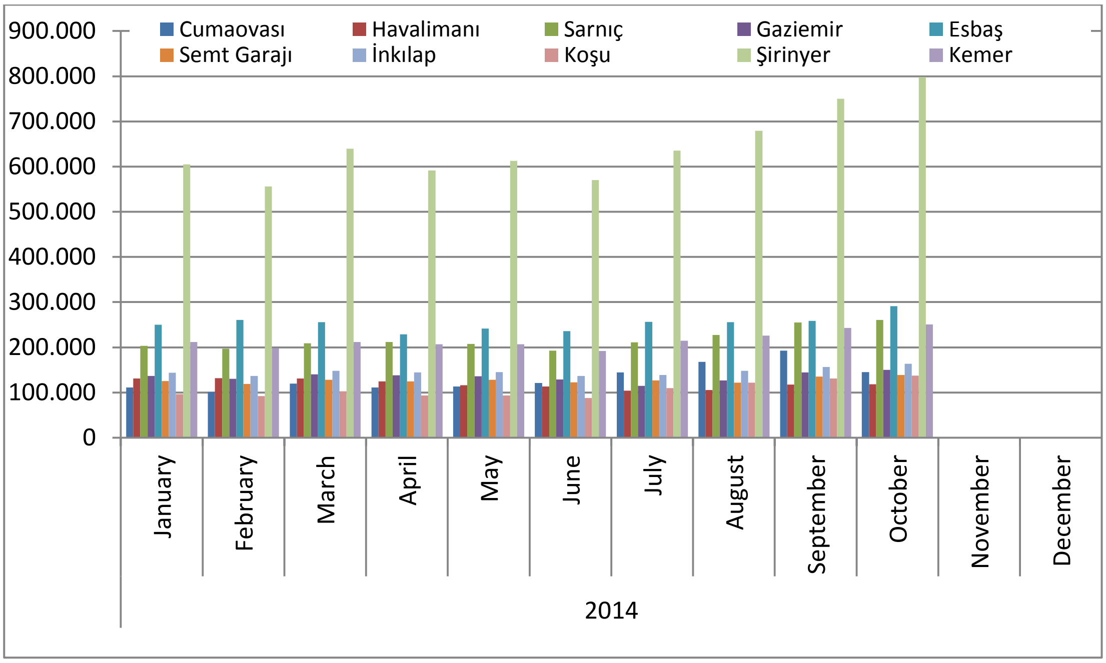
Graph 26: Monthly Ridership of Zone 3 in 2012
*The February ridership data is missing

In 2013 all stations continued to increase their ridership and Airport station has the ridership of 1411149



Graph 27: Monthly Ridership of Zone 3 in 2013

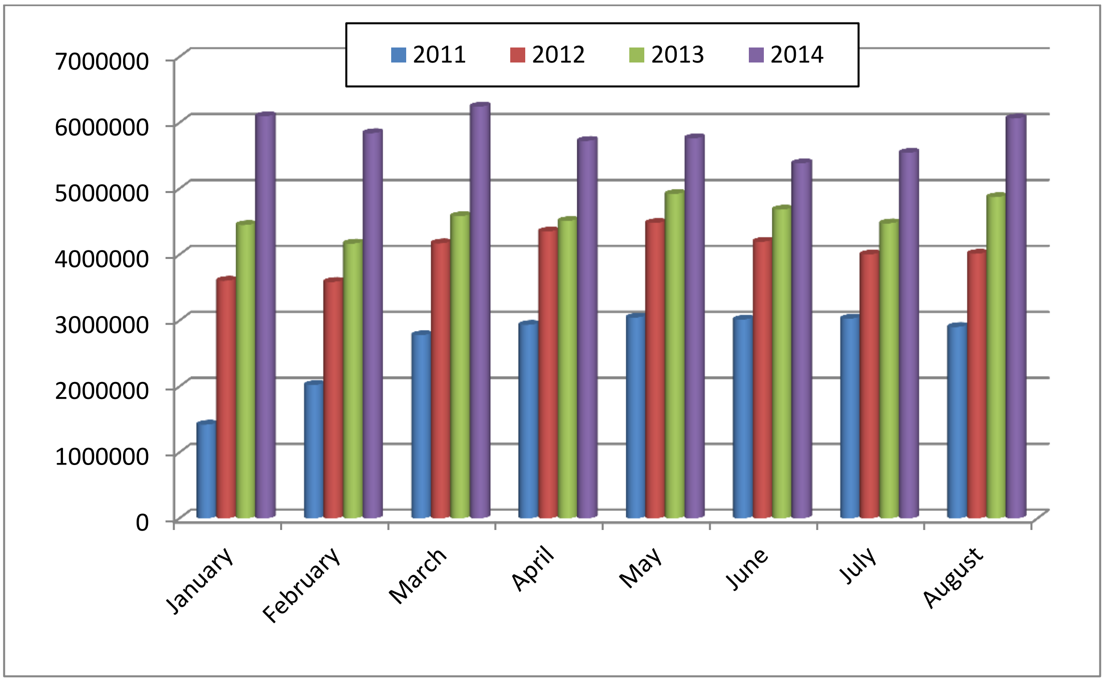
In 2014 all the stations also continued to increase and Airport stations has a ridership of 1194622.



Graph 28: Monthly Ridership of Zone 3 in 2014

Because of the missing data, the best comparison can be done 8 months of the years between 2011 and 2014.

The graph below shows that the ridership increased since 2011 to 2014. The new stations in Metro also has affected the ridership increase of IZBAN.

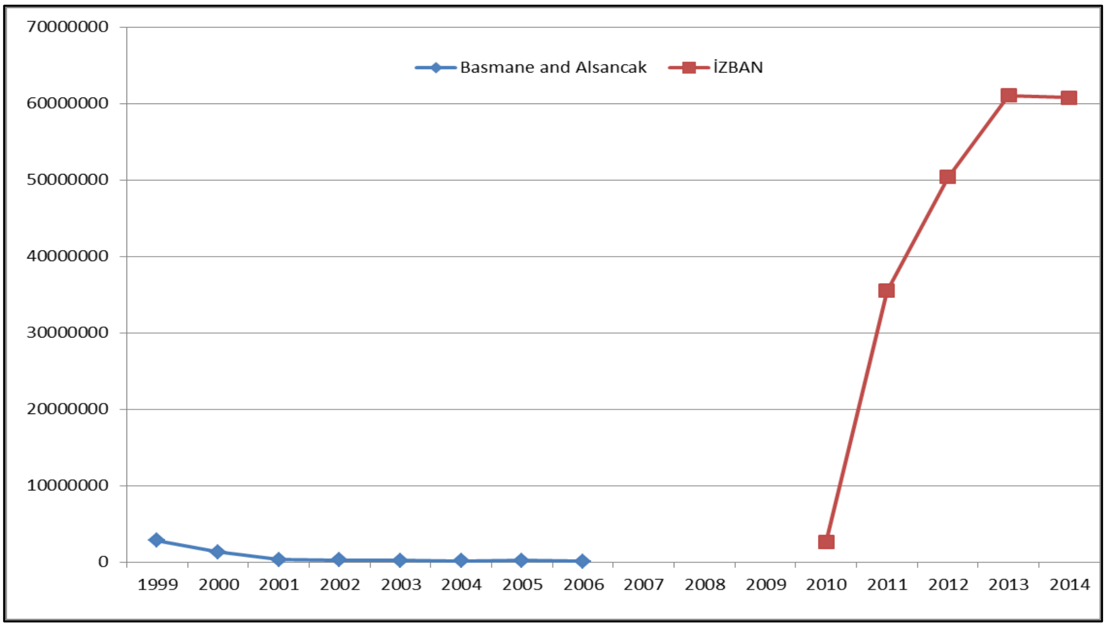


Graph 29: Annual and Monthly Ridership of IZBAN

Figure 36: Total Ridership of IZBAN between 2010-2014

In the figure above the ridership of IZBAN is compared between the opening on August 2010 and the end of 2013. The ridership also shows us the seasonal effects (the opening and closing of schools) in the year. The slight decrease in 2013 is the long religious holiday.

