ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY

TERRITORIAL IMPACT ASSESSMENT OF MAJOR TRANSPORT PROJECTS: A CASE STUDY ON ISTANBUL BY TEQUILA MODEL

M.Sc. THESIS

Hıfzı AKSOY

Department of Urban And Regional Planning

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

BÜYÜK ULAŞIM PROJELERİNİN ALANSAL ETKİ DEĞERLENDİRMESİ: İSTANBUL ÖRNEĞİNDE TEQUILA MODELİ UYGULAMASI

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Hıfzı AKSOY, a **M.Sc.** student of ITU **Institute of Science** student ID 502081705, successfully defended the **thesis** entitled "**TERRITORIAL IMPACT ASSESSMENT OF MAJOR TRANSPORT PROJECTS: A CASE STUDY OF ISTANBUL**" which he prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

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Date of Submission : 06 May 2011
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To my devoted parents,

FOREWORD

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February 2012

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ABBREVIATIONS

AB	**:** Avrupa Birliği
BCA	**:** Benefit-Cost Analysis
BCR	**:** Benefit-Cost Ratio
CANAMEX	**:** Canada to Mexico Corridor
CGE	**:** Computable General Equilibrium
EC	**:** European Commission
EIA	**:** Environmental Impact Assessment
ETP	**:** European Transport Policy
EU	**:** European Union
ESPON	**:** European Observation Network, Territorial Development and Cohesion
F	**:** France
GB	**:** Great Britain
GDP	**:** Gross Domestic Product
IA	**:** Impact Assessment
IMPC	**:** Istanbul Metropolitain Planning Center
KTX	**:** Korea Train Express
MCDM	**:** Multi Criteria Decission Making
NAFTA	**:** Northern America Free Trade Aggreement
NHS	**:** National Highway System
OECD	**:** Organization for Economic Cooperation and Development
SASI	**:** Socio-Economic and Spatial Impacts of Transport Infrastructure Investments and Transport System Improvements
SIA	**:** Social Impact Assessment
SWOT	**:** Strengths, Weaknesses, Opportunities, Threats
TEA	**:** Transportation Efficiency Act
TEM	**:** Trans European Motorway
TENs	**:** Trans European Networks
TEN-T	**:** Trans European Transport Networks
TEQUILA	**:** Territorial Efficiency, Quality, Identity Layered Model
TIA	**:** Territorial Impact Assessment
TTC	**:** Trans-Texas Corridor
TxDOT	**:** Texas Department of Transportation
UK	**:** United Kingdom
UN	**:** United Nations
UNDP	**:** United Nations Development Program
U.S.	**:** United States
USA	**:** United States of America

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TERRITORIAL IMPACT ASSESSMENT OF MAJOR TRANSPORT INFRASTRUCTE PROJECTS: A CASE STUDY ON ISTANBUL BY TEQUILA MODEL

SUMMARY

The start point of this thesis topic is "transportation". Despite the fact that the topic transportation itself was really wide and it needs to be narrowed. According to my Civil Engineering background, transportation was considered an intersection topic with regional planning. But, it must not only be a technical issue but also be combined with regional planning context. So that, after reading the literature on the relation between transportation and regional planning; it was seen and questioned that how transportation effects regional development and what the consequences of this effection would be. Then, the topic took shape around impact assessments. Furtheermore, Territorial Impact Assessment was chosen as implementation instrument in order to investigate the bond between regional planning and transportation. Other impact assessments such as Environmental Impact Assessment and/or Social Impact Assessment, etc. were inadequate to explain the impacts of transportation in the regional context. Finally, the topic was narrowed into: Major Transport Infrastructures and Their Territorial Impacts. And I wanted to investigate this relationship by using mathematical methods, models, etc. After the research related to this topic, I decided to implement TEQUILA Model on Istanbul (under the tought of taking Istanbul as a region).

In the context of candidance of Turkey into EU; a lot of changes has been making like all compliences with the law. All transport modes (road, railroad, air and maritime transport) have been reconfiguring according to EU regulations and major transport infrastructure projects of rehabilitation of current lines with new ones and/or roads take place in the current agenda. These projects are essentially big scale investments which aim to integrate with the TEN-T. But, the researches that are done on which regional impacts of this amount of big scale projects are restricted with social, environmental and economic impacts. In this thesis, a Territorial Impact Assessment was implemented in a selected region, Istanbul, so that the territorial impacts of Third Bridge on Bosphorous as a major project was investigated by using TEQUILA (**T**erritorial **E**fficiency, **Qu**ality, **I**dentity **L**ayered **A**ssessment) Model which is used in European Observation Network, Territorial Development and Cohesion (ESPON). Although there are many different methods to make an Impact Assessment; I decided to use TEQUILA Model because this model includes other impact assessment types which are in order: Social Impact Assessment, Economic Ipact Assessment and Environmental Impact Assessment. I could not make a simulation just because I made a case study for Istanbul only therefore, I supported the outcome of TEQUILA by using Ex-Ante Assessment. In conclusion, by making the Territorial Impact Assessment which was implemented for Istanbul, it is aimed to bring a different aspect in order to determine the territorial impacts of Third Bridge

on Bosphorous in this thesis. First of all, it is very significant to indicate that TEQUILA Model is a macro scale model. It measures regional accessibility; inter connectivity and regional identity. That means most of the urban transport indicators (for example transport modes such as maritime transport, aviation, etc.) are absent in the model. Simply highway and railway endowment data are used. The land use data were not directly used in the model. The model measures the maximum area fragmentation by 1-10 scale. The weight (0.333) was selected in order to stand equally from the regions. It can be said that, TEQUILA supplies a "general" determination base for further studies. So that, Istanbul was selected under the consideration of Istanbul Region and TEQUILA was implemented to take a snapshot of Istanbul in a macro scale about major transport infrastructure projects. TEQUILA simply focuses on macro scale indicators. It presents a general view about transport projects and their territorial impacts. It is a whole with it SIP Module which evaluates the results of the model via mapping as shown above in the section 4.4 It is not important for TEUILA that a project done "where"; but it is significant that whether the project is "done" or "not". In this study, TEQUILA model was directly implemented for Istanbul Region. Furthermore, the weight might be determined for Istanbul Region by a council that consists of professionals interested in the subject. So is maximum area fragmentation level. It should be taken into consideration that number of theaters and museums was taken constant. In other words, it is assumed that the territorial identity data would not change in 2018 because of lack of projection data on these indicators. However, if TEQUILA model can be improved and can be adapted into urban transport, future studies are going to be more detailed and urban transport indicators can be directly in the model. And the results of the model will be changed. This study should be taken into consideration as a "general" determination that aims to make baseline for future studies.

TEQUILA MODELİ İLE ALANSAL ETKİ DEĞERLENDİRMESİ: İSTANBUL ÖRNEĞİNDE BÜYÜK ULAŞTIRMA ALTYAPI PROJELERİNİN ALANSAL ETKİLERİ

ÖZET

Bu tezin çıkış noktası ulaştırma genel başlığı altında "koridor gelişimi" alt başlığından yola çıkılarak belirlenmiştir. Ulaştırma başlığının çok genel bir başlık olduğu düşünülmekle beraber planlama-mühendislik ilişkisinin arakesiti olarak koridor gelişimi konusu bir çıkış noktası olması açısından kritik bir rol üstlenmektedir. Planlamanın son derece önemli uygulama araçlarından olan ulaştırma; ilerleyen teknoloji ve ulaştırmanın ulaştığı son nokta göstermektedir ki bölgeler arası iletişim, bilgi paylaşımı, sürdürülebilir kalkınma, rekabet ve işbirliği konularında ulaştırmanın önemi yadsınamaz ölçüdedir. Ülkemizin de üyelik sürecinde olduğu Avrupa Birliği'nin sürdürülebilir kalkınma ve bölgesel yakınsama başlıkları altında öne çıkan büyük ulaştırma projeleri konunun önemine vurgu yapması yönünden dikkatle incelenmelidir. Nitekim bu tezin içeriğinde sözkonusu ulaştırma projelerinin kapsamlı bir değerlendirmesi yapılmıştır. Uluslar arası Avrupa Ağları'nın tek örnek olmadığı ise Amerika ve Asya örnekleri ile desteklenip konunun dünya literatüründeki yeri araştırılmış ve Türkiye'deki ulaştırma politikaları ve uygulamaları ile karşılaştırılmıştır. Ülkemizdeki büyük ulaştırma altyapı projeleri irdelenmiş olup Uluslar arası Avrupa Ağları ve AB uyum süreci ile aradaki bağlantının sorgulanmasına çalışılmıştır. Bu bağlamda Türkiye'nin Güney Avrupa bölgesel entegrasyonunun sınır ötesi işbirlikleri yoluyla ulaştırma yatırım ve projelerinin etkinliği bu tez araştırma konusunun temelini oluşturmaktadır. Bu etkinliğin nasıl ölçüleceği sorusuna gelindiğinde ise nicel yöntemlerin öne çıkmasıyla bir sayısal model olan TEQUILA Modeli seçilmiş ve seçilen Istanbul Bölgesi için uygulama yapılmıştır. Modelin çıktıları başlangıçta şaşırtıcı göünse de İstanbul bir bölge olarak ele alındığından tüm ulaştırma modlarının ve kentsel ulaşımın alt göstergelerinin modele bir veri girişi sağlamadığını özellikle tekrar edersek; modelin uygulamsından elde edilen bulguların kabaca bir fikir vermesi olağandır.

Sınırötesi işbirlikleri kapsamında desteklenen bölgesel projeler araştırılmış ve ulaştırma genel başlığı ile birleştirildiğinde Yunanistan ile Türkiye arasında inşa edilecek olan Via Egnatia Otoyolu projesinden hareketle projenin getirileri ile götürüleri üzerine araştırma yapılmış ve Alansal Etki Değerlendirmesi başlığı net olarak belirlenmiştir.

Tarihte çok önemli bir yere sahip olan Via Egnatia (Egnatia Yolu), Roma ile İstanbul'u Trakya üzerinden birbirine bağlamaktaydı. AB TENs politikaları kapsamında günümüzde tekrar eski önemine kavuşmuş ve yapısal fonlar ile desteklenerek Trakya bölümü hizmete açılmıştır. Türkiye bölümü ise 3. Köprü ve bağlantılı çevre yolunun inşaası ile Via Egnatia'nın tamamlanması projesi gündemdedir. Buradan hareketle, ulaştırma genel başlığı daraltılmış ve literatür

araştırması ile Alansal/Karasal Etki Değerlendirmesi başlığı bu tezin temel noktası olarak belirlenmiştir.

Bu bağlamda, Türkiye'nin Avrupa Birliği adaylığı çerçevesinde yapılan tüm diğer reformlar ve çıkarılan tüm uyum yasaları gibi ulaştırma alanında da birçok değişiklik yapılmaktadır. Tüm ulaşım modları (karayolu, demiryolu, havayolu ve denizyolu) AB standartlarına göre yeniden yapılandırılmakta olup mevcut hatlarda iyileştirme çalışmaları ve yeni hatlar ve/veya yollar için birçok büyük ölçekli ulaştırma altyapı projeleri gündemdedir. Bu projelerin başlıcaları da Trans Avrupa Ulaşım Ağı'na entegrasyon adına yapılan büyük bütçeli yatırımlardır. Ancak, AB tarafından desteklenen (yapısal fonlar, hibeler ve benzeri bütçe yardımları yoluyla) bu denli büyük ulaşım altyapı yatırımlarının olası alansal veya karasal etkileri üzerine yapılan çalışmalar çevresel ve ekonomik etkiler başlıkları ile sınırlıdır.

Dünyada örnekleri oldukça fazla olan Alansal/Karasal Etki Değerlendirmesi; Kuzey Amerika, Avrupa ve Asya örnekleri ile ortaya konmuş ve politika üretenler için vazgeçilmez bir araç olarak ulusal planlamada yerini almıştır. Büyük ulaştırma yatırımlarının ve alansal/karasal etkilerinin değerlendirildiği örnekler arasında tüm ulaştırma modlarının dahil edildiği projelere yer verilmesine özen gösterilmiş olup ülkemizde uygulaması bulunmayan "iç su yolları ulaşımı" da Güney Kore örneği ile AB örneğinde göze çarpmaktadır.

Ne yazık ki ülkemizde Alansal/Karasal Etki Değerlendirmesi örneğine rastlanamamıştır. Ancak ülkemiz megakenti İstanbul'un bir bölge olarak ele alındığı bu tez kapsamında İstanbul için bir alansal etki değerlendirmesi yapılmış olup bu büyük altyapı yatırımlarının alansal veya karasal etkileri araştırılmıştır. Çevresel ve ekonomik etki değerlendirmelerinden farklı olarak bir Alansal Etki Değerlendirmesi (TIA) modeli olan TEQUILA modeli (Alansal Etkinlik, Kalite, Kimlik Katmanlı Değerlendirme) bu araştırmanın merkezinde olup İstanbul özelinde 2010 ve 2018'de yapılması planlanan 3. Köprü (büyük ulaştırma altyapı projesi olarak değerlendirilmiştir) için de sonuçlar genel olarak irdelenmiştir. Kullanılan TEQUILA modelinin içerdiği göstergeler aynen alınmış ve İstanbul kent ölçeği olarak değil bölge ölçeğinde ele alınmıştır. Modelin sonuçları kabaca bir değerlendirme sunduğundan çalışmanın bulguları da bu yönde değerlendirilmelidir. Kent ölçeği için alınması mutlak surette gerekli olan göstergelerin çoğu modelin içeriği gereği kullanılmadığından bulguların değerlendirilmesinde bu husus göz önüne alınmalıdır. Modelin eleştirel noktasını oluşturan konu da bu noktada belirmektedir: Detaydan uzak kabaca bir çerçeve çizmektedir.

Kullanılan modelde belirlenen değişkenlerin ve buna bağlı olarak modelin çıktısının bölgesel ve bölgeler arası erişim, bölgesel etkinlik ve bölgesel kimlik adına kabaca bir fikir vermesi açısından bu çalışmada da ileriki çalışmalara altlık oluşturmak amaçlanmış olup kentsel ölçekte yapılmış bir çalışma olmadığının altını çizmek gerekir. Modelin değişkenleri arasında bulunan tiyatro ve müze sayıları gibi alt göstergeler için projeksiyon verisi olmadığından 2018 yılı için de yine 2010 yılı verileri kullanılmıştır. Model içinde kritik öneme haiz olmadığından sabit olarak alınmasında bir sakınca görülmemiştir. Ancak, yapılacak yeni alansal veya karasal kimlik (territorial identity) araştırmalarından elde edilecek bulgular modele veri olarak dahil olduğunda veya yapılacak bir projeksiyon ile bu veriler tahmin edilebildiğinde modelin sonuçları daha farklı olarak değerlendirilebilecektir.

İstanbul Bölgesi için yapılan bu tez çalışmasında esas amaç 3. Köprü için bir çalışma ortaya koymak değil, genel olarak büyük ulaştırma altyapı projelerinin İstanbul

Bölgesi için bir alansal etki değerlendirmesi yoluyla incelenmesidir. Bu incelemenin bölgesel ve/veya makro ölçekte olduğu belirtilmelidir. Modelin uygulaması microsoft office programı olan excel ile hazırlanmış olup herhangi özel bir yazılım kullanılmamıştır. Emisyon gazları değişkeninin projeksiyon verileri ise trend analizi yöntemi kullanılarak kestirim yapılması yoluyla belirlenmiş ve modele bu şekli ile dahil edilmiştir. Modelin özgün yapısında ayrıca bir simülasyon yazılımının varlığı ile görsel bulgulara erişmek mümkündür fakat maddi ve uluslar arası erişim sorunları nedenleriyle simülasyon yapılamamış, sadece modelin çıktıları yorumlanabilmiştir. Modelde yeşil alan tahribatı göstergesi ise İstanbul Üniversitesi Orman Fakültesi tarafından hazırlanan 3. Köprü Projesi Raporu'na dayanmaktadır. Raporun ortaya koyduğu veriler TEQUILA Modeli'ne veri oluşturmuştur. Bu bağlamda, modelin sonuçlarını sıralayacak olursak:

Toplam etkinlik başlığında, alansal erişilebilirlik anlamında, büyük ulaştırma yatırımlarının alansal/karasal etkilerinin pozitif; ancak alansal kalite ve alansal kimlik başlıklarında ise %90'a varan negatif etkileri olduğu sonucuna ulaşılmıştır. Bu sonuçların alınmasında kuşkusuz Marmaray Projesi kapsamında artan demiryolu uzunluğu (km olarak), 3. Köprü Projesi ile artacak olan karayolu uzunluğu (km olarak), trafikteki araç sayısının artışı, hızla artan nüfus, yeşil alan tahribatı ve diğer göstergelerin ilk bakışta vermesinin beklendiği negatif sonuç toplam etkinlik katmanında pozitif çıkarak yorumlarda eleştiriye neden olabilir. Nüfus ve karayolu bağımlılığı nedeniyle ortaya çıkan karayolu uzunluğu modeli doğrudan etkilediğinden negatif etkilerin beklenmesi çok açıktır. Unutulmaması gereken nokta ise en başta ifade edildiği gibi bölge bazlı düşünülmesi gerektiğidir. Kentsel ulaşımın bölgesel ulaşım ile ayırdının bu tez kapsamında net olarak yapıldığını söylemek gerekir.

