

DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED
SCIENCES

**EVALUATING TRANSPORT POTENTIAL OF
TURKEY IN RELATIONSHIP WITH EUROPEAN
UNION AND A MODEL SUGGESTION FOR A
MODAL SHIFT FROM ROADS TO RAILWAYS**

by
Emre KÜÇÜKAVCU

November, 2006

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**A Thesis Submitted to the
Graduate School of Natural and Applied Sciences of Dokuz Eylül University
In Partial Fulfilment of the Requirements for the Degree of Master of Science in
Industrial Engineering, Industrial Engineering Program**

**by
Emre KÜÇÜKAVCU**

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M.Sc THESIS EXAMINATION RESULT FORM

We have read the thesis entitled **“EVALUATING TRANSPORT POTENTIAL OF TURKEY IN RELATIONSHIP WITH EUROPEAN UNION AND A MODEL SUGGESTION FOR A MODAL SHIFT FROM ROADS TO RAILWAYS”** completed by **EMRE KÜÇÜKAVCU** under supervision of **ASST. PROF. DR. MEHMET ÇAKMAKÇI** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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Emre KÜÇÜKAVCU

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ABSTRACT

On account of Turkey's geopolitics importance, there has a relation between Europe and Asia like a bridge. In this perspective, we evaluate the transport potential of Turkey in the view of accession to European Union in this study. We also evaluate road and railway developments in European Union and Turkey. The main purpose of this study is to forecast the level of road freight transport up to the year of 2015 in order to investigate the modal shift from road transport to railway transport. The aim of forecast is to analyze the development of increasing road freight transport in Turkey. Forecasting is based on Multiple Regression Analysis and Trend Analysis using annual data of the level of road freight transport from the year 1983 to 2004 and factors which are considered to affect the road freight transport in Turkey. Moreover, the existence of statistical relationships of these factors between each other and with road freight transport will be investigated. The statistical program MINITAB 14 is used to do this.

Keywords: Railway Transport, Road Transport, European Union, Freight Transport, Forecasting

TÜRKİYE’NİN ULAŞTIRMA POTANSİYELİNİN AVRUPA BİRLİĞİ İLE İLİŞKİLERİ ÇERÇEVESİNDE DEĞERLENDİRİLMESİ VE KARAYOLLARINDAN DEMİRYOLLARINA GEÇİŞ İÇİN MODEL ÖNERİSİ

ÖZET

Türkiye’nin jeopolitik konumu göz önüne alındığında, Avrupa ve Asya arasında köprü gibi bir bağlantı vardır. Bu çerçevede, Avrupa Birliği’ne girişi göz önüne alınarak Türkiye’nin ulaştırma potansiyeli değerlendirilmiştir. Ayrıca, Avrupa Birliği ve Türkiye’de karayolu ve demiryolu taşımacılığındaki gelişmeler değerlendirilmiştir. Bu çalışmanın ana amacı ise karayollarından demiryollarına geçişin araştırılması için karayolu yük taşımacılığının 2015 yılına kadar oluşacak seviyesinin tahminlemesi yapılmıştır. Yapılan tahminlemenin amacı, Türkiye’de artan karayolu taşımacılığının gelişiminin analiz edilmesidir. Tahminleme, 1983 yılından 2004 yılına kadar elde edilen yıllık yük taşımacılığı verileri ve karayolu taşımacılığını etkilediği düşünülen faktörler kullanılarak Çoklu Regresyon Analizi ve Trend Analizi ile yapılacaktır. Aynı zamanda bu faktörlerin birbiriyle ve karayolu yük taşımacılığı ile arasında istatistiksel bir ilişki olup olmadığı araştırılacaktır. Bunu yapmak için, istatistiksel paket programı MINITAB 14 kullanılacaktır.

Anahtar Kelimeler: Demiryolu Taşımacılığı, Karayolu Taşımacılığı, Avrupa Birliği, Yük Taşımacılığı, Tahminleme

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CHAPTER ONE

INTRODUCTION

Logistics deals with the planning and control of material flows and related information in organizations, both in the public and private sectors. Broadly speaking, its mission is to get the right materials to the right place at the right time, while optimizing a given performance measure (e.g. minimizing total operating costs) and satisfying a given set of constraints (e.g. a budget constraint). In the military context, logistics is concerned with the supply of troops with food, armaments, ammunitions and spare parts, as well as the transport of troops themselves. In civil organizations, logistics issues are encountered in firms producing and distributing physical goods. The key issue is to decide how and when raw materials, semi-finished and finished goods should be acquired, moved and stored. Logistics problems also arise in firms and public organizations producing services. This is the case of garbage collection, mail delivery, public utilities and after-sales service.

A logistics system is made up of a set of facilities linked by transportation services (Ghiani, Laporte & Musmanno, 2004). Transport services are very important elements for modern and civilized societies, and it is concerned with daily life of people in many aspects. In addition to this social property, another important property of transport services is to be one of the infrastructures of economical progress (Türkiye Bilimsel ve Teknolojik Araştırma Kurumu [TÜBİTAK], 1996).

The freight transportation market is an essential component of any economic system. As such, it is continuous change as a result of the growth and change of the economic activity (Wong, Niu & Ferreira, 2003). It supports production, trade, and consumption activities by ensuring the efficient movement and timely availability of raw materials and finished goods. Transportation accounts for a significant part of the final cost of products and represents an important component of the national expenditures of any country (Crainic, 2002).

Freight transportation plays a key role in today's economies as it allows production and consumption to take place at locations that are several hundreds or thousands of kilometers away from each other. As a result, markets are wider, thus stimulating direct competition among manufacturers from different countries and encouraging companies to exploit economies of scale. Moreover, companies in developed countries can take advantage of lower manufacturing wages in developing countries. Finally, perishable goods can be made available in the worldwide market.

Freight transportation often accounts for even two-thirds of the total logistics cost and has a major impact on the level of customer service. It is therefore not surprising that transportation planning plays a key role in logistics system management (Ghiani et al.).

In passenger and freight transport; economy, speed, safety and comfort are the properties required to be sought for every transport mode. Besides these, the minimum pollution of the environment, utilization of the energy resources available in the country and in the meanwhile, low energy consumption per passenger-km or tone-km, the initial installation and maintenance-repair ease are the other elements which should be taken into consideration in preference of the transport modes.

There is no country in the world benefiting from only one of the transport modes in passenger and freight transport. In almost every country, besides railway, land, air transport, maritime transport according to the geographical location of the country and pipelines in liquid freight transport are utilized. Here, the important point is the selection of the transport modes which fit the social condition and financial facilities, the properties of the energy resources and land, the technological structure of the country and the required emphasis to be given to each of them (Vakıfbank, 2001).

Within the transport sector, road transport's market share is the largest and is increasing due to its superior service, in term of greater flexibility, speed and lower probability of damage. The whole economy depends on road transport that can be

highlighted by the followings (The International Road Transport Union [IRU], 2002):

- Trucks carry nearly 80 % of all goods in industrialized countries,
- Everyday trucks deliver 70 kg of goods for every person living in industrialized countries,
- Trucks in Europe pay about 40 billion in taxes per year.

The road freight industry consists of the transportation by road of goods among firms and between firms and consumers. In the past two decades, this mode of transportation has grown very rapidly: for instance, its output (in terms of billion tone-kilometers) has doubled in the broad European area. Over the same period, there was a tendency in many OECD Member countries to implement major liberalization packages. However, in many countries, regulations still restrict market entry and the choices of firms (Boylaud & Nicoletti, 2001).

International experience demonstrates that the full truckload segment of the road freight market can be a competitive market with relatively little regulatory intervention because it typically has only small economies of size and scope, and entry and exit costs are relatively low. Volumes of freight are large relative to efficient or permitted truck size, timeliness is generally not critical and the full loading of the truck excludes other scope economies. This sector is generally focused on business to business delivery. Consequently, in the absence of entry restrictions, this industry is generally characterized by a large number of relatively small firms and market outcomes tend to be competitive. Liberalization in many countries has lowered freight rates, which, because they are more efficiently aligned with costs, improve productivity, reduce costs, and improve the quality of service and responsiveness to customer demands (Organization for Economic and Co-Operation [OECD], 2002).

Road transport is the backbone of Europe's economy and of its national and international goods transport (Engel, 1998). Throughout the past 10 years in Europe

– a period marked by the introduction and then consolidation of the process of liberalizing road freight transport – road haulers have seen their business increase, while that of other inland modes remained static at best. The disparity in trends is especially striking for rail transport, which governments are nevertheless still anxious to see pick up. Despite all the restrictions that have been imposed on road transport on some corridors, its growth is real (European Conference of Ministers of Transport [ECMT], 2001).

Against this background, traffic forecasts for inland freight transport all see growth in road freight transport continuing into the near future, if only at the same pace as economic growth. It is widely estimated that road freight traffic will increase by +50 or +60 per cent by 2015 in Europe, although other, slightly less favorable estimations exist. In contrast, it appears that rail transport will be utilized to full capacity, at least in most European Union countries. Growth in road freight transport is therefore inevitable. This future growth raises at least two problems: first, the impact on the environment and on congestion; and secondly, the impact on road safety. Although growth in road transport brings some positive benefits – for instance, productivity gains, which are good for the economy – it can be seen to have some negative impacts, too (ECMT, 2001).

In the world, the present transport system with overland emphasis is restricting the mobility which plays the greatest role in development of the economy with the pollution, accidents and traffic jams it causes. In many countries of Europe and Asia, special importance has been given to railways in order to change this situation and advanced technology product high speed trains which were initially started to be used in Japan in 1960's, have become widespread in all Europe starting from the 1980's.

With rail freight transport at best only managing to hold its own in a rapidly-expanding transport market, the whole question of the specific market for rail transport arises. Traditionally, structural effects are distinguished from competition effects. Rail transport undeniably has a strong propensity to transport heavy goods

(for example, steel products) which are produced by industries that have all undergone restructuring and whose weight in the developed economies is steadily shrinking. The growing service content of the developed economies is not favorable to rail, which is much better at transporting primary and secondary products. However, modeling and careful analysis showed that rail has lost ground even in its traditional markets, and the competition effect has compounded the structural effect; rail has proved unable to take up the challenge from road transport, even in its core markets (ECMT, 2002).

On account of Turkey's geopolitics importance, there has a relation between Europe and Asia like a bridge. In this perspective, we evaluate the transport potential of Turkey in the view of accession to European Union in this study. We also evaluate road and railway developments in European Union and Turkey. In the perspective of transport developments, especially railway transport developments, we investigate the adaptation of Turkish railways to European Union.

The main purpose of this study is to forecast the level of road freight transport up to the year of 2015 in order to investigate the modal shift from road transport to railway transport. The aim of forecast is to analyze the development of increasing road freight transport in Turkey. The forecast is based on the annual data of the level of road freight transport and the macro economical factors which can effect the development of road freight transport. We also investigate a statistical relationship among the factors effecting road freight transport and between these factors and road freight transport. We use statistical methods of "Multiple Regression Analysis" and "Trend Analysis" for forecasting. We use statistical program of MINITAB 14 to do this. It is also aimed that these forecast will help the determination of transport strategy of Turkey. Besides, the actual transport developments of European Union must be taken into consideration. The forecasting methodology which is applied in this research work can be used for a feasibility study of an investment project.

This study consists of seven chapters. "Chapter One" includes the explanations about the importance and purpose of the research. In "Chapter Two", transport

developments in European Union are evaluated. Statistical data about transport infrastructure and performance is used in order to make an evaluation about European transport developments. In “Chapter Three”, railway transport measures and transport corridors about railways within European Union are investigated. In “Chapter Four”, we give information about railway developments in Turkey. Meanwhile, the historical development of Turkish railways is summarized. We evaluate the position of Turkish railway system within other transport systems. In “Chapter Five”, we investigate the position of Turkey in Euro – Asian railways and the potential of Turkey about transportation. In this chapter, transport projects of Turkey about Euro – Asian railways are given. We also make suggestions about the requirements of Turkey in transportation area for accession to European Union. In “Chapter Six”, the models related to railways in literature are investigated. Within these models, we determine the most suitable model to Turkish railways. In “Chapter Seven”, we apply the suggested model to Turkish railways. In this chapter, the level of road freight transport is forecasted up to the year of 2015 by using “Multiple Regression Analysis” and “Trend Analysis”.

CHAPTER TWO

LITERATURE REVIEW

In order to determine the most economic and suitable transport system convenient to the country conditions, investigating the transport measures of European Union, adaptation of Turkish transport modes to European Union and transport potential of Turkey is one of the approaches of this study. In addition, the main approach of this study is to investigate a modal shift from roads to railways by suggesting a forecasting model because of increasing level of road freight transport. In this study, we generally utilize from internet based written sources. In the whole study, we benefit from international literatures except for the railway developments of Turkey.

2.1. Transport Developments and Programs in European Union

While the share of railway transport has been decreasing, the share of road transport has been increasing for the last three decades. Scherp (2005) states that for around 30 years railway transport has been in relative decline in comparison to other modes. This is particularly well illustrated by the development of rail freight. The European freight transport sector enjoyed vigorous growth in the last decade. The traffic performance rose by roughly 2.5 percent per annum outstripping growth in GDP by approximately 0.5 percentage points and thereby underlining the very high freight transport intensity of economic growth. However, the rail freight sector was unable to take part in this strong growth. Its share in the five transport modes (in the European Union of 15 member states before the last enlargement) fell from 21 percent in 1970 to about 8 percent in 2002.

Engel (1998) indicates that road transport is the backbone of Europe's economy and of its national and international goods transport. In tone-km terms, road transport carries almost 80% of all freight in the ECMT countries. Since 1970, its market share has increased by more than 20%. In European countries in transition, road transport started from a significantly lower level, but, given the recent tremendous change, it

seems only a matter of time before road transport becomes the number one mode in these countries, too.

Because of this increasing level of road freight transport, it is obvious the use of railways will be needed for the freight transport in the future. It was stated in the Round Table 125 of European Conference of Ministers of Transport in 2002 that the many empirical studies that have been conducted during the nineties on the interrelationship between growth in transport and aggregate economic growth, have shown that the elasticity of road freight transport services with respect to aggregate income is greater than one. These trends will be exacerbated by the adjustment processes associated with the EU enlargement. Many observers share the view that the dramatic increases in freight transport cannot be accommodated by the contemporary road freight system, given current congestion levels and given the current limits to the extension of the road infrastructure. On the other hand, absolute rail freight transport volumes have been stagnating at best. Comparing what is observed in Europe with statistical data of other continents, it is obvious that the weak position of rail freight is peculiar to Europe. This Round Table 125 discussed the empirical trends of rail freight in Europe, how these trends should be evaluated and what role the integration of European railways should play to improve the competitiveness of the railways vis à vis the road transport sector.

In the perspective of increasing level of road freight transport, European Union has started some transport programs in order to attach importance to railway transport. The most important one of these programs is Trans European Network (TEN). Schürmann, Spiekermann and Wegener (2002) states that the European Union expects to contribute to reducing the socioeconomic disparities between its regions by the development of the trans-European transport networks (TEN). The TEN are one of the most ambitious initiatives of the European Community since its foundation. The master plans for rail, road, waterways, ports and airports together require public and private investment between 400 and 500 billion ECU until the year 2010.

Another transport program supported by European Union is Pan-European Transport corridors. Railway transport has an important role within the Pan-European Transport corridors. Short (2001) indicates that railway reform is the crucial element of a policy that will allow and encourage the mode to play a full part in Pan European transport in the future.

Europe – Asia transport corridors have been determined for political, economic and social contacts between the two continents, Europe and Asia. The Second International Euro-Asian Conference on Transport, held in 2000 in St. Petersburg, identified the four Euro-Asian Land Transport Corridors presented to this Conference by UNECE and UNESCAP as constituting the main backbone of the Euro-Asian Land Transport System.

2.2. Railway Transport Developments and Transport Potential of Turkey

In Turkey, railway and motorway policies have been the most controversial subjects since 1950's. In 1950's, radical changes were made in this policy, and a policy accepting the motorway transport as the base axle started to be followed. In the Series of Sector Researches of Vakıfbank in 2001, it was reported that railways were the main transport system of Turkey. Railways were evaluated as they serviced for creating the concept "national economy". Railways orientated the location of industries. After 1950, as a result of conditions and country's economic possibilities, because of not providing a stable resource distribution between railways and roads, two main transport systems, which completed each other in the transport sector and, on the other hand, since railway investments which should have been made parallel with developing railway technology required great financial resource, projects of improving and modernization of railway system were slow down. After that, railways partially continued modernization works together with keeping the function of the present system and providing continuity of traffic with limited possibilities. Finally, while the share of railway freight transport was 22 % in 1955, it decreased to 5 % in 1995.

In Turkey, railways have not adapted the positive technologies in the world and make progress in order to integrate high-speed train network which has been tried to build in Europe. Therefore, the share of railway transport has continued increasing day by day.

Despite the decrease in railway transport, Turkey has a very important potential in the region. Turkey's geopolitical position make transport sector very crucial for the economic development of the region. Kutlu (2003) states that keeping in mind the economic role of Asia in the 21st century it is obvious that a great deal of activities should be carried out for the countries of the region. Planning the necessary links between Asia and Europe and facilitation of transit transport, especially for the Asian countries, is an important priority. For this reason, Turkey participates in and supports the prominent projects in the region in order to contribute to the developing volume of trade between Asia and Europe. Turkey's expectations with regard to EU accession and the growing role of Turkey in trade between Central Asia and the South Caucasus make the focus on transport even more important.

Ministry of Foreign Affairs of Turkey reported that Turkey is at the cross-roads of existing and planned multimodal intercontinental transportation links. It is at the epicenter of road, railway, maritime, inland waterways and air transportation interconnecting Europe, Caucasus, Central Asia, Northern Africa and the Middle East. Creating an efficient and cost effective outlet to major markets, Turkey is a key transportation terminal at a point of regional and international convergence.

As mentioned before, the main purpose of this study is to investigate a modal shift from roads to railways. For this purpose, we apply to forecasting in this study. Applied models related to forecasting in railway area will be mentioned in the following.

2.3. Applied Models Related to Forecasting in Railway Area

Present strategies to improve rail transport are often based on infrastructure developments to eliminate the existing bottlenecks of the rail network. This is a necessary but insufficient condition to promote a re-equilibrium of the modal split. As shown by several surveys, a modal shift from road to rail can be achieved only by improving the overall quality of the rail transport supply taking into account the needs of the shippers, such as frequency and time of transport. As a matter of fact, a potential customer of rail assesses the quality of door-to-door service (Guglielminetti, Lyvraz & Rivier, 2001).

The planning and design of rail network development requires realistic and plausible patronage forecasts for a range of development scenarios and rail networks. Rail strategy and system design decisions will be made on the basis of the patronage forecasts. Given the engineering cost of rail systems, the planning resources dedicated to optimizing the rail system can prove to be extremely cost effective (Küçükavcu & Cakmakçı, 2005).

In most European countries, slower growth of industrial production may lead to slower growth in freight transport, as these two variables are undeniably related. However, one may reasonably expect that trends such as further globalization, the increasing significance of the services sector in Western Europe, and the changing business environment in Central and Eastern Europe (e.g. EU enlargement) will generate further growth. The extent of this growth will, of course, vary for different goods categories and, indeed, for different geographical connections. Shifts will undoubtedly occur in interregional transport patterns. On a number of axes, including the West-East axis, transport will increase more strongly than on others. Here, the problem arises of growth poles in newly emerging markets, which are catching up in terms of economic performance, with or without help from the European Union (Meersman & Van de Voorde, 2002).

The demand for rail freight transportation is a continuously changing process over space and time and is affected by many quantitative and qualitative factors. In order to develop a more rational transport planning process to be followed by railway organizations, there is a need to accurately forecast freight demand under a dynamic and uncertain environment (Wong et al., 2003).

