ISTANBUL TECHNICAL UNIVERSITY ★ INFORMATICS INSTITUTE

SPATIAL DECISION SUPPORT SYSTEM FOR SITE SELECTION OF INVESTMENTS OF PROMINENT SECTORS – THE CASE OF EAST MARMARA

M.Sc. THESIS

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Cem Bayrak, a **M.Sc.** student of ITU Informatics Institute student ID **706131007**, successfully defended the **thesis** entitled "**SPATIAL DECISION SUPPORT SYSTEM FOR SITE SELECTION OF INVESTMENTS OF PROMINENT SECTORS – THE CASE OF EAST MARMARA**", which he prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

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FOREWORD

This study is one of many approaches to use geospatial location in terms of economic development. Using the Geographical Information System (GIS) as a decision support tool, it aims to offer a guide for site selection of investments in accordance with the maximum benefit of both the region and the investor. Offering a new term "*smart spatialization*" as a next step of smart specialization, it adopts several GIS-based spatial analysis methods as well as statistical data analyses.

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TABLE OF CONTENTS

ABBREVIATIONS

ADNKS **:** Address-Based Population Registration System

DBMS : Database Management System

EU : The European Union

GDP : Gross Domestic Product

GIS : Geographic/Geospatial Information System

GVA : Gross Value Added

ITU : Istanbul Technical University

MCDM : Multi Criteria Decision Making

N.E.C. : Non-Elsewhere Classified

NUTS : Nomenclature of Territorial Units for Statistics

OECD : Organisation for Economic Co-operation and Development

OGC : Open Geospatial Consortium

RIS3 : Regional Innovation Strategies for Smart Specialization

SMEs : Small to Medium Enterprises

SGK : Social Security Organisation

TURKSTAT : Turkish Statistical Institute

W-KPI : Weighted Key Performance Indicators

LIST OF TABLES

LIST OF FIGURES

SPATIAL DECISION SUPPORT SYSTEM FOR SITE SELECTION OF INVESTMENTS OF PROMINENT SECTORS – THE CASE OF EAST MARMARA

SUMMARY

Along with the factors effecting directly the competitiveness such as the level of capital accumulation, qualified and cheap labor force, market opportunities and the development level of the supporting sectors, the geospatial location and spatial distribution of the firms are another factors which effect competitiveness. Due to the developing economic structure and increasing urbanism, the land, also, has become a scarce source which must be used efficiently. Thus, the question of "for what purpose should the land be used?" is now a strategic decision and it has to be emphasized importantly for the maximum social, economic and environmental benefit at the regional scale. Furthermore, globally adopted "Smart Specialization" concept is used for defining sectoral roles to the regions. The NUTS 2 Region of East Marmara was chosen as the case study because of being the most specific region that encounters the land scarcity and the heterogeneity of capital and labor market. The purpose of the study is to find answer for such a hard question like "how a city and a region benefits the most in terms of sectoral site selection of a specific zone?" For that purpose, the zones which are defined as industrial zone will be examined by considering the requirements and site selection criteria of the 8 most competitive sectors of the region. Finally with the help of the Geographical Information System, spatial analyses will be applied for the optimization of investments for the competitive sectors at regional scale of East Marmara and all of these will be performed by the newly suggested "Smart Spatialization" approach within the context of "Smart Specialization".

ÖNCÜ SEKTÖRLERDE YATIRIMLARIN YER SEÇİMİNDE MEKANSAL KARAR DESTEK SİSTEMİ – DOĞU MARMARA ÖRNEĞİ

ÖZET

Sermaye birikim düzeyi, kalifiye ve ucuz işgücü, pazar olanakları, destekleyici sektörlerin gelişmişliği gibi rekabet gücünü doğrudan etkileyen bileşenlerin yanı sıra firmaların mekansal konumları ve mekansal dağılımları da rekabet edebilirlik düzeylerini etkilemektedir. Gelişen ekonomik yapı ve büyüyen kentleşme nedeniyle arazi de etkin kullanılması gereken kıt kaynaklar sınıfına girmiştir. Bu nedenle belirli bir toprak parçasının ne amaçla kullanılacağı stratejik bir karar haline gelmiş ve bölge ölçeğinde en yüksek fayda için sözü edilen toprak parçasının ne amaçla kullanılması gerektiği üzerinde önemle durulması gereken bir olgu olmuştur. Diğer taraftan, küresel ölçekte kabul gören "Akıllı İhtisaslaşma" olgusu ile bölgelere sektörel roller biçilmektedir. Türkiye'de arsa kıtlığının yaşandığı, sermayenin ve emek piyasasının heterojen dağılım gösterdiği bölgelerin başında yer alan, İstatistiki Bölge Birimleri Sınırlandırmasında TR42 Düzey-2 kodlu Doğu Marmara Bölgesi tez çalışması kapsamında örnek çalışma alanı olarak seçilmiştir. Çalışmanın amacı belirli bir arazinin hangi sektörlerin kullanımına açılırsa o arazinin bulunduğu kent ve bölgenin gelişimine en fazla katkı sağlayacağı gibi zor bir soruya cevap aramaktır. Bu amaçla bölgede sanayi arazisi olarak belirlenmiş alanların, bölgenin öne çıkan sekiz sektörünün yer seçim kriterleri göz önüne alınarak, seçilen sektörlerden hangileri için yatırımın daha uygun olacağı Akıllı İhtisaslaşma yaklaşımı ve tez kapsamında ileri sürülen "Akıllı Mekansallaşma" yaklaşımı ile birlikte kullanılarak Coğrafi Bilgi Sistemi temelli mekansal analizler üzerinden saptanmaya çalışılmıştır.

Çalışmanın ilk aşamasında, TR42 Düzey-2 kodlu Doğu Marmara Bölgesi'nde hangi sektörlerin önceliklendirilmesi gerektiği konusu ele alınmış, bunun için benimsenen Akıllı İhtisaslaşma yaklaşımı ile sektör seçimi üzerine eğilinmiştir. Akıllı ihtisaslaşma ile ilgili kuramsal araştırmalar yapılmış ve bunun neticesinde yatırım, istihdam,

ihracat, katma değer, araştırma ve geliştirme ile finansman istatistikleri üzerinde çeşitli analizler uygulanmış ve bu yöntemle yapılan çalışmalar değerlendirilmiştir. Sektörel olarak derlenen bu veri setleri yığınlaşma, değişim eğilimleri, değişim payları ve ağırlıklı önemlendirilmeleri çerçevesinde ele alınmış ve sekiz adet sektör tespit edilmiştir. Bu 8 sektör "o bölgede hangi sektörlere ağırlık verilirse o bölge için en yüksek fayda sağlanabilir?" sorusuna yanıt vermektedir. Bir başka deyişle, bölgede bu sekiz sektör geliştiği takdirde o bölge ekonomik olarak en optimum kaynak yönetimini sağlamış olacaktır. Bu da o sektörler için yatırımcı çekilmesi, devlet desteklerinin kurgulanması ve sektörel işbirliklerinin sağlanması gibi kalkınma ile ilişkili kamu faaliyetleri için odak alan belirlenmiş olmasını sağlamaktadır.

Çalışmanın bir sonraki aşaması ise "o bölgede hangi sektörlere ağırlık verilirse o bölge için en yüksek fayda sağlanabilir?" sorusuna alınan sektörel yanıtların ardından "o sektörlerde faaliyet gösteren yatırımcılar bölgenin hangi kesimine yatırım yaparlarsa yatırımdan en yüksek fayda sağlanabilir?" sorusunu cevaplamayı amaçlamıştır. Bunun için de Coğrafi Bilgi Sistemleri tabanlı çok ölçütlü değerlendirme analizi kurgulanmıştır. Bunu yaparken de kuramsal altyapı incelenmiş, yatırım yer seçimi ile ilişkili kriterler sıralanmıştır. Mevcut ve gerçek zamanlı mekansal yatırım yeri bilgileri imar ve yapılaşma koşulları, mülkiyet, maliyet ve parsel büyüklüklerine göre; mekansallaştırılmış iktisadi veriler sektörel yığınlaşma, sektörel girdi, pazar potansiyeli ve devlet teşvikleri; diğer mekânsal veriler ise işgücü maliyetleri, doğal eşikler, ulaşım altyapısı, lojistik olanaklar ve gümrük olarak mekânsal analizlere altlık teşkil etmiştir. Sektörlerin yer seçim optimizasyonu için tercihleri dikkate alınarak veriler farklı coğrafi bilgi sistemi tabanlı analizlere tabi tutulmuş ve bu sürecin neticesinde bölge için faydalı sektörlerin bölgenin neresinde yatırım yaparlarsa daha yüksek fayda edinebilecekleri irdelenmiştir. Edinilen sonuçlar mevcut yatırımlar doğrultusunda değerlendirilmiş, mevcut yatırımlarla aralarındaki korelasyonlar ve daha farklı bölgelerde gelişmesinin avantajlı olacağı sektörler yorumlanmıştır.

Çalışma kapsamında bu iki aşamada uluslararası iyi uygulama örnekleri de ele alınmış ve Türkiye şartlarında uyarlama imkânları analiz edilmiştir.

Her iki süreç neticesinde edinilen tecrübeler doğrultusunda çeşitli öneriler getirilmiş, Türkiye'de Düzey-2 Bölgeleri bazında akıllı ihtisaslaşma ve akıllı mekansallaşma önerileri getirilmiştir. Akıllı ihtisaslaşmada daha ideal bir yaklaşıma ulaşabilmek için veri kaynaklarında, veri analiz süreçlerinde, analiz yorumlanmasında yapılabilecek

yenilikler hakkında öneriler getirilmiştir. Akıllı mekansallaşma aşamasında ise yatırım süreçlerinde en kritik unsurlardan olan yatırım yeri temini için öneriler getirilmiş, ulusal ölçekte bir uygulama ile daha bilimsel ve hızlı bir şekilde yatırımcıya yer temini yapılabilmesi için "Yatırım Yeri Bilgi Sistemi (YATBİS)" önerisi getirilmiş ve detaylandırılmış ve bu uygulamanın yatırım yeri üretilmesinde kullanım alanları irdelenmiştir.

1. INTRODUCTION

Development has been a key factor, somehow, in all disciplines. Thus, all disciplines study development in order to increase welfare and boost sustainability. Studies over development vary from discipline to discipline. Among those, regional planning focus more on spatial decisions and one of the basic pillars of production is “land”. A new term “smart specialization” is being adopted by many decision makers for economic development. This term, simply, is for defining production roles for regions.

As land is a place where many interests conflict and needs intersect such as urban rent, housing requirements, minerals, water cycle, agriculturally fertile soil, forests, cultural heritages, logistics, security zones etc., it has to be planned efficiently. As economic roles of regions needs land usage, they have to be distributed smartly as well, while conflicting with other land use issues.

This thesis takes both aspects at focal point and aims to show the intersection of the smart specialization and smart land use selection. It also evaluates the sectoral and locational situation for setting most efficient land use alternative by bringing East Marmara case to the table. To achieve this properly, the thesis utilizes Geographical Information System (GIS)-based approach.

This study first aims to determine the prominent sectors in the case region and then makes sectoral land selection suggestions according to various data sets and site selection criteria. In the scope of this thesis, GIS is used as a decision support tool to evaluate spatial dimension of the multi-criteria problem and to select best alternatives for industrial investments.

1.1 Case Study Area: East Marmara NUTS-2 Region

As the study is focused on an economic region, the NUTS classification of the European Union was taken into consideration. NUTS is a French abbreviation standing for Nomenclature of Territorial Units for Statistics (Nomenclature Des Unités Territoriales Statistiques in French) (Eurostat, 2015). The General Directorate of the

European Union for statistics, which is known as Eurostat, defines 3 phases of NUTS regions, namely NUTS 1, NUTS 2 and NUTS 3. As shown in the figure 1.1; NUTS 1 regions are major socio-economic regions, NUTS 2 regions are basic regions for the application of regional policies and NUTS 3 regions are small regions for specific diagnoses (Eurostat, 2016).

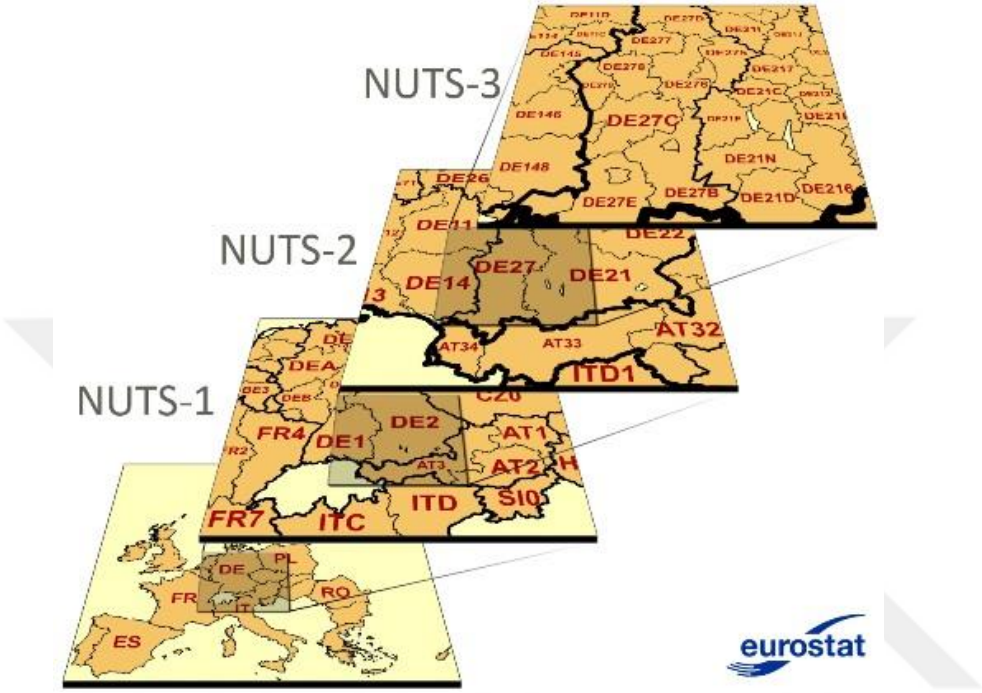

Figure 1.1 NUTS maps at different scales within Europe (Eurostat, 2016)

In the thesis, the NUTS 2 region level was adopted to work on as this level is both used for the application of regional policies and cohesion policy of the EU is being prepared in this level.

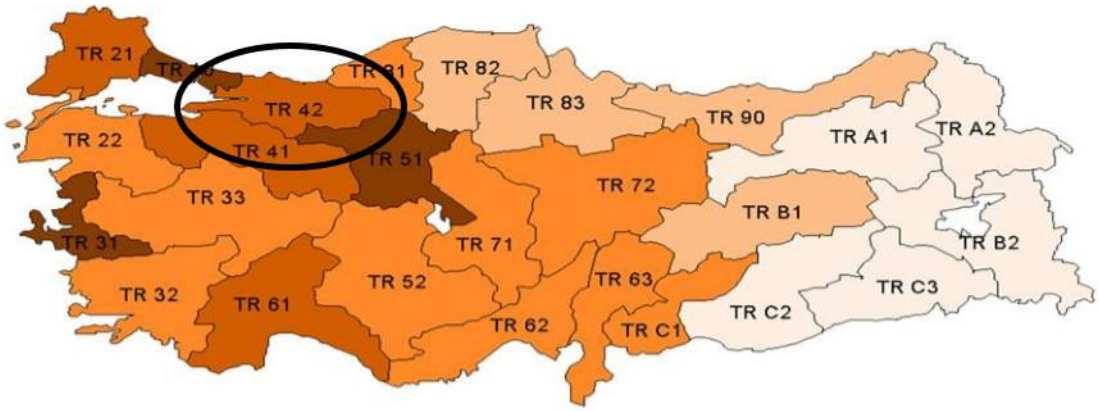

Figure 1.2 NUTS 2 Regions of Turkey with East Marmara in Circle (The Ministry of Science, Industry and Technology, 2016)

East Marmara (TR42 in Figure 1.2) is among the NUTS-2 Regions in Turkey located on the northwest of the country as shown in figure 1.2. The Region covers 5 provinces (Kocaeli, Sakarya, Duzce, Bolu and Yalova); and it is literally a hub connecting Turkey's three major metropolises, İstanbul, Ankara and Bursa. The Region is distinguished with its high accessibility by every mode of transportation and with Turkey's largest port area as well as its exceptional green habitat and hot springs. It stretches over an area of 20.272 km^2 (nearly 2.5% of total area of Turkey). With a population of approximately 3.62 million (nearly 4.4% of Turkish population); East Marmara generates 14% of total Turkish tax revenues and accounts for 8% of Turkish Gross Domestic Product (GDP) according to Turkish Statistical Institute (Turkstat) data of 2015 (Turkstat, 2015). East Marmara comes the third in Turkey regarding per capita Gross Value Added (GVA). There are some 80.3 thousand firms registered in East Marmara provinces as of April 2016; 768 of which are foreign-stock companies (Social Security Organisation, 2016). It is also a home for a large number of reputable companies operating in various sectors. During 2008-2016, 1.926 incentive certificates were issued to foreign investments to East Marmara corresponding to a total fixed capital investment of 44.799 billion TL. During the same period 31.422 incentive certificates were issued to both foreign and domestic investments that is worth 513.398 billion TL fixed capital investment in Turkey, 8.72% being in East Marmara (The Ministry of Economics, 2016). These statistics show East Marmara is an economically important part of the country as economic data are compared with the population ratio of the Region.

1.2 Methodology

The study is structured onto two main parts; "Smart Specialization" and "Smart Spatialization". In smart specialization part, the prominent sectors are to be determined via statistical analyses and data interpretation. In the smart spatialization part, the results of the previous part are to be analyzed via statistically normalized spatial data and using GIS analysis techniques. The Figure 1.3 displays general methodology of the study as a flow chart.

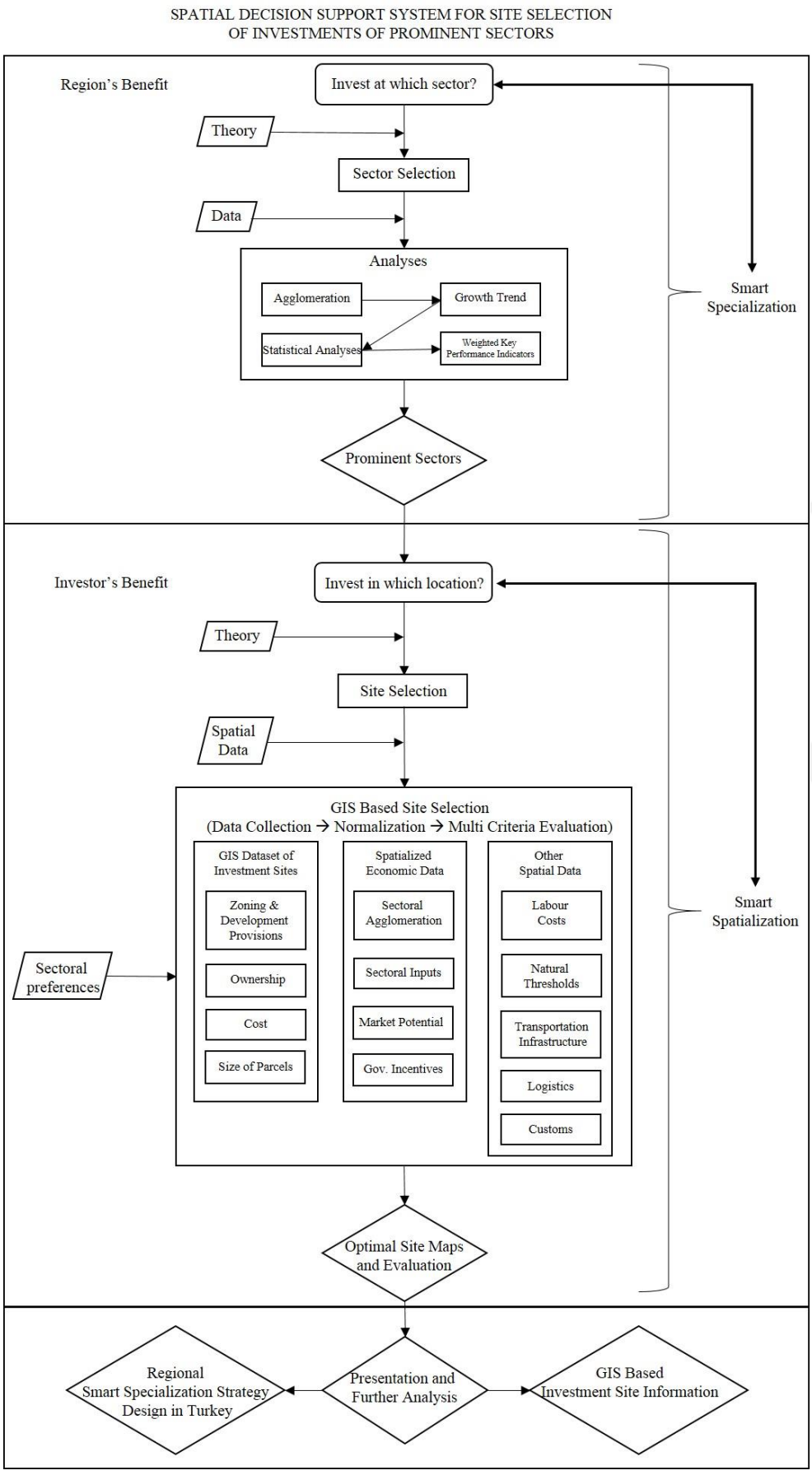

Figure 1.3 Flow Chart of the Thesis

2. SMART SPECIALIZATION

2.1 Regional Development

Development is a comprehensive term including not only economic development, but also social and environmental. World Bank's report on "What is development?" (2010) says:

> "*It is true that economic growth, enhances its potential for reducing poverty and solving other social problems. But history offers a number of examples where economic growth was not followed by similar progress in human development. Instead growth was achieved at the cost of greater inequity, higher unemployment, weakened democracy, loss of cultural identity, or overconsumption of resources needed by future generations*".

Regional development deals with developmental issued at regional level. In the thesis economic aspect of regional development is embraced.

According to the Ministry of Development of Turkey (former State Planning Organization), regional development is all the efforts considering the regional vision consisting of the mutual interaction of the regions of the country to other regions and to the globe. Regional development takes as principle the terms of participation and sustainability. And it is a complement of efforts to increase the regional welfare by improving the human resources and by bringing the economic and social resources into action (Temizel, 2013).

According to Dinler (2005), regional development aims to decrease both intra and inter-regional imbalances, facilitates the compliant distribution of resources, economic and demographic sources and organizes the region in spatial manner.

Regional Planning is a tool for coordinating the regional development. The M.Sc. in Regional Planning Program web site of the Middle East Technical University defines it as a scientific field that was brought to agenda in 1950s for elimination of the regional inequalities. However, that term was transformed into organizing socio-

economic activities of a region in spatial manner, as defined in the Development Act of 3194, article 8.

2.1.1 Intraregional sectoral development

In regional economic development, different economic activities of different basic sectors. The basic sector here, as defined in Lowry Models by Rodrigue in his book of "the Geography of Transport Systems" in 1964 is the employment sector that meets non-local demand. It produces good and services, which are exported outside the urban area. It generates a centripetal capital flows into the city, which results in economic growth and surpluses. Most industrial sector employment is within this category. This sector is usually less constrained by urban market accessibility considerations since the local market is not the main outlet of the output. (Rodrigue, 2013).

The sectors other than basic sectors are mostly service sectors or industrial/agricultural sectors of which final customers are local people. Thus, basic sectors are important for economic development of regions which has exports potential.

In countries where knowledge and technology are not being developed or commercialized like Turkey, foreign direct investments are important for basic sector development.

2.1.2 The importance of foreign direct investments

Investments for a specific region or province could be made by local entrepreneurs, public investments with the decisions of the central authority or by direct foreign investments.

In developing countries such as Turkey, and their regions and provinces, the trend of increasing population, makes the regions to have sustainability in economic growth and development. As it was seen in many examples, the investments from the local entrepreneurs and the increase in the efficiency of the existing facilities are not enough for such growth and development without public investments and external private investments.

The increase in the communication and transportation opportunities since last two centuries and adopting specialization in the production cycle within global large scale companies increases the direct foreign investments around the globe. Such investments bring many advantages for both the firms and the location of the investments.

Companies benefit from smart specialization and scale economies by differences of labor force and competitive advantages of the regions or provinces. On the other hand, regions or provinces enjoys the increase in employment and Gross Domestic Product (GDP) and new technologies or implementations i.e. innovations of the global companies and also the side industry and service sector with such investments. According to Broadman and Recanatini (2001), a 1% increase in direct foreign investment increases the income per capita by 0,8% which is calculated by scientist and published in United Nations Conference on Trade and Development (UNCTAD).

2.2 Conceptualization of Smart Specialization

Smart specialization has settled in the center of economic development and growth policies in the European countries in the recent years. This concept is regarded by the European Commission as the mainmast of Europe 2020 strategy. Smart specialization, suggested by Dominic Foray and Bart van Ark for the first time to fill in the blanks in transatlantic productivity, has been developed by expert group of "Knowledge of Growth". Smart specialization has two main approaches away from standard economic growth models; first is innovation logic and the other is system mechanism (McCann Ortega-Argilés, 2011).

Smart specialization, according to Organization for Economic Co-operation and Development (OECD), is a concept that does not fit to the leading information regions but to the regions where Small and Medium-Sized Entreprises (SMEs) are dominant rather than international companies where the sector is relatively less apparent. On the other hand, smart specialization at regional scale and determination of policies depending on it in non-internationalized and isolated regions will have limited effect (OECD, 2013).

The concept of smart specialization goes back to the policy brief of Dominique Foray, Paul A. David and Bronwyn Hall in 2009 as "*the Smart Specilisation – the Concept*". Short after the concept was put forward, The European Union, OECD and United States announced several policies or strategies referring smart specialization (McCann and Ortega-Argilés, 2011).