Sonuç olarak, bu tezde, Istanbul için yapılan Alansal Etki Değerlendirmesi; büyük ulaştırma altyapı projelerinin (3. Köprü projesi bu anlamda seçilmiştir) alansal veya karasal etkilerini ortaya koymak adına farklı bir bakış açısı getirmek amaçlanmıştır. Sonuçların beklentiyi kısmen karşıladığı rahatlıkla söylenebileceği gibi veri eksikliği ve projeksiyon veriler ile çalışmanın güçlüğü sorunlarının aşılmasından sonra bulguların değişebileceğini bir kez daha belirtmek gerekmektedir.

1. INTRODUCTION

Transportation had started to be an important topic since the human being had begun to move from one point to another. With time and technologic growth, transportation is a very complex issue today. Not only passenger circulation but also freight transport had so significant and/or basic roles in terms of economic and regional development. It is an indispensible part of planning; however, many planning problems occur with transport problems. Moreover; transport has the major role in linking regions and cohesion policy which the EU deals with.

In this context, major infrastructure investments of transport are needed. For instance, Trans European Transport Networks (TEN-T) project supports the big scale transport infrastructure investments. Similar implementations can be observed in Northern America and Asia. For instance, with the help of NAFTA, there are many transport networks and corridors in the USA, in Canada and in Mexico not only nationally but also internationally. On the other hand, these major infrastructure transport investments have impacts of environmental and territorial both. Therefore, the research topic, transportation, was narrowed to investigation of major transport infrastructure investments of regional transport policies by making territorial impact assessment. Furthermore, this study is mainly focused on a determination of transport policies of Istanbul. It is considered to open a different research area for the next researchers in different scales such as Turkey and south-east Eouro-Region.

1.1 Purpose of Thesis

Since Istanbul, with nearly 13.5 million inhabitants, is the biggest city in south-eastern Europe, transportation policies of this metropolitan city are expected to be very complex. In terms of regional development, transportation can be described as the backbone. When it should be considered, transportation, as an interdisciplinary subject; there are a lot of research problems that can be investigated at both scales: city and regional transportation. In this point, it is the best to say that the aim of this study is to evaluate the transport policies of Istanbul in recent years and near future.

In this context, because of my academic background is Civil Engineering, I decided to investigate the territorial impacts of the major transport infrastructure investment in Istanbul. The start point of this thesis is the SIMCODE: IGT Project that was held under EU Transport and Cohesion Policies Between Euro-regions and Co-operation with Neighboring Countries. SIMCODE: IGT Project focuses on an ancient inter-regional road called VIA EGNATIA that starts from Italy passes through Northern Greece and ends in Tekirdağ-Turkey. It draws a conceptual frame and creates a tool for information baseline in order to make an assessment of the spatial impact of transport along the multimodal transport corridor that bonds South Italy, Northern Greece and Northwest Turkey. By this project, there was a chance to investigate territorial impacts of major transport infrastructure projects in a regional aspect. If the endpoint of SIMCODE: IGT project is Tekirdağ then it should be related to Istanbul somehow. So that, it shoould be taken into consideration that all major transport infrastructure projects planned and/or constructed in Istanbul is linked with VIA EGNATIA. Despite the fact that there are many similar studies on Marmaray Project and 3rd Bridge on Bosphorus, it is aimed to evaluate the transport policies by a different aspect. By implementing Territorial Impact Assessment, it is put forwarded that current and future transport policies of Istanbul have some impacts not only environmental but also territorial.

1.2 Context

Since Istanbul, with nearly 13.5 million inhabitants, is the biggest city in south-eastern Europe, transportation policies of this metropolitan city are expected to be very complex. In terms of regional development, transportation can be described as the backbone. When it should be considered, transportation, as an interdisciplinary subject; there are a lot of research problems that can be investigated at both scales: city and regional transportation. In this point, it is the best to say that the aim of this study is to evaluate the transport policies of Istanbul in recent years and near future. In this context, because of my academic background is Civil Engineering, I decided to investigate the territorial impacts of the major transport infrastructure investment in Istanbul: the 3rd Bridge. Despite the fact that there are many similar studies on Marmaray Project and 3rd Bridge on Bosphorus, it is aimed to evaluate the transport policies by a different aspect. By implementing Territorial Impact Assessment, it is

put forwarded that current and future transport policies of Istanbul have some impacts not only environmental but also Territorial.

1.3 Method

This study consists of two parts. First part is based on Territorial Impact Assessment and the second part is Ex-Ante Analysis. In order to make an effective, useful and compact Territorial Impact Assessment the TEQUILA (Territorial Efficiency Quality Identity Layered Assessment) model developed by Camagni has been selected. Furthermore, TEQUILA model has a simulation. But the simulator was not used because of some challenges about finding SIP software which comes with the model. Istanbul region was selected for the implementation of the model. Required data were provided by Istanbul Metropolitan Planning Centre, Governorship of Istanbul and Turkish Librarians Association. In addition, the data which the variable of "number of theathers" uses in the model has been taken from internet by simple data-mining. Specifically, the variable of "CO_2 emission" were taken from the working paper presented by Diler *et al.* in the 7th National Clean Energy Symposium, 2008. However, the data in the working paper were not the data of 2010 and 1018. Instead, I used simple Trend Analysis, in order to predict the data of CO_2 emissions for 2010 and 2018, which was created by using Least Squares Method in statistics, basically.

TEQUILA model was applied twice, with the data which has been provided by Istanbul Metropolitan Planning Centre. According to data which were predicted for the 3rd bridge project of Istanbul (considered year is 2018), I decided to make Ex-Ante Analysis by using the results of the model.

Moreover, I had an assumption that variables such as "number of theatres" and "number of monuments and museums" are going to be constant because of lack of data for the variables of "cultural entities" for 2018. Similarly, there were no data for prediction.

2. IMPACT ASSESSMENT FOR MAJOR TRANSPORT INFRASTRUCTURE PROJECTS

Every day, a new transport infrastructure project can be observed in regions according to regional transportation policies made by plan and/or policy makers and decision makers at the top of the planning system. The problem is the lack of investigation about their impacts on territories once they were planned. The feasibility etudes are made for the projects but what about their potential consequences? For example, a new inter-regional motorway is planned and it is feasible to construct it but the project should be investigated in terms of its potential territorial impacts. In this section, it is aimed to explain what the territorial impacts are and how it can be measured.

2.1 What Is Impact Assessment?

In Physics, as we remember from Newton's third rule, every action has a re-action. When we consider this rule in Impact Assessment, this principle can be adapted into every areas of research. Similarly; every project, policy, programme, plan, etc. has has some effects or impacts. If there is an action there will be some consequences of this action. These consequences are defined as impacts. Impacts might be positive or negative. From this point of view, researchers observe, analise and finally assess these impacts. This procedure is defined as Impact Assessment. From another point of view; Impact Assessment can basicly be defined as it is a continious process of an evaluation of future effects of current or up-to-date actions. The word "impact" is important here. It refers to the question "What if the action would happen and/or what if it would not?" European Commission directly defines impact assessment as:

> "It is a process that prepares evidence for political decision-makers on the advantages and disadvantages of possible policy options by assessing their potential impact".

In his article (2010) Davidson states that the impact assessment is a process of investigation and ensurement of possible futuristic affects of a partial governmental intervention on a project, plan, programme, policy, etc. in terms of environment, society or the economy to understand decissions which interest the improvements and implementation of that intervention made by decission makers. Impact assessment aims to:

- Prepare info/data for decision-making which analyzes the social, economic and environmental result of planned actions.
- Provide diaphaneity and the public participation into decision-making process.
- Define steps and methods for the follow-up (monitoring and reducing of opposite outputs) in policy, planning and project circle.
- Assist to sustainable development and protect the environment.

The impact assessment was completely recognized internationally in 1992 at the United Nations Conference on Environment and Development in Rio, Brazil.

Figure 2.1 : Stages of the impact assessment adapted from UKDIBS, 2011.

Although there are many different types of impact assessment such as Health Impact Assessment, Privacy Impact Assessment according to the are of interest; impact

assessment is isvestigated in three main subtitles that are Socio-Economic Impact Assessment, Environmental Impact Assessment and Territorial Impact Assessment. According to Zonnevelt (2009), the Impact Assessment procedure exclusively aims at policy proposals by the European Commission, but aims to involve stakeholders from all administrative levels. The main objective of IA is to improve the quality, effectiveness and efficiency of Commission proposals, to provide more policy consistency and transparency and to improve and simplify the regulatory environment. The idea is that, through IA, proposals do not only tackle the problem they aim to solve but also take into account side effects on other policy areas.15 In so doing, the procedure is regarded an aid to political decision making, not a substitute for it.

Finally, impact assessment is can be defined as it is a process of futuristic effects of any plan, project, policy or any governmental intervention. If there is an action in an area, there will be some reactions. These reactions are called "impacts" and the process of assessing them, in terms of both negative and positive or advantages and disadvantages, is called "impact assessment".

2.2 Types Of Impact Assessment

Although there are different classifications on impact assessment, three main areas take place in the literature: Socio-economic Impact Assessment, Environmental Impact Assessment (Environmental Assessment or Strategic Environmental Assessment) and Territorial Impact Assessment. In some countries, especially in countries of use bottom-up planning, impact assessments are good, legal and effective planning tools with wide public participation. On the contrary, in some countries with top-down planning and in other developing countries, impact assessment is not mandatory by laws and is not widely used. However, as a planning tool, impact assessment is very effective in policy, project, action, etc. decision making.

2.2.1 Socio-economic impact assessment

Almost in every field of research, social and economic words are used together. Because, economy exist when there are at least two people in an area. This means that economic actions have some impacts on people, directly. On the other hand, the

more we think social and economic word together, the more our researches get wider. However, in some areas such as anti-governmental protesting, journalism, political science, etc. social impacts should be investigated on its own, specifically because of their very indirect economic impacts.

In their annotated bibliography of post-project studies, socio-economic impacts of Canadian Megaprojects, Nancy et al. (1993) determined the socio-economic impacts and grouped them into two parts: benefit part and cost part. In benefit part, according to their study six categories are defined:

a) Employment of current regional inhabitants in terms of directly with the megaproject and/or and indirectly related activities for example megaproject suppliers.

b) Employment for members of target groups (that usually have the minimum employment prospects in these regions with these sort of projects

c) Training for existing regional residents provided as a direct result of the megaproject or indirectly through supplying or retailing industries related to the megaprojects

d) Improvements in regional social or economic infrastructure such as community or regional recreation facilities or transportation facilities

e) Increased social and economic stability of existing communities

f) Developed entrepreneurship among current residents and businesses

In cost part, Nancy et al. define four categories:

a) Extremely raised and fail impacts (local inflation in housing prices and land values, pressure on community infrastructure and services and higher unemployment rates) resulting from uncontrolled population growth and demographic changes and their impact on existing residents

b) Environmental impacts

c) Social impacts such as increased crime and loss in the community cohesiveness, between existing regional residents and communities

d) Financial or tax (toll impact in highway projects) impacts for instance increased school taxes or hospital taxes and their impacts on regional inhabitants

In parallel, some economic actions or developments such as differentiation of cash flow, consolidated budget, etc. must be investigated on their own aspects because of their very indirect social impacts. Therefore, I searched the literature separately, below: social impact assessment and economic impact assessment

2.2.1.1 Social impact assessment

If an action, not only in specific areas of qualitative researches but also in the quantitative researches, occurs or planned to be act there will always be some both negative and positive social impacts. As a sub-topic of Impact Assessment; Social Impact Assessment is defined as analysing, observing and administrating the social results of development. Social Impact Assessment is an area of study and implementation, or a model which includes a body of knowledge, techniques, and values. As a method or instrument, Social Impact Assessment is the procedure that is followed by researchers of social issues to assess the social impacts of planned direct and/or indirect interventions (policies, projects, plans or programmes) or events, and to advance actions for the current observing and management of those impacts both negative and positive. Social Impact Assessment is not only a task of forecasting social impacts in an impact assessment process but also the processes of determining, observing and advancement of the intended and unintended social results (Vanclay, 2003).

In addition, Vanclay (2003) states that the area of interest of Social Impact Assessment is a forward-looking attitude to development and better development outputs, neither the description nor improvement of negative or undesired outcomes. Assisting communities and other stakeholders to identify development aims, and to be sure of that positive outputs are increased, can be more important than reducing damage from negative impacts. Social impacts are much wider than certain impacts in environment impacts. According to the declaration by The Inter-organizational Committee on Principles and Guidelines for Social Impact Assessment in 2003, social impacts of actions are the affections on people:

> "By social impacts we mean the consequences to human populations of any public or private actions-that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society".

So that, a limited Social Impact Assessments will have confinement problems unles they include the related impact assessments such as Health Impact Assessment, Cultural Impact Assessment, Heritage Impact Assessment, Privacy Impact Assessment, Aesthetic Impact Assessment or Gender Impact Assessment.

Shortly, all issues that effect people should be taken into consideration in Social Impact Assessment. Because if there is no one in the territory it is not meaningful to make Social Impact Assessment. Consequently, if a development (any sort of development) occurs, there will be impacts of it on the society. And, the assessment of these impacts is called Social Impact Assessment.

2.2.1.2 Economic impact assessment

Economic impacts are the effects on a selected area depending on its development level. Economic impacts are investigated in five main indicators which are: business output (sales), gross regional product, wealth (including values of properties), personal income (plus wages), and employment.

In other words, the clear economic impact is generally defined as economic change of an area's economy. For instance, the changes in opening, closing, expansion or contraction of a facility, project or program generates the economic impact. Economic impact assessment is not also prepared for new actions but also it can be prepared for an existing facility, project or program in order to observe their economic condition and economic change both negatively or positively.

The economic impacts are assessed into four main subtitles that are direct impacts, indirect business impacts, induced business impacts and dynamic economic impacts.

> *Direct economic impacts* are the deviations in local business activity showing up as a *direct result* of public or private business decisions, or public policies and programs.

Indirect business impacts are increases/decreases in the business. The consequences of changes in sales for suppliers to the directly-affected businesses including trade and services at the retail, wholesale and producer levels generates the indirect business impacts.

Induced business impacts are the results of further expenditures of food, clothing, transport, technology and other consumer goods and services and the changes in workers and payroll of directly and indirectly affected businesses. This impact causes business growth/decline throughout the local economy.

Dynamic economic impacts are consequences of wider differentiation of population growth over time, business location patterns, and of land price patterns that might also influence government costs and revenues. Besides, these changes are ultimately going to affect income and wealth not only for overall but also for any different groups of people in the impacted area.

There are different models and simulations used in order to measure the economic impact but the most well known one is Benefit/Cost Ratio.

The aim of Benefit-Cost Analysis to take into consideration all benefits and costs accruing to society from a project, development, plan, program or project inconsiderate of which particular party realizes the benefits, and/or costs, or the shape these benefits and costs take. If used properly, BCA reveals the efficient investment alternative economically, that is, the one that increases the net benefits to the greatest amount/value, to the public from a share of resources.

Benefit-cost ratio is defined as a measurement of the comparison of the benefits to costs. The B/C ratio is often used to select among projects if there are funding restrictions. According to U.S. Department of Transportation (2003),

> […]In this measure, the present value of benefits (including negative benefits) is placed in the numerator of the ratio and the present value of the initial agency investment cost is placed in the denominator. The ratio is usually expressed as a quotient (e.g., $2.2 million/$1.1 million = 2.0). For any given budget, the projects with the highest BCRs can be selected to form a package of projects that yields the greatest multiple of benefits to costs […].

Consequently, economic impacts are the effects on a selected area depending on its development level. Economic Impact Assessment is the research of the way in which the direct benefits and costs of a development affect the economy in levels of local, regional and national. Furthermore, Economic Impact Assessment should not be confused with Environmental Impact Assessment. Additionally, indirect economic impacts measured by Economic Impact Assessment based on the results of B/C Ratios are of major interest to decission makers, planners and public.

2.2.2 Environment impact assessment

Environmental impacts are the possible side effects caused by a development, by industrial or any infrastructure projects, plans and policies on the environment. For example, the nuclear power plants have really dengerous impacts on environment when one of the personnel working in the plant had a mistake or when some construction problems occurred. On the contrary, if they are well constructed and well administrated they are really good energy supplyers rather than thermal power plans. We, as a nation, lived and experienced the undesired environmental impacts of Chernonbil Power Plant and in the near past, Fukushima Power Plant had serious impacts on environment, intercontinentally. Furthermore, transport infrastructure investments have some positive and negative impacts on environment. The chain relationship of transport infrastructure and its environmental impact is shown in Figure 2.2, below.