Forecasting is important to firms because it can help ensure that effective use is made of resources. There are a number of forecasting techniques or models that are available to management and the choice of technique requires a number of considerations. If management believes that the future facing their firm is predictable or fairly predictable then statistical forecasting is a useful tool. If, on the other hand, an organization faces a very turbulent environment where the future is mostly unpredictable or wholly uncertain, then there is a little point in attempting to utilize statistical techniques to forecast the future (Caruana, 2001).

There are some studies from literature about demand analysis and forecasting in railway area in the following:

Singh (2004) considered to forecast the level of rail – as well as road – based passenger mobility in India up to the year 2015-16. Forecasting is based on estimation of S – shaped growth curves using annual data of the level of passenger mobility from 1950-51 to 1995-96. The statistical program LIMDEP Version 7.0 is used for estimation. After estimation of the level of passenger and road transport, it is found that the gap between percentage share of rail and road in passenger movement will widen further. By the end of year 2015-16, around 95 % of surface-based passenger traffic will be handled by road.

Griskeviciene, Griskevicius & Simenas (2004) analyzed evolution of freight and passenger transportation by Lithuanian railways as well as market development opportunities, to foresee perspectives of transportation activities and to represent forecast of freight and passenger transportation up to 2020. To this effect an analysis of freight transportation market and of its changes was carried out, as well as the

current status in the Lithuanian railways was examined. Based on the analysis of the development indicators of the Lithuanian railway transport sector in 1997 – 2003, the SWOT analysis (of strengths, weaknesses, opportunities, and threats) was carried out. The most important factors and premises, which form a basic foundation for the long-term railway transport strategy, were identified. In order to form a perspective, the study was based on macro economical indicators of the Lithuanian economy, of their evolution and forecasts. Also, external and internal factors having impact on the evolution of freight and passenger transportation were analyzed; perspective directions were put forward, and as well as possible risk factors were identified. When determining long-term freight transportation forecasts, references were made to the “Long term strategy of the Lithuanian transport development (up to 2025)”, which was prepared on the basis of factors and assumptions, arising out of an analysis of tendencies of the Lithuanian economic and transport sector development and out of the general forecast. Besides, the newest development tendencies of the EU transport sector were taken into consideration, as well as economic evolution (Basel) scenarios and (Lisbon) strategy directions and methods. In this study, the rate of economics development of European Union and the joint states corroborate the possibilities of the increasing of freight transportation by railway transport. On the results of restructuring of Lithuanian Railways, the assumptions are created for the increasing of freight flows, improvement of the service quality, increasing the speed and security of transportation. The forecasts scenarios based on the internal factors and external assumptions create the conditions for reliability of forecasting of future freight transportation by railway transport even until year 2020.

Tsai, Lee & Wei (2005) developed two dynamic neural network structures to forecast short-term railway passenger demand. The first neural network structure follows the idea of autoregressive model in time series forecasting and forms a nonlinear autoregressive model. In addition, two experiments are tested to eliminate redundant inputs and training samples. The second neural network structure extends the first model and integrates internal recurrent to pursue a parsimonious structure. The result of the first model shows the proposed nonlinear autoregressive model can attain promising performance. The result of the second model shows the proposed

internal recurrent neural network can perform as well as the first model does and keep the model parsimonious.

2.4.Summary

In this chapter, a brief literature review has given about transport developments and programs in European Union, railway developments and transport potential of Turkey. Applied models related to forecasting in railway area have also evaluated because of our main purpose. Next, we will examine these subjects in details in the following chapters. We will first evaluate the transport modes and developments in European Union in the next chapter.

CHAPTER THREE

TRANSPORT MODES AND DEVELOPMENTS IN EUROPEAN UNION

Transport systems provide transportation of good, passengers and information from one place to another. Therefore, transport modes have been important components in the life and economical functions of people. Both increasing demand in passenger transport and developments in international trade have affected the transport modes.

It is difficult to conceive of vigorous economic growth which can create jobs and wealth without an efficient transport system that allows full advantage to be taken of the internal market and global trade. Even though, at the beginning of the 21st century, we are entering the age of the information society and virtual trade, this has done nothing to slow down the need for travel; indeed, the opposite is true. There are two key factors behind the continued growth in demand for transport. For passenger transport, the determining factor is the spectacular growth in car use. The number of cars has tripled in the last 30 years, at an increase of 3 million cars each year. Although the level of car ownership is likely to stabilize in most countries of the European Union, this will not be the case in the candidate countries, where car ownership is seen as a symbol of freedom. By the year 2010, the enlarged Union will see its car fleet increase substantially (European Commission, 2001).

3.1. Transport Infrastructure

On a global scale, the EU offers a dense transport network. Increasing demand for transport services, both for passengers and goods, have had an impact on the development of the infrastructures. This development has however its particularities, both with regard to the individual member states and the mode of transport in question.

In 2000, the total length of railways in the first 15 member states of European Union amounted to 156,353 km (see Table 3.1). Although half of this network is

electrified, the overall length in use steadily decreased until 1998 (European Commission, 2003).

Table 3.1 Network lengths in EU-15 (km) (European Commission, 2003)

	1970	Share (%)	2000	Share (%)	Change (1970-2000)
Rail	170,662	5.95	156,353	4.45	-8 %
Roads	2,639,646	91.99	3,254,743	92.66	+23 %
of which motorways	15,864	0.55	51,559	1.47	+225 %
Pipelines	11,441	0.40	21,675	0.62	+89 %
Inland waterways	31,748	1.11	28,381	0.81	-11 %
Total networks	2,853,497	100.0	3,512,711	100.0	+23 %

As can be seen from Table 3.1, the biggest increase in the development of transport networks attribute to road network with a growth of 23 %. On the other hand, rail and inland waterways network decreased by 8 % and 11 %, respectively. In addition, the length of motorway network increased from 15,864 km to 51,559 km. This represents an increase of 225 %. We can conclude from Table 3.1 that road network constitutes the backbone of European Union transport network.

Table 3.2 gives a general overview of the network length of the various states that forms the last 10 member states of European Union and the candidate countries group.

Table 3.2 Network lengths in the candidate countries (km) (European Commission, 2003)

	1995	Share (%)	2001	Share (%)	Change (1995-2001)
Rail	75,568	76.63	72,297	73.24	-4 %
Motorways	3,785	3.84	5,135	5.20	+36 %
Pipelines	10,122	10.26	12,248	12.41	+21 %
Inland waterways	9,140	9.27	9,026	9.14	-1 %
Total networks	98,615	100.0	98,706	100.0	+1 %

It appears from Table 3.2 that rail network decreased by 4 % from 1995 to 2001. On the other hand, motorway network was increased by 36 % in this short period.

Similarly, the length of pipe lines was increased by 21 %. The length of inland waterways did not change significantly.

Within the candidate countries group, one could expect a considerable weight of Turkey on the basis of its considerable geographical size. With regards to transport network lengths, this does not apply. However, when looking at air transport for instance, the weight of Turkey is high, mainly induced by an important tourism sector (European Commission, 2003).

Table 3.3 outlines the length of transport networks of the first 15 member states.

Table 3.3 Length of transport networks 2000 – key indicators (European Commission, 2003)

	Railways			Motorways		
	km	km/100,000 inhab.	Km/1,000 km ²	km	km/100,000 inhab.	Km/1,000 km ²
Belgium	3,471	34.0	113.8	1,702	16.6	55.8
Denmark	2,047	38.3	47.5	922	17.3	21.4
Germany	36,652	44.6	102.7	11,712	14.3	32.8
Greece	2,299	21.8	17.4	707	6.7	5.4
Spain	14,303	36.2	28.3	9,049	22.9	17.9
France	32,515	53.7	59.8	9,766	16.1	18.0
Ireland	1,919	50.7	27.3	103	2.7	1.5
Italy	16,499	28.6	54.8	6,478	11.2	21.5
Luxemburg	274	62.5	105.4	115	26.2	44.2
Netherlands	2,802	17.6	67.5	2,289	14.4	55.2
Austria	6,281	77.5	74.9	1,633	20.2	19.5
Portugal	2,814	28.1	30.6	1,482	14.8	16.1
Finland	5,854	113.1	17.3	549	10.6	1.6
Sweden	11,560	130.5	25.7	1,506	17.0	3.3
United Kingdom	17,067	28.6	69.9	3,546	5.9	14.5
EU-15	156,357	41.4	48.3	51,559	13.6	15.9

We can see from Table 3.3 that in 2000, the railway network of Germany was the longest in the first 15 member countries of European Union with 36,652 km of railway network which constituted 23.4 % of the total EU-15 railway network. The French, United Kingdom and Italian railway network followed with 20.8 %, 10.9 % and 10.6 %, respectively. These four member states stood for 65.7 % of the entire European Union network.

When we examine the networks in terms of density, we can see that Belgium had the highest rail network density with 113.8 km per 1,000 km². Luxembourg and Germany followed with 105.4 km and 102.7 km per 1,000 km², respectively. Within these countries, Finland and Greece had the lowest railway network density with 17.3 km and 17.4 km per 1,000 km², respectively.

In Table 3.4, the length of transport networks of the candidate countries with regard to the year of 2001 is outlined. In this table, the countries except for Turkey, Bulgaria and Romania are now the members of European Union.

Table 3.4 Candidate countries: length of transport networks 2001 – key indicators (European Commission, 2003)

	Railways			Motorways		
	km	km/100,000 inhab.	Km/1,000 km ²	km	km/100,000 inhab.	Km/1,000 km ²
Bulgaria	4,320	52.9	39.0	324	4.0	2.9
Cyprus	-	-	-	257	3.1	2.3
Czech Republic	9,523	92.7	120.8	517	5.0	6.6
Estonia	967	67.4	21.4	93	6.5	2.1
Hungary	7,679	75.5	82.5	448	4.5	4.8
Latvia	2,413	99.9	37.4	-	-	-
Lithuania	1,696	45.9	26.0	417	11.3	6.4
Malta	-	-	-	-	-	-
Poland	21,119	54.6	67.5	398	1.0	1.3
Romania	11,015	49.1	46.2	113	0.5	0.5
Slovak Republic	3,665	67.8	74.7	296	5.5	6.0
Slovenia	1,201	60.3	59.2	427	21.5	21.1
Turkey	8,671	13.3	11.3	1,851	2.8	2.4

As reported in Table 3.4, Poland had the longest railway network with 21,119 km in 2001. Turkey had a network less than half of Poland with 8,671 km in spite of the fact that Turkey is geographically the largest country and more than double as large as Poland. When we express in railway length per 100,000 inhabitants, it can be seen that all countries except for Turkey are situated well over EU average (41.4 km / 100,000 inhabitants – in 2000). In the perspective of network length to the national territory, Czech Republic had the highest density with 120.8 km per 1,000 km², and this length is more than double of the EU average (48.3 km per 1,000 km²). As can be seen from Table 3.4, The Island Cyprus and Malta did not have railway network in 2001.

In contrast with the railway network, the motorway network of these countries was less developed except for Slovenia. Neither Malta, nor Lithuania had any motorways. Turkey had the longest motorway network with 1,851 km in 2001. With regard to motorway density, all countries except for Slovenia were far off the EU average of 15.9 km per 1,000 km² in 2001.

3.2. Traffic and Transport Performances

3.2.1 General Performance

The performance of the European transport sector has been in line with the expanding economy. As reported in Table 3.5, from 1970 to 2000, total European Union goods transport in the first 15 member states grew from 1,407,000 to 3,078,000 million tone-km, 119 %.

Table 3.5 Goods transport in EU-15 (1,000 million tone-km) (European Commission, 2003)

	Road	Rail	Inland Waterways	Pipelines	Sea Intra-EU	Total
1970	487	282	102	64	472	1,407
1980	717	290	106	85	780	1,978
1990	974	256	107	70	922	2,329
1995	1,139	220	114	82	1,071	2,627
1997	1,206	237	118	82	1,124	2,768
1998	1,265	240	121	85	1,142	2,852
1999	1,322	236	121	85	1,197	2,960
2000	1,348	249	125	85	1,270	3,078
1970-80	47 %	3 %	4 %	33 %	65 %	41 %
1980-90	36 %	-12 %	1 %	-18 %	18 %	18 %
90-2000	38 %	-3 %	17 %	21 %	38 %	32 %
70-2000	177 %	-12 %	23 %	33 %	169 %	119 %

When we consider about inland transport in European Union, we can see from Table 3.5 that the considerable growth was realized by road transport. Goods transport in roads increased from 487 to 1,348 million tone-km (177 %) between 1970 and 2000. On the other hand, it decreased from 282 to 249 million-tone km (-12 %) in the same period. When we concern about the other transport modes, we can see that only pipe line transport grew from 1970 to 2000 (33 %).

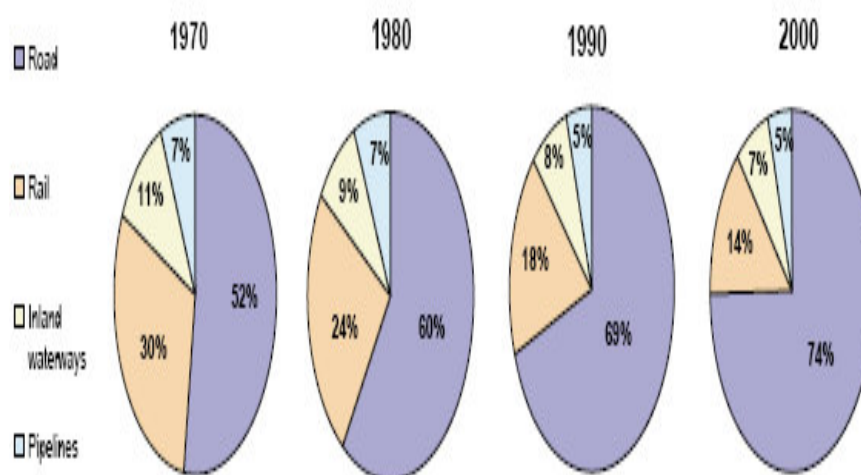


Figure 3.1 Goods transport: modal split of inland modes – EU-15 – Basis: tone-km (European Commission, 2003)

Figure 3.1 shows the share of road, railway, inland waterway and pipe line freight transport. As can be seen, the share of road freight transport increased from 52 % to 74 % between 1970 and 2000. In contrary, the share of railway transport decreased from 30 % to 14 %. Although the amount of freight transport increased by 33 % (see Table 3.5), the share of this transport mode decreased from 7 % to 5 % in the same period.

We can also see the spectacular growth of road freight transport in Figure 3.2. On the other hand, the amount of goods transported by railways decreased year by year. In addition, the development of the two remaining modes, pipe lines and inland waterways, was less spectacular.

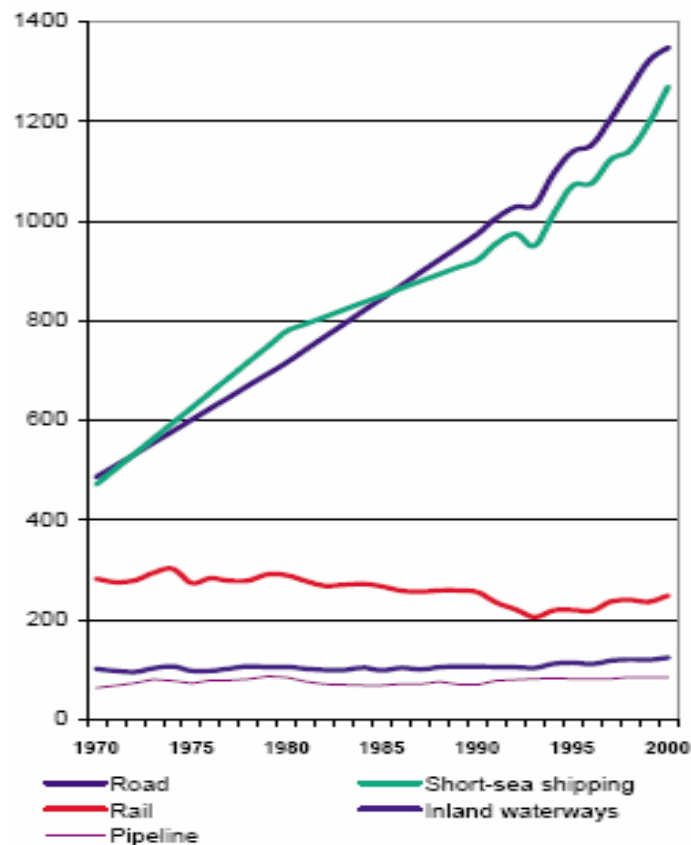


Figure 3.2 Goods transport evolution in EU-15 (European Commission, 2003)

Table 3.6 outlines that for all first 15 member states of European Union except for the Netherlands and Austria road transport was the main carrier of goods in 2000. In Austria and the Netherlands, the share of road transport was less than 50 %, while it was more than 50 %. It performed even more than 80 % in Greece, Spain, Ireland, Italy, Portugal and the United Kingdom.

Although road transport is seen as the main carrier for European Union as stated in Table 3.6, we can also see that railway transport was important for some countries. In Austria, Sweden and Finland, the share of railway transport was more than 25 % in 2000. Greece had the highest share for road transport and lowest share for railway transport in 2000.

Table 3.6 Goods transport: modal split by country 2000 – in % based on tone-km performed (European Commission, 2003)

	Road	Rail	Inland Waterways	Pipelines
Belgium	67.5	16.0	13.1	3.4
Denmark	73.3	8.6	-	18.1
Germany	68.7	15.2	13.1	3.0
Greece	97.7	2.3	-	-
Spain	85.7	8.9	-	5.4
France	75.9	15.8	2.1	6.2
Ireland	93.0	7.0	-	-
Italy	88.0	8.2	0.1	3.7
Luxembourg	71.6	19.3	9.1	-
Netherlands	47.3	3.9	42.7	6.1
Austria	39.9	37.2	5.6	17.3
Portugal	87.1	12.9	-	-
Finland	72.5	26.5	1.0	-
Sweden	61.8	38.2	-	-
United Kingdom	84.1	9.7	0.1	6.1
EU-15	74.6	13.8	6.9	4.7

In Table 3.7, the freight amounts transported in the last 10 member countries, Turkey, Bulgaria and Romania are outlined. As reported in this table, road transport was responsible for the growth of the total performance between 1993 and 2001. The most spectacular growth was observed in pipe line transport and its share was also higher than the first 15 member states of European Union (13 %). In this same period, a decrease was seen in railway transport by 16 %. It is also seen that total performance of transport in all transport modes decreased by 3 % between 2000 and 2001.

3.2.2 National Freight Transport

The amount of national transport is largely dependent on the industrial and commercial development of the countries concerned (European Commission, 2003).

Table 3.7 Goods transport in the candidate countries (1,000 million tone-km) (European Commission, 2003)

	Road	Rail	Inland waterways	Pipelines	Total
1993	223	173	6	24	425
1994	249	169	6	31	455
1995	296	178	9	31	514
1996	309	177	9	35	531
1997	335	179	10	51	575
1998	346	161	10	74	590
1999	346	148	7	77	578
2000	353	156	7	77	592
2001	352	145	7	73	577
1993-2001	58 %	-16 %	21 %	204 %	36 %
2000-2001	0 %	-7 %	-1 %	-5 %	-3 %

Table 3.8 outlines the amount of goods transported in the first 15 European Union countries. As shown in the table, the biggest amount of freight was transported in Germany in 2001 (by road 2.9 billion tone, and by rail 189 million tones). When comparing the 2001 rail transport volume figures with those of 1995, a decrease in Greece and Denmark can be displayed in the number of tones. We can also see that the amount of goods transported by rail was doubled in Italy and Portugal between 1985 and 2001. When we evaluate the road transport, the volume of road transport progressed slightly. Increases were highest in Ireland, Spain and France. Conversely, Belgium is the country that displays a decline in volumes forwarded.

Table 3.9 shows the performance of road versus rail in tone-kilometers. We can see from Table 3.9 that road transport increased except in all member states except for Portugal, Luxembourg and Sweden. This increase was seen especially in Ireland, Spain and Belgium. According to Table 3.9, rail transport registered the most important decline in performances in Greece, Denmark and Belgium while Austria, Spain and Sweden show a progress of 29 %, 22 % and 20 %, respectively.

