END OF LIFE VEHICLES MANAGEMENT IN TURKEY

(TÜRKİYE'DE ÖMRÜNÜ TAMAMLAMIŞ ARAÇLARIN YÖNETİMİ)

by

Mehmet NİZİPLİOĞLU, B.S.

Thesis

Submitted in Partial Fulfillment

of the Requirements

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MEHMET NİZİPLİOĞLU
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LIST OF SYMBOLS

AIDS:	Acquired Immune Deficiency Syndrome
ANP:	Analytical Network Process
ARN:	Auto Recycling Netherland
ASR:	Automotive Shredder Residue
CBU:	Completely Build Unit
CHP:	Combined Heat and Power
CKD:	Completely Knock Down
CZK:	Czech Koruny
DC:	Disposal Center
DO:	Dissolved Oxygen
ELV:	End of Life Vehicle
EoL:	End of Life
EPR:	Extended Producer Responsibility
EU:	European Union
GA:	Genetic Algorithm
GASA:	Genetic Algorithm – Simulated Annealing
GTZ:	Gesellschaft für Technische Zusammenarbeit
IARC:	Agency for Research into Cancer
IFRLN:	Integrated Forward Reverse Logistics Network Design
JIT:	Just-In-Time
LCA:	Life Cycle Analysis
LDPE:	Low-Density polyethylene
MCDM:	Multi-Criteria Decision-Making
MSW:	Municipal Solid Waste
OEM:	Original Equipment Manufacturer
PAH:	Polycyclic Aromatic Hydrocarbon
PC:	Process Center
PD:	Place of Delivery
PVC:	Polyvinyl Chloride
PP:	Polypropylene
PS:	Polystyrene
R & D:	Research and Development
SA:	Simulated Annealing
SDPC:	Simultaneous Delivery and Pick-Up Problem with Constraint Capacity
SMILP:	Stochastic Mixed Integer Linear Programming
TSA:	Temporary Storage Area
UK:	United Kingdom
VLAREA:	Vlaams Reglement voor Afvalvoorkoming en -beheer
WEEE:	Waste Electrical and Electronic Equipment
ZOGP:	Zero-One Goal Programming

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ABSTRACT

All products and services have certain life cycles. The life cycle refers to the period from the product's first launch into the market until its final withdrawal. After product's useful life, it will enter to end of life stage and it should be collected from customers to treat properly. ELVs (short for End of Life Vehicles) are cars and light trucks that are considered waste and that must be disposed of. If the disabled automobiles can't be recycled in time and effectively, much resource will be wasted and the environment will be polluted as well. Countries which are aware of these dangers made their laws to obligate producers to collect and treat ELVs properly. These laws depend on the extended producer responsibility principle. ELV Directive in Turkey [1] also obligates vehicle producers to collect ELVs from end customers where producer denotes retail or corporate merchant who is manufacturer of vehicle or professional importer of vehicle for commercial purposes. They have to receive vehicles that have negative market value without demanding any price from vehicle owners. Since building ELV delivery plants and transportation of ELVs to collection and processing centers without demanding any price are producers' responsibilities, these operations should be realized in a cost effective way. So we can see that reverse logistics is helpful to reduce resource waste and the pollution and destroy to ecological environment. In this study, a model has been developed to minimize recovery cost of ELVs by considering ELV Directive in Turkey. This model decides which facilities should be opened and assignment of a facility to the next stage facility in reverse logistics network. Also Turkey's current ELV reverse logistics network has been investigated and facility assignments that minimize the cost of parts and material flow between facilities have been specified. Reuse and recycling rates have been changed to state the effect of these parameters in cost of reverse logistic activities.

RÉSUMÉ

Tous les produits et services ont un cycle de vie. Le cycle de vie du produit commence avec le lancement du produit et se termine avec le retrait du marché. Dès que le temps de fonctionnement se termine, les produits doivent être collectés et évalués de manière appropriée. Les véhicules hors d'usage sont considérés comme des déchets qui doivent être disposés. Si ces véhicules ne sont pas recyclés au bon moment d'une façon effective, de nombreuses ressources seront gaspillées et l'environnement sera pollué. À l'aide des lois, les pays conscients de ce danger forcent les producteurs à ramasser et évaluer régulièrement les véhicules hors d'usage. Ces lois sont basées sur le principe de «Responsabilité élargie des producteurs». En Turquie, «le règlement sur le contrôle des véhicules hors d'usage » définit le producteur celui qui produit ou bien qui importe le véhicule et oblige ces producteurs à collecter les véhicules hors d'usage. Ces producteurs sont obligés de collecter les véhicules de leurs propriétaires sans exiger aucune compensation même si la valeur marchande du véhicule est négative. L'ouverture des points de livraison pour des véhicules hors d'usage, la collection et la transportation de ces véhicules aux centres d'opérations sont en responsabilité de producteur, alors il est nécessaire de ménager ces actions de manière rentable. A ce point-là, l'effet de logistique inverse qui diminue le gaspillage de ressource, la pollution de l'environnement et la destruction de l'environnement s'apparaisse. Dans cette étude, en prenant en considération le règlement pour des véhicules hors d'usage en Turquie, un modèle qui minimise le coût du recyclage des véhicules est présenté. Ce modèle aide à déterminer les facilités à ouvrir, en plus à décider à quelle facilité les pièces et les matériaux doivent être envoyés prochainement dans un réseau de logistique inverse. Dans cette étude on a examiné l'état actuel du réseau de logistique inverse des véhicules hors d'usage en Turquie, on a déterminé l'installation des facilités qui minimise les couts de flux de pièces et de matériaux et puis on a déterminé les couts de ces flux. En calculant les couts des flux, les taux de réutilisation et de recyclage ont changé afin de déterminer dans quelle mesure ces paramètres affectent sur les couts des activités de logistique inverse.

ÖZET

Tüm ürün ve servislerin belirli bir yaşam döngüsü vardır. Bu yaşam döngüsü ürünün piyasaya sürülmesiyle başlar ve piyasadan çekilmesiyle sona erer. Kullanım süresinden sonra ürünler müşterilerinden toplanarak uygun şekilde değerlendirilmelidir. Ömrünü tamamlamış araçlar, atık olarak düşünülen ve bertaraf edilmesi gereken araçlardır. Eğer bu araçlar zamanında ve etkili bir şekilde geri dönüştürülemezse birçok kaynak boşa harcanacak ve çevre kirletilmiş olacaktır. Bu tehlikenin farkında olan ülkeler yaptığı kanunlarla üreticileri ömrünü tamamlamış araçları toplamaya ve düzenli bir biçimde değerlendirmeye zorlamaktadırlar. Bu yasalar 'Genişletilmiş Üretici Sorumluluğu' prensibine dayanmaktadır. Türkiye'deki Ömrünü Tamamlamış Araçların Kontrolü Hakkındaki Yönetmelik [1] üreticiyi aracı üreten veya ticari amaçla ithal eden gerçek ve tüzel kişi olarak tanımlar ve üreticiyi ömrünü tamamlamış araçları son müşterilerinden toplamaya zorunlu kılar. Üreticiler negatif piyasa değerine sahip araçları da araç sahiplerinden herhangi bir bedel talep etmeksizin toplamak zorundadırlar. Herhangi bir bedel talep etmeden ömrünü tamamlamış araç teslim yerleri açmak ve ömrünü tamamlamış araçları toplama ve işleme merkezlerine taşımak üretici sorumluluğunda olduğundan bu işlemler uygun maliyetli bir biçimde yapılmalıdır. Buradan tersine lojistiğin kaynak israfı, çevre kirliği ve çevre tahribatını azaltmada yardımcı olduğu görülebilir. Bu çalışmada Türkiye'deki ömrünü tamamlamış araç yönetmeliği göz önüne alınarak ömrünü tamamlamış araçların geri kazanım maliyetini en küçükleyen bir model oluşturulmuştur. Bu model, hangi tesislerin açılması gerektiğine ve bir tesisteki parça ve maddelerin, tersine lojistik ağında bir sonraki adımdaki tesislerden hangisine gönderilmesi gerektiğine karar vermektedir. Çalışmada ayrıca Türkiye'nin mevcut ömrünü tamamlamış tersine lojistik ağı incelenmiş, tesisler arası parça ve madde akışının maliyetini en aza indiren tesis atamaları ve bunların maliyetleri belirlenmiştir. Bu maliyetler belirlenirken yeniden kullanım ve geri dönüşüm oranları değiştirilerek bu parametrelerin tersine lojistik faaliyetinin maliyetini ne ölçüde değiştirdiği de belirlenmiştir.

1 INTRODUCTION

All products and services have certain life cycles. The life cycle refers to the period from the product's first launch into the market until its final withdrawal and it is split up in phases [2]. Products are manufactured using raw materials. Raw materials can be obtained from nature or they can be recycled materials. After production phase, products are delivered to end customers via distributors or directly. After product's useful life, it will enter to end of life stage and it should be collected from customers to treat properly. Figure 1.1 shows a general lifecycle of products [3].

When a product reaches its EoL, there are a number of recovery options available such as reusing the product or its components, remanufacturing, material recycling, incineration and landfill [4].

Reuse means the usage of the recovered product directly or with minimum intervention. Reused product can be used with the same purpose of the original product or it can be used in manufacturing of another product. Overheads to be considered for reuse are logistics, inspection and testing, packaging and others like labels and instruction booklets [5, 6].

Remanufacture is defined as the product that is recovered and either restored to its original condition (both function and cosmetics) or its function is modified. This includes the reuse of components and materials. Logistics, disassembly and sorting, cleaning and testing, packaging and disposal of remaining scrap items are overheads to be considered for remanufacturing [6].

Recycling is defined as the disassembly of the product to recover the materials and perhaps components but normally losing its function as a system. Logistics, disassembly and sorting, recycling, packaging and disposal of scrap items are overheads of recycling [6].

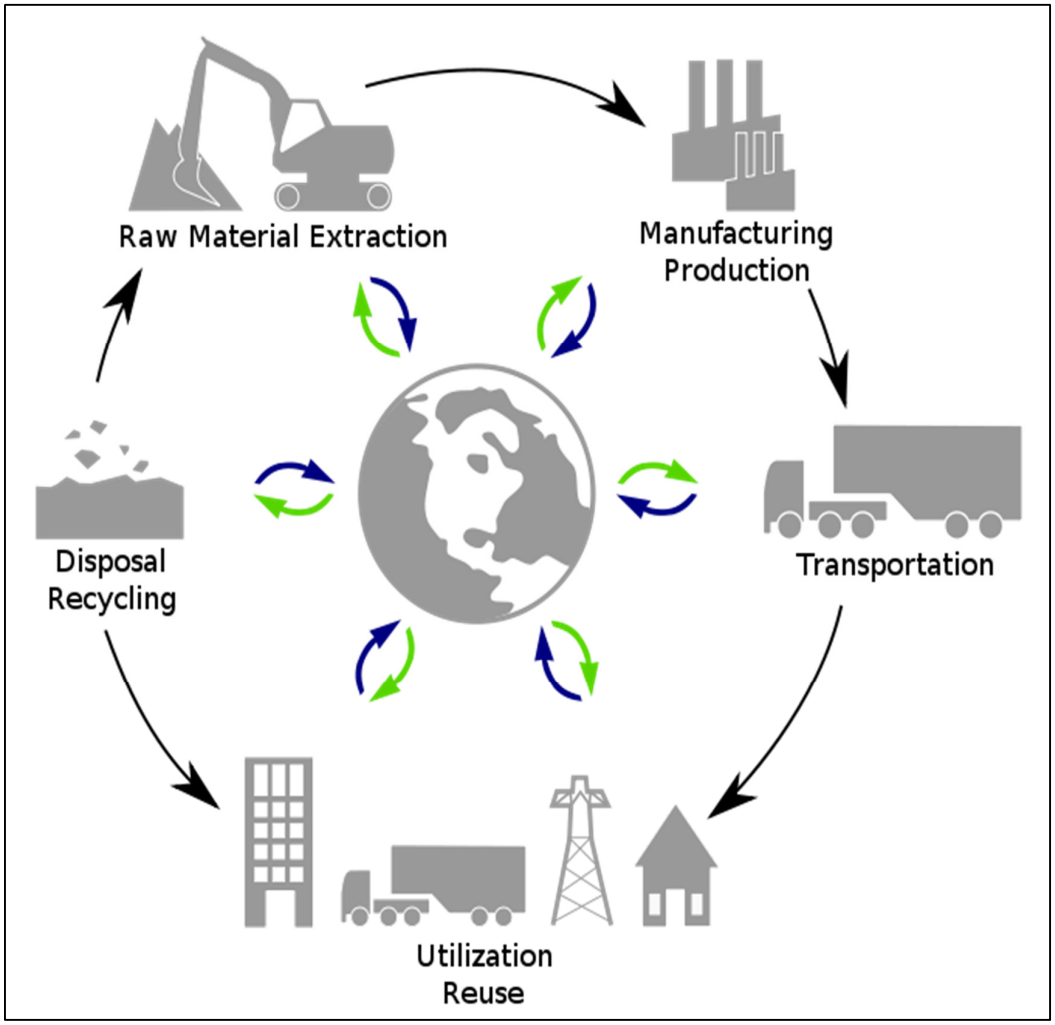

Figure 1.1 A generic lifecycle of products

Products and components those cannot be reused, remanufactured and recycled are scrapped via landfilling or incineration. Logistics, disassembly and sorting, disposal landfill cost and toxicity surcharge are overheads of landfilling and incineration [6].

Selecting a suitable strategy is mainly based on the quality of the parts and components and also the economic considerations [4].

End of Life Vehicles are cars and light trucks that are considered waste and that must be disposed of [7]. Vehicles are great sources of waste when they reach their EoL stage. If the disabled automobiles can't be recycled in time and effectively, much resource will

be waste and the environment will be polluted as well [8]. Table 1.1 shows the material composition and composition estimation of a typical ELV over time [9].

Table 1.1 Material Composition of Typical ELV Over Time (kg per tonnes of ELV) [9]

Material	2002	2006	2015
Ferrous Metal	680	680	650
Non-Ferrous Metal	80	80	90
Plastics and Process Polymers	100	100	120
Tyres	30	30	30
Glass	30	30	30
Batteries	13	13	13
Fluids	17	17	17
Textiles	10	10	10
Rubber	20	20	20
Other	20	20	20
Total	1,000	1,000	1,000

Landfilling of waste from shredders, poor environmental practices at some auto dismantlers and vehicles abandoned in the environment cause environmental pollution and material loss. Oil, coolant, fuels, brakes and other fluids; heavy metals including lead (Ld), mercury (Hg), cadmium (Cd), chromium VI (Cr(VI)) are materials in ELVs that have potential environmental consequences. Insufficient rates of ELV reuse, material recycling and recovery are the second category of potential environment impacts relate to waste and resource loss. Figure 1.2 shows the ideal treatment flow of ELVs [10].