According to Rienstra (1994) there is a chain relationship between transport infrastructure investments and environmental impact. Transport infrastructure affects transportation costs; transportation costs affect productivity of firms and households and accessibility at the same time; productivity of firms affects both employment and freight and passenger mobility; employment is affected by locational accessibility; finally employment and freight and passenger mobility affect environment together. Furthermore, Transport infrastructure impacts environment indirectly. On the other hand, physical transport infrastructure projects have some direct impacts on environment in terms of green area fragmentation.

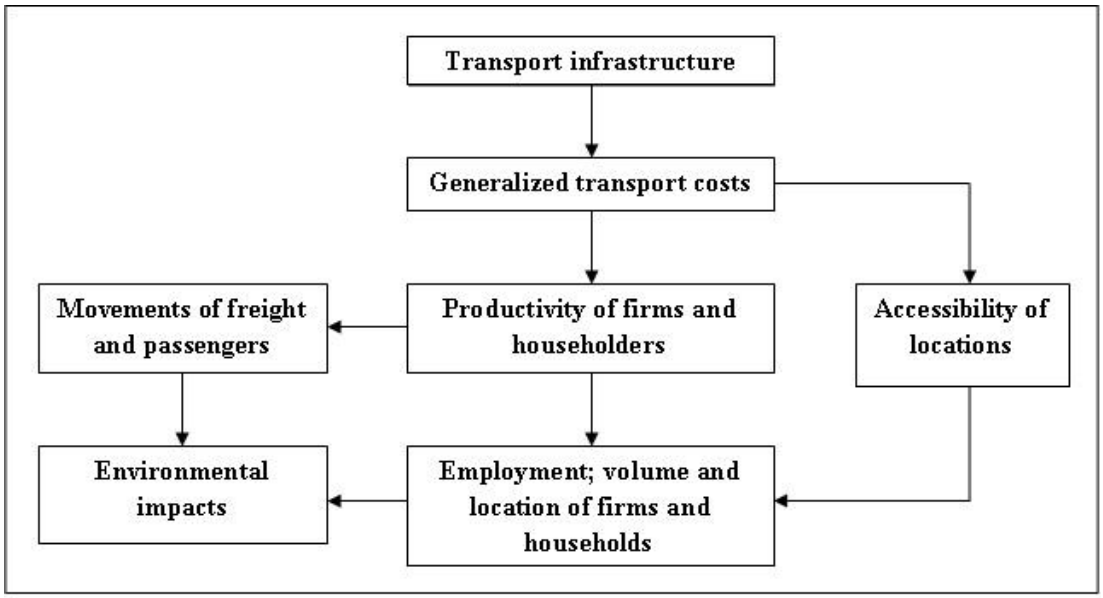

Figure 2.2 : Relationship between transport infrastructure and spatial development, adapted from Rienstra et al., 1994.

Thus, future is not known but, possible future can be predicted. So that, it should be nececssery to assess the possible impacts both positive and negative before the development begins. In Figure 2.3 below, environmental impacts can be seen in a chain in physical and economic terms.

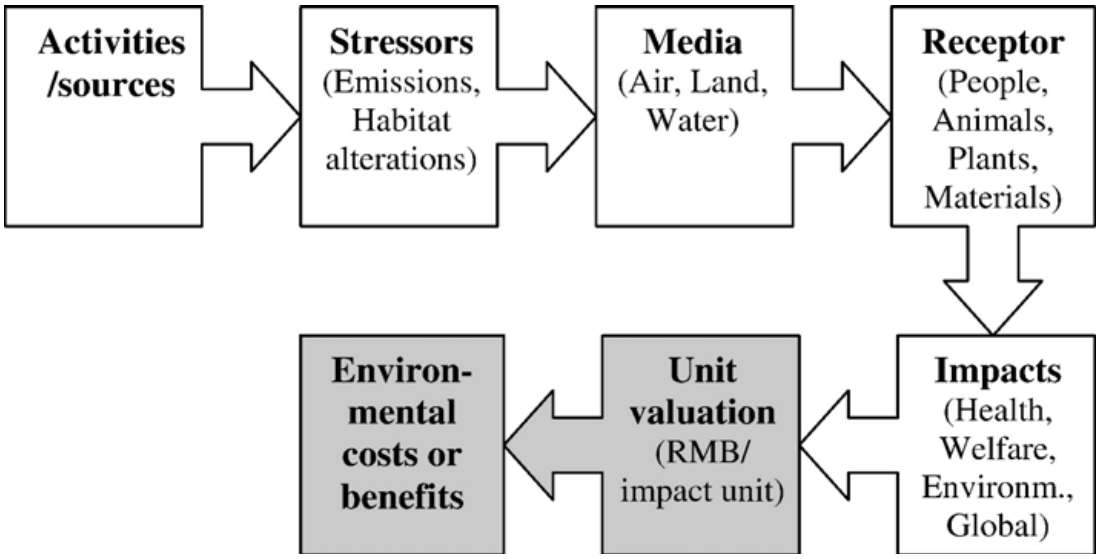

Figure 2.3 : The steps of identifying and predicting environmental impacts in pysical and economic terms adapted from ADB, 1996.

Environmental Impact Assessment is an investigation on environmental effects of a development, plan, project, investments or policy *before deciding.* It is created to show developers or decision makers and other actors, such as local administrations

and local authorities, understand the significance of environmental consequences of the action. Australian EIA Network defines the EIA as:

> "Environmental Impact Assessment (EIA) is the process of assessing the likely environmental impacts of a proposal and identifying options to minimise environmental damage. The main purpose of EIA is to inform decision makers of the likely impacts of a proposal before a decision is made. EIA provides an opportunity to identify key issues and stakeholders early in the life of a proposal so that potentially adverse impacts can be addressed before final approval decisions are made."

EIA was firstly introduced into the United States of America in 1970 and has spread fast since then it became a worldwide planning tool. EIA is still relatively new in some countries, but in general, all countries have it as a legal or administrative requirement for policy-making. The focus of Environment Impact Aassessment is generally, as expected, environment concern. But a good EIA also addresses to social and economic impacts. EIA is often made for a physical project such as dams, industrial plants, transport infrastructure (airport runways and roads), farm enterprises and natural resource exploitation. On the other hand, as a brach of EIA, Strategic Environment Assessment is used for policies, plans and projects. When it is considered for a planning tool, EIA is often confused with SWOT but in practice, EIA uses SWOT analysis.

In the mid-1990s, Sadler (1996) implemented a major international review of the effectiveness of EIA. Sadler's study was wide in its scope and comprehensive in its analysis depth and provides the most updated contrastive information on the strengths and weaknesses of EIA. The review showed that all countries should adopt EIA and its legal procedures. Of course, any legal improvements tend to enforce these legal procedures and improve the scope and effectiveness EIA. Therefore, EIA has been tried and got result at the project level. The main advantages of EIA according to United Nations Environment Programme are:

- developed project design
- good decision-making (with opportunities for public participation)
- more environmentally concerned decisions;
- improved accountability and transparency during the development process;

- improved integration of projects into their environmental and social setting;
- decreased environmental damage;
- more effective projects in terms of meeting their financial and/or socio-economic objectives; and
- a positive contribution towards achieving sustainability

in decision-making.

Principle 17 of the Rio Declaration on Environment and Development (1992) refers to EIA as a national instrument which "*shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment".* EIA is applied by countries with various levels of development, governmental policies and cultural heritage. The arrangements and practices that are in place in various countries differ, as a consequence of these factors. A general difference can be made between the distinctions of EIA systems of developed and developing countries. Since developing countries are less advanced, the EIA process is not very different, with common units, steps and activities. Additionally, the same primary principles for EIA practice apply internationally to both developed and developing countries (EIA Centre, 1995).

In short, Environmental Impact Assessment is implemented not only for physical projects of industry or infrastructure but also for plans, programs and policies. The key word for EIA is "before". If EIA is prepared before the action, it is easy to foresee the possible positive and negative impacts of it. Every plan, policy, project or physical infrastructure investment need to be assessed, environmentally. As we learnt from past, sustainanble development requires optimum usage of natural resourses. For that reason, when planning, making decissions and/or policies about any physical project EIA is crucial in terms of sustainable development.

2.2.3 Strategic environmental assessment

Strategic Environmental Assessment (SEA) is a tool for planning that helps to notified decisions in support of sustainable development by encompassing environmental concerns about the development of public policies and strategic decisions made by policy makers. SEA is crucial for plans and programs which are prepared for agriculture, forestry, fisheries, energy, industry, transport, wastewater

management, telecommunications, tourism, urban and regional planning or land use and which determine the future development goals.

From the last ten years, the world showed a fast, though argumentative, improvement of the environmental policy agenda. Progressively, traditional environmental decision making is being argued, not because it has not improved efficient legal mechanisms or methodological tools, or because it did not search to find solutions for critical environmental deterioration, but also because it is not efficiently supplying to the new challenges of the late 20th century, as confirmed and proclaimed by the United Nations Conference on Environment and Development in 1992. In particular, it is not fully achieving the initially desired consequences regarding environmental wellness and relations with economic and social issues.

Although there is a negative movement currently, much effort is done to ameliorating environmental performances, to increasing environmental concern across development sectors, in public, governmental, or private decision making, in inviting and guiding transformation in policy making attitudes and its other supporting values. Important environmental policy development is occurring not only in the developed countries but also in the developing and transitional economies.

Strategic Environmental Assessment (SEA) has been emerging in this context. There is a progressive complication behind and around current condition of development and decision making processes derived from the blast of electronic communications, the high speed of knowledge production and consumption, the critical public values of equity and fairness, the urgency of proportional decisions supported by rare or deficient information and conflicting priorities, all development vectors that are named for new forms of forward-looking intervention in more strategic contexts. Furthermore, the major difference between EIA and SEA is that in EIA the private sector is (depending on the project) involved, whereas actors involved in SEA are usually from the public sector. Therivel explains the popularity of SEA as:

> “The reason that SEA is so attractive is that SEA gets in earlier, before decisions are made on the overall direction to be taken by a program. If SEA is not done at an early stage, the set direction or pathway often becomes irreversible, and the alternatives to individual project actions become limited. Worse, individual project decisions become burdened by the

need to revisit other program alternatives that were examined at the strategic level and rejected. In addition, SEA is often the best way to address cumulative effects and synergistic effects issues, along with sustainability implications."

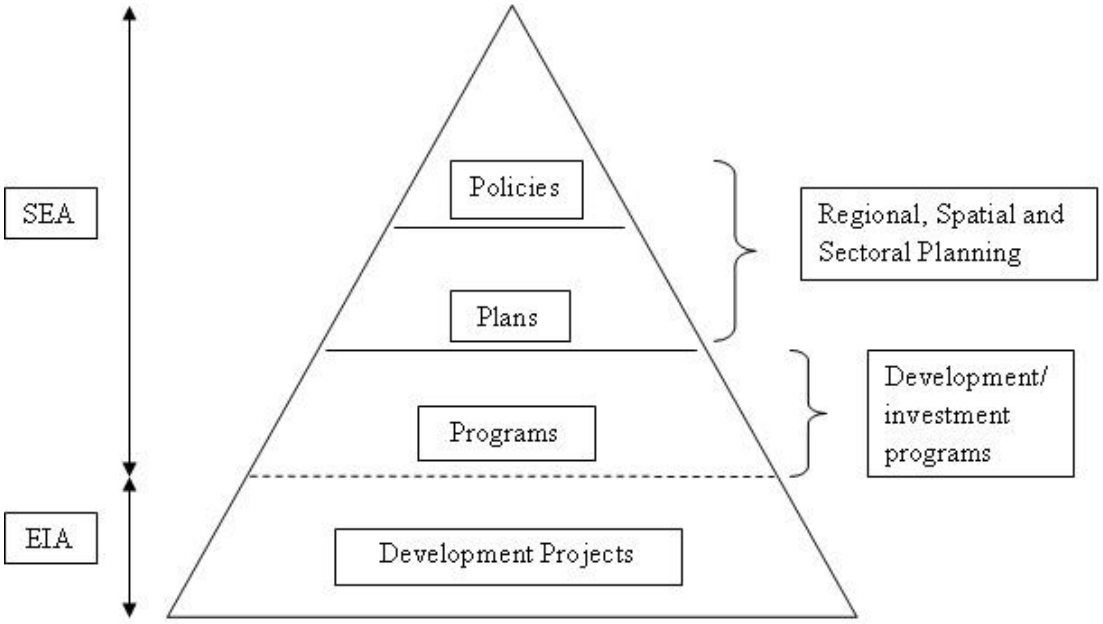

Figure 2.4 : Various levels of tiering SEA and EIA, adapted from Naseer, 2004.

In figure 2.4 above, the difference between SEA and EIA can be observed easily. SEA starts from the point that EIA ends.

2.2.4 Territorial impact assessment

Territorial impact can best be described as the impact of spatial development against spatial policy objectives or prospects for a defined territory. (ESDP Action Programme Progress Reports). Similarly, territorial impact cannot be restrained by scale because impact itself is not local or national. Territorial impact should be considered as social impact, economic impact, environmental impact, cultural impact, etc. European Commission's Impact Assessment (IA) procedure, which was introduced on 5 June 2002, is a relative new instrument. It continued on the report of the Mandelkern Group on Better Regulation (2001) and the White paper on Governance (EC, 2001) and the Mandelkern group was the stimulating factor behind the curtain. Both documents give directions to the 2000 Lisbon European Council's statement on better regulation which was emphasized at the Götenburg and Laeken

Councils in 2001. The Integrated Assessment points out to replace pre-single-sector initiatives and to assess the potential impact of policy proposals and legislation from an economic, social and environmental perspective. There are different methods that are used in order to determine the territorial impact. They can be either qualitative or quantitative. Some quantitative methods might be consisting of complex mathematical models and/or simulations. Analysis of territorial impact of EU policies on various areas such as transport infrastructure, cohesion, technology, etc. is a relatively new field of research, which has come alive in the wake of the European Spatial Development Perspective (EC, 1999) and Tampere ESDP Action Programme (Finnish Presidency 1999; Faludi & Waterhout 2002). Except for some early accounts (for example Williams 1996; Zonneveld & Faludi 1997) a first attempt to assess the EU wide territorial impact of EU policies was the report 'Spatial impacts of Community policies and the costs of non-coordination' by Robert et al. (2001). At the EU level this has been followed up by several impact studies in the ESPON programme. Also some national analyses have been carried out, but mainly in member states that have experienced disproportional negative impact of EU policies.

The technique of doing a territorial impact assessment has not settled down yet. For example, the ESPON studies, each of which assessed the impact of a single EU policy sector against the objectives of the ESDP, devoted much of their research budget on developing a suitable assessment approach. Between them, these approaches varied considerably. The approach used by Robert et al. (2001) was based partly on case study research and partly on general desk research. Also, most efforts until yet are ex-post analysis, whereas territorial impact assessment proper will be ex-ante research. Within ESPON there is attention for developing such an ex-ante assessment technique called TEQUILA.

The conceptual root of the term TIA can be went back to German and Austrian practice. Both countries have long standing formal procedures which relate specifically to TIA. In the case of Austria, TIA procedures date back to 1959, pre-dating by several years the introduction of environmental impact assessment, which only occurred in the context of the incorporation of the *acquis* in preparation for accession.

The concept of Territorial Impact Assessment (TIA) has been proposed in the European Spatial Development Perspective. It is a new planning practice although there is not a specific definition for TIA, it can be defined as a tool for assessing the impact of spatial development against spatial policy objectives or prospects for an area (Healy, A., May 2001). The sphere of transport policies was indicated as a priority one, confronted with an accessibility / environment trade-off but also with the challenge of a spatially equilibrated infrastructure endowment and provision: ‘‘Comprehensive integrated spatial development strategies’’ are needed, and ‘‘in the future, Territorial Impact Assessment should be the basic prerequisite for all large transport projects’’ [ESDP, CMSP, par. 109, 1999]. In other words it is suggested in the ESDP that it should be used as an instrument for the spatial assessment of large infrastructure projects. Generally TIA consists of four fundamental phases which are;

Scoping, Analysis, Conclusions, Monitoring of the Results.