In Foray's presentation in the Smart Specialization Conference in Sofia/Bulgaria (2012), he summarizes the concept with the following words; "*Regions cannot do*

everything in science, technology and innovation so they need to focus on certain domains". Furthermore, he mentions that the concept is not a planning doctrine that would require a region to specialise in a particular set of industries but an approach to policy that considers whether those activities already strong or showing promise for a region can benefit from more R&D and innovation. (Foray, 2012)

One of the most definition-like explanations of the smart specialization is within the study of Ortega-Argilés (2012) namely "*Economic Transformation Strategies - Smart Specialization Case Studies*" as one of the examples for strategy development. He mentions evidence based process of discovery of the industrial engines of regional economic growth by identifying the embedded sectors in the region and analyzing the related industries and activities that complement and improve the regional economic structure in order to define the best prioritization of sectors based on the resources already available.

In the "RIS3 Guide" for European Regions in 2012, which was published with direct effects of the creators of the concept, the regional innovation strategies for smart specialization (RIS3) was defined as follows:

> *National/regional research and innovation strategies for smart specialization (RIS3) are integrated, place-based economic transformation agendas that do five important things:*
>
> *• They focus policy support and investments on key national/regional priorities, challenges and needs for knowledge-based development, including ICT-related measures;*
>
> *• They build on each country's/region's strengths, competitive advantages and potential for excellence;*
>
> *• They support technological as well as practice-based innovation and aim to stimulate private sector investment;*
>
> *• They get stakeholders fully involved and encourage innovation and experimentation;*
>
> *• They are evidence-based and include sound monitoring and evaluation systems.*

2.3 Implementation of the Smart Specialization

Being a recently studied term, smart specialization studies are spreading and implementing. The European Union can be seen as the pioneer, whereas the United States and studies of the OECD mentions about the smart specialization strategies (McCann and Ortega-Argilés, 2011).

Both OECD and the EU encouraged the nations and regions to develop smart specialization strategies. Australia as a country, is forthcoming with its grain researches for instance, Flanders as a region is specialises with nanotech for health and sustainable chemistry (Innovation-driven Growth in Regions: The Role of Smart Specialization, 2013).

In the case of the EU, the European Commission sees the Structural Funds as a tool for supporting the concept (EU Joint Research Center web page, 2016). In the official web page, importance is stated as follows: "*The efficient use of Structural Funds and its management is a crucial factor for many regions in Europe to overcome the economic crisis. For this reason, to develop a Research and Innovation strategy for Smart Specialization (RIS3) is currently a prerequisite in order to receive funding from the European Regional Development Fund (ERDF)*".

An organization named the Smart Specialization Strategies Platform (S3 Platform) has been established within the Joint Research Center of the European Commission in Sevilla to assist the EU Countries and regions to develop, implement ant review their Research and Innovation Strategies for Smart Specialization (RIS3) which is open to candidate and neighboring countries and their regions (S3 Platform web page, March 6th 2016).

The strategies which S3 Platform reviews are of NUTS-2 level regions. In the Balkan and Eastern European, Baltic countries such strategies are at national level as the area covered of them are relatively small.

In Turkish Case, smart specialization strategies have not been officially implemented in a comprehensive manner, yet. However, the sectoral strategies are being adopted by related Ministries, especially the Ministry of Science, Industry and Technology. Moreover, the Ministry of Development encouraged the Regional Development Agencies to develop regional innovation strategies as defined in the National Strategy for Regional Development (BGUS).

Some Regional Development Plans including the East Marmara Regional Plan sets strategies for smart specialization and all plans include sectoral prioritization. In East Marmara Regional Plan, ensuring smart specialization was adopted as an aim within the "competitive region" axis and supported by the following tools (East Marmara 2014-2023 Regional Plan, 2014):

- Focusing on prominent sectors
- Structuring tourism according to regional potentials and target markets
- Ensuring branding and innovation on regional agricultural products
- Developing clusters and cooperation on sectoral agglomerations
- Enhancing target market based internationalization
- Determination of promising new production, service and employment fields.

2.3.1 Case study for smart specialization: Piemonte

According to the presentation of the regional strategy for peer review of smart specialization strategy of the Piedmont Region (2013) had started in 2005 with the preparation of the first report and establishing a regional committee, a scientific commission and an evaluation team in 2006.

After developing four thematic groups for sectors under the themes of labour, production system competitiveness, innovation; environmental valorization and protection; improvement in quality of life and social inclusion; education training and skills and having national stakeholders attend to the process, following sectors had been chosen:

- Aerospace,
- Chemicals,
- Automotive,
- Made in Piemonte: textile and fashion, food, style and design,
- Mechatronic,
- Life Sciences.

2.3.2 Case study for smart specialization: Emilia-Romagna

Emilia-Romagna is a region in Italy, known as the production base of agriculture, food, automotive and mechanics industry and one of the regions with highest GDP over Europe.

Emilia-Romagna has got a clear regional strategy on innovation started on 2002 with the Regional Law no. 7/02:“Promotion of the Industrial Research, Technology Transfer and Innovation in the productive system of Emilia Romagna” (Peer Review Presentation of Regione Emilia-Romagna, 2012).

As described within the peer review presentation of Regione Emilia-Romagna to the S3 Platform (2012), the process was started in 2002 with the identification of clusters with highest employment and competitiveness and it was followed with the determination of the clusters with innovative aspects and technology. Along with these and taking national strategies into account five sectors were chosen as smart specialization preferences:

- Agrofood,
- Construction
- Mechatronics
- Health industries,
- Creative industries.

2.3.3 Case study for smart specialization: Lombardy

The Lombardy region is the financial center of Italy, with its capital; Milano and is the fourth most populated region of Europe and fifth in terms of GDP in the Europe (Regional Innovation Strategies for Smart Specialization in Regione Lombardia, 2013, p.4).

After a three year of study, the region had developed its sectors to specialise in:

- Aerospace,
- Agri-food,
- Green industry,
- Creative and cultural industries,
- Health industries,
- Advanced manufacturing,
- Sustainable mobility.

One of the main differences of the Lombardy’s strategy is that it has “district based” industrial policy aspects (Regional Innovation Strategies for Smart Specialization in Regione Lombardia, 2013, p.7). The method adopted for the study is both past

experiences and outlining the system of production and scientific skills and highlighting the value chains.

2.3.4 Case study for smart specialization: Campania

Well known for its historic and natural values, Campania region is relatively a less developed region compared with the regions in the North of Italy. In the Estratto RIS3 Regione Campania report (2014, Capitolo IV), following sectors are defined as specialised fields:

- Aerospace,
- Smart communities,
- Sustainable energy,
- Nanotechnology and new materials,
- Agriculture and food production,
- Transport and logistics.

The main difference of Campania with the others is that, not only industrial sectors were chosen, but also service sectors were defined as prominent fields.

In the cases of Italy, mentioned in the cases for smart specialization, all the regions have aerospace as a sector to focus on. Another fields could be key enabling technologies such as; IT and nanotechnology or creative industries. Such intersections could be eliminated or guided via the benchmarking tools.

The examples above show several cases for developing smart specialization strategies. The further step, according to the policy papers such as RIS3 Guide, is supposed to focus on those specific sectors and help the region more developed in that fields.

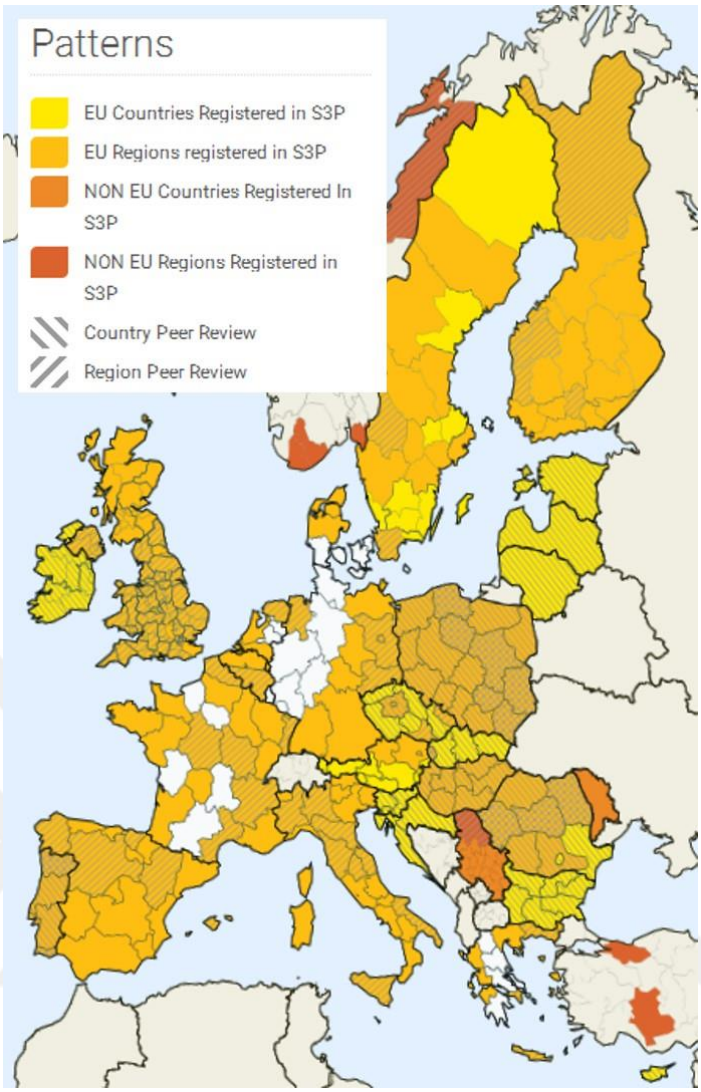

Figure 2.1 Smart Specialization Strategies of NUTS-2 Regions of Europe According to Their Status, as of April, 2016 (S3 Platform, 2016)

The S3 Platform conducts peer review studies for the regions to evaluate the method and results as a coordinative manner (S3 Platform web page, March 9th 2016).

2.4 Coordination of Regional Smart Specialization Strategies

As mentioned at the beginning of the thesis, smart specialization strategies are, somehow, the best prioritization of the sectors within a region. There are different organizations in different countries that are responsible for developing smart specialization strategies. For instance, in Italy regional authorities and their affiliates are in charge of developing strategies, whereas in the Eastern European countries, the authority belongs to related ministry. In the case of Turkey, regional development

agencies work on such issues under the umbrella of the Ministry of Development (former State Planning Organization) according to the act of 5449 (2006).

In the member countries of the EU, EUROSTAT is the main source for data and the classification of the data which is important for benchmarking. However, in Japan and in the USA, the classification methods for economic activities may differentiate. For instance a machinery for the automotive sector might be classified under machinery in one classification and motorized vehicle production in another. In the case of Turkey, main data producer is Turkish Statistical Institution (TURKSTAT / TÜİK). However, there are many other institutions to produce data in accordance with their fields of work. According to the web site of TURKSTAT (2016), the studies for reconciliation between TURKSTAT and EUROSTAT has begun in 1993 with the protocol signed. Furthermore, the programs like "Improving the Statistical System of Turkey" (TİSG) and "Mediterranean Statistical Cooperation Program" (MEDSTAT) have been implementing in Turkey.

Such differences between countries brings difficulties in comparison of the interregional data and analyses. In the case of the European Union, the S3 Platform has developed a system called Eye@RIS3 to make benchmarking and comparison between regions (S3 Platform, 2016).

The S3 Platform uses following data sources for benchmarking as mentioned in their web page:

- EU Cluster observatory
- RIM Plus - Regional Innovation Monitor Plus
- Regional Innovation Scoreboard 2014
- Regional Competitiveness Index 2013
- KETs Observatory
- Digital Entrepreneurship Monitor
- Eurostat "Regional Statistics Illustrated" per NUTS2 region 2003-2011

The same web site defines Eye@RIS3 as an online database intended as a tool to help strategy development rather than a source of statistical data. Apart from the statistical data, each region's accepted authority defines the regional sector priorities within the tool. The guide to the Eye@RIS3 report of the S3 Platform (2014) mentions another benefit would be for the regions to find their counterparts in specific sectors or fields

of study for collaboration in Horizon2020 projects, expansion of the knowledge and innovation communities, Interreg projects and thematic workshops.

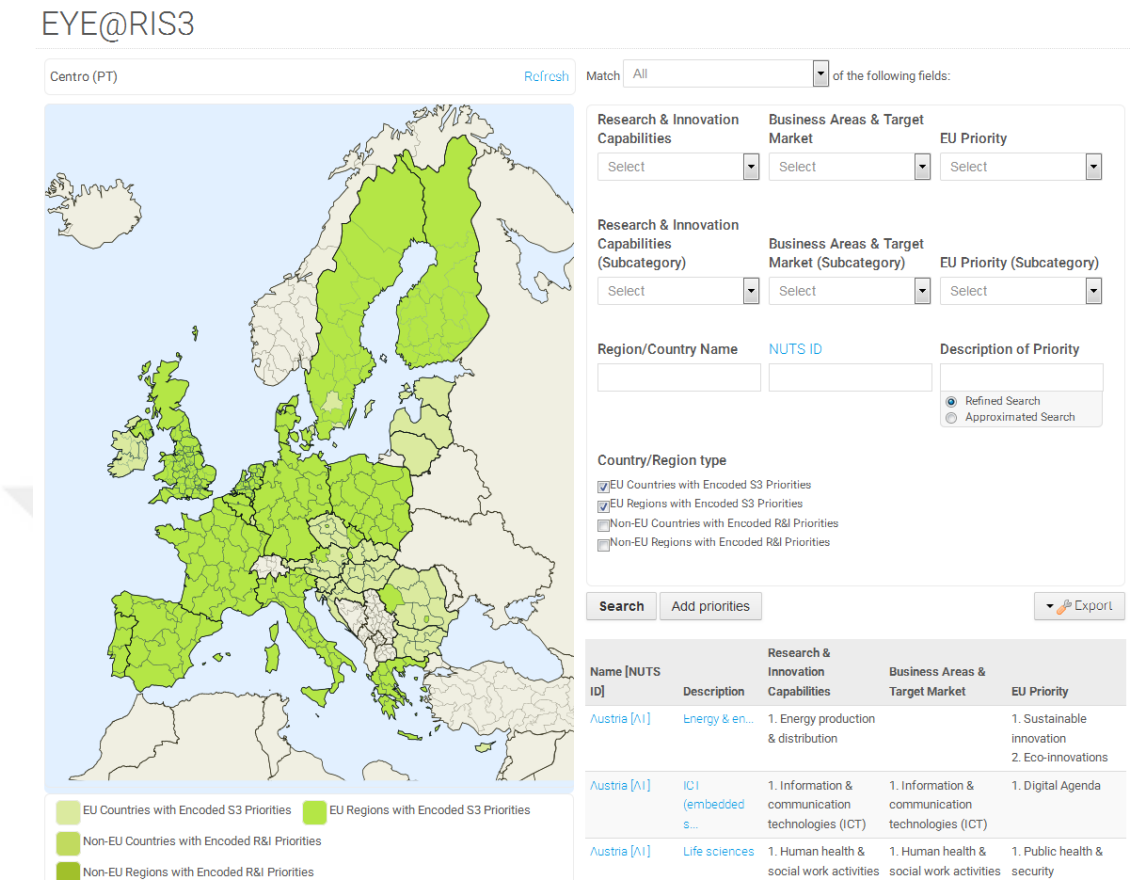

Figure 2.2 Eye@RIS3 Web Page Screenshot (S3 Platform, 2016)

In the case of Turkey, there is a commonly used interactive map showing basic economic data and distribution of activities over space, prepared by the Investment Support and Promotion Agency of Turkey (ISPAT).

Figure 2.3 Interactive Map of ISPAT Web Page Screenshot (ISPAT, 2016)

One of the reasons to coordinate the regional priorities could be the consistency of the sectors or fields. In the cases of Italy, mentioned in the cases for smart specialization, all the regions have aerospace as a sector to focus on. Another fields could be key enabling technologies such as; IT and nanotechnology or creative industries. Such intersections could be eliminated or guided via the benchmarking tools.

Another issue to focus on is that the sectors with stronger lobbies might tend to become more prominent for the government or the European Union to provide financial assistance. This should also be managed in a consistent manner.

Although, smart specialization has no legal or any sanction other than the European Union, it is becoming more and more advised by the international organizations of development. The Cohesion Policy document (2013) mentions the relation between smart specialization and funds as follows: “National and regional authorities across Europe shall design smart specialization strategies in entrepreneurial discovery process, so that the European Structural Investment Funds (ESIF) can be used more efficiently and synergies between different EU, national and regional policies, as well as public and private investments can be increased”.

Policies on innovation are generated in almost all of the international organizations and unions intensively affected by Europe and America and this subject is evaluated as the most critical element in terms of economic development (MARKA, 2014).

The innovation policy of World Bank, prepared in 2010, defines the frame of boosting regional development by supporting innovation capacities of developing countries. It defines regional governments and authorities as "gardeners" and key actors of setting regional strategies. Also, innovation, R&D and technology is seen as the main recovery tool for economic crises (Özden C.U. et. al., 2013).

The policy paper of Philip Cook and Olga Memedoviç prepared for the United Nations Industrial Development Organization (UNIDO), strategies for regional innovation systems, defines the concept of regional innovation systems and explains the vehicles of regional development by contrasting different regions from different continents and advocates the promotion of systemic innovation with public and private partnership at regional level (Özden et. al., 2013).

OECD examines the innovation structures of regions and analyses the outcomes of the regions in terms of production. After making such examination in details, they develop offers for transnational corporations and supports dissemination of best practices. (Özden et. al., 2013).

2.5 Methodology for Evaluation of the Sectors in the case of East Marmara

Presenting regional differences is in the center of strategy setting process. Information and data are compiled and physical and social innovative infrastructure of the region, problems and obstacles, potentials and opportunities should be presented by means of desk researches, questionnaires with broad participation, interviews and meetings, and evaluation of workshops and previously implemented similar activities.

As potential and preferences of the region as well as international positioning are deemed as the requirement of smart specialization, they are addressed on the basis of the region and sectors.

Firstly, existing situation analyses and sectoral priorities should be detected by considering all bodies included in the innovation ecosystem on national and regional basis in determination of innovation indicators and the data produced by them.

In this scope, following data and information were found available for making analyses:

Ministry of Science, Industry and Technology

- Information related to the projects applied to and approved by Industrial Theses (SANTEZ) program
- Information and employee numbers of private sector Research and Development (R&D) centers
- Information related to technology development regions
- Information related to projects benefiting from techno-initiative capital support
- Information related to projects supported by the European Union Entrepreneurship and Innovation Program (EIP) program
- Efficiency Statistics General Directorate of Productivity (VGM)
- Information related to projects supported within the scope of the European Union Competitiveness and Innovation Framework Programme (CIP) program

Regional Development Agency

- Region Plan statistics
- Information related to the projects supported in R&D and Innovation Financial Support Program

Ministry of Economy

- Direct foreign capital inflow and sectoral distribution
- Investment incentive certificate statistics and sectoral distribution
- Sectoral export statistics

Small and Medium Industry Development Organization (KOSGEB)

- Number of applications to / approvals by R&D, innovation and industrial implementation support in the region and their sectoral distribution
- Distribution of organizations applying for support and benefiting from the support according to provinces and sectors

Ministry of Finance

- Number of Taxpayers Benefiting from R&D Discounts and Amount of Discount

Senior Institution for Organized Industrial Zones (OSBÜK)

- Information related to organized industrial zones
- Sectoral distribution in organized industrial zones

Social Security Institution

- Employment statistics and sectoral distribution
- Workplace statistics and sectoral distribution

Scientific and Technological Research Council of Turkey (TÜBİTAK)

- General R&D and innovation indicators
- Information related to R&D, technology and innovation projects implemented with support of TUBITAK in the region
- Statistics of researches registered to ARBİS
- Information related to TEYDEB projects (budget, subject, sector)
- Information related to TEYDEB R&D projects
- Information related to projects supported within the scope of framework programs

Turkish Patent Institute (TPE)

- Patent statistics and sectoral distribution
- Useful model statistics and sectoral distribution
- Geographical marking statistics
- Brand statistics

Turkish Exporters Assembly

- Sectoral export statistics

Turkish Statistical Institute

- Regional indicators
- R&D and Innovation statistics

Turkish Foundation for Development of Technology

- Information related to the projects supported in the region

Universities and General Directorate of Higher Education Credit and Hostels Institution (YÖK)

- Area-subject distribution and numbers of Academic units (Department, Faculty, Institute, College, Vocational High School)
- Area-subject distribution of the students
- Area-subject distribution of number of academicians
- Distribution of European Commission, DPT, BTSB, MARKA, CFCU, Municipality, etc. supported technology, R&D and innovation projects prepared or partnered by the university
- Sectoral distribution of publications issued addressing the university (article, letter, meeting abstract, proceedings paper, review)
- Index distribution of foreign scientific publications issued addressing the university according to faculties
- Information related to research centers and laboratories of universities
- Share allocated for scientific research projects
- Information related to common activities implemented with private sector
- Information relating to technology transfer offices
- Information related to technology development regions of universities

Other

- Central and State Institutes and Research Centers in the Region (GTHB)
- IT companies in the region (TÜBİDER)

Determination of data sources also based on the availability of data in the region and in Turkey.

Most of the listed datasets are open to public, however not being published dynamically. Thus, an authorized body has to apply for the data producing institution. The 6th article of the act of 5449 in Turkey, gives the regional development agencies the right to collect the necessary data. As the smart specialization strategies are being developed by them, this is an important aspect.

2.5.1 Evaluation of the sectors: determination of criteria groups

One of the primary elements that need to be addressed in smart specialization based regional development is the necessity of selecting the sector to support. Not analyzing all details of the sectors and prioritizing the sectors with powerful lobbies risk the success of the support mechanisms. In order to prevent this risk, the sectors prominent in the region should be identified and then it should be decided which of these sectors will be developed in which way. In this regard, it is considered necessary that smart specialization be ensured in East Marmara Region and leading sectors and how these sectors will be developed be determined within a sustainable innovation system. To do so, statistical data have gathered for each analysis as mentioned in the following analyses.

2.5.1.1 Investment

Sectoral preferences of private sector investments in the last 10 years have been examined. Preferences of domestic and foreign investors in investment statistics with incentive certificates, shares of the sectors within the region and change of these shares, position of the shareholders of the sectors in the region in Turkey and development trends of this position in the 10-year period have been examined. When identifying the prominent sectors in the region, the issue that privilege the investment statistics with incentive certificate is that first level has been completed among the sectors that are located in the region in line with the information obtained from these statistics. With this study where the investment preferences in the region were examined in detailed, more than ten sectors were eliminated in East Marmara Region where activities are performed in many main manufacturing industries and 18 sectors have been determined. In line with the evaluations basing on the investment incentive statistics, not only main sectors but also some sub-sectors have also stand out in the manufacturing sector according to their activity status.

In addition to the analysis of investments with incentive certificates, SME dominance have been analyzed basing on the company structures and company sizes in the sectors where investments concentrate. In line with the reality that large-scale and multinational companies put the items such as employment, export, and turnover forward in the sectors they take place, SME dominance have been considered important to determine the developed sectors that bear potential and that are developed

with internal dynamics of the region. Another determiner element in identification of the concentration of investment in the sectors is opinion of the community. In the surveys that were conducted in the preparation period and that could access to a wide audience, questions related to the sectors that are preferred in terms of investments were included and the community was expected to determine their advance sector preferences.

2.5.1.2 Employment

The second criteria group referred for determination of the prominent sectors in the region was the analyses basing on the employment data. Agglomeration analysis was carried out using the employment data on the basis of the sectors and, therefore, the sectors that put the region forward within the company have been determined. At the same time, employment change rates in the last 4 years and employment created in the last 10 years of the sectors were also calculated and the sectors that contribute to the employment volume in the region were identified. Another analysis method prepared setting off from the employment structure of the sectors is shift share analysis. With shift share analysis, it was calculated that which sector was how effective in regional development and it was revealed that which sectors led economic development or decrease in the region.

2.5.1.3 Research

Many sectors have significance due to high scale investments with large employment and export values. However, most of the times technology, design and high value added parts transfer to the production location and middle income trap occurs. However, having a clustering of a sector within the region should bring research and development phases to the region. Having integration with academy and research centers, the decision for sector selection could become more accurate and precise. Thus, indicators showing research levels should be examined.

2.5.1.4 Added Value

The U.S. Department of Commerce defines added value as; the contribution of a private industry or government sector to overall GDP. Different economic activities create different added values and equals to the difference between an industry's gross output. Having several techniques to determine, the most recognized is input-output analysis. In regional level in Turkey, General Directorate of Productivity publishes

productivity data for different economic activities. For a region, having specialization with high value added sectors, welfare will increase relatively. However, in some cases this could be discarded in order to increase employment instead.

2.5.1.5 Exports

Within the scope of evaluation of the sectors in the region according to export, the sectors were sorted according to their export volumes and the sectors that export over the export value defined per sector for the region were determined. Additionally, export change values of the sectors were also calculated and sectors with high export increase rate were identified.

2.5.1.6 Financing

Financing is an important aspect in investments. The higher the investment budget, the longer the credit period is needed. In the sectors such as shipbuilding, the bank loans are given up to 20 years. The Turkish Eximbank is an example for such credits (Eximbank web page, 2016). The financing is an important criteria for sectoral preferences within a region. The sectors with high employment and exports does not mean that sector is important alone without considering the high bad loan rates. In that case, the sector could be considered as unsustainable.

2.5.2 Evaluation of the sectors: statistical analyses

There are various data analysis techniques for determining prioritized sectors. Some of the most frequently used are agglomeration analysis, growth trend analysis, data examining methods which are used in this study. Furthermore, weighted key performance indicators method was adopted which is similar to multi-criteria data analysis.

2.5.2.1 Agglomeration analysis

The terms “agglomeration” or “cluster” are used to refer to various forms of geographic concentrations (Fujita and Thisse, 2002; Martin and Sunley, 2003; McCann and Sheppard, 2003).

Location Quotient (LQ) is a localization measure, in the sense that it allows the assessment of the relative concentration degree of a given activity (k) in a given region (i) where (x) is the specific value. Analytically,

$$LQ_{ik} = (x_{ik} / x_j) / (x_k / x),$$

Equation 2.1 Location Quotient Formula

where the numerator measures the concentration of the gross value added of region (i) in sector (k) and the denominator measures the concentration of the reference region's gross value added in sector k (Diniz and Upadhay, 2010, p 107).