The importance of management of the ELVs in the developing countries where the number of vehicles on the roads is increasing at an alarming rate is becoming more apparent. There are many reasons for this increase, namely: transfer of car manufacturing know-how and machineries from the developed countries, inefficient public transport system, a potential source of job creation for their increasing

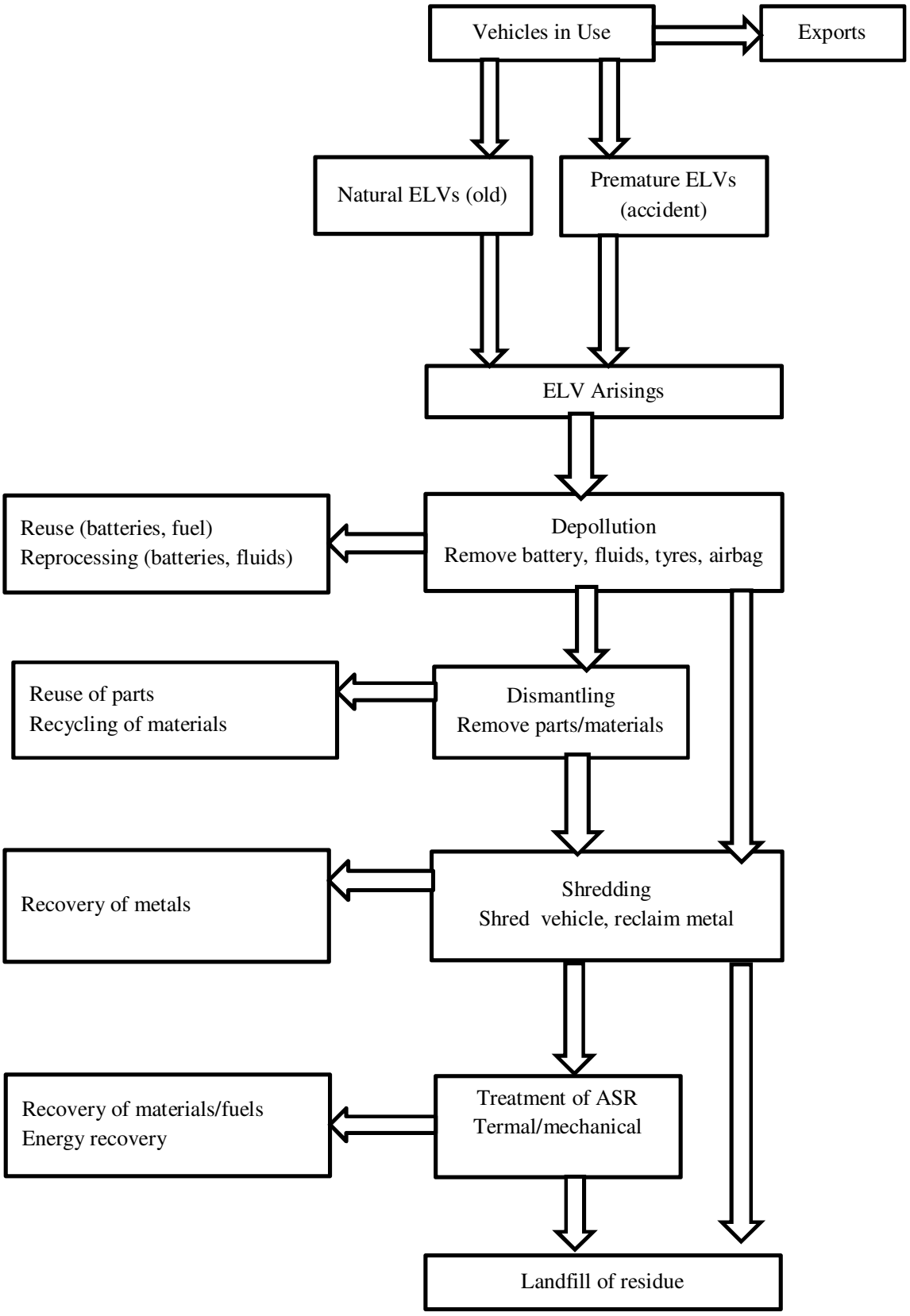

Figure 1.2 Description of ELV Arisings and Treatment

population, source of export revenues and a sign of affluence in the wealthier countries [4].

Countries which are aware of these dangers made their laws to obligate producers to collect and treat ELVs properly. These laws depend on the extended producer responsibility principle. These laws also specify minimum reuse, recovery and recycling rates for ELVs. Since implementation of these laws is not an easy task, countries those started building tack back systems earlier have more success in fulfilling the legal obligations. Netherlands that has a voluntary tack back system since 1990s and Sweden that obligates producers to collect and treat ELVs by a law that came into force in 1998 are two examples of successful countries in handling ELVs [11]. On the other hand, in Iran, there are legislations in place, but mainly voluntary, with some cash incentives in order to encourage the owners of old vehicles to remove their vehicles from the roads. But this has had little success and more importantly there are currently no incentives of obligations for the manufacturers [4].

ELV Directive in Turkey [1] also obligates vehicle producers to collect ELVs from end customers where producer denotes retail or corporate merchant who is manufacturer of vehicle or professional importer of vehicle for commercial purposes. They are also responsible for building ELV delivery plants in provinces which don't have ELV delivery plants or that have insufficient plants. They have to receive vehicles that have negative market value without demanding any price from vehicle owners.

Since building ELV delivery plants and transportation of ELVs to collection and processing centers without demanding any price are producers' responsibilities, these operations should be realized in a cost effective way. So we can see that reverse logistics is helpful to reduce resource waste and the pollution and destroy to ecological environment. Meanwhile it can reduce the cost of disposing of rejected material and improve the efficiency of the enterprise and the whole supply chain and realize social and economic benefit [8].

Reverse logistics encompasses the logistical activities all the way from used products that are no longer required by the user, to the products that could be sold on the market

[12]. Decisions on the number of facilities, their locations and capacities and the quantity of flow between them affect both costs and customer service levels [13]. Since opening and closing a facility is both an expensive and time-consuming process, chancing network design is impossible in the short run.

First in the following section, automotive industry in the world, evolution of automobile industry and automotive industry in Turkey are introduced. Then the third section deals with waste management, ELV management, environmental impacts of ELVs and ELV Directive in Turkey. In the fourth section, a detailed literature review of reverse logistics activities, network design for returned products and ELV management is presented. In the fifth section, a model is presented to manage ELVs in Turkey due to the directive in Turkey. The proposed model decides which facilities should be opened and which facilities should be assigned to other one. Also current situation about ELV management is investigated.

2 AUTOMOTIVE INDUSTRY

2.1 Automotive Industry

Automotive industry is the business of producing and selling self-powered vehicles, including passenger cars, trucks, farm equipment, and the other commercial vehicles [14].

The automotive sector is one of the world's largest invested sectors. In sector, a capital expenditure of 85 billion € becomes true and a 433 billion € tax revenue is gained in countries those have invested. Automotive sector has a turnover of about 2 trillion €. This means that, if the automotive sector was a country, it would be the sixth largest economy of the world. Automotive industry directly employs more than 8 million employees. This number is greater than 5% of world production sector [15].

There are about 50 motor vehicle producers in the world that operates in 20 different countries. Production is generally classified as automobile and commercial vehicle. Automobile and light truck production corresponds to 90 % of overall production in industry [15].

Figure 2.1 shows total motor vehicle production numbers in world between 2005-2010. Total production number increases year by year except 2008 and 2009 because of the economic crisis. 70.5 million vehicles production in 2008 was 61.7 million in 2009 by decreasing 12% percent. In 2010, effects of economic crisis have decreased and number of vehicles produced was 77 million [15].

Table 2.1 shows production numbers by countries between 2005-2009. Turkey, which ranks 15th in the world production in 2008, ranked 17th in 2009 because of global crisis. Production of 18.4 million vehicles in the EU in 2008 decreased by 17 % in 2009 and declined to 15.2 million units [15].

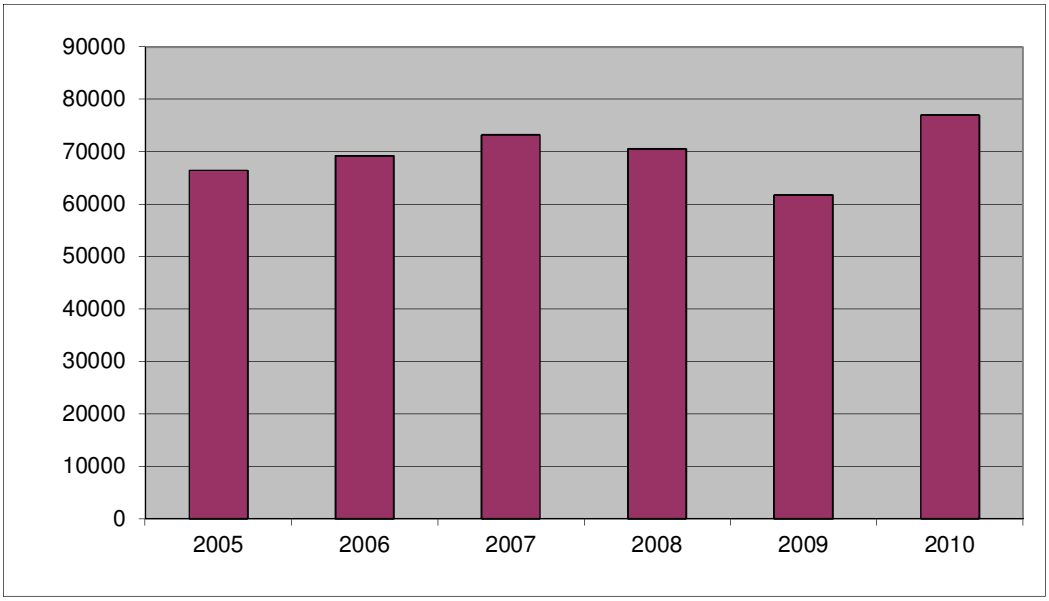

Figure 2.1 Total motor vehicle production numbers in world (millions)

Table 2.1 Production numbers by countries [15]

	2005		2006		2007		2008		2009	
1	US	11,946,653	Japan	11,484,233	Japan	11,596,327	Japan	11,575,644	China	13,790,994
2	Japan	10,799,659	US	11,263,986	US	10,780,729	China	9,299,180	Japan	7,934,516
3	Germany	5,757,710	China	7,188,708	China	8,882,456	US	8,693,541	US	5,708,852
4	China	5,708,421	Germany	5,819,614	Germany	6,213,460	Germany	6,045,730	Germany	5,209,857
5	South Korea	3,699,350	South Korea	3,840,102	South Korea	4,086,308	South Korea	3,826,682	South Korea	3,512,926
6	France	3,549,008	France	3,169,219	France	3,015,854	Brazil	3,215,976	Brazil	3,182,617
7	Spain	2,752,500	Spain	2,777,435	Brazil	2,977,150	France	2,568,978	India	2,632,694
8	Canada	2,687,892	Brazil	2,611,034	Spain	2,889,703	Spain	2,541,644	Spain	2,170,078
9	Brazil	2,530,840	Canada	2,572,292	Canada	2,578,790	India	2,332,328	France	2,047,658
10	UK	1,803,109	Mexico	2,045,518	India	2,253,729	Mexico	2,167,944	Mexico	1,561,052
11	Mexico	1,684,238	India	2,019,808	Mexico	2,095,245	Canada	2,082,241	Canada	1,490,632
12	India	1,638,674	UK	1,648,388	UK	1,750,253	Russia	1,790,301	Iran	1,395,421
13	Russia	1,354,504	Russia	1,508,358	Russia	1,660,120	UK	1,649,515	UK	1,090,139
14	Thailand	1,122,712	Italy	1,211,594	Thailand	1,287,346	Thailand	1,393,742	Thailand	999,378
15	Italy	1,038,352	Thailand	1,194,426	Italy	1,284,312	**Turkey**	**1,147,110**	Czech Republic	974,569
16	Belgium	926,528	**Turkey**	**987,780**	**Turkey**	**1,099,413**	Iran	1,051,430	Poland	884,133
17	**Turkey**	**879,452**	Belgium	918,056	Iran	997,240	Italy	1,023,774	**Turkey**	**869,605**
18	Iran	817,200	Iran	904,500	Czech Republic	938,648	Czech Republic	946,567	Italy	843,239

Automotive sector directly employs more than 8 million employees in the world. This amount is greater than 5 % of world production sector employment. It is estimated that there are more 50 million employees in automotive sector with indirect employment.

EU automotive sector directly employs 2.2 million employees. This number is 9.8 million with indirect employments [15].

2.2 Evolution of Automotive Industry

The first automobile was built in France by Nicolas-Joseph Cugnot in 1769. In 1789, the first automobile patent was granted to Oliver Evans in the United States and in 1805, Evans produced his self-propelled automobile which wasn't anything like how our vehicles work today. In 1860, Frenchman Jean Joseph Ètienne developed the first practical internal-combustion engine. In 1870, an inventor by the name of Seigfried Marcus put an internal liquid fuel engine in a horse carriage. So he was the first man to propel a vehicle by means of gasoline [14, 15].

Karl Benz built his first automobile in 1885, was granted a patent in 1886, and began producing automobiles in 1888. In 1889 Gottlieb Daimler and Wilhelm Maybach also designed a vehicle. These vehicles were gas-powered vehicles and they dominated the industry because they were lighter and less expensive to build. French companies set the design of the modern auto by placing the engine over the front axle in the 1890s and US manufacturers made important advances in the mass production of the auto by introducing cars with interchangeable machine-produced parts. By 1900s, mass production on vehicles under way in France and the US. The first company formed to exclusively build cars was Panhard et Levassor in France and Duryea Motor Wagon Company founded after that was the first company in the US to produce vehicles [14, 15].

In 1902 Oldsmobile dominated this era of automobile production with a production line up and running. By 1903, Cadillac, Winston and Ford were all producing cars in the thousands [16]. In 1908, Ford Model T was introduced and by 1914 and Henry Ford and his employees created the world's first assembly line. Model T combined innovative engineering with revolutionary manufacturing methods to become the first mass-produced car. Ford also provided loans consumers to buy cars and this made the Model T affordable to the middle class [14, 17].