Table 3.8 National transport of goods by country and mode – in 1,000 tones (European Commission, 2003)

	1985		1995		2000		2001	
	Road	Rail	Road	Rail	Road	Rail	Road	Rail
Belgium	265,386	34,425	352,047	27,198	315,830	23,902	291,739	22,788
Denmark	199,932	2,348	175,949	2,238	206,907	1,646	189,997	1,576
Germany	2,213,709	238,937	3,019,144	232,836	3,058,994	193,626	2,934,972	189,632
Greece	158,371	1,198	178,794	575	203,176	334		341
Spain	913,337	25,024	588,151	20,948	907,734	20,734	1,006,083	20,845
France	1,197,942	114,290	1,324,143	80,817	1,843,606	88,912	1,915,969	80,905
Ireland	89,731	3,379	78,531	3,015	175,413	2,680	185,640	
Italy	327,555	17,219	1,220,917	27,425	1,176,437	31,546	1,125,468	30,495
Luxembourg	11,127	2,540	28,437	2,702	19,448		23,440	2,742
Netherlands	338,658	5,527	391,766	4,349	464,660	5,219	470,372	4,363
Austria			219,616	15,980	241,239	20,239	244,479	20,143
Portugal	190,554	4,688	263,198	7,628	103,898	8,288	127,174	8,138
Finland			349,128	21,874	415,611	24,071	372,887	23,992
Sweden			343,209	29,741	325,063	19,367	306,307	
United Kingdom	1,407,000	139,326	1,658,408	95,379	1,628,099		1,612,072	

Table 3.9 National transport of goods by country and mode – in million tone-km (European Commission, 2003)

	1985		1995		2000		2001	
	Road	Rail	Road	Rail	Road	Rail	Road	Rail
Belgium	10,379	2,537	18,616	2,231	19,754	2,031	24,045	1,904
Denmark	8,343	609	9,327	448	11,000	456	10,887	362
Germany	98,615	37,798	201,299	35,710	226,529	35,038	220,061	34,556
Greece	10,353	289	12,357	155	19,322	112		107
Spain	74,144	8,793	78,744	7,992	106,936	9,587	114,002	9,775
France	79,093	37,494	135,300	28,797	163,163	32,815	168,586	29,874
Ireland	3,727	601	5,000	602	8,337	424	9,009	
Italy	98,443	7,095	150,301	10,606	158,250	11,789	154,746	11,019
Luxembourg	205	86	531	104	415	101	487	98
Netherlands	18,189	1,064	26,683	721	31,538	945	30,954	839
Austria			11,069	3,001	12,389	3,892	11,348	3,875
Portugal	8,636	1,135	11,119	1,767	15,312	1,872	9,520	1,834
Finland			21,804	5,936	27,717	6,802	26,680	6,588
Sweden			28,357	10,432	31,451	12,420	26,615	12,501
United Kingdom	100,541	16,811	146,714	12,440	150,337			

Figure 3.3 shows the national goods transport by distance class. The figure shows that only 10 % of the volume of goods (expressed in tone-km) forwarded by rail have a distance of up to 150 km. The equivalent number for road haulage is 32 %. This shows the flexibility of road transport for shorter distances and the relative importance of rail for longer distances. It should however be noted that certain members (Belgium, Ireland, Luxembourg and the Netherlands) are not able to

perform national journeys of more than 500 km. If national rail transport is to be promoted within the framework of intermodality, it is clear that this will mainly be appropriate for larger member states like Germany, France or the United Kingdom.

Table 3.9 gives a general overview of the national transport of goods for the last 10 member states, Bulgaria, Romania and Turkey. Rail transport of goods has registered a clear decline in all the candidate countries, especially in Slovenia and the Czech Republic, by 50 % and 44 % respectively. However, rail transport performance remains high in some countries like Poland (34,287 million tone-km) and Romania (12,760 million tone-km). For the latter country, as well as for Bulgaria and Estonia, the goods transport performance of rail (expressed in tone-km) is significantly higher than that of road.

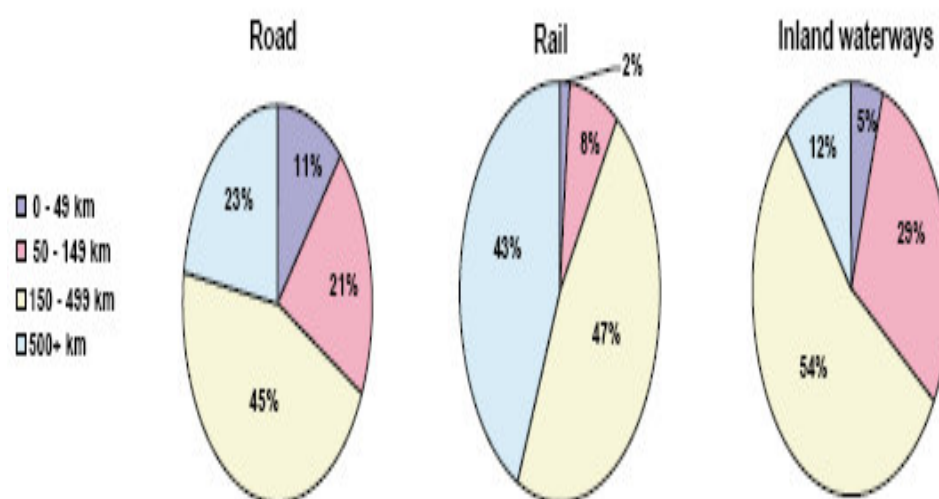


Figure 3.3 National goods transport by distance class, on the basis of tone-km forwarded (European Commission, 2003)

As can be seen in Table 3.10, the general trend is the increase of goods transport by road. Two countries alone account for about 80 % of the total national goods transport in these countries: Turkey, with 151,400 million tone-km (61 %) and Poland, with 46,365 million tone-km (19 %). The Slovak Republic registered the most important progression with +390 % between 1993 and 2001, followed by the Czech Republic with +215 %. In contrary, a decline was seen in Bulgaria by 76 % on the same period.

Table 3.10 Candidate countries: national freight transport by mode (million tone-km) (European Commission, 2003)

	Rail			Road		
	1993	2001	Evolution	1993	2001	Evolution
Bulgaria	6,543	4,139	-37%	13,989	3,310	-76%
Cyprus						
Czech Republic	12,570	7,091	-44%	5,105	16,082	215%
Estonia	877	726	-17%	502	548	9%
Hungary	2,457	1,967	-20%	9,224	11,848	28%
Latvia	534	390	-27%		1,645	
Lithuania		1,522			1,518	
Malta						
Poland	52,046	34,287	-34%	37,340	46,365	24%
Romania	15,908	12,760	-20%	13,349	10,645	-20%
Slovak Republic		2,207		1,085	5,318	390%
Slovenia	497	249	-50%	298	216	-28%
Turkey	8,118	7,149	-12%	97,843	151,421	55%

3.2.3 International Freight Transport

The globalization of the economy and especially the increasing integration of the European economies have led to a considerable growth of the entire transport sector. Currently being deregulated, especially within rail transport, the sector is expected to increase efficiency and thus experience further growth (European Commission, 2003).

In 2001, international goods movements of member states amounted to approximately 296,000 million tone kilometers (tone-km) for road (without cross-trade and cabotage transport), 89,000 million tone-km for rail and 71,000 million tone-km for inland waterways. Compared to 1990, this represents an increase of around 62 % for international road transport, 18 % for rail transport and 15 % for transport over navigable inland waterways.

The territory of the European Union includes several highly industrialized and densely populated areas; both are generating considerable inland transport flows of raw materials, final products and foodstuffs.

Although at EU-level railways are taking care of only a minor part in total international transport, the importance of this mode is substantial for some member

states; railways carry substantial volumes in international transport in Sweden and Finland. The modal comparison in international goods transport throughout the member states is impossible due to the fact that road transport declarations include transport performed outside the country where haulers are registered whereas the territorial principle applied to transport performance declarations of rail and inland waterways. Furthermore, Italy for instance has no inland waterway connection with any other member state; international goods transport by rail for the United Kingdom became only possible with the opening of the Channel tunnel. The Republic of Ireland records rail goods transport to and from Northern Ireland as national traffic.

Table 3.11 outlines the level of international rail transport in million tone-km. As reported in this table, Germany performed close to 32,000 million tone-km in rail freight transport followed by France and Italy with 14,000 and 11,000 million tone-km respectively in 2001. Portugal's volume of international rail transport doubled between 1990 and 2001, whereas Sweden's transport recorded a decline of 15 %.

Table 3.11 International rail transport – loaded and unloaded (million tone-km) (European Commission, 2003)

	1990	1995	1998	1999	2000	2001	Evolution (1990-2001)
Belgium	4,954	4,648	4,918	4,978	5,419	4,895	-1.2 %
Denmark	569	602	671	608	699	657	15.5 %
Germany	22,127	25,384	27,755	27,161	32,875	32,016	39.3 %
Greece	411	147	196	244	311	268	-34.8 %
Spain	1,381	1,761	2,148	1,944	2,027	1,942	40.6 %
France	12,983	13,804	13,563	13,740	15,026	14,007	7.9%
Ireland							
Italy	10,141	11,065	11,006	10,435	10,946	11,091	9.4 %
Luxembourg	419				262	263	.37.2 %
Netherlands	2,016	2,295	3,030	3,110	3,577	3,454	71.3 %
Austria		6,884	8,025	8,067	9,096	9,191	33.5 %
Portugal	156	252	410	318	311	304	94.9 %
Finland		3,357	3,572	3,373	3,305	3,269	-2.6 %
Sweden		8,313	7,261	7,054	7,668	7,047	-15.2 %
United Kingdom	193						

Table 3.12 shows that the member states with the most voluminous international road haulage in 2001 were Germany (52,150 million tone-km), Spain (45,323), the Netherlands (37,470) and France (35,917). As can be seen from the table, the

progress more than 100 % was seen in Denmark, Spain, Ireland and Portugal. The most important progress in road transport was seen in Spain by 269.4 %. According to Table 3.12, international road transport trends increased in nearly all countries between 1990 and 2001.

Table 3.12 International road transport – loaded and unloaded (million tone-km) (European Commission, 2003)

	1990	1995	1998	1999	2000	2001	Evolution (1995-2001)
Belgium	19,433	22,833	19,900	17,250	25,320	26,501	36.4 %
Denmark	5,145	12,421	10,796	12,276	12,166	10,510	104.3 %
Germany		33,664	42,173	45,652	48,684	52,150	54.9 %
Greece	2,119	867	1,272			1,500	-29.2 %
Spain	12,271	22,513	32,814	35,066	40,472	45,323	269.4 %
France	34,064	40,041	40,291	41,975	37,863	35,917	5.4 %
Ireland	1,008			1,699	2,650	2,295	127.7 %
Italy	20,498	12,497		24,465	25,742	30,553	49.0 %
Luxembourg		3,341	1,245	1,461	1,529	2,009	-39.9 %
Netherlands	30,896	33,901	36,809	41,005	37,876	37,470	21.3 %
Austria		12,474	14,610	15,653	16,712	18,623	49.3 %
Portugal	5,152	7,199	10,188	10,990	11,855	12,228	137.3 %
Finland			4,515	3,712	3,977	3,671	
Sweden		3,057	2,916	2,721	3,732	3,681	20.4 %
United Kingdom	10,651	14,415	16,122	16,905	14,951	13,208	24.0 %

As for the first 15 EU member states; the last 10 member countries, Bulgaria, Romania and Turkey have seen their overall volume of international freight transport growing constantly. As visible in Table 3.13 this general upward trend has not been steady, neither by mode nor by individual country.

With regards to rail transport, Slovenia has seen the volume of its freight transport more than doubled between 1993 and 2001 (+110 %) while Estonia and Romania registered considerable decreases (with respectively -47 % and -46 %) during the same period. The main countries in terms of absolute volumes handled are Poland (10,593 million tone-kilometers), the Czech Republic (7,939 million tone-kilometers) and the Slovak Republic (5,634 million tone-kilometers), even though the latter country presents the second biggest annual decrease between 2000 and 2001 (-37 %) just after Romania (-42 %).

Table 3.13 International total freight transport (loaded + unloaded) in the candidate countries by mode of transport (million tone-km) (European Commission, 2003)

		1993	1994	1995	1996	1997	1998	1999	2000	2001
ROAD	Bulgaria	911	645	711	603	563	666	507	729	537
	Cyprus									
	Czech Republic	10,145	10,272	10,749	10,456	9,636	8,839	8,129	8,277	7,939
	Estonia	843	874	961	725	653	825		427	448
	Hungary	4,117	4,088	4,712	4,078	4,565	4,467	4,101	4,719	4,297
	Latvia	1,277	1,006	900	1,136	1,583	1,615	1,307	1,412	1,115
	Lithuania		2,374	2,322	2,145	2,240	2,181	1,541	1,453	1,409
	Malta									
	Poland	8,907	10,620	15,264	12,715	12,904	13,197	10,048	11,649	10,593
	Romania	5,647	5,321	5,848	5,754	5,358	3,871	3,795	5,202	3,026
	Slovak Republic					9,097	8,657	7,439	8,918	5,634
	Slovenia	416	731	776	720	778	776	770	838	872
	Turkey	268	172	211	223	273	387	270	322	330
RAIL	Bulgaria								2,756	3,125
	Cyprus									
	Czech Republic		10,515	15,072	14,052	21,120	13,318	18,612	20,482	22,202
	Estonia									
	Hungary	3,220	3,590	3,801	4,900	5,414	6,433	6,212	6,690	6,320
	Latvia					1,731	1,867	1,951	2,417	2,789
	Lithuania			1,975	1,397	2,186	2,505	4,126	4,104	4,447
	Malta									
	Poland	2,837	3,839	10,336	13,257	18,862	21,605	22,593	24,522	27,166
	Romania	1,146	1,736	2,197	2,646	3,204	4,912	3,605	4,248	7,666
	Slovak Republic					1,710	1,974	2,098	7,029	6,434
	Slovenia	1,445	1,465	1,338	1,308	1,341	1,485	1,440	1,620	1,751
	Turkey									

The evolution of road transport is more consistent for each of these countries: it has a clear upward trend. The figures suggest that a country can increase its international road transport significantly in a short period. For instance, Romania shows an increase of 80 % between 2000 and 2001, becoming the 3rd candidate country in terms of road transport freight volume with 7,666 million tone-kilometers, but far behind Poland (27,166 million tone-kilometers) and the Czech Republic (22,202 million tone-kilometers).

3.3.Means of Transport

Transport equipment can roughly be defined as all means that enable the transport of goods and/or persons; thus not only passenger cars, buses, lorries, trains (composed of locomotives and wagons), inland waterway vessels and aircraft are meant here, but also road trailers and semi-trailers, rail goods vehicles, bicycles and powered two-wheelers.

The European transport equipment industry is of considerable importance, both for intra- and extra-European trade: the automotive industry alone accounts for roughly 10 % of the total industrial value added. It is estimated that one out of every 10 European Union jobs is directly or indirectly linked to the automotive industries, and although the market for passenger cars and goods vehicles is sensitive to economic fluctuations, this industrial branch has kept its importance within the European Union economy (European Commission, 2003).

When we consider the European Union data relating to railway transport in Table 3.14, we can see the considerable change in railway transport. For the first 15 member states, all three categories (locomotives, rail passenger vehicles and rail goods wagons) show a significant drop in numbers. On the other hand, for road transport it can be seen that the number of all vehicles for each category increased between 1970 and 2000. As reported in the table, passenger vehicles and goods vehicles increased by three times in 2000 when comparing with 1970.

Table 3.14 Means of inland transport for the first 15 member states (European Commission, 2003)

		1970	1990	1995	1998	1999	2000
ROAD	Passenger cars (million)	62.48	143.27	160.00	169.03	173.76	177.39
	Buses and coaches (1,000)	331	484	486	510	525	535
	Goods vehicles (1,000)	7,460	17,399	19,795	21,998	22,855	23,671
	Trailers and semi-trailers (1,000)	1,748	6,409	6,682			
RAIL	Locomotives and railcars (units)	49,969	44,524	40,042	38,787	38,330	39,280
	Passenger transport vehicles (unit)	97,561	84,386	79,046	76,507	77,130	76,185
	Goods transport wagons (1,000)	1,509	888	627	522	517	

Table 3.15 details that the first 15 member states experienced very serious cuts in their stock of rail goods vehicles. In the entire EU, roughly one million goods wagons were taken out of service between 1970 and 2000.

Table 3.15-a Rail transport equipment (Locomotives and railcars – unit) (European Commission, 2003)

	1970	1980	1990	1995	1998	1999	2000
Belgium	1,536	1,740	1,727	1,579	1,595	1,621	1,670
Denmark	1,740	461	524	507	438	433	415
Germany	18,071	18,949	15,507	13,369	12,714	12,509	13,731
Greece	514	313	400	430	638	244	244
Spain	1,928	1,791	1,922	1,856	1,730	1,670	1,693
France	6,261	6,204	7,279	7,009	6,952	7,129	7,158
Ireland	307	192	166	171	158	172	172
Italy	4,715	4,916	4,818	4,660	4,454	4,623	4,697
Luxembourg	95	85	97	110	104	113	124
Netherlands	2,140	2,174	2,372	2,345	2,240	2,170	1,965
Austria	1,501	1,451	1,553	1,573	1,552	1,551	1,500
Portugal	626	583	530	633	618	624	589
Finland	877	752	669	761	746	742	735
Sweden	1,408	1,576	1,350	1,039	948	929	887
United Kingdom	9,510	5,452	5,610	4,000	3,900	3,800	3,700
TOTAL	49,969	46,639	44,524	40,042	38,787	38,330	39,280

Table 3.15-b Rail transport equipment (Goods transport rail wagons – 1,000) (European Commission, 2003)

	1970	1980	1990	1995	1998	1999	2000
Belgium	48.9	43.4	30.3	20.3	19.1	18.6	18.8
Denmark	10.3	8.3	4.6	4.1	3.2	2.5	2.2
Germany	459.0	476.4	419.7	256.0	201.3	191.7	190.4
Greece	9.0	10.9	11.0	11.1	2.7	3.5	3.5
Spain	41.0	41.0	37.2	29.7	26.5	26.5	26.5
France	302.4	253.1	162.0	131.9	117.2	96.3	94.8
Ireland	9.5	4.7	1.8	1.8	1.8	1.6	1.9
Italy	125.9	113.4	99.7	89.1	76.0	76.2	65.0
Luxembourg	4.2	3.7	2.7	2.4	2.3	2.3	2.4
Netherlands	19.2	12.3	6.7	6.0	4.6	4.6	4.7
Austria	35.5	35.4	30.5	21.8	18.6	18.1	18.4
Portugal	9.0	6.7	4.6	3.9	4.6	4.2	3.9
Finland	21.9	21.5	15.2	14.0	13.1	12	11.8
Sweden	48.2	45.9	27.5	20.2	17.2	17.6	17.6
United Kingdom	364.9	141.2	34.4	14.2	14.0	41.0	
TOTAL	1,509	1,218	888	627	522	517	

The number of locomotives and railcars is estimated to have declined by 21 % at EU level between 1970 and 2000 (see Table 3.15-a). The largest reduction in stock

compared to 1970 was registered in the United Kingdom (-60 %, based on estimates), followed by Greece (-52%) and Ireland (-44 %).

The number of rail goods wagons decreased from 1,509,000 to 517,000 between 1970 and 1999. We can see the most significant decrease in the United Kingdom by 88.8 % (from 364,900 to 41,000).

In Table 3.16, the number of road transport equipment for the first 15 European Union countries.

When considering the strong increase of road goods transport, the number of goods road vehicles has experienced a substantial increase over the last three decades: more than triple the number of 1970. Goods road vehicles as mentioned in Table 3.16 include lorries, road tractors (only capable of goods haulage when a semi-trailer is attached) and sometimes vans and pick-ups.