Agglomeration is one of the main factors for clustering. High volumes of agglomeration and scale tend to create clusters. Another dimension to define competitive sectors is the added value analysis of each sector. For that purpose, the data of Gross Value Added per employee in the sectoral basis were used. The difference between the sale price and the production cost of a product is the value added per unit (Deardorff, 2009). In other words, value added is the difference between output and input of a production process and is equal to the sum of employee expenditures and total profit and also shows the increase in the value of a product.

Agglomeration analysis can be used with other datasets, such as correlation with the value added and growth rate of employment. In the study of East Marmara Regional Innovation Strategies for Smart Specialization (MARKA, 2014), two methods were adapted; namely; agglomeration – added value correlation in figure 2.4; agglomeration – sectoral growth rate correlation in figure 2.5 with the following results.

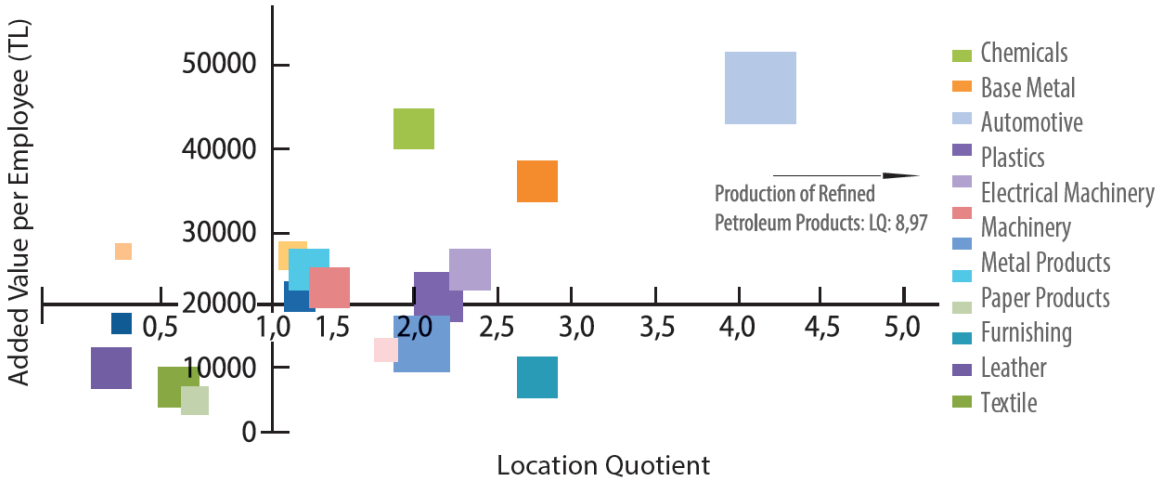

Figure 2.4 Agglomeration – Added Value Correlation Analysis (Manufacturing Sectors) (East Marmara Regional Innovation Strategies for Smart Specialization, 2014)

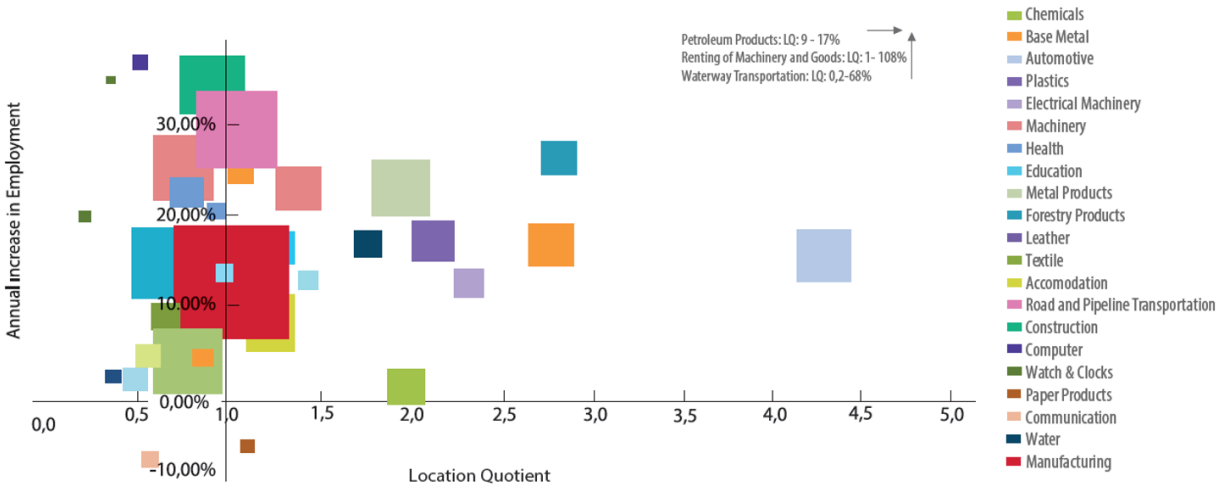

Figure 2.5 Agglomeration – Sectoral Growth Rate Correlation Analysis (All Sectors) (East Marmara Regional Innovation Strategies for Smart Specialization, 2014)

In both agglomeration analyses, chemicals, base metal, automotive, plastics, electrical machinery, machinery, metal products, paper industry, furnishing, leather and textile are among the most agglomerated sectors.

2.5.2.2 Shift share analysis

Shift-share analysis is another method for evaluating sectoral performances of a given region. Shift-share analysis evaluates one sector growth trend by eliminating the national increase share of the same sector, growth ratio of the region within the country and growth rate of the country.

Henry et al. begins their book "*Shift-Share Analysis Revisited: The Allocation Effect and Stability of Regional Structure*" by defining shift-share as a technique to analyze the relationship between regional growth and industrial structure. Than they mention that the technique first developed and used by several regional economists such as Ashby, Dunn and Punchs.

The shift-share analysis requires a time series data in order to view the increases and decreases. Having several formulae, most common ones are the following:

$$NS_{ir}^{t} = E_{ir}^{t-1} \, x \left(\frac{E_{C}^{t}}{E_{C}^{t-1}} - 1 \right)$$

$$IM_{ir}^{t} = E_{ir}^{t-1} \, x \left(\frac{E_{iC}^{t}}{E_{iC}^{t-1}} \right) - \left(\frac{E_{C}^{t}}{E_{C}^{t-1}} \right)$$

$$RS_{ir}^{t} = E_{ir}^{t-1} \, x \left[\left(\frac{E_{C}^{t}}{E_{ir}^{t-1}} \right) - \left(\frac{E_{iC}^{t}}{E_{iC}^{t-1}} \right) \right]$$

Equation 2.2 Shift-Share Analysis Formulae

where; NS is National Share, IM is Industrial Mix, RS is Regional Share, t is current time period, i is specific industry, r is the region and E is employment.

In the case of East Marmara, the method was already used by the employment data of Social Security Organization in the document of Regional Innovation Strategies for Smart Specialization in East Marmara 2014-2018 (2014). With shift share analysis, it was calculated that which sector was how effective in regional development and it was revealed that which sectors led economic development or decrease in the region (MARKA, 2013).

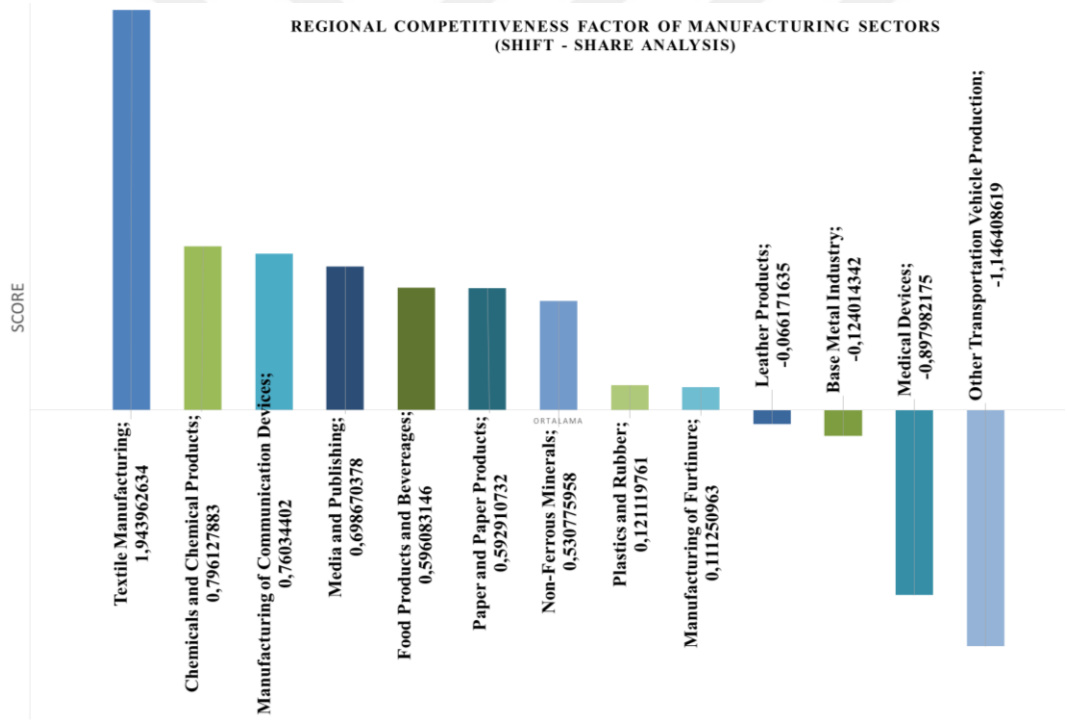

Figure 2.6 Results of Shift-Share Analysis of Production Sectors

The data used in the regional strategy brings the results above, where textile and clothing; chemicals and chemical products, production of electrical machinery (communication devices, radio and TV); printing and publishing; food and beverages; paper; non-ferrous materials show the highest shift between 2003 and 2008 as shown in figure 2.6.

2.5.2.3 Trend analysis

Gathering data for time series, regardless the subject of datasets, is beneficial as it shows the trend. In geography for instance, knowing a short time trends of temperature can provide information about the weather, however long time data can provide information about the climate change. According to mission pages of National Aeronautics and Space Administration of the United States of America (NASA) namely "What's the Difference Between Weather and Climate?", "the difference between weather and climate is defined as a measure of time. Weather is what conditions of the atmosphere are over a short period of time, and climate is how the atmosphere "behaves" over relatively long periods of time". This, somehow, means that long term data give more precise information than shorter periods.

The same condition exists in economic data analyses. For instance, having a small number of increase in employment over three years, one can conclude that there is a trend of growth in a specific economic activity within that period. However, when a main actor with large number of employment enters or leaves the market at the end of that ten years, all situation may change. Thus, keeping tracks of the data for longer periods will be helpful.

In an economic habitat of a specific territory; employment, exports and imports, investments, academic studies on economic activities and their agglomerations can provide important information of competitiveness and prominent economic sectors.

2.5.2.4 Weighted key performance indicators (W-KPI)

This method was used within the East Marmara Regional Innovation Strategies for Smart Specialization (2014) as a tool for determining the prominent sectors with objective preferences of pre-defined criteria. The method was summarized as follows:

> "*The sectors operating in the region are classified into three groups as a result of 20 different studies conducted on the basis of four criteria for identification of main manufacturing sectors that are already active in the regional economy in East Marmara Region. The sectors that contribute mostly to the regional economy and parse mostly in the national economy in terms of export, employment, added value and R&D structuring currently in the region are located in the first group*".

In this W-KPI study conducted by East Marmara Development Agency, following scoring in table 2.1, main and sub-groups were used on the basis of sectors. As defined above, manufacturing and gross scores on the basis of region or provinces were not included due to lack of the needed data.

Table 2.1 Scoring Groups for W-KPI Data (East Marmara Regional Innovation Strategies for Smart Specialization (2014))

Scoring main group	Sub-group	Spatial framework	Data source
Investment	Amount of investment Of $ 1 million per investment projected employment	Provincial level	Investment Incentive Data
	Share of foreign investment	Provincial level	Investment Incentive Data
	Rate of increase in the amount of investment	Regional level	Investment Incentive Data
Employment	Foreseen employment in investments	Provincial level	Investment Incentive Data
	Employment foreseen per 1 million TL investment	Provincial level	Investment Incentive Data
	Employment growth rate	Regional level	Investment Incentive Data
Research	Patent and utility model applications	National level	TPE statistics
	Rate of increase in applications	National level	TPE statistics
Gross Added Value	Gross Added Value	National level	VGM statistics
	Gross Added Value Growth Rate	National level	VGM statistics
Export	Amount of exports	Provincial level	TİM statistics
	Growth rate in the amount of exports	Provincial level	TİM statistics
Financing	Amount of bad loans	Provincial level	BDDK
	Rate of increase in bad loan amounts	Provincial level	BDDK

This method is similar to the multi-criteria decision making process. After gathering the statistical data, they were normalized for comparison. After normalizing the data each of them were given weights by the Senior Advisory Board consisted of the vice rectors of universities, secretary generals of chambers of commerce and industry, secretary general of the development agency and representative from the statistical institution. Having the existing analyses presented and the normalized data were shown, the board was asked to give weighted values to each criteria; investment, employment, research, gross added value, export and financing.

W-KPI calculation was made by multiplying the values obtained as a result of the evaluation made for each data Sub-Group on the basis of each province constituting

the region with the Sub-Group coefficients. Regional W-KPI values were obtained by summing up the W-KPI values composing for each Sub-Group on the basis of the provinces. The final results are given in table 2.2.

Table 2.2 Results for Scoring of W-KPI Data Analysis (East Marmara Regional Innovation Strategies for Smart Specialization (2014))

TR-42	**Machinery**	**Electrical Machinery and Equipment**	**Automotive Main and Supplier Industry**	**Non-ferrous Materials**	**Chemistry and Medicine**	**Agriculture and Ornamentals**	**Forestry Products**	**Transportation and Ship Building**	Energy	Metal Products	Paper	Iron-Steel	Weaving and Textile	Plastic and Rubber	Glass	Livestock	Food and Beverage	Logistics and Storage	Tourism	Electronics	Leather Products
Investment	**32,24**	**13,05**	**69,81**	**59,24**	**20,99**	**0,00**	**43,21**	**28,02**	19,78	15,81	17,39	27,75	5,52	24,37	35,89	4,14	18,43	18,83	2,85	2,97	8,28
Intensity (TR-42)	**17,95**	**8,28**	**19,33**	**38,65**	**8,28**	**0,00**	**40,03**	**24,85**	1,38	11,04	11,04	5,52	5,52	6,90	35,89	4,14	4,14	5,52	0,00	1,38	8,28
Foreign Intensity (TR-42)	**14,29**	**4,76**	**47,64**	**6,35**	**12,70**	**0,00**	**3,18**	**3,18**	12,70	4,76	6,35	22,23	0,00	17,47	0,00	0,00	14,29	4,76	0,00	1,59	0,00
Growth Trend (TR42)	**0,00**	**0,00**	**2,85**	**14,23**	**0,00**	**0,00**	**0,00**	**0,00**	5,69	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	8,54	2,85	0,00	0,00
Employment	**49,41**	**62,38**	**18,23**	**22,86**	**8,77**	**3,04**	**23,76**	**37,55**	12,16	14,91	31,74	16,84	27,02	6,35	18,76	43,64	18,49	10,46	9,84	3,04	5,25
Employment Intensity (TR-42)	**9,95**	**7,74**	**12,16**	**13,26**	**2,21**	**0,00**	**17,69**	**34,27**	12,16	8,84	4,42	7,74	5,53	3,32	15,48	25,42	3,32	1,11	0,00	0,00	2,21
Employment Intensity per 1 Million TL (TR-42)	**39,46**	**54,64**	**6,07**	**3,04**	**0,00**	**3,04**	**6,07**	**0,00**	0,00	6,07	27,32	9,11	18,21	3,04	0,00	18,21	15,18	6,07	0,00	3,04	3,04
Growth Rate (TR42)	**0,00**	**0,00**	**0,00**	**6,56**	**6,56**	**0,00**	**0,00**	**3,28**	0,00	0,00	0,00	0,00	3,28	0,00	3,28	0,00	0,00	3,28	9,84	0,00	0,00
Research and Development	**106,04**	**90,13**	**24,75**	**21,21**	**38,91**	**0,00**	**37,11**	**0,00**	0,00	42,42	0,00	0,00	0,00	26,51	0,00	0,00	5,30	0,00	0,00	3,54	0,00
Patent and Utility Model (TR)	**106,04**	**90,13**	**21,21**	**21,21**	**21,21**	**0,00**	**37,11**	**0,00**	0,00	42,42	0,00	0,00	0,00	26,51	0,00	0,00	5,30	0,00	0,00	0,00	0,00
Growth Trend (TR)	**0,00**	**0,00**	**3,54**	**0,00**	**17,7**	**0,00**	**0,00**	**0,00**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	3,54	0,00

Gross Added Value	**0,00**	**16,0**	**27,0**	**0,00**	**27,0**	**0,00**	**0,00**	**15,5**	44,1	0,00	25,9	9,86	0,00	0,00	0,00	0,00	6,75	6,75	0,00	0,00	0,00
Gross Added Value (TR)	**0,00**	**6,75**	**27,00**	**0,00**	**27,00**	**0,00**	**0,00**	**0,00**	44,18	0,00	13,50	6,75	0,00	0,00	0,00	0,00	6,75	6,75	0,00	0,00	0,00
Growth Trend (TR)	**0,00**	**9,32**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**15,5**	0,00	0,00	12,4	3,11	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Export	**3,98**	**1,43**	**22,26**	**15,63**	**21,14**	**103,58**	**0,00**	**17,16**	0,00	0,00	0,00	15,63	30,65	0,00	0,00	7,15	0,00	0,00	0,00	0,00	0,00
Export (TR42)	**1,43**	**1,43**	**17,16**	**2,86**	**18,59**	**39,72**	**0,00**	**17,16**	0,00	0,00	0,00	2,86	0,00	0,00	0,00	7,15	0,00	0,00	0,00	0,00	0,00
Growth Trend (TR42)	**2,55**	**0,00**	**5,11**	**12,77**	**2,55**	**63,86**	**0,00**	**0,00**	0,00	0,00	0,00	12,77	30,65	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Finance	**0,00**	**0,00**	**-0,05**	**-0,05**	**0,00**	**-0,64**	**0,00**	**-4,75**	-0,03	0,00	-2,35	-0,08	-5,21	-0,58	0,00	-0,64	-0,58	-0,58	-0,05	0,00	-4,62
Bad Loan	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**-0,58**	**0,00**	**-2,91**	0,00	0,00	-2,33	0,00	-5,23	-0,58	0,00	-0,58	-0,58	-0,58	0,00	0,00	-4,65
Growth Trend (TR)	**0,00**	**0,00**	**-0,05**	**-0,05**	**0,00**	**-0,05**	**0,00**	**-1,85**	-0,03	0,00	-0,03	-0,08	0,03	0,00	0,00	-0,05	0,00	0,00	-0,05	0,00	0,03
Total	**191,67**	**183,06**	**162,00**	**118,88**	**116,81**	**105,98**	**104,08**	**93,51**	76,09	73,14	72,71	70,00	57,99	56,65	54,65	54,29	48,40	35,45	12,63	9,54	8,90

2.5.3 Results

Specialization takes its roots to 500 B.C., the period of Greek philosophy. In the book of "Republic" of Plato or in Plato's dialogues, Sokrates mentions about specialization in labor and its division. First specialization in labor could be classified as a farmer, a builder, a weaver and a shoemaker (Evers, 1980). This specialization enhances in accordance with new economic activities. Soldiers, medics, architects, athletes etc. all have been becoming expert in their specific fields and benefited from each other's product or services via trade.

Economic activities are too diverse in today's world for one individual to specialise at. Thus, companies, clusters and even regions are to specialise in specific activities. Adam Smith, in his famous book Wealth of Nations, argues that the division of labor is limited by the extent of the market (Smith, 1776). Having used the concept of "smart specialization" people, somehow, consider the market as the globe.

Determination of prominent sectors have been a main aspect of regional economic sciences as mentioned. Taking the existing study of weighted key performance indicators of the East Marmara Development Agency, its results are considered as the chosen sectors.

Machinery, Electrical Machinery and Equipment, Automotive and Supplier Industry sectors stand out as the sectors to focus on within the scope of study and within the framework of smart specialization concept as a conclusion of these results.

Non-ferrous Materials, Chemistry and Medicine, Agriculture and Ornamentals, Forestry Products, Transportation and Ship Building sectors follow these main sectors.

3. SMART SPATIALIZATION

The locational aspects of investments are the most crucial and important criterion for an investment. Deciding the location of an investment is the key factor as it is unreturnable due to its high fixed cost in short term (Bayrak, 2016).

The spatial aspects of an investment have not been considered as an important issue in Turkey, as the investments (more specifically public investments) are mostly established due to political aspects instead of economic issues such as agglomeration and clustering or suitability of location. The decentralization of İstanbul's industry to East Marmara is an example for such decisions. The East Marmara Regional Plan of 1963 was prepared to keep industrialization away from İstanbul's metropolitan area and to make the planned zone an industrial base.

Becoming an industrial base has become a problematic as the East Marmara Region lies over the North Anatolia fault zone, moreover mostly consists of forests, protected zones and agricultural land (MARKA, 2014). The case of Ford Otosan in Kocaeli is an example for such situation for a private sector investment with politic concerns. In this case, the investment was attracted with incentives and free land, although it was located directly on the main fault zone and required high fortification and construction cost (Hürriyet Newspaper, 2000). Lessons learnt from such examples, make it necessary to use the land for investments in a smart manner.

Thus, the concept of "Smart Spatialization" is being put forward via this thesis study. The term is based on smart specialization as there is lexical and word similarity (i.e. paromasis). As smart specialization deals with prioritizing economic sectors for the regions, smart spatialization is for finding optimum locations for those sectors. Smart specialization defines prominent sectors for a region, whereas smart spatialization exposes the spatial distribution of those sectors within the region.

The GIS Dictionary of ESRI defines spatialization as "*The transformation of complex, multivariate, non-spatial data into a spatial representation located in an information space. The relative positioning of data elements within the spatial representation shows relationships between them. Spatialization is used to allow exploration of nonspatial data using spatial metaphors and spatial analysis*" (ESRI Support Page, 2015). According to Skupin, spatialization is the transformation of high-dimensional data into lower-dimensional, geometric representations on the basis of computational methods and spatial metaphors (Skupin, 2007). Such definitions generate the idea that spatialization is the term to use space as the basis for examining and manipulating the data.

Smart specialization for East Marmara was set over NUTS 2 region. Thus, smart spatialization also will be examined at the same level. A NUTS 2 region could have similarities in terms of economic distribution of activities. However, there are other aspects making NUTS 2 regions heterogeneous in the same terms:

- Geographic thresholds
    - Slopes
    - Land Cover
    - Water Bodies and Basins
    - Absolute Agricultural Lands
    - Fault Zones and Risky Areas
    - Protected Areas / Coasts
    - Other Restricted Areas
- Land Use
    - Development and Zoning Plans
    - Cadaster
    - Ownership
- Economics / Demography
    - Labor Force Quality
    - Labor Force Costs
    - Incentives
    - Land Costs
    - Sectoral Agglomeration

- Accessibility
    - Transportation Networks
    - Transit Infrastructure
    - Closure to Raw Materials / Semi Manufactured Materials
    - Closure to Markets
    - Logistics

These aspects are some of the reasons causing space based differentiation for economic activities. These aspects could be varied according to the needs of the land use preferences or some could be unimportant for some cases.

3.1 Economic Geography

Smart spatialization could be accepted as a sub-term of economic geography as it is the intersection of economics and geography.

Geography is a science which considers with human and land. The economic activities taking place on land is therefore a subject of geography as well. Thus, economic geography is considered with spatial distribution of economic activities and asks "where, why and how?" (Dicken and Lloyd, 1976). The question of "when" could be added to these. And as the same questions "what, where, when and how?" are also asked by GIS, it could be argues that GIS is both an economic as a thematic domain and a geographical aspect as a spatial domain.

As McCann mentions all economic activities are done within a space (McCann, 2001). Tümertekin and Özgüç mention there is a deep relation between economy and space, thus economic geography is the intersection of two sciences (Tümertekin and Özgüç, 1995). However, many economists are not interested with space. Working only on numbers, economists, somehow, miss the space and this causes macroeconomics loose the regional science branch, which clearly argues that space is an important factor.

According to Taafle (1974), the disciplines related to geography and economics have different perspectives. These sciences intersect in the fields of international trade economy, development economy, regional economy, regional science, location analysis and theoretical economic geography. Figure 3.1 illustrates Taafle's intersection approach of disciplines of economics and economic geography.

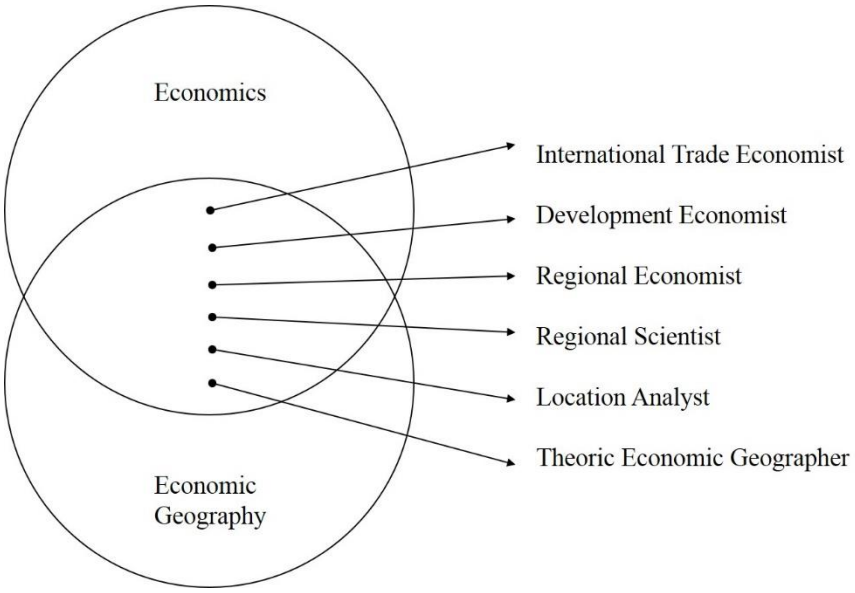

Figure 3.1: Intersection of disciplines of economics and economic geography (Taafle, 1974).