In 1910 the Mercer Raceabout debuted as the world's first sports car. Slightly over a decade later the Austin debuted and was the most widely copied vehicle ever and served as a template for cars around the world. In 1920s, General Motors started to introduce new models each year and marketed different lines of cars to different income brackets. In 1934 the Citroen Traction Avant was the first mass produced vehicle with front wheel drive. Oldsmobile introduced the first automatic transmission in 1940 [14, 16].

US auto sales grew from 4,100 in 1900 to 895,000 in 1915, to 3.7 million in 1925. Sales dropped to only 1.1 million in 1932 and during World War II, the auto factories were converted to wartime production. After 1945, sales once again took off, reaching 6.7 million in 1950 and 9.3 million in 1965 [14].

Automotive industry generally developed in dominance and leadership of US. After the World War II, Japan came as a competitor to US firms those share dominance with European firms [18].

Automotive industry that entered restructuring process in 1980s started investment and production activities in developing countries due to the fact that markets in Japan, North America and Europe had been saturated. Also, advances of Japan vehicles manufacturers in R & D, design and production technologies caused other producers to revise their current production systems [18].

2.3 Automotive Industry in Turkey

Automotive industry is economically important sector in Turkey due to its added value, export potential and employment amount. Also it interacts with main industries such steel-iron, petro chemical, textile, glass and electric-electronic industries [15].

All kind of vehicles needed by tourism, infrastructure, construction, transportation and agriculture sectors are provided by automotive industry. Sector also interacts with raw material and supplier industry and marketing, vendor, service, fuel, finance and insurance sectors that help arrival of products to consumers. It also helps to the improvement of defense industry [15].

Besides, sector plays an important role in transferring technology to Turkey and employees using these technologies form man power potential for strategically important sectors of Turkey [15].

Automotive industry realized great improvements in Turkey from 1960s, the date when it was built. These improvements can mainly be grouped in main five categories [19]:

1. Assembly production of tractors and commercial vehicles as import substitution as in 1960s.
2. Automobile production and localization of spare part production in 1970s.
3. Capacity and technology investments in 1980s.
4. Restructuring for global competition and integration with global industry in 1990s.
5. Introduction to "Sustainable Global Competition Process" for design and production for global market by creating value added [15].

Turkish automotive industry started to operate in 1963 by producing 11,000 motor vehicles. Vehicle production increased continuously till 1976 and 146,000 vehicles were produced in 1976. During the next decade car production decreased continuously and production was 141,000 again in 1986. Car production number reached to 453,000 in 1993 by a continuous increase starting from 1986. This number was the maximum for the term before 2000 [15].

After the crisis and collapse term between 1994-1999, Turkish automotive industry reached production amount at 1993 in 2000. After the economic crisis in 2001 and 2002, a six years term with big production scale and a stable production increase made 2008 production 1.15 million. This increase is parallel to the increase in vehicle export to global markets achieved with new models developed. In 2009, economic crisis caused a decrease in vehicle production but in 2010, an increase of %26 has been realized and vehicle production number reached to number in 2007. In 2009 number of vehicles produced is 870,000 and 1.1 million in 2010 [19]. Figure 2.2 shows vehicle production numbers in Turkey between 2000 and 2010 [15].

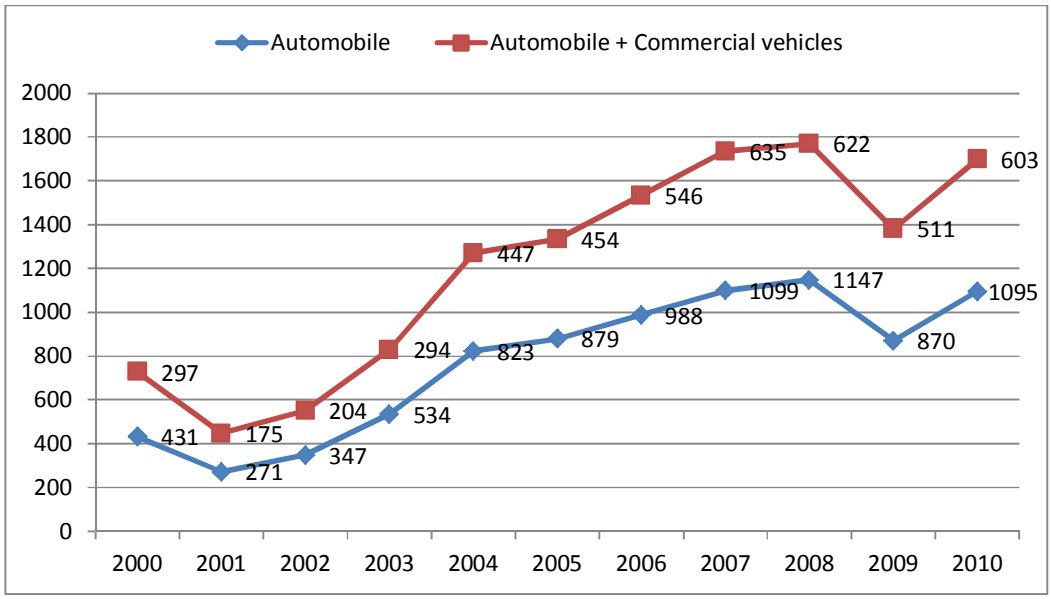

Figure 2.2 Vehicle production numbers in Turkey

Turkey automotive sector has an annual production capacity of about 1.5 million. Intensive investments have been made in the main and supplier industry especially due to consistent increase of demand at 25% level. Technology renewing for competition and R & D investments as well as capacity increase has great speed during this period. In the last decade, annual production capacity has increased about 70 %. At this point, importance of capacity usage rate is increasing more. Low capacity usage rate is one the basic reasons of cost increase [15]. Figure 2.3 shows capacity usage rate in Turkish Automotive Industry for years 2001, 2005, 2006, 2007, 2008, 2009, 2010.

Automotive industry is an industry that provides directly or indirectly employment opportunities in the supply chain. Presence of qualified manpower is considered to be fundamental for sustainable international competition in an advanced automotive sector. In Turkey, main automotive industry approximately employs 50,000 persons and supplier industry 200,000 persons. This number reaches to 400,000 with persons employed in distribution, marketing and sales networks [15].

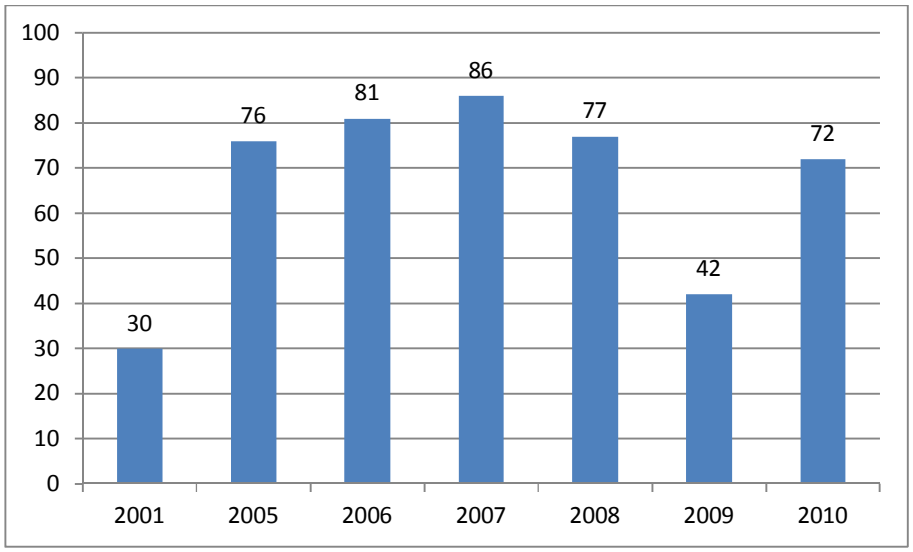

Figure 2.3 Capacity usage rates in Turkey

In Turkey, average of motor vehicles is 138 for per 1,000 persons and this number is 144 in the world. Turkey is an unsaturated market for automotive industry with its number of vehicles per capita that is under the world average [15].

Motor vehicle parts produced by automotive supplier industry in Turkey allow 85-90 % of a vehicle to be produced domestically. Main product groups produced by automotive supplier industry are [15]:

- Engine and engine parts
- Transmission component
- Brake system and its parts
- Hydraulic and pneumatic components
- Safety components
- Rubber and tire parts
- Chassis parts and components
- Forging and casting parts
- Electric equipment and lighting systems
- Accumulator
- Automotive glass
- Seats

In automotive industry, many products take place in foreign trade in terms of both import and export. Import and export balance is very important in this sector. Imported and exported goods financially highly burden. Balancing this load is very important for country's economy. The automotive sector is affected by market changes very quickly. For this reason, year to year fluctuations in this industry are met quite normal [15]. Table 2.2 [20] shows automotive sector exports for years 2009, 2010 and 2011.

Table 2.2 CBU and CKD Exports - $ [20]

Sector	2009 (Total)	2010 (Total)	2011 (Total)
Total Vehicle Industry	**9,612,631,033**	**10,524,185,321**	**11,726,938,161**
Passenger Cars	6,092,424,656	6,200,089,720	6,534,083,060
Bus	771,886,548	611,349,266	749,503,794
Others	2,748,319,829	3,712,746,334	4,443,351,307
Total Component Industry	**4,919,345,973**	**5,381,571,154**	**6,782,905,606**
Spare Parts and Components	3,939,201,533	4,294,684,843	5,459,197,113
Tyres	826,346,700	958,038,048	1,217,982,750
Batteries	83,818,491	78,585,048	79,076,921
Safety Glasses	69,979,249	50,263,215	26,648,821
Total	**14,531,977,006**	**15,905,756,475**	**18,509,843,767**

Source: UİB, OAİB

The automotive sector is among the leading sectors in the manufacturing industry in Turkey when its share of production and economic rate of contribution are evaluated. The domestic values that the sector created have a very important place in the economy. Sector's share of the total production of manufacturing industry is 9.2% and this share is 4.5% above of production industry sectors' average [15].

Sector's domestic contribution rate in total production is 80.4% higher than the average in the manufacturing industry. Economic contribution value, sum of the domestic input utilization and value-added rate is 81.4 %. Imported input utilization rate is lower than many sectors in the industry [15].

There are 15 companies and 17 factories in automotive industry in Turkey. Automobiles, light commercial vehicles, heavy commercial vehicles and tractor are vehicle types produced. 85 % of production and supply is in Marmara. Figure 2.4 shows producers in automotive sector in Turkey [21].

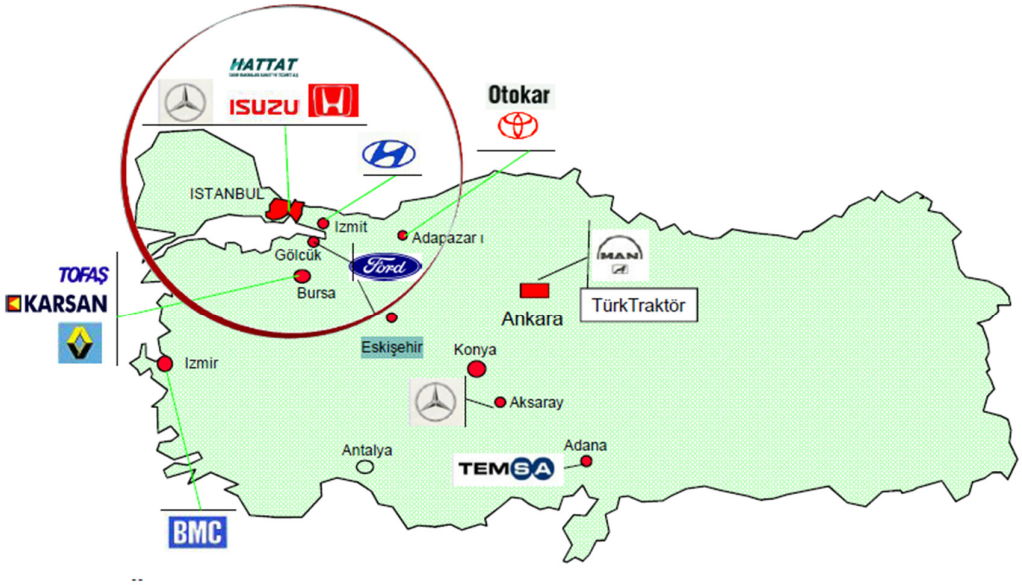

Figure 2.4 Vehicle producers in Turkey

3 END OF LIFE VEHICLES

As all other product, vehicles have a useful life. After this useful life, end of life vehicles (ELV) will begin to accumulate at garbage dumps as wastes if they are not managed well. This garbage accumulation brings significant danger to the environment and the human health. Because of this, forming of wastes caused by ELVs should be discouraged.

Landfill, reuse and recycling are treatment ways for ELVs. Disposal as landfill is not a nature friendly solution. Also disposal cost and cost of landfilled material made landfill, the final solution. Due to this fact, ELV directives obligate high reuse and recycling ratios for ELVs. Reuse or recycling of unused equipment prevents augmenting garbage caused by ELVs. Especially increase in amount of reused products will not only decrease garbage amount but also discourage use of raw materials. This process causes an extra cost to build new facilities such as waste collection centers and disposal centers. Operations in these facilities such as decomposition, reprocessing and repairing will create new cost sources. But when a sufficient reuse ratio has been reached, cost reduction gained from reusing will be probably higher than total reuse and recycling cost.

3.1 Waste Management

Waste management is the collection, transport, processing or disposal, managing and monitoring of waste materials. The process is generally undertaken to reduce wastes' effect on health, the environment or aesthetics. Every task, from preparing a meal to manufacturing a car, is accompanied with the production of waste material, which cannot be used for other things and needs to be disposed of effectively. Developing effective waste management strategies is critical for nations all over the world, as many forms of waste can develop into a major problem when they are not handled properly. The management of wastes treats all materials as a single class,

whether solid, liquid, gaseous or radioactive substances, and tried to reduce the harmful environmental impacts of each through different methods [22, 23].

Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers. Management for non-hazardous waste, residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator [22].

In Turkey, waste management has been the subject of legal regulations since 1930s and municipalities are entrusted as the main implementing agencies. Policy determination in national level and directing implementation tasks initial carried out by the Ministry of Health are now by the Ministry of Environment and Forestry [24].

Waste prevention at source, decomposition of waste at source, gaining back the recyclable wastes to the economy and so reducing the amount of waste to be warehoused and warehousing the wastes that cannot be recycled in a way that won't harm environment and human health are basic elements of a health waste management system. Turkey needs to work much to meet these requirements. More than half of the waste generated in Turkey is recyclable or at least can be converted to a value. By increasing recycling, cost of waste management will decrease and municipalities, which spend 40% of their income due to the data provided by the Ministry, will be able to gain profit from recycling of waste [24].