Road tractors alone will not carry goods: semi-trailers will be attached to them. The number and size of semi-trailers gets more attention when considering their potential in combined (road – rail) transport.

The vehicle registers of the member states are not all able to give a complete breakdown of the various trailer categories; however the number of trailers and semi-trailers registered in the nine countries for which data were available in 2000 increased by 21.5 % between 1995 and 2000.

Table 3.16-a Road transport equipment (Goods vehicles – 1,000) (European Commission, 2003)

	1970	1980	1990	1995	1998	1999	2000
Belgium	212	268	343	402	453	480	503
Denmark	245	249	287	333	347	362	373
Germany	1,188	1,511	1,653	2,215	2,371	2,466	2,527
Greece	105	401	743	871	974	1,010	1,043
Spain	710	1,338	2,333	2,937	3,393	3,605	3,780
France	1,504	2,457	4,670	4,926	5,214	5,320	5,456
Ireland	49	65	143	142	171	189	206
Italy	877	1,338	2,349	2,709	3,171	3,221	3,298
Luxembourg	9	9	11	16	18	19	20
Netherlands	286	314	553	654	795	872	939
Austria	121	184	253	290	310	319	327
Portugal	157	350	781	1,175	1,436	1,541	1,658
Finland	103	149	264	252	281	294	304
Sweden	145	182	310	308	338	354	374
United Kingdom	1,749	1,828	2,706	2,565	2,726	2,803	2,861
TOTAL	7,460	10,642	17,399	19,795	21,998	22,855	23,671

Table 3.16-b Road transport equipment (Number of trailers and semi-trailers – 1,000) (European Commission, 2003)

	1970	1980	1990	1995	1998	1999	2000
Belgium	25	51	95	126			
Denmark	35	128	318	409	497	526	555
Germany	1,070	1,905	3,565	3,029	3,371	3,502	3,632
Greece	2	5	9	12	13		
Spain	18	48	106	157	201	221	243
France	81	156	165	179	311	320	3,294
Ireland	9	12	19	17			
Italy	104	264	600	765	815	800	812
Luxembourg	6	12	9	6			
Netherlands	33	68	140	190			
Austria	79	165	296	384	446	465	480
Portugal	31	72	160	279	317	333	348
Finland	10	23	345	418	477	500	523
Sweden	85	252	348	476	502	515	533
United Kingdom	160	204	234	235	238	238	238
TOTAL	1,748	3,365	6,409	6,682			

Table 3.17 displays selected items of the road transport equipment of the last 10 member countries of European Union, Bulgaria, Romania and Turkey with regard to goods vehicles. From this table, we can see a similar progress as in the other two categories. Between 1995 and 2001, their number increased by an impressive 70 % in Turkey and close to 50 % in Czech Republic, Poland and Latvia. Lithuania is the only country where the number of goods road vehicles experienced a decline (-8 %).

Table 3.17 Road transport equipment for the candidate countries (Goods vehicles – 1,000) (European Commission, 2003)

	1995	1998	1999	2000	2001
Bulgaria	264	283	293	301	312
Cyprus	101	109	111	115	118
Czech Republic	219	280	289	298	321
Estonia					
Hungary	325	337	328	353	366
Latvia	69	85	90	97	100
Lithuania	109	99	97	99	100
Malta					
Poland	1,355	1,564	1,684	1,880	1,979
Romania	343	410	442	449	456
Slovak Republic		156	160	153	161
Slovenia	43	50	52	55	56
Turkey	747	1,034	1,109	1,229	1,271

3.4.Summary

In the previous chapter, it is stated that road transport is the backbone of European transport system. In this chapter, this opinion is proved by statistics of European Union countries in the view of transport infrastructure, traffic performances and the number of transport equipment. Because of this development in road transport, European Union has started to support some transport programs related to railways. In the next chapter, we will mention about these transport programs and the measures for the railway sector and in European Union.

CHAPTER FOUR

RAILWAY TRANSPORT MEASURES AND APPLICATIONS ABOUT RAILWAYS IN EUROPEAN UNION

The many empirical studies that have been conducted during the nineties on the interrelationship between growth in transport and aggregate economic growth, have shown that the elasticity of road freight transport services with respect to aggregate income is greater than one. These trends will be exacerbated by the adjustment processes associated with the EU enlargement. Many observers share the view that the dramatic increases in freight transport cannot be accommodated by the contemporary road freight system, given current congestion levels and given the current limits to the extension of the road infrastructure. On the other hand, absolute rail freight transport volumes have been stagnating at best. Comparing what is observed in Europe with statistical data of other continents, it is obvious that the weak position of rail freight is peculiar to Europe. The consequent question, whether the fact that the European railway system remains largely fragmented along national boundaries is the basis of this negative diagnosis (ECMT, 2002).

Railway policies in European Union based on the independence of railway enterprises, separation of operating and infrastructure, the right accesses for cabotage, determination of infrastructure utilization costs fairly and improving financial structure of railway enterprises. Directives of European Union suggest reconstruction of the railway transport in European Union.

4.1. Measures for Railway Sector in European Union

For around 30 years railway transport has been in relative decline in comparison to other modes. This is particularly well illustrated by the development of rail freight. The European freight transport sector enjoyed vigorous growth in the last decade. The traffic performance rose by roughly 2.5 percent per annum outstripping growth in GDP (Gross Domestic Products) by approximately 0.5 percentage points and thereby underlining the very high freight transport intensity of economic growth.

However, the rail freight sector was unable to take part in this strong growth. Its share in the five transport modes (in the European Union of 15 member states before the last enlargement) fell from 21 percent in 1970 to about 8 percent in 2002. For passenger transport the trend was similar: rail's modal share dropped from 10.5 percent to around 6 percent over the same period (Scherp, 2005). This persisting situation is leading to an uneven distribution of traffic, generating increasing congestion, particularly on the main transport corridors and in towns and cities (European Commission, 2001).

At the end of the 1980s and in the 1990s some member states of the European Union started to restructure the railway sector and to reform the regulatory framework in order to open up rail markets. At the European Community level, the White Paper in 1996 on rail transport (European Commission, 1996) laid down the strategic principles aimed at revitalizing the railway sector in order to increase its competitiveness and attractiveness with customers. Ideally, the railway sector must be able to participate in transport growth by allowing railway firms to act as commercial entities at a European level. The Community Transport White Paper of 2001 (European Commission, 2001) confirmed this approach and defined a political target of maintaining the 1998 rail modal share by the year 2010. In order to reach this target the Community rail policy aims at (Scherp, 2005):

- Ensuring non-discriminatory market access and transparent market structures,
- Providing incentives for an efficient infrastructure use,
- Contributing to a sustainable financial restructuring of railway undertakings and infrastructure managers,
- Triggering a positive rail market development.

European Union transport policies include performing free access to the infrastructure of all railway enterprises, associated works between railway enterprises, coordination between transport modes and improving transport services (especially with regard to safety, comfort, and environmental effect).

The growing awareness on the part of the operators, who recently engaged on a joint definition of a common strategy for European rail research to create a single European railway system by 2020, must be welcomed. In the “White Paper” signed by the International Union of Railways (UIR), the Community of European Railways (CER), the International Union of Public Transport (IUPT) and the Union of European Railway Industries (UNIFE), the rail stakeholders agree to achieve the following objectives by 2020 (European Commission, 2001):

- For rail, to increase its market share of passenger traffic from 6 % to 10 % and of goods traffic from 8 % to 15 %,
 - A trebling of man power productivity on the railways,
 - A 50 % gain in energy efficiency,
 - A 50 % reduction in emissions of pollutants,
 - An increase in infrastructure capacity commensurate with traffic targets.

What is needed, therefore, is a veritable cultural revolution to make rail transport, once again, competitive enough to remain one of the leading players in the transport system in the enlarged Europe. The priority must be to resolve the problems holding back its development: the lack of infrastructure suitable for modern transport and of interoperability between networks and systems, the constant search for innovative manufacturing technologies, the non-transparency of costs, and the patchy productivity and shaky reliability of the service, which is failing to meet customers’ legitimate expectations (European Commission, 2001).

The European Commission’s White Paper highlights the rail mode’s shortcomings affecting the transport system as a whole with foreseeable trends pointing to greater congestion, especially on the roads, and severe problems for the economy and for the quality of life of Europe’s citizens. In this system, each mode must play its role and make the most of its intrinsic assets. The rail mode is seen as a very suitable mode for hauling goods over long distances which the European dimension of the economy is stretching even farther and for passengers insofar as the quality of service meets expectations. The standard of safety and the environment-friendly qualities of this

transport mode make it a preferred mode that should be promoted vigorously (Vinois, 2002).

The White Paper proposes a range of measures targeting all transport modes and which should have a strong impact on the rail mode's ability to achieve the objectives expected (Vinois, 2002):

- Infrastructure user charging and especially for road infrastructure which should take account of external costs such as congestion, pollution and accidents,
- Developing the trans-European network and especially the rail network,
- Supporting alternative modes to the roads by setting up the ambitious “Marco Polo” program which has a € 115 million budget for the 2003 – 2007 periods and aims to foster the launch of transport services offering different alternatives to road transport.

The most concrete step on the issue of forming the common rules encouraging the European Union countries to develop their railways is the Council Directive no: 91/440 dated July 29, 1991. This Directive which aims to facilitate structuring of the union railways in compliance with the requirements of the single market and to increase their efficiency can be summarized in four articles (TÜBİTAK, 1996):

- *Administrative Independence*: The member countries should take the precautions required to obtain an independent structure in which the railway establishments can perform activities in conformity with the market needs and commercial company norms.
- *Separation of the Infrastructure and Business Administration*: The activities regarding the infrastructure and business administration should managerially be separated from each other and their budgets should be held individually.
- *Improvement of the Financial Structures*: The member countries should assure the present railway companies belonging to the government or under government inspection to acquire a good financial structure.

- *The Right of Access to the Railroad Infrastructure (Cabotage)*: The right of access and passage to the infrastructure of the member countries should be granted to the international groups formed by the union of the railway companies of the member countries. In the same manner, the right of access to the infrastructure of the member countries should be granted to the union firms which perform combined forwarding in international freight transportation.

4.2.High-Speed Trains in European Union

The historical decline of railways as the main way of transport for passengers and freight is in contrast with the popularity of the new railway technology known as “high-speed”. This new technology consists of a special infrastructure and trains that allow running passengers’ convoys at speeds over 250 km per hour. For medium distances, these trains are presumed to have an advantage with respect to road and air transport (Rus & Inglada, 1997).

The existing overland emphasized transportation system hinders the sustainable development of communication with the pollution, accidents and traffic jam it causes and destructs the mobility which plays the greatest role in economic development. In many countries of Europe and Asia, special importance have been given to the railways to change this situation and the advanced technology product high speed trains which were initially started to be used thirty years ago in Japan, have been widespread all over Europe starting from the 1980’s. In the countries where high-speed trains provide service, transportation by railway is preferred to airway transportation in distances between 200-600 kilometers.

In many European countries investments are being made in infrastructure for high-speed trains. The objective is to make rail transport once more competitive with respect to road and air transport. To this end, step by step a European network for high-speed trains is being built up. The development of that network can be seen as a renaissance of rail transport (Pol, 2003).

The European Commission which has detected that the high-speed railway establishments can already attract a significant market share to themselves, has started to realize the extensive policies created with the objective of developing the railway establishments in Europe and assuring the sustainable mobility.

The European Commission has put the *Trans-European Network*; TEN Projects which cover the establishment of the Europe High-Speed Train Network and also the construction and restorations of the conventional railway, port, airport and overland routes into effect and provided the starting financing for the 14 TEN Projects with priority of which nine is about railways. The Commission considers the provision of the environment required in order for the European High-Speed Train Network to generate the expected economic benefit as the primary mission regarding the European Communication Network and aims intensification of the technology development studies in this area.

4.3.Important Investments about Railways

4.3.1. Railways in Trans-European Corridors

The Trans-European Network (TEN) consists of a number of projects of common European interest in the transport, energy and telecommunication sectors. The purpose of these projects is simply to enhance the infrastructure in the EU. The TEN programs is complementary to other EU policies such as economic and social cohesion, employment and environmental policies creating employment, growth and wealth not only directly but also indirectly through the improved functioning of the single European market (Vestgaard, 1999).

Trans-European Network provides connections between European Union and Scandinavian countries, Central and East European countries, countries thorough Mediterranean. It performs adaptation of road, railway, maritime and airway transport infrastructures. Trans-European Railway Network includes high-speed trains, conventional trains and combined transport modes.

TEN plays a crucial role in securing the free movement of passengers and goods in the European Union. It includes all modes of transport and carries about half of all freight and passenger movements. One of the key objectives of creating a multimodal network is to ensure that the most appropriate transport mode may be chosen for each stage of a journey (European Commission, 2005).

The transport part of European Network mentioned above is about the project of developing and building railways, harbors, airports and main roads (TEN Projects). 9 of 14 TEN projects are about railways and the most of them are linked with high-speed train lines.

The Europe Council organized a meeting in Essen in December 1994 and they approved these 14 TEN projects. That is (TÜBİTAK, 1996);

- 1) High-speed Train (**Paris-Brussels-Koln-Amsterdam-London** line; PBKAL)
- 2) High-speed Train / Combined Transport, North-South Line (Berlin-Nuremberg and Munich-Verona)
- 3) High Speed Train, South Line (France-Spain connection)
- 4) High Speed Train, Paris-East France-South Germany Line (including Metz-Luxemburg links)
- 5) Conventional Train / Combined Transport, Betuwe Line (line which links the main industry and consumption centers of Europe [Rhine/Main; Rhine/Neckar] to Harbor Rotterdam)
- 6) High-speed Train / Combined Transport, France-Italy (Lyon-Turin, Turin-Milano-Venice-Trieste lines)
- 7) Greece Highways, Pathe and Via Egnatia
- 8) Multimodal Link Portugal – Spain – Central Europe
- 9) Conventional Railway Link, Cork-Dublin-Belfast-Larne-Stranraer line
- 10) Malpensa Airport, North Italy
- 11) Train/road Link, between Denmark and Sweden - Resund

- 12) North Triangle (Oslo-Copenhagen, Oslo-Stockholm, Copenhagen-Stockholm, Turku-Helsinki [Russia border] combined transport)
- 13) Road Link, Ireland-England-Benelux connection
- 14) West Coast Main Line

The followings are also the priority projects proposed by the European Union in 2001 (European Commission, 2001):

New projects;

- Global navigation and positioning satellite system Galileo
- High-capacity rail link across the Pyrenees
- Eastern European combined transport/high-speed train
- Danube river improvement between Vilshofen and Straubing
- High speed rail interoperability on the Iberian peninsula
- Fehmarn Belt : fixed link between Germany and Denmark

Extensions;

- High-speed train/combined transport north-south (Verona – Naples and Bologna – Milan)
- High-speed train South (Montpellier – Nimes)

The map for Trans European Network is shown in Figure 4.1. We can see the importance of railways from this figure. Road network is shown with yellow line and railway network is shown with green line. It is seen that railway network is more intensive than road network.

The rail networks of the first 15 EU Member States have a total length of 156,000 km, of which some 78,000 km are designated. This infrastructure is used to move more than half of the rail freight traffic. The target in the guidelines defines a network to be composed, by 2010, of one third high-speed lines (around 16% of new high-speed lines and 21% of upgraded high-speed lines) and two thirds conventional lines. The development of completed high-speed lines, new and upgraded, continued

to progress in the period described. The total length of high-speed sections in operation increased from 6,800 km in 1996 to 10,000 in 2001.

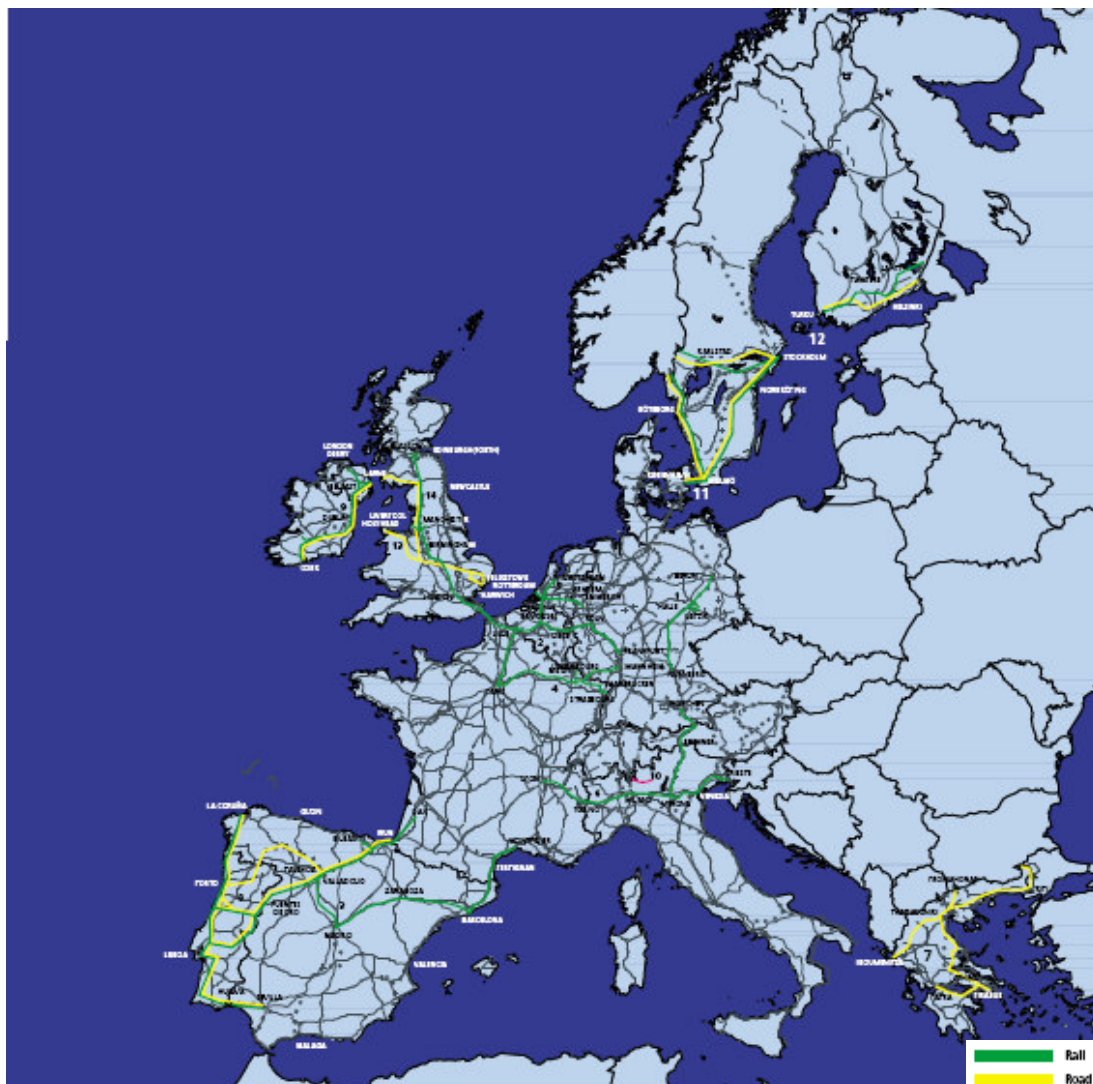


Figure 4.1 Map of Trans European Network (European Union, 2001)

Investments in the TEN rail network totaled € 69.1 billion during 1998-2001. This amount implies a significant increase in the funding effort allocated to the network if compared with the €15 billion invested in the EU in 1996-1997. Altogether, € 84.1 billion was invested from 1996 to 2001.

The total cost of completing the TEN rail network as defined in the guidelines can be estimated at around €324 billion (European Commission, 2004). 80 % of that is

railway investment, 9 % of that is about the connection of main roads and railways. But, 10 % of the investment forms the main roads construction so; we can understand that Europe Union isn't interested in main roads. It is interested in the alternative project instead of the main roads. The high speed train project of them will constitute the main structure of the Europe High-Speed Train Network.