One aim of the study was to compare the before and after situation for this line. The graphic below shows the ridership of Izmir Commuter Line when it was operated by TCDD, and the ridership of the system after it became the IZBAN regional rail system. It is clearly seen that the ridership increased radically after the modernization and transformation of the commuter line into the IZBAN regional rail system.



Graph 30: Annual Ridership of TCDD and IZBAN between 1999-2014

A general comparison of TCDD and IZBAN will be done at the end of this section.

Table 11: Most Intense Stations between 2012-2014

2012	**2013**	**2014 (10 months)**
Şirinyer (4702987)	Şirinyer (6458526)	Şirinyer (6437860)
Karşıyaka (4109411)	Karşıyaka (5193530)	Halkapınar (4878554)
Çiğli (2943231)	Halkapınar (4422110)	Karşıyaka (4500127)
Halkapınar (2611713)	Çiğli (3608375)	Çiğli (3472699)

*In 2012 February data is missing
*In 2014 November and December data is missing
*Transfers are not included

IZBAN is the only regional railway system in Turkey that serves an airport in the city. Istanbul is another example with an urban rail connection, where the light metro provides connection to the airport. Adnan Menderes Airport in İzmir is one of busiest airports in Turkey. The passenger statistics of the airport is in the figure below. Clearly serving this airport with the IZBAN system had contributed to the ridership as well. Before IZBAN, the commuter rail line was also serving the airport but the frequency and the ridership were low. The total passenger number in Adnan Menderes Airport is 10.2 million and the ridership of IZBAN is 1.411.149. By a simple math it can be said that %15 of the transportation is provided by IZBAN.

Figure 37: Adnan Menderes Airport Station

Table 12: Passenger statistics of Adnan Menderes Airport (*1000000)

Passengers	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
International	1.3	1.5	1.5	1.4	1.5	1.7	1.5	1.6	1.7	1.7	2.1	2.4	2.4	2.5
Domestic	1.2	1	1	1	1.4	2	3	3.6	3.8	4.5	5.4	6.1	7	7.7
Total	2.5	2.5	2.5	2.4	2.9	3.7	4.5	5.2	5.5	6.2	7.5	8.5	9.4	10.2

Source 56: http://www.adnanmenderesairport.com/tr-TR/havayollari1/Pages/istatistikler.aspx

Table 13: Ridership of Havalimanı Station by years

	2012	2013	2014
HAVALİMANI	1.022.751	1.411.149	1.186.380

*In 2012 February data is missing
*In 2014 last 2 months data is missing.

While the analysis of ridership clearly shows the improved performance of the line after it was modernized and started being operated IZBAN, the literature review in the earliest chapters of this study had revealed a number of criteria for regional rail operations. These are also used to compare the state of the line before and after the modernization. These criteria and the comparison are shown in the table below.

CRITERIA	TCDD	IZBAN
Right of way	In some places there were at grade crossings	Category A, i.e. fully segregated
Station spacing	Almost same with IZBAN	2435m
Station design	Old, not providing disabled access	Modernized, new design, 4 of them underground, all of them with disabled access friendly
Platforms and boarding	There were platform steps, and platform gap fillers	All the platforms are ground level, no gaps
Yards and maintenance sites	Halkapınar yard: the site was in the inner city with limited opportunity for expansion Old technology	2 yards very large yard in Çiğli -other one is Halkapınar
Operating schedule; headway, service hours	1 train every hour	Peak hour headway /hour (every 10minutes) Off-peak hour headway: /hour (every 25 minutes)
Integration of the system with other transportation modes	Only integration with buses in some stations	Integrated with most of the transportation modes except ferries

5.5.2. Integration and Coordination in Planning: Achievements, Challenges and Future Plans

The second research question was “Have there been a better integration and coordination in planning and transport operations after the local authority took over the operation?

2.1 Has the urban planning and transport planning coordination been improved?

2.2 Has the integration between transport modes been improved in terms of both planning and operation?

In order to answer the questions above, in-depth semi-structured interviews were made with the executive staff of TCDD, Izmir Greater Municipality, İzmir Metro Inc. and IZBAN. The interview questions are given in Chapter 3. The first interview was made with an engineer from the TCDD. In general terms questions were asked about the partnership project and their opinions regarding the project. The second interview was made with one of the managers in IZBAN. The third interview was made with the staff in the İzmir Greater Municipality and the last interview was made with the executive staff in İzmir Metro Inc. According to the gathered information from the interviews, there is not a committee that regulates the operation in IZBAN. General Manager of İzmir Metro and Assistant General Manager of IZBAN is the same person. This is important because of the less bureaucracy between institutions.

In accordance with interviews in general terms IZBAN is a unique organization in Turkey. There are several advantages and disadvantages of this system.

The jurisdiction in the system is one of the biggest problems. The task distribution of IZBAN and State railways is distinct but in critical times disagreements occur. The railway infrastructure belong to the State Railways and therefore in case of a problem in the railway line, such as a train breaking down and blocking all operations, IZBAN has no jurisdiction and cannot move the train. The priority for TCDD is safety so TCDD closes the line and all the regional rail operation stops. However, IZBAN is the responsible agency for providing a certain level of service to its customer and therefore its priority is too keep the frequency of the service in line with promised and announced time schedules. A major disruption to the service just because of a broken-down train is not accessible from IZBAN's operating policy perspective and they would require the immediate removal of such a train. However, in order to intervene and remove the train, a substantial amount of paperwork has to be completed, which can take hours before the removal procedure can start. This inability to immediately solve a problem on the tracks was highlighted by the local operator as a major challenge in system operation.

The most important achievement of the system was described by the interviewers as the integration of IZBAN with other transportation modes. IZBAN has two transfer stations–Halkapınar and Hilal with İzmir Metro. The bus system has several routes integrating with the IZBAN stations. Passenger can make transfers to buses in the stations below.