Yavan mentions American Economist Isard (1956, pg 25) had created a discipline called Regional Science in 1950's to put economics in a spatial base, saying "economists think economic activities take place in wonderland and make their studies without spatial basis". In 2001, McCann mentioned about this new term as space economics is established with this initiative and thus city and regional planners began to work with economists and geographers (Yavan, 2006, pg 5).

These studies affected both the decision making processes of governmental organizations and site selection criteria of companies. The first company based study is accepted as Socony Mobil Oil Company which was mentioned in the magazine called "Economic Geography" (McNee, 1958). The term "geography of enterprise" has become a new sub study area which was about the locational behaviors of large scale companies in 1960 by McNee (McNee, 1958).

Geography affects the activities of all economic activities in a large scale from small agricultural enterprises to global companies. There are two scales in the locational behaviors of the companies: Inter Country Level and Subnational Geographical Level (McCann and Mudambi, 2005).

The site selection of companies starts with the selection of the country – if it is made by an international investor – then, the region and province is being chosen. After

these, the specific site for the facility is being selected in terms of zoning and parcel. Upper scale decision making is mostly dependent on price policies and political issues. The case of Ford Otosan in Kocaeli can be accepted as such an example where the land was allocated by the government like many other foreign direct investment, hence it required many fortifications and additional huge amounts of construction cost (Hürriyet Newspaper, 2000) as mentioned earlier in Chaper 3.

Labor prices, security, closure to markets could be considered as other examples of site selection criteria at international scale. In the regional and provincial scale, criteria such as land prices, logistical advantages, zoning and development conditions become more significant.

Economists and business administrators are interested mostly in national and regional level. On the other hand geographers and city and regional planners are interested also in intra and inter-urban level for site determination. Recently, some scientists deal with site selection in small scales and research the effects of investments in city systems and urban economics and development (Sit and Yang, 1997; Wu, 1999; Wu and Radbone, 2005).

In the thesis, these small scale aspects are considered as some of the site selection criteria. With addition to them, some data regarding provincial and regional aspects have also been added as site selection criteria such as government incentives.

In 1991, Krugman published a book called “geography and trade” about “the new economic geography” concept concerning the spatial basis of economic activities. The new economic geography took service based sectors at focus, as the new industries have been relying on computers and internet. This process changed the economic activities over space as such new activities created digital economy, which is not the same as manufacturing. Followed by the “Creative Class” term of Richard Florida, new economic geography underlined the importance of qualified labor force for regional and cluster development (Florida, 2002).

With the increasing globalization and decline of logistic costs and communication developments. A Nobel Award winning theory in 2008, Paul Krugman explains the process of changes in spatial distribution of economic activities from the more traditional concepts such as small or large scale agglomeration or clustering, to

computer and internet based and service sector driven “new economic geography” concept (Krugman, 2004). It can be concluded that the space based activities will tend to decline in time.

The new economic geography studies have been arguing the dependency of land in economic activities decreases. Yet, space based activities still depends strongly to land, especially industrializing countries such as Turkey.

3.2 Location Theory

The location theory is the basis of the economic geography and regional economics (Gorter and Nijkamp, 2001) and interests in the spatial aspects of economic activities. It includes cultural, political, social aspects along with economic aspects for both households and industry and is one of the first studies to find answers for where and why economic activities choose place, taking profit maximization tendency of the producers into account. In the book of “the Isolated State”, von Thünen had taken transportation costs into consideration over Ricardo’s economic rent (1828).

This theory has three main founders: Von Thünen for agricultural location theory, Alfred Weber for industrial location theory and Cristaller-Lösch for settlements as financial centers. The Thünen, Weber, Alonso, and Christaller models are not the sole contributors to location theory, but they are its foundation. These theories have been expanded upon and refined by geographers, economists, and regional scientists.

3.2.1 Thünen’s theory

Johann Heinrich von Thünen, a Prussian landowner, introduced an early theory of agricultural location in Der isolierte Staat (1826) (The Isolated State). The Thünen model suggests that accessibility to the market (town) can create a complete system of agricultural land use. His model envisaged a single market surrounded by farmland, both situated on a plain of complete physical homogeneity. Transportation costs over the plain are related only to the distance traveled and the volume shipped. The model assumes that farmers surrounding the market will produce crops which have the highest market value (highest rent) that will give them the maximum net profit (the location, or land, rent). The determining factor in the location rent will be the transportation costs. When transportation costs are low, the location rent will be high,

and vice versa. This situation produces a rent gradient along which the location rent decreases with distance from the market, eventually reaching zero. This process makes transportation costs a criteria in decision making for a production and locating site.

The Thünen model also addressed the location of intensive versus extensive agriculture in relation to the same market. Intensive agriculture will possess a steep gradient and will locate closer to the market than extensive agriculture. Different crops will possess different rent gradients. Perishable crops (vegetables and dairy products) will possess steep gradients while less perishable crops (grains) will possess less steep gradients.

3.2.2 Weber's theory

In 1929, the German location economist Alfred Weber formulated a theory of industrial location in his book entitled Über den Standort der Industrien (Theory of the Location of Industries, 1929). Weber's theory, called the location triangle, sought the optimum location for the production of a good based on the fixed locations of the market and two raw material sources, which geographically form a triangle. He sought to determine the least-cost production location within the triangle, as in the figure 3.2, by figuring the total costs of transporting raw material from both sites to the production site and product from the production site to the market. The weight of the raw materials and the final commodity are important determinants of the transport costs and the location of production. Commodities that lose mass during production can be transported less expensively from the production site to the market than from the raw material site to the production site. The production site, therefore, will be located near the raw material sources. Where there is no great loss of mass during production, total transportation costs will be lower when located near the market.

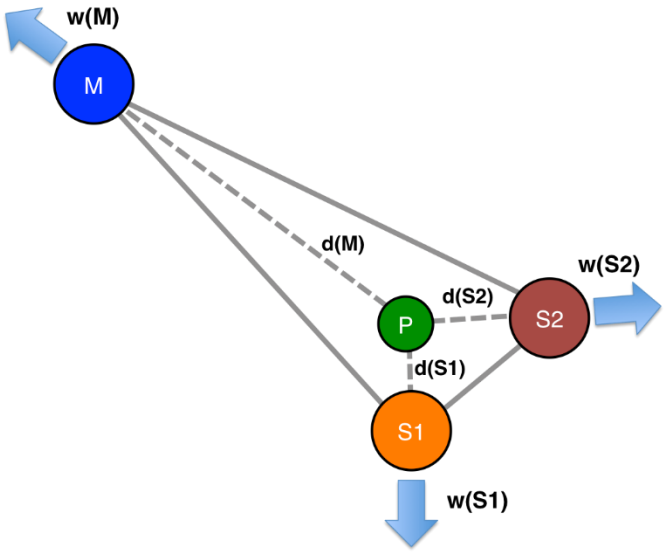

Figure 3.2 Weber's location triangle (d=distance; w=weight, M=market, P=least-cost location; w (M) = weight of finished product. w (S1) and w (S2) = tons of materials coming from S1 and S2) (Penn State University, 2016)

Once a least-transport-cost location had been established within the triangle, Weber attempted to determine a cheap-labor alternate location as in the figure 3.2. First he plotted the variation of transportation costs against the least-transport-cost location. Next he identified sites around the triangle that had lower labor costs than did the least-transport-cost location. If the transport costs were lower than the labor costs, then a cheap-labor alternative location was determined.

3.2.3 Christaller's theory

Another major contribution to location theory was Walter Christaller's formulation of the central place theory in 1933, which offered geometric explanations as to how settlements and places are located in relation to one another and why settlements function as hamlets, villages, towns, or cities. Christaller takes place into consideration as geometric objects (Sonis, 2005). Having further developed by Lösch, the central place theory models the space with triangles or hexagons as they are the service areas.

3.2.4 Alonso's theory

William Alonso (Location and Land Use: Toward a General Theory of Land Rent, 1964) built upon the Thünen model to account for intra-urban variations in land use. He attempted to apply accessibility requirements to the city center for various types of land use (housing, commercial, and industry). According to his theory, each land use

type has its own rent gradient or bid rent curve. The curve sets the maximum amount of rent any land use type will yield for a specific location. Households, commercial establishments, and industries compete for locations according to each individual bid rent curve and their requirements for access to the city center. All households will attempt to occupy as much land as possible while staying within their accessibility requirements. Since land is cheaper at the fringe of the city, households with less need for city center accessibility will locate near the fringe; these will usually be wealthy households. Poor households require greater accessibility to the city center and therefore will locate near the center, competing with commercial and industrial establishments. This will tend to create a segregated land use system, because households will not pay commercial and industrial land prices for central locations.

Four main approaches to economic geography are as mentioned. The main similarity of those theories is that distance is the key factor for land use. Also, the tendency of site selection could be understood by evaluating the value chain including locations of raw materials and the market. As this study mainly deals with prominent sectors within an industrialized region, the economic geography of industrial activities is being considered. This could have been different if the case study was an agriculture-driven region or a region with high concentration of creative class or creative industries such as design, informatics or culture industries. Thus, the Weber's theory is more applicable for East Marmara case.

Furthermore, in the case of Weber's least cost theory; transportation, labor and agglomeration were defined as the criteria for industrial location preference. The smart spatialization concept of this thesis will be based on Weber's least cost theory.

3.3 Geobusiness Intelligence

GIS has become a featured tool for business making. There exist many companies using GIS as a decision support tool for locating their own businesses. Jim Warner mentions in his article of Location in the Language of Business (Warner, 2013) that "*Everyone talks about the value of location*" and Google commissioned Boston Consulting Group (BCG) found out "*geospatial services drove $1.6 trillion in revenues and $1.4 trillion in cost savings for organizations utilizing geospatial services*" (Henttu et. al., 2012).

The companies using GIS, as mentioned above, now tend to use geoexperts, geoapplications and geodata for their businesses. This makes geobusiness a business with its own companies serving in terms of site and customer selection and optimization.

Another related term for geobusiness is spatial business intelligence. The business intelligence is a common technique used in business to turn the raw data into decision support entity. Including space dimension to the business intelligence spatial data could be used as a decision support tool. Gonzales (2005), in his article at Directions Magazine, this term as "the where of business intelligence" by asking questions such as where the customers are located, how big the market area is, what the potential spending does a market offer and where the new sites should be opened.

3.4 Methodology: G.I.S. Approach

The basis of smart spatialization study is to select suitable land for industrial and business development and zoning. Thus, main spatial data of smart spatialization concept is cadastral parcel. The cadastral parcel data is also core spatial data sets of Spatial Data Infrastructures (SDIs) of countries, regions and cities. In practice, cadastral parcel data is used with deed information in order to perform spatial queries of ownership and size of the parcel.

Parcel coordinates have to be known in a specific coordinate system which is also geodetic infrastructure of National Spatial Data Infrastructure (NSDI). In Turkey, the Large Scale Map and Map Information Production Regulation identifies a unique geodetic coordinate system based on ITRF96 datum and 2005.000 epoch.

In the scope of this study, cadastral parcel data sets have been used as core data. The coordinates of the parcels are in ITRF96 datum, of which reference ellipsoid is GRS80, with a reference epoch of 2005.000 coordinates have been used.

The main dataset for the study is "parcel" data, source of which is Kocaeli Investment Support Office (2015). In the Table 3.1, FID, SHAPE, CODE, AREA and COST were available within the database. Having used the database, remaining fields were created to use within the analyses. In this table, attributes were abbreviated such as "AGG" is the agglomeration, "GOVINC" is the government incentives, "LABCOST" is the

labour cost and the "_N" at the ends of the filed names stands for normalized data. The sectors were represented with their first three letters.

Table 3.1 Attribute Fields of Parcels

Attribute	Data Type	Details
FID	Object ID	Key Field
SHAPE	Geometry (Polygon)	Spatial data
CODE	Text (14)	Nomenclature for each parcel
AREA	Double (8/2)	Total Area Covered
COST	Integer	Cost per m^2 of the Parcel
AREA_N	Float (3/2)	Normalized value of total area covered
COST_N	Float (3/2)	Normalized value of land cost (negative)
AGG_MAC_N	Float (3/2)	Normalized value of machinery agglomeration
AGG_ELE_N	Float (3/2)	Normalized value of electrical machinery and eq. agglomeration
AGG_AUT_N	Float (3/2)	Normalized value of automotive and sup. ind. agglomeration
AGG_NFM _N	Float (3/2)	Normalized value of non-ferrous minerals agglomeration
AGG_CHE_N	Float (3/2)	Normalized value of chemicals and medicine agglomeration
AGG_AGR_N	Float (3/2)	Normalized value of agriculture and ornamentals agglomeration
AGG_FOR_N	Float (3/2)	Normalized value of forestry agglomeration
AGG_TRA_N	Float (3/2)	Normalized value of transportation and shipbuilding agglomeration
INPUT_N	Float (3/2)	Normalized value of inputs
MARKET_N	Float (3/2)	Normalized value of market potential analysis
GOVINC_N	Float (3/2)	Normalized value of government incentives
LABCOST_N	Float (3/2)	Normalized value of labor costs
TOLL_N	Float (3/2)	Normalized value of transportation infrastructure analysis
PORT_N	Float (3/2)	Normalized value of logistics analysis
CUSTOMS_N	Float (3/2)	Normalized value of customs analysis
MAK_SCORE	Float (3/2)	Score of Machinery
ELE_SCORE	Float (3/2)	Score of Electrical Mac. And Eq.
AUT_SCORE	Float (3/2)	Score of Automotive and Sup. Ind.
NFM_SCORE	Float (3/2)	Score of Non-Ferrous Minerals
CHE_SCORE	Float (3/2)	Score of Chemicals and Med.
AGR_SCORE	Float (3/2)	Score of Agriculture and Orn.
FOR_SCORE	Float (3/2)	Score of Forestry
TRA_SCORE	Float (3/2)	Score of Transportation and Shipb.

The remaining spatial data are as shown in the following table:

Table 3.2 Spatial data used for the analyses

Dataset / Layer	Type
Base map layer	Raster
Districts	Polygon
Provinces	Polygon
Cultural heritages	Polygon
Water bodies and their basins	Polygon

Zones with development prohibits	Polygon
Urban areas and their future development areas	Polygon
Agricultural lands	Polygon
Road data	Polygon
Ports data	Point
District centers	Point
Customs	Point

A geodatabase has been created in ArcCatalog of ArcGIS Desktop software of ESRI. Spatial data sets have been stored in this geodatabase. Non-spatial data sets have been stored in a Relational Database Management System (RDBM). The relations between spatial data sets and non-spatial data sets have been established. In the database approach, the parcels could be indexed according to their locations (province, district, organized industrial district, tourism center, tourism development zone, free zone, technopark etc.) and their types (industrial, commercial, tourism, logistics, housing and other services such as health and education).

A 14 digit key was developed for investment sites as unique ID or the key field. As displayed in Figure 3.3, this key has first four characters of NUTS-2 region code, the following one is the initial letter of the province, the next three are the code of the district, next two are the type of the parcels and last four digits are the number of the parcel.

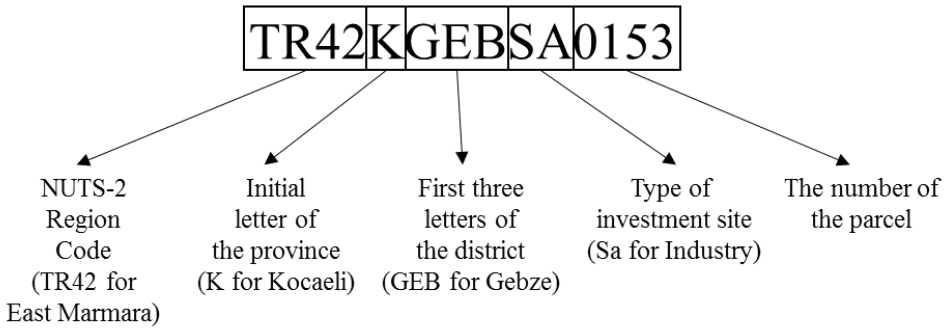

Figure 3.3 Indexing of the investment sites

Figure 3.4 A map showing TR-42 provinces and district

ESRI's ArcGIS Desktop 10 software was used in the study to create spatial model, to perform spatial queries and analyses, and to produce result thematic maps. The extent of the study is the provinces and districts as shown in figure 3.4.

3.4.1 Determination of sectoral needs

Investments of each sector have different requirements in terms of feasibility and land use optimization. Thus, specific needs should be evaluated to use as an optimization data. For the sectoral classification, the Nomenclature of Economic Activities (NACE) Rev 2.0 is used as it is the main statistical classification of economic activities in the European Community.

The needs of 8 sectors that already determined in Chapter 2 are given below in order to examine in decision support, along with their sub-sectors according to the NACE Rev 2.0 classification. The results of the analyses for each sector will also cover its sub-sectors.

3.4.1.1 Machinery

Being one of the most important economic sectors, machinery is also a key sector for other sectors as machinery is used almost in every production processes of others. Also, it is one of the highest value added economic activities as examined in the Machinery Working Group Report of 10th Development Plan of Turkey (2015).

- Manufacture of general-purpose machinery
    - Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
    - Manufacture of fluid power equipment

    - Manufacture of other pumps and compressors
    - Manufacture of other taps and valves
    - Manufacture of bearings, gears, gearing and driving elements
- Manufacture of other general-purpose machinery
    - Manufacture of ovens, furnaces and furnace burners
    - Manufacture of lifting and handling equipment
    - Manufacture of office machinery and equipment (except computers and peripheral equipment)
    - Manufacture of power-driven hand tools
    - Manufacture of non-domestic cooling and ventilation equipment
    - Manufacture of other general-purpose machinery n.e.c.
- Manufacture of agricultural and forestry machinery
- Manufacture of metal forming machinery and machine tools
    - Manufacture of metal forming machinery
    - Manufacture of other machine tools
- Manufacture of other special-purpose machinery
    - Manufacture of machinery for metallurgy
    - Manufacture of machinery for mining, quarrying and construction
- Manufacture of machinery for food, beverage and tobacco processing
- Manufacture of machinery for textile, apparel and leather production
- Manufacture of machinery for paper and paperboard production
- Manufacture of plastics and rubber machinery
- Manufacture of other special-purpose machinery n.e.c.

3.4.1.2 Electrical machinery and equipment

Electrical machinery and equipment, like machinery, is an important sector with various uses within other main industrial production processes. Mostly, electrical machinery and equipment are used for lighting (with 46,5% of total companies in Turkey in 2008) (Development Bank, 2010).

- Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus
    - Manufacture of electric motors, generators and transformers
    - Manufacture of electricity distribution and control apparatus

- Manufacture of batteries and accumulators
- Manufacture of wiring and wiring devices
    - Manufacture of fibre optic cables
    - Manufacture of other electronic and electric wires and cables
    - Manufacture of wiring devices
- Manufacture of electric lighting equipment
- Manufacture of domestic appliances
    - Manufacture of electric domestic appliances
    - Manufacture of non-electric domestic appliances
- Manufacture of other electrical equipment

3.4.1.3 Automotive and supplier industry

Automotive industry is a huge branch of production and even its suppliers have great capacities and market. The sector is categorized mostly according to TIER's such as TIER 1 as main manufacturer and 2, 3 and 4 as suppliers with the graduations of scale. Automotive is also referred to as the main purchaser of other industries, thus it creates many value chains and supports other sectoral activities (East Marmara Development Agency, 2014).

- Manufacture of motor vehicles
- Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
- Manufacture of parts and accessories for motor vehicles
    - Manufacture of electrical and electronic equipment for motor vehicles
    - Manufacture of other parts and accessories for motor vehicles

3.4.1.4 Non-ferrous materials

Non-ferrous or non-metalic minerals have a variety of sub-sectors and an important source for construction sector.

- Manufacture of glass and glass products
- Manufacture of refractory products
- Manufacture of clay building materials
- Manufacture of other porcelain and ceramic products
- Manufacture of cement, lime and plaster

- Manufacture of articles of concrete, cement and plaster
- Cutting, shaping and finishing of stone
- Manufacture of abrasive products and non-metallic mineral products n.e.c.

3.4.1.5 Chemistry and medicine

Chemistry and medicine is one of the most value added economic activities and have many uses for both industrial and daily activities.

- Manufacture of chemicals and chemical products
    - Manufacture of basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber in primary forms
    - Manufacture of pesticides and other agrochemical products
    - Manufacture of paints, varnishes and similar coatings, printing ink and mastics
    - Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
    - Manufacture of other chemical products
    - Manufacture of man-made fibers
- Manufacture of basic pharmaceutical products and pharmaceutical preparations
    - Manufacture of basic pharmaceutical products
    - Manufacture of pharmaceutical preparations

3.4.1.6 Agriculture and ornamentals

Agriculture is the oldest and the key sector for human life. Having many sub-sectors, ornamental plant propagation will be examined within this study.

- Plant propagation

3.4.1.7 Forestry products

Foresty is mainly the raw material activity for furnishing and construction sectors. It agglomerates in the places where industrial forest activities are dense.

- Forestry and logging
    - Silviculture and other forestry activities
    - Logging

- Gathering of wild growing non-wood products
- Support services to forestry

3.4.1.8 Transportation and ship building

Transportation is the only economic activity having effect on all economic activities. Thus, it is important for efficiency of all sectors. Within the study warehousing and shipbuilding activities will be examined.

- Building of ships and boats
  - Building of ships and floating structures
  - Building of pleasure and sporting boats
- Warehousing and support activities for transportation
  - Warehousing and storage
  - Support activities for transportation

3.4.2 GIS-based site selection

Site selection is referred to as the basis and the most irrevocable phase of any public or private investment. According to Rikalovic et al. (2014), site selection is one of the basic vital decisions in the start-up process, expansion or relocation of businesses of all kinds. Construction of a new industrial system is a major long-term investment, and in this sense determining the location is critical point on the road to success or failure of industrial system.

As investments are made over space and the GIS is a powerful tool for spatial decision making, site selection could be easily made via GIS. Decision problems that involve geographical data are referred to as geographical or spatial decision problems (Malczewski, 2004). Having many methodologies, GIS based site selection is frequently used with multi criteria decision making or analysis processes. The figure 3.5 is an example for such methodology.

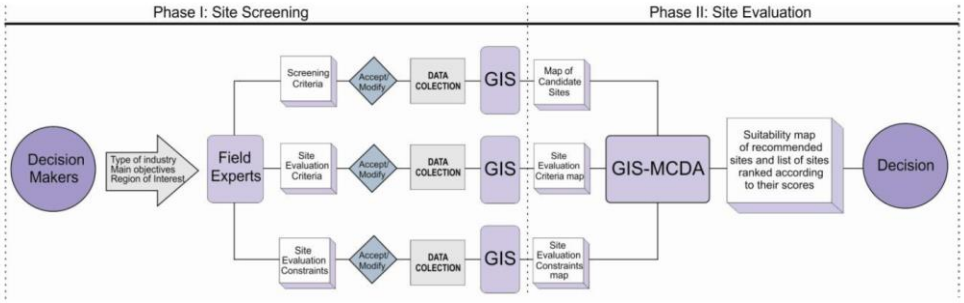

Figure 3.5 Architecture of the GIS based MCDA approach for Industrial site selection (Rikalovic et al., 2014)

Especially in industrial investments by the private sector, reduction of costs is extremely important. In feasibility studies, many factors are evaluated such as raw materials, market potentials, operating costs and so on. It may have the same cost to construct a factory in different locations. Yet, it is still a high expenditure. However, operating costs, labor costs, market potential and transportation costs may differ from location to location. Taking these into account and knowing the construction is not a movable good, the site selection must be done in a good and precise manner. Thus, spatial dimension of decision making is important.

In this study, common aspects of feasibility studies are taken into account as sectoral preferences for site selection.

Each sector has its own priorities and requirements to develop and compete with its rivals in other regions or countries. In order to increase competitiveness, choosing the right place to invest is important. Although these investment processes have many variables, this study aims to get results from simplified data. Such simplified data can be the average value within the district or province for each investments within that boundary or the speed limit over a road section.

This method is similar with the Weighted Key Performance Indicators (W-KPI) method used in the previous chapter for determining the prominent sectors. Three main pillars exist within this study; sectors, criteria and parcels.

As sectors are known from the previous chapter, each sector was graded with a number between 1 and 5 (where 1 is no significant importance and 5 is of greater importance). “X” stands for non-applicable or obligatory as it may have nothing to do with that

criteria or it has to be suitable for that criteria. Table 3.3 shows the weights of sectoral preferences, which is changeable according to preferences of the investors.

Table 3.3 Weighted Values of Location Choice Criteria

	Machinery	**Electrical Machinery and Equipment**	**Automotive and Supplier Industry**	**Non-Ferrour Materials**	**Chemistry and Medicine**	**Agriculture and Ornamentals**	**Forestry Products**	**Transportation and Shipbuilding**
Zoning and Development Provisions	X	X	X	X	X	X	X	X
Ownership	X	X	X	X	X	X	X	X
Cost	2	3	1	3	2	5	5	1
Size of Parcels	2	1	5	2	3	5	5	2
Sectoral Agglomeration	4	4	4	2	5	3	1	5
Sectoral Inputs	3	5	4	5	1	1	3	3
Market Potential	3	4	1	2	1	3	4	1
Government Incentives	5	4	1	3	5	5	4	1
Labor Costs	2	3	1	5	4	5	5	2
Natural Thresholds	X	X	X	X	X	X	X	X
Transportation Infrastructure	3	1	4	2	2	1	1	5
Logistics	3	2	5	3	2	1	1	5
Customs	3	3	4	3	5	1	1	5
TOTAL	30	30	30	30	30	30	30	30

3.4.3 Statistical normalization of data for each criterion

In order to compare data sets with different scales and units, they need to be arranged within the same scale with minimum and maximum values, or sometimes average values. This process is called normalization. In this case of analyzing attribute data for multi criteria analysis of the investment sites, the land value varies between 75 Turkish Liras (TL) and 3053 TL/m^2, whereas the smallest land is 281.66 m^2, where the largest one is 984925.81 m^2.