There are several factors of not having an efficient and sustainable waste management system:

- Not giving priority to waste management as a national policy.
- Not providing a qualified institutional infrastructure to waste management in national and local level.
- Not giving enough resource for waste management services.
- Pressure caused by the need of finding solution to the problems of past and meeting today's requirements.

- Being insufficient of taxes and fees collected for the services given in this field.
- Lack of adequate coordination and cooperation between the large number of state agencies and organizations which are given authorization and responsibility.
- Existing technical capacity is insufficient, infrastructure facilities are insufficient in terms of number and the vast majority of them have very primitive conditions.
- Insufficient implementation of legal regulations that fits to international standards and EU norms.
- Insufficient auditing and monitoring activities.
- Not enforcement of sanctions to the contrary behavior [24].

More detailed information about waste management in Turkey can be found in Appendix A.

3.1.1 Methods of Disposal

Landfill

Disposing of waste in a landfill involves burying the waste, and this remains a common practice in most countries. Landfills were often established in abandoned or unused quarries, mining voids or borrow pits. A properly designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials. Older, poorly designed or poorly managed landfills can create a number of adverse environmental impacts such as wind-blown litter, attraction of vermin, and generation of liquid leachate. Another common byproduct of landfills is gas (mostly composed of methane and carbon dioxide), which is produced as organic waste breaks down anaerobically. This gas can create odour problems, kill surface vegetation, and is a greenhouse gas [22].

Incineration

Incineration is a disposal method in which solid organic wastes are subjected to combustion so as to convert them into residue and gaseous products. This method is useful for disposal of residue of both solid waste management and solid residue from

waste water management. This process reduces the volumes of solid waste to 20 to 30 percent of the original volume. Incineration and other high temperature waste treatment systems are sometimes described as "thermal treatment". Incinerators convert waste materials into heat, gas, steam and ash [22].

Incineration is carried out both on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste). Incineration is a controversial method of waste disposal, due to issues such as emission of gaseous pollutants [22].

Recycling

Recycling is a resource recovery practice that refers to the collection and reuse of waste materials such as empty beverage containers. The materials from which the items are made can be reprocessed into new products. Material for recycling may be collected separately from general waste using dedicated bins and collection vehicles, or sorted directly from mixed waste streams. Known as kerb-side recycling, it requires the owner of the waste to separate it into various different bins (typically wheelie bins) prior to its collection [22].

The most common consumer products recycled include aluminum such as beverage cans, copper such as wire, steel food and aerosol cans, old steel furnishings or equipment, polyethylene and PET bottles, glass bottles and jars, paperboard cartons, newspapers, magazines and light paper, and corrugated fiberboard boxes [22].

PVC, LDPE, PP, and PS are also recyclable. These items are usually composed of a single type of material, making them relatively easy to recycle into new products. The recycling of complex products (such as computers and electronic equipment) is more difficult, due to the additional dismantling and separation required [22].

Biological Reprocessing

Waste materials that are organic in nature, such as plant material, food scraps, and paper products, can be recycled using biological composting and digestion processes to decompose the organic matter. The resulting organic material is then recycled as mulch or compost for agricultural or landscaping purposes. In addition, waste gas from the process (such as methane) can be captured and used for generating electricity and heat (CHP/cogeneration) maximizing efficiencies. The intention of biological processing in waste management is to control and accelerate the natural process of decomposition of organic matter.

Energy Recovery

The energy content of waste products can be harnessed directly by using them as a direct combustion fuel, or indirectly by processing them into another type of fuel. Thermal treatment ranges from using waste as a fuel source for cooking or heating and the use of the gas fuel, to fuel for boilers to generate steam and electricity in a turbine. Pyrolysis and gasification are two related forms of thermal treatment where waste materials are heated to high temperatures with limited oxygen availability. The process usually occurs in a sealed vessel under high pressure. Pyrolysis of solid waste converts the material into solid, liquid and gas products. The liquid and gas can be burnt to produce energy or refined into other chemical products (chemical refinery). The solid residue (char) can be further refined into products such as activated carbon. Gasification and advanced Plasma arc gasification are used to convert organic materials directly into a synthetic gas (syngas) composed of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam. An alternative to pyrolysis is high temperature and pressure supercritical water decomposition (hydrothermal monophasic oxidation) [22].

Resource Recovery

Resource recovery (as opposed to waste management) uses LCA (life cycle analysis) attempts to offer alternatives to waste management. For mixed MSW (Municipal Solid Waste) a number of broad studies have indicated that administration, source separation

and collection followed by reuse and recycling of the non-organic fraction and energy and compost/fertilizer production of the organic waste fraction via anaerobic digestion to be the favored path [22].

Avoidance and Reduction Methods

An important method of waste management is the prevention of waste material being created, also known as waste reduction. Methods of avoidance include reuse of second-hand products, repairing broken items instead of buying new, designing products to be refillable or reusable (such as cotton instead of plastic shopping bags), encouraging consumers to avoid using disposable products (such as disposable cutlery), removing any food/liquid remains from cans, packaging, ..[25] and designing products that use less material to achieve the same purpose (for example, light weighting of beverage cans) [26].

3.2 ELV Management

There are four main activities in processing ELVs. These activities are [27]:

- Dismantling
- Shredding
- Post-shredder material separation and processing
- Landfill disposal of ASR

From the above, key facilities engaged in ELV management activities include [27]:

- Dismantlers, consisting of two distinct types:
    - High-value parts dismantlers
    - Salvage/scrap yards
- Shredding facilities
- Non-ferrous separation facilities
- Steel mills
- Landfills

3.2.1 Dismantling

Once the decision is made to permanently (and properly) retire a vehicle (without just abandoning it), the vehicle owner, or more frequently, a towing service delivers the new ELV to a "dismantler." There are two distinct types of dismantlers:

- High-value parts dismantlers: Retail/wholesale businesses that remove and inventory useful, high-value parts (e.g., starters, alternators) for resale. After processing, the ELVs may be either sent directly to a shredder, or first sold to a salvage/scrap yard.
- Salvage/scrap yards: Typified by traditional "U-Pull-It"- and/or "mom and pop"-type businesses, these are low-tech operations that essentially store ELVs while parts are gradually removed and sold (ELVs can remain an average of 2 to 5 years in scrap yards [Ecology Center et al., 2001]). They do not maintain detailed parts inventories and sell parts mainly to local repair shops and "do-it-yourselfers." These operations tend to collect older, less desirable vehicles (i.e., those not valued by high-value parts dismantlers) and operate on a relatively low volume, slow turnover basis [27].

In terms of removal practices, dismantlers remove specific parts and materials from ELVs primarily because of economic reasons (i.e., value and demand for individual parts and materials), but also, in certain cases (vehicle fluids, air conditioning refrigerant gases, batteries), at least in part due to environmentally based legal requirements. Other factors also impact removal practices – safety considerations dictate removal of residual gasoline and the actual fuel tank, while shredders refuse to accept tires, dictating their removal by dismantlers. Finally, available space in salvage/scrap yards can be a factor potentially limiting which parts are removed and sold [27].

Theoretically, the entire contents of an ELV could be removed for reuse in one form or another in another vehicle. Realistically, however, logistical and economic reasons limit removal operations. Listed below are typical parts/materials removed and their typical ultimate disposition [27].

- Electro-mechanical parts (clutches, water pumps, engines, starters, alternators, transmissions, and motors for power windows): Typically remanufactured and sold for reuse.
- Structural body parts (body panels, wheels etc.): Removal for use in repairing accident damaged vehicles.
- Aluminum and copper parts: Removal for sale directly to nonferrous processors. Alternatively, dismantlers can make ingots from the parts and sell them to the nonferrous scrap market.
- Gasoline: Recovered for use.
- Vehicle fluids (engine oil, transmission fluid, ethylene glycol, windshield cleaning fluid): Recycled.
- Batteries: Sent to a lead-acid battery recycler for recycling.
- Tires: Sent to a scrap tire dealer for disposition (typically burned for energy recovery, landfilled or stockpiled).
- Catalytic converters: Sent to a recycler for precious metal (platinum) recovery.
- Air conditioning refrigerant gases: Recovered for reuse or destruction.
- Air bags: Recovered for reuse or deployed and disposed of.
- Fuel tanks: Steel tanks are flattened and recycled; plastic tanks are disposed of in landfills.

What remains of the vehicle after dismantlers remove all useful parts and materials is commonly referred to as the "hulk." Typically, hulks consist of steel structural materials, plastic dashboards, foam seats, and other components. Although stripped of many parts and items, hulks typically retain at least 70% of the original weight of the ELV. The hulk is typically flattened for ease of transport to the shredder. During flattening, a shattered glass waste stream is generated, which the dismantler typically disposes of in a landfill [27].

By its very nature, dismantling is relatively manual-labor intensive. Dismantlers use a variety of tools such as air driven tools, impact notches, hand tools, abrasive blades and oxyacetylene torches to remove targeted parts (oxyacetylene torches are only used when parts cannot otherwise be removed). Most of the dismantling performed requires

human energy. The only potentially significant mechanical energy expended involves flattening of dismantled hulks prior to transport to the shredder [27].

The economics underpinning traditional salvage/scrap yards and high-value dismantlers are fundamentally different:

- Traditional salvage/scrap yards rely on low capital and operating costs. This is especially true in the case of "U-Pull-It" operations that seek to minimize expenses by having customers perform actual dismantling.
- High-value parts dismantlers rely on quick turnover of selected high-value items that entail relatively high margins upon sale. In return, however, such operations make significant expenditures in terms both performing actual dismantling (a labor-intensive activity) as well as technology (listing specific parts available in computer databases to reach a wide range of potential customers) and shipping (getting parts to customers) [27].

No matter which type of operation employed, basic costs to dismantlers consist of ELV processing (including removal and disposition of fluids, batteries, tires and typically flattening remaining hulks prior to transportation) and transportation of remaining hulks to shredders. On the other hand, basic income to dismantlers results from sales of removed parts and materials, along with sale of the remaining hulk to the shredder [27].

3.2.2 Shredding

Following the dismantling process, gutted ELVs are sent (typically flattened) to a shredder for shredding, followed by separation of shredded material into two basic streams (ferrous metal and nonferrous materials). In addition to ELVs, shredders typically also process "white goods" (appliances – refrigerators, washers, etc.) and other discarded objects containing sheet and light structural steel [27].

At shredder facilities, hulks are inspected prior to shredding to ensure that potentially hazardous components such as batteries, gas tanks, and fluids have been removed. Hulks (and other collected materials) are then shredded into fist-sized pieces using large hammer mills [27].

The shredding of intact vehicle hulks into fist-size chucks using a hammer mill entails a significant expenditure of electrical energy. Shredding energy varies as a function of load (tons / hr) and the horsepower requirements of the shredder motor (from 2,000 hp to 7,000 hp) [27].

Basic costs to shredders consist of hulk processing, transportation of recovered metals to metal processors and transportation and disposal of ASR. Income to shredders consists of payment for both ferrous and nonferrous scrap metals produced [27].

Shredder income is wholly dependent on the sale of recovered metal scrap to metal processors - particularly iron and steel scrap to steel mills. Thus, key factors influencing shredder income include:

- Prices for scrap metals, particularly scrap steel.
- Metal content and mixtures in ELVs.
- Production of clean ferrous and nonferrous scrap from hulks.
- Proximity of shredders to scrap metal industries [27].

3.2.3 Post – Shredder Material Separation and Processing

Following shredding, two basic separations are made:

- An initial separation of the combined material stream into ferrous and nonferrous fractions using a magnetic separation process.
- Separation of the nonferrous material stream into metal and non-metal fractions using a variety of techniques (typically air separation if performed at the shredder) [27].

The three basic streams thus generated are:

- Ferrous metal (iron and steel) – 65 to 70% by weight.
- Non-ferrous metal (aluminum, stainless steel, copper, brass, lead, magnesium, zinc, and nickel) – 5 to 10% by weight.
- Auto Shredder Residue (ASR or “fluff”, consisting of “other materials – plastics, glass, rubber, foam, carpeting, textiles, etc.) – 20 to 25% by weight [27].

As neither of the separations are 100% efficient, a certain level of contamination exists in each material steam generated. The ferrous metal fraction, however, is relatively pure, typically containing only 0.5 to 1% of impurities (consisting of fines, rust and non-ferrous metals – principally copper). ASR, on the other hand, typically contains an appreciate amount of metallic fines, along with significant quantities of dirt and moisture entering during normal processing activities [27].

Ferrous Metal Fraction

The separated ferrous metal fraction (containing iron and steel) is sent for recycling to steel smelters. ELV scrap is almost exclusively handled by electric arc furnaces (EAFs), which utilize electric energy to melt and refine scrap in a batch process to make steel products [27].

Nonferrous Metal Fraction

The separated non-ferrous metal fraction (containing aluminum, brass, bronze, copper, lead, magnesium, nickel, stainless steel, and zinc) is typically sent to another, specialized facility to separate the stream into its individual metals by a variety of means. Aluminum and stainless steel are separated by both "light-media" and "heavy-media" plants. Copper and brass require additional separation, which is accomplished mainly by image processing. Separated nonferrous scrap is typically further processed into ingots, for ultimate sale to the nonferrous scrap market [27].

In performing these separations, a significant amount of contaminants (non-metals) are removed. This waste, referred to as "heavy ASR," is sent for landfill disposal [27].

Nonferrous separation energy varies depending on the type of materials separated and the extent of separation performed. According to Huron Valley Steel, typical energy requirements for a light-media plant are 66 kJ/kg, while separation in a heavy media plant usually requires 170 kJ/kg [27].

The main cost to nonferrous processors involves materials processing and disposal of heavy ASR produced, while income is derived from sale of recovered non-ferrous scrap metal [27].

3.2.4 Automotive Shredder Residue (ASR) Fraction

Generated ASR contains the bulk of non-metallic materials present in shredder hulks (plastics, glass, rubber, foam, carpeting, textiles, etc.), entrained metallic fines, dirt and moisture. Two types of ASR streams can be generated from overall ELV processing:

- "Light" ASR ("fluff"): Generated at the shredder facility when the nonferrous fraction is separated into metal and nonmetallic streams using air classification processes (the nonmetallic fraction being "fluff").
- "Heavy" ASR: Generated at the non-ferrous metal processing facility during separation of the various metal steams (the heavy ASR representing rejected contaminants extracted during processing) [27].