Table 14: IZBAN Stations and ESHOT routes

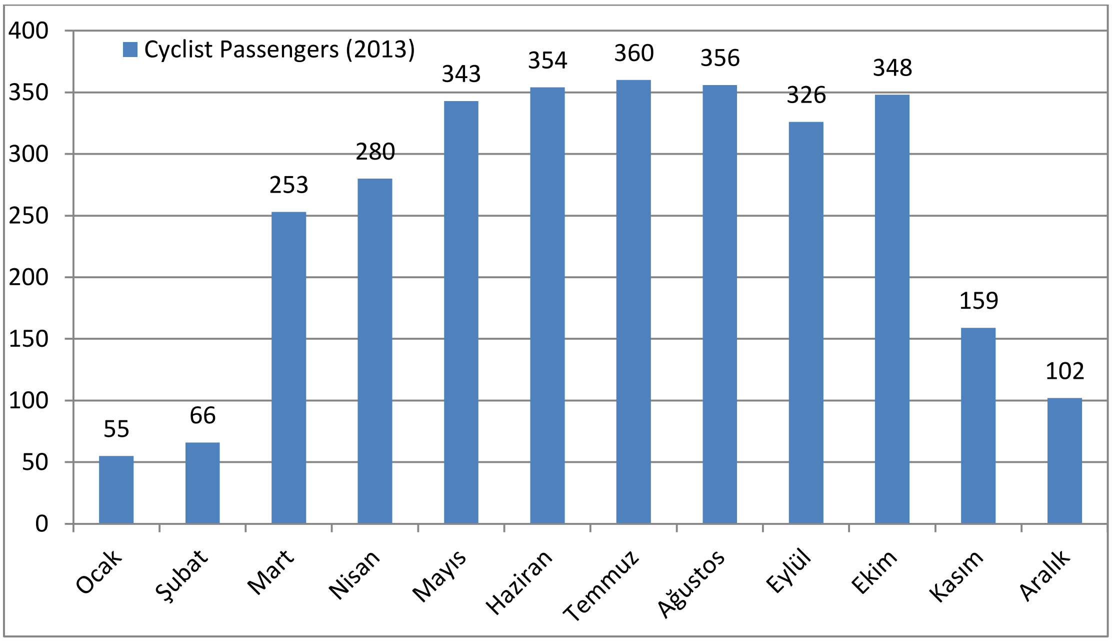
STATION NAME	**Number of Bus Route**
CUMAOVASI	10
SARNIÇ	4
ESBAŞ	5
GAZİEMİR SEMT GARAJI	9
ŞİRİNYER	11
KEMER	8
HALKAPINAR	25
ŞEMİKLER	1
MAVİŞEHİR	6
ÇİĞLİ	14
EGEKENT	1
MENEMEN	5
ULUKENT	4
HATUNDERE	2
BİÇEROVA	2

In the future plans, there will be tram systems in İzmir and these systems also have integration with IZBAN. Mavişehir-Alaybey tram system will have transfer stations in the same stations of IZBAN. Halkapınar-Fahrettin Altay tram system will have transfer stations in Halkapınar and Alsancak stations.

IZBAN and İzmir Metro are the only rail systems in Turkey that allow cyclist to travel with their bikes on the system. Since January the 1st, 2013, IZBAN and Izmir Metro’s cyclist passengers can use public transport vehicles carrying their bikes on the system at certain off-peak hours. Passengers with bikes are allowed only at the first and last rail car entries, marked and defined especially for bikes, and cannot pass to the gateway. This is to minimize the possible negative effect of bikes on other passengers. Cyclist passengers can only use fixed ladders, and neither escalators nor elevators in order to provide passenger safety rules. Cyclist passengers can use public transportation with Kentkart (paying an extra ticket for their bikes) at 09:30-11:00

and 20.00-00.00 in weekdays and Saturdays, 05:00-09:00 and 20:00-00:00 in Sundays.

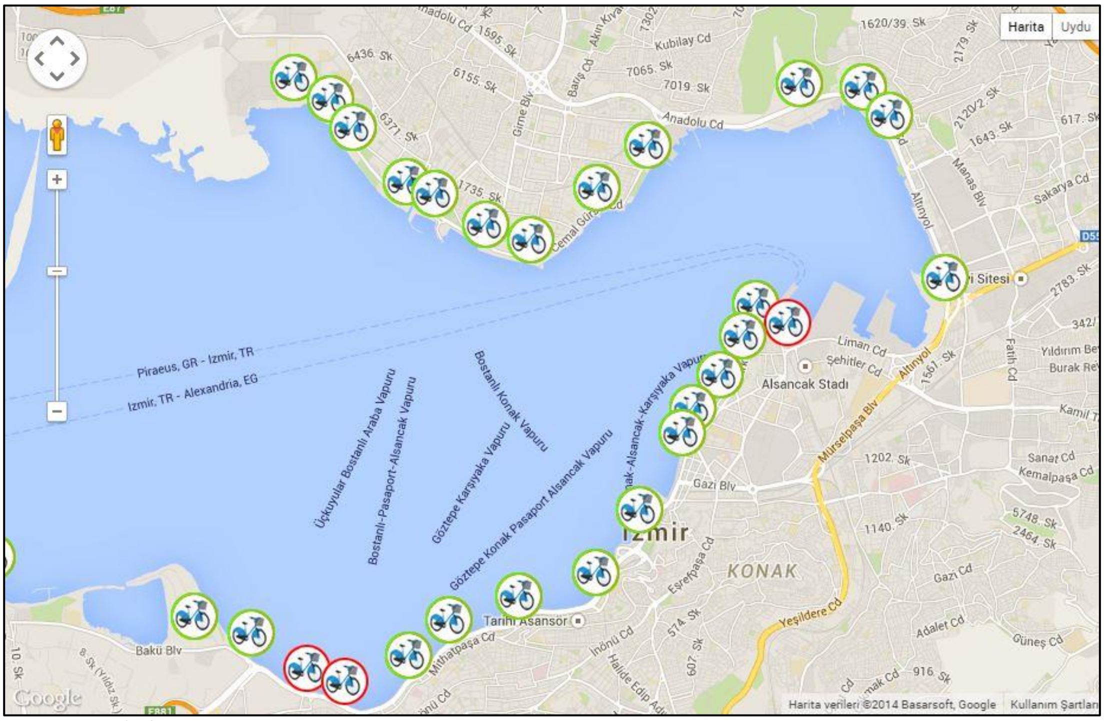
The figure below shows the statistics of cyclist passengers. The differences in monthly ridership appear to reflect the effect of weather conditions on cycling. In general, it is seen that cyclist passengers increased in number until the winter months.



Graph 31: Number of Cyclist Passengers in 2013

The city-wide bike-share system "BİSİM" also started on 18th January 2014 in İzmir. The system has 25 active, 4 inactive 311 bicycles and most of the system is planned along the coast line. The charge for BİSİM (Smart Bicycle System for public transportation) is 2 TL for upto one hour, and then every additional hour is charged with 1 TL. Bike rentals for BİSİM member card do not include any deposit charges.

Smart bike system is off at the period of 23:00 - 06:00 hours. There is no integration of the system with IZBAN but the new route which is under construction will have a transfer point with IZBAN at Turan station. The smart card system is not valid in this system. Passengers have to buy BISIM member cards with no fee



Map 20: BİSİM Bicycle Stations

There is not a park-and-ride system in IZBAN stations. However, many passengers use the system in this manner by parking their cars in the vicinity of the stations and then riding the system. The lack of appropriately-designed purpose-built park-and-ride facilities appears to be a shortcoming of the system, particularly from the point of view of transport systems integration. Passengers park their cars in the streets around the stations and this causes a traffic and parking problems near the stations.

Figure 38: The parking problem around Halkapınar station

One of the biggest transformations about the urban transport in İzmir is the smart card system "Kentkart". Kentkart has been in use since 1999 and with opening of each new system the integration is made quickly. Within 90 minutes from the time of the first boarding, unlimited numbers of transfers are allowed without an additional charge. For the trips from city center to districts, city center price list is charged for the first ride in 90 minutes. On the other hand, from districts to city center trips, district price list is charged at the first ride and further rides are free. The connected transportation system is not valid in Airport and Baykuş (The bus that operates during night) lines with 3-5 ticket. 5 minutes protection period is applied on cards for the system safety rules and this period could be checked after every ride and ticket charge. This is to prevent the abuse of the free transfer system by multiple users who may try to use one single card among themselves. In order to benefit the free transfer privilege, each ride should be in a same type of use, for example all them are full fare, or all discounted. The disabled, ghazi, ghazi relatives and 65 years and above are free of charge at public transportation.