4.3.2. Railways in Pan-European Transport Corridors

The ideal of the economically powerful single Europe which has been on the agenda of Europe since the 1950's, has obtained the character of a multi-aspect union with the Maastricht Summit in the year 1992. The developments in the transportation sub-systems which are one of the key sectors for the economic and social integrity are also evaluated and directed by the European Union with importance. In achievement of the economic development compatible with the environment, the European Union policies regarding the transportation sector is especially directed at developing the railway infrastructure. In assurance of the economic and social harmony and integration of the Old Eastern Block countries with the developed European countries, especially with the objective of developing the railway infrastructure, 10 Pan-Europe Multi-Mode Transport Corridors have been determined and the studies are carried on (Vakıfbank, 2001).

The Pan – European Transport Network consists of the following components (European Commission, 2002):

- The Trans – European Transport Network on the territory of the European Union (TEN);
- The TINA (Transport Infrastructure Needs Assessment) Network, which is composed of the ten corridors and the additional network components within the candidate countries for accession,
- The ten Pan – European Transport Corridors situated in the candidate countries for accession, in the NIS (New Independent States) and beyond;

- The four Pan – European Transport Areas (PETrAs) covering maritime areas; and
- The Euro – Asian Links, notably TRACECA (Transport Corridor Europe Caucas Asia).

The overview over the Pan – European Corridors are as the following:

Corridor I (Rail: 1,655 km; Road: 1,630 km): Tallinn – Riga – Kaunas – Warszawa

Corridor II (Rail: 2,313 km; Road: 2,200 km): Berlin – Warszawa – Minsk – Moscow – Niznij Novgorod

Corridor III (Rail: 1,650 km; Road: 1,700 km): Dresden – Wrocław – Lviv – Kiev

Corridor IV (Rail: 4,340 km; Road: 3,640 km): Dresden – Praha – Bratislava/Wien – Budapest – Arad

Corridor V (Rail: 3,270 km; Road: 2,850 km): Venezia – Trieste/Koper – Ljubljana – Budapest – Uzgorod – Lviv

Corridor VI (Rail: 1,800 km; Road: 1,880 km): Gdansk – Grudziadz/Warszawa – Katowice – Zilina

Corridor VII (2,415 km): Danube

Corridor VIII (Rail: 1,270 km; Road: 960 km): Durres – Tirana – Skopje – Sofia – Varna/Burgas

Corridor IX (Rail: 6,500 km; Road: 5,820 km): Helsinki – St. Petersburg – Pskov/Moscow – Kiev – Ljubasevka – Chisinau – Bucuresti – Alexandroupolis

Corridor X (Rail: 2,528 km; Road: 2,300 km): Salzburg – Ljubljana – Zagreb – Belgrade – Nis – Skopje – Veles – Thessaloniki

The map of Pan – European Transport Network is shown in Figure 4.2.

The initial goals of the European Union’s Trans-European Network program were supporting the internal market, furthering economic and social integration and aiding the formation of the "Single Europe"; nevertheless, the need to reach neighboring and even more distant countries was not forgotten. The term “Pan-European Transport Network” was later introduced to develop relationships with neighboring countries and increase

this effort's area of impact. Under the Pan-European concept, central and eastern European countries were included in an integrated European transport policy and began to form closer relationships. Next, the borders of the transport network area were enlarged to cover south-eastern European, Black Sea and Mediterranean countries. At the second Pan-European Transport Conference (Crete, March 1994), nine transport corridors were chosen to form a basis for future infrastructure projects in central and Eastern Europe and the CIS countries. Corridor IV (Berlin/Nuremberg, Prague, Budapest, Constanta / Thessaloniki-Istanbul) pertains to Turkey because of its Istanbul connection. At the third Pan-European Transport Conference (Helsinki, June 1997), Corridor X and its three branches were determined. One of the branches also involves Turkey. The area that EU transport policy covers is defined as reaching to the Black Sea and Central Asia via the pan-European corridors (Evren, 1998).



Figure 4.2 Map of 10-modes Pan – European Network (European Commission, 2001)

4.3.3. Railways in Europe-Asia Transport Corridors

The onset of the 21st century is being shaped by far-reaching, unprecedented changes in the world economy and in the interactions between countries and continents. The volume of international trade is growing sharply, driven in particular by countries in Asia. Annual gross domestic product increases in excess of 5%, and near 10%, for populations of more than a billion, as in China and India, are exerting a heretofore unknown “mass effect” on production and world trade.

In Europe, the economic growth of recent years has clearly not been as brisk, with recovery lagging behind while in 2003 numerous economic indicators had already started becoming much more favorable around the world, in Asia and America, and Russia was entering into a phase of sustained growth.

Against this backdrop, Europe too is undergoing profound change in its institutions, and following a phase of enlargement to the countries of Central Europe it is undertaking a policy of co-operation and outreach to its new neighboring countries in the Commonwealth of Independent States (CIS), Central Asia and the Mediterranean (ECMT, 2005).

The Second International Euro-Asian Conference on Transport, held in 2000 in St. Petersburg, identified the four Euro-Asian Land Transport Corridors presented to this Conference by United Nations Economic Commission for Europe (UNECE) and United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) as constituting the main backbone of the Euro-Asian Land Transport System. The four corridors adopted in 2000 are (United Nations Economic Commission for Europe [UN/ECE], 2004):

1) Transsiberian Corridor

The Transsiberian corridor is a connecting link between European countries and Asia- Pacific region countries. In 2000, 98,000 (20 foot) containers were transported

on the Transsiberian railway corridor. In the first quarter of 2003, the volume of container traffic was up by 75% compared to the same period of 2002. The rail corridor became an important two-track railway line, fully electrified, stretching about 10,000 km. Its technical capacity enables it to carry up to 100 million tones of goods per year and up to 140,000 20 foot containers (UN/ECE, 2004).

In order to promote further use of this transport link in international transport, the International Coordinating Council on Transsiberian Transportation was established in 1993 by more than 80 collective members, including the Ministry of Transport of the Russian Federation, the State Customs Committee of the Russian Federation, the railways of Belarus, Estonia, Finland, Germany, Hungary, Russian Federation, Kazakhstan, Poland, Slovakia, Mongolia, Latvia, Lithuania, Ukraine, and associations of freight forwarders from Europe, Japan, Republic of Korea and the Russian Federation. The main task of the Council is to enhance the competitiveness of the Transsiberian rail corridor by ensuring a stable, competitive transit time, security of cargo, competitive rates, etc.

2) *TRACECA (Transport Corridor Europe – Caucasus – Asia)*

The TRACEA (**T**ransport **C**orridor **E**urope–**C**aucasus–**A**sia) Program was initiated more than 10 years ago by the European Union (EU) as an additional route to the existing transport corridors and is a catalyst for transport infrastructure and economic development in involved countries. The program conforms to the global strategy of the European Union towards the TRACECA member countries (Armenia, Azerbaijan, Bulgaria, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Mongolia, Romania, Tajikistan, Turkmenistan, Turkey, Uzbekistan and Ukraine), and aims at assisting in political and economic sustainability, promoting regional cooperation and optimal integration of the international transport corridor Europe-Caucasus–Asia–TRACECA with Trans-European Networks (TENs).

Countries along this corridor have high regard for its strategic importance in the context of Euro-Asian transport links and consider it as complementary to

commercial exchanges between themselves and the Far East, with the possibility of the ancient Silk Route becoming once again a major trade corridor (UN/ECE, 2004).

When the TRACECA corridor is completed, a continuous railway line will follow part of the ancient Silk Road from the Chinese port of Lianyungang on the Yellow Sea to the Georgian ports of Poti and Batumi on the Black Sea and then on into Western Europe. A so-called “transport delta” is also planned to be created on the Georgian coast of the Black Sea with ferry connections to new ports at Supsa, Kulevi, Anaklia, Ochamchira and Sukhumi, linking the countries of the Commonwealth of Independent States (CIS) into a truly trans-Euro-Asian transport infrastructure.

At present, most trade between Europe and the Far East uses the maritime route through the Suez Canal into the Indian Ocean and then through the Malacca Strait. Land routes to Pakistan, India, Thailand, Cambodia and Vietnam are obstructed by natural barriers like the Himalayan Mountains, so most international trade with these countries is by sea as well although Pakistan and India have extensive rail networks. Almost all freight in Afghanistan is carried by trucks because there is not a functioning railway, but there are road links connecting with railways in Pakistan, Iran, Turkmenistan, and Uzbekistan. Iran is connected to Europe via ports on the Persian Gulf and by rail via Azerbaijan, the Russian Federation, Ukraine and Belarus. There is also a rail connection via Turkey but the two water barriers at the Bosphorus and Lake Van can only be passed by ferry. Most rail freight to the east travels via Poland, Belarus, and then through the Russian Federation from Moscow on the Transsiberian railway route.

This would seem a disadvantage compared to an average speed of 37 km/h for some freight trains on some potential TRACECA sections but the average speed of freight trains on long sections is just 12 km/h. Even on good freight lines in Western Europe, the average speed is only 14 km/h. To improve the competitive ability of rail, one aim of TRACECA is to rehabilitate existing track infrastructure to achieve an average speed of 30 km/h over long distances for loaded wagons, and 90 km/h for

empty wagons. One reason why average speeds are at the low levels is the long standing times at many customs posts and border crossings in the region. A more difficult problem to solve is the change of gauge between some countries, such as, for example, between Ukraine and the Russian Federation with Kazakhstan, Kazakhstan and China, and Azerbaijan and Iran. If these problems can be overcome, rail could be a more economic and faster mode of international freight transport than maritime transport, and a more ecologically-friendly means for carrying domestic freight than road transport.

3) *Southern Corridor*

This corridor connects South-eastern Europe through Turkey, the Islamic Republic of Iran and through Central Asia with China, and with South -South-East Asia. The detailed analysis of potentials of this corridor can be found in the UNESCAP study “Development of the Trans-Asian Railway–Trans-Asian Railway in the Southern Corridor of Asia-Europe routes” which distinguishes 3 particular routes of international significance in the corridor (UN/ECE, 2004).

The first (TAR-S1) starts in Kunming (China), crosses the territory of Myanmar, India, Bangladesh, Pakistan, the Islamic Republic of Iran and through Turkey and ends on the border with Bulgaria, at Kapikule. From Kunming to Kapikule the total length would be 11,700 km of which 84% of line is in place, 15% would need to be constructed mostly through difficult mountainous terrain, and 1% comprises ferry links. The total distance between Kunming and Frankfurt would be approximately 13,500 km, and between its eastern and western extremities this route would cross 7 national borders (with another 5 to be crossed west of Turkey).

The second route (TAR-S2) would start from Thailand, proceeding west or northwest to Myanmar and join the existing railway network of that country where it would connect with TAR-S1. Between Bangkok and Kapikule the total distance using route TAR-S2 would be 11,500 km, and between Bangkok and Frankfurt

13,200 km. This route would cross seven national borders with necessary inter-gauge transfers at four locations.

The third route (TAR-S3) would connect the landlocked Central Asian countries with Europe and South/Southeast Asia. The route would start from Sarakhs on the border between the Islamic Republic of Iran and Turkmenistan and would link Sarakhs with the border between Iran and Turkey at Razi. From Sarakhs, the route will go through Turkmenistan, Uzbekistan and Kazakhstan to Aktogai and then to the Druzba border crossing entering China and then following the direction to Urumqi, Lanzhou, Zhengzhou to either the Shenzhen port in the south or Beijing in the north or to the Chinese ports Shanghai, Lianyungang, etc. This route could also go northward from Aktogai and connect to the Transsiberian corridor at Omsk or Novosibirsk. From Sarakhs through Fariman, Bafq (or Tehran) and Sirjan this route also could provide a connection with the port of Bandar Abbas.

4) *Northern Corridor*

The North–South corridor is the shortest way connecting Europe with the Far and Middle East, the Indian Ocean and South-eastern Asia. The corridor stretches from ports in India across the Arabian Sea to the southern Iranian port of Bandar Abbas, where goods then transit Iran and the Caspian Sea to ports in the Russian Federation’s sector of the Caspian Sea. From there, the route stretches along the Volga River via Moscow to northern Europe. Analysts indicate that Indian cargo transported via this route has increased dramatically over the past year, reversing the dramatic decline of the 1990s. In the Soviet era, millions of tons per year of transit cargo passed from Europe to Iran via the USSR and between the USSR and India along this route. Small shipments of tea and tobacco first made their way to the Russian Federation from India through Iran in 2000. The Russian Federation exports mainly metals, timber, paper, machinery and chemicals to Iran, while Iran sends mainly foodstuffs, cars and buses to the Russian Federation. Experts believe that the volume of traffic on this corridor may reach 20-30 million tones of freight per year.

The revived route is expected to offer both quicker and cheaper transportation than the primary alternative—the shipment of goods from South Asia through the Suez Canal and the Mediterranean and then into the Atlantic and North Sea to Baltic ports. Russian analysts predict that delivery time using the North-South Corridor will be reduced anywhere from 10–20 days, and the cost per container will decrease by US\$ 400-US \$500. The opening of the Central Asian region and the new markets in the Indian Ocean and Persian Gulf area are very important for both the European and Asian continent. The route starts from the Indian Ocean (Bombay and other ports) and links it with Bandar Abbas through maritime transport. It then continues from Bandar Abbas to Northern Iranian ports on the Caspian Sea (Bandar Anzali and Bandar Amir Abad) through roads and railways and then goes on to Astrakhan and the Lagan ports in the Russian Federation. From the Russian Federation ports, freight will continue by road and rail to Moscow and St. Petersburg and from there to Scandinavia. Access to rail and the road network in Central Asia and the Russian Federation will be provided after completion of the Astara– Qazvin railway.

Among the other advantages of North–South Corridor is the existence of several potential crossings with other existing corridors between Central Asia and Europe including TRACECA which may provide good links between north-south and east-west freight flows (UN/ECE, 2004).

4.4.Combined Transport in European Union

The European Conference of Ministers of Transport adopted a declaration on combined transport at the Council session in Budapest on 29-30 May 1996 which read as follows (ECMT, 1998):

“At the European level, combined transport has to be understood as an individual mode of transport which makes maximum use of the advantages of the various modes of land transport and short sea shipping, choosing those modes most suitable. Combined transport thus implies the organization of intermodal door-to-door transport by transferring goods from one mode of transport to another without

changing the loading unit. To be more precise, combined transport is based on an Intermodal Transport Unit (ITU) in which the goods are transported from door to door by using the most adequate modes of transport:

- The road for the initial and terminal hauls only,
- Rail and/or inland motorways and/or short sea for the major part of the journey, the choice of modes depending on the itinerary, whereby the transfer between the different transport modes must be handled as efficiently as possible.”

Combined transport is an example for a rational network which combines the benefits of the various transport techniques and can be understood as a candidate for all evaluations or adaptations which help to improve the transport chain (ECMT, 1998).

The central goal of EU transport policy is sustainable mobility. The objective of the free movement of goods, people, services and capital, which has been the basic goal of the European Community from the outset, should be achieved at the least cost to society as a whole and in an environmentally-friendly way. To this end, the framework of the transport market needs to be modified in order to ensure that every transport mode handles only that transport which it can perform most efficiently. The Common Transport Policy endeavors to contribute to the elimination of the handicaps from which combined transport still suffers and to encourage users to choose combined transport (ECMT, 1998).

Transport volumes are rising in line with the growth of international trade in Europe; at the same time, some high-volume trade routes are developing. While most large international trade flows tend to be concentrated on certain routes and crossing points, this is not always the case. Some countries trade with neighboring countries via very many routes, all of them carrying only a small amount of total trade. For example, part of the trade between France and Germany, moves through very many small border crossing points. But in most cases, however, flows are more concentrated.

The concentration of traffic on certain routes lends itself particularly to combined transport. Combined transport creates efficiency gains by concentrating small loads such as truck loads into larger units such as block trains, inland waterway barges or coastal (container) ships. Larger units make possible savings on infrastructure use, operating costs and energy consumption, and are less polluting than multiple single units. For combined transport to be cost-effective and competitive, the savings must at least offset the costs of terminal transfer. The larger the volume of freight moved on a given route, the easier it is to concentrate loads. For this reason, large-scale European transport flows are conducive to the development of combined transport.

The main routes on which the volume of freight carried by combined transport is high or increasing rapidly are listed below, moving from Western Europe to Eastern Europe (ECMT, 1998):

- Britain (mainly from the Midlands and London metropolitan area) to Europe via the Channel Tunnel and Channel Ferries,
- The North – South axis in Western Europe,
- The United Kingdom, Netherlands, Belgium and France to Italy,
- Central Europe to Italy via Switzerland,
- Central Europe to Italy via Austria,
- Scandinavia to Central Europe via the Baltic,
- Belgium/Netherlands to the South – East via Cologne and Mannheim, then on to Switzerland and Italy, or via Cologne and Munich to Austria and South – East Europe,
- Central Europe via France to Spain and Portugal,
- Central Europe to Eastern Europe: Berlin – Warsaw – Moscow

Central Europe to South – East Europe: from western and northern Central Europe via the Czech Republic, and from southern Central Europe via Austria and Hungary to Romania, Bulgaria, Turkey and Greece.

4.5.Summary

In this chapter, we see that European Union has started to attach importance to railway transport as a result of increasing trend in road transport. Therefore, some transport programs about railways has started to be supported by European Union. In addition, determined objectives in the transport sector are devoted to develop the railway transport in European Union. After investigating the transport developments in European Union, we will discuss the railway transport sector and transport potential of Turkey in the following chapters. First, we will mention about the development of railway transport.

CHAPTER FIVE

RAILWAY NETWORK, RAILWAY TRANSPORT SYSTEM AND PROBLEMS OF RAILWAYS IN TURKEY

In Turkey, railway and motorway policies have been the most controversial subjects since 1950's. In the years of foundation of Republic of Turkey, building railways in the country constituted the base of policy. In 1950's, radical changes were made in this policy, and a policy accepting the motorway transport as the base axle started to be followed. In 1980's, highway investments started to be made. In 1970's, some changes in this policy attempted to be made such as development of infrastructure and building new railway lines, we can even say that some projects were started; but it is known that such tendencies, especially building new line projects were postponed (Devlet Planlama Teşkilatı [DPT], 2001). On the other hand, in transport policies of West Europe and the Far East, operations were accelerated about the development of railways. In these operations, especially, on account of Turkey's geopolitical importance, there has been a relation between Europe and Asia like a bridge (Küçükavcu & Cakmakçı, 2005). Turkey, which accepted the railway transport as a choice of countries outside market economy in 1980's, should at least decide what to do today. Railway infrastructure of Turkey reflects underdeveloped technology, and a development in the perspective of a master plan including the replacement of railway infrastructure in the base of modern technology might be a milestone for Turkish economy (DPT, 2001).

5.1. The Historical Development of Turkish Railways

The first railway in Turkey had been constructed between Izmir – Aydın under the privilege granted to an English Company in 1856. The construction of the total of 130 km line had been completed in 1866.

Izmir – Turgutlu – Afyon line section and 98 km of Manisa – Bandırma line section constructed by another privileged English Company had been put into service

in 1865. The remaining parts of the line had been completed in the subsequent years. Construction privilege of 2,000 km Orient Railways had been granted to Baron Hirsch in 1869. Istanbul – Edirne and Kırklareli – Alpullu line sections which remained within the national borders having length of 336 km had been completed and given into service in 1888, so Istanbul had been linked to Europe.

Railways envisaged to be constructed in Anatolia had been planned to be carried out by own means of the State. Construction of Haydarpaşa-Izmit line had been started by a command published in 1871 and 91 km of this line had been completed in 1873. But later on, the construction of Anatolian Railways, as well as Baghdad and Southern Railways, had been realized by German Funds.

In this regard 4,000 km. of railway lines had been constructed and operated by various foreign companies before the Republic period, remained within the national borders by the declaration of the Republic.