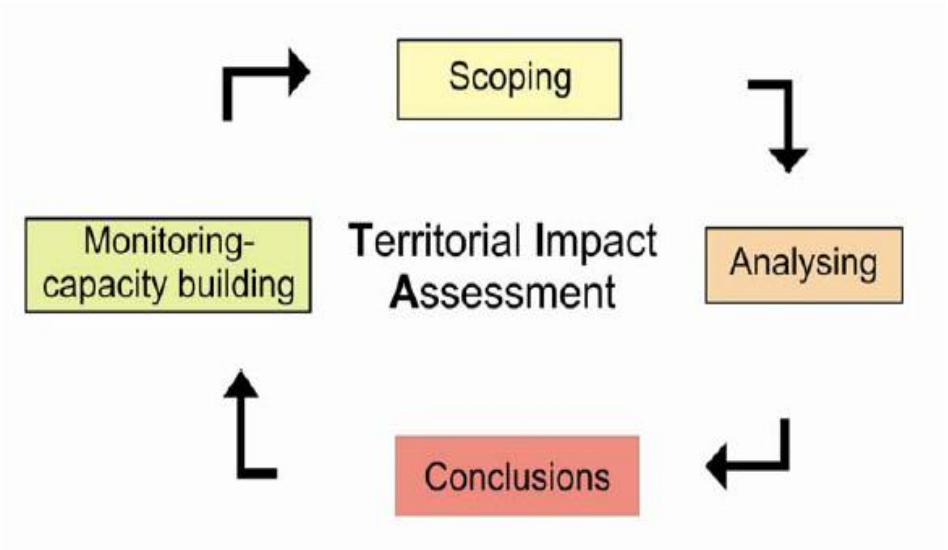

Figure 2.5 : 4-level procedure of TIA adapted from Miclavcic, 2007.

Figure 2.5 show that TIA has a continuous circle, which contains four phases in order: scoping, analyzing, conclusions and monitoring-capacity building. First, there must be an aim for assessing the territorial impacts, for instance, measurement of accessibility, transport infrastructure projects, policies (environmental, cohesion, transport policies, etc.), plans, programs and so on. After scoping phase terminated, it should be decided which method (qualitative, quantitative or both) will be used to analyze the data. This phase has extra importance because it changes the method of

analyzing. In conclusions phase, the results/findings of analyzed data are given and findings are evaluated according to the scope defined at the beginning. Finally, the monitoring-capacity building phase refers to the conclusions, terminates the circle by making the territorial impact assessment and involves the public into the issue. By monitoring the findings, public participation and public concern for any development will be completed successfully.

Normally, the outputs are relevant to different areas, so one TIA can effectively assist to improve policy coherence in different fields. The last or the first phase of the TIA is an on-going sound and careful monitoring which enables individual evaluation of measure during and after the implementation period and can significantly add to improved sector policy adopted later on.

Consequently, Territorial Impact can be defined that it is a combination of social, environmental, economic, and cultural impacts. Evaluation of these impacts in the same concept names the Territorial Impact Assessment for sure. Territorial Impact Assessment generally used for the territorial policies that are made by decision makers.

3. SELECTED CASES ON TRANSPORT POLICIES IMPACT ASSESSMENT

It is imported to look at world examples on transport impact assessment. As it is known very well that, there are different planning systems that countries implement. Top-down planning systems are different from bottom-up planning systems. Our country, as a candidate country for EU, has a top-down planning system like most of the EU countries. For example, in France, planning decisions are made by the central government but in co-ordinance with local authorities. Planning system of Italy looks more like our planning system. Our development plans are made by the central government to balance between eastern and western regions. Italian central government makes it on its northern and southern regions in a similar way. On the contrary, the United Kingdom has a bottom-up planning system. Planning in this country starts from the local authorities and public has an important role in the system. It is same in the USA. In short, it will be useful to investigate world examples on transport policies impact assessment in order to observe what the countries do on this issue and to determine what our condition is.

3.1 Trans European Networks (TENs)

First, it is useful to look at the developments in the recent past. As it is totally early to assess the impact of a series of policy measures taken since 2000, a few determiners can in spite of what preceded be refined from market trends and data. These can be assessed against the policy objectives took in the consideration in the mid-term review of the White Paper and those set for transport by the sustainable development strategy (SDS) of 2006. Transport is one of the most important element of the European economy. Rodrigue (2006) shows the importance of linking border regions and the relationship between transport and regional integration and regional economy below in Figure 3.1.

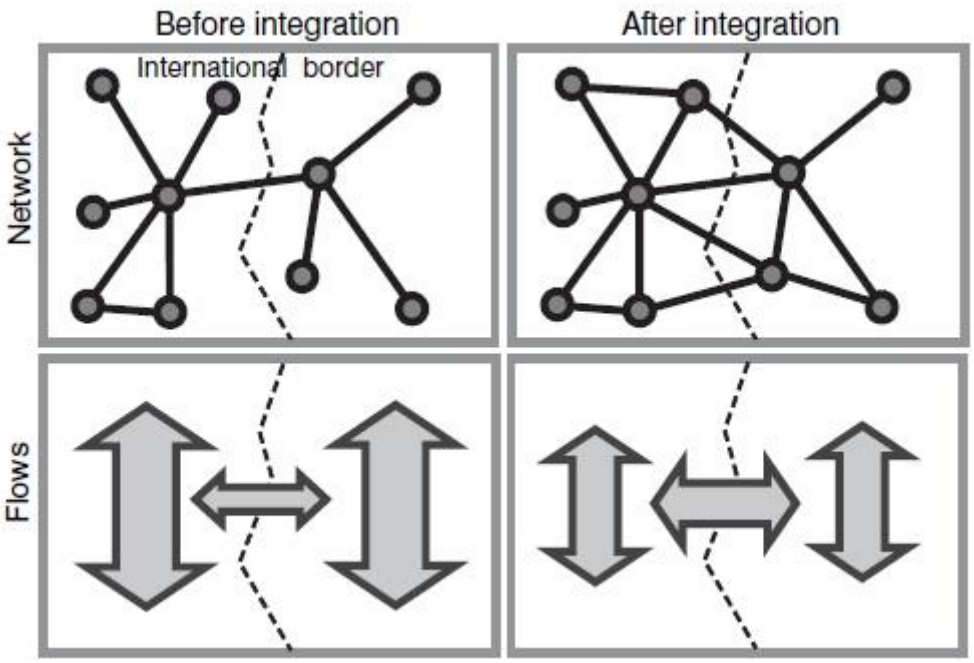

Figure 3.1 : Impacts of integration process on networks and flows adapted from Rodrigue, 2006.

The investments and the projects, which developed in the sector of transportation, are highly related to national and regional development and regional competition. For instance, when the history of EU countries is investigated; the big scale transport projects attract attention. The sector of transportation takes place for the national economy with its direct and indirect contributions in terms of for not only transport investors but also national economy. For that reason, it would not be appropriate to assess the transport investments for only their cost-benefit analysis and from the eye of investors and of constructors.

It must be taken into consideration that the safer and cheaper transportation of people and freight is possible by an improved transport infrastructure and by modern transport equipments (Cole, 2005). The transport industry at large accounts for about 7 % of GDP and for over 5 % of total employment in the EU. The European Transport Policy has contributed to a mobility system that compares well in terms of efficiency and effectiveness with that of the economically most advanced regions of the world. The ETP has assisted social and economic cohesion and promoted the competitiveness of the European industry thereby contributing significantly to the Lisbon agenda for growth and employment. More limited, however, have been the results with respect to the goals of the EU SDS: as indicated in the progress report of

2007. The European transport system is still not on a sustainable path in several aspects. EC said in 2009 that it was decided to update the existing infrastructure because of high costs of built new ones. According to the European Commission, transport industry has 7 % of GDP and 5 % of total employment in the EU. European Transport Policy (ETP) is essentially based on efficiency and effectiveness with that of the economically most advanced regions of the world. In this respect, sustainability in transportation has the most important role in the EU transport policies. In other words, ETP stipulates less dependence on highways and requires more balanced transportation modes study provided a unique opportunity to look at forecast issue with a wide range of model types and new clustering approach for model. Priemus and Zonneveld explains where the idea of TENs comes from:

> […] "In regional policy there was a firm belief that enhancing the level of connectivity would stimulate the economic performance of regions lagging behind. This line of thinking was scaled up to the level of Europe. Economic integration pushed forward by the Europe 1992 project should thus be accompanied by a policy program aimed at the physical integration of the European territory. This was linked in part to the expectation that certain areas and regions would profit more from integration than others, and that there will also be some clear losers. Geographical location has a lot to do with this, so it was assumed. New cross-border and transnational infrastructure would offset remoteness and peripherality and, in general, make economic integration physically possible. Assumptions and expectations like this have led to the project of Trans European Networks, which is probably (at least in financial terms) one of the most important outcomes of the European infrastructure discourse" […].

Additionally, in the White Paper 2011, EU transportation goals for 2050 are listed as:

- No more conventionally-fuelled cars in the cities.
- 40% use of sustainable low carbon fuels in aviation; at least 40% cut in shipping emissions.
- A 50% shift of medium distance intercity passenger and freight journeys from road to rail and waterborne transport.
- All of which will contribute to a 60% cut in transport emissions by the middle of the century.

In the Focus Groups' Report, 2009, it is emphasized that existing and planned to construct Trans European Transport Networks support a regional integration in the EU. In this context, the aim of European Regional Integration is to make strong bonds and improve these bonds between EU and Mediterranean and Non-EU European countries.

Besides, in the White Paper, it is emphacised that weaknesses in transport planning are also in relation with the Trans-European Transport Network. TEN-T planning and implementation has not been coordinated sufficiently by a coherent European design so far. National infrastructure planning remains to a large scale disconnected from planning at EU level, and is mainly done at a modal level rather than in an integrated way across countries and modes of transport. The lack of international cooperation and coordination often caused a number of inefficiencies: lack of joint congession estimations leading to differing investment plans; disconnected or even contradictory timelines; lack of joint investment calculation and joint financial structures; incompatible technical characteristics; inadequate joint management of cross-border infrastructure projects. Moreover, national and European infrastructure projects have been generally developped improving individual priority projects rather than creating a network. Infrastructure planning and assessment of individual projects failed to give an accurate representation of various effects of infrastructure projects and of how these projects contribute to the overall infrastructure network. In summary, White Paper shows that the consideration of transport demands and of shifting transport flows is currently not sufficiently integrated in land-use planning decisions, resulting in excessive or sub-optimally distributed transport demand. The negative environmental, territorial and socio-economic impacts of transport are aggravated.

Any biggest change in transport will not be possible without the support of a sufficient network and more intelligence in using it. In total, transport infrastructure investments have a positive impact -unless they are not in coordination with the transport network plan which are prepared by National Planning Level and/or EU Level- on economic growth, create wealth and jobs, and enhance trade, geographical accessibility internation connectivity and cross-border cooperation and the mobility of people. Big infrastructure investments must be planned in a way that increases positive impact on economic growth and reduces negative territorial impacts. Trans

European Networks designed by the end of the 1980's together with the aimed Single Market and competitiveness in the world. It is necessary for a big single market, with freedom of movement within it for goods, persons and services, if the different regions and national networks making up that market are not properly combined by new and efficient infrastructure. However, TENs divide into three parts: transport, energy and telecommunication.

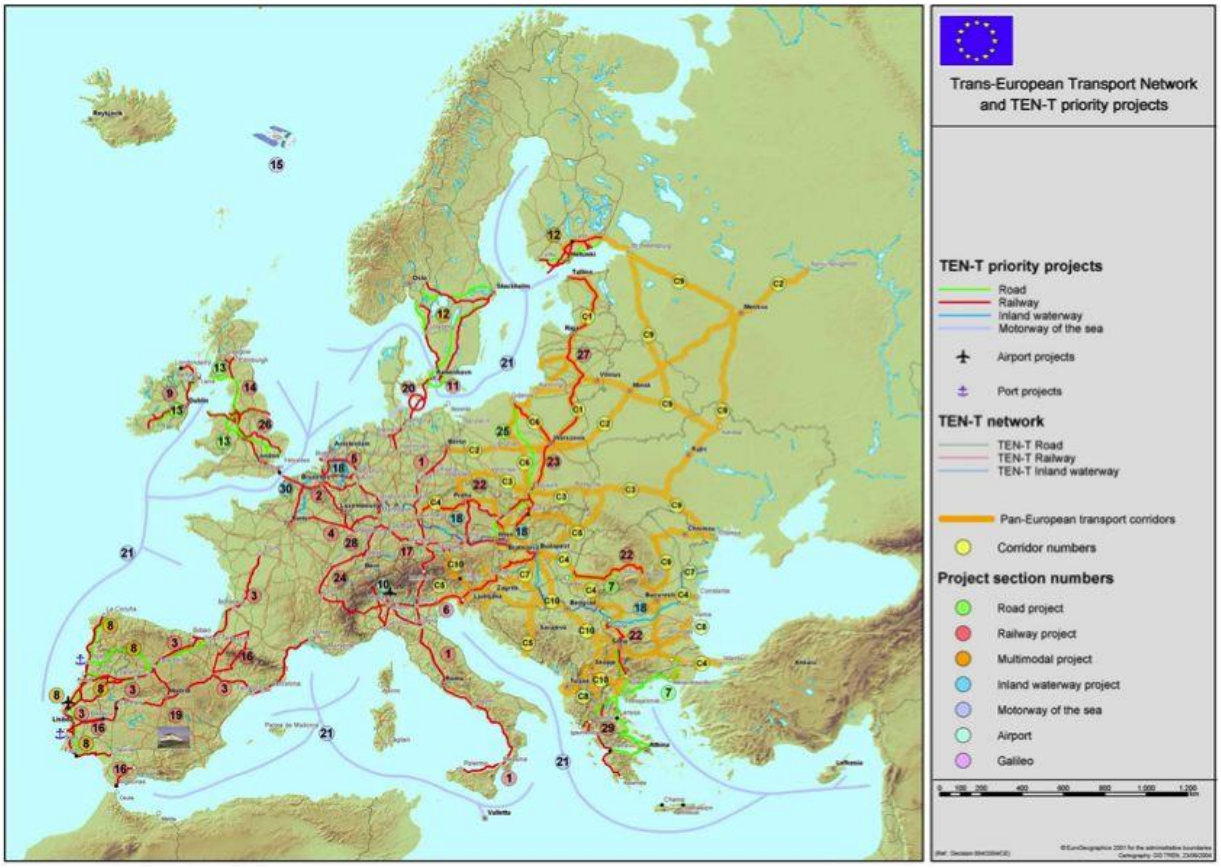

Figure 3.2 : Trans European Networks adapted from EU, 2010.

In Figure 3.2 above, it is seen the existing transport corridors and and EU-Neighboring partnership transport corridors projects. When we look at the south and southeast Europe, we can observe that most of the transport projects take place in eastern European regions in terms of TENs because of EU enlargement and because of neighboring policy.

3.2 Trans European Transport Networks (TEN-T)

Transport infrastructure is essential in order to keep market strong. Most of the transport infrastructures had developed under national policy-making authorities. In

order to establish a single, multi-modal network that integrates land, sea and air transport networks throughout the Union, Trans European Transport Networks, allowing goods and people to circulate quickly and easily between member states and assuring international connections are decided to establish by the European policy-makers. Additionally, in terms of competitiveness of the European Union regions in the world, creating a single market, mobility and linking the regions each other, several financial instruments of the EU such as European Commission, the Cohesion Fund, the European Regional Development Fund and European Investment Bank support TEN-T project.

The European Commission defined the elements of Pan-European Transport Network strategy as Pan-European transport corridors and areas, extending the TEN-T to new union member states, a common approach to the use of transport technology, the intelligent use of transport networks and Pan-European cooperation in R&D. The transport Policy is defined by the European Commission's Directorate-General for energy and transport, whilst the Trans European Transport Network Executive Agency turns it into action. The agency was founded in 2006 to implement and manage the TEN-T program on behalf of the European Commission until December 31, 2015. The Pan-European Transport Conferences held in Prague in October 29-31, 1991; in Crete March 14-16, 1994; and in Helsinki June 23-25, 1997 have resulted in the adoption of ten Pan-European Corridors. The commission realized that the transport sector is increasingly international and that therefore EU needs to ensure further connection with its neighbors in order to improve economic and environmental interests to the mutual benefit of both, EU and the neighboring countries. The EU and its neighbors face many of the challenges such as climate change and advancing safety and security, so it would be sensible to co-operate on them. In 2007, in European Commission Impact Assessment Working Paper, it is indicated that the commission decided to make principles for transport in Europe and neighboring regions, which extended the major European transport axes to the neighboring countries. It identified five cross-border axes (four of them are land based one of them is water based) to connect the EU with its neighbors:

A northern axis that connecting the northern EU to Norway, Russia and Belarus;

A central axis linking central Europe to Ukraine and the Black Sea;

A southeastern axis linking the EU with The Balkans and Turkey and with the countries of the southern Caucasus, the Caspian Sea and the Middle-East including Egypt and the Red Sea; and

A southwestern axis linking the EU with Switzerland and the Maghreb countries.

At the Naples conference (2009) there was representatives from neighboring countries such as Russia, Senegal and Turkey, who were there to discuss how transport links could be improved together. Additionally, Turkey is connected to the TEN-T via Istanbul; the fourth corridor which is shown in Figure **3.2** with green line. The projects cover the transportation modes of air, rail, road, maritime, inland waterways, logistics, co-modality and innovation. According to Trans European Transport Network Executive Agency, the entire TEN-T project covers the transportation modes of air, rail, road, maritime, inland waterways, logistics, co-modality and innovation. According to Trans European Transport Network Executive Agency, the entire TEN-T projects as:

At the Naples conference (2009), there were representatives from the neighboring countries such as Russia, Senegal and Turkey, which were there to discuss how transport link could be improved together. Additionally, Turkey is connected with the TEN-T via Istanbul. The fourth corridor is shown in Figure **3.2** with green line.