ŞEHİR MERKEZİ (Otobüs/Metro/Vapur/Banliyö)	Tam	Öğrenci	Öğretmen	3-5 Bilet
	2,00	1,10	1,40	1 Kontör
TORBALI-SARNIÇ AKM	3,50	1,90	2,10	2 Kontör
URLA-F. ALTAY AKM	3,50	1,90	2,10	2 Kontör
SEFERIHISAR-F. ALTAY AKM	3,50	1,90	2,10	2 Kontör
BALIKLIOVA-F. ALTAY AKM	3,50	1,90	2,10	2 Kontör
FOÇA-HATUNDERE AKM	3,50	1,90	2,10	2 Kontör
YENİFOÇA-BIÇEROVA AKM	3,50	1,90	2,10	2 Kontör
KEMALPASA-BORNOVA METRO	3,50	1,90	2,10	2 Kontör
SELÇUK-TORBALI	3,50	1,90	2,10	2 Kontör
ÖZDERE-CUMAOVASI AKM	3,50	1,90	2,10	2 Kontör
DOGANBEY-CUMAOVASI AKM	3,50	1,90	2,10	2 Kontör
GERENKÖY-BIÇEROVA AKM	3,50	1,90	2,10	2 Kontör
İ.Y.T.E-F. ALTAY AKM	3,50	1,90	2,10	2 Kontör
BAYKUŞ	4,00	2,20	2,80	2 Kontör
HAVAALANI	4,00			2 Kontör

3-5 BİLET (2 Binişlik)	6,50
3-5 BİLET (3 Binişlik)	9,40
3-5 BİLET (5 Binişlik)	15,20

MERKEZDE 90 DAKİKA İÇİNDE 2. VE SONRAKİ TÜM BİNİŞLER ÜCRETSİZDİR.

İLÇELERDEN ŞEHİR MERKEZİNE ULAŞIMDA 90 DAKİKA İÇİNDE 2. VE SONRAKİ TÜM BİNİŞLER ÜCRETSİZDİR

ŞEHİR MERKEZİNDEN İLÇELERE ULAŞIMDA 90 DAKİKA İÇİNDE İLÇE TARİFESİNDEN TAM'dan 2,00 TL, ÖGRETMEN'den 1,40 TL, ÖGRENCİ'den 1,10 TL ÜCRET DÜŞÜLECEKTİR.

Figure 39: Kertkart Fare Collection

One of the problems about the system is that other trains of TCDD use the same lines with IZBAN and this affects the frequency. TCDD trains stops at Alsancak and Basmane stations with few passengers. The trains are mostly old and cause problems in different ways such as break downs, slow trains and air pollution. According to the interviews made with the executive staff it was offered to transform the Menemen station as the final inter-city railway station in Izmir direction and to collect the passengers from Memenen station free of charge with IZBAN into the city centre to Alsancak station. However, this proposal was not accepted and the problem is not solved.

IZBAN has created emergency scenarios of problems. There is command and control center in Çiğli where also the large yard is built.

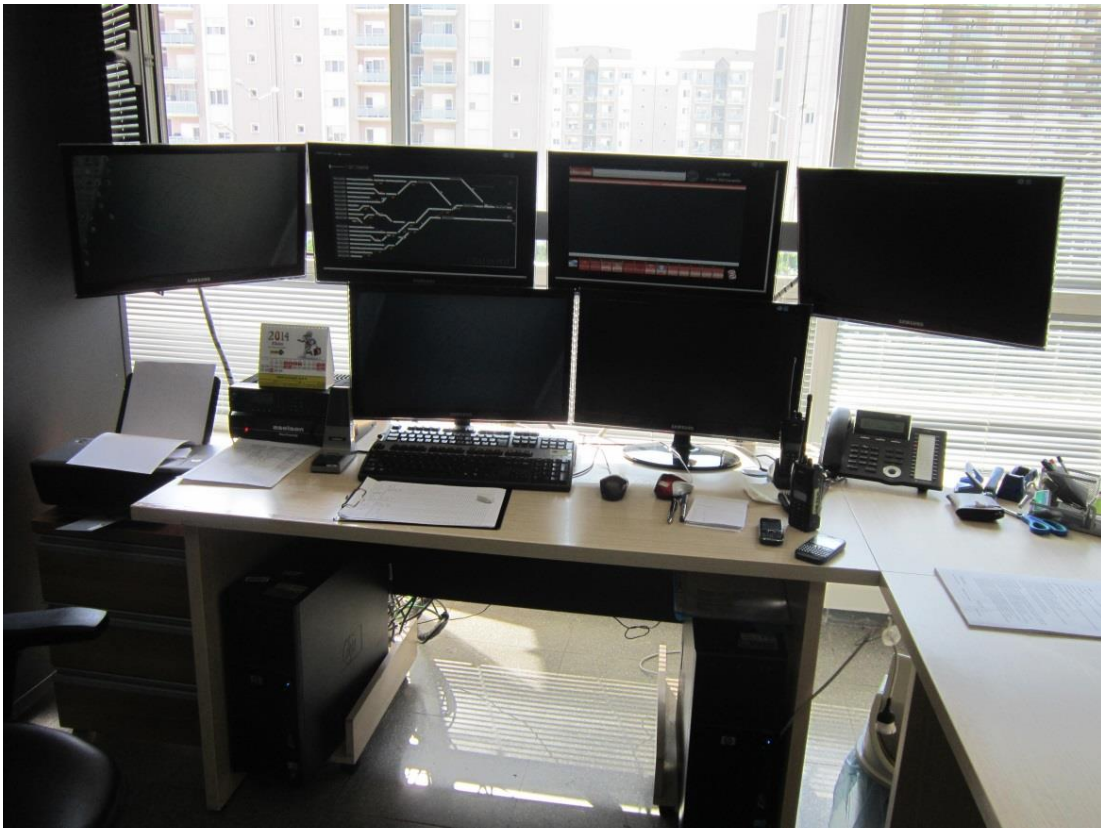


Figure 40: Command and Control Center in Çiğli

The system is using a program called Savronik Scala which is created for IZBAN specially.

IZBAN is a modernized commuter rail system for which entirely new lines and routes were not created. In some routes additional rail line were built along the existing lines using the existing right-of-way because creating a full new route is very expensive. The maintenance and yard is in Çiğli, which is the biggest yard in Turkey with 77000 m^2 area (20000 m^2 is closed area). There is a train yard with 18 rail lines in Çiğli. The first 8 lines are called as cleaning rails and the rest 10 lines are maintenance lines. There are cameras in each station and in the yard for security.

In addition to the integration of the system with other transportation modes, which has been described above, another aspect of analysis was the integration and coordination of urban planning and transportation planning. One of the research questions of the study is whether the transfer of operation from central railways agency to a partnership involving the local authority resulted in a better coordination and integration of urban plans and regional rail system plans.

In the latest plans of İzmir the city is planned to develop along a north-south axis with special emphasis on the development of the north axis. Although not as stressed as the north corridor, there are few development points in the south axis too. IZBAN is operating in the north-south axis in İzmir and therefore supports this urban development strategy. From this point of view, the system appears well integrated into the urban development plan; however, this cannot really be attributed to the new partnership model of IZBAN that includes the local authority. This is because the railway line was never changed and hence IZBAN uses the same route where the commuter line has been serving. It can be argued that the whole project of IZBAN, i.e. modernizing the infrastructure and providing a high-quality frequent service, as a whole represents a good integration with urban plans since this new service is very much in line with the strategy of developing this corridor.

Not withsanding the above argument, there is no clear evidence that the new partnership involving the local authority resulted in better integration and coordination in urban and transport planning. The interviews also revealed no such cases of improved integration. The future extensions of the IZBAN system, for example, is planned taking into consideration existing railway lines as has been the case so far. Using the existing lines indicates routes to the east whereas the urban development plans designate the areas to the east for agriculture. Therefore, it appears that the coordination that was attained between urban planning and the planning of the regional rail system was due to the convenient location of the existing line which was along the development corridor. However, for future extensions, interviews did not reveal a particular concern from regional rail agencies' (TCDD and IZBAN) point of view with regards to planning and extending the system in coordination with current urban development plans. Interviews by city planners at the local authority also revealed that the city planning department of the municipality did not have an effect on the planning of future lines of the system.