Before the Republic term, railway transport serviced for foreign economies and political self-interests in the control of foreign companies because of the privilege given to them. After the Republic term, the railway transport was built for national self-interests and it is aimed to create a concept for “national economy” and to activate the country’s resources. The clear characteristic of this term is that main industries such as iron-steel, coal and machine are taken priorities in the 1st and 2nd Five-Year Industrialization Plans made in 1932 and 1936. Railway investments were featured in order to transport this kind of mass freight at the minimum cost. Therefore, railway lines were orientated to national resources and they got an effective role for the spread process of industry to the country and determining the facilities. In this term, despite all negative conditions, building and operating of railways were managed by national power (Türkiye Cumhuriyeti Devlet Demiryolları [TCDD], n.d).

After 1950, as a result of conditions and country’s economic possibilities, because of not providing a stable resource distribution between railways and roads, two main

transport systems, which completed each other in the transport sector and, on the other hand, since railway investments which should have been made parallel with developing railway technology required great financial resource, projects of improving and modernization of railway system were slow down. After that, railways partially continued modernization works together with keeping the function of the present system and providing continuity of traffic with limited possibilities (DPT, 2001).

In the second half of the 19th century, while England, Germany and France which had the most advanced railway technology in European countries were effective on the taking shape of Ottoman Railways, the USA which had the most modern automotive industry in the world was effective on constituting of road network of Turkish Republic at the end of 1940s. After the Second World War, the USA industries started to produce work machines instead of tanks and they had to sell them. The USA internally started to experience roads and airways instead of railways rapidly with a strategic decision. Expanding of the automotive industry in Detroit, the relationship of fuel companies with this system and moving of the biggest companies to this group caused to increase their political effects and it was the expansion term to the world markets. Marshall Assistancess for Turkey had a situation in point of passing to road transport (Kaynak, 2002).

After the planned development terms of 1960, the anticipated objectives for railways have never reached. In these plans, although it was aimed to provide coordination among transport sub-systems, characteristics of pre-plan term continued, the coordination among transport sub-systems have never been provided, and investments for roads have kept their weight throughout all plans term. In all plans, despite investments, re-arrangements and modernization projects for railways were adopted to concentrate to meet the increasing demand of industries in time, they have never been performed. As a result of these policies, only 30 km average of new railway line has been able to be built yearly between 1950 and 1980.

In middle of 1980s, the building of road network was accelerated in our country. Motorways were accepted as the third main project after GAP (Güney Anadolu Projesi – South Anatolian Project) and tourism. In this perspective, it had been invested \$ 2 billion yearly in motorways until the middle of 1990s. On the other hand, it can be seen that any investments for railway infrastructure projects haven't been applied. The most of present railway network have been obliged to the geometry which was built in the beginning of this century.

Finally, after the transport policies which were road weighted in 1950s, the length of road network was increased by 80% while the length of railway network was increased by just 11 %. For the share of transport investments, railway transport was taken a 30 % share and road transport was taken a 50 % share. After 1985, the investment share of railway transport has been under 10 %. As a result of these transport policies, the transport system of Turkey has been mostly based on a single system (TCDD, n.d).

5.2.The Position of Railways within Other Transport Systems in Turkey

Failing to realize the physical infrastructures of railway and sea transport in conformity with the increasing transport demand on time and the most convenient mode of transport for door-to-door transportation being the land transportation has led to freight and passenger transport to be mainly loaded on the overland network. Even if long-term planning is made, the increasing transport demand causes the restricted resources to be allocated to land route improvement and construction investments with short-term concerns. The competitive power of the railways operated on an old infrastructure is decreasing every passing day. Consequently, the restricted resource, wrongly based overland emphasized structure and continuously increasing demand has created a negative system which feeds itself (DPT, 2006).

Turkey has a very important potential when we think about the geopolitical position of it between Europe and Asia. Turkey which has a strategic importance as a bridge between Europe and Asia has 63,706 km road network totally, 1,892 km

motorways and 61,814 km state highways and provincial roads while the length of railway network is just 8,697 km in the year of 2004 (See Table 5.1). As reported in Table 5.1, the length of railway network is stable in the last nearly 25 years. Road network started to extend after 1990s especially because of the motorway investments. While the length of state highways and provincial roads followed a stable trend, motorway length increased year by year.

In Turkey, while the share of road freight transport was 87 %, this share increased to %94 in 2004. Otherwise, the share of railway freight transport was 12 % in 1980 and 16 % in 1985 while it was % 5 in 2004. This decrease in railway freight transport can also be seen in Figure 5.1.

In the event that the growth trends in the past 25 years last, it may be expected that in the year 2020, the passenger traffic in Turkey shall escalate to approximately 3.3 times (540 Million Passengers/km) from the 164 million passengers/km level of today and freight traffic to 2.5 times (300 Million Tons/Km) from 120 million tons/km. Meeting the transportation demand which shows a continuous increasing trend in Turkey by overland is not an endurable policy. In order for the increasing transportation demand to be met, the railway network should be expanded.

Table 5.1 Lengths of roads and railways (km) (Karayolları Genel Müdürlüğü [KGM] & Türkiye Cumhuriyeti Devlet Demiryolları [TCDD])

Years	State Highways and Provincial Roads	Share (%)	Motorways	Share (%)	Main Line Railway	Share (%)
1980	60,761	87.82	27	0.03	8,397	12.15
1985	59,302	87.49	81	0.12	8,400	12.39
1990	59,128	87.16	281	0.41	8,429	12.43
1991	59,221	87.04	387	0.57	8,429	12.39
1992	59,842	86.69	757	1.10	8,430	12.21
1993	59,770	86.29	1,070	1.54	8,430	12.17
1994	59,832	86.15	1,167	1.68	8,452	12.17
1995	59,999	86.08	1,246	1.79	8,459	12.13
1996	60,225	85.61	1,514	2.15	8,607	12.24
1997	60,836	85.72	1,528	2.15	8,607	12.13
1998	60,885	85.49	1,726	2.42	8,607	12.09
1999	60,923	85.38	1,749	2.45	8,682	12.17
2000	61,090	85.40	1,774	2.48	8,671	12.12
2001	61,305	85.35	1,851	2.58	8,671	12.07
2002	61,368	85.36	1,851	2.57	8,671	12.07
2003	61,491	85.31	1,892	2.62	8,697	12.07
2004	61,814	85.37	1,892	2.61	8,697	12.02

In Turkey, railways have been neglected for years seriously. The concrete indicator of this negligence is that enough resources haven't been supplied for railways for years. As reported in Table 5.2, road transport investment has got much share than railways in all Five-Year Development Plans. It can also be seen that actual share has never covered the planning share for railway investments. The actual share has always been taken part under the planning share.

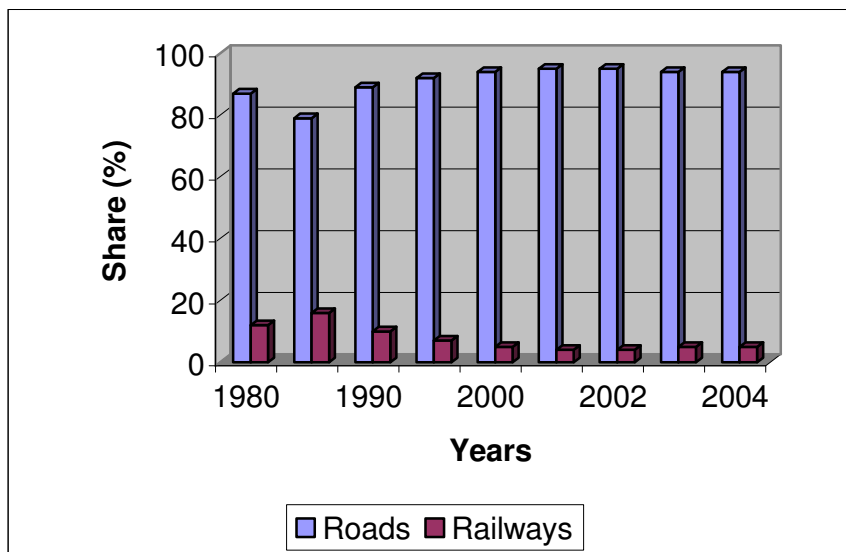


Figure 5.1 Share of freight transport for roads and railways (DPT, 2006)

The distribution of investments in Table 5.2 is the indicator of recession of railways. In addition, in the view of policies which are not enough to solve the transport problems, road transport mode is preferred in the transport sector.

Table 5.2 Planned and actual capital investment for transport systems (%) (Kaynak, 2002)

		Roads	Railways	Other
I. FYDP	Planned	71.2	17.5	11.3
	Actual	71.2	17.5	11.3
II. FYDP	Planned	72.7	18.8	8.5
	Actual	72.7	18.8	8.5
III. FYDP	Planned	52.0	22.4	25.6
	Actual	74.6	13.9	11.4
IV. FYDP	Planned	60.7	24.6	14.7
	Actual	74.6	10.6	14.8
V. FYDP	Planned	49.2	21.9	28.9
	Actual	43.3	16.0	40.7
VI. FYDP	Planned	78.9	8.5	12.6
	Actual	82.7	7.2	10.1
VII. FYDP	Planned	68.6	7.8	23.6
	Actual	68.0	7.5	24.5

FYDP: Five-Year Development Plan

The railway alternative which must be used mostly is not used enough except for some freight types which railways have natural advantages on. In passenger transport, long travel time and low safety cause insufficient demand (DPT, 2006).

5.3.Problems of Railway Sector in Turkey

The sector authorities have stated that the errors and differentiations in the transportation policies underlie behind the significant fall that the market share of the railways show as of years. After 1950's, sufficient railways could not be built in parallel to the developments in the country, the low physical and geometric standards of the existing ones could not be sufficiently improved, an operation which can comply with the developments in the market could not be realized.

On one hand, the inferiority of the geometric and physical standards of the available railway network built by the technology of the beginning of the 20th century and single line operation create problems which makes contemporary operation impossible, and on the other hand, since the sufficient quantity of railways were not built in parallel to the progresses because of the transportation policies after the 1950's, satisfactory service according to the dimensions of the country and population intensity cannot be produced with the available railway network (DPT, 2001).

According to the authorities, outside the problems originating from the errors in transportation policies, the railways have also some problems born from the managerial gap in maintaining the coordination, the insufficiencies in the management and organization structure, qualified labor and training problems, financing bottleneck and shortage of investments. For the solution of the problems, first of all, the started restructuring studies should be finalized and the Railways Law should be published. The personnel problem which is one of the most important should be solved in the context of restructuring studies in a way to include also the employment of the qualified employees needed and the personnel being subject to a serious training. The elimination of the financing bottleneck should also be solved

together with the restructuring. Also, to shed a light on the decisions, the development of the management-informatics system and the data systems which will allow the monitoring of the wagons/trains is a prerequisite. Moreover, the modernization of the railway network and formation of an optimum network which shall unite the major centers of Turkey with a standard at the European level is necessary in the first quarter of the 21st century.

5.4.The Goals of Turkish Railways

The main objective is the development of the railways which support the national recovery most efficiently to provide possibility for harmony with the international developments and at the same time, within the direction to fulfill the functions commissioned to it in formation of a transformation system with the cheapest cost to the country covering all exterior effects by acquiring a contemporary quality both in technical and economic aspects (DPT, 2001).

The short-term objective is the evaluation of the available facilities to meet the demand which cannot be responded to because of the problems like qualified active personnel shortage, wagon insufficiency which can be solved in short time and the expected potential demand to be activated and the necessary precautions to be taken to that effect. On the other hand, during this period, the structural transformations required by the long-term goals and preparatory studies of the legal arrangements should be made.

The long-term objective is to contribute to the domestic transportations by contemporary conditions with the determined application of the dynamic and flexible plans which will be prepared without delay and realization of the required plans and actions to ensure harmony and integration with the EU railway network and EU criteria.

5.5.Summary

In this chapter, we gave information about the historical development of Turkish railways and evaluated the position of railway system within other transport modes. We also mentioned about the problems and objectives of Turkish railway sector. In the view of transport developments and programs discussed before, we will evaluate the position of Turkish transport system, especially railways in relationship with European Union in the following chapter.

CHAPTER SIX

THE PROSPECT OF RAILWAYS IN TURKEY FOR ACCESSION TO EUROPEAN UNION

Keeping in mind the economic role of Asia in the 21st century it is obvious that a great deal of activities should be carried out for the countries of the region. Planning the necessary links between Asia and Europe and facilitation of transit transport, especially for the Asian countries, is an important priority. For this reason, Turkey participates in and supports the prominent projects in the region in order to contribute to the developing volume of trade between Asia and Europe (Kutlu, 2003).

6.1.The Position of Turkey in Euro – Asian Railways

Turkey's geopolitical position as a link between the East and the West makes the transport sector crucial for the economic development of the region. Turkey is a major player both as a transit country and as an origin and destination of freight. Turkey's expectations with regard to EU accession and the growing role of Turkey in trade between Central Asia and the South Caucasus make the focus on transport even more important (Kutlu, 2003).

Turkey is at the cross-roads of existing and planned multimodal intercontinental transportation links. It is at the epicenter of road, railway, maritime, inland waterways and air transportation interconnecting Europe, Caucasus, Central Asia, Northern Africa and the Middle East. Creating an efficient and cost effective outlet to major markets, Turkey is a key transportation terminal at a point of regional and international convergence (Deveci, Cerit & Tuna, 2002).

Besides corridor 4 (Berlin / Nurnberg - Praha - Budapest - Constanta / Thessaloniki / Istanbul), several other priority road and railway corridors within the *Pan- European Transportation System* involves Turkey through corridor 4 to Istanbul. This system aims to develop a Europe-wide transport policy based on coordinated infrastructure development, harmonization of national transport

regulations, border crossing facilitation and an expanded research effort. Turkey is also the eastern gateway of *Trans-European Networks (TENs)* particularly designed for European Union members and included in one of the four *Pan-European Transportation Areas (PETRAs)*.

European transport network, in the process of integration with the West European transport system via Pan-European Transport Corridors and Areas, is in search of new transport connection projects towards Asia where new markets emerge. The most prominent of such projects is the TRACECA Program. TRACECA, which was originally designed to connect Europe and Asia through East and West Black Sea ports via Caucasasia and Caspian, diversified its modes and routes of transport with the participation of Turkey. This project constitutes a considerable part of the historical Silk Road and Turkey planned significant infrastructure projects on this route as one of its 12 members. TRACECA is a development program supported by the European Union and intensive studies are carried out in order to further develop this corridor (Kutlu, 2003). The suggested map for TRACECA corridor after the membership of Turkey is shown in Figure 6.1.

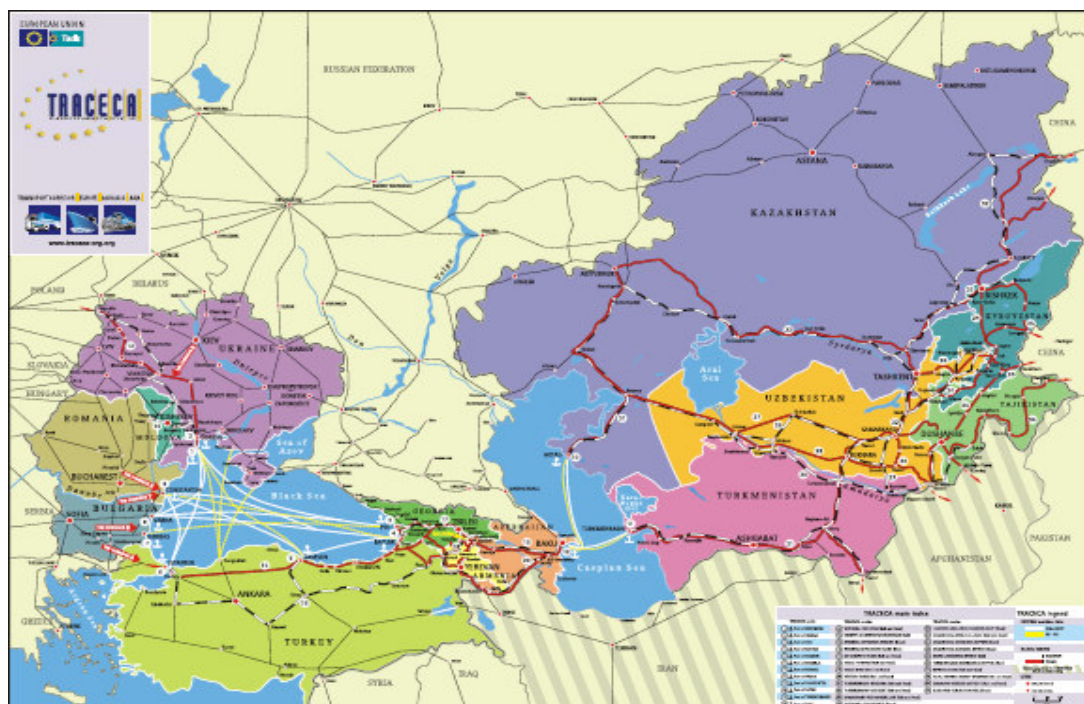


Figure 6.1 Map for TRACECA corridor after the membership of Turkey (<http://www.traceca.org/>)

6.2. The Old Silk Road

The old Silk Road was a historical trade route (with its zenith in the 7 – 9th century) linking Asia and Europe that changed the nature of commerce in the medieval and renaissance world (Rupel, Timmers, Pinder, Gotschlich, Czyzowicz, Lakshminarayanan & Chereskin, 2004). In essence, the Silk Road was a network that enabled the exchange of a wide variety of goods including silk, precious stones, and even rhubarb, as well as information. The old Silk Road is little more than histories now although the cities and countries spread out across the old networks have not entirely disappeared (Vogel, Davison, Gricar, Harris & Sorrentino, 2003).

The building of deep seaports and receiving terminals in the Mediterranean and the Black Sea, construction of a rail tube tunnel crossing through the Straits of Istanbul, building of a transcontinental bridge over the Dardanelles, completion of the Kars-Tbilisi railway (as a complementary part of TRACECA), as well as the production and trade centers in Anatolia, will position Turkey in 2010 and 2020 at the regional and intercontinental control panel of multimodal transportation (Deveci et al., 2002).

Consequently Turkey, envisaged as an energy bridge and terminal of the future, also forms the transportations backbone of three major continents in a fashion reminiscent of the historical silk route for the 21st century.

6.3. Transport Projects of Turkey Related to Euro – Asia Transport Corridors

Construction of the Bosphorus Strait Tunnel Crossing: The 4.5 km ferry crossing of Bosphorus Strait between Haydarpasa Station on the Anatolian side and Sirkeci Station on the European side undoubtedly creates delays which are disproportionate to its length, given that two hours are required to marshal and re-marshal trains either side of the strait. A tunnel crossing of the strait has been mooted for many years, but the scale of the Works and associated costs has been considered prohibitive by successive governments. The latest cost estimate for a twin track tunnel and

associated above ground connecting lines of 13.3 km length is US\$ 766 million (UN/ESCAP, 1999). It will not only provide an uninterrupted connection for railway transportation between Europe and Asia but also join the Pan-European Corridor IV ending in Istanbul to TRACECA, BSEC, ECO and ESCAP Networks.

Construction of the Lake Van By-pass Line: With the proposed Bosphorus Tunnel, completion of a new line of 237 km length around the northern side of Lake Van would provide a continuous railway line within Turkey for Trans – Asia transport corridor. The current ferry crossing of Lake Van typically imposes delays to through trains of up to 9 hours (5 hours for the ferry trip and 2 hours at either side of the lake for train assembly/disassembly). When the number of rail vehicles arriving at the ferry terminals exceeds 80 (the number which can be accommodated on the ferry deck), goods are sent by road. The cost of this project has been estimated at US\$ 500 million.

Ankara – Istanbul Rehabilitation Project: This project has been proposed primarily to halve the running times of passenger trains between Ankara and Gebze by realigning the sections containing the sharpest curves in order to accommodate maximum passenger speeds of 200 km per hour. The project should also permit an increase in freight train speeds (and hence in line capacity). Its construction has been estimated at US\$ 237 million (United Nations Economic and Social Commission for Asia and the Pacific [UN/ESCAP], 1999).