TEN-T project covers the transportation modes of rail, road, maritime, aviation, inland waterways, logistics, co-modality and innovation. According to Trans European Transport Network executive Agency, the entire TEN-T project aim:

- Establish and develop the key links and interconnections needed to eliminate existing bottlenecks to mobility.
- Fill in missing sections and complete the main routes - especially their cross-border sections.
- Cross natural barriers.

It is possible to say that rail projects have a huge percentage of the total transport infrastructure projects under the term 2007-2013 according to Figure 3.3.

Figure 3.3 : TEN-T rail corridors in EU and its neighbors adapted from COM, 1997.

Figure 3.3 shows that Turkey joins to TEN-T from the fourth corridor in terms of rail transport corridors. Sofia (Bulgaria) is the intersection point of fourth and eighth corridors. The fourth corridor starts from Nuremberg, Germany and lies to Thessalonica, Greece and Istanbul, Turkey separated from Sofia, Bulgaria.

As a major transport infrastructure project, Channel Tunnel did not change the economic condition of Kent region in the UK according to Vickerman. In his ex-post analysis Vickerman states, there was a good employment during the construction of the Channel Tunnel in the Kent region and the economic condition of the region was changing positively.

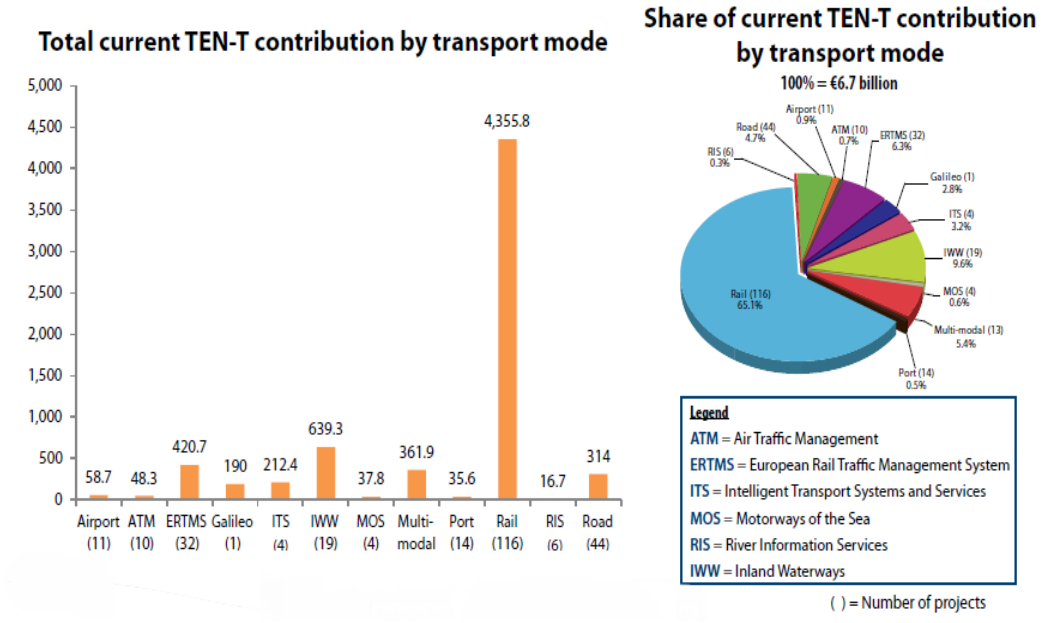

Figure 3.4 : TEN-T projects in numbers adapted from COM, 1997.

Figure 3.5 : The Channel Tunne adapted from Eurotunnel, 2010.

However, afterwards, the Channel Tunnel made railways strong actor in transport sector against roads. First, it was seen that the Channel Tunnel could reduce the maritime traffic in the English Channel but then, the ferries which carry freight and people between the UK and France, were still competing with the tunnel. Because of high fees of Eurotunnel, companies and people preferred mostly ferries but nonetheless Eurotunnel is not affected by any weather conditions. This is an important advantage of Eurotunnel comparing to other transport modes used in the English Channel. Finally, all the facts from a period, which may have seen big changes on Kent's economy, point to radical permansion of the status quo: a major

infrastructure transport project implemented in a region does not change, in a dispensable way, the economic wealth of that region. From this point of view, Trans European Networks (TENs) policies were developed for not only to supply a sustainable transport to union but also to make the regional differences reduce between the regions of the EU. When bonding the regions, big scale infrastructure projects usually occur for instance The Channel Tunnel between the UK and France. Although the TENs policies are primarily based on railways, maritime and inland waterways, highways have still important role on bonding the regions of the EU and on bonding the EU with its neighbors.

For our country, there are two main major transport infrastructure projects under construction and decided to be constructed: The Marmaray Railway Crossing (immersed tube tunnel) and The Third Bridge Highway Crossing with its connected motorways. Firstly, the highways are very significant for Turkey in terms of EU integration *for short term*. It can easily be seen from the existing transport infrastructure cartographies. From this point of view, the role of Istanbul for Turkey to the EU is critical just because Istanbul is the biggest region on its own in the southeast Europe region. On the other hand, in person, it is not enough to construct highways in long term to connect southeast Europe with Istanbul and other alternatives should be taken into consideration. Therefore, the Marmaray project is planned for the regional integration of Istanbul to the southeast regions of the EU. Extension of Marmaray Railway Crossing in east-west direction is not only a big step in terms of TEN-T in regional integration but also increase the economic welfare both regional and national. At the same time with the Marmaray project, a new transport policy has been planned: The Third Bridge Highway Crossing. According to the decision makers, the major transport infrastructure investment is going to reduce the regional transport traffic (freight transport generally) load together with Marmaray. The aim is to take the transit traffic from existing roads and mitigate the heavy urban traffic. Nevertheless, this new axe will be connected to the existing main motorway: E6, in other words or its most well known name Trans European Motorway (TEM). Therefore, it is always open into criticism in terms of regional integration and its effectiveness. Besides, the major transport infrastructure projects have some environmental, socio-economical and territorial impacts on the regions where they are planned to construct.

Finally, the Trans European Transport Networks project is a dynamic project according to EU regional integration and spatial development policies. Linking the regions of Europe and of neighboring countries requires time and experience. Besides, it is getting complicated because of laws, regulations and legislatives of the Non-EU countries. Neighboring countries, such as Turkey, should adapt their transport and regional development polices to the EU regulations via revising and/or renewing. In this context, Turkey, as a neighboring country of the EU, has been negotiating on EU membership. Nevertheless, transportation of Turkey under the topic of regional integration is still depending on roads.

3.3 Pan Korea Grand Waterway

Asian examples from Korea (Korean Republic) in terms of major transport infrastructure projects are the construction of highway between Seoul and Pusan cities, the railroad project of Korea Train Express (KTX) and Pan Korea Grand Waterway and the Saemangeum and land reclamation project. These projects announced by Korean government are the results of rapid economic growth and being an industrialized country in such a short time. But Ahn et.al. state that public concern was not enough and people in Korea were not participating into decission-making process until 70's because of naturally tought Confucian philosophy. But it had been seen that environmental concern, social and territorial impacts of major transport infrastructure investments by President of Korea so that government intervention to the transport polices was announced presidentially for the construction of Pan Korea Grand Waterway which is a project planned to be a canal length of 540 km. connecting Seoul and Busan, South Korea's two metropolitans. The canal would construct diagonally across the country connecting the Han River, which flows through Seoul into the Yellow Sea, to the Nakdong River, which flows through Busan into the Korea Strait. The planned to be constructed canal would crosswise tough mountainous geography. They also stated that early experiences of unclear cost-and-benefit analysis on major transport infrastructure projects caused great suspicion to Korean community since the share of cost-and-benefit tended to reduce over time. As seen in Figure 3.5, Pan Korean Grand Waterway project is a really big infrastructure investment example for inland waterways transport policy. Although there a many difficulties to construct such a project which passes the

country from north end to the south, it is planned by Korean policy makers. And the consequences and/or impacts of the project have still been criticizing publicly.

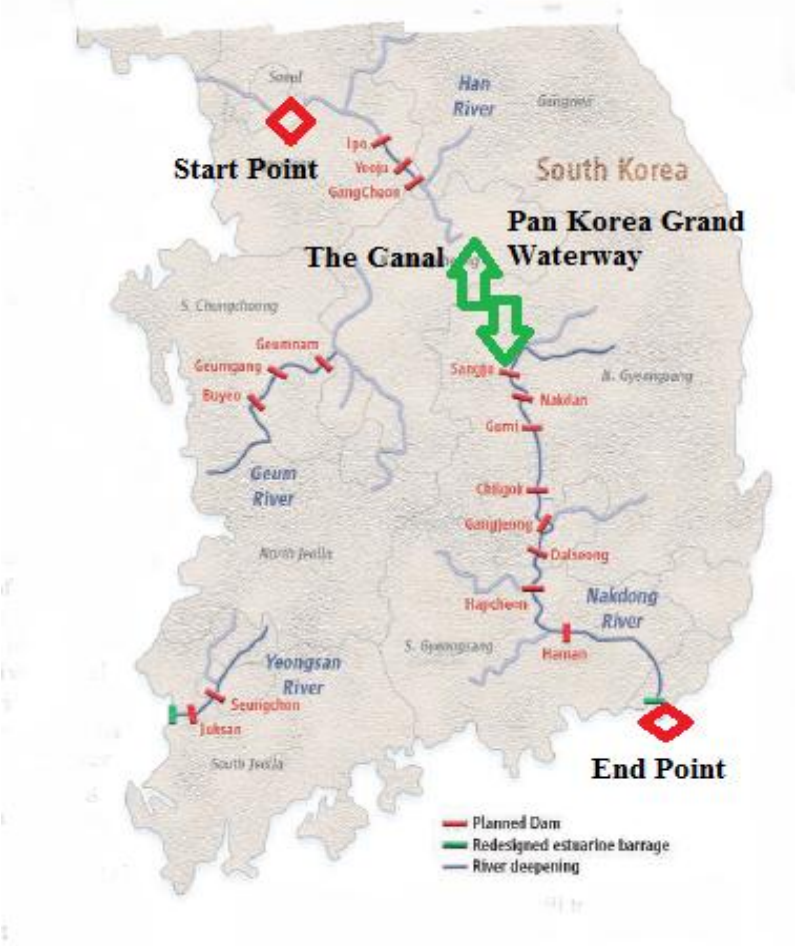

Figure 3.6 : Pan Korea Grand Waterway adapted from Yeojou, 2010.

If the Pan Korea Grand Waterway project it will be new and efficient inland waterway corridor in terms of regional transportation, however, Korean media and society do not believe the feasibility of Pan Korea Grand Waterway project because of its high budget of construction. Moreover, the environmental and socio-economic impacts of the project concern the public and the NGOs in Korea.

3.4 CANAMEX Corridor

As we know from the EU transport policies that, transport corridors are components of TEN-T project. As I stated before, Turkey joins from the fourth corridor to the TEN-T. This type of network creation also exist in the north America via NAFTA.

Despite the national transport corridors currently exist in the USA, via NAFTA, there are international or crossborder transport corridor examples under the cooperation of northern American countries; Canada, United States and Mexico.

The North American Free Trade Agreement (NAFTA) is founded in 1994, bringing into existence one of the world's largest free trade zones and deepening the foundations for powerful economic development and increasing welfare for Canada, the United States, and Mexico. From 90's to nowadays, NAFTA has proved that wealth and competitiveness, supplement of really good earnings to householders, agriculture sector, manufacture, and service sector are improved by free trade. In order achieve the goals of socio-economic aspect in Northern America, the NAFTA members needed to develop transport corridors similar to TENs. One of these corridor projects, the most improved one, is CANAMEX Corridor. The CANAMEX Corridor is a cross-border corridor, with multi-modal transport, identified in the federal Intermodal Surface Transportation Efficiency Act, the 1995 National Highway System (NHS) Designation Act and the Transportation Equity Act of the 21st Century (TEA-21) as high priority corridors. CANAMEX comprises transportation, commerce and communications components. The transportation component calls for the development of a continuous four-lane roadway from Mexico through the US CANAMEX states, into Canada. The NHS Designation Act specifies the CANAMEX Corridor beginning from Mexico City to Nogales, Arizona, through Las Vegas, Nevada, to Salt Lake City, Utah, to Idaho Falls, Idaho, to Montana, to the Canadian border city Edmonton.

According to CANAMEX Corridor Coalition (n.d.) the development of the CANAMEX Corridor is advanced in organization through a multi state cooperation together with representatives of public and private sector selected by the Governors of the five states of the USA (Arizona, Nevada, Utah, Idaho and Montana). The Governor of Arizona assigned a team that represents state directors, and community and business leaders. The aim is to strategically have an infrastructure investment and technology to be professional on a focused agenda to improve competitiveness in global trade, to increase employment by creating new jobs and to widen the economic potential of the five state regions.

Figure 3.7 : CANAMEX Corridor adapted from Canamex Maps, 2012.

As Figure 3.6 shows that CANAMEX corridor is a cooperated project between USA, Canada and Mexico. It consists a series of multi-modal transport projects both freight and passenger transport.

However, there are some challenges of construction of the road called U.S. 93 because of bypassing the Hoover Dam by a new bridge on Colorado River. Furthermore, this additional bridge construction increased the concerns in terms of the negative environmental impacts. Although there are negative environmental impacts, CANAMEX corridor supplies a good regional development and accessibility from Canada to Mexico through USA.

3.5 Trans-Texas Corridor

Trans-Texas Corridor (TTC) planned to be a 6437 km-long network of auto and truck lanes (with payment), high-speed freight and passenger rail tracks, and right- of -way for electric power lines and gas and water pipelines. The corridor runs from north to south (to the Mexican Border) through the center of the state. The quarter wide corridors (the length of the corridor is 4000 miles in non-metric units) of TTC

parallels major Interstate highways, take 2331 km^2 (900 square miles) of land, and affect 2428 km^2 (600,000 acres) of land and water habitat. The cost estimation for the project is about $184 billion.

The purpose of the TTC is to accelerate the freight flow from Latin America and Asia through Texas to the Midwest, the Northeast and Canada. However, TTC is not designed to address the transportation problems of Texas State, which are in the metropolitan areas; TTC bypasses major cities and rural communities. It is a major transport project example (transport corridor) from Texas, the USA.

According to Environment Defence Fund (2012), authority for the TTC was not supported in 2002 by any serious legislative debate or consultation with commissioners, local city officials or regional planning agencies. The public and most of the local NGOs were first informed of the project in 2005 when the Texas Department of Transportation (TxDOT) held one public meeting in each of the 254 counties. The Environment Defence Fund states the public concern for the project as:

> "As public opposition to the TTC has grown over its environmental and property impacts, it became a major issue in the 2006 statewide elections, drawing opposition from the Republican, Democratic, Libertarian, and Independent Parties as well as the Farm Bureau, the Cattle raisers, environmental organizations, and hundreds of local city councils and county commissioner's courts."

As a multi-modal transport project, Trans Texas Corridor is open to criticism for environmental and regional economic aspects. In their study, Juri and Kockelman (2005) predict a few deviations in production, suggesting stronger differentiation in most productive counties located near points of final demand, and more noticeable impacts in counties spread out of the TTC. The construction of TTC has little impact in the final demand distribution pattern, explaining the increased predominance of the same counties when intra-Texas transport costs are reduced.

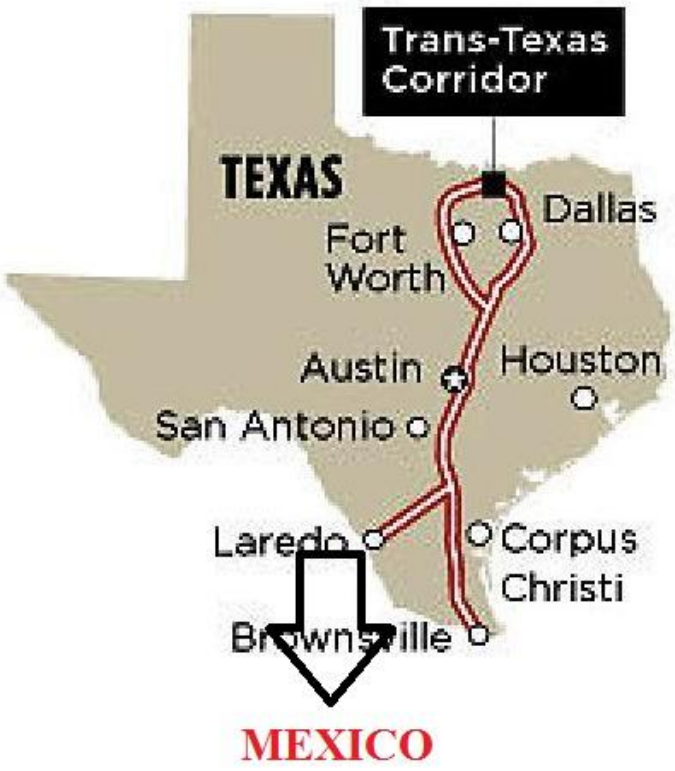

Figure 3.8 : TTC route adapted from Texas Department of Transportation, 2012.