From the point of view of city planners in the local authority, supporting this corridor is instrumental for the attainment of their strategic urban plan. Therefore, they see the IZBAN Line as an effective tool for realizing their urban growth strategy. Nevertheless, there are not significant projects at station sites with a view to make these areas the focal development points for sub-settlements. There have been a particular interest in the Halkapınar Station, which was planned to become a major transport interchange point and both urban transport planning and urban planning efforts were coordinated to attain this strategy. However, for stations outside the inner city, it is not possible to suggest that urban plans are being shaped to focus development at the station area to create rail-oriented growth patterns.

As a result, from the perspective of integrated planning, the new partnership that involved local authority appears to have had a clear positive effect in terms of urban transport integration, and particularly the integration of different public transport modes into the regional rail system. In terms of urban and transport planning coordination, the effects are limited.

5.6.Result of the Analysis

After giving information about the before and after of the partnership project, as mentioned in Chapter 2 and 3 the criteria decided from the literature review was used to analyze IZBAN. In order to make this analysis, both qualitative and quantitative data has been used. In this section the result of the analysis will be summarized.

Right of way

IZBAN uses the right of way category A. The system is fully segregated from the vehicle traffic whereas the previous commuter line was not fully segregated and comprised at-grade crossings. This full-segregation feature of IZBAN makes the system both faster and safer than before.

Station spacing

The stations are the modernized old stations and therefore the spacing between before and after is not different. However, 4 stations are taken underground but in general terms the spacing is equal.

Station design; facilities and amenities at the stations; disabled access

IZBAN stations provide disability access where this was not the case during the commuter line operation before the modernization project. There are escalators and elevators in each station.

Platforms and boarding

The platforms in IZBAN are at ground level and no gaps between the train and the station. It is a handicap friendly system and safer than before. There were platforms steps and platform gap filters when TCDD was operating the system. It was not a handicap friendly and a safe system.

Yards and maintenance sites

The yard and the maintenance systems of TCDD was old and operating slowly. Moreover, the site was in the inner city. After IZBAN a large yard was opened in Çiğli which has a system called train recognition center. The important thing about these systems is that the trains are X-rayed every day after their operation and in the X-ray the problems are seen and fixed without taking the trains from the rail. The tracks are cleaned every day.

Fare collection

There were ticket offices in stations and tickets were bought from the offices and then went to the train when TCDD was operating the system. This made it difficult to enforce payment and it was also hard to collect data and statistics on passenger ridership. After IZBAN the smart card system in İzmir "Kentkart" started to be used for the regional rail system too. This also provided free transfer opportunities between modes, as summarized below under the integration title.

Operating schedule; frequency, service hours

The frequency has significantly increased under IZBAN when compared to the previous operation under TCDD. Before IZBAN there was a train every hour. After IZBAN the frequencies increased to 6 in peak hours. During off-peak hours there are trains every 20-25 minutes. The frequency increases if a public event occurs or decreases in holidays.

Integration and coordination between urban planning and regional rail system planning

According to the latest plan of İzmir, there is a strategy for urban development in the north-south axis of the city, with a particular emphasis on the northern corridor. IZBAN operates in the north-south axis and therefore supports the decision of the plan. However, this cannot really be attributed to the new partnership model of IZBAN that includes the local authority. This is IZBAN uses the existing route where the commuter line has been serving and it did not shape or change the route to better integrate it into urban plans. It can be argued that the modernization project of IZBAN as a whole represents a good integration with urban plans since providing high-quality frequent service along this growth corridor is very much in line with the strategy of the urban plan. However, future extensions are not necessarily supporting the plan decisions, and in fact the city planning department of the local authority has no effect on the planning of the system. As mentioned before, the city planning department only makes changes in line with the information provided to them by IZBAN.

Integration of transport planning and operation

İzmir has a transportation master plan in 2009. According to the plan, the city should give more importance to public transportation especially urban rail modes. IZBAN system works successfully by its integration with transport planning and operation.

Integration of the system with other transportation modes

The integration of the system can be noted as successful. There is integration with all public transport modes except ferries. The integrated fare system, which includes all public transport modes, also includes the IZBAN rail system, and this further strengthens the integration. In addition, the IZBAN rail system and the Metro allow cyclist passengers to use the system with their bikes on board, and this is the only case in Turkey so far. It should be noted however that the bike-share system has no stations in integration with IZBAN, and that effective park-and-ride facilities are limited.

In conclusion, among all the criteria above, it can be said that the IZBAN project has been a success in terms of improvements it created in the level of service of public transportation in this corridor. The partnership, which involved the local authority in this railway line that was previously operated only by State Railways, also resulted in successful integration of the system with public transport modes, and to a certain extent with bikes. It was expected that this partnership would also have had positive impact in coordinated planning or the city and transport system; however, the analysis and interviews revealed that such coordinated planning approach was limited.

CHAPTER 6

CONCLUSION

6.1.Summary and Main Findings

Commuter rail operations in Turkey have not been widely used and do not exist in every metropolitan city. Only Ankara, Istanbul, and Izmir have had commuter rail services historically, operated by State Railways Agency (TCDD). These services have generally been used by small numbers of passengers when compared to the passenger numbers using other public transport systems, and among then the commuter rail system in İzmir was the least used system compared to other commuter rail lines in Turkey. Then, a partnership has been made between TCDD and the local authority in Izmir with a view to modernize the commuter line and transform into a modern regional rail system. The new system, named IZBAN, has become a pioneer project in Turkey to implement this project that both modernized the rail service and introduced a partnership model with the involvement of the local authority. In spite of this pioneering role, a comprehensive analysis of this experience has not been carried out.

In order to analyze the project two main research questions were formulated including two sub-questions in each. The first analysis was done by the quantitative data and the second one were done with the qualitative data based on interviews made with experts, managers and decision makers. The research questions were as follows:

1. How has the general performance of İzmir regional rail system changed after the partnership project between state and local authority?

1.1. Has the performance been improving since the local authority took over the operation?

1.2. What factors have been effective in enhancing or hindering the performance of the system?

2. Have there been a better integration and coordination in planning and transport operations after the local authority took over the operation?

2.1 Has the urban planning and transport planning coordination been improved?

2.2 Has the integration between transport modes been improved in terms of both planning and operation?

In order to analyze the first research question, ridership levels of the system before and after the IZBAN project has been analyzed. In addition, the literature review on regional rail operations revealed a number of criteria, such as service frequency, right-of-way, station spacing, station amenities, platform levels/boarding, fare collection methods, etc., and these were also used to observe the performance of the system and the effect of the IZBAN project. For the second research question, urban and transport plan of Izmir were analyzed, and interviews were made with experts and executive staff at the IZBAN system, TCDD, and the İzmir Greater Municipality.

The analysis showed that ridership of the system increased significantly under IZBAN as a result of the modernization of the commuter service. Since its opening, ridership of the system has been steadily increasing every year, which is also a sign of good performance. Furthermore, the ridership of the Izmir Metro also increased after the opening of IZBAN, which indicates that IZBAN brought passengers to the Metro and increased the coverage and impact area of the whole public transport system. The analysis of the system based on the criteria mentioned above revealed that with IZBAN service frequency increased significantly when compared to the commuter service operated by TCDD. The right of way of the line is now fully segregated from other traffic, which was not the case under TCDD operation, and this increases the speed, reliability and safety of the system. Station spacing has remained the same as the new system used the old track and its stations; however, stations have been improved with new amenities and disability-access provision. Level boarding also helps disabled access and general accessibility and easy-usage of the system, as well as safety. In terms of fare collection method and fare integration too, IZBAN operation brought improvements to the old system.