3.2.5 Environmental Burdens of ELVs

The environmental burdens associated with ELV management are strongly dependent on the material composition of vehicles processed and the infrastructure in place to process those vehicles. These factors also influence the potential for material and energy recovery, which reduces burdens experienced both at end-of-life and upstream in the life cycle such as during materials production and vehicle manufacturing/assembly activities [27].

Overall, there are a number of environmental burdens associated with ELV management, including:

1. Wastes produced as an immediate and direct end result of normal ELV processing, principally:
    - ASR
    - Scrap tire
2. Waste/emissions produced in ancillary activities associated with ELV processing. Such ancillary activities include:

- Recycling of removed vehicle fluids, batteries, catalytic converters, and, when used for energy recovery, tires.
- Remanufacturing of removed electro-mechanical parts (engines, alternators, etc.
- Smelting of recovered scrap iron and steel.
- Production of ingots from recovered non-ferrous metals.

3. Burdens associated with abandoned ELVs (approximately 6% all ELVs), principally leaking of vehicle fluids and air conditioning refrigerant into the environment.
4. Burdens associated with traditional scrap/salvage yards, due to the historic low-tech nature of operations that often operate with little regard for environmental protection – the principal concern being releases of ELV fluids and air conditioning refrigerant into the environment.
5. The potential release to the environment of mercury (a toxic chemical) from mercury containing switches potentially present in ELVs during hulk shredding and subsequent ferrous metal recovery activities (i.e., at EAF plants) [27].

Characterization of the ASR and scrap tire waste streams is presented below [27].

3.2.6 Automotive Shredder Residue

Automotive Shredder Residue (ASR) is considered to be essentially comprised of all non- metallic materials present in ELVs, except for vehicle fluids and scrap tires removed during dismantling (this ignores removal by dismantlers of parts containing non-metallic components, which is believed insignificant). A theoretical composition of ASR is presented in Table 3.1 [27].

In reality, however, two factors significantly affect the actual composition of ASR:

- Presence of moisture and dirt, entering from normal exposure to the elements during ELV/hulk processing.
- Presence of metal fines, the result of incomplete separation of metals [27].

Table 3.1 Theoretical Composition of ASR [27]

Material	Amount (lbs / ELV)	% of Total
Plastics	220	48 %
Rubber	57	13 %
Glass	86	19 %
Other materials (mostly carpeting and textiles)	91	20 %
Total	454	100 %

3.2.7 Scrap Tires

The issue of scrap tires naturally extends beyond just ELVs, given that the bulk of scrap tires generated are due to normal wear and tear rather the vehicle itself being permanently retired [27].

3.3 Environmental Impacts of End of Life Vehicles

Potential environmental impacts of ELVs fall into two main categories: pollution and material loss. Possible sources of environmental impacts within these categories are: landfilling of waste from shredders, poor environmental practices at some auto dismantlers and vehicles abandoned in the environment [10].

Oil, coolant, fuels, brakes and other fluids; heavy metals including lead (Ld), mercury (Hg), cadmium (Cd), chromium VI (Cr(VI)) are materials in ELVs that have potential environmental consequences. Insufficient rates of ELV reuse, material recycling and recovery are the second category of potential environment impacts relate to waste and resource loss [10].

3.3.1 Fluids

Table 3.2 shows fluid types and their quantities in ELVs. Table also shows total quantities of these fluids those require treatment and quantity treated in ATFs in European Union 25 countries per year. Due to the table, each ELV contains 22,42 kg fluids, this amount is about 2 % of an ELV by weight [9].

Table 3.2 Fluids in ELVs [9]

Fluid	Quantity	Total in ELV requiring treatment	Total in ELV treated in ATF
Engine oil	2.86 kg/ELV		
Transmission oil	2.06 kg/ELV		
Suspension oil	0.58 kg/ELV		
Brake fluid	0.37 kg/ELV		
Oil filter oil	0.14 kg/ELV		
Power steering	0.09 kg/ELV		
Sub-total oil	**6.10 kg/ELV**	**66 kt in Eu25/yr**	**31 kt in Eu25/yr**
Coolant	3.43 kg/ELV		
Screen wash	1.60 kg/ELV		
Sub-total water-based fluids		**54 kt in Eu25/yr**	**25 kt in Eu25/yr**
Sub-total fuel		**122 kt in Eu25/yr**	**56 kt in Eu25/yr**
Total fluids		**242 kt in Eu25/yr**	**112 kt in Eu25/yr**

Fuels are generally separated from other fluids because of their economic value and can be easily reused on-site. In uncontrolled dismantling places, waste oils and water-based fluids are partly split into the soil and partly left in the body of the car [10].

The environmental impact of waste oils reversed in soil or water depends on the levels and types of contaminants present in the oil. The most toxic components of waste oils include heavy metals (arsenic, cadmium, chromium, etc.) and PAHs (Polycyclic Aromatic Hydrocarbons such as benzene, toluene, xylene). These highly toxic substances tend to concentrate in soil, water, and biota. Due to their high persistence in the environment and their tendency to bio-amplificate through food chains, they can accumulate directly or indirectly (through food chains) in humans causing adverse effects on human health. The latter include a wide range of illnesses, from irritations to cancer, anaemia, skin ulcerations and cardiovascular disease. Animals and aquatic organisms will share some of the human health effects. Observed effects include acute toxicity23 in aquatic organisms as a result of poisoning by heavy metals; acute toxicity

in fish, and tumours, caused by mixtures of PAHs. Oil contaminants also have a range of properties poisonous to plants [18].

When any substance is burned, the elements and compounds of which it is made up are released into the air as gases or particles, or they collect in the ash. If released in high enough quantities, some of these gases and particles can have harmful effects on human health and the environment [10].

The combustion of oils containing carbon and chlorine can produce a wide range of organochlorine compounds. These can include 17 dioxins and furans, which pose a risk to human and environmental health. Toxic responses include skin toxicity, immunotoxicity, carcinogenicity, and adverse effects on reproduction, development and endocrine functions [10].

Some conditions are required to burn oil without causing adverse effects on human health and the environment, including: controlling the content of the substance burned, using filters and scrubbers to remove particles and chemicals from the discharge, designing chimney stacks to ensure good dispersion of the discharge, ensuring the burner operated to a particular degree of combustion efficiency, specifying methods of containing and disposing of ash [10].

Once water-based fluids are released into the environment, ethylene glycol partitions mainly into surface water or groundwater. It does not bioaccumulate or persist in the environment, primarily due to biodegradation. But as it biodegrades rapidly in the aquatic environment, it has the potential to induce depletion of the dissolved oxygen (DO) in receiving waters [10].

Laboratory tests exposing aquatic organisms to stream water receiving runoff from airports have demonstrated toxic effects and death. Terrestrial organisms are much less likely to be exposed to ethylene glycol and generally show low sensitivity to the compound [10].

However, available data from oral acute poisoning cases (humans) and repeated-dose toxicity studies (experimental animals) indicate that the kidney is a critical organ for the toxicity of ethylene. It also induces slight reproductive effects and developmental toxicity, including teratogenicity, namely in rodents exposed by the oral route [10].

3.3.2 Batteries

Table 3.3 materials in batteries and their quantities in ELVs. Table also shows total quantities of materials those require treatment and quantity treated in ATFs in European Union 25 countries per year [9].

Sulphuric acid discharged in the environment poses substantial health risk to aquatic organisms and soil fauna mainly due to its corrosive and irritant properties and its capacity to rapidly cause substantial changes in the pH of soil and/or water. Laboratory and field studies show that even at very low concentrations, this acid is particularly toxic to aquatic ecosystems, namely to fish and algae [10].

Table 3.3 Materials in ELV batteries [9]

Battery	Quantity	Total in ELV requiring treatment	Total in ELV treated in ATF
Lead containing components	8.6 kg	93 kt in Eu25/yr	43 kt in Eu25/yr
Electrolyte (sulphuric acid)	3.8 kg	41 kt in Eu25/yr	19 kt in Eu25/yr
Polypropylene	0.7 kg	8 kt in Eu25/yr	4 kt in Eu25/yr
Other	0.4 kg	4 kt in Eu25/yr	2 kt in Eu25/yr
Sub-total oil	**13.5 kg**	**146 kt in Eu25/yr**	**68 kt in Eu25/yr**

Since the soil mobility of sulphuric acid is very high, once it enters the soil, it can readily reach groundwater or surface waters and endanger drinking-water supplies [10].

In all biota, including humans, the contact with sulphuric acid causes severe burnings. Moreover, according to the International Agency for Research into Cancer (IARC), the occupational exposureto strong inorganic acid mists containing sulfuric acid is carcinogenic [10].

According to GTZ (Gesellschaft für Technische Zusammenarbeit), depending on the level of mechanisation and environmental standards, the following hazards can arise by improper batteries treatment:

- Wind dispersal of lead dust if crushed battery scrap is stored without protection
- Substantial atmospheric emissions (lead-containing dust, soot, SO, chlorides, dioxins, etc.) when battery scrap is melted (e.g. in illegal scrap yards or uncontrolled burning equipment) due to: processing the entire battery including its organic parts (PP casing for instance), inadequate removal of gases and vapors during the smelting and refining process, absent or inadequate flue gas treatment
- Open tipping of residues and waste such as batteries casings [10]

3.3.3 Liquefied Gas Tank

Each ELV contains 0.06 kg liquefied gas tanks [28]. Potential environmental problems with liquefied gas tanks include:

- Uncontrolled propane emissions into the air. Propane emissions have an impact on photochemical oxidation meaning that their presence in the air can lead to the creation of the ozone that can cause skin and eye irritations.
- Noise due to the explosion [10].

But the main potential problem is the security for workers during the shredding [10].

3.3.4 Tyre

Tyres were mainly re-used (for the good ones), landfilled or stockpiled. Used tyres present a difficult management problem in landfill or when stockpiled because of their volume, their resource loss and the fire hazard they pose [29].

3.3.5 Plastics

Each ELV contains about 100-140 kg of plastics. Plastics were part of the ASR sent to landfill. Main potential problems are linked to leachate water and pollutant discharge via the leachate water route [10].

Regarding air pollution, no landfill gas -CH4, CO2- is usually considered being formed from ELV plastic parts (because no biologically active carbon occurs in these plastics). The other environmental problem known for plastics landfilling is the loss of resources [10].

3.4 ELV Directive in Turkey

Objective of this Directive [1] is to prevent waste from vehicles, to reduce the disposal of waste by means of reusing, recycling and other forms of recovery of end-of-life vehicles and their components to protect environment and human health, to state standards and obligations precisely which economic operators and temporary storage areas are subject to.

ELV Directive gives different responsibilities to vehicle owners, economic operators, vehicle manufacturers, Ministry of Environment and Forestry and insurance companies. Vehicle owners are responsible for delivering its ELV to ELV delivery plants, temporary storage areas or treatment facilities and getting deregistration and disposal form for their ELVs.

Economic operator denotes manufacturer, distributor and importer of the vehicles and parts and materials of vehicles and plants that does any of the operations of collection, dismantling, shredding, recovery, recycling of end of life vehicles.

They are responsible for complying with the prohibitions of hazardous substance use, fulfilling the obligations of required coding, reporting, licensing and type approval, setting up an ELV collection system or to take part in a collection system and processing, re-use, recovery and recycling of the collected cars for the specified rates. Producer denotes retail or corporate merchant who is manufacturer of vehicle or professional importer of vehicle for commercial purposes. They are responsible for building ELV delivery plants in provinces which don't have ELV delivery plants or that have insufficient plants. They have to receive vehicles that have negative market value without demanding any price from vehicle owners. Dismantling information of

vehicles is prepared by vehicle or part manufacturers that can be reached either as a manual or in electronic media to process ELVs in an environmentally safe way.

Ministry of Environment and Forestry is responsible for giving environmental permit and license. Ministry evaluates reports prepared and creates a database for it. It inspects economic operators, processing plants and temporary storage areas and applies criminal procedures if it determines contradiction to the provisions of this regulation.

Due to the Directive, importing ELVs is forbidden. To promote recycling practices, use of recycled materials in vehicles are increased. Vehicles and their materials and parts are designed to ease dismantling, reuse, recovery and recycling after its end of life. Usage of hazardous material is limited to ease recycling, to prevent the spread of hazardous materials to the environment and to reduce the amount of hazardous waste to be disposed and usage of hazardous materials is reduced to the minimum level in forward -looking designs.

Economic operators set up vehicle delivery plants and temporary storage areas to collect end of life vehicles and spare parts resulting from maintenance and repairing of vehicles. ELV delivery plants are set up with a sufficient quantity due to the vehicle number and in distances that can be easily reached. ELV delivery plants are built by manufacturers in regions without ELV delivery plants or that have insufficient plants. Manufacturers receive vehicles that have negative market value without requesting any price from vehicle owner.

Directive clearly states reuse and recovery rates also. Reuse - recovery rate should be 85 % of average vehicle weight and reuse – recycling rate should be 80 % of average vehicle weight in ELVs. Reuse - recovery rate cannot be smaller than 75 % of average vehicle weight and reuse – recycling rate cannot be smaller than 70 % of average vehicle weight in vehicles produced before 01/01/1980. Reuse - recovery rate cannot be smaller than 95 % of average vehicle weight and reuse – recycling rate cannot be smaller than 85 % of average vehicle weight in vehicles after 01/01/2020.

3.5 ELV in Turkey

There are 16,200,876 vehicles on roads by the end of April 2012 in Turkey due to the data provided by TurkStat [30]. From 1994 to 2012, number of vehicles on traffic has substantially increased. This increase is a potential source of ELV increase for next years. Table 3.4 [31, 32, 33, 34] shows number of automobiles registered and deregistered between 1994 and 2012.

Turkey, as one of the candidates for European Union (EU) membership has prepared a new regulation [1] about ELVs for the purpose of adaptation of EU's legislation which is not very different from ELV Directive published by European Commission (Directive 2000/53/EC) on 21st October 2000.

Turkey has the oldest vehicle park of Europe. More than half of the vehicles are older than 12 years and one-third percentages of vehicles are older than 16 years. Removal of these old vehicles from traffic will be more important when considering application of strict emission rules applied in Europe to these vehicles [35].

Ministry of Environment and Urban Planning identified ELV delivery facilities that will accept ELVs since 1 January 2011 based on ELV Directive. These 842 facilities took over 44,159 vehicles as scrap in 2011 [35].

ELVs pollute environment more than vehicles produced by high technology. Removal of vehicles those are older than 16 years will decrease cancer-causing and hazardous gases emitted to atmosphere in one – fifth percent. Age averages of automobiles in Europe are lower than Turkey's vehicles age average. Age average of vehicles are 8.1 in Germany, 8 in Belgium, 7.7 in Austria, 7.1 in England, 6.3 in Ireland. Age averages of vehicles are greater than 10 in countries like Greece, Portugal, Slovakia and Finland [36].