There are several techniques for normalizing the data. The statistical or Z-Score normalization method calculates the mean and standard deviation for each feature and first subtracting the mean value from the feature, then dividing it to standard deviation. This method is beneficial when outlying data are of less importance. The feature scaling normalization, usually, takes maximum values as “1” and minimum ones as

"0", then rescales them between 0 and 1. Such method is advantageous while the ratio relations are wanted to be preserved. Another method is median normalization in which the feature is just divided into pre-calculated median value of the data set. This case is useful while performing the distribution of the features. Fourth one is the sigmoid normalization, which is useful while estimating features within noisy data and takes the feature value as positive and negative power of Euler's number and divides their difference to their sum. Mean and standard deviation normalization, student's t-statistic, standardized moment, coefficient of variation and statistical column normalization are several other examples for normalization (Jayalakshmi and Santhakumaran, 2011).

Among the statistical techniques, feature scaling method of statistical normalization was adopted to make data interoperable and comparable while conducting the analyses. The main reason here is to preserve the ratios of the features within their data sets and make them comparable by rescaling them at the same range.

Implementing rescaling and having all values between 0 and 1, all variables got ready for multi criteria decision analyses. Equation 3.1 shows how to apply the feature scaling method.

$$x_i = \frac{x_i - \min(x)}{\max(x) - \min(x)}$$

Equation 3.1 Feature Scaling Method for Statistical Normalization (Jayalakshmi and Santhakumaran, 2011)

This method was implemented in each of the following criteria.

3.4.3.1 Development plans

According to the Act of 3194, the Development Law, in order to construct any establishment the following are required:

- Environmental Plan, (1/25.000 to 1/100.000 scale)
- Urban Development Plan, (1/5.000 to 1/50.000 scale)
- Implementation Plan (1/1000 scale)

The Implementation Plan gives spatial land use decisions for parcels, such as industrial, commercial, residential, services, non-residential urban work spaces,

educational, health and logistics. Thus, the locations of investments must be suitable to the plan decisions.

3.4.3.2 The ownerships of parcels

Ownership of the suitable lands for investment is an essential factor. Turkish Cadaster System enables parcels with many owners with different interests over the parcel. In such cases, one of the shareholders may not allow the land to be rented or sold. Another condition may be unwillingness of the owner for some specific land uses such as polluting activities over rented land. Thus, in the thesis, only parcels available for selling, renting or allocation were used.

3.4.3.3 The cost of parcels

The costs of the parcels are real time data gathered from the Investment Support Offices of the five provinces. Although, some parcels may not have cost data as they could be for hire or suitable for allocation by local or public authorities. In such cases, the cost data were produced examining the closest parcels with a cost value. The cost values were used over square meters (m^2) for making comparison.

Among the available parcels, the cheapest parcel have a value of 75 Turkish Liras (TL) per square meter, where the most expensive one is 3053 TL/m^2. Thus, the normalization is made via these values using the feature scaling method. The cost is a negative data as it is more feasible when the cost decreases. Thus, the formula was adopted as follows by decreasing the normalization value from "1". Equation 3.2 displays how this approach is applied in ArcGIS Desktop software. This normalized cost data is to be used in the final analyses.

```
cost_n =
1 - ( [M2_bedel] - 75) / (3053-75)
```

Equation 3.2 Normalization formula for cost data with Field Calculator in ArcGIS

3.4.3.4 The size of parcels

As size of the parcels are highly important for some sectors, the land size data were required. As the data used within the study are real time data with coordinates, sizes of the parcels were calculated by "Calculate Geometry" tool of the ArcGIS Desktop software as displayed in the figure 3.6.

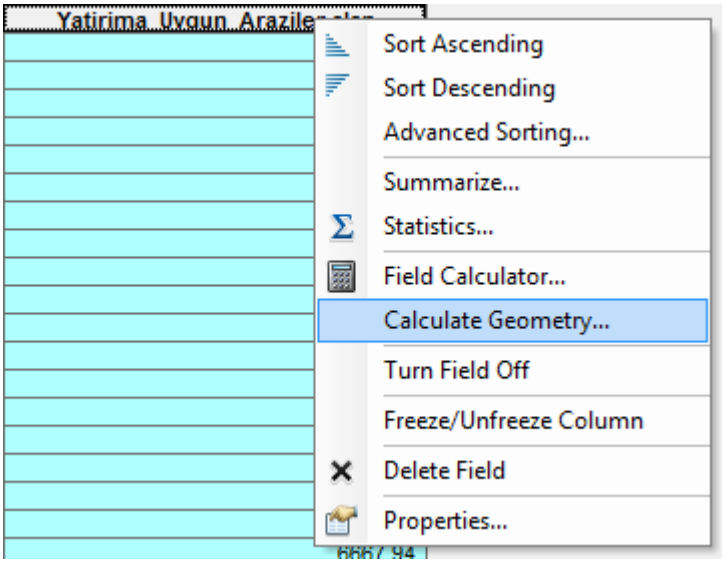

Figure 3.6 The Calculate Geometry Tool of ArcGIS Software

While conducting the calculation, the projection system of the data layer was used and some of the results were compared with the deeds and the results were found to be sufficient in order to use the values obtained from spatial data rather than the deeds.

The minimum area is 281.66 m^2, where the largest one is 984.925,81 m^2. Thus, these values were used for normalization as illustrated in Equation 3.3. This normalized area data is to be used in the final analyses.

```
area_n =
( [alan] - 281.66) / (984644.15)
```

Equation 3.3 Normalization formula for area data in ArcGIS Desktop

3.4.3.5 Sectoral agglomeration

As mentioned in -2.5.2.1, the terms “agglomeration” or “cluster” are used to refer to various forms of geographic concentrations (Fujita and Thisse, 2002; Martin and Sunley, 2003; McCann and Sheppard, 2003).

According to Tina, among many indices that have been discovered, agglomeration is widely calculated by “Location Quotient (LQ)” method as it is simple and requires less data (2013). This method is referred to as Economic Base Analysis.

Economic Base Analysis is a common model used regional planning for determining the prominent economic sector via LQ. Fundamentally, the LQ measurement assesses

"*the extent to which total export employment is spread among various industries and whether the economic base is becoming more diversified over time or more widely spread among industries*" (Galambos and Schreiber 1978).

The LQ is mostly used for a province or a regions share within a country. In this study, the reference space is the region, where 5 provinces are sub divisions. Thus, sectoral shares or location quotients were calculated by their shares over the region.

As mentioned in Chapter 2 and given in equation 2.1, LQ is a localization measure, in the sense that it allows the assessment of the relative concentration degree of a given activity in a given region.

After the Location Quotient was conducted, provincial scores was gathered for the selected sectors. As this is one of the criteria for optimization, the data is needed to be normalized. Thus, feature scaling method was implemented to each score, results of which are given in the table 3.4.

Table 3.4 Location Quotient Scores and Their Normalized Values with Feature Scaling

	Machinery	**Electrical Machinery and Equipment**	**Automotive and Supplier Industry**	**Non-Ferrour Materials**	**Chemistry and Medicine**	**Agriculture and Ornamentals**	**Forestry Products**	**Transportation and Shipbuilding**
Kocaeli (LQ)	7,98	8,33	10,21	8,11	7,07	2,06	3,46	5,57
Kocaeli (N)	0,53	0,55	0,68	0,53	0,46	0,09	0,2	0,35
Sakarya (LQ)	4,53	1,42	3,25	2,65	1,98	2,64	3,33	2,64
Sakarya (N)	0,42	0,13	0,30	0,24	0,18	0,24	0,31	0,24
Düzce (LQ)	0,72	0,66	0,32	1,27	4,66	0,70	2,16	0,06
Düzce (N)	0,10	0,10	0,05	0,18	0,67	0,10	0,31	0,01
Bolu (LQ)	0,37	3,21	0,02	1,05	0,08	6,89	3,73	0,01
Bolu (N)	0,03	0,27	0,00	0,09	0,01	0,57	0,31	0,00
Yalova (LQ)	0,23	0,19	0,02	0,72	0,03	1,52	1,13	5,53
Yalova (N)	0,04	0,03	0,00	0,13	0,01	0,27	0,20	0,99

3.4.3.6 Sectoral inputs

In value chains, different economic sectors are connected in input-output relationship. For instance, raw material of forestry products is logging, input sector for shipbuilding is iron-steel and so on. As value chains are complex processes, machinery sector itself

was accepted as the main input sector as machinery is being used in all production activities. Despite being a precise adaptation, this analysis was conducted to examine the results of sectoral inputs. To do so, economic agglomeration or location quotient in the previous analysis was adopted along with its normalization value. Table 3.5 displays the normalization and the location quotient values of the machinery sector of each province.

Table 3.5 Location Quotient Scores and and Their Normalized Values with Feature Scaling Method for Machinery Sector

	Machinery
Kocaeli (LQ)	7,98
Kocaeli (N)	0,53
Sakarya (LQ)	4,53
Sakarya (N)	0,42
Düzce (LQ)	0,72
Düzce (N)	0,10
Bolu (LQ)	0,37
Bolu (N)	0,03
Yalova (LQ)	0,23
Yalova (N)	0,04

3.4.3.7 Market potential

Main two aspects of determining the market potential of a location is where customers are located and where the logistic infrastructure is connected to. In the thesis, the population living around the region and their density was used at provincial level as the market potential. There are three main neighboring provinces; İstanbul, Ankara and Bursa and 5 provinces of the region itself which adopted. Of the 5 provinces, 51 district centers were accepted as the foci of the population within.

In order to use the population data as market potential, the 2014 data of Address-based Population Registration System (ADNKS) was used and entered into the GIS database as attribute to point data of district centers.

Among the methods for density mapping and interpolation, Inverse Distance Weighting (IDW) was chosen to conduct the analysis. IDW determines cell values using a linear-weighted combination set of sample points and the weight assigned is a function of the distance of an input point from the output cell location (Childs, 2014).

An average distance value of 100 km was chosen as effective zone with the power value of 1. As İstanbul, Bursa and Ankara dominates the map with their relatively

much high population, the map shows those provinces as more dominant markets than the region itself. Except from the central districts, Düzce and Bolu provinces show the least market potential as expected. Figure 3.7 illustrates the result map of the spatial analysis of this criterion.

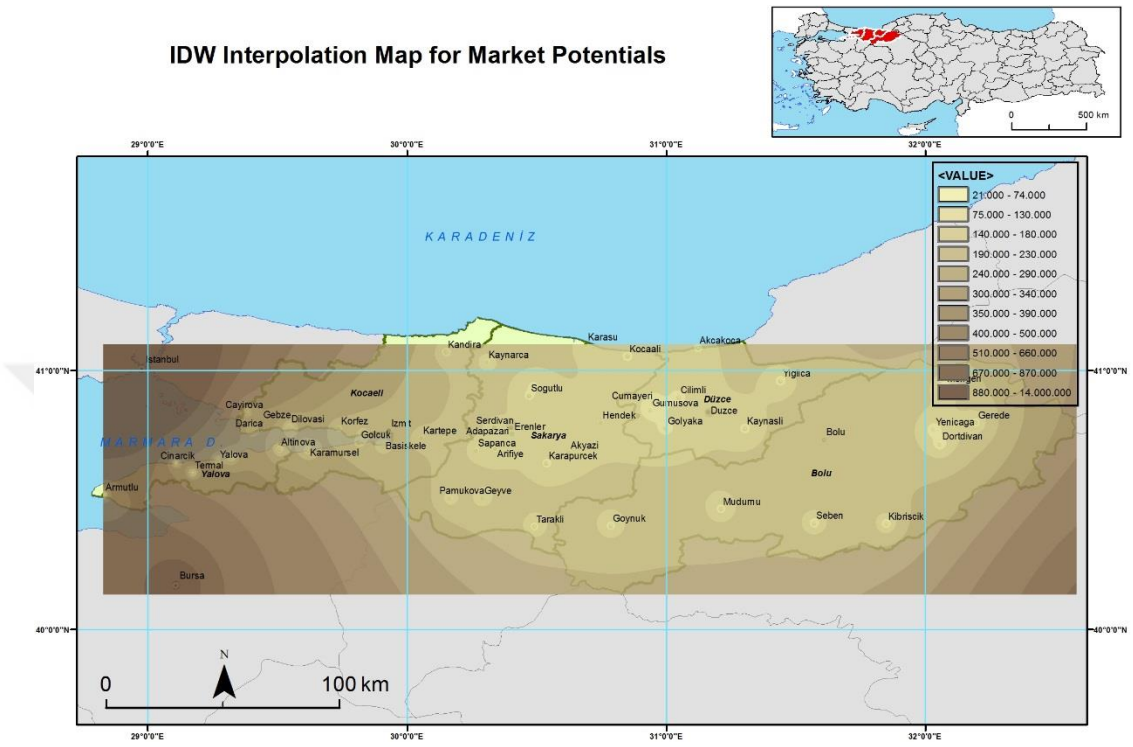

Figure 3.7 IDW Interpolation Map for Market Potentials

To make this dataset comparable with the rest of the analyses, the results were normalized with feature scaling. In doing so, the highest value which is 1560287.714 was scaled as "1" and the lowest value which is 5687.114 was scaled as "0", and the remaining values were calculated relatively with the equation 3.1.

3.4.3.8 Government incentives

Government incentives are important factors for investors to make the decision over space. The Regional Incentive System of Turkey was chosen to be used for this criterion. According to Prime Ministry Investment Support and Promotion Agency of Turkey, effective as of January 1st, 2012, regional incentives include Value Added Tax (VAT) Exemption, Customs Duty Exemption, Tax Reduction, Social Security Premium Support (Employer's Share), Income Tax Withholding Allowance, Social Security Premium Support (Employee's Share), Interest Rate Support and Land Allocation varying at different rates.

Higher the number of the region, higher the amounts of incentives are organized. Figure 3.8 shows the distribution of incentive regions over provinces of Turkey. The study area of this study includes Kocaeli at 1st (lowest), Sakarya, Bolu and Yalova at 2nd and Düzce at 4th incentive region which means Düzce is the most beneficial province for investment incentives where Kocaeli is the least.

In GIS database, incentive data were added after normalizing each parcel over 6 degrees with the feature scaling method. (Kocaeli 0; Sakarya, Bolu and Yalova 0,20; Düzce 0,60)

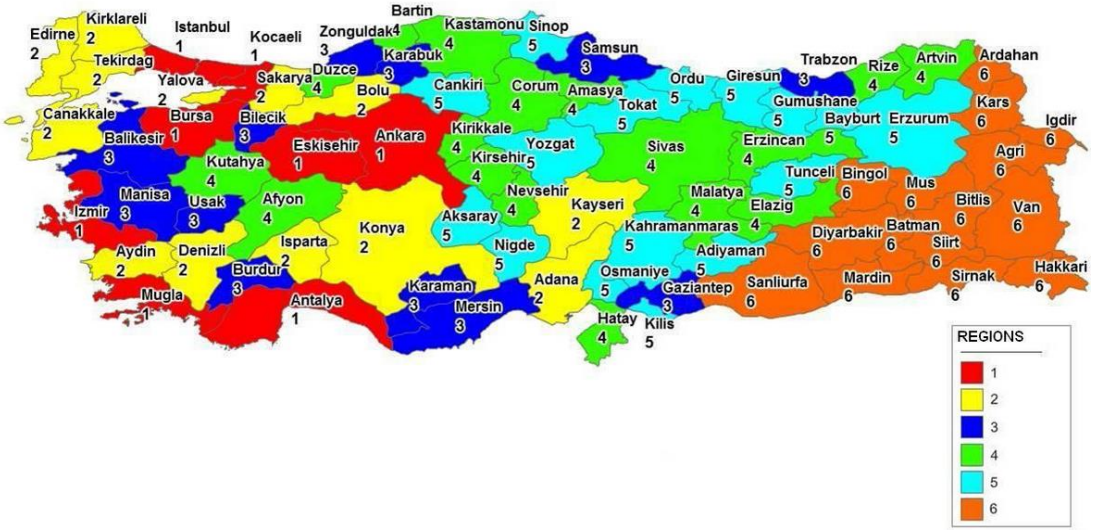

Figure 3.8 Regional Incentive Scheme of Turkey (The Ministry of Economy, 2016)

3.4.3.9 Labor costs

To analyze the labor costs, statistical data of Social Security Institution of 2012 were used. To do so, total the average daily earning taken as basic to premium were divided to overall working days on daily basis over 51 districts. After calculating the daily average income for all sectors, the minimum amount of 31,39 TL at Yığılca and maximum amount of 68,44 TL at Dilovası were gathered.

Figure 3.9 shows the distribution of daily average incomes for all sectors to districts according to the data. As it is seen from the map, the labor costs in the industrialized zones are higher than the rest of the region.

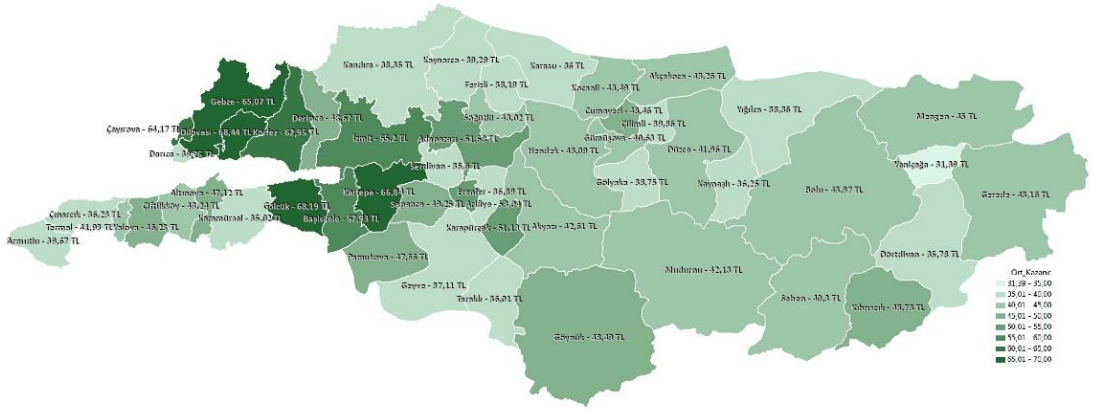

Figure 3.9 Distribution of Daily Average Incomes for all Sectors to Districts

The data are listed in the table 3.6 with information of total working days of all workers and the average daily earning (ADE) taken as basic to premium. Than the averages of those and their normalized data are listed in the same table.

Table 3.6 Labor Costs Related Data and Normalization Values (Social Security Institution, 2012)

	Working Days	ADE Costs	Average Daily Income	Normalization
Adapazarı	18.893.806	976.498.112,16 ₺	51,68 ₺	0,55
Akçakoca	1.002.313	43.358.015,23 ₺	43,26 ₺	0,32
Akyazı	3.025.314	128.904.170,88 ₺	42,61 ₺	0,30
Altınova	2.027.564	95.528.928,58 ₺	47,12 ₺	0,42
Arifiye	800.627	42.466.422,38 ₺	53,04 ₺	0,58
Armutlu	255.525	10.137.572,39 ₺	39,67 ₺	0,22
Başiskele	4.536.416	262.809.083,63 ₺	57,93 ₺	0,72
Bolu	9.054.091	398.096.924,85 ₺	43,97 ₺	0,34
Cumayeri	300.415	14.558.352,53 ₺	48,46 ₺	0,46
Çayırova	6.234.799	400.062.741,30 ₺	64,17 ₺	0,88
Çınarcık	369.758	13.397.655,46 ₺	36,23 ₺	0,13
Çiftlikköy	1.067.614	46.167.312,60 ₺	43,24 ₺	0,32
Çilimli	580.618	23.141.388,33 ₺	39,86 ₺	0,23
Darıca	2.572.972	102.295.356,76 ₺	39,76 ₺	0,23
Derince	2.578.147	125.467.351,52 ₺	48,67 ₺	0,47
Dilovası	3.245.629	222.141.542,87 ₺	68,44 ₺	1,00
Dörtdivan	110.531	3.954.800,66 ₺	35,78 ₺	0,12
Düzce	11.671.162	489.736.644,17 ₺	41,96 ₺	0,29
Erenler	546.223	20.149.671,47 ₺	36,89 ₺	0,15
Ferizli	238.610	9.112.518,13 ₺	38,19 ₺	0,18
Gebze	38.697.852	2.517.949.248,15 ₺	65,07 ₺	0,91
Gerede	1.168.010	50.409.374,01 ₺	43,16 ₺	0,32
Geyve	1.028.833	38.175.014,18 ₺	37,11 ₺	0,15
Gölcük	2.871.595	195.823.686,65 ₺	68,19 ₺	0,99
Gölyaka	413.156	16.009.806,97 ₺	38,75 ₺	0,20
Göynük	546.562	26.500.287,66 ₺	48,49 ₺	0,46
Gümüşova	648.059	26.330.282,58 ₺	40,63 ₺	0,25
Hendek	2.926.762	126.110.277,63 ₺	43,09 ₺	0,32
İzmit	19.513.522	1.077.152.384,21 ₺	55,20 ₺	0,64
Kandıra	2.725.607	104.532.584,60 ₺	38,35 ₺	0,19
Karamürsel	884.788	30.987.165,55 ₺	35,02 ₺	0,10
Karapürçek	248.645	12.712.564,00 ₺	51,13 ₺	0,53
Karasu	1.033.910	37.218.838,22 ₺	36,00 ₺	0,12
Kartepe	6.302.988	421.266.051,28 ₺	66,84 ₺	0,96
Kaynarca	387.226	15.214.074,00 ₺	39,29 ₺	0,21
Kaynaşlı	681.296	24.697.425,64 ₺	36,25 ₺	0,13
Kıbrıscık	33.264	1.620.904,59 ₺	48,73 ₺	0,47
Kocaali	212.975	9.261.668,65 ₺	43,49 ₺	0,33
Körfez	5.677.304	357.392.914,92 ₺	62,95 ₺	0,85
Mengen	433.373	19.503.756,46 ₺	45,00 ₺	0,37
Mudurnu	691.377	29.125.382,16 ₺	42,13 ₺	0,29
Pamukova	1.124.658	53.488.714,81 ₺	47,56 ₺	0,44
Sapanca	1.448.088	71.322.522,01 ₺	49,25 ₺	0,48
Seben	118.149	4.761.235,79 ₺	40,30 ₺	0,24
Serdivan	849.762	30.249.307,03 ₺	35,60 ₺	0,11
Söğütlü	904.936	38.926.155,56 ₺	43,02 ₺	0,31
Taraklı	123.530	4.448.773,56 ₺	36,01 ₺	0,12
Termal	169.374	7.101.824,31 ₺	41,93 ₺	0,28
Yalova	4.860.882	224.735.214,94 ₺	46,23 ₺	0,40
Yeniçağa	263.422	8.267.721,49 ₺	31,39 ₺	0,00
Yığılca	155.480	5.963.582,85 ₺	38,36 ₺	0,19

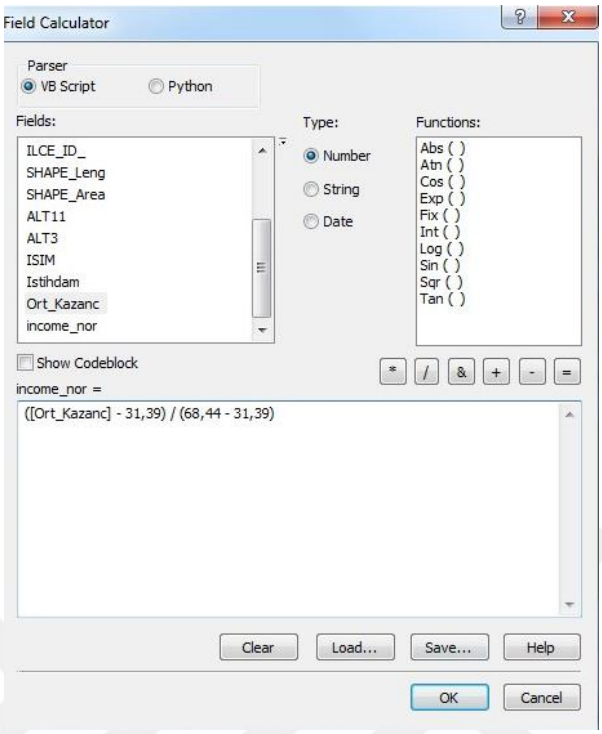

Figure 3.10 Normalization via Field Calculator in ArcGIS Desktop Software

Following the normalization, the data was added into the table of districts layer as an attribute to conduct the analysis and make comparison. To use the data over parcels, score of each district was added on the parcel dataset as an attribute value. The figure 3.10 shows the field calculator and the equation entered for the analysis.

3.4.3.10 Natural thresholds

As the population grows and new lands are required for urban use, some locations which have not planned or occupied before might need to be planned and inhabited. At a moment when such future plans are not available it is hardly possible to foresee which exact location will be planned for any specific urban use. Some natural thresholds, however, are easy to predict not to be developed for urban usage in the future. Such thresholds could be fault zones, forests, protected areas, water bodies and their close basins, etc. The figure 3.11 displays such areas overlaid and their distribution over the region. As mentioned in chapter 3, the East Marmara region has many natural thresholds such as fault zones, agricultural lands, protected areas and mainly forests. According to the General Directorate of Forests, 41% of Kocaeli, 42% of Sakarya, 51% of Düzce, 64% of Bolu and 59% of Yalova are forests (2016). Thus,

the suitable lands for investment are expected to be relatively low in the region, which is another important issue for smart spatialization.