Public transport integration, which was enabled both by fare integration and physical integration, such as transfer stations, has been one of the main achievements of the project. Under TCDD, the commuter line had limited interaction with urban transport, and very poor integration with public transport. In fact, the "Transformation in Transportation" project of the Izmir Greater Municipality was the main factor that brought a well-integrated approach in public transport. This project was launched in 1999, and after the opening of the Izmir metro in 2001, all ferries, busses, and the metro system were integrated into each other. Later the smartcard ticketing was introduced and made the integration stronger. As a result, having the local authority involved in the management of the new regional rail system IZBAN meant that the system was introduced as an integral component of the public transport system and included in the smartcard ticketing. IZBAN is integrated with the metro and bus systems of the city both physically and in terms of fares. The system can also be considered as integrated with bikes since it allows passengers to bring their bikes on board; however, its integration with the bike-share programme and car parks remain limited.

In spite of the limited integration with car parks and bike-share programme, the strong integration with public transport is a clear evidence that the partnership that included local authority in system planning and management resulted in better coordination and integration of transport modes. Although a similar outcome was expected for the coordination of urban and transport planning, this does not appear to be the case. The location of the regional rail line supports the urban growth corridors proposed in the development plans; however, this does not necessarily indicate coordinated planning. In future extensions, IZBAN focuses on using existing lines as it did before, but they are not in line with development plan strategies. Interviews revealed that city planning department did not have a say in planning future extensions. In addition, while there have been efforts to coordinate transport planning and urban planning in major interchange stations, such as the Halkapınar Station, for stations outside the inner city it is not possible to suggest that urban plans are being shaped to focus development at the station area to create rail-oriented growth patterns. Overall, the coordination between urban planning and regional rail planning, while not completely non-existent, requires improvement.

6.2.Recommendations

The model of IZBAN, which launched a partnership between the state and local authority as well as modernized the existing commuter line and its services, is likely to be adopted in the metropolitan cities of Turkey, namely Ankara and Istanbul. The commuter lines in these cities were also being operated by the State Railways Agency, and in both cities, efforts started to establish a partnership between the greater city municipalities and the State Railways.

Lessons learned from the İzmir IZBAN case are useful for these cities. Some general recommendations derived from this study are as follows:

- The system should use the right-of-category A that segregates itself fully from vehicles and people. In existing commuter lines, this is often not the case and this limits the speed, reliability safety of operations. Full-segregation should be seen as an important component of system modernization since this improves quality of service.
- The station for both commuter and regional trains need a bigger space compared to the stations of other rail modes. The station location is important since it can affect accessibility by other modes, and hence level of integration with other public transport systems.
- The design of the stations should be functional, safe, legible, seamless, universally inclusive, walkable, engaging, enduring, enjoyable, and durable. There should be facilities and amenities that normally do not take place in other urban rail stations, such as restrooms, shops, cafes, information kiosks, etc.
- Another aspect is the type of the platforms, that is whether they are level-boarding. In earlier practices, train platforms were low so that people had to use steps to reach the car floor. The platforms should be at level with train doors and there should not be gaps between the track and the platform so that ease of boarding and disability access is ensured. The yards need a large space for construction and the

location of the yard is important for future plans. It is nearly impossible to build yards in the city center. The yard should be accessible for the existing and the future of the railway routes.

- Fare collection of the system should be integrated with other transportation modes not only rail systems but also buses, ferries, etc. Use of smart cards are helpful in that they can provide transfer reductions or free transfers.

- The regional rail systems serve a bigger patron when compared to other urban rail modes. This may require larger and more comfortable cars when compared to metro or LRT cars. IZBAN has also has this feature: the system has much larger cars with more comfortable seating.

- The frequency of the system is extremely important in modernizing commuter services. Commuter lines often provide much less frequent services when compared to other urban rail modes, such as metro and LRT systems. Modernized regional rail systems should be like the other public transportation modes, providing high frequency of service. IZBAN was also a showcase in this aspect since it resulted in a very significant increase in service frequency, which made a major change in service levels and consequently the ridership of the system. The signaling should also be flexible to give good service, such as increasing the frequency in public events.

- There should be an integration with all public transport modes in the city. Stations should be integrated physically, providing convenient transfers. The integrated fare system, which includes all public transport modes, also further strengthens the integration. In addition to public transport systems, cycling should also be integrated, both by allowing bikes to be taken on board and by creating bike-parks at stations. The system should also be supported with park-and-ride lots. Well-designed safe car parks should exist at peripheral stations in order to encourage car users to park their cars and ride the system. This remains as one of the weak points of the IZBAN system.

- Introducing a partnership model that involved local authorities in the currently state-operated commuter lines in Ankara and Istanbul, also creates a major opportunity for coordination of planning. One aspect of this is the opportunity for integrated transport planning, as described above. The second aspect is the opportunity for better coordination between urban planning and regional rail system planning. With their fixed infrastructures and high-quality service levels due to the modernization, these systems can be powerful tools in shaping urban areas, and their stations can become major focal point for future developments. Local authorities should make the most of such potentials. At the same time, when these systems are extended toward new areas in the future, involvement of local authorities city planning departments is crucial to ensure coordination between urban planning and regional rail system planning so that the system can support future development strategies.

The task distribution between IZBAN and TCDD has several shortcomings that affects the partnership project. The legal procedures between these two actors cause timing problems in emergency situations as mentioned in chapter 5. In the future partnership projects that are currently being considered for Ankara and İstanbul commuter services, the local authorities should have a bigger power in implementing these projects and the state should be the controller rather than being actively involved in day-to-day operation.

One of the most important actors in this partnership project is the local municipality. All the plans and implementations were approved without delays and the project completed in a very short time.

6.3.Further Research

It is still early to make certain analysis about the IZBAN project because the system is very new, barely 4 years old. Land-use impact analysis, in particular, could not have been made although this could have shown the effect of the system in terms of creating new development and supporting the existing development strategies in the urban plans. The data from institutions regarding land-use change are very limited and not reliable.

If the data of the workplaces and residential areas can be found in district basis in Izmir where the regional rail stations operate, then there can be an analysis about the urban development effect of the system. Such data must be available for a period of time so that changes in land-use can be analyzed and a study can be made to find out whether such changes can be attributed to the IZBAN system.

In the following years, it seems that the modernization of commuter lines and their operation through a similar partnership of State Railways and local authorities will be adopted in Ankara and İstanbul. After operation starts on these systems, a comparative analysis can reveal more lessons regarding commuter rail modernization, regional rail operation, and integrated planning. There can also be a comparative analysis regarding the urban impacts of the systems in the 3 largest metropolitan cities in Turkey. Furthermore, international comparisons can be made by including more case studies from the world.

There are future extensions planned for the IZBAN system, and after new routes are opened, both the performance and the impact of the system should be analyzed comprehensively.

IZBAN system is using the existing lines of State Railways Agency (TCDD) and no new lines are developed. There can be studies that carry out feasibility and impact analysis for entirely new corridors and routes.

In this study, the project has been analyzed with a before-and-after approach. It is common to carry out a with-or-without analysis in feasibility studies for rail investments. Such an analysis would require the collection of a different set of data and hence was not included. However, in further research, such an analysis can be made to complement the one carried out here.

The relation between IZBAN and the other transportation modes cannot be analyzed due to the lack of data. The buses working as feeders and the new opened metro stations do not have enough data. In the following years there can be a comprehensive research between transportation modes and the shifts in public transportation.