Table 3.4 Numbers of automobiles registered and deregistered [31, 32, 33, 34]

Year	Automobiles registered	Automobiles deregistered
1994	244,289	3,490
1995	200,658	3,787
1996	219,230	3,166
1997	299,108	2,783
1998	271,843	3,317
1999	238,074	3,340
2000	349,473	4,147
2001	117,017	4,573
2002	70,191	4,854
2003	176,217	76,014
2004	432,728	250,630
2005	406,807	34,502
2006	396,542	28,295
2007	353,495	22,331
2008	353,168	28,695
2009	357,986	60,651
2010	485,619	34,712
2011	602,248	34,008
2012	75,580	3,135
Total	5,650,813	606,430

3.6 European Countries

3.6.1 Austria

Automotive industry has a considerable importance in Austria. Most of the cars and other vehicles are exported, only a small fraction of produced cars are used within the country. So, the problem of end of life vehicle problem is one that concerns retailers and importers of vehicles [11].

Austria already had a voluntary tack back system for ELVs for ELV Directive enacted and take back became legally mandatory on 6 November 2002. To finance take and treatment system, a price is included in the price for new cars. No problems have been reported about Austria take back system and none expected because valuable materials that ELVs contain [11].

After ELV Directive came into effect, there is not increase in illegal shipment and dumping of cars for disposal but number of ELVs requiring disposal has decreased. Main cause of this, as Economic Chamber of Austria reported, export of old cars to Germany or the new Member States of the European Union [11].

3.6.2 Belgium

Number of ELVs scrapped in Belgium is a small fraction of Belgium vehicle fleet. Main reason of this is second hand car export. West Africa, the Middle East and the former Western bloc countries are mainly importers of these cars. Many of these exports are illegal as before ELV Directive implementation [11].

Flemish waste decree, the VLAREA-rules on waste prevention and waste Management obligates economic operators to take back ELVs since 1999. New VLAREA, entered into force on 1 June 2004, introduced free take back for ELVs. Cost of take back and transportation of ELVs to treatment facilities are paid by economic operators since 1999 [11].

3.6.3 Czech Republic

The Czech Republic has a relatively aged car fleet. Although number of new cars sold increased in recent years, the country's second hand market ranks among the biggest in the EU [11].

Free take back is applicable for final users since 1 January 2007 and producers are obliged to take back all cars of all brands since this date if they are delivered to authorized take back facility. Produces that don't offer take back in their facilities

contract with take back facilities. Importers of cars which do not meet technical requirements have to pay a fee of 5,000 CZK (about € 180). Costs of take back for these vehicles are financed from this fee transferred to the State Environmental Fund [11].

Problematic issues related with ELVs in Czech Republic are cost-demanding investment into the treatment facilities, system of fees, a lack of capacity to process certain materials (glass, plastics and rubber) and the existence of so-called "car cemeteries". Car cemeteries are places where people leave their cars and there is no consequent treatment process [11].

3.6.4 Germany

German hosts a variety of car producers and buyers prefer national brands, so cars sold and used in Germany have also been manufactured in Germany. There is great difference between the numbers of deregistered and scrapped vehicles. Main reason of this situation is the second hand car export to other countries. Illegal collection and recovery are another reasons because of highly priced materials as metals [11].

German ELV Ordinance before ELV Directive had met some requirements of ELV Directive such as treatment/recovery of ELVs including recovery and recycling targets. It has been adapted to ELV Directive on 1 July 2002. Producers have to take back all the vehicles of their brand in an authorized permitted collection facility or an authorized dismantling facility designated by the car producer. German take back system works effectively. German ordinance obligates car producers to the installation "sufficiently comprehensive network of authorized collection facilities or authorized dismantling facilities". High steel price is another factor increasing take back system effectiveness [11].

3.6.5 Hungary

Before about 20 years, Hungary has not been a car manufacturer. From the beginnings of 1990, a couple of international car and car component manufacturers have started to operate [11].

Second hand cars are mainly imported from Western Europe, German is the most popular country of them. Number of cars imported is decreasing due to the regulation of imports getting stricter. Hungary has a car fleet which is 11 years old on average.

ELV Directive came into force in 1 January 2005. Due to the Hungarian ELV Directive implementation, ELV processing facilities must be able to be reached within 50 km on public road from any points of the country [11].

Although ELV take back is theoretically free for final users, they should pay € 16 for certifying the take back and about € 6 for the final withdrawal from traffic of the vehicle. Transportation cost of ELVs to the processing facility should also be paid by final users, if transportation is necessary. Because of free take back obligation, some producers contract with ELV processing facilities and other producers have to set up their own contractor network [11].

3.6.6 Ireland

ELV Directive came into force in Ireland on 8 June 2006 through the Waste Management Regulations. This regulation obligates producers – vehicle manufacturers and Professional importers – to establish national collection systems and require treatment facilities to meet specific environment standards [11].

Producers should have at least one authorized treatment facility in every city and county council area providing free take back for their brands. A new treatment facility should be opened in the relevant county or city for each additional 150,000 persons. Produces are also charged a fee based on their annual turnovers in country to cover Local Authority costs [11].

3.6.7 Italy

In Italy, car manufacturers are responsible for the creation of a network of retailers or treatment plants for the free take back of vehicles. Due to the agreement signed in May 2005 between the car manufacturers and the car dealers trade association and the association of dismantlers and scrap dealers, producers accepted to pay for the ELV take back, excluding the last owner's costs of transport to the retailer or to the treatment facilities and the administrative costs of deregistration. Agreement also aims at creating networks that will facilitate the achievement of recovery targets by minimizing costs and achieving economic sustainability [11].

3.6.8 The Netherlands

In the Netherlands, number of cars produced is relatively small and most of the cars newly registered are imported, of which 60 % are from Germany and France. Due to the decrease in annual sales of new cars in recent years, average vehicle life increases. Besides, export of second hand cars has increased in recent years, especially to Poland and other new EU member states [11].

The Netherlands has a voluntary free take back system since 1990s. An organization named 'Auto Recycling Netherland' was established to operate the system. ARN pays for unprofitable parts of recycling and scrapping operations. System is financed by a fee that is levied on all new cars not older than 25 years. This fee was € 45 from 2000 to 1 January 2007 and is € 15 now [11].
The Decree on car wreck management, entered into force in July 2002, made free take back system applicable for all vehicles. Producers and importers are obliged to ensure a collection and treatment system covering the whole country [11].

The Dutch system for the collection and treatment of ELVs is generally regarded as an effective one, since the EU Commission's proposal for the ELV Directive was inspired by the pre-existing Dutch system [11].

3.6.9 Sweden

The Ordinance on Producer Responsibility for Cars, which came into force on 1 January 1998 before ELV Directive had tackled the ELV problem. Also 85 % reuse, recovery and recycling target for 2006 due to ELV Directive was set at 2002 in Sweden [11].

Before the Ordinance on Producer Responsibility for Cars, when a new car has been registered, a charge was levied and these charges were collected in a non-interest fund. The fund was then used for paying scrapping premiums. But this ordinance extended producer responsibility. Now manufacturers and importers are responsible for financing the treatment and establishing a system that took care of end-of-life cars, regardless of their age. Car owners have to pay for transportation costs of cars to any collection points/scrap yards [11].

3.6.10 United Kingdom

Price of scrap metal and scrapping cost have important effect on number of ELVs abandoned in UK. After 2000, during two years, due the low price of metal and high cost of scrapping, number of ELVs abandoned decreased dramatically. After that, free take back system, higher price of scrap metal and the existence of a clearly defined network for collection started to increase the number of ELVs abandoned [11].

End-of Life Vehicles Regulation 2005 gives take back, treatment, reuse, recycling, recovery and disposal responsibility to producers. Regulation obliges producers to contract with a network of Authorized Treatment Facilities (ATFs), and with the reprocessing and recycling industries. Also 75 % of last owners should be within 10 miles on average of the nearest ATF, and no one should be more than 30 miles distance. It is ATFs' choice to accept an ELV without a producer contract [11].

3.6.11 Economical Evaluation of Automobile Industry

Table 3.5 [37, 38, 39, 40] shows contribution of automotive industry to economy for some of the EU countries and Japan. From these countries, Japan automotive industry has total manufacturing share, number of motor vehicles and number of passenger cars.

Table 3.5 Economical Evaluation of Automobile Industry [37, 38, 39, 40]

	Direct Automotive Employment	As a share of total manufacturing	Production of motor vehicles	Of which production of passenger cars	Car tax revenues (€ bn)	As a share of GDP	Car fleet in 1,000	Car density (per 1,000 inhabitants)
France	258,304 (2007)	7.3% (2006)	2,567,983 (2008)	2,144,957 (2008)	64 (2007)	3.4 % (2007)	31,443 (2007)	508 (2007)
Spain	159,052 (2007)	6.1 % (2006)	2,541,644 (2008)	1,943,049 (2008)	30.5 (2007)	2.9 % (2007)	21,760 (2007)	481 (2007)
Portugal	22,590 (2007)	2.7 % (2005)	175,155 (2008)	132,242 (2008)	6.4 (2006)	4.1 % (2006)	4,379 (2007)	412 (2007)
Ireland	3,863 (2006)	1.8 % (2006)			5.1 (2007)	3.2 % (2005)	1,910 (2005)	434 (2007)
UK	173,884 (2007)	5.7 % (2006)	1,649,515 (2008)	1,446,619 (2008)	52.6 (2007)	2.6 % (2007)	29,101 (2007)	476 (2007)
Belgium	40,575 (2007)	7.7 % (2006)	724,498 (2008)	680,131 (2008)	12.1 (2004)	4.2 % (2004)	5,049 (2007)	473 (2007)
Italy	168,435 (2007)	3.6 % (2006)	1,023,774 (2008)	659,221 (2008)	70.4 (2007)	4.6 % (2007)	35,680 (2007)	598 (2007)
Netherlands	22,284 (2007)	2.9 % (2006)	132,494 (2008)	59,223 (2008)	17.4 (2007)	3.1 % (2007)	7,392 (2007)	451 (2007)
Germany	833,837 (2007)	11.8 % (2006)	6,040,582 (2008)	5,526,882 (2008)	80 (2007)	3.3 % (2007)	41,184 (2007)	501 (2007)
Denmark	6,758 (2007)	1.5 % (2006)			6.7 (2008)	2.9 % (2008)	2,068 (2007)	378 (2007)
Austria	33,075 (2007)	5.3 % (2006)	150,877 (2008)	125,436 (2008)	12.3 (2006)	4.8 % (2006)	4,246 (2007)	510 (2007)
Czech Republic	126,223 (2007)	8.3 % (2006)	945,822 (2008)	933,312 (2008)			4,280 (2007)	412 (2007)
Hungary	58,806 (2007)	6.6 % (2006)	346,055 (2008)	342,359 (2008)			3,012 (2007)	300 (2007)
Slovakia	76,000 (2007)	7.1 % (2006)	575,776 (2008)	575,776 (2008)			1,434 (2007)	265 (2007)
Sweden	85,561 (2007)	10.7 % (2006)	308,405 (2008)	252,287 (2008)	7.9 (2008)	2.4 % (2008)	4,258 (2007)	464 (2007)
Poland	137,000 (2007)	4.6 % (2006)	945,500 (2008)	840,000 (2008)			14,589 (2007)	383 (2007)
Japan	787,000 (2010)	13%	9,628,920 (2010)	8,310,362 (2010)				

4 LITERATURE SURVEY

After their useful lives, products enter to the end of life stage. End of life products are source of waste if they are left to nature. This action will not only pollute environment but also cause material loss by preventing material recovery. New material usage will also increase if the materials from end of life products are not recovered. Countries are aware of these dangers and several legislations have been made to specify how to collect and treat end of life products. These legislations generally depend on "Extended Producer Responsibility" principle. EPR uses financial incentives to encourage manufacturers to design environmentally-friendly products by holding producers responsible for the costs of managing their products at end of life. EPR is based upon the principle that because producers (usually brand owners) have the greatest control over product design and marketing and these same companies have the greatest ability and responsibility to reduce toxicity and waste [41]. Since these responsibilities bring additional costs to producers, reverse logistics activities and network design for facilities for returned products should be considered by producers.

Mansour and Zarei [4] state that the management of EoL products is an important research area, because of their potential for polluting the environment and also their hidden economic values, which may turn the recovery process into a profitable business for the original producers. The main problem facing manufacturers is how to collect the EoL products and how to treat them in order to obtain maximum benefits from their recovery and fulfilling the relevant legislations. Selecting the recovery option for EoL products is mainly based on the quality of the parts and components and also the economic considerations. Main objective of their study is to minimize the logistical costs of implementing the EU Directive on manufacturers. A mathematical multi-period model is derived to achieve this. The proposed solution methodology was a multiple start search with a heuristic method performed in each iteration.

Pishvaee et al. [13] bring out that decisions on the number of facilities, their locations and capacities and the quantity of flow between them affect both costs and customer service levels. They state that opening and closing a facility is both an expensive and time-consuming process, chancing network design is impossible in the short run and due to the fact that designing the forward and reverse logistic separately leads to sub-optimal designs with respect to costs, service levels and responsiveness, the design of the forward and reverse logistics networks should be integrated. Due to Pishvaee et al., this kind of integration can be considered as "horizontal integration", as it encompasses the integration of related optimization problems at the same decision level. They proposed a model for integrated logistics network design to avoid the sub-optimality caused by a separate, sequential design of forward and reverse logistics networks by the opinion that in such an integrated logistics network, hybrid processing facilities offer potential cost savings compared to separate distribution or collection centers. The IFRLN (integrated forward reverse logistics network design) therefore considers a hybrid distribution-collection facility whereby both distribution and collection centers are established at the same location. They developed a bi-objective mixed integer programming formulation to minimize the total costs and maximize the responsiveness of a logistics network. They also developed an efficient multi-objective memetic algorithm to find the set of non-dominated solutions.

El-Sayed et al. [42] developed a multi-period multi-echelon forward-reverse logistics network design under risk. The proposed network structure consists of three echelons in the forward direction, (suppliers, facilities and distribution centers) and two echelons, in the reverse direction (disassembly, and redistribution centers), first customer zones in which the demands are stochastic and second customer zones in which the demand is assumed to be deterministic, but it may also assumed to be stochastic. They formulated the problem in a stochastic mixed integer linear programming (SMILP) decision making form as a multi-stage stochastic program. In their study, returned quantities are assumed to be stochastic and returned quantities depend on the first customer demand. The objective of their model is to maximize the total expected profit. They found out that the total expected profit is linearly proportional to the total demand. At certain

instances, it decreases slightly due to the shortage cost as it is not profitable to open extra location.