The 4000 centerline miles of highways of TTC and railways will have definitely impacts on the economy of Texas and its public travel choices. Juri and Kockelman state that the household and business location decisions also will be affected. Economic activities and trade is going to rearranged, particularly in areas poorly connected in to the transportation network currently. Industrial production is going to differ with in each zone and commercial markets will grow. With Trans Texas Corridor project, only 52 % of counties of Texas will gain benefits in terms of economics. Additionally, expropriation of huge amount of private land is significant in one of the most public concerns. On the contrary, community accepts this expropriation in terms of constructing one huge transport corridor rather than less amount of roads depending on the raised nececity and demand of roads. In other words, TTC project will have some positive territorial impacts in terms of regional development, however, the tolls still are high and this causes that the inefficiency of the project is inevitable.

Finally, as it is seen from the examples of major transport infrastructure projects from world that, every single transport investment has not only environment and/or socio-economic impacts but also considerable territorial impacts in the context of regional development and integration. Unless the policy makers decide to make an investment in terms of transport infrastructure on their own without any impact assessment tools (especially TIA), the consequences of these investments will generally be negative in long term.

4. METHODS AND MODELS OF IMPACT ASSESSMENT

Generally, qualitative methods are preferred in social sciences. On the contrary, there are some examples that qualitative methods combined with quantitative methods are used in future studies such as ex-ante, ex-post and scenario analysis. In order to determine possible futures for a defined problem, these methods might be so useful and complementary of commenting the results of statistically analyzed data. There are very complex methods which forecast the territorial impact of transport according to determine the problem which has been looking for. There are generally ex-post analysis, ex-ante analysis and scenario analysis as qualitative methods and causality analysis, SASI Model, Spatial-Equilibrium Model, Multi-Criteria Decisions Making as quantitative methods. This study is based on a quantitative analysis. First of all, beginning with the specific methodology of causality analysis of regional production and accessibility is going to be very important in order to explain why TEQUILA model has been chosen for this study. After this fundamental model, causality analysis, it is going to be presented the quasi-production function model with accessibility, the SASI model. On the other hand; Spatial-Equilibrium Model of Trade and Passenger Flows, which uses the outputs of the SASI Model as inputs, is going to be another model which forecasts the territorial impact of transport. Finally, the TEQUILA model is going to be presented in detail.

Table 4.1 : The classification of methods and models of impact assessment.

Methods & Models	**Classification**	
	Qualitative	Quantitative
Ex-Post/Ex-Ante Analysis	☑	☑
Scenario Analysis	☑	☑
MCDM		☑
Causality Analysis	☑	☑
Quasi-production Function Model		☑
The SASI Model		☑
TEQUILA Model		☑

Although methods and models of impact assessment can be classified simply as qualitative and quantitative, some methods can be in both classifications. Table 4.1 shows a brief classification of the methods and models of impact assessment. For example, Scenario Analysis can be also quantitative because in some scenarios statistically data analysis is possible. For that reason, the rigid classification might be inappropriate.

In this section, methods and mathematical models are going to be presented related to the thesis topic. As I explained before, in quantitative part TEQUILA model is going to be implemented and ex-ante will be supporting method in this study.

4.1 Qualitative (or Mixed) Methods

Qualitative methods are generally used in social sciences but there are some examples which qualitative methods are used in future studies such as ex-ante, ex-post and scenario analysis. In order to determine possible futures for a defined problem, these methods might be so useful and complementary of commenting the results of statistically analysed data.

4.2.1 Ex-post and ex-ante analysis

Ex-Post and Ex-Ante are the opposite concepts so that Ex-Post means “after the event” and Ex-Ante means “before the event”. Ex-Ante is more like modelling or prediction. Ex-Ante evaluation, which is a process itself, is an essential tool for efficient management and a formal requirement. The aim of Ex-Ante is to collect data and put in effect analysis which help to define objectives to gurantee that these objectives are able to be met, that the tool used are cost-effecient and that reliable later evaluation is going to be possible. According to The Communication of Evaluation of July 2000 (point 2.3.1) a well designed Ex-Ante analysis is necessary because it enables a suitable esteem of if the recommended grade of funding and resources are coherent with the expected results and impact plus reliable Ex-Post analysis, and hence accountability for results and impacts, is largely dependent on the quality of the preparation of the intervention at its outset. An ex ante assessment can occur at variance levels of activity. It can direct a policy, a programme or a project which is related to this study: major infrastructure transport projects. When a major infrastructure project is considered to be constructed; analysing the current

and/or past economic and social conditions, employment rate, income, etc of the region before the major transport project is completed, defines Ex-Ante Analysis. It can also use the projection data in order to precast the territorial impacts of a policy, programme and project. Similarly, the analysis done after a major project is completed and publicly used defines Ex-Post Analysis. For example, the analysis which is done by researchers about Marmaray Project today can be Ex-Ante. On the contrary Ex-Post Analysis can be done after the Marmaray Project was finished. Similarly, Third Bridge Project and new regional transport policy for Istanbul can be an example of an investigation which is methodologically made by using Ex-Ante Assessment. Therefore, Ex-Ante becomes an instrument for decission makers to evaluate possible and or expected results of a policy or a project which are planned to start. For that reason it is vital to make an Ex-Ante Assessment before beginning to any project. In addition, any earlier works, regulations, projects, plans, financial calculations, economic indicators and their projection data for future (for the completing time of a planned project). Moreover, Myrdal defines Ex-Ante and Ex-Post in this way:

[…] an important distinction exist between prospective and retrospective methods of calculating economic quantities such as incomes, savings and investments and; […] a corresponding distinction of great theoretical importance should be drawn between two alternative methods of defining these quantities. Quantities defined in terms of measurements at the end of the period in question are referred *ex-post*; quantities defined in terms of action planned at the beginning of the period in question are referred to *ex-ante* (Myrdal, 1939).

On the other hand, because of its primary aim is improving the quality of a programmed project and collecting data for the decision makers to evaluate the value and possible results; it is very significant to begin ex-ante analysis work early on in the process. In parallel, ex-ante analysis should be fed very often from ex-post reports in order not to repeat the same mistakes that were held in the past. According to European Commission, an ex-ante assessment consists of seven main components:

> *Problem analysis and needs assessment*: Relation between problem and total goals to achieve can be defined as Problem Analysis and Needs Assessment require a deep analysis of the policy, program or project and SWOT is very useful for Needs Assessment.

Objective setting and related indicators: Translation of the overall goals into measurable objectives is important and indicators, qualitative or quantitative, are needed to make an Objective Setting in three levels: general, specific and operational objectives.

Alternative delivery mechanisms and risk assessment: Alternative ways are always possible and it should be identified and assessed how it can occur the potential impacts of the risk should also be identified.

Lessons from the past

Planning future monitoring and evaluation

Helping to achieve cost effectiveness

4.2.2 Scenario analysis

Future Studies, scenario analysis is basically used as a determination instrument. Future is not certain so that there are so many possible futures.

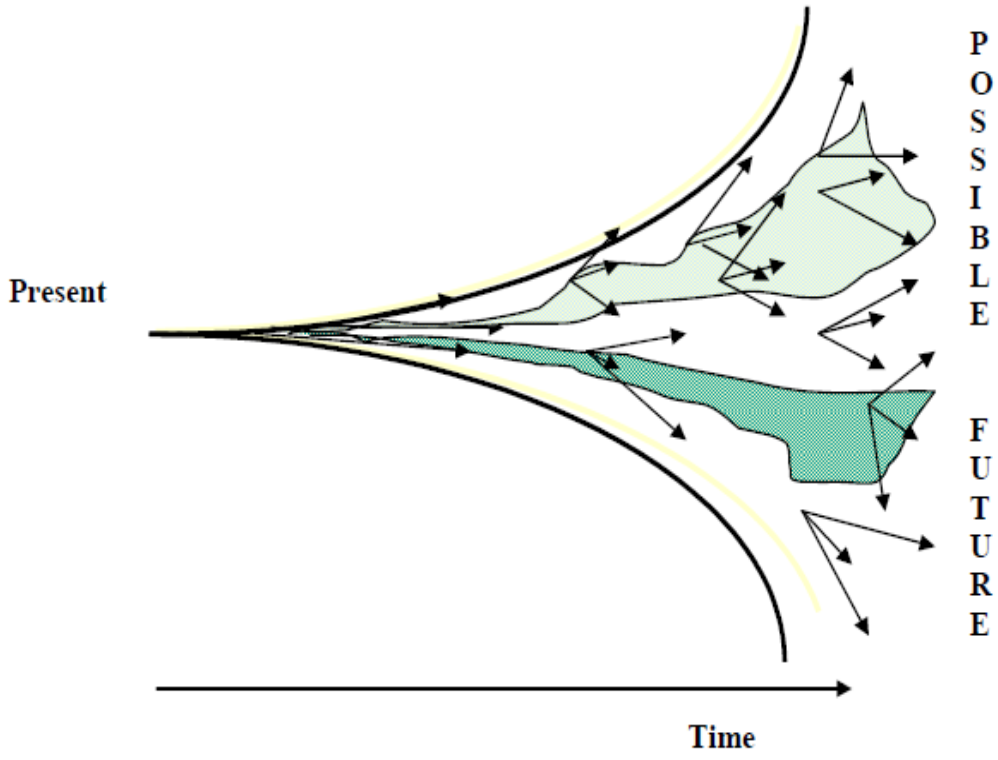

Figure 4.1 : Possible future adapted from Nijkamp, nd.

The history of scenario goes really back, for instance Plato had described his ideal future Republic. Whilst its long history also in the military, the first documents

which is considered today to be regarded as scenarios do not come into view til the 19th century in the writings of Von Clausewitz and Von Moltke, two Prussian military strategists also think that they have "the first formulated the principles of strategic planning" (Nijkamp). Modern day scenarios had started by the post- war period about 1960s. There are two main scenario schools, U.S. and French. Difference between their techniques is global vision. The U.S. school maintains scenarios for the entire world; however, French school is narrower so that the technique is developed only for France itself.

There are very different scenario methods today such as descriptive vs. normative scenarios, projective vs. prospective scenarios, commonsense-oriented vs. expert-based scenarios, or trend-based vs. opened-ended scenarios. Scenario studies usually experimental in nature and have assumed a solid position in the field of planning and policy analysis (Nijkamp).

In the context of sustainability, integrated scenarios might be seen as compatible and sensible stories, generated in words and numbers, about the possible co-evolutionary shortcuts of integrated human and environmental systems. They include a definition of problem edges in general, a qualification of current conditions and dynamic change of processes, an identification of significant hesitations and assumptions on how they are analysed, and view of the future. The qualification of the nature of human and environmental responsibility under confronting future conditions is keys in scenario making. Reflecting respect for the hesitation existing in such systems, scenarios are not predictions or forecasts. Scenario analysis is a developing concept. The term has been applied to distinct efforts ranging from formal descriptions to model-based projections, from foresighted thinking to slight modifications to "business-as-usual" projections. Despite the fact that scenario development, as a methodical way of vision of the future, has a far history it has not been systematized into a mutual set of definitions and algorithms. Such methodological uncertainty is in different ways a source of strength for this improving field of cross-examination. The range of purposes and the pure complicacy of the problem demand flexibleness and innovative research (Swart, et.al.).

Additionally, there is another classification of scenarios: descriptive and normative scenarios. Descriptive scenarios are describing possible improvements beginning from what is known about current conditions and trends. And normative scenarios

which are produced to lead to a future, that is afforded a distinct subjective value by the scenario makers. None of these kinds is non-value, although both concretize additional scientific decisions about how the problem is to be defined, and what are acceptable or feasible assumptions. Nevertheless, they differ in terms of total purpose. Plus, the selection between descriptive or normative scenarios is dependent on the objectives of the scenario development experience. Normative scenarios show organized approaches at assessing the feasibility and results of trying to achieve certain expected outcomes or avoid the risks of unexpected ones. Descriptive scenario analysis, on the other hand, tries to express different logical future social developments, and explore their results.

Methodologically, scenario makers can try to discover the likely outcome of a range of "expected" trends, five outline the implications of various assumptions not elected on the basis of likelihood (what-if analysis) or investigate the feasibility and implications of expected futures—or risks of unexpected ones (back casting).

4.2 Quantitative Methods

Most of the time, qualitative methods are not enough to reach the result. Qualitative research aims at "understand" and to answer the question of "how?". On the contrary, quantitative research aims at "causal explanation". Therefore, the data which quantitative research requires must be quantified, measured and numeric. Primary or secondary data needed to be collected. Unlike the qualitative methods quantitative methods require at least one statistical analysis depending on the data set and of the variables. In this study, secondary data were used and lack of data was compensated by using a sub-model for the estimation.

4.2.1 Multi-criteria decission making (MCDM)

Although multi-criteria decision making seems tough, most people use it also in their everyday life. For instance, there are many variables which have to be considered when buying a new car because choosing the best option is very important. Despite the fact that MCDM problems are always common, relatively brief story of MCDM as a discipline goes back about 30 years. The development of the MCDM discipline is closely related to the rapid growth of computer technology. In one side, the unstoppable development of computer technology in recent years has made it

possible to conduct systematic analysis of complex MCDM problems. On the other side, the common use of computers and information technology has renewed a very big amount of information, which makes MCDM increasingly significant and advantageous in supporting decision making in general [Ling and Jian-Bo].

In its most basic form, MCDM assumes that a single decision maker or a group of decision makers is to choose among a set of options whose objective function values or characteristics are known with definiteness. A lot of problems in MCDM are expressed in a formula as multiple objectives linear, integer, or nonlinear mathematical programming problems, and most of the procedures proposed for their solution are interactive [Dyer, et al.]. The actual decision summarizes to selecting "the best choice" from a number of available choices. Each choice symbolizes a decision alternative. In the multi-criteria decision making (MCDM) context, the selection is facilitated by evaluating each choice on the set of criteria. At an easy-to-use level, mathematical programming under multiple objectives emerged as a strong tool to help in the process of searching for decisions which best satisfy a multitude of conflicting objectives, and there are a number of various methodologies for multi-criteria decision making problems that exist. These methodologies can be categorized in a variety of ways, such as form of model (e.g. linear, non-linear, stochastic), characteristics of the decision space (for example finite or infinite), or solution process (example prior specification of preferences or interactive) (UN, n.d.). According to Massam, multi-criteria decision making refers a process of giving values to options which are evaluated along multi-criteria. MCDM can be separated into two main parts of multi-attribute decision making and multi-objective decision making. If the problem is to determine a finite possible set of alternatives and to choose the best option based on the scores of a set of attributes, it is a multi-attribute decision making problem. The multi-objective decision making deals with the selection of the best option based on a series of conflicting objectives (Massam, 1988).

4.2.2 Causality Analysis

Regional production is usually affected by several factors, such as capital, human capital and accessibility. It is often considered that accessibility will have a positive impact on regional production. However, the converse relation might be true as well:

highly productive regions may want to invest parts of their prosperity in infrastructure, therefore they advance regional accessibility. As a matter of fact, the problem of *causality* occurs: which factor affects the other to what extent? To what extent is regional production affected by accessibility, and to what extent is accessibility influenced by regional production? The empirical answer to these questions will be difficult to obtain, generally. Nevertheless, the availability of sufficient data will permit for answering at least a part of these questions. If suitable devices exist, then this method has the advantage over the estimation of a structural model, essentially, it is more flexible. In order to be able to implement the Causality Analysis by using panel data is strongly preferred over the use of a pure cross-section over regions. The latter will not let purging regional effects that are not discerned, for example, the regional institutional settings, and will therefore not be able to separately define the effects of accessibility on production from institutional effects on production. Conversely, if regional data are recorded during a certain time period, then one is able to filter away such effects, by making use of a "fixed effects" specification. Thus, time-series data is required for analysing the causal direction. (ESPON Second Interim Report, TENs).

4.2.3 Quasi-production fuction model with accessibility

When mentioning the economic effects of transport infrastructure projects, first, one has to make a classification between direct and indirect effects, temporary and permanent effects, and market and non-market or external effects (Table 4.2).

Temporary economic effects are going to show up during construction both directly and indirectly through demand effects. Although it is not discussed much, indirect supply or crowding-out effects are also significant, both through the capital market as a result of the necessity for finance and through the labour market as a result of drawing on specific spatial and occupational segments.

Besides economic effects, there will be direct temporary external effects, such as noise and environmental disturbances during construction activities, as well as indirect temporary external effects, such as emissions due to backward economic effects away from the current construction sites.

Table 4.2 : Types of effects of transport infrastructure investments.