Another research can be the comparison of automobile dependency and public transportation modes in İzmir.

There can be a research on rail systems that serves transportation from city center to the airport. This is an important issue in time and cost saving. Izmir is the only existing city in Turkey that has a rail system giving service between city center and airport.

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APPENDICES

Table 15: Annual and Monthly Ridership of Hilal and Halkapınar transfer stations between 2012-2014

	2012				2013				2014			
	Metro		IZBAN		Metro		IZBAN		Metro		IZBAN	
	hilal	halkapınar	hilal	halkapınar	hilal	halkapınar	hilal	halkapınar	hilal	halkapınar	hilal	halkapınar
January	33231	295510	---	184542	38732	391743	---	322852	381434	770880	312146	684500
February	32968	293371	---		34604	376604	---	266564	349557	713506	282694	629846
March	37243	350073	---	144845	42929	456444	---	85860	418538	854967	320888	596326
Aprıl	36542	348433	---	222905	41654	442096	---	72941	404129	472874	309105	273471
May	38343	348439	---	220108	43175	431872	---	282272	404726	454110	299611	251741
June	35350	320813	---	228452	40890	402376	---	292021	363247	401152	272085	229654
July	30089	288203	---	224611	39018	363216	---	297858	377622	501267	283260	247918
August	31012	283319	---	220998	227476	302609	174788	224549	415231	647105	312056	372796
September	34330	347198	---	252875	350135	519127	293924	413167	479486	1060150	413201	793274
October	37415	372157	---	272175	382041	772198	338418	720002	-	-	-	-
November	37551	399200	---	311445	399739	802841	351340	727032	-	-	-	-
December	38290	402379	---	328757	414632	822783	352037	738656	-	-	-	-

*The data of February 2012 IZBAN ridership is missing.
*Hilal transfer station opened on August 2013

ZONE 1

Table 16: Monthly Ridership of Zone 1 in 2012

	January	February	March	April	May	June	July	August	September	October	November	December
Demirköprü	138797		107.011	159.096	165.073	146.555	134.812	136.585	164.040	175.272	174.898	183.298
Şemikler	56898		34.209	75.722	70.394	64.236	58.816	59.745	73.694	74.985	76.157	73.893
Mavişehir	43275		33.835	51.830	55.477	46.660	42.145	41.102	54.255	59.432	63.136	63.364
Çiğli	239148		179.767	264.582	277.261	257.173	253.714	255.925	290.129	308.579	306.847	310.106
Ata Sanayi	53679		41.546	62.310	66.371	62.458	56.754	55.555	63.068	68.306	70.567	71.138
Egekent	47007		36.026	53.969	57.107	52.834	44.515	44.087	46.754	48.913	46.707	46.732
Ulukent	56938		48.202	65.736	71.983	53.201	48.331	50.788	66.002	87.764	84.351	84.822
Egekent-2	61607		47.562	71.866	75.275	73.489	70.583	69.753	77.852	79.732	79.043	78.396
Menemen	171389		130.405	197.906	208.899	196.925	179.451	182.705	210.653	221.646	215.200	214.441
Hatundere	32732		26.780	44.551	48.950	57.450	64.747	60.439	54.765	47.745	43.282	39.673
Biçerova	20477		17.640	28.845	36.343	54.455	70.254	58.077	43.968	33.402	30.364	29.246

Aliağa	113712		88.165	141.505	153.516	176.143	193.329	179.038	172.545	156.240	153.687	150.298

*The February ridership data is missing

Table 17: Monthly Ridership of Zone 1 in 2013

	January	February	March	April	May	June	July	August	September	October	November	December
Demirköprü	173.939	160.795	187.337	184.079	189.114	168.593	153.681	149.870	181.296	186.789	196.149	203.349
Şemikler	77.076	70.134	74.366	79.342	86.992	77.429	66.427	80.105	82.590	84.428	88.244	91.618
Mavişehir	61.276	58.886	70.689	69.833	71.236	58.311	55.489	52.889	72.386	75.688	83.936	87.439
Çiğli	300.928	281.515	326.025	319.012	320.874	294.873	285.062	269.475	293.198	298.406	307.608	336.794
Ata Sanayi	70.537	66.864	77.897	76.689	83.324	79.319	73.978	78.038	91.867	95.386	102.045	103.900
Egekent	46.671	42.236	48.771	49.809	53.732	52.218	52.975	53.038	58.138	69.215	72.228	72.957
Ulukent	61.531	55.030	82.282	81.179	83.882	62.986	49.717	51.690	70.147	87.096	95.173	101.364
Egekent-2	79.832	76.021	89.225	87.474	92.388	89.551	92.002	92.696	105.820	105.041	108.167	109.710
Menemen	209.167	199.159	234.122	235.613	246.629	227.456	205.346	217.442	244.204	244.398	247.646	253.627
Hatundere	39.280	38.637	46.749	51.314	57.553	59.815	57.897	62.009	54.296	47.193	47.866	47.719
Biçerova	29.246	28.549	34.947	38.151	46.760	58.388	69.726	69.721	53.335	39.090	37.539	35.691
Aliağa	152.926	151.173	168.476	171.966	184.804	195.494	200.503	215.615	195.825	177.863	174.565	179.577

Table 18: Monthly Ridership of Zone 1 in 2014

	January	February	March	April	May	June	July	August	September	October	November	December
Demirköprü	196.243	182.818	197.799	193.103	191.617	169.399	154.120	165.336	196.669	205.724		
Şemikler	63.492	106.405	90.143	88.024	89.047	77.302	80.297	82.023	95.123	100.083		
Mavişehir	80.265	73.365	78.842	77.330	75.912	64.893	58.056	68.781	81.188	87.513		
Çiğli	341.589	327.281	373.511	360.343	354.840	345.701	326.523	334.133	345.319	363.459		
Ata Sanayi	98.414	88.836	99.008	99.521	99.881	89.046	72.576	77.303	83.318	89.107		
Egekent	62.778	67.774	75.643	74.251	75.143	68.263	97.405	100.668	118.558	138.253		
Ulukent	91.287	82.192	99.715	107.511	94.793	69.913	56.591	61.308	89.015	114.429		
Egekent-2	105.254	98.918	107.600	106.347	108.045	100.036	104.537	116.672	124.715	128.430		
Menemen	250.607	236.924	254.977	253.352	257.026	236.901	215.450	226.727	255.766	263.618		
Hatundere	47.436	46.675	48.910	51.809	54.972	55.429	58.486	67.375	55.591	53.455		
Biçerova	33.621	41.330	39.160	39.250	44.643	58.628	57.563	81.919	53.933	42.560		
Aliağa	179.426	169.786	180.072	185.212	190.467	201.631	204.678	231.138	196.192	188.552		

*****November and December data is missing

ZONE 2

Table 19: Monthly Ridership of Zone 2 in 2012

	January	February	March	April	May	June	July	August	September	October	November	December
Alsancak	301029		226.833	352.110	357.525	226.287	149.155	145.058	167.259	155.810	51.542	0
Halkapınar	184542		144.845	222.905	220.108	228.452	224.611	220.998	252.875	272.175	311.445	328.757
Salhane	55268		45.801	67.629	69.987	67.667	65.686	55.661	73.989	73.406	81.716	82.687
Bayraklı	153479		114.847	176.024	185.526	182.179	176.909	181.317	191.272	202.578	194.935	198.777
Turan	39050		30.748	46.826	50.338	52.814	54.739	54.650	62.206	65.780	72.330	70.351
Naldöken	54712		39.491	60.085	62.787	56.938	51.406	50.859	58.804	62.016	61.919	63.128
Alaybey	95337		71.765	110.350	112.908	99.351	89.986	88.386	105.436	110.784	113.420	114.212
Karşıyaka	349444		254.076	378.107	395.896	369.684	336.495	363.984	398.973	432.321	406.278	424.153
Nergiz	161520		123.676	186.306	193.415	173.649	156.194	154.073	174.875	187.606	195.320	198.079