Lee and Dong [43] developed a deterministic programming model for systematically managing forward and reverse logistics flows. A two-stage heuristic approach has been introduced to decompose the integrated design of the distribution networks into a location-allocation problem and a revised network problem. They state that in integrated logistics network, instead of dealing with separate warehouse or collection centers, a type of hybrid processing facility considered. Advantages of building such facilities in electronic industry include cost savings and pollution reduction as results of sharing material handling equipment and infrastructure. Purpose of their model is to minimizing the total cost in the logistics network. They adopted a selection strategy to obtain the locations of the depots at the first stage and then a tabu search algorithm is applied to get the improved shipment solution for EoL returned products at the second stage.

Chan et al. [44] studied the relationships between reverse logistics and just-in-time (JIT) philosophy. They state that both reverse logistics and JIT philosophy are related to reducing the impact on the environment. But they are in conflict sometimes, JIT focuses on moving the materials smoothly which require a stable demand and supply but predicting the amount of returned products is difficult in reverse logistics. They tried to fill this gap in that study. Integrating JIT philosophy in four processes of reverse logistics, collection, distribution, inventory management and remanufacturing, can reduce cost and can increase response time. For example, if the returned products require fast processing, the collection points should be set close to the customer and frequency for collection should be increased. Another core principle of JIT, proper selection of supplier base and maintaining a good relationship between them can facilitate the product development cycle by bringing in suppliers and encourage their involvement so that design for remanufacturing can be achieved easier.

Lee and Dong [28] proposed dynamic location and allocation models to cope with reverse logistics issues. They state that the characteristics of reverse logistics network

may include considerable system uncertainty and they developed a stochastic programming model by which a deterministic model for dynamic reverse logistics network design can be extended to explicitly account for the uncertainties. They proposed using hybrid processing facilities instead of only handling separate forward processing and collection facilities which aims at cost savings and pollution reduction as a result of sharing material handling equipment and infrastructure. They also developed a solution method by integrating a sample average approximation scheme with a simulated annealing (SA) based heuristic algorithm to obtain solution.

Ravi et al. [45] investigated the selection of a reverse logistics project for end-of-life computers. They state that the reverse logistics project selection is a multi-criteria decision-making (MCDM) problem. They used analytical network process (ANP) and zero-one goal programming (ZOGP) as solving methodologies in their research. Shorter product life cycles in the computer industry have increased product returns, waste related with EoL products and related costs. So, prioritizing reverse logistics projects may be of great value for top management in arriving at a strategic decision for efficient running of reverse logistics programs. Increased use of resource reduction, increase of eco-efficiency, development of green products and cost of implementation of reverse logistics programs are criteria for selection of reverse logistics projects in that study. ANP has been used to determine the degree of interdependence among the criteria and projects and the inner dependence among them. ANP lacks taking into account resource limitations required. Because of this, ZOGP has been used to include constraints by which it can provide a feasible solution that best satisfies the priority goals of the decision maker.

Anbuudayasankar et al. [46] studied problem termed as simultaneous delivery and pick-up problem with constraint capacity (SDPC). The problem can be explained as delivering the goods to customers and simultaneously picking-up the used containers such as bottles, cans, etc. in the same vehicle in the place of the delivered loads. The requirement is to route the vehicle with due consideration to the loads involved in delivery as well as pick-up with the constrained capacity. They state that in SDPC, a vehicle from a depot has to visit all the nodes of the given set and the objective is to

minimize the distance travelled. To solve the problem, they used an extended branch and bound construction algorithm in the first phase and in the second phase they used GA, SA and GASA embedded with pairwise interchange heuristic.
End of Life Vehicles are cars and light trucks that are considered waste and that must be disposed of [7]. Vehicles are great sources of waste when they reach their EoL stage. If the disabled automobiles can't be recycled in time and effectively, much resource will be wasted and the environment will be polluted as well [135]. There are several studies considering ELVs. Most of these studies are related with reverse logistics network design problem for collecting and treating ELVs.

Schultmann et al. [47] investigated the case of enhancing ELV recycling in Germany by reprocessing selected material fraction. They evaluated network design concepts for separating and reprocessing of plastic ELV components. They emphasize that the objective consists of establishing a product recovery network that fulfills predefined recycling targets at minimal costs. Transportation costs represent a major portion of the total cost for recycling step, so economic optimization can be achieved by effective network design with respect to reverse logistics. In their study, reverse logistics modeling is done by vehicle routing planning using Tabu Search. They concluded that flexible algorithms are necessary to compare different scenarios of establishing a reverse supply chain for collecting secondary material. This will contribute to comprehensive reverse logistics planning for the application presented.

Amelia et al. [48] identified the existing conditions of automotive reuse in Malaysia in their study. They specify that the components that are being manufactured and reused include clutches, brake shoes, engine block, starters, alternators, water pumps, and carburetors. But reuse for these components is only possible after market. Neither OEMs nor automotive manufacturers are in favor of using reused parts-components in newly produced ones. They also state that the importance of vehicles design to facilitate reuse, remanufacture, and recycling of ELV legislations seems to be far from implementation. Due to the study, difficulty in disassembly, the need for additional production process, high labor cost for disassembly and decrease in quality are barriers to reuse.

Cruz-Rivera and Ertel [49] studied the issues related with strategic network design for ELV collection in Mexico. The objective of their model is to maximize the ELV incorporation so as to reverse supply chain activities. They state that the current management of ELV carried out in Mexico is driven by market conditions, where the most valuable materials and components are recovered from ELV. Main reason of this is the lack of consolidated networks adding value to ELV and legal incentives and disaggregation. Reverse logistics modeling is done through an Uncapacitated Facility Location Problem in the study.

Wang et al. [50] studied the reverse logistics network design problem for a diesel engine enterprise. They state that the remanufacturing is the most complicated task that returns the EoL product to good as new condition by replacing components or reprocessing used parts. And since product knowledge is required for remanufacturing, it tends to be performed in-house and this requires appropriate network structures. The company which is subject to their study remanufactures returned engines in its facilities for after-sale service, so Wang et al. developed a MILP model for determining the disassembly centers' quantity and position among the existing spare parts warehouses.

Williams et al. [51] proposed a recycling planning model for automotive shredders to make short-term tactical decisions regarding to what extent to process and to reprocess materials through multiple passes and this mixed integer programming model determines whether to combine materials for shipment. The objective of the study is to maximize the profit from selling the output materials separated from the purchased input. Study focuses automotive recycling on shredding and separating metallic and nonmetallic materials from car hulks through magnetic separation and eddy current separation.

5 CASE STUDY

5.1 Problem Definition

The purpose of this study is defining reverse logistics network parameters for end of life vehicles based on ELV Directive in Turkey. End of life vehicles are collected on vehicle owners' demand. Collected ELVs can be stored in the places of delivery of ELVs due to a maximum delay time and then they are sent to economic operators (temporary storage areas and processing centers). ELVs are purified and dismantled in temporary storage areas. Parts that can be reused are sent to automotive production plants and automotive repair services from temporary storage areas. Recyclable materials are sent to recycling centers. Vehicles purified and dismantled are then sent to shredders. After shredding, recyclable materials are sent to recycling centers and wastes are sent to disposal centers.

5.2 Model Formulation

The objective of the model is minimizing the total cost, which includes fixed investment costs, operations cost in processing and waste collection centers and transportation costs. Transportation costs [12, 52, 53, 54, 55], processing costs [53, 55], facility opening costs [12, 49, 55] and capacity constraints [12, 53, 54, 55, 56, 57] and material flow balance between facilities [54] are subject of most reverse logistics network design problems.

The place of delivery of ELVs should be located near customer zones. The design of the reverse logistic activities is given as a flowchart in Figure 5.1. The distance between customer zones and the place of delivery of ELVs cannot be greater than a specified value which has been specified by parameter named *md*. Each customer zone will be assigned to one place of delivery, a^{pd}_{z} specifies this assignment and DV_{pd} will be used as decision variable to specify whether the place of delivery will be opened or not. q_z is the quantity of ELVs that are carried to the place of delivery in each period.

Distance between customer zone and the place of delivery is d^{pd}_{z} and cost of transporting an ELV to collection center is tc^{pd}_{z} per kilometer.

Also one place of delivery can send vehicles to only one temporary storage area. Reusable parts dismantled in temporary storage areas are sent to automotive repair services in proportion to r^{s}_{tsa} and automotive production plants in proportion to r^{p}_{tsa}. Depolluted and dismantled vehicles are sent to ELV processing centers. One temporary storage area is assigned to ELV one processing center. d^{pc}_{tsa} is the distance between the processing center and temporary storage area and tc^{pc}_{tsa} is the transportation cost per kilometer from ELV temporary storage area tsa to ELV processing center pc. DV_{tsa} and DV_{pc} are decision variables that specify whether the temporary storage area tsa and ELV processing center will be opened or not. a^{pc}_{tsa} specifies whether the temporary storage area tsa has been assigned ELV processing center pc or not. Wastes can be sent to directly disposal centers from temporary storage areas. Recyclable materials obtained from ELVs processed in ELV processing centers are sent to recycling centers and waste materials are sent to disposal centers.

Thus, transportation costs, facility opening costs and operations cost in processing centers, waste collection centers, recycling centers and disposal centers form total cost for ELV management in automotive industry.

Index set:

Z	Set of fixed customer zones	Z = {z| 1, … Z}
PD	Set of places of delivery of ELVs	PD = {cc| 1, … CC}
TSA	Set of temporary storage areas	TSA = {tsa| 1, … TSA}
PC	Set of ELV processing centers	PC = {pc| 1, … PC}
R	Set of recycling centers	R = {r| 1, … R}
D	Set of disposal centers	D = {d| 1, … D}
P	Set of fixed automotive production plants	P = {p| 1, … P}
S	Set of fixed automotive repair services	S = {s| 1, … S}

Parameters

q_z quantity of ELVs in customer zone z to be carried to places of delivery

q_{pd} quantity of ELVs in places of delivery of ELV pd to be carried to ELV temporary storage areas

q_{tsa} quantity of ELVs in ELV temporary storage area tsa to be carried to automotive repair services, automotive production plants, recycling centers and ELV processing centers

q_{pc} quantity of ELV in ELV processing center pc

q_d quantity of EEE in disposal center d

q_r quantity of EEE in recycling center r

c_{tsa} cost of depollution and dismantling ELVs and grouping parts by type in temporary storage area

c_{pc} cost of operations in processing center per unit

c_r recycling cost per unit

c_d disposal cost per unit

d^{tsa}_{pd} distance from place of delivery of ELV pd to ELV temporary storage area tsa

d^{pd}_{z} distance from customer zone z to the place of delivery of ELV pd

d^{pc}_{tsa} distance from ELV temporary storage area tsa to ELV processing center pc

d^{s}_{tsa} distance from ELV temporary storage area tsa to automotive repair service s

d^{p}_{tsa} distance from ELV temporary storage area tsa to automotive production plant p

d^{r}_{tsa} distance from ELV temporary storage area tsa to ELV recycling center r

d^{r}_{pc} distance from ELV processing center pc to ELV recycling center r

d^{d}_{pc} distance from ELV processing center pc to disposal center d

tc^{pd}_{z} transportation cost per kilometer from customer zone z to the place of delivery of ELV pd

tc^{tsa}_{pd} transportation cost per kilometer from the place of delivery ELV pd to ELV temporary storage area tsa

tc^{pc}_{tsa} transportation cost per kilometer from ELV temporary storage area tsa to ELV processing center pc

tc^{s}_{tsa} transportation cost per kilometer from ELV temporary storage area tsa to automotive repair service s

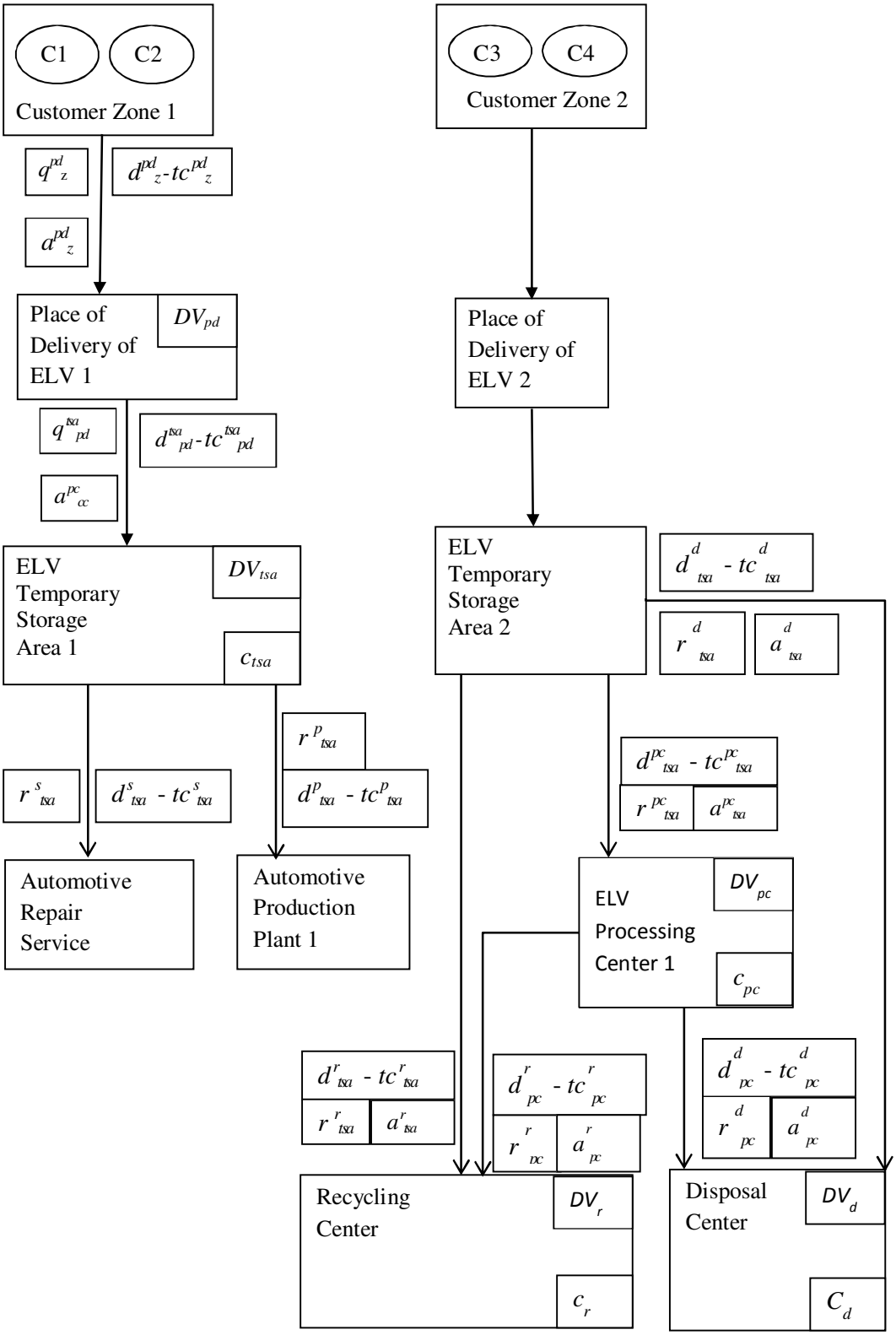

Figure 5.1 Flow of ELVs from customer zones to other facilities

tc^{p}_{tsa} transportation cost per kilometer from ELV temporary storage area tsa to automotive production plant p

tc^{r}_{tsa} transportation cost per kilometer from ELV temporary storage area tsa to ELV recycling center r

tc^{r}_{pc} transportation cost per kilometer from ELV processing center pc to recycling center r

tc^{d}_{pc} transportation cost per kilometer from ELV processing center pc to disposal center r