Kars – Tbilisi Railway Project: Kars - Tbilisi Railway Project will ensure a direct railway connection between Turkey and Georgia which is the missing link of the East-West railway connection. Ministry of Transport is in charge of coordinating the feasibility studies and construction.

This new 68 km line forms the major part of a 98 km rail connection project between Kars and Georgian capital Tbilisi. The connection of the railway networks of two countries will facilitate international railway transportation between Europe, the Caucuses, and the Central Asia Countries by the shortest route, where the most

important petroleum-natural gas reservoir of the world is found. Upon its completion, the project will connect China, Mongolia, Central Asian Independent States and Caucasian Countries to the Mediterranean and to Europe over the shortest possible route through Turkey.

6.4. Transport Potential of Turkey

Turkey, as of the properties it carries at both strategic and geopolitical aspects, is a country which is obliged to increase its authority in its region every passing day. The proximity to the Middle East and Caspian petroleum in geographic and economic respects, relationships with the Turkic Republics, connections with the natural resource rich Caucasian and common cultural past, its being in the intersection point of the transportation ways of the Mediterranean region, in short, its being located on the intersection point of the axis of the east-west and north-south, shows that Turkey carries the potential of being a regional power (Kaynak, 2003).

From the perspective of Turkey which wants to have the authority to comment in international transportation and regional transport, the realization of the investment projects inside our country which shall shorten the East-West corridor extending from Europe to China and Far East also carries great importance. The development and acceleration of the railways in Turkey is obligatory at the aspect of obtaining a share from the international transportation occurring in its environs or increasing the share it takes as well as in respect of domestic transport. In order for Turkey which is a party to many international agreements and has gained candidacy status to the European Union, to have the authority to comment on international transportation occurring around it, its realization of the investment projects which shorten the international routes especially in railways and elimination of the existing infrastructural deficiencies in shortest time carries great importance. The time lost on this subject, shall lead to the assimilation of the alternative routes and Turkey's remaining outside the Europe-Asia transport for which it has a great potential (Kaynak, 2002).

According to the European Council of Ministers planning, Europe will achieve a high-speed railway network in 30.000 km length in the year 2015. This network is envisioned to be connected to Turkey over two separate corridors. Within Turkey, the extension of this line towards the east and south-east via Border-Istanbul-Ankara-Sivas, to be the main axis in character of being the backbone of our railways shall come into the agenda. At the same time, this line shall gain a special importance for being on the Europe-Asia transit passage (See Figure 6.2). 9 of the 14 projects planned within the scope of TEN Project are related with railways. It is obligatory for Turkey to keep up with the developments in the EU. Since the fulfillment of the EU transportation policies, formation of a sufficient railway network in EU conditions and being involved on its link with Asia shall gain importance for our country in the context of harmony with the EU, all kinds of efforts on this subject should be carried out on time and with priority (TÜBİTAK, 2003).



Figure 6.2 Map for railway network of Turkey (<http://www.trainsofturkey.com/maps.htm>)

6.5.Summary

In this chapter, we evaluated the position of Turkish transport system in Europe – Asia transport corridors. We especially mentioned the importance of railways. We dealt with the important projects about railways related to Euro – Asia transport corridors. We also evaluate the transport potential of Turkey for accession to European Union.

The main purpose of this study is to forecast the level of road freight transport up to the year of 2015 in order to investigate the modal shift from road transport to railway transport. The aim of forecast is to analyze the development of increasing road freight transport in Turkey. In the next chapter, we will apply to a forecasting model in order to make predictions about the level of road freight transport in the future.

CHAPTER SEVEN

A MODEL SUGGESTION FOR PROBLEMS RELATED TO RAILWAYS IN TURKEY

In Turkey, road transport takes the market share of railway transport in passenger and freight transport. In the past 25 years, the market share of road transport has always increased while the share of railway transport has been decreased. Meeting the transport demand of Turkey with roads is not the right and continuous policy. In this chapter, we forecast road freight transport mobility of Turkey up to the year of 2015 in order to investigate the modal shift from roads to railways. The aim of forecast is to determine the development of road freight transport and investigate whether an alternative transport mode in the perspective of the level of road freight transport. The forecast is based on the annual data of the level of road freight transport and the macro economical factors which can effect the development of road freight transport. We use the annual data of the level of road freight transport from 1983 to 2004. We also investigate a statistical relationship among the factors effecting road freight transport and between these factors and road freight transport. We use statistical methods of “Multiple Regression Analysis” and “Trend Analysis” for forecasting. We use statistical program of MINITAB 14 to do this.

7.1. Multiple Regression Analysis

Many regression problems involve more than one regressor variable. Such models are called multiple regression models. Multiple regression model is one of the most widely used statistical techniques. In general, the dependent variable or response y may be related to k independent variables. The model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k + \varepsilon$$

is called a multiple linear regression model with k independent variables. The parameters $\beta_j, j = 0, 1, \dots, k$, are called the regression coefficients. The parameter β_j represents the expected change in response y per unit change in x_j when all the

remaining independent variables $x_i (i \neq j)$ are held constant. The parameters $\beta_j, j = 1, 2, \dots, k$ are often called partial regression coefficients, because they describe the partial effect of one independent variable when the other independent variables in the model are held constant (Hines, Montgomery, 1990).

Multiple linear regression models are often used as approximating functions. That is, the true functional relationship between y and $x_1, x_2, \dots, x_k$ is unknown, but over certain ranges of the independent variables the linear regression model an adequate approximation.

This research analyzes the data collected from 1983 to 2004 road freight transport (billion / km.). In our model, the dependent variable, y , are the level of road freight transport. The factors (independent variables), x , which affect road freight transport are given below:

- GDP – Gross Domestic Products (Billion \$)
- Total Exports & Imports (billion \$)
- Population (million)
- Production Index
- Total number of trucks
- Road transport policy
- Turkey's national environment policy

Let us give the definitions of these factors below:

GDP: It is the total value of goods and services produced by a nation.

Total Exports & Imports: It shows the total value of goods exported and imported in billion dollars.

Population: It shows the total number of inhabitants living in Turkey.

Production Index: It is a ratio of reporting-year production to the prior reporting-year production. The index is calculated to most closely reflect activities.

Total Number of Trucks: It shows the total number of trucks on Turkey roads. It includes private, commercial, official and municipal trucks

Road Transport Policy: It is a qualitative factor here. When applied policies in the transport sector affect road transport positively, this variable gets the value of 1. Otherwise, it gets the value of 0.

Turkey's National Environment Policy: It is another qualitative factor. When the national environment policy in Turkey is in road transport's favor, it gets the value of 1. Otherwise, it gets the value of 0.

In Table 7.1, the level of road freight transport (dependent variables) and the factors (independent variables) from 1983 to 2004 are given.

Table 7.1 Road freight transport with the factors from 1983 to 2004 (Devlet İstatistik Enstitüsü [DİE])

YEARS	ROAD FREIGHT TRANSPORT (BILLION TONE-KM)	GDP (BILLION \$)	TOTAL EXPORTS & IMPORTS (BILLION \$)	POPULATION (MILLION)	PRODUCTION INDEX	TOTAL NUMBER OF TRUCKS	ROAD TRANSPORT POLICY	TURKEY'S NATIONAL ENVIRONMENT POLICY
1983	42.19	142.40	14.90	47.86	76.20	190,277	0	0
1984	43.88	157.70	17.80	49.07	84.50	197,721	0	0
1985	45.63	169.40	19.30	50.31	89.50	205,496	0	0
1986	48.46	185.40	18.50	51.43	100.00	217,111	0	0
1987	58.83	208.50	24.40	52.56	110.50	225,872	0	0
1988	62.48	220.30	26.00	53.72	112.30	234,166	0	0
1989	66.42	229.20	27.40	54.89	116.40	241,392	0	0
1990	65.71	260.10	35.30	56.15	127.40	257,353	0	0
1991	61.97	171.70	34.60	57.26	130.70	273,409	0	0
1992	67.70	294.60	37.60	58.37	137.40	287,160	0	0
1993	97.84	325.60	44.70	59.49	108.20	305,511	1	0
1994	95.02	314.30	41.40	60.61	101.50	313,771	1	0
1995	112.52	343.80	57.30	61.73	114.30	321,421	1	1
1996	135.78	375.80	66.80	62.87	122.90	333,269	1	1
1997	139.79	406.00	74.80	64.02	137.10	353,586	1	1
1998	152.21	421.00	72.90	65.16	139.50	371,163	1	1
1999	150.97	403.70	67.30	66.29	135.00	378,967	1	1
2000	161.55	459.80	82.30	67.42	141.40	394,283	1	1
2001	151.42	420.90	72.70	68.53	132.40	396,493	1	1
2002	150.91	453.90	87.10	69.63	141.40	399,025	1	1
2003	152.16	492.90	116.60	70.71	150.40	405,034	1	1
2004	156.85	551.90	160.60	71.79	161.40	647,295	1	1

Firstly, we try to find a statistical relationship among the variables and between the variables and road freight transport. In statistics, correlation coefficient is used to do this. The Pearson product moment coefficient of correlation r is a measure of the strength of the linear relationship between two variables (Neter, Kutner, Nachtsheim & Wasserman, 1996). The Pearson Correlation is to test for a linear relationship between two quantitative variables. It is important to remember that Pearson's correlation only provides information about the direction and strength of the linear relationship between the two variables. If the research hypothesis involves some other pattern of relationship (i.e., curvilinear), then some other statistical analysis will be necessary. Fortunately, researchers are usually interested in linear relationships between variables, so this is a very useful statistical test. The Pearson correlation matrix is given in Table 7.2.

The Pearson correlation coefficient can take values from -1 to +1. A value of +1 show that the variables are perfectly linear related by an increasing relationship, a value of -1 show that the variables are perfectly linear related by an decreasing relationship, and a value of 0 show that the variables are not linear related by each other. There is considered a strong correlation if the correlation coefficient is greater than 0.8 and a weak correlation if the correlation coefficient is less than 0.5. The coefficient of determination (or r squared) gives information about the proportion of variation in the dependent variable which might be considered as being associated with the variation in the independent variable.

Spearman's correlation is a non-parametric test for the strength of the relationship between pairs of variables. Spearman's correlation does not need interval or ratio scale data (Cakmakci, Kucukavcu and Demirel, 2006). Road transport policy and Turkey's national environment policy data are nominal scale, so the Spearman's correlation matrix is given in Table 7.3.

Spearman's correlation is satisfactory for testing the null hypothesis of no relationship, but is difficult to interpret as a measure of the strength of the relationship.

Table 7.2 Pearson correlation coefficients

$\begin{matrix} r \\ \text{p-value} \end{matrix}$	Road Freight	GDP	Total Export & Import	Population	Production Index	Total No. of Trucks
Road Freight	1.00000	0.96277	0.86374	0.96009	0.77708	0.85030
GDP	(0.000)	1.00000	0.93546	0.97250	0.83266	0.91976
Total Export & Import	(0.000)	(0.000)	1.00000	0.90882	0.82509	0.96977
Population	(0.000)	(0.000)	(0.000)	1.00000	0.86921	0.90425
Production Index	(0.000)	(0.000)	(0.000)	(0.000)	1.00000	0.81710
Total No. of Trucks	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	1.00000

Table 7.3 The Spearman's correlation coefficient

$\begin{matrix} r \\ \text{p-value} \end{matrix}$	Road Freight	Road Transport Policy	Turkey's National Environment Policy
Road Freight	1.00000	0.863	0.863
Road Transport Policy	(0.000)	1.00000	0.833
Turkey's National Environment Policy	(0.000)	(0.000)	1.00000

According to Table 7.2 and 7.3, all correlation coefficients are very high. Road freight transport and GDP are very highly correlated ($r=0.96277$) and the correlation coefficient is significant ($p=0.000 < \alpha = 0.05$). Road freight transport and the other factors correlation coefficients are significant. On the other hand the factors are highly correlated with each other. GDP and population are very highly correlated. The correlation coefficient $r=0.97250$ and it is significant ($p=0.000 < \alpha = 0.05$).

Here, we confront a multicollinearity problem. In most multiple regression problems, the independent or regressor variables, x , are intercorrelated. In situations which this intercorrelation is very large, we say that multicollinearity exists (Cakmakci, Kucukavcu and Demirel, 2006). Multicollinearity can have serious effects on the estimates of the regression coefficients and on the general applicability of the estimated model. If multicollinearity is near (less than perfect), the regression

coefficients although determinate, possess large standard errors (in relation to the coefficients themselves), which means the coefficients cannot be estimated with great precision or accuracy. For this reason, multiple linear regression model is not contained all the factors.

An important problem in many applications of regression analysis is the selection of the set of independent or regressor variables to be used in the model. Usually, the problem consists of selecting an appropriate set of regressor from a set that quite likely includes all the important variables, but we are sure that not all these candidate variables are necessary to adequately model the response y .

In such a situation, we are interested in screening the candidate variables to obtain a regression model that contains the “best” subset of regressor variables. We would like for the final model to contain enough regressor variables so that in the intended use of the model (prediction, for example) it will perform satisfactorily. On the other hand, to keep model maintenance costs to a minimum, we would like the model to use as few regressor variables as possible. The compromise between these conflicting objectives is often called finding the “best” regression equation. A great deal of judgment and experience with the system being modeled is usually necessary to select an appropriate set of independent variables for a regression equation (Hines and Montgomery, 1990).

“All Possible Regressions” approach requires that the analyst fit all the regression equations involving one candidate variable, all regression equation involving two candidate variables, and so on. Then these equations are evaluated according to some suitable criteria to select the “best” regression model. If there are k candidate variables, there are 2^k total equations to be examined.

There are a number of criteria that may be used for evaluating and comparing the different regression models obtained. Perhaps the most commonly used criterion is based on the coefficient of multiple determination. Let's R^2 denote the coefficient of determination for a regression model with p terms, that is $p - 1$ candidate variables

and an intercept term (note that $p \leq k + 1$). R^2 increases as p increases and is a maximum when $p = k + 1$. Therefore, the analyst uses this criterion by adding variables to the model up to the point where an additional variable is not useful in that it gives only a small increase in R^2 .

A second criterion is to consider the mean square error (MS_E) for the p -variable equation. Generally, MS_E decreases as p increases, but this is not necessarily so. If the addition of a variable to the model with $p - 1$ terms does not reduce the error sum of squares in the new p term model by an amount equal to the error mean square in the old $p - 1$ term model, MS_E will increase, because of the loss of one degree of freedom for error. Therefore, a logical criterion is to select p as the value that minimizes MS_E , or since MS_E is usually relatively flat in the vicinity of the minimum, we could choose p such that adding more variables to the model produces only very small reductions in MS_E .

A third criterion is the C_p statistic, which is a measure of the total mean square error for the regression model. The values of C_p for each regression model under consideration should be plotted against p . The regression equations that have negligible bias will have values of C_p that fall near line $C_p = p$, while those with significant bias will have values of C_p that plot above this line. One then chooses as the “best” regression equation either a model with minimum C_p or a model with a slightly larger C_p that does not contain as much bias (i.e., $C_p \cong p$) as the minimum.

Another criterion is based on a modification of R^2 that accounts for the number of variables in the model. This statistic is called adjusted R^2 . The experimenter would usually select the regression model that has the maximum value of adjusted R^2 . However, it should be noted that this is equivalent to the model minimizes MS_E .

All possible regressions tables for our data with qualitative and without qualitative factors are shown in Table 7.4 and 7.5. In these tables, x_1 , x_2 , x_3 , x_4 , x_5 , x_6 , x_7 denotes to the factors of GDP, Total Exports & Imports, Population, Production Index, Total Number of Trucks, Road Transport Policy and National Environment Policy, respectively.

When we compare Table 6.4 and Table 6.5, lower MS_E and higher R^2 are seen in the models with qualitative factors. Within these models, the highest the three-variable model (x_4 x_6 x_7) is superior in the perspective of R^2 because of the highest R^2 . Therefore, we would select this model as the best regression equation. The assumptions are checked. Random error term is normally independent distributed with 0 means and σ^2 constant variance. The final model is

$$\text{Road Freight Transport} = - 5.86 + 0.57317*(\text{Production Index}) + 42.189*(\text{Road Transport Policy}) + 31.226*(\text{National Environment Policy})$$

Table 7.4 All possible regressions for the data with qualitative factors

Number of variables	p	Variables in model	R^2	Adj. R^2	C_p	MS_E
1	2	x_1	92.7	92.3	50.0	158.332
1	2	x_3	92.2	91.8	54.8	169.494
2	3	x_3 x_7	96.7	96.4	14.3	74.266
2	3	x_1 x_7	96.5	96.2	16.2	78.970
3	4	x_3 x_6 x_7	97.9	97.6	5.5	50.552
3	4	x_4 x_6 x_7	98.8	97.5	6.1	51.872
4	5	x_1 x_4 x_6 x_7	98.1	97.6	5.8	48.701
4	5	x_1 x_3 x_6 x_7	98.1	97.6	5.8	48.806
5	6	x_1 x_2 x_3 x_6 x_7	98.4	97.9	4.6	42.475
5	6	x_1 x_2 x_5 x_6 x_7	98.4	97.8	5.3	44.594
6	7	x_1 x_2 x_3 x_4 x_6 x_7	98.5	97.9	6.2	44.128
6	7	x_1 x_2 x_3 x_5 x_6 x_7	98.5	97.8	6.3	44.516
7	8	x_1 x_2 x_3 x_4 x_5 x_6 x_7	98.5	97.7	8	46.557

Table 7.5 All possible regressions for the data without qualitative factors

Number of variables	p	Variables in model	R^2	Adj. R^2	C_p	MS_E
1	2	x_1	92.7	92.3	8.1	158.332
1	2	x_3	92.2	91.8	9.9	169.494
2	3	$x_1 x_2$	93.8	93.1	6.2	141.800
2	3	$x_1 x_3$	93.7	93.1	6.3	142.850
3	4	$x_1 x_2 x_3$	94.8	93.9	4.5	125.126
3	4	$x_1 x_3 x_4$	94.8	93.9	4.6	125.194
4	5	$x_1 x_3 x_4 x_5$	95.5	94.4	4.2	115.713
4	5	$x_1 x_2 x_3 x_4$	95.4	94.3	4.4	116.986
5	6	$x_1 x_2 x_3 x_4 x_5$	95.5	94.1	6.0	121.484

Production index and road freight transport's matrix plot is given in Figure 7.1 In this matrix plot road policy is taken into consideration. From the Figure 7.1, a linear relationship with Road Freight Transport and Production Index is clearly found. When there is no policy, the slope is few, but when there is a policy, the slope is increased. There is not to take into consideration that existence policy is improved the road freight transport (Cakmakci, Kucukavcu and Demirel, 2006).