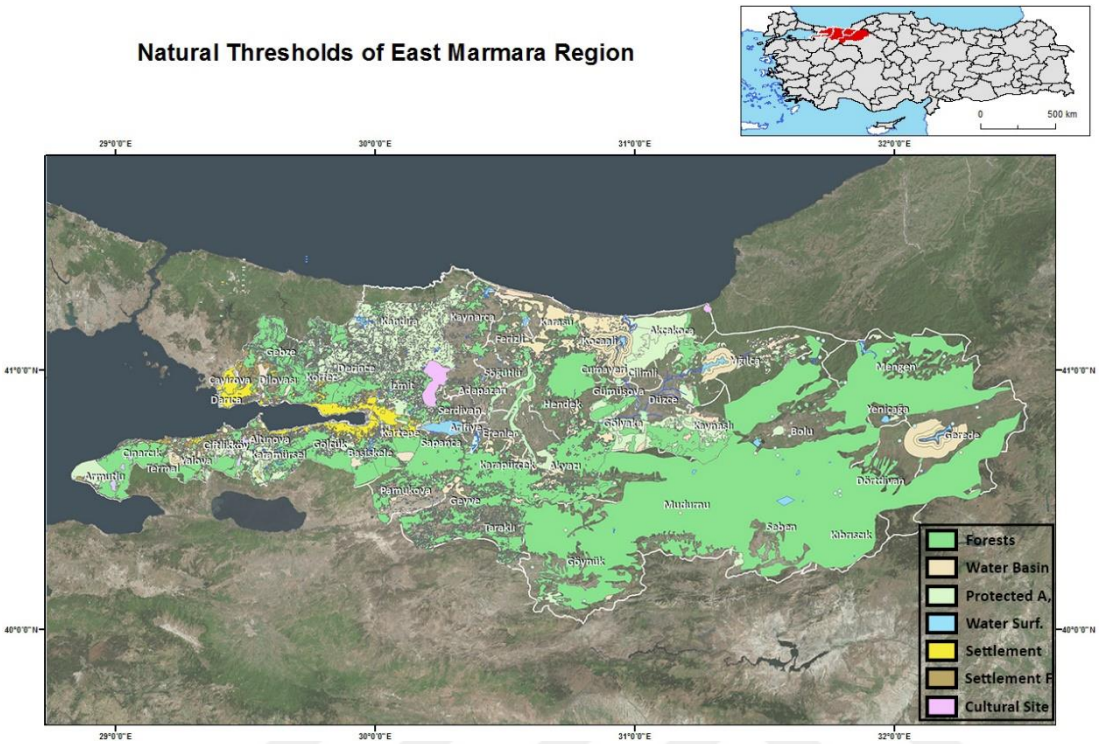

Figure 3.11 Natural Thresholds

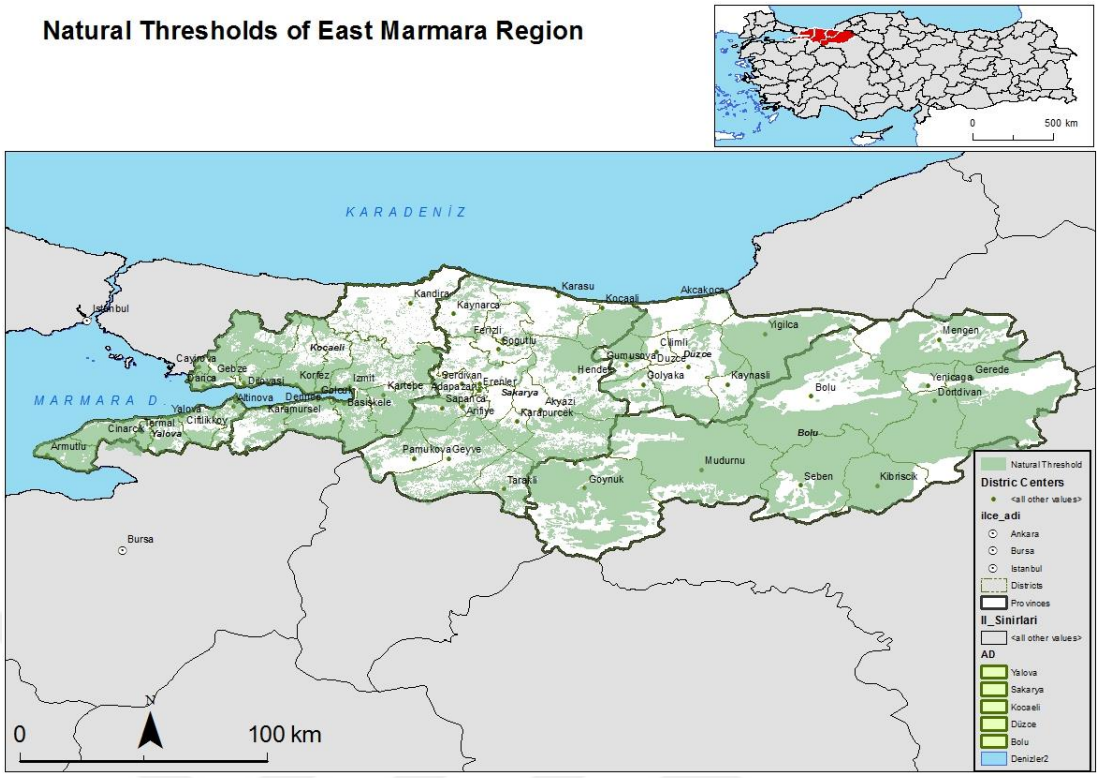

Figure 3.12 Masked Natural Threshold to Determine Unsuitable Lands for Investment

The figure 3.12 shows the same locations with masked green color to point out those areas are not suitable for investments regardless they are within the optimum zones of the sectors. It is also used for overlaying with the final sectoral optimization of space for seeing the possible sites not suitable for investment.

3.4.3.11 Transportation infrastructures

According to 2012 data of TURKSTAT, in Turkey, domestic freight transportation is heavily dominated by road transportation (89.4%) (Reşat and Turkay, 2015).

East Marmara Region is one of the few NUTS 2 regions in Turkey to have highway passing within. Having easy access to the highways increases comparative advantage in terms of logistics. As highways are accessible from the tollhouses, tollhouse (point) data were used to conduct the analysis of accessibility.

The figure 3.13 shows an example for choosing this method which is the Düzce 1st Organized Industrial District (OIZ). This location is close to the main motorway, however far to the nearest tollhouse.

In figure 3.13, the ruler tool of Google Earth software shows the distance 2.3 km from Düzce 1st OIZ to the closest part of the Trans European Motorway (TEM) as the crow flies. However, the route analysis shows the same places as 29.5 km as there is no connection with the highway close. And, as the method, buffer analysis for 5, 10, 25 and 50 kilometer rings were conducted to the tollhouses as in figure 3.14 and the values were normalized between 0 and 1.

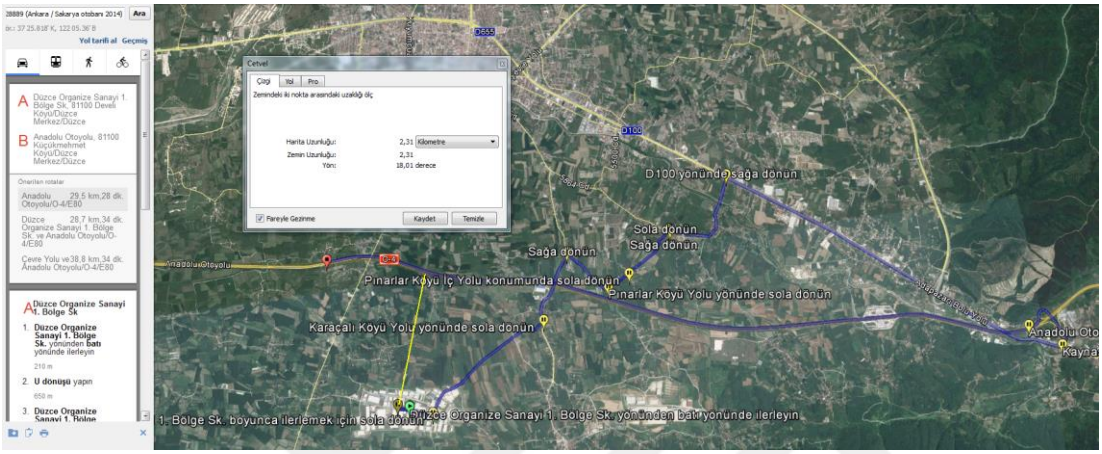

Figure 3.13 Shortest distance from Düzce 1st OIZ to the TEM (route analysis from Google Earth)

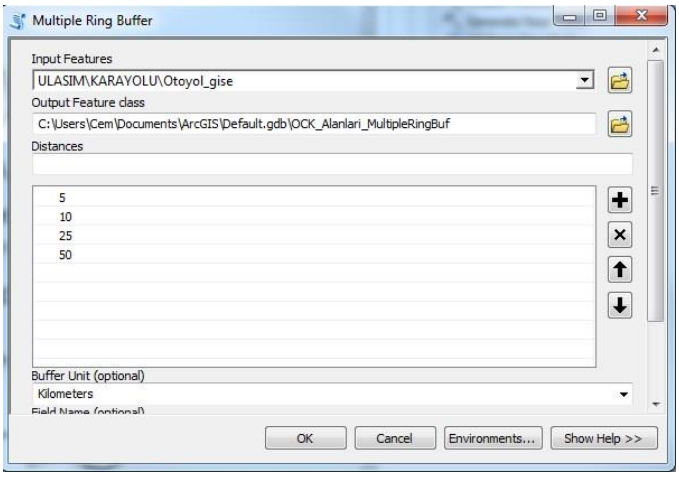

Figure 3.14 Multiple Ring Buffer Variables in ArcGIS Desktop software

The figure 3.14 shows the multiple ring buffer tool of ArcGIS Desktop Software as the method of the analysis. The following map (Figure 3.15) was gathered as the result.

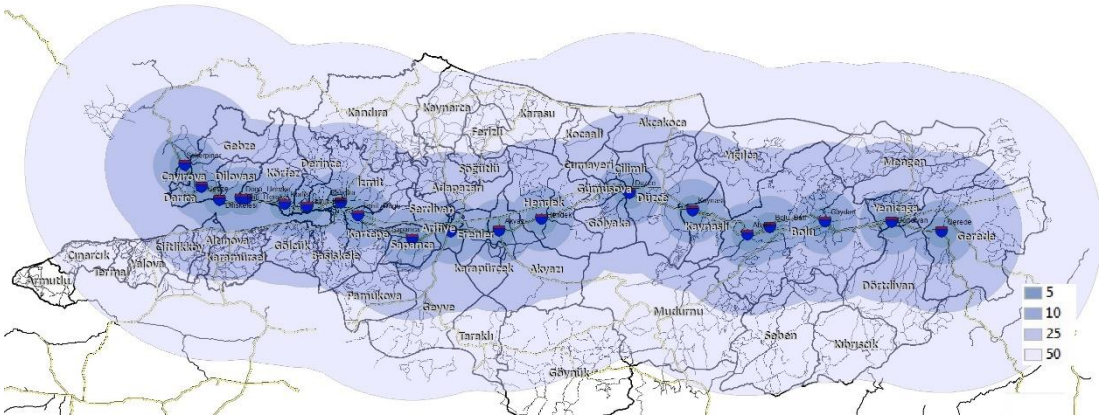

Figure 3.15 Multiple buffer rings for toll houses

The buffers are to be used as normalized attribute data for each parcel.

3.4.3.12 Logistics

A World Bank study also has noted that the quality of national logistics services is now a major detriment of capital flows into developing countries (Jayaweera, 2015). Logistics links suppliers with customers and it integrates functional entities across a company (Introduction to logistics, University of Houston, 2015). In the chain of logistics, road transportation, railway transportation, seaport transportation, air transportation and pipeline transportation are the alternatives or the phases within the multimodal transportation.

Sea transportation has the highest ratio in international trade among the transportation modes. In terms of time and cost, railroad transportation is more optimal than road transportation, seaway transportation is more optimal than railroad and airway transportation is more optimal than seaway as the distance increases (The Ministry of Transportation, Communication and Maritime, 2010). Only exception could be weight of the goods, which can change the optimal mode and distance relation.

The unbalanced use of transportation modes creates negative impacts on congestion, carbon emissions, and safety risks. On the other hand, intermodal transportation is a new concept for the Turkish transport industry due to lack of intermodal transportation infrastructure within the country. However, Turkish logistics companies use the available intermodal infrastructure in the Europe. For example, more than 125 000 trucks use RO-RO (Sea+Road modes) lines: most commonly used routes include Pendik, Turkey; Trieste, Italy or Illichecvsk, Ukraine ports and then they use either

road transportation or RO-LA (Rail+Road modes) lines to reach their customers in Austria and Germany every year. Also, the intermodal transportation routes between Turkey and Central Europe is heavily used by more than 300 000 trucks per year and most of the trips to Germany and Austria are made on the RO-LA lines from Istanbul, Turkey to Wels, Austria (Reşat and Türkay, 2015). Figure 3.16 displays the financial advantages of intermodal transportation according to this study.

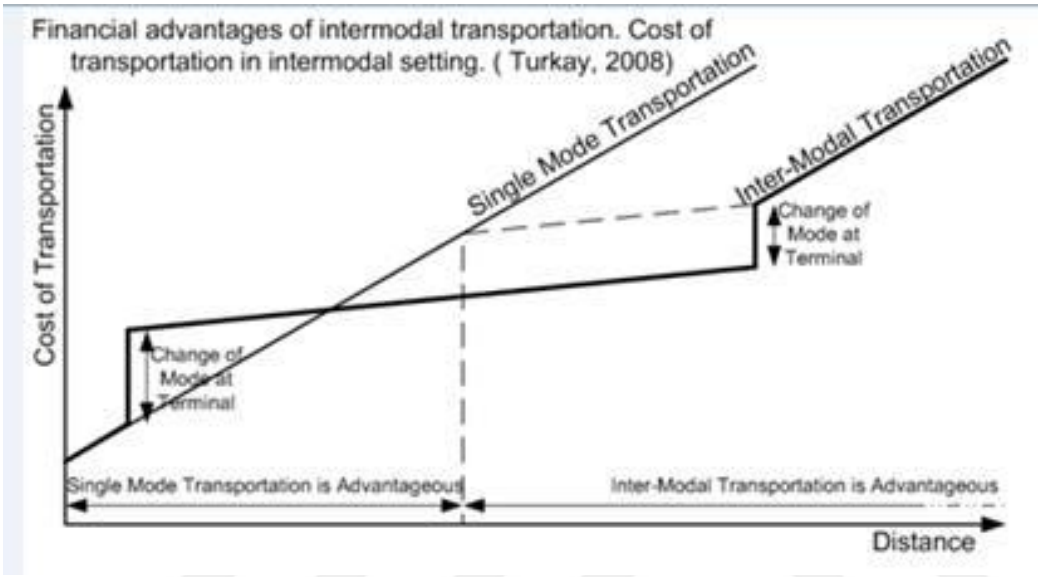

Figure 3.16 Financial advantages of intermodal transportation (Resat and Turkay, 2015)

For this thesis, intermodal transportation is accepted as the logistic basis as the imports and exports are made mostly via ports after both road and railroad transportation phases. Thus, distances to ports were examined.

To conduct such an analysis, the port data (point) and road data (polyline) were used. In order to conduct service area analysis for ports, a network dataset (ND) is required as it possess connectivity information. Thus, a network dataset layer is created by ArcGIS software and the road data were transformed into network dataset. This enabled the service area analysis by defining ports data as the input feature.

Choosing ports as the facilities and defining network service polygons at 10, 25, 50 and 100 kilometers as shown in table 3,7 and five different classification were gathered as displayed in figure 3.17.

Table 3.7 Grades According To Service Polygons of Ports

Distance	Grade
0-10 km	1
10-25 km	0,75
25-50 km	0,50
50-100 km	0,25
More than 100 km	0 – N/A

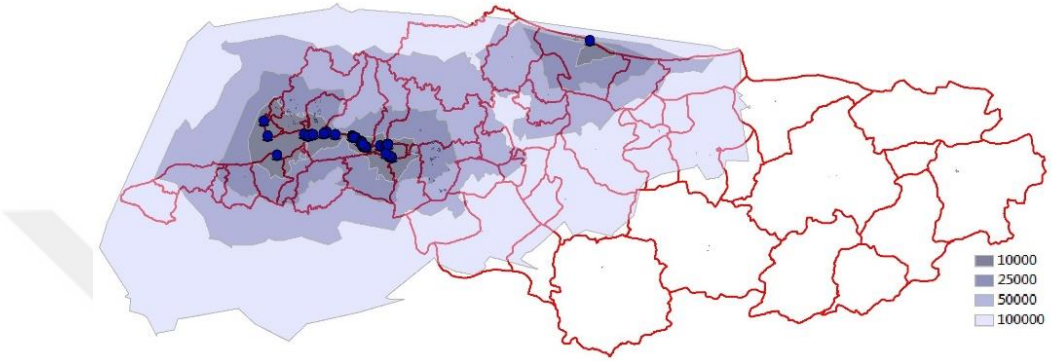

Figure 3.17 Service Area Analysis of the Ports

The grades are to be used as normalized attribute data for each parcel.

3.4.3.13 Customs

According to Wordreference.com, customs is an authority or agency in a country responsible for collecting tariffs and for controlling the flow of goods, including animals, transports, personal effects, and hazardous items, into and out of a country. The role of Customs is to control the movement of goods and thereby secure the state's interests and safeguard revenue collection (World Custom Organization, 2008). Before the import or export is made, all commodities has to be processed in the customs. Table 3.8 shows the names and the locations of the Customs Directorates within the study area.

Table 3.8 Locations of the Customs in the Region

	Name of the Directorate	Location
1	İzmit Costoms Directorate	Kocaeli
2	Derince Costoms Directorate	Kocaeli
3	Dilovası Costoms Directorate	Kocaeli
4	Gebze Costoms Directorate	Kocaeli

5	Körfez Costoms Directorate	Kocaeli
6	Sakarya Costoms Directorate	Sakarya
7	Bolu Costoms Directorate	Bolu

Giving custom offices as the facilities, a service area network analysis was conducted to show the places within 25, 50 and 100 kilometer distances as shown in the table 3.9. After conducting the service area analysis, figure 3.18 is gathered as the result.

Table 3.9 Grades According To Service Polygons of Customs

Distance	**Grade**
0-10 km	1
10-25 km	0,75
25-50 km	0,50
50-100 km	0,25
More than 100 km	0 – N/A

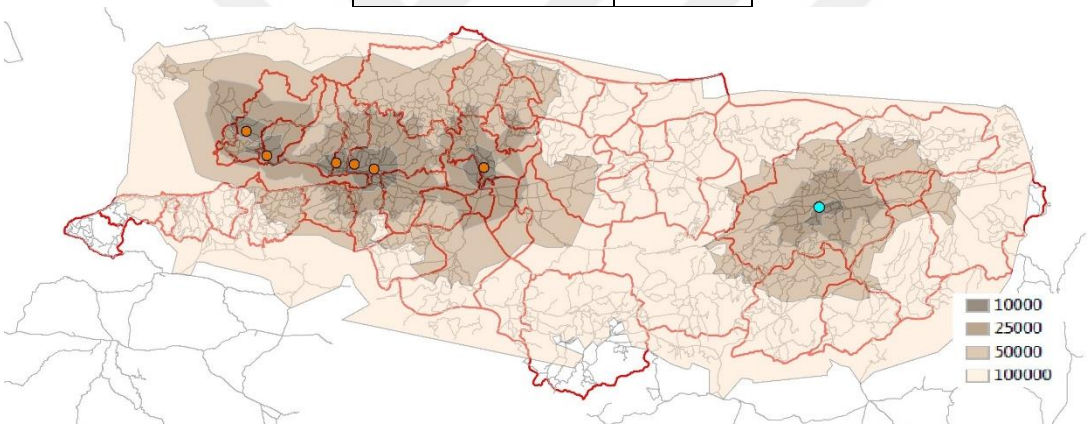

Figure 3.18 Service Area Analysis of the Customs

After normalizing the scores, customs are to use in the final analysis.

3.4.4 Spatial decision support

In the spatial decision support system, there are 8 sectors, 13 criteria and 359 parcels available for the analyses. Weighted final scores were determined for each sector according to their normalized data.

Spatial Multi Criteria Decision Making approach is used to determine optimal site selection preferences of prominent sectors within East Marmara region and finally optimal investment site selection maps were produced as thematic maps at the end of GIS-based multi criteria decision analyses.

As data of each criteria has normalized and the weighted values have defined, the spatial multi criteria decision making process was implemented to each parcel in the database. In doing so, each normalized data was entered as an attribute to investment sites (parcels) layer and eight new attribute fields were created to calculate the weighted values of these parcels according to their sectoral scores. The weighted values were already determined in the table of Weighted Values of Location Choice Criteria. The scores to be analyzed were calculated as follows using Weighted Sum Model:

Machinery

([cost_n] * 2 (weight)) + ([area_n] * 2) + ([agg_mak_n] * 4) + ([Input_n] * 3) + ([mark_n] * 3) + ([govinc_n] * 5) + ([labcost_n_] * 2) + ([toll_buf_n] * 3) + ([ports_n] * 3) + ([customs] * 3)

Electrical Machinery and Equipment

([cost_n] * 3) + ([area_n] * 1) + ([agg_ele_n] * 4) + ([Input_n] * 5) + ([mark_n] * 4) + ([govinc_n] * 4) + ([labcost_n_] * 3) + ([toll_buf_n] * 1) + ([ports_n] * 2) + ([customs] * 3)

Automotive and Supplier Industry

([cost_n] * 1) + ([area_n] * 5) + ([agg_aut_n] * 4) + ([Input_n] * 4) + ([mark_n] * 1) + ([govinc_n] * 1) + ([labcost_n_] * 1) + ([toll_buf_n] * 4) + ([ports_n] * 5) + ([customs] * 4)

Non-Ferrous Materials

([cost_n] * 3) + ([area_n] * 2) + ([agg_nfm_n] * 2) + ([Input_n] * 5) + ([mark_n] * 2) + ([govinc_n] * 3) + ([labcost_n_] * 5) + ([toll_buf_n] * 2) + ([ports_n] * 3) + ([customs] * 3)

Chemistry and Medicine

([cost_n] * 2) + ([area_n] * 3) + ([agg_che_n] * 5) + ([Input_n] * 1) + ([mark_n] * 1) + ([govinc_n] * 4) + ([labcost_n_] * 4) + ([toll_buf_n] * 2) + ([ports_n] * 2) + ([customs] * 5)

Agriculture and Ornamentals

([cost_n] * 5) + ([area_n] * 5) + ([agg_agr_n] * 3) + ([Input_n] * 1) + ([mark_n] * 3) + ([govinc_n] * 5) + ([labcost_n_] * 5) + ([toll_buf_n] * 1) + ([ports_n] * 1) + ([customs] * 1)

Forestry Products

([cost_n] * 5) + ([area_n] * 5) + ([agg_for_n] * 1) + ([Input_n] * 3) + ([mark_n] * 4) + ([govinc_n] * 4) + ([labcost_n_] * 5) + ([toll_buf_n] * 1) + ([ports_n] * 1) + ([customs] * 1)

Transportation and Shipbuilding

([cost_n] * 1) + ([area_n] * 2) + ([agg_tra_n] * 5) + ([Input_n] * 3) + ([mark_n] * 1) + ([govinc_n] * 1) + ([labcost_n_] * 2) + ([toll_buf_n] * 5) + ([ports_n] * 5) + ([customs] * 5)

Next step here was to transform polygon data into point data to conduct interpolation analysis to visualize the distribution of the results within the region. Thus, Feature to Point (Data Management Tool) conversion was performed in ArcGIS Desktop software.

There exists 359 parcels within the system, most of which were distributed in westernmost of the region, namely Gebze, Dilovası and İzmit as shown in figure 3.19. The rationale behind this distribution is western parts of the region is being economically more active and having more population.

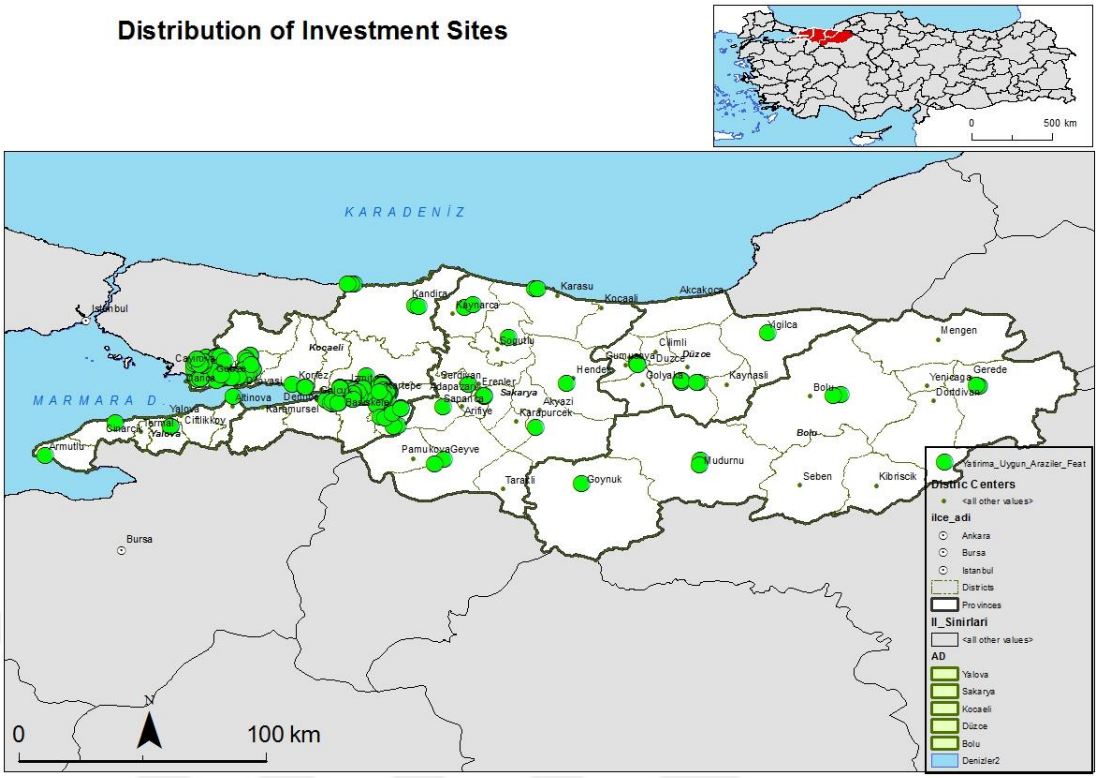

Figure 3.19 Distribution of Investment Sites

Having converted the data into point features, interpolation was conducted with Inverse Distance Weighting (IDW) method. The purpose was to see the distribution of the results as accurate as possible. The dataset of investment sites (parcels) were not distributed over space evenly.