*The February ridership data is missing

Table 20: Monthly Ridership of Zone 2 in 2013

	January	February	March	April	May	June	July	August	September	October	November	December
Hilal								174.788	293.924	338.418	351.340	352.037
Alsancak	0	0	0	0	2	0	0	155.160	255.927	274.640	291.760	303.811
Halkapınar	322.852	266.564	85.860	72.941	282.272	292.021	297.858	224.549	413.167	720.002	727.032	738.656
Salhane	83.942	81.827	100.623	95.850	96.761	89.057	87.329	69.643	89.891	81.401	95.950	97.373
Bayraklı	197.250	186.438	220.620	216.315	225.446	218.730	204.965	211.798	218.727	218.742	215.686	220.617
Turan	69.757	64.889	74.433	74.104	80.800	77.200	74.460	69.454	74.810	72.569	75.319	76.466
Naldöken	62.684	58.047	64.616	64.892	66.474	62.285	57.355	55.608	64.709	64.632	68.009	67.470
Alaybey	112.931	104.534	121.240	117.618	121.849	108.648	99.380	99.067	115.761	118.461	125.980	129.403
Karşıyaka	413.722	393.031	454.437	440.198	452.940	426.882	388.550	414.417	450.585	472.137	451.411	471.143
Nergiz	192.741	180.222	205.477	192.436	211.276	181.240	177.263	170.880	200.233	203.541	216.065	219.792

Table 21: Monthly Ridership of Zone 2 in 2014

	January	February	March	April	May	June	July	August	September	October	November	December
Hilal	312.146	282.694	320.888	309.105	299.611	272.085	283.260	312.056	413.201	426.960		
Alsancak	300.352	290.975	347.369	313.206	329.739	284.140	298.938	350.425	383.615	376.640		
Halkapınar	684.500	629.846	596.326	273.471	251.741	229.654	247.918	372.796	793.274	799.028		
Salhane	96.788	93.260	99.301	94.723	95.779	92.830	103.120	105.034	124.462	115.392		
Bayraklı	214.681	205.102	221.515	214.308	219.274	208.565	220.369	227.950	236.127	239.979		
Turan	70.679	64.880	73.532	71.669	72.712	69.122	57.158	56.117	58.003	55.719		
Naldöken	66.116	60.361	67.097	66.480	67.877	61.758	60.088	64.047	68.948	72.877		
Alaybey	124.175	116.786	126.759	122.758	123.103	110.542	105.421	119.192	127.286	135.082		
Karşıyaka	460.550	438.821	462.700	445.962	455.127	412.419	419.102	434.447	474.701	496.298		
Nergiz	211.934	197.626	213.396	206.980	207.564	190.101	181.286	192.766	213.501	223.301		

ZONE 3

Table 22: Monthly Ridership of Zone 3 in 2012

	January	February	March	April	May	June	July	August	September	October	November	December
Cumaovası	91463		68.876	109.726	120.807	141.859	167.863	154.999	134.740	120.911	113.565	109.361
Havalimanı	87167		56.243	90.103	95.613	94.625	96.064	99.529	103.828	102.711	96.383	100.485
Sarnıç	133916		105.790	159.554	160.728	150.776	144.599	143.955	162.443	167.898	172.062	170.605
Gaziemir	95828		74.713	114.263	114.154	107.013	97.934	99.551	113.807	120.757	116.901	124.847
Esbaş	45779		54.930	192.268	163.437	168.256	169.291	196.572	173.218	201.644	180.240	212.410
Semt Garajı	80377		59.117	88.278	94.417	95.557	94.050	99.787	101.415	113.052	105.539	108.738
İnkılap	89233		67.221	102.685	106.179	100.529	96.553	99.756	106.683	115.221	112.585	117.800
Koşu	57299		44.785	65.498	63.374	66.603	60.813	61.752	67.870	71.182	72.949	73.784
Şirinyer	352329		277.800	452.370	460.955	420.707	406.606	401.055	437.516	502.065	492.455	499.129
Kemer	134818		102.442	157.421	164.612	150.914	145.590	146.763	163.120	171.316	176.072	179.504

*The February ridership data is missing

Table 23: Monthly Ridership of Zone 3 in 2013

	January	February	March	April	May	June	July	August	September	October	November	December
Cumaovası	110.585	101.706	115.242	120.030	133.586	152.935	167.169	176.007	149.323	132.307	114.181	111.248
Havalimanı	106.179	107.551	111.246	112.163	116.541	113.752	115.967	116.069	128.275	126.266	126.028	131.112
Sarnıç	168.579	155.553	180.689	185.333	189.581	173.288	166.196	162.774	189.800	186.407	202.850	207.351
Gaziemir	118.683	103.555	132.126	130.758	129.951	122.828	110.201	111.462	129.982	129.880	132.106	150.042
Esbaş	219.195	216.337	220.286	202.837	211.935	218.072	215.187	248.769	225.208	264.852	225.816	272.681
Semt garajı	106.242	100.744	116.630	115.466	119.769	114.746	111.278	116.641	122.882	131.721	126.014	132.081
İnkılap	116.217	109.738	126.980	127.756	130.760	123.765	118.771	124.136	136.328	139.781	142.812	150.244
Koşu	75.171	70.431	84.286	77.964	80.364	77.367	70.799	84.280	91.279	93.333	95.253	95.786
Şirinyer	486.249	427.771	523.365	513.556	541.291	518.799	467.552	512.774	591.939	629.435	630.506	657.753
Kemer	183.297	171.081	203.065	202.764	205.260	186.000	180.759	180.827	202.098	202.251	221.710	218.884

Table 24: Monthly Ridership of Zone 3 in 2014

	January	February	March	April	May	June	July	August	September	October	November	December
Cumaovası	111.248	101.515	119.385	111.445	113.473	121.363	144.809	168.088	192.768	145.295		
Havalimanı	131.112	131.979	131.379	124.794	116.507	113.424	104.326	105.757	117.330	118.014		
Sarnıç	203.309	196.933	209.178	211.835	207.827	192.845	211.096	227.077	254.795	260.676		
Gaziemir	136.881	130.236	140.045	138.430	135.955	128.957	114.596	126.621	144.442	149.859		
Esbaş	250.187	260.348	255.641	228.596	241.199	235.704	256.234	255.751	258.276	290.805		
Semt Garajı	125.107	119.082	127.961	124.441	128.476	122.551	126.564	122.072	134.992	138.663		
İnkılap	143.736	136.823	147.970	144.579	145.036	136.972	138.510	148.102	156.828	163.830		
Koşu	96.418	91.781	102.442	93.471	93.766	87.579	109.482	121.481	131.202	137.551		
Şirinyer	605.028	555.804	639.256	591.614	612.430	570.531	635.242	679.472	750.232	798.251		
Kemer	211.828	197.823	211.950	206.969	206.565	191.622	214.888	226.276	242.787	251.060		

Table 25: Annual and Monthly Ridership of IZBAN

	2011	**2012**	**2013**	**2014**
January	1420605	3603457	4448688	6098321
February	2022345	3585971	4167368	5842249
March	2777643	4170662	4582107	6244945
April	2934024	4350426	4509997	5724630
May	3044804	4479715	4919207	5764954
June	3014507	4195439	4682131	5384254
July	3028548	4001995	4473842	5543399
August	2902395	4012504	4871570	6065163