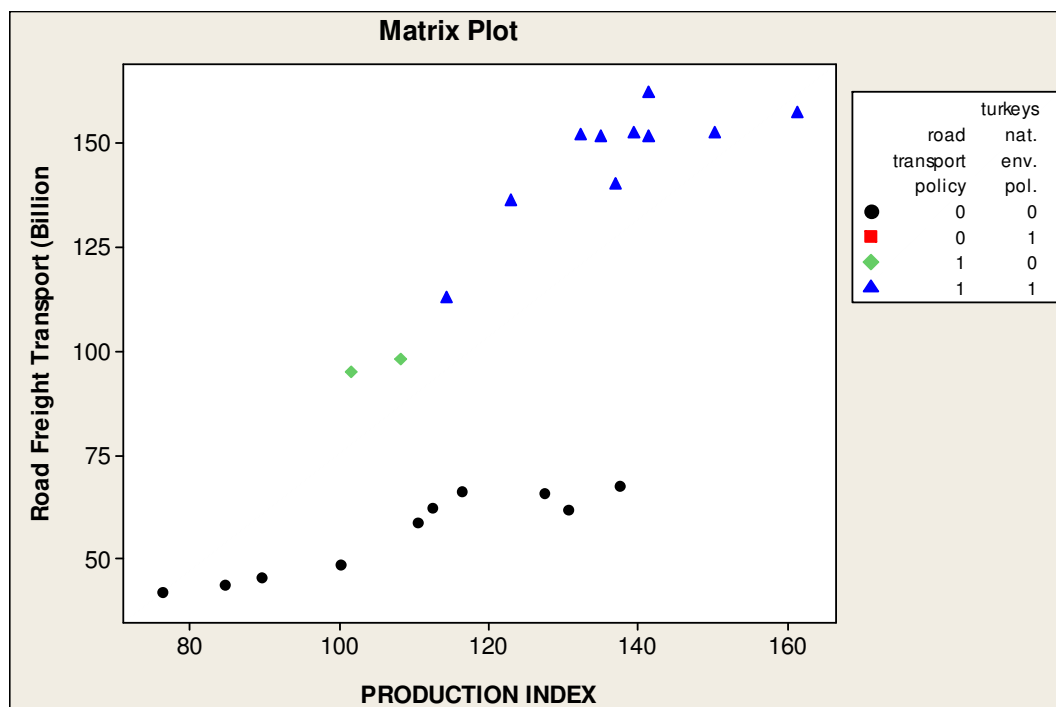


Figure 7.1 Matrix plot for road freight transport and production index with groped road transport policy and Turkey's national environment policy

7.2. Forecasting Methodology

The time series analysis of road freight transport is not done because of the inadequate observations. Instead of Box-Jenkins method, the trend analysis is applied. Trend analysis fits a general trend model to time series data and provides forecasts. Choose the best model among the linear, quadratic, exponential growth or decay, and S-curve models. This procedure to fit trend when there is no seasonal component in series. The data is obtained yearly, so seasonal factor is eliminated. Three measures of accuracy of the fitted model: MAPE, MAD, and MSD computes for each of the simple forecasting and smoothing methods.

MAPE (Mean Absolute Percentage Error) measures the accuracy of fitted time series values. It expresses accuracy as a percentage. MAD (Mean Absolute Deviation) measures the accuracy of fitted time series values. It expresses accuracy in the same units as the data, which helps conceptualize the amount of error. MSD (Mean Squared Deviation) is a commonly-used measure of accuracy of fitted time series values.

Here we forecast the level of road freight transport using trend analysis. We apply to trend analysis for actual data and fitted data obtained from multiple regression analysis. First, we apply to multiple regression analysis. To do this, we use the dependent variable, road freight transport, and independent variables, production index, road transport policy and Turkey's national environment policy. We use these independent variables in the model, because we found these variables the most significant after applying stepwise regression. When we apply to multiple regression analysis, we found the fitted data for road freight transport. The actual and fitted data for road freight transport are given in Table 7.6.

Table 7.6 Actual and fitted variables for road freight transport

Years	Actual Data	Evolution (%)	Fitted Data	Evolution (%)
1983	42.19	-	37.819	-
1984	43.88	+4.01	42.577	+12.58
1985	45.63	+3.99	45.442	+6.73
1986	48.46	+6.20	51.461	+13.25
1987	58.83	+21.4	57.479	+11.69
1988	62.48	+6.2	58.511	+1.80
1989	66.42	+6.31	60.861	+4.02
1990	65.71	-1.07	67.166	+10.36
1991	61.97	-5.69	69.057	+2.82
1992	67.70	+9.25	72.897	+5.56
1993	97.84	+44.52	98.350	+34.92
1994	95.02	-2.88	94.510	-3.90
1995	112.52	+18.42	133.073	+40.80
1996	135.78	+20.67	138.002	+3.70
1997	139.79	+2.95	146.141	+5.90
1998	152.21	+8.88	147.516	+0.94
1999	150.97	-0.81	144.937	-1.75
2000	161.55	+7.01	148.606	+2.53
2001	151.42	-6.27	143.447	-3.47
2002	150.91	-0.34	148.606	+3.60
2003	152.16	+0.83	153.764	+3.47
2004	156.85	+3.08	160.069	+4.10

We apply to trend analysis by using the actual data and fitted data obtained by multiple regression analysis. We compare the MAPE, MAD and MSD statistics for both models. For all three measures, the smaller the value, in this study the linear model is better to fit of the model.

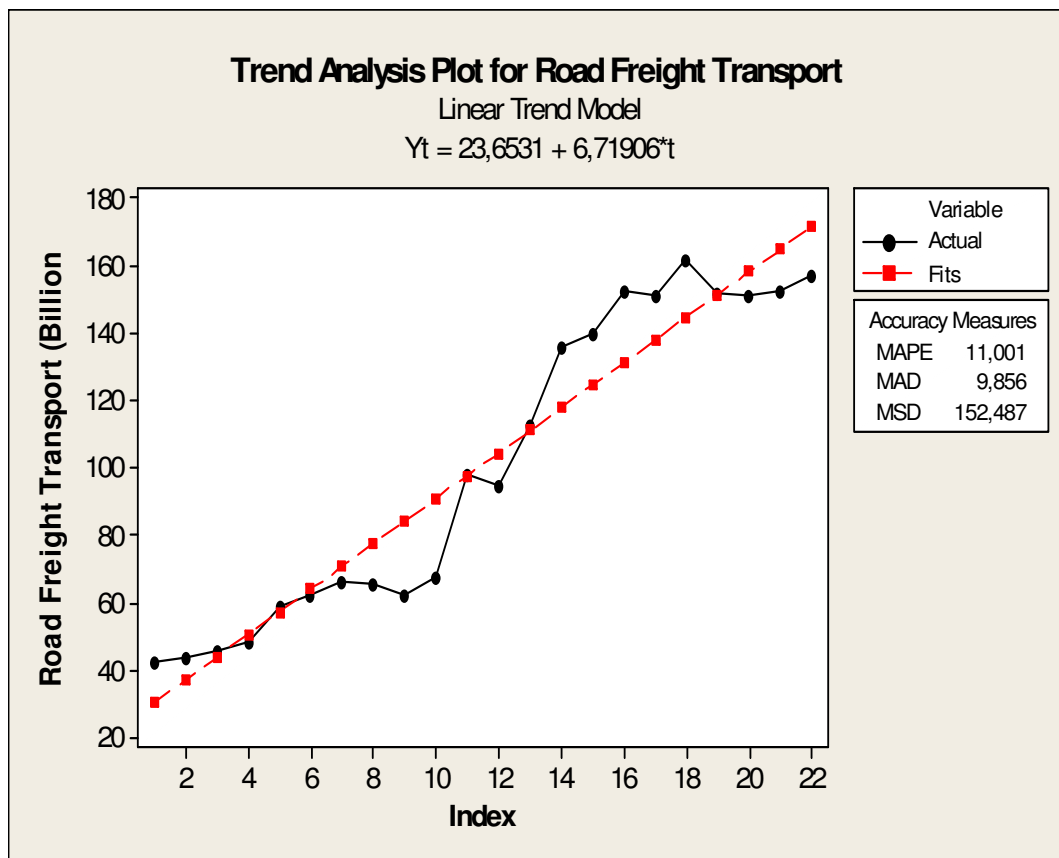


Figure 7.2 Trend analysis plot for road freight transport

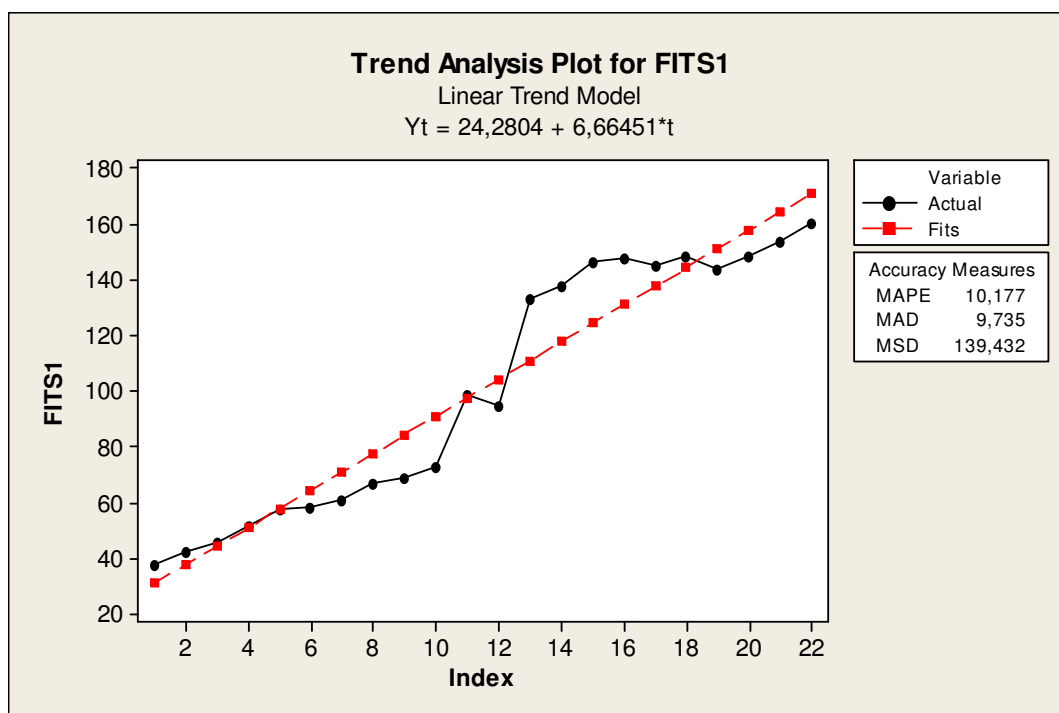


Figure 7.3 Trend analysis plot for road freight transport fits

Trend analysis graph for actual data is given in Figure 7.2 and trend analysis graph for fitted data is given in Figure 7.3. MAPE, MAD and MSD statistics for both models are given in Table 7.6. From Table 7.7, we can make the comparison for the models and we refer the model with smaller MAPE, MAD and MSD as the appropriate model.

As shown in Table 7.7, MAPE, MAD and MSD statistics are smaller for trends analysis with fitted data.

Table 7.7 MAPE, MAD and MSD Statistics for both models

	MAPE	MAD	MSD
Road Freight Transport	11.001	9.856	152.487
Road Freight Transport Fits	10.177	9.735	139.432

7.3. Results

Trend analysis provides forecasts. Forecasts are extrapolations of the trend model fits. Nowadays, long time forecasts are not reliable results. In this study, from 2005 to 2015 forecasts are calculated.

Table 7.8 Forecasts of road freight transport and road freight transport fits

Years	Road Freight Transport Trend Forecast (Billion tone / km.)	Change from 2004 (%)	Road Freight Transport Fits Trend Forecast (Billion tone / km.)	Change from 2004 (%)
2005	178.191	+13.6	177.564	+13.2
2006	184.910	+17.9	184.229	+17.5
2007	191.630	+22.2	190.893	+21.7
2008	198.349	+26.4	197.558	+26.0
2009	205.068	+30.7	204.222	+30.2
2010	211.878	+35.1	210.887	+34.4
2011	218.506	+39.3	217.551	+38.7
2012	225.225	+43.6	224.216	+42.9
2013	231.944	+47.9	230.880	+47.2
2014	238.663	+52.2	237.545	+51.4
2015	245.382	+56.4	244.209	+55.7

In Table 7.8, forecasts for road freight transport from 2005 to 2015 are given. As reported in this table, the road freight transport increased by passage of time. In Figure 7.4 and Figure 7.5, the green dots are displayed the forecasts.

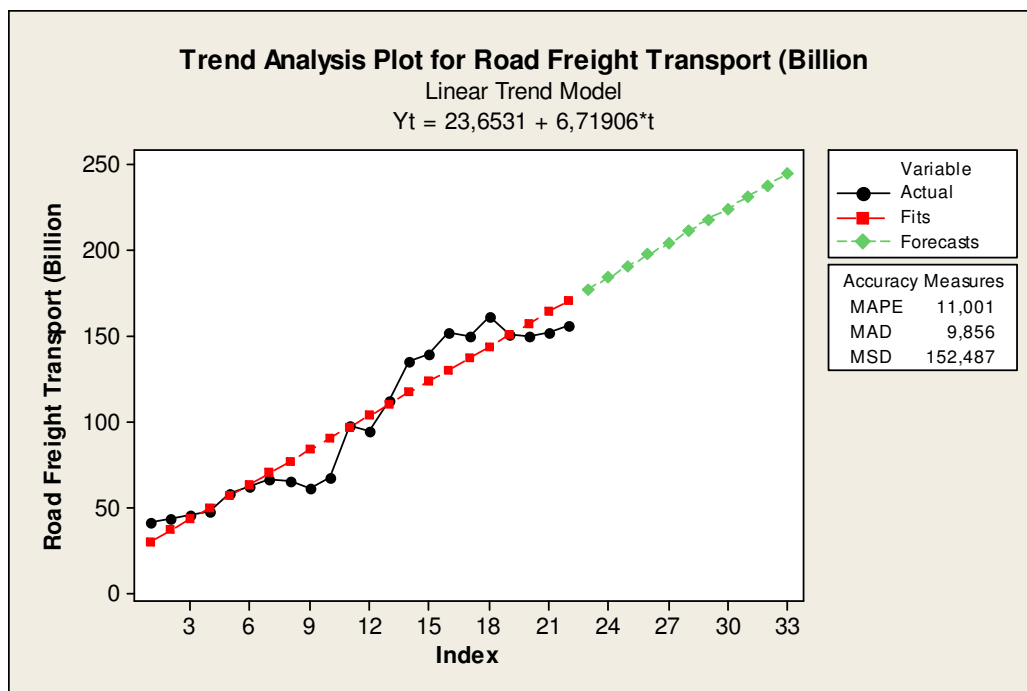


Figure 7.4 Trend analysis plot for road freight transport

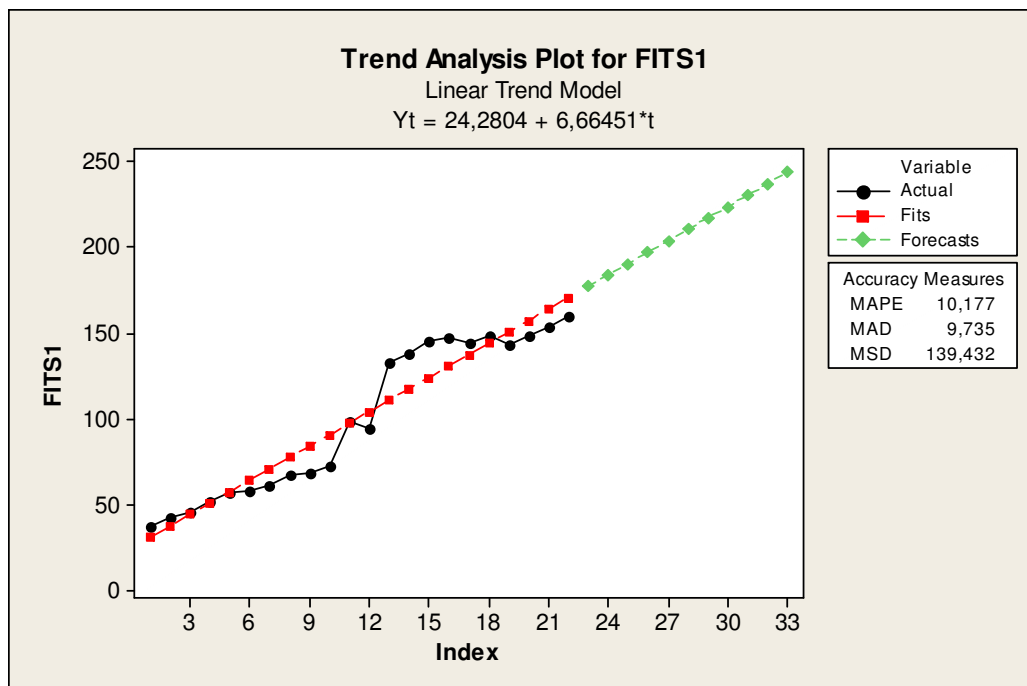


Figure 7.5 Trend analysis plot for road freight transport fits

The result of this research work is detailed forecast of “Road Freight Transport in Turkey”. This forecast shows that there will be a continuing increase in the movement of freight over the road in Turkey. This data shows that by 2015, total freight transport on Turkey’s roads will have increased from 156.85 billion tone-km to 244.209 billion tone-km (by almost 55.7%) over the level experienced in 2004. This increase in freight transport volumes indicates there will be more trucks on the roads in Turkey in the near future (Cakmakci, Kucukavcu and Demirel, 2006).

That means more commercial vehicles on the roads of Turkey. Turkey will have more operational, financial, and organizational road problems, and in shortly, there will have infrastructure problems. That means also more pollutants to the environment and thereby it will be given more regional based social freedom problems. In the future Turkey must shift the freight transport from the road to the rail.

7.4.Summary

In this chapter, a model suggestion was made in order to investigate a modal shift from roads to railways in Turkey. We used multiple regression analysis and trend analysis for our purpose. The forecast was based on the annual data of the level of road freight transport and the macro economical factors which can effect the development of road freight transport. We used the annual data of the level of road freight transport from 1983 to 2004. After applying to multiple regression analysis and trend analysis, we found the forecast of the level of road freight transport in Turkey from 2005 to 2015. We found that the level of road freight transport will increase by % 55.7 by 2015.

CONCLUSION

We should first state that if transport and communication infrastructures of a country are not enough, that country cannot be described as a developed country. The level of transport and communication services is the indicator of civilization. Therefore, railway transport mode should be considered as a public service and evaluated in the perspective of transport policies.

If Turkey continues performing policies based on road transport, cities will be covered by underpasses, overpasses, car parks; and noise and air pollution arisen from transport will threat people's lives.

Turkey, which has expectations with regard to European membership, should improve the transport activities as in industry and agriculture.

Developed European Union countries has converted their transport to public transport and started to utilize high-speed train technology. Although Turkey is late for applying high-speed trains, our country should perform this technology immediately. High-speed train technology should be evaluated in the perspective of purer environment, energy gain, safety, superiority in passenger and freight transport over 150 – 200 km, appropriateness to combined and container transport.

In this study, we evaluated transport developments and programs in European Union. It is seen that there are many organizations involved with European Union railways. These organizations are involved with Trans – European Network, Pan – European Network and Europe – Asian transport corridors.

In this study, the last 50 years of Turkey have been interrogated in the view od railways and discussed the solutions about the possible transport insufficiency in the future. As stated before, Turkey's geopolitical position is very important between Europe and Asia and this make the transport sector crucial in the region. Turkey is

both a transit and origin and destination of freight. Turkey's expectations with regard to European Union accession and the growing role of Turkey in trade between Europe and Asia make the transport more important. For this reason, Turkey must participate in the projects in the region to contribute the trade between Europe and Asia.

Freight transport sector in Turkey and in the EU is the one area where demand for road is forecast to increase significantly by 2015. But in both, the rail is loser and still forecast to lose mode share in particular to road and market share of rail is declining. At the same time, operating costs are increasing. Forecasts developed as part of this research work supports this view.

The forecasts in this study show that the level of road freight transport will increase by 55.7 % (from 156.85 to 244.209 billion tone-km) over the level experienced in 2004. This increase in freight transport volumes indicates there will be more trucks on the roads in Turkey in the near future Turkey will have more operational, financial, and organizational road problems, and in shortly, there will have infrastructural problems. That means also more pollutants to the environment, congested traffic on roads and thereby it will be given more regional based social freedom problems. When we consider these situations, Turkey should shift the freight transport from the road to the railway transportation in the future.

Turkey must increase the standard of railway transport services for the structural adaptation with European Union. Turkey should develop the railways to increase the share of its international transport. When we think about the accession to European Union, it is important to realize the projects which shorten the international lines especially railway lines. If Turkey spends time, alternative routes might be determined and Turkey might be excluded Europe – Asia transport which Turkey has a very important potential.

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