		Temporary	Permanent
Direct	Via markets:	Construction effects	Exploitation and time saving effects
	External effects	Environmental effects	Environmental, safety, etc. effects
	Via demand:	Backward expenditure effects	Backward expenditure effects
Indirect	Via supply:	Crowding-out effects	Productivity and location effects
	Environmental effects:	Indirect emissions	Indirect emissions, etc.

Permanent direct economic effects naturally include the using cost, and transport cost and time benefits for people and freight. These user benefits, generally, are the primary reasons for investments of infrastructure projects. Therefore, one speaks of a *passive infrastructure policy*, meaning that investments firstly follow the increasing demand for transportation, where it exists, and try to avoid or lower the costs of congestion.

In addition to direct effects, there will always be permanent indirect economic effects. First, these relate to the backward expenditure effects of the using of infrastructure. Second, these relate to the so-called program or *induced effects*, which are described as the results of the decrease in transport cost for production and location decisions of people and firms, and the consecutive effects on income and employment of the population at large (Rietveld and Nijkamp, 2000). Naturally, these supply-driven effects are going to on their turn also have demand effects. When coming through these cost-induced effects is the essential objective of searching in infrastructure, one speaks of an *active infrastructure policy* which attempts to affect location and production decisions of firms and thus attempts to prompt private investments. On the other hand, these economic effects will have also permanent direct effects which are external to the market, such as noise, safety, emissions and environmental disturbances. Furthermore, the indirect economic effects also cause

indirect external effects that need to be covered by the analysis when a fair valuation of investments in alternative transport systems is concerned. In their working paper (2000), Oosterhaven and Knaap, summarize CGE as:

> "Evers (et al 1987, Evers and Oosterhaven, 1988) were the first to embody with border dummies and a modal separation parameter into a multi-sectoral potentials model, and to use it to predict the economic impacts of a proposed high speed rail connection from Amsterdam to Hamburg. Their approach was shown to have a micro economic (log it) foundation based on the profit maximizing location behavior of firms, and was shown to produce the "right" spatial pattern of impacts but not necessarily the right maco level of these impacts (Rietveld, 1989). Later on Bröcker (1995) showed that the gravity type of spatial impact pattern could also be produced by the even more satisfactory use of a spatial CGE model."

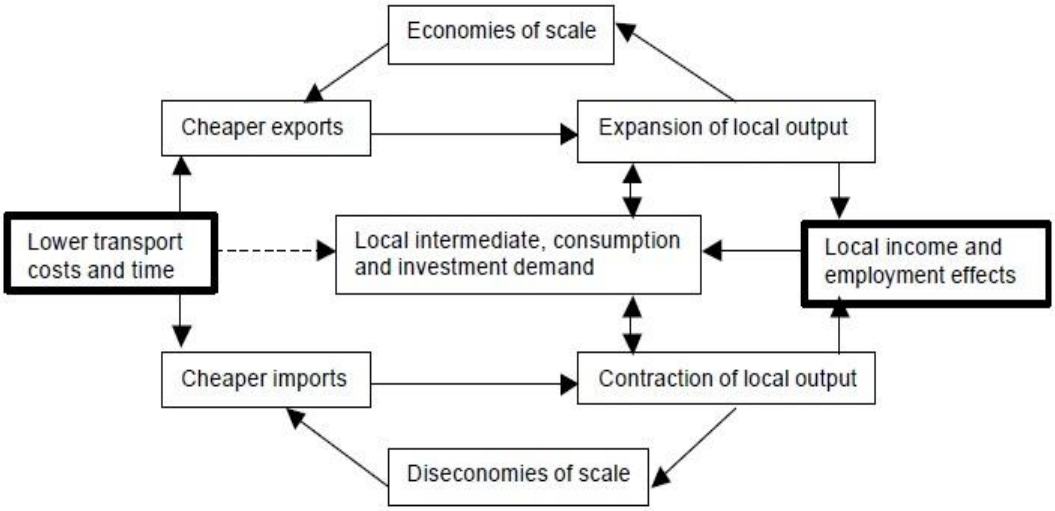

Figure 4.2 : A conceptual partial equilibrium model of transport impacts, adapted from Oosterhaven, 2011.

In the figure, Oosterhaven and Knaap, in 2000, argues that all indirect economic impacts begin from the supply side with the transport cost and time gains. It further articulates that infrastructure principally may have both positive and negative economic effects for any region that is affected by the transportation cost decrease. For some sectors and products improved accessibility will increase that region's exports, whereas for other sectors and products it will guide to increased competition on its home market and a contraction of local output, income and employment. These

positive and negative effects may be boost because of economies of scale. When present, (internal) scale economies at the firm level will further raise already positive impacts, whereas they may further decrease the negative impacts for other sectors. These conclusions will be changed and abstruse because of inter-industry and expenditure demand feedbacks, which may guide to further (external) cluster economies for other indirectly affected firms.

Finally, the dashed impact indicates the direct effect of transport cost savings on the demand for all non-transport products. This shows that the net welfare effect of new infrastructure tends to be positive, if the contraction effects are not really heavy and of course if the project is not too expensive when compared to its benefits. This type of model is based on an extension of the production- function approach in which the classical production factors are supplemented by one or more variables representing the advantage of location, or accessibility of a region. As an example of a quasi-production function model, the SASI (Socio-Economic and Spatial Impacts of Transport Infrastructure Investments and Transport System Improvements) model has great importance.

4.3 The SASI Model

The SASI model is a repeating simulation model of socio-economic development of regions in Europe, subject to exogenous assumptions about the economic and demographic development of the European Union as a whole and transport infrastructure investments and transport system improvements, especially the trans-European transport networks. For each region the model forecasts the development of accessibility, GDP per capita and unemployment. Additionally, cohesion indicators which are stating the impact of transport infrastructure investments and transport system improvements on the convergence (or divergence) of socio-economic development in the regions of the European Union are calculated. The main concept of the SASI model is to explain locational structures and locational change in Europe in integrated time-series regressions, with accessibility indicators being a subset of a range of explanatory variables. Accessibility is measured by spatially disaggregate accessibility indicators which comprise in an account that accessibility within a region is not homogenous but decreases fast with increasing distance from the nodes of the networks. The focus of the regression approach is on

long-term spatial distributional effects of transport policies. Factors of production including labor, capital and knowledge are considered as mobile in the long run, and the model incorporates determinants of the redistribution of factor stocks and population. The model is therefore suitable to check whether long-run tendencies in spatial development coincide with development objectives. Its application is restricted, however, in other respects: The model generates distributive, not generative effects of transport cost reductions, and it does not produce regional welfare assessments fitting into the framework of cost-benefit analysis. The SASI model differs from other approaches to model the impacts of transport on regional development by modeling not only production (the demand side of regional labor markets) but also population (the supply side of regional labor markets), which makes it possible to model regional unemployment. A second distinct feature is its dynamic network database based on a 'strategic' subset of highly detailed pan-European road, rail and air networks including major historical network changes as far back as 1981 and forecasting expected network changes according to the most recent EU documents on the future evolution of the trans-European transport networks. Sub-models of SASI are:

European Developments: Here assumptions about European developments are entered that are processed by the subsequent sub-models. European developments include assumptions about the future performance of the European economy as a whole and the level of immigration and outmigration across Europe's borders. Another relevant European policy field is transfer payments by the European Union via the Structural Funds or the Common Agricultural Policy or by national governments to assist specific regions, which, because of their concentration on peripheral regions, are responsible for a sizeable part of their economic growth. The last group of assumptions is those about policy decisions on the trans-European networks. A network scenario is a time-sequenced investment program for addition, upgrading or closure of links of the road, rail or air networks.

Regional Accessibility: This sub-model calculates regional accessibility indicators expressing the locational advantage of each region with respect to relevant destinations in the region and in other regions as a function of travel

time or travel cost (or both) to reach these destinations by the strategic road, rail and air networks.

Regional GDP: This sub-model forecasts gross domestic product (GDP) by industrial sector generated in each region by a quasi-production function incorporating endowment indicators and accessibility. Endowment indicators are indicators measuring the suitability or capacity of the region for economic activity. They include traditional location factors such as availability of skilled labor and business services, capital stock (i.e. production facilities) and intraregional transport infrastructure as well as 'soft' location factors such as indicators describing the spatial organization of the region, i.e. its settlement structure and internal transport system, or institutions of higher education, cultural facilities, good housing and a pleasant climate and environment.

Regional Employment: Regional employment is derived from regional GDP by exogenous forecasts of regional labor productivity by industrial sector (GDP per worker) modified by effects of changes in regional accessibility.

Regional Population: Regional population changes due to natural change and migration. Births and deaths are modeled by a cohort-survival model subject to exogenous forecasts of regional fertility and mortality rates. Interregional migration within the European Union is modeled in a simplified migration model as annual net migration as a function of regional unemployment and other indicators expressing the attractiveness of the region as a place of employment and a place to live.

Regional Labor Force: Regional labor force is derived from regional GDP and exogenous forecasts of regional labor force participation rates modified by effects of regional unemployment.

Socio-economic Indicators: Total GDP and employment are related to population and labor force by calculating total regional GDP per capita and regional unemployment. Accessibility, besides being a factor determining regional production, is also considered a policy-relevant output of the model. In addition, equity or cohesion indicators describing the distribution of

accessibility, GDP per capita and unemployment across regions are calculated.

Consequently, the SASI model is a repetitive simulation model of socio-economic development of regions in Europe. It refers to the subject of exogenous assumptions about the economic and demographic development of the entire EU and transport infrastructure investments and transport system developments, in particular of the TEN-T. In addition, Wegener (2008) states the difference of the SASI model from other approaches that it is distinguished from other methods to model the impacts of transport on regional development by modeling not only production but also population. Another distinction of SASI is dynamic network database of it conserved by RRG Spatial Planning and Geo-information based on a "strategic" subset of highly detailed pan-European transport networks (road, rail, maritime, inland waterways and air) including major historical network changes from 1981's and predicting desired network changes according to the latest EU documents on the future determination of the TENs.

4.4 TEQUILA Model

After explaining the methods which can be used in order to do Territorial Impact Assessment for a defined region; the reason that I chose TEQUILA Model in this study is to open a new aspect to investigate the territorial impacts of the major transport infrastructure investments. The model combines the qualitative variablels with the quantitative ones. So that, it can be classified as a combination of multi-criteria method and ex-ante. On the other hand, TEQUILA Model is easy to use in other quantitative methods of Territorial Impact Assessment. Unlike the other complex quantitative methods such as SASI model, TEQUILA simply focuses on three dimensions which are *territorial efficiency, sensitivity* and *identity.* Therefore TEQUILA model is an Ex-Ante Analysis by itself. That provides advantages to assess the territorial impact of major infrastructure investments. The results are evaluated as "positive impacts" and "negative impacts" on territorial efficiency, territorial quality and territorial identity. Additionally, a general or global impact is the last outcome of the model. In this case study the evaluation of the outcome of TEQUILA is made by general impact, only. The model has two parts: first part is the sensitivity impact part and the second one is potential impact part. The variables of

these two sub-models are going to be defined in the section 5.1: The structure of the model. However, it can be defined in short that sensitivity variables are mostly related to environmental and socio-economic impacts; and the potential impact variables refer to transport infrastructure impacts.

The results are evaluated as “positive impacts” and “negative impacts” on territorial efficiency, territorial quality and territorial identity. Additionally, a general or global impact is the last outcome of the model. In this case study the evaluation of the outcome of TEQUILA is made by general impact.

In fact, in his article Camagni (2009) states that TEQUILA is not only a mathematical model but also a simulation model and it is called exactly “TEQUILA SIP”. By SIP module of the TEQUILA, it can also be determined the periphery image and accessibility condition of the selected regions. However, it requires a software to simulate the output of the model and the number modelling regions should be more than one. An example TEQUILA SIP output is shown in Figure 4.3 below.

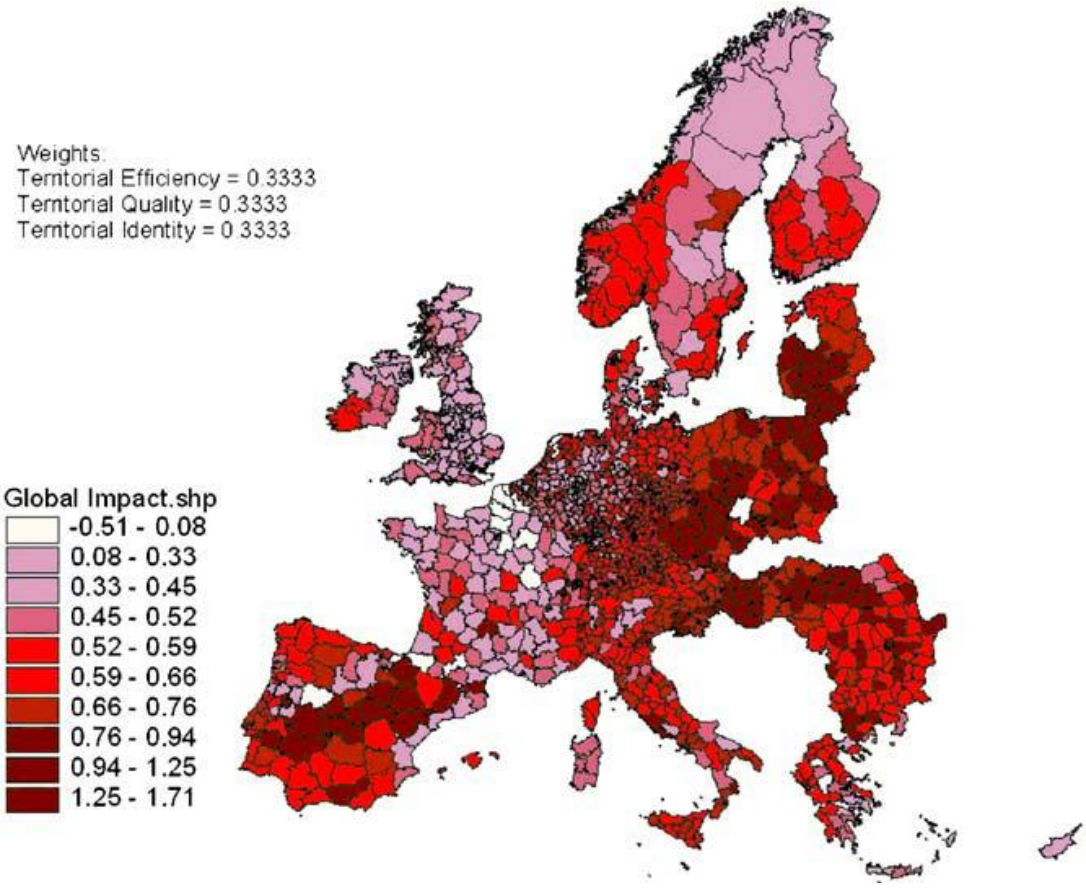

Figure 4.3 : Global territorial impact, adapted from Camagni, 2009.

5. A CASE STUDY FOR ISTANBUL

After explaining the methods which can be used in order to do Territorial Impact Assessment for a defined region; the reason that I chose TEQUILA Model in this study is to open a new aspect to investigate the territorial impacts of the major transport infrastructure investments. On the other hand TEQUILA Model is easy to use in other quantitative methods of Territorial Impact Assessment. Unlike the other complex quantitative methods TEQUILA simply focuses on three dimensions which are *territorial efficiency, sensitivity* and *identity.* Therefore TEQUILA model is an Ex-Ante Analysis by itself. That provides advantages to assess the territorial impact of major infrastructure investments.

Since I could not create a simulation technique or software, I decided to make a case study on Istanbul so that further other researchers can develop a software and implement TEQUILA to the regions of Turkey, in the future. Despite the fact that there are significant transport infrastructure projects in Istanbul currently and planned to be done, the aspects to evaluate them are mostly based on qualitative and/or environmental studies. Under the concept of sustainability and quantitative research, implementing TEQUILA and making a quantitative research about Istanbul via Territorial Impact Assessment of Major Transport Infrastructure Projects will hopefully open a new aspect to the topic.

In this context, Istanbul Metropolitan Region has been chosen for the implementation region. Furthermore, Istanbul, which is the biggest metropolis of Turkey and which the TEN-T integration of Turkey starts; has major transport infrastructure investments. The data that TEQUILA model requires were taken from three different institutions: Istanbul Metropolitan Planning Centre, Governorship of Istanbul and Turkish Librarians Association. The data used in the model are presented in the last part of the study. Although it has been reached almost every data set to use in the model, there is lack of collecting data in EU standards/Eurostat at Istanbul Metropolitan Planning Center (IMPC) in terms of emissions data.

Therefore, with a bit of data mining, the emissions data were found but this time the data that were reached as time series and the data set was not coming to the year 2010, at all. Despite using the data from IMPC the emissions data were taken from other source and simple trend analysis was used in order to estimate the 2010 and 2018 values as it was explained in the previous sections.