According to the User Guide Manual of QGIS 2.2, in the IDW interpolation method, the sample points are weighted during interpolation such that the influence of one point relative to another declines with distance from the unknown point wanted to be created.

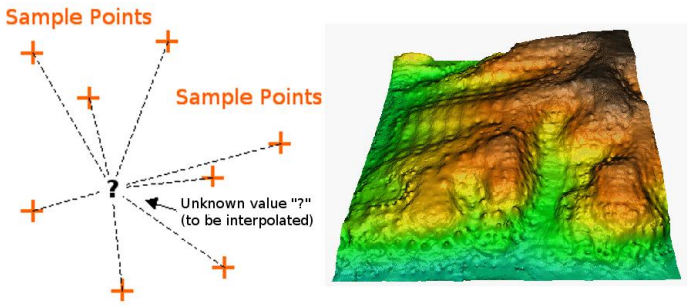

Figure 3.20 Inverse Distance Weighted interpolation based on weighted sample point distance (left). Interpolated IDW surface from elevation vector points (right). Image Source: Mitas, L., Mitasova, H. (1999).

Shown in figure 3.20, the IDW function should be used when the set of points is dense enough to capture the extent of local surface variation needed for analysis (Childs, 2014). IDW determines cell values using a linear-weighted combination set of sample points. The weight assigned is a function of the distance of an input point from the output cell location. The greater the distance, the less influence the cell has on the output value.

During the analysis process, distance for nearest data search radius was determined as 10 kilometers where the power for Z values had taken as “1”.

The weighted multi criteria analysis was adopted for each sector in accordance with their needs. The scores were gathered for each parcels differently. To spatialize the results, maps were produced with IDW Mapping technique. Each sector has mapped according to its scores for each independent parcel. While visualizing, 6 different grades were assigned to see the maximum and minimum values as well as trends of increase and decrease.

The scores of each sectors had different condensations among themselves. And, as the results for each sector does not need to be comparable in terms of scores, the classification were made via quantile distribution as in figure 3.21.

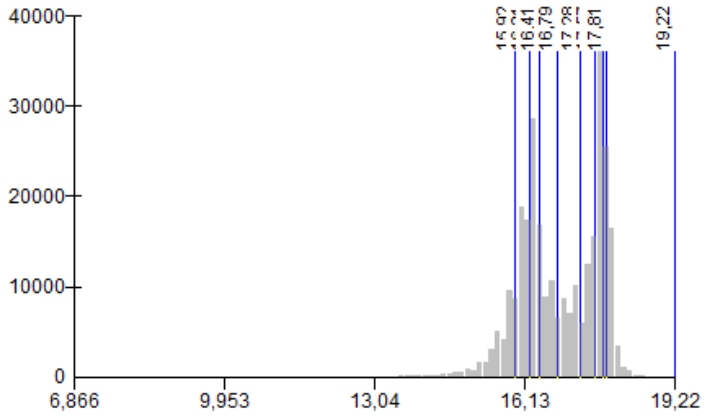

Figure 3.21 Example of Score Distribution (Transportation and Shipbuilding)

3.4.5 Thematic maps

The results of the GIS-based multi criteria analyses are as follow. Result site selection maps of each sector were produced using IDW.

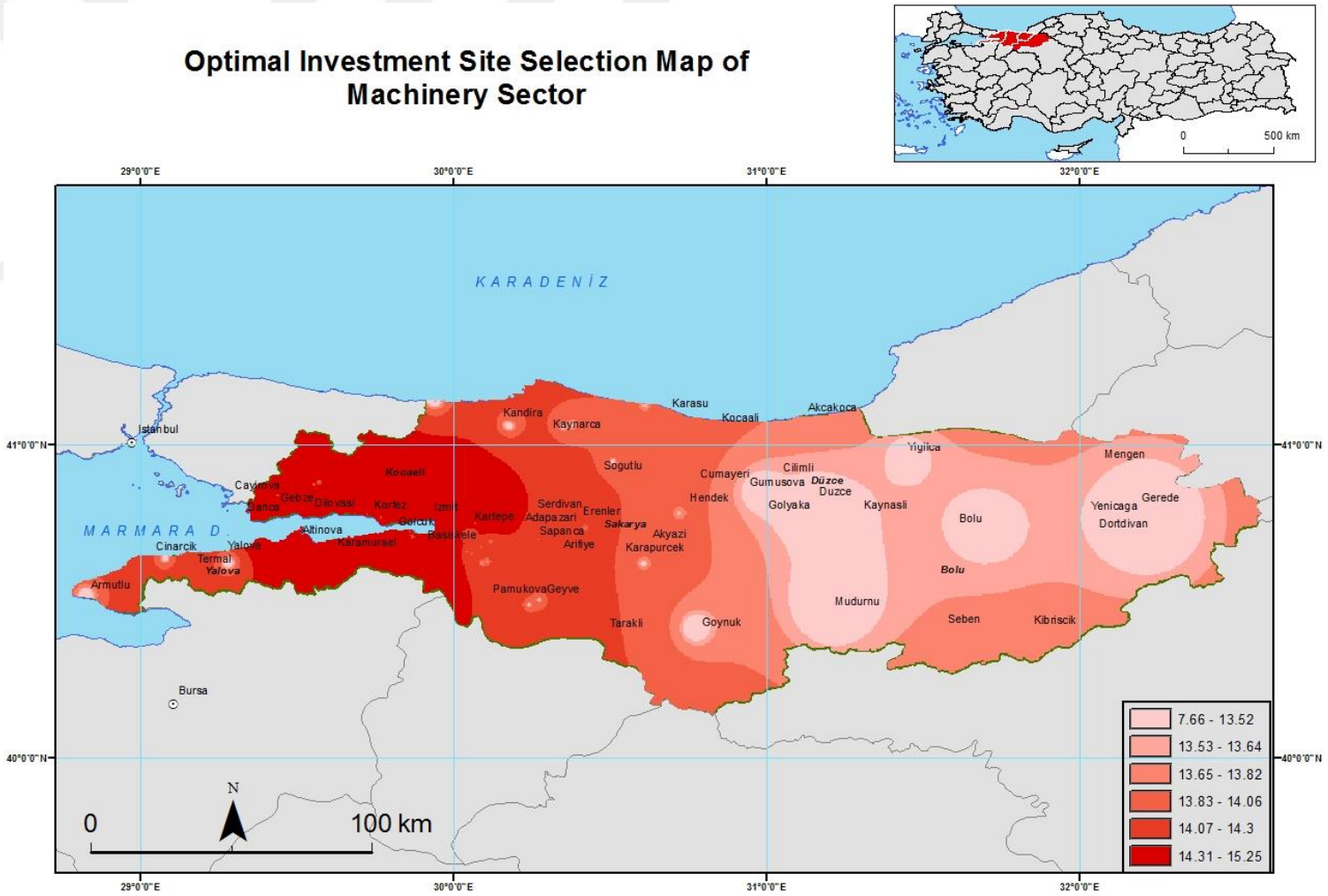

Figure 3.22 Optimal Investment Site Selection Map of Machinery Sector in East Marmara

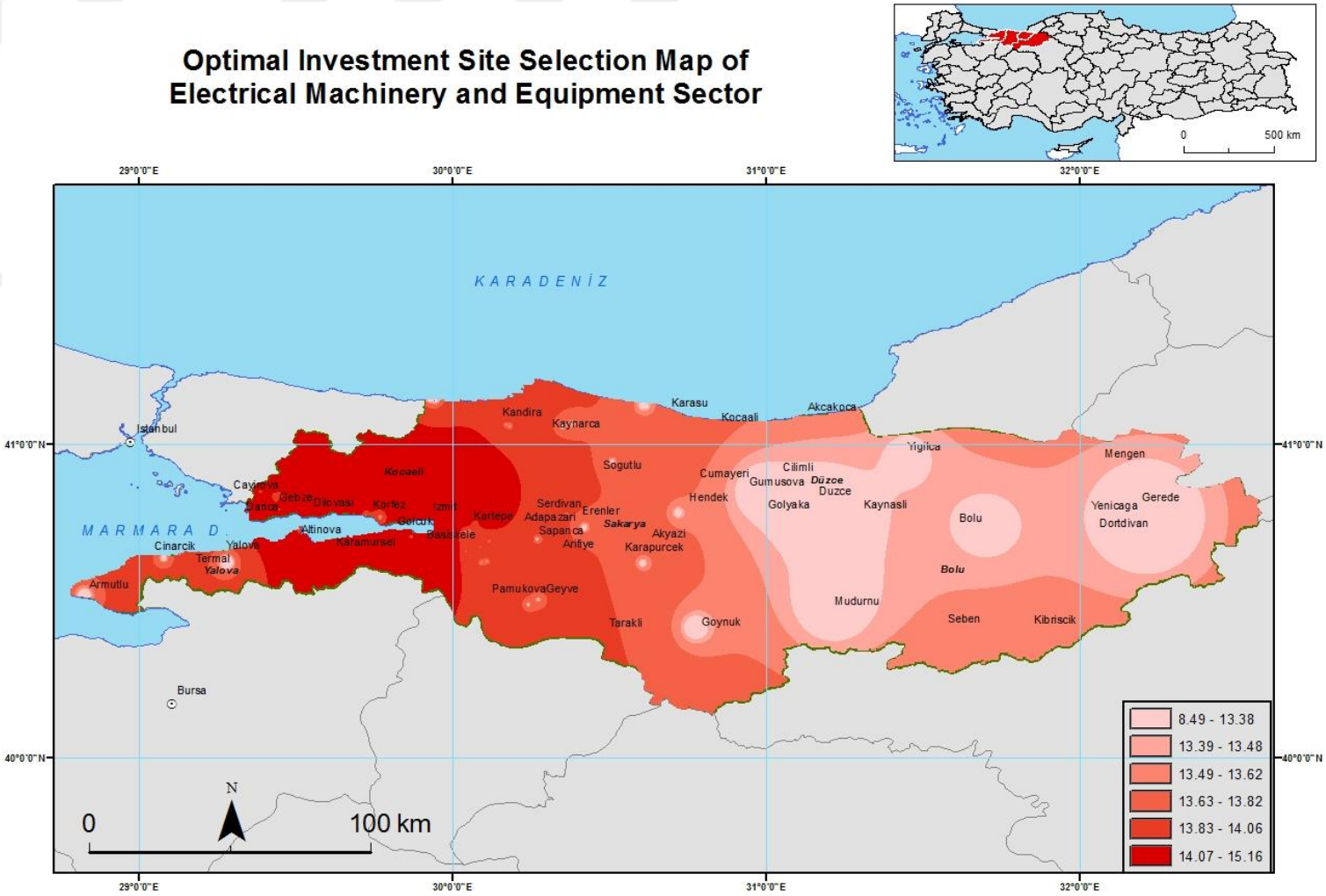

Figure 3.23 Optimal Investment Site Selection Map of Electrical Machinery and Equipment Sector in East Marmara.

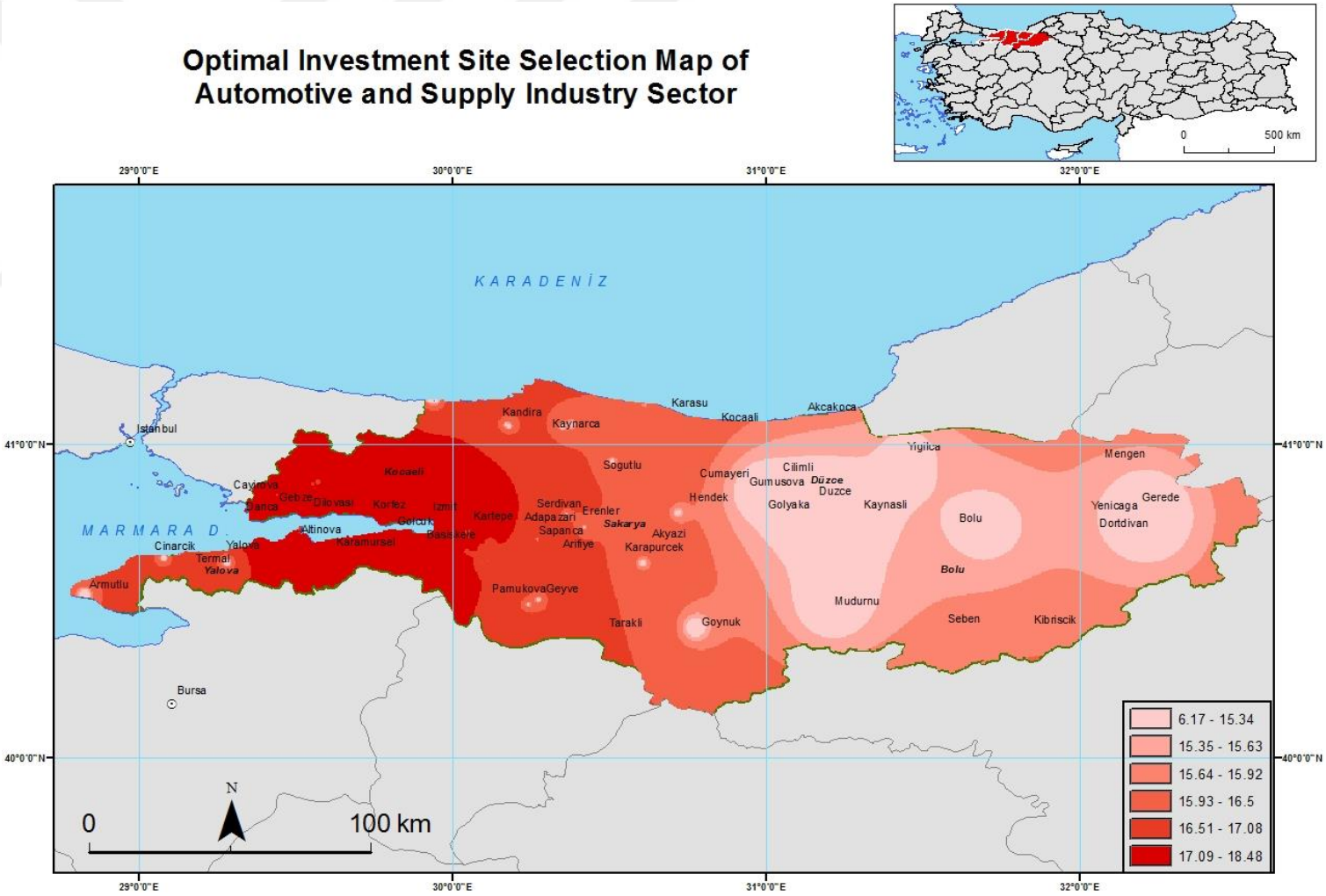

Figure 3.24 Optimal Investment Site Selection Map of Automotive and Supplier Industry Sector in East Marmara.

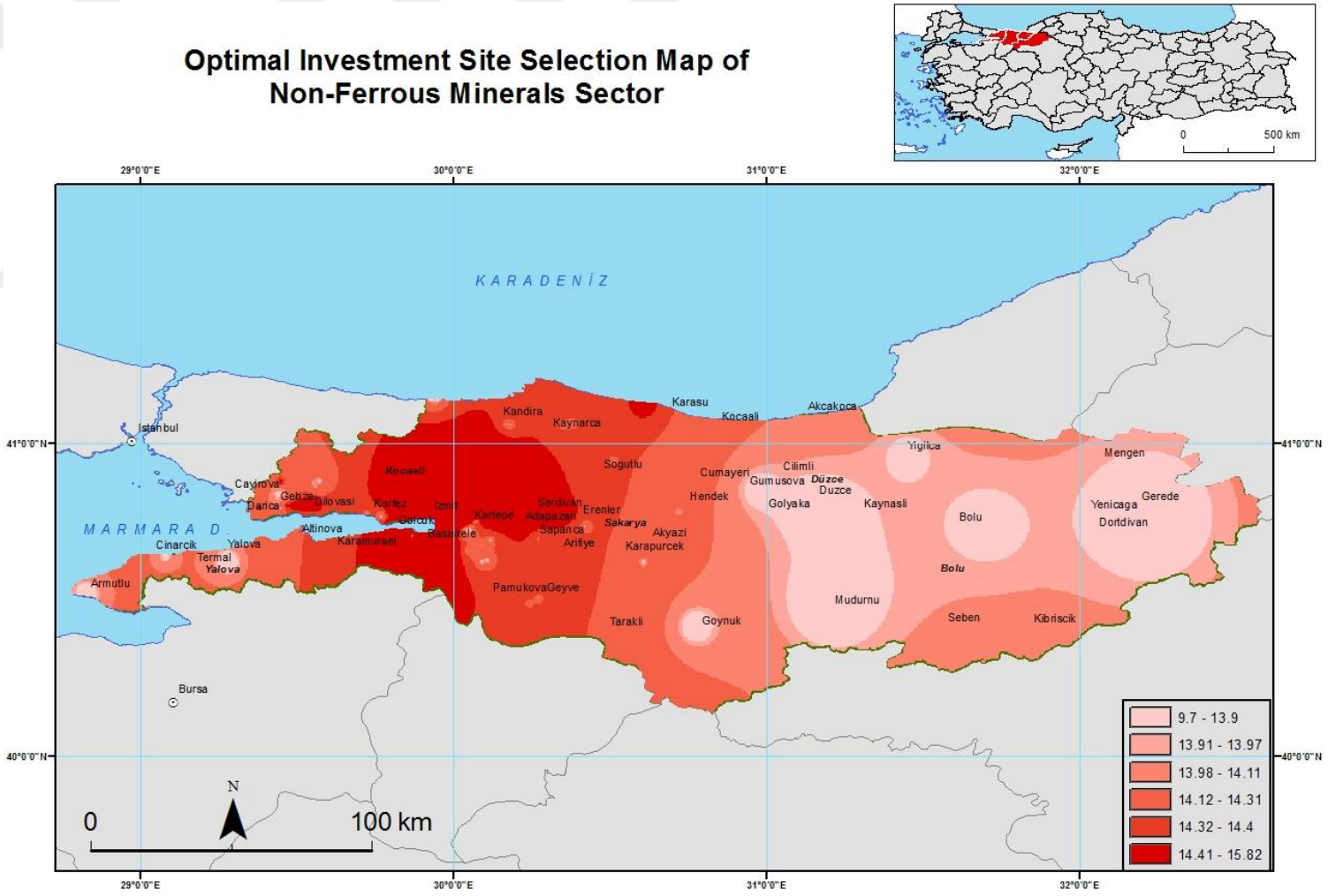

Figure 3.25 Optimal Investment Site Selection Map of Non-Ferrous Materials Sector in East Marmara.

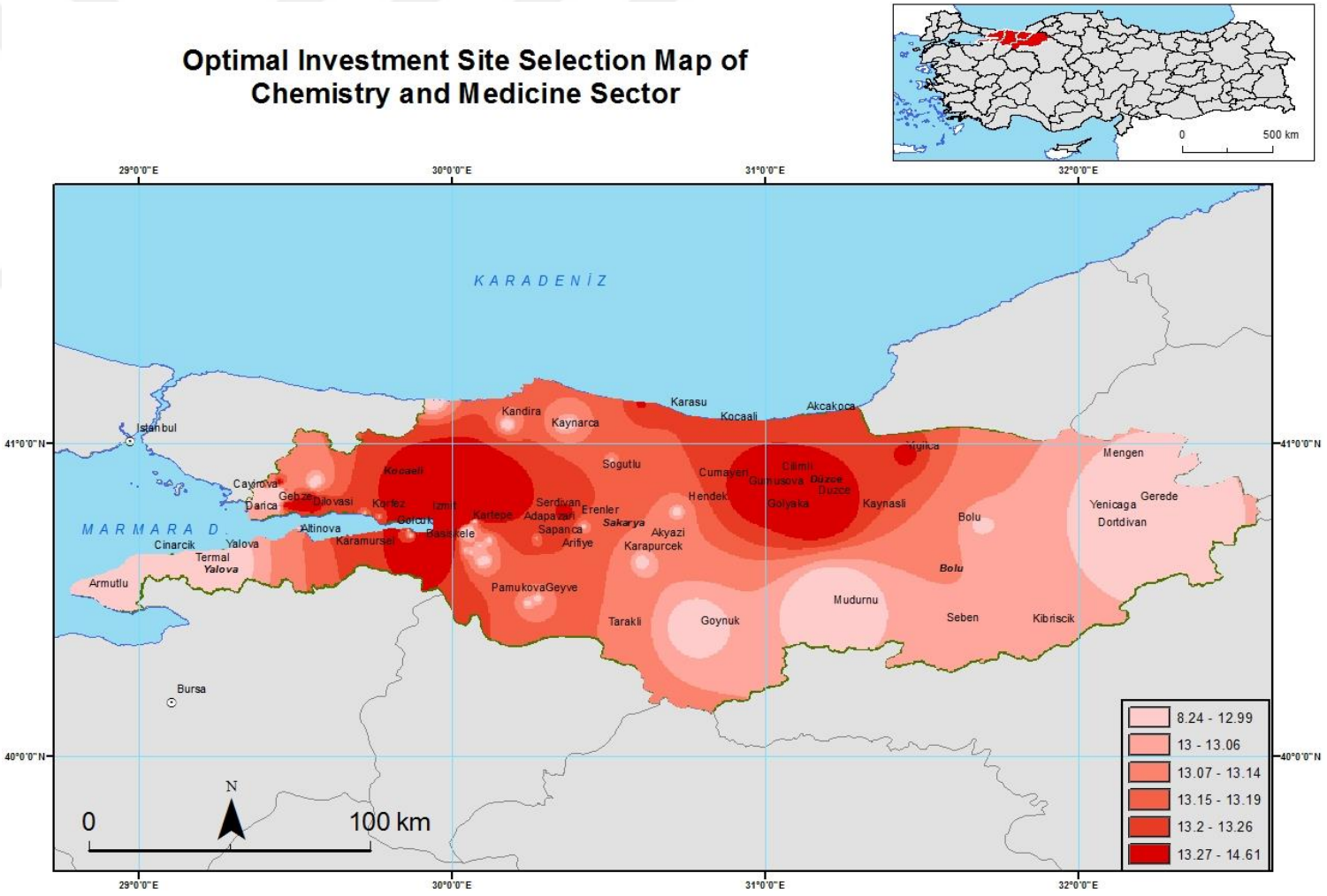

Figure 3.26 Optimal Investment Site Selection Map of Chemistry and Medicine Sector in East Marmara.

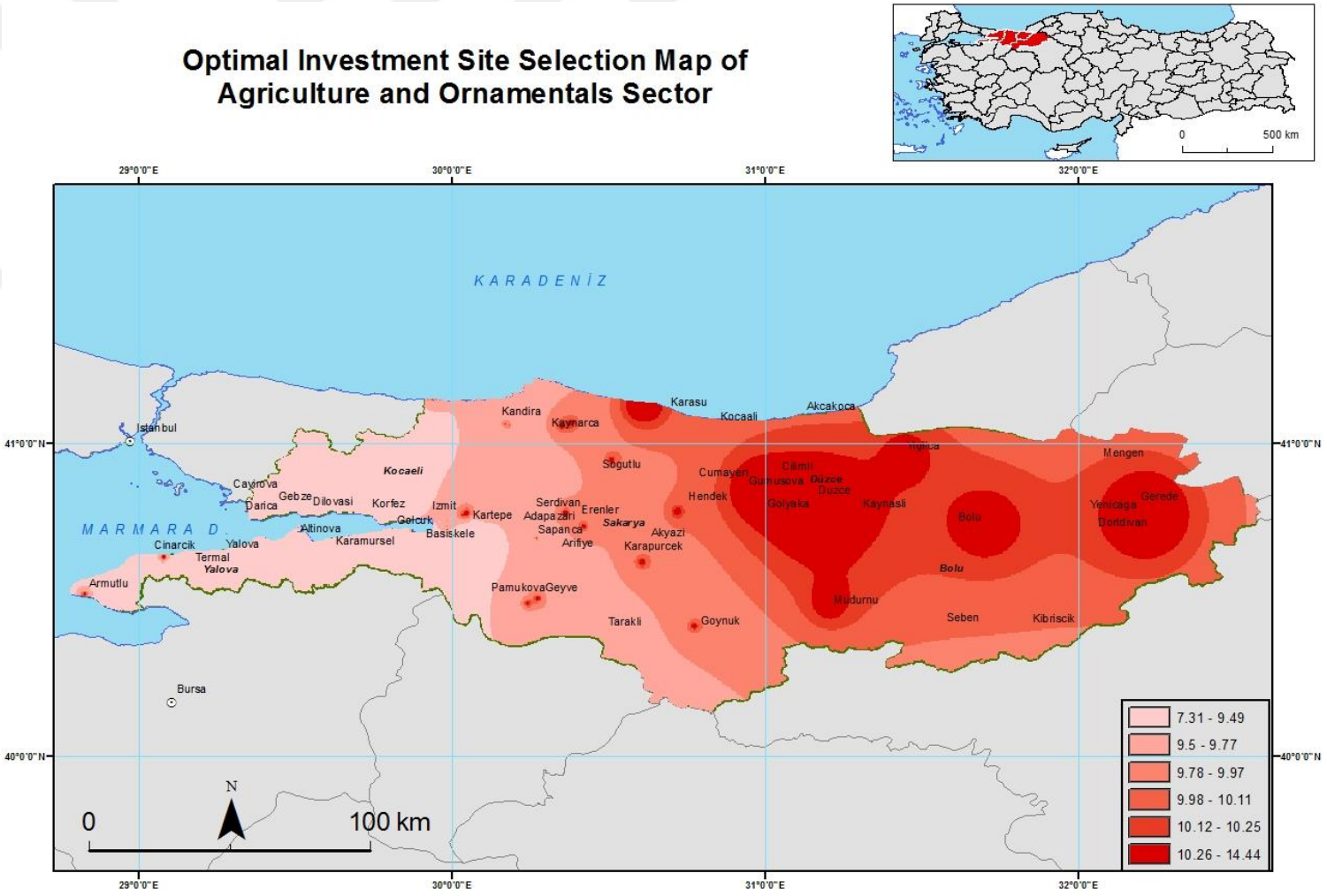

Figure 3.27 Optimal Investment Site Selection Map of Agriculture and Ornamentals Sector in East Marmara.