5.1 Structure Of TEQUILA Model

A Territorial Impact Model (TIM) is built, for assessing the impact on single regions r (second layer). TIM is built of two separate multipliers which are Sensitivity and Potential Impact. TEQUILA is intended to be simple, operational and relatively user-friendly and it is defined as in the formulas **(5.1)** and **(5.2)** below.

$$TIM_r = \sum \theta_c \, (S_{r,c} PIM_{r,c}) \qquad \textbf{(5.1)}$$

Where TIM is the territorial impact (for each dimension: efficiency, quality, identity), c the criterion and sub-criterion of the multicriteria method, r the region, θ_c the co-efficient of the c criterion/sub-criterion ($0 \leq \theta_c \leq 1$; $\sum \theta_c = 1$), Sr,c the sensitivity of region r to criterion c, and PIMr,c is the potential impact of policy (abstract) on criterion c according to quantitative assessment. The co-efficient, θ, is generally determined through various ways: via an internal expert discussion, via a discussion with policy makers, via Delphi inquiries or else. In this study it has been taken 0,333 in order to equally stand to all variables.

$$S_{r,c} = D_{r,c} V_{r,c} \qquad \textbf{(5.2)}$$

Where $D_{r,c}$ is the desirability of criterion c for region r (territorial ‘‘utility function’’) and $V_{r,c}$ is the vulnerability of region r to impact on c (receptivity for positive impacts).

5.2 Quantitative Impact Variables ($PIM_{r,c}$)

Potential Impact (PIM) multiplier consists of three main criteria and 9 sub-criteria (and three sub-criteria for each main criterion) according to the model, TEQUILA. The main criteria are Efficiency, Quality and Identity. And the sub-criteria of these

main criteria in order are internal connectivity, external accessibility, growth; congestion, emissions, transport sustainability; creativity, cultural heritage and landscape. Their indicators and unit of measures has been showed in Table 5.1.

First of all, it is very significant to indicate that TEQUILA Model is a macro scale model. It measures regional accessibility; inter connectivity and regional identity. That means most of the urban transport indicators (for example transport modes such as maritime transport, aviation, etc.) are absent in the model. Simply highway and railway endowment data are used. The land use data were not directly used in the model. The model measures the maximum area fragmentation by 1-10 scale. The weight (0.333) was selected in order to stand equally from the regions. It can be said that, TEQUILA supplies a "general" determination base for further studies. So that, Istanbul was selected under the consideration of Istanbul Region and TEQUILA was implemented to take a snapshot of Istanbul in a macro scale about major transport infrastructure projects.

TEQUILA simply focuses on macro scale indicators. It presents a general view about transport projects and their territorial impacts. It is a whole with it SIP Module which evaluates the results of the model via mapping as shown above in the section **4.4.** It is not important for TEUILA that a project done "where"; but it is significant that whether the project is "done" or "not".

5.3 The restrains of TEQUILA

In this study, TEQUILA model was directly implemented for Istanbul Region. Furthermore, the weight might be determined for Istanbul Region by an expert group that consists of professionals interested in the subject. So is maximum area fragmentation level. It should be taken into consideration that number of theaters and museums was taken constant. In other words, it is assumed that the territorial identity data would not change in 2018 because of lack of projection data on these indicators. However, if TEQUILA model can be improved and can be adapted into urban transport, future studies are going to be more detailed and urban transport indicators can be directly in the model. And the results of the model will be changed. This study should be taken into consideration as a "general" determination that aims to make baseline for future studies.

Table 5.1 : Quantitative Impact Variables of TEQUILA Model, Camagni, 2003.

PIM_r	Sub-Criteria	Indicator	Unit of Measure	Dir.	Variation	Weight
PIM_E1	Internal connectivity	Dif transport endowment (road + rail) / GDP	(km / GDP)	(+)	0--4	0.333
PIM_E2	External accessibility	Dif accessibility (road/rail passenger travel)	Number of people	(+)	2--5	0.333
PIM_E3	Growth	Dif GDP	Dif % GDP/inhabitant	(+)	2--4	0.333
PIM_Q1	Congestion	Dif flows	Million vehicles/km	(-)	2-- (-5)	0.333
PIM_Q2	Emissions	Dif CO_2 Emissions	Million tons CO_2/year	(-)	2-- (-5)	0.333
PIM_Q3	Transport sustainability	Dif Rail – Dif Road	km-km	(+)	(-3)--3	0.333
PIM_I1	Creativity	Dif accessibility x [knowledge and creative services]	(# people) x(# libraries + # theatres)	(+)	1--4	0.333
PIM_I2	Cultural heritage	Dif accessibility x [# monuments + museums]	(# people) x(# monuments + # museums)	(+)	1--4	0.333
PIM_I3	Landscape	Dif. Transport endowment (road + rail)/GDP	(km / GDP)	(-)	0--(-4)	0.333

Table 5.2 : Sensibility Variables of TEQUILA Model, Camagni, 2003.

Sensitivity	Sensitivity Parameters	Unit of Scale	Variation	Functional Shape
S_E1	D = LOG of current density of transport endowment [density = (road + rail)/GDP] R=1 S=D norm	Log (km road + rail) / GDP	0.8 - 1.2	Linear
S_E2	D = LOG [current accessibility]; R=1 S=Dnorm	LOG [# of people daily accessible by car]	0.8 - 1.2	Non-Linear
S_E3	D = GDP PPP per inhabitant; R=1 S=D norm	GDP PPP per inhabitant	0.9 - 1.2	Linear
S_Q1	D = Present congestion V = Share of natural areas S = mean of normalised D and V	D = Million vehicles/network km V = share of natural areas (km2)	0.8 - 1.2	D=Non-Linear
S_Q2	D = Present emissions V = Share of natural areas S = mean of normalised D and V	Present emissions CO2 year [million tons] V = share of natural areas (km2)	0.8 - 1.2 0.9-1.2	D=Non-Linear V=Linear
S_Q3	D = Present share of railways on total tran. ntw. R=1 S=D norm	km/km (%)	0.8 - 1.2	D=Non-Linear
S_I1	D = GDP PPP per inhabitant R=1 S=D norm	GDP PPP per inhabitant	0.9 - 1.2	Linear
S_I2	D = GDP PPP per inhabitant R=1 S=D norm	GDP PPP per inhabitant	0.9 - 1.2	Linear
S_I3	D=1 V = Natural vulnerability (natural area fragmentation) S=V norm	Natural area fragmentation indicator 1–5: 1 = very low; 5 = max fragmentation	0.9 - 1.2	Linear

6. FINDINGS AND EVALUATIONS

The main data used in the model are given in Table 6.1. The year 2018 refers to the planned year of Third Bridge Highway Crossing on Bosphorus construction according to Istanbul Metropolitan Planning Centre.

Table 6.1 : Transport data of Istanbul taken from IMP, 2010.

Transport Data	**2010**	**2018**
Total length of roads (km)	29.702	30.153
Total length of railroads (km)	150,46	322,5
Total trip (daily)	24.271.995	29.242.645
BUS	4.925.713	3.886.286
RAIL	1.255.190	7.226.002
MARITIME	333.474	119.688
MINIBUS	2.579.058	2.815.767
SMALL VAN	69.558	49.984
SUBURBAN	522.275	1.047.814
METROBUS	347.364	1.256.114
PEDESTRIAN	10.888.024	10.573.885
CAR	4.584.887	8.238.315
SERVICE VEHICLE	2.551.807	2.330.922
Number of cars per km in roads	0,061982358	0,10589328
CO2 emission (daily)-cost	*7.656.836 $*	*17.831.760 $*
Number of trips made by cars (daily)	4.584.887	8.238.315
Number of vehicles in traffic (daily)		
GDP ($)	9.733	16.521
Number of cars	1.841	3.193

The data of CO_2 emission provided by IMP is in unit of daily-cost. But the TEQUILA Model requires million tons / year. I used this data from the working paper presented by Diler in 7th National Clean Energy Symposium, instead. I used Linear Trend Analysis based on Least Squares Method. And I estimated the value of CO_2 emissions in 2010 and 2018 in million tons / year. In addition, the data of share of natural area was taken from the report Third Bridge Construction and its environmental impacts prepared by University of Istanbul, 2008.

The projection data of CO_2 emissions (million tons) for the year 2018 are shown in Table 6.2.

Table 6.2 : Emissions data for Istanbul taken from Diler, 2008.

Years	CO_2 emissions (million tons)
2000	5,238
2001	4,783
2002	4,477
2003	4,474
2004	7,451
2005	7,682
2006	8,203

In Table 6.3 below, I used simple trend analysis in order to predict emissions data for the year 2018. However, there is lack of data on emissions by year the model is acceptable since the significance is 67 %.

First, it should be said that the Territorial Impact (TIM) of the major transport infrastructure project, 3rd bridge, is a major road investment. Total territorial impact for Istanbul for year 2010 is shown in Table 6.4 and Table 6.5.

Same calculations were done also for the year 2018 which is the year that third bridge is planned to be constructed. And total territorial impact for Istanbul for 2018 was executed and results are shown in Table 6.6 and Table 6.7.

The output of TEQUILA shows that the most significant positive impacts are observed in territorial efficiency. In terms of territorial quality, the most negative impacts can be observed easily from the output of the model and the decrease of territorial identity is not acceptable.

Firstly, total efficiency will increase up to 75% in 2018 comparing to the total efficiency value of the year 2010. This increase might be evaluated good because transport endowment will increase and this result shows the accessibility for Istanbul Region will be more developped. This means that major transport infrastructure investments have positive impacts on Istanbul Region in terms of territorial efficiency. This increase also points out that the regional integration of Istanbul Region to the south-east Europe will be go further in terms of accessibility. Therefore, it can be said that, mega structures of transportation can make the regions

more efficient, on the context of regional development, in the territory where they are constructed.

Secondly, territorial quality will increase about 65 % which shows us that congession and carbondioxide emissions will increase dramaticly. This output shows that there will not be sustainable transport in Istanbul Region in 2018. The main reason for this highly increase is depanding mostly on highway transport systems. Sustainability is almost in every topic of policies in the EU and sustainable transport for Istanbul Region, according to these results, seems very difficult to achieve. Thus, impacts of major transport infrastructure investments in terms of total quality might be negative depanding on the regional trasnsport policies under the topic of "sustainability".

Finally, it can be said that the major transport infrastructure projects have large negative impacts in terms of territorial identity. This time a dramatic decrease of impact in terms of territorial identity is about 90 %. The main reason of this decrease is the high natural area fragmentation. Although Istanbul has a deep cultural heritage, social and recreational wealth and being the Capital of Culture in 2010; is not going to able to balance this dramatic decrease because of natural area fragmentation.

However, in terms of territorial efficiency of this planned transport investment has advantages for the region, the negative impacts of territorial quality and territorial identity can not be compansated by this positive impact. According to these General Territoial Impact values, as a result of TIA, the general territorial impact for Istanbul will increase 71 % in 2018. It is seen from TEQUILA that, Territorial Impact values are very high comparing to the results of TEQUILA for Europe by Camagni. The reason is population and lack of rail transport users in Istanbul. And it should be taken into consideration that this model was implemented for only Istanbul region.

Comparing to EU regions these results might have seen exaggerated. But, Istanbul region has 13 million of population and transport policy of the region has been based on roads for years. When the near history of Turkey is investigated it can easily be seen that after 1950's, with the Marshall Plan, national transport policy was based on highways. The consequences of this transport policy currently show that constructing only roads is "not" enough either in regional or in national level. Because of top-down planning comprehention in Turkey, the decission makers generally make decission in planning (at any level). In order to join the NGOs and/or public into the planning process will affect the decissions that are taken by policy makers.

Table 6.3 : Predicted emissions data by trend analysis.

YEARS	CO_2 emissions (Y)	X_i	X_iY_i	X_i^2	Y_i	Y_i-Y_{av}	$(Y_i-Y_{av})^2$	$Y-Y_{av}$	$(Y-Y_{av})^2$
2000	5,238	-3	-15,714	9	4,144	-1,9	3,61	-0,806	0,649636
2001	4,783	-2	-9,566	4	4,775	-1,269	1,610361	-1,261	1,590121
2002	4,477	-1	-4,477	1	5,406	-0,638	0,407044	-1,567	2,455489
2003	4,474	0	0	0	6,037	-0,007	0,000049	-1,570	2,4649
2004	7,451	1	7,451	1	6,668	0,624	0,389376	1,407	1,979649
2005	7,682	2	15,364	4	7,299	1,255	1,575025	1,638	2,683044
2006	8,203	3	24,609	9	7,93	1,886	3,556996	2,159	4,661281
TOTAL	42,308	0	17,667	28			11,14885		16,48412
Y_{av}	6,044								
		N	7		s	2,22977		Y_{2010}	10,454
$Y = 6,037 + 0,631X$		β_0	6,037		R^2	0,67634		Y_{2018}	15,502
		β_1	0,631						

Table 6.4 : Potential impacts and sensitivity impacts for 2010.

2010			
PIM		**S**	
PIM-E1	3,067139	S-E1	0,48673
PIM-E2	8,471838	S-E2	3,56608
PIM-E3	0,000746	S-E3	0,00075
PIM-Q1	0,061982	S-Q1	1,89719
PIM-Q2	10,454	S-Q2	2,37584
PIM-Q3	-2,3	S-Q3	0,00507
PIM-I1	5429188128	S-I1	0,00075
PIM-I2	22408451961	S-I2	0,00075
PIM-I3	3,067138601	S-I3	2

Table 6.5 : Total efficiency, quality and identity impacts and TIM for 2010.

	E	**Q**	**I**
	1,492879	24,943	6,13428
Weighted	0,497129	8,30601	2,04271
		TIM:	**10,8459**

Table 6.6 : Potential impacts and sensitivity impacts for 2018.

2018			
PIM		**S**	
PIM-E1	1,844652	S-E1	0,35128
PIM-E2	2,245322	S-E2	3,80523
PIM-E3	0,001146	S-E3	0,00115
PIM-Q1	0,105893	S-Q1	1,919
PIM-Q2	15,502	S-Q2	2,46125
PIM-Q3	-1,97	S-Q3	0,0107
PIM-I1	5993408928	S-I1	0,00115
PIM-I2	24737219061	S-I2	0,00115
PIM-I3	1,844652261	S-I3	3

Table 6.7 : Total efficiency, quality and identity impacts and TIM for 2018.

	E	Q	I
	1,984685	38,3364	5,53396
Weighted	0,6609	12,766	1,84281
		TIM	**15,2697**

On the other hand, transport policies evolving due to EU standards. In order to achieve regional integration, in terms of transportation, with South-East Europe other transport projects have been implementing, for instance Marmaray, high-speed regional trains, high-standard roads, etc. The results of the TIA for Istanbul show that Third Bridge Project as a major transport infrastructure investment has extremely negative impacts. As it observed by the 1st and 2nd Bridges practices on Bosphorus before, new urban development dynamics, pressures and speculations will be created on the groves decreasing rapidly and the forests having significant role on sustainable and ecological development of Istanbul Region by the effect of northern 3rd Bridge proposal. So that, the unplanned development in built-up areas and inefficient control in planning, new northern crossing are very objectionable for the forest land as being an important ecological community for Istanbul Region (Tezer, 2004).

Despite the fact that the ongoing construction of Marmaray, the negative territorial impact of Third Bridge can not be compasated by Marmaray Rail Project. In the report of OECD called "Territorial Reviews Istanbul, Turkey" in 2008 it has been directly emphasized the lack of railway transport and transport policies and plans were criticised:

> "The extent of transport congestion in Istanbul requires bold political measures. Turkish policy makers have recognised that the former Transportations Master Plans (the last one enacted in 1996) have not been implemented, and that the proposed shift in the modal split, away from cars towards the railway system, has not materialised. In fact, with more than 2.5 million motor vehicles, the province of Istanbul concentrates approximately 25% of all cars in the country. The latest comprehensive survey, conducted in 1997, shows private car use represents 33% of total trips and the motorisation rate in Istanbul is the highest in the country. Only prioritising mass transportation can stop this trend. The railway network, both at the national and regional / local scale, remains rather limited."

The transport policy of Istanbul is not only based on roads today but also there are major railroad infrastructure investments such as Marmaray. Despite the fact that TEN-T project does not only consist of railroads; these results show that Istanbul does need more rail and maritime infrastructure investments rather than roads or motorways. Supportingly, Tezer (2004) says in her study:

> "Although the Transportation Master Plan of Istanbul foresights the progression of railway infrastructure (Naming Marmaray Project), the Ministry of Public Works and local representatives-the Directory of State Highways still support the third crossing for Istanbul. The success of integrated urban transportation systems can not be achieved with the competence among different transportation modes but only can via supporting to each other. Either local officials or central government's representative bodies have to evaluate extensively the impacts of investments and have to take into account local tendencies."

Personally, the construction of third bridge might decrease the traffic congestion but in order to integrate with Trans European Transport Network this major transport infrastructure project needed to compensate with other sustainable transport infrastructure investments. Otherwise, territorial impact for Istanbul after the construction of this project will increase approximately 78 %. From this point of view, according to territorial impact assessments of Istanbul for now and before the major transport infrastructure investment is done; transport policy should have revised into railroad transportation.

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