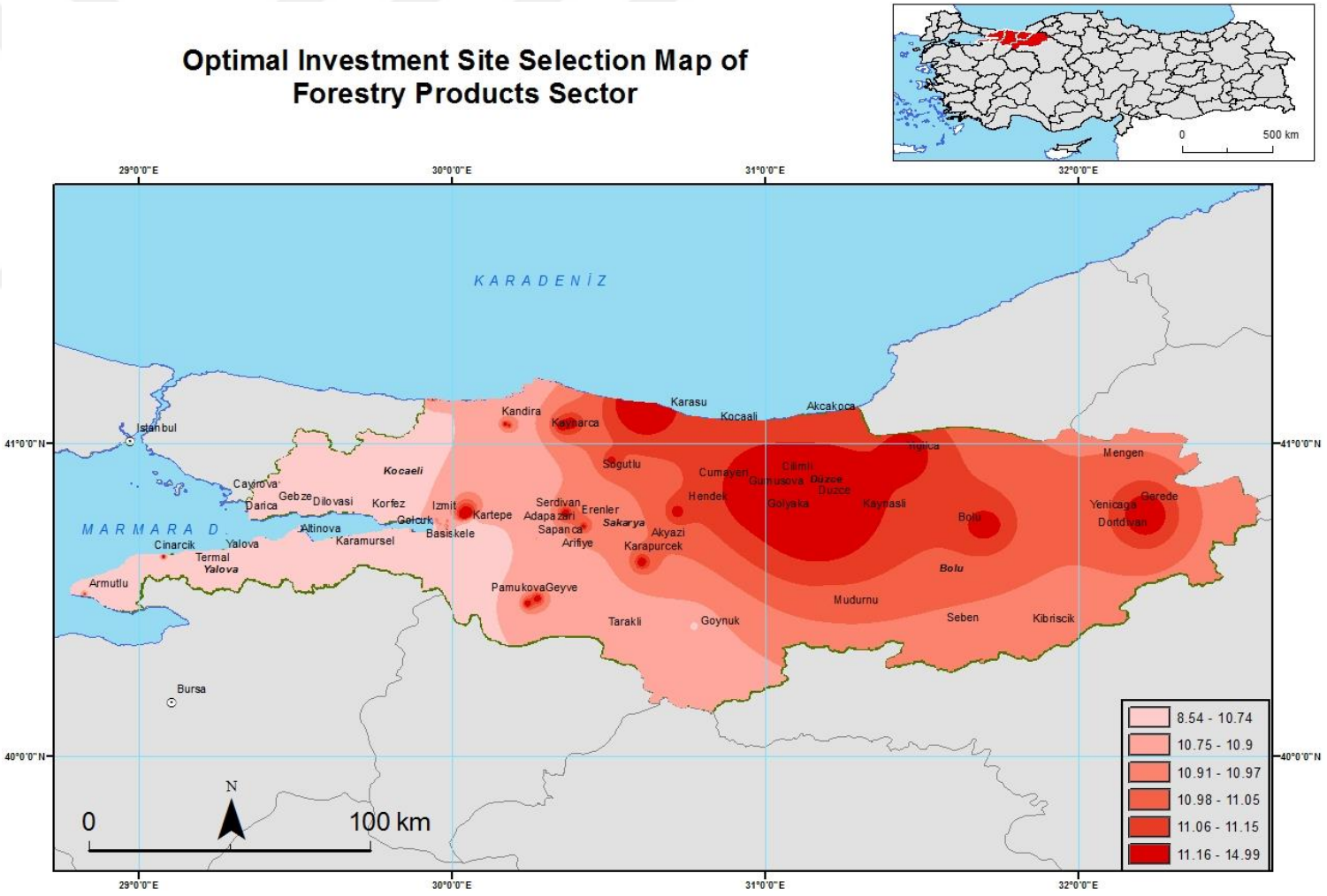

Figure 3.28 Optimal Investment Site Selection Map of Forestry Products Sector in East Marmara.

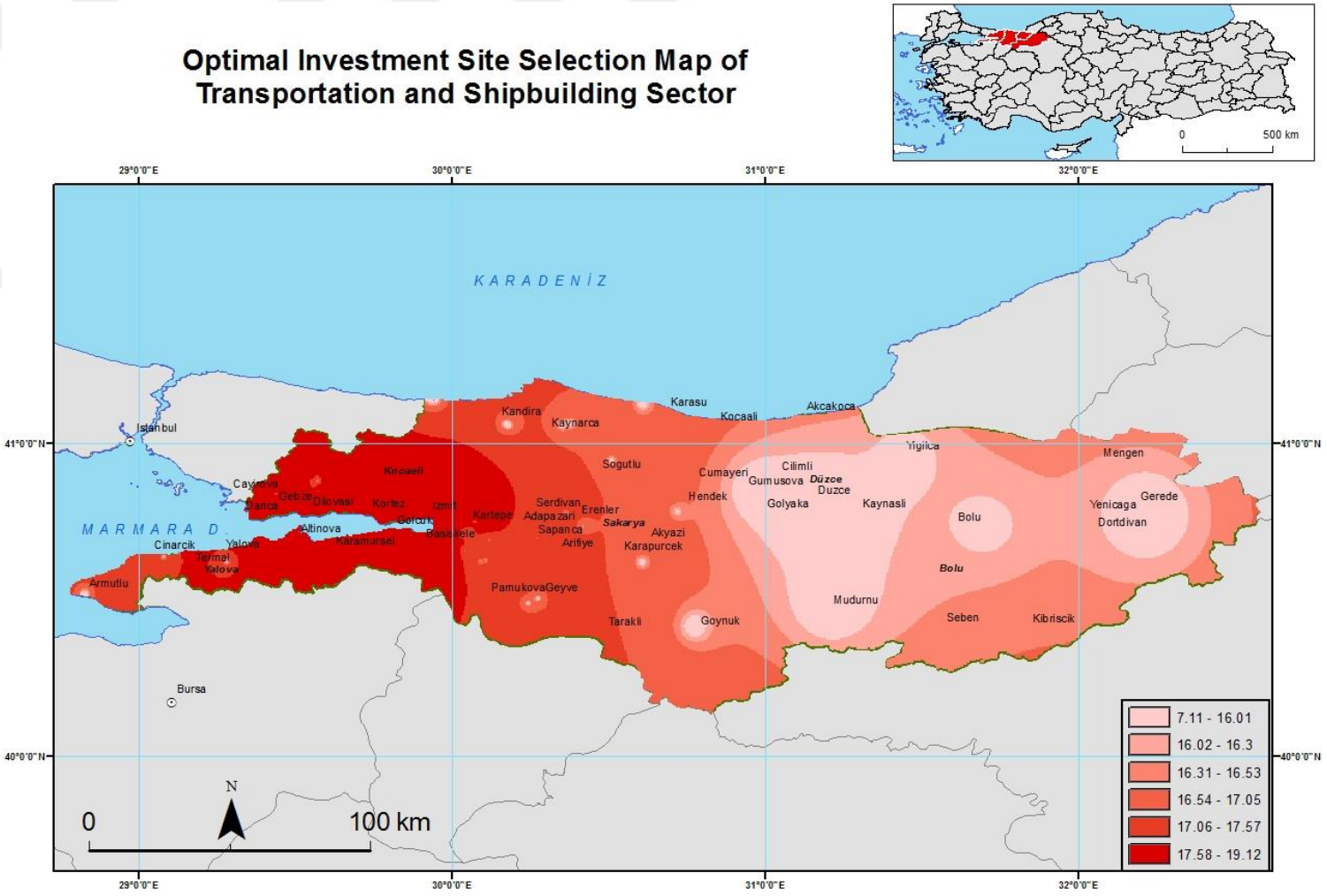

Figure 3.29 Optimal Investment Site Selection Map of Transportation and Shipbuilding Sector in East Marmara.

As shown in figure 3.22, Machinery sector, as the most prominent within the region, tend to locate in western parts of the region. It can be concluded that the sector is less effected by land and labor costs, land size and different from the weight table; government incentives. Thus; Gebze, İzmit, Gölcük and Altınova should be more preferable locations for the sector to invest.

As shown in figure 3.23, Electrical Machinery and Equipment, similar to machinery sector, tends to be located in the western part of the region. Gebze, İzmit, Gölcük and Altınova should be more preferable locations for the sector to invest.

As shown in figure 3.24, Automotive and Supplier Industry, as another sector with high added value, should be locating to the western parts of the region. Different from the machinery and electrical machinery and equipment sector, for automotive and supply industry Körfez district is a profitable location for investments.

As shown in figure 3.25, Non-Ferrous Materials, as a more labor and input oriented economic activity, the tendency moves to the east from the westernmost parts of the region, except from Dilovası. Apart from the parcels in Derince, İzmit, Gölcük and Başiskele of the Kocaeli province, central districts of Sakarya like Adapazarı and Serdivan are suitable for non-ferrous materials sector. Another zone for the sector is Karasu district on the Black Sea coast of Sakarya.

As shown in figure 3.26, Chemistry and Medicine sector is found to have two main profitable investment zones; one in İzmit and its surrounding and the second in Düzce. As both places have existing sectoral agglomeration, both focuses are suitable for chemicals and medicine sector. Apart from these two zones, Dilovası can also be another location for the sector.

As shown in figure 3.27, Agriculture and Ornamentals is a sector requiring large land sizes and cheap labor and land costs. Thus, the analysis shows Düzce, Bolu, Gerede and Mudurnu as main foci for sectoral development. Furthermore, Karasu is another alternative. It can be concluded according to the map below, that Düzce and its

neighboring districts like Yığılca, Çilimli, Gümüşova and Kaynaşlı are the most suitable place for the sector in general terms.

As shown in figure 3.28, Forestry Products, as a low added value sector, requires cheap land and labor costs like agriculture and ornamentals. The map below shows Düzce is the most suitable land for the sector to invest with given data.

As shown in figure 3.29, Transportation and Shipbuilding is directly related with logistics and warehousing as well as other transportation vehicle production. Thus, it is highly related with transportation infrastructure and logistic opportunities. The data analysis shows that the surroundings of the İzmit Gulf is the correct place to invest for the sector. Altınova, İzmit, Körfez and Gebze districts hosts the highest values of the analysis.

3.4.6 Evaluation of the maps

Knowing each sector and each investment has its own dynamics, this study was performed to design an upper scale perspective for the prominent sectors for smart specialization and their location preferences for smart spatialization with the case of East Marmara NUTS-2 Region of Turkey.

Some outcomes of this study might be that each province and even district has different potentials and taking those potentials they should determine their investment promotion activities as well as creating new suitable lands for investment for the said sectors.

As the results are compared with the current situation within the region, they show consistency in many cases. For instance, the automotive sector is already located around the İzmit Gulf as gathered in figure 3.24. The chemistry and medicine sector in figure 3.16, as another example, is already developed in Düzce. Despite being effected by sectoral agglomerations, the analysis results shows correlation with past investments.

Table 3.10 gives the scores for preferable sectors and districts by calculating the value of district centers within the range of each sector and transforms the scores from map to table.

Table 3.10 Sectoral Scores According to the Districts

	Machinery	Electrical Machinery and	Automotive and Supplier Industry	Non-Ferrour Materials	Chemistry and Medicine	Agriculture and Ornamentals	Forestry Products	Transportation and Shipbuilding
Adapazarı								
Akçakoca								
Akyazı								
Altınova								
Arifiye								
Armutlu								
Başiskele								
Bolu								
Cumayeri								
Çayırova								
Çınarcık								
Çiftlikköy								
Çilimli								
Darıca								
Derince								
Dilovası								
Dörtdivan								
Düzce								
Erenler								
Ferizli								
Gebze								
Gerede								
Geyve								
Gölcük								
Gölyaka								
Göynük								
Gümüşova								
Hendek								
İzmit								
Kandıra								
Karamürsel								
Karapürçek								
Karasu								
Kartepe								
Kaynarca								
Kaynaşlı								
Kıbrıscık								
Kocaali								
Körfez								
Mengen								
Mudurnu								
Pamukova								
Sapanca								
Seben								
Serdivan								
Söğütlü								
Taraklı								
Termal								
Yalova								
Yeniçağa								
Yığılca								

Regional thresholds were analyzed as one of the subjects among the spatial data effecting investments. Although the thresholds were not used in the optimal investment site maps, it could be used as a mask for the interpolation maps as the example for machinery sector in figure 3.30.

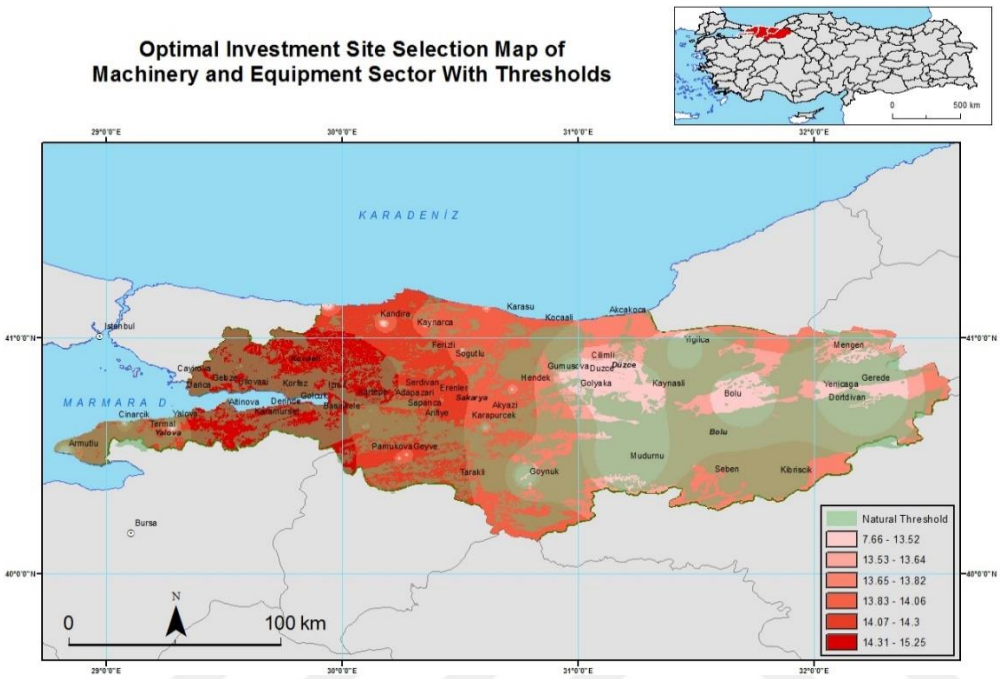

Figure 3.30 Overlaying Thresholds with Optimal Investment Site Selection Map (Machinery)

This would be a more precise map for site selection optimization as the unsuitable lands are subtracted from the possible sites.

The data used for the study are dynamic. For instance, the labor cost may change according to the demographical changes. Another example might be any change of the government incentive system. Thus, this analyses have to be dynamic. Furthermore, each new investment will change the situation itself. A new investment could decrease the labor costs as it increases the demand for employment. It also will change the sectoral agglomeration. One can clearly say that the analyses conducted above are open to changes. In other words, it has to be dynamic and take into account temporal dimension of entire data sets.

These issues, namely the requirement of inventory of suitable sites for investment, opening new sites to sectoral development, thresholds and dimension of time as well

as guiding investments for regional strategies brings forth the idea of developing **a 4D (3D+time) GIS based investment site information system**.

4. CONCLUSIONS AND RECOMMENDATIONS

To ensure sustainable development, an efficient land use planning and management is essential. Thus, two approaches – smart specialization and smart spatialization are integrated within this thesis. After offering a method for directing specific economic activities in specific locations and integrating this with offering an accurate choice method for land, the questions of "for what purpose should the land be used?" and "how a city and a region benefits the most in terms of sectoral site selection of a specific zone?" are answered with the produced maps and recommendations.

Smart specialization approach provides information for sectoral choices while investing and smart spatialization approach provides information for locational choices while investing. Along with the following recommendations, two "worth to try" suggestions are offered for both intersecting approaches.

4.1 Design of a Regional Smart Specialization Strategy in Turkey

International and national examples were examined during the preparation process of the study which brought a background of smart specialization strategy development recommendation. There are many methods and techniques used for sectoral prioritization including Herfindahl-Hirschmann indexing, location quotient, shift-share, three star, trend analyses and so on.

In the Turkish case, such analyses could be done over NUTS-2 regions. However, the data should be consistent in doing so. As examined, the data are produced in different resolution and classifications by related institutions. Having a national data production with a specific classification is important to make analyses. Furthermore, each data should be published at least in provincial scale to gather information at the largest scale possible. This is important for intraregional analyses and therefore reducing intraregional development differences. The Tenth Development Plan and its transition

programs define a strategy for developing statistical information infrastructure. These requirements should be considered while implementing the program.

Having collected the adequate data, next phase is conducting sectoral data analyses. Within this step, methods may vary from region to region. For instance, in a region to the East of Turkey, generating jobs for the unemployed could be the priority. In such regions, analyses for employment could be chosen with a greater importance than exports. On the other hand, in developed regions in the West added value could be chosen as more important data to analyze.

Taking NUTS-2 regions as the basis for regional economic analyses, the body to develop the strategies and conduct the analyses should be regional development agencies as they are vested with the authority to prepare regional plans.

In order to manage the process and make all the region adopt the chosen sectors; public, private sector and academia should take part in the process. An advisory board consisting of top representatives of governorates, chambers of industries and universities should play the role of management. And a technical committee should make the secretariat consisting of members from techno parks, technology transfer offices, organized industrial zones, provincial directorates of industry and chambers of industry, statistical institution and the development agency.

Apart from the prominent sectors, regions should focus also on non-prominent but promising sectors. These are activities with no significant importance in employment, investment, exports and so on, however they can gain importance in the future. Some examples could be nano-technology, robotics, software, creative industries, organic food, apiculture etc.

As mentioned, determining sectors to focus on is to develop them more together with production, employment, academic researches and finance. Sectoral financial support mechanisms should be adopted. The development agencies are opening calls for proposals for financial support for the important fields on their regions. Smart specialization should be an important input for financial supports and financial supports should be an important tool for ensuring smart specialization.

Another tool for specializing smartly, investment promotion should be focused more on smart specialization. As investors tend to invest at destinations with already developed infrastructure, investment promotion activities should focus on specific fields. Sectoral exhibitions and Business to Business (B2B) meetings should also focus on them. And brandization will follow smart specialization.

In the case of the EU, as mentioned in the chapter 2.3, the S3 Platform coordinates the smart specialization activities of the member regions in several terms, one being the EYE@RIS3. As the main aim is to track the regional priorities, mapping techniques are efficient methods. Thus, designing a national GIS based regional or provincial priority tracking interface would be helpful in comparing them and providing information to potential investors. Such an interface should include filtering for the preferred sectors and sectoral agglomerations. The potential web platform for such application should be the interactive map of the Prime Ministry Investment Support and Promotion Office (ISPAT) web page.

4.2 Design of a GIS Based Investment Site Information System to Boost Smart Spatialization

According to the World Bank Scoping Mission on Industrial Land Allocation Interim Report (January 2014) foreign direct investment (FDI) rose from just over US$1 billion in the early 2000s to an average of US$11.2 billion in the 2002–12 period in Turkey. There is room for further improvement, however, as Turkey's FDI inflows are still lower than comparable figures for much of Eastern Europe, Chile, Colombia, Brazil, Mexico, China and Malaysia, albeit marginally higher than Indonesia and the Philippines. According to surveys with investors, bureaucracy and a lack of predictability with regard to the regulatory framework still hold back FDI. (World Bank Scoping Mission Report, 2014)

The same study mentions that stakeholders consulted during this Mission signaled as "the most critical factor for investors" existing constraints for land allocation.

The World Bank and the International Federation of Surveyors (FIG) addresses "*fit for purpose*" approach for land administration in a more efficient and sustainable manner. As technologies such as aerial imaging, remote sensing and geographic information

system develop, land management has been given the opportunity for more automatization. Gathering efficient land information provides efficient land market and effective land use management solutions. These consist land tenure, land value, land use and land development aspects in order to secure the land and its owner (WB and FIG, 2014). In the case of Turkey, the Ministry of Environment and Urbanization carries operations for establishing and managing such systems. However, those systems should be used more for land management to provide "*fit for purpose*". The legislations for allocation and alienation of public immovable properties enables any kind of investor including non-manufacturing activities to use public lands. Having important contribution for investments, these legislations should be upholded responsibly. Thus, such national systems should be integrated with land use plans and only planned land should be allocated to the investors.

These brings the requirement of an investment ready site inventory and opening new investment sites and present them to the potential investors. In accordance with this study, a GIS based investment site information system was suggested and the details of such a system are structured below in table 4.1.

Table 4.1 Attribute Details for Suggested System

GROUP	ATTRIBUTE	TYPE	CHOICES	QUERYING METHOD	VISUALIZATION METHOD
CODE	**CODE (Unique)**	Text (14)	-	Search	List
LOCATION	**MAP SECTION**	Text (20)	-	Search	List
	BLOCK (ISLAND)	Integer	-	Multiple Choice	List
	PARCEL	Integer	-	Multiple Choice	List
	PROVINCE		• Kocaeli • Sakarya • Düzce • Bolu • Yalova	Multiple Choice	List
	DISTRICT	Text (20)		Multiple Choice	List
	LOCATION	Text (100)	-	Search	List
DEVELOPMENT CONDITIONS	**CATEGORY**		• Industrial • Commercial • Tourism • Logistics and Warehousing • Agriculture and Forestry • Education	Multiple Choice	List

			• Health • Other		
	ZONING STATUS	Text	• Industrial • Industrial (OIZ) • Industrial (Free Zone) • Non-Residential Working Zone • Commercial • Commercial + Residential • Tourism Facility • Recreation • Excursion Facilities • Recreation • Warehousing • Truck Parking & Garage • Logistics Center • Ports • Agricultural • Marginal Agricultural • Forage • Kindergarden • Educational • Higher Education • Health • Residential • Residential Future Development • Mass Housing • Administrative Usage • Other	Multiple Choice	List
	TOTAL AREA (sqm)	Integer	-	Filtering by chosing minimum and maximum values	List
	FAR – BCR / Building Area	Text	-	-	List
	Hmax / Existing Height	Text	-	-	List
	Facility / Vacant Land	Text	• Facility • Vacant Land	Multiple Choice	List
	Details	Text (254)	-	-	List
	Infrastructure	Text (254)	-	-	List
PRICE AND OWNERSHIP	**Owner / Representative**	Text (254)	-	-	List
	Commercial Status	Text (20)	• For Sale • For Rent • Tender • Allocation	Multiple Choice	List
	Price • **TL** • **USD** • **EURO**	Integer		Filtering by chosing minimum and maximum values	Accordeon menu between min and max values.
	Date of Update	Date	Via calendar	-	Date

	Attached Documents		-	-	Link
	External Link	Text	-	-	Link
	Photograph	.jpeg	-	-	Preview + Link
	File	.pdf	-	-	Preview and Download Links

One of the essential components for the construction of a spatial data infrastructure at a regional, national or global level is the geospatial catalogue service. The Land Administration Domain Model (LADM) specified in ISO 19152 standard provides a base for building ontologies in real estate cadaster domain (Govedarica, 2010). While considering this system, the metadata should be established along with the attributes above.

The system should be used by Investment Support Offices in each province for data entry and querying as well as presenting to the potential investors. ISPAT should also be an end user as their duty is to promote investment opportunities.

The privacy of such a system is important as the brokers or real estate agents could use for their own interests. Establishing such privacy should be done via Geospatial Digital Rights Management (GeoDRM). According to GeoDRM Reference Model of Open Geospatial Consortium (OGC) Inc. (OGC, 2006), bundling a certain set of functionalities into a function package allows defining interfaces between the packages to ensure interoperability and responsibilities for each package to return the expected result upon a given request. It includes rights model, rights expression language, encryption, trust, license verification, enforcement and authorization and authentication. In accordance with privacy issues, all data of OIZ's should be open to the public as they are the prior places to invest.

Along with GIS based investment site information, such system should also include demographical, sectoral and infrastructural data as they are the first data used for feasibility studies.

Having a regional analysis for smart specialization and smart spatialization, if made precisely, both regions and investors see benefits. The regions would use the space more optimal and the investments would choose sites with higher profitability. To manage this process, regional plans and urban plans could be tools. The Law of Development (act of 3194) organizes the planning and zoning processes in Turkey. In the 6th article of this law, the plans are prepared by the local municipalities except

several special planning zones. And those plans has to be in accordance with regional plans as stated in the 8th article. Regional plans, if necessary, are prepared by the Ministry of Development. In practice the regional plans are being prepared by the Regional Development Agencies established with the act of 5449 since 2006 and two generation of regional plans have been prepared ever since. At the moment, 26 different regional plans are effective at NUTS-2 level, 25 of which were prepared by the development agencies except the Yeşilırmak Basin Development Plan which had been prepared by the State Planning Organization (State Planning Organization, 2005). Some of the regional plans contains sectoral priorities. Thus, the conclusion of the first phase, the smart specialization, could be accepted as an example of this prioritization.

The European Union has established the Smart Specialization Strategies (S3) Platform to guide and unofficially approve the regional sectoral priorities. In the case of Turkey, the Ministry of Development could do the same and the development agencies could apply smart spatialization processes. Being in charge of regional planning, the agencies could guide the sub-scale development plans which the municipalities are in charge with to develop suitable lands of so called prominent sectors in development or zoning plans. This could enable the land availability and boost the sectoral development in accordance with regional priorities.

As the development agencies are established with the same act and with defined missions. Such GIS based inventory should be added as a clause to the 16th article which defines the duties of the Investment Support Offices, after any possible legislative regulation.

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