HC_{pd} capacity of the place of delivery of ELV pd

HC_{tsa} capacity of the temporary storage area tsa

HC_{pc} capacity of ELV processing center pc

HC_{r} capacity of recycling center r

HC_{d} capacity of disposal center d

FC_{pd} fixed cost of opening the place of delivery of ELV pd

FC_{tsa} fixed cost of opening temporary storage area tsa

FC_{pc} fixed cost of opening ELV processing center pc

FC_{r} fixed cost of opening recycling center r

FC_{d} fixed cost of opening disposal center d

md max distance allowed between customer zones and ELV collection centers

Variables

r^{s}_{tsa} ratio of parts in temporary storage are tsa that can be used by automotive repair service s

r^{p}_{tsa} ratio of parts in temporary storage are tsa that can be used by automotive production plant p

r^{r}_{tsa} ratio of parts in temporary storage are tsa that can be recycled by recycling center r

r^{r}_{pc} ratio of parts in ELV processing center pc that can be recycled by recycling center r

r^{d}_{tsa} ratio of parts in ELV processing center pc that can be disposed by disposal center d

$$DV_{pd} = \begin{cases} 1, & \text{If the place of delivery of ELV pd will be opened} \\ 0, & \text{otherwise} \end{cases}$$

$$DV_{tsa} = \begin{cases} 1, & \text{If the temporary storage area tsa will be opened} \\ 0, & \text{otherwise} \end{cases}$$

$$DV_{pc} = \begin{cases} 1, & \text{If the processing center pc will be opened} \\ 0, & \text{otherwise} \end{cases}$$

$$DV_{r} = \begin{cases} 1, & \text{If the recycling center r will be opened} \\ 0, & \text{otherwise} \end{cases}$$

$$DV_{d} = \begin{cases} 1, & \text{If the disposal center d will be opened} \\ 0, & \text{otherwise} \end{cases}$$

$$a^{pd}_{z} = \begin{cases} 1, & \text{If the customer zone z has been assigned to the place of delivery pd} \\ 0, & \text{otherwise} \end{cases}$$

$$a^{tsa}_{pd} = \begin{cases} 1, & \text{If the place of delivery pd has been assigned to temporary storage area tsa} \\ 0, & \text{otherwise} \end{cases}$$

$$a^{pc}_{tsa} = \begin{cases} 1, & \text{If the temporary storage area tsa has been assigned to process center pc} \\ 0, & \text{otherwise} \end{cases}$$

$$a^{r}_{tsa} = \begin{cases} 1, & \text{If the temporary storage area tsa has been assigned to recycling center r} \\ 0, & \text{otherwise} \end{cases}$$

$$a^{r}_{pc} = \begin{cases} 1, & \text{If the process center pc has been assigned to recycling center r} \\ 0, & \text{otherwise} \end{cases}$$

$$a^{d}_{pc} = \begin{Bmatrix} 1, \text{ If the process center pc has been assigned to disposal center d} \\ 0, \text{ otherwise} \end{Bmatrix}$$

$$\text{Min z} = \sum_{z=1}^{Z}\sum_{pd=1}^{PD} q_z * d^{pd}_{z} * tc^{pd}_{z} * a^{pd}_{z}$$

$$+ \sum_{tsa=1}^{TSA}\sum_{pd=1}^{PD} q_{pd} * d^{tsa}_{pd} * tc^{tsa}_{pd} * a^{tsa}_{pd}$$

$$+ c_{tsa} * \sum_{tsa=1}^{TSA} q_{tsa} * DV_{tsa}$$

$$+ \sum_{tsa=1}^{TSA}\sum_{pc=1}^{PC} q_{tsa} * d^{pc}_{tsa} * tc^{pc}_{tsa} * a^{pc}_{tsa} * r^{pc}_{tsa}$$

$$+ c_{pc} * \sum_{pc=1}^{PC} q_{pc} * DV_{pc}$$

$$+ \sum_{tsa=1}^{TSA}\sum_{r=1}^{R} q_{tsa} * d^{r}_{tsa} * tc^{r}_{tsa} * a^{r}_{tsa} * r^{r}_{tsa}$$

$$+ \sum_{tsa=1}^{TSA}\sum_{d=1}^{D} q_{tsa} * d^{d}_{tsa} * tc^{d}_{tsa} * a^{d}_{tsa} * (1 - r^{p}_{tsa} - r^{s}_{tsa} - r^{pc}_{tsa} - r^{r}_{tsa})$$

$$+ \sum_{pc=1}^{PC}\sum_{r=1}^{R} q_{pc} * d^{r}_{pc} * tc^{r}_{pc} * a^{r}_{pc} * r^{r}_{pc}$$

$$+ \sum_{pc=1}^{PC}\sum_{d=1}^{D} q_{pc} * d^{d}_{pc} * tc^{d}_{pc} * a^{d}_{pc} * (1 - r^{r}_{pc})$$

$$+ c_{r} * \sum_{r=1}^{R} q_{r} * DV_{r}$$

$$+ c_{d} * \sum_{d=1}^{D} q_{d} * DV_{d}$$

$$+ \sum_{pd=1}^{PD} DV_{pd} * FC_{pd}$$

$$+ \sum_{tsa=1}^{TSA} DV_{tsa} * FC_{tsa}$$

$$+ \sum_{pc=1}^{PC} DV_{pc} * FC_{pc}$$

$$+ \sum_{r=1}^{R} DV_{r} * FC_{r}$$

$$+ \sum_{d=1}^{D} DV_{d} * FC_{d} \qquad (5.1)$$

$$\sum_{pd=1}^{PD} a^{pd}_{z} = 1 \qquad \forall (z \in Z) \qquad (5.2)$$

$$\sum_{tsa=1}^{TSA} a^{tsa}_{pd} = 1 \qquad \forall (pd \in PD) \qquad (5.3)$$

$$\sum_{pc=1}^{PC} a^{pc}_{tsa} = 1 \qquad \forall (tsa \in TSA) \qquad (5.4)$$

$$\sum_{r=1}^{R} a^{r}_{tsa} = 1 \qquad \forall (tsa \in TSA) \qquad (5.5)$$

$$\sum_{d=1}^{D} a^{d}_{tsa} = 1 \qquad \forall (tsa \in TSA) \qquad (5.6)$$

$$\sum_{r=1}^{R} a^{r}_{pc} = 1 \qquad \forall (pc \in PC) \qquad (5.7)$$

$$\sum_{d=1}^{D} a^{d}_{pc} = 1 \qquad \forall (pc \in PC) \qquad (5.8)$$

$$\sum_{z=1}^{Z} q_{z} * a^{pd}_{z} \leq HC_{pd} * DV_{pd} \qquad \forall (pd \in PD) \qquad (5.9)$$

$$\sum_{pd=1}^{PD} q_{pd} * a^{tsa}_{pd} \leq HC_{tsa} * DV_{tsa} \qquad \forall (tsa \in TSA) \qquad (5.10)$$

$$\sum_{tsa=1}^{TSA} q_{tsa} * a^{pc}_{tsa} \leq HC_{pc} * DV_{pc} \qquad \forall (pc \in PC) \qquad (5.11)$$

$$\sum_{tsa=1}^{TSA} q_{tsa} * a^{r}_{tsa} * r^{r}_{tsa} + \sum_{pc=1}^{PC} q_{pc} * a^{r}_{pc} * r^{r}_{pc} \leq HC_r * DV_r \qquad \forall (r \in R) \qquad (5.12)$$

$$\sum_{tsa=1}^{TSA} q_{tsa} * a^{d}_{tsa} * (1 - r^{p}_{tsa} - r^{s}_{tsa} - r^{r}_{tsa} - r^{pc}_{tsa}) + \sum_{pc=1}^{PC} q_{pc} * a^{d}_{pc} * (1 - r^{r}_{pc}) \leq HC_d * DV_d$$

$\forall (d \in D)$ (5.13)

$$d^{pd}_{z} \leq md \qquad (5.14)$$

$DV_{cc}, DV_{pc}, DV_{wcc}, DV_r, DV_d, a^{cc}_{z}, a^{pc}_{cc}, a^{wcc}_{pc}, a^{r}_{wcc}, a^{d}_{wcc} \in \{0,1\} \ \forall (z \in Z), \ (cc \in CC), (pc \in PC), (wcc \in WCC), (r \in R), \ (d \in D)$ (5.15)

$0 \leq r^{s}_{tsa}, r^{p}_{tsa}, r^{r}_{tsa}, r^{r}_{pc}, r^{d}_{tsa} \leq 1$ (5.16)

Objective function (5.1) minimizes the total cost, which includes fixed opening costs, cost of operations in processing and waste collection centers and transportation costs. Constraints (5.2)–(5.8) assure that one center/customer zone is assigned to a center if there is a material flow between them. Constraints (5.9)–(5.13) are capacity constraints for places of delivery, collection, processing, recycling and disposal centers. Constraint (5.14) ensures that the distance between customer zones and place of deliveries cannot be greater than a specified value. Constraints (5.15)-(5.16) are binary and non-negativity restrictions on corresponding decision variables.

5.3 ELV in Turkey

Model presented in Section 5.2 deals with all reverse logistics network design issues for ELVs but in Turkey, there are a lot of facilities already opened in reverse logistics network. So the problem has been reduced to assignment of a facility to the next level facility in reverse logistics network to minimize cost of reverse logistics activities. It has been assumed that 50,000 vehicles will be deregistered each year and this number has been shared due to the vehicle numbers by cities by February 2012 [58]. Figure 5.2 shows number of vehicles deregistered by cities. Ministry of Environment and Urban Planning web site contains a list of facilities those deal with ELVs including their addresses [59]. Using these addresses, latitudes and longitudes of facilities have been specified nearly. Using their addresses, latitudes and longitudes of vehicle production

plants have been specified also [60]. It has been assumed that each city contains one automotive repair service and they have been located in city center. Their latitude and longitude information have been specified due to these assumptions. Ratios of parts sent from temporary storage areas to vehicle production plants have been calculated based on production amounts of these plants by the year 2011 and ratios of parts sent from temporary storage areas to automotive repair service have been calculated based on the vehicle numbers by cities by February 2012 [58, 61]. Process and disposal centers have been specified from Ministry of Environment and Urban Planning web site [62]. Using these latitude and longitude information, distances between facilities have been calculated. Vehicles deregistered have been distributed to temporary storage areas randomly. Facilities, their locations, calculated distances, automotive production plants' production ratios, cities' vehicle ratios have been stored in a database and model have been coded and solved by *Lingo 9*® software. Table 5.1 shows parameters changed and costs of reverse logistics activities found in each execution of program written in *Lingo 9*®. r_1 denotes reuse ratio by vehicle production plants, r_2 denotes reuse ratio by automotive repair services, r_3 denotes recycling ratio and finally r_4 denotes disposal ratio of materials sent from processing centers to disposal centers. Negative cost means that the reverse logistics activity is profitable. Details of values cited above can be found in Appendix B. Transportation cost from temporary storage area and processing center to disposal center is 0.23 TL / km and 0.40 TL / km between other facilities. Cost of operations in temporary storage areas is 220 TL, cost of operations in processing centers is 130TL and cost of operations in disposal centers is 50 TL per vehicle. Recycled vehicles and reused parts in automotive repair services provide an income of 525 TL. These values have been taken another study about ELV management [21]. Income gained from vehicles those are reused by automotive repair services has been accepted 1050 TL.

Table 5.1Parameters used in the model and corresponding results

r_1	r_2	r_3	r_4	Cost
0	0.4	0.4	0.25	5,462,153.6
0.05	0.25	0.6	0.1	-361,972.7
0.15	0.25	0.5	0.1	-2,731,776.7

The problem has been executed 3 times with different reuse and recycling parameters. Results show that increasing reuse rate decreases cost of reverse logistics activities and a reuse rate 0.15 by vehicle production plants, a reuse rate 0.1 by automotive repair services and a recycling rate 0.5 make ELV treatment profitable. Results also show that some of the temporary storage areas have 0 vehicle assigned to them, meaning none of the place of deliveries will send vehicles to them. Kocaeli has an ELV processing center and an ELV disposal center, so Kocaeli has the biggest share for processed and disposed vehicles among other cities. İzmir, another city that has a processing and disposal center, ranks second in number of vehicles processed and disposed.

Table 5.2 shows costs and incomes for parameter sets in Table 5.1. First column of the table shows costs and incomes for the first parameter set. It is seen that reuse in automotive repair services and recycling activities are profitable but costs of operations in temporary storage areas, processing centers and disposal centers are greater than these incomes, so reverse logistics activities with the first parameter set have negative market value. When investigating second column of table, it is seen that increasing r_1 to 0.05 and also a little increase in sum of r_2 and r_3 makes reverse logistics activities profitable. And finally decreasing recycling ratio and adding this ratio to reuse ratio in automotive production plants increases profit of reverse logistics activities nearly 8 times.

Details of results such assignments of facilities can be found in Appendix C. Program written in *Lingo 9*® can be found in Appendix D.

Figure 5.3, Figure 5.4 and Figure 5.5 shows vehicle quantities after the program has been executed for the first parameter set. Figure 5.3 shows vehicle quantities in temporary storage areas after the place of deliveries have been assigned to them. Figure 5.4 shows vehicle quantities in process centers after the temporary storage areas have been assigned to them. And Figure 5.5 shows vehicle quantities in disposal centers after the temporary storage areas and process centers have been assigned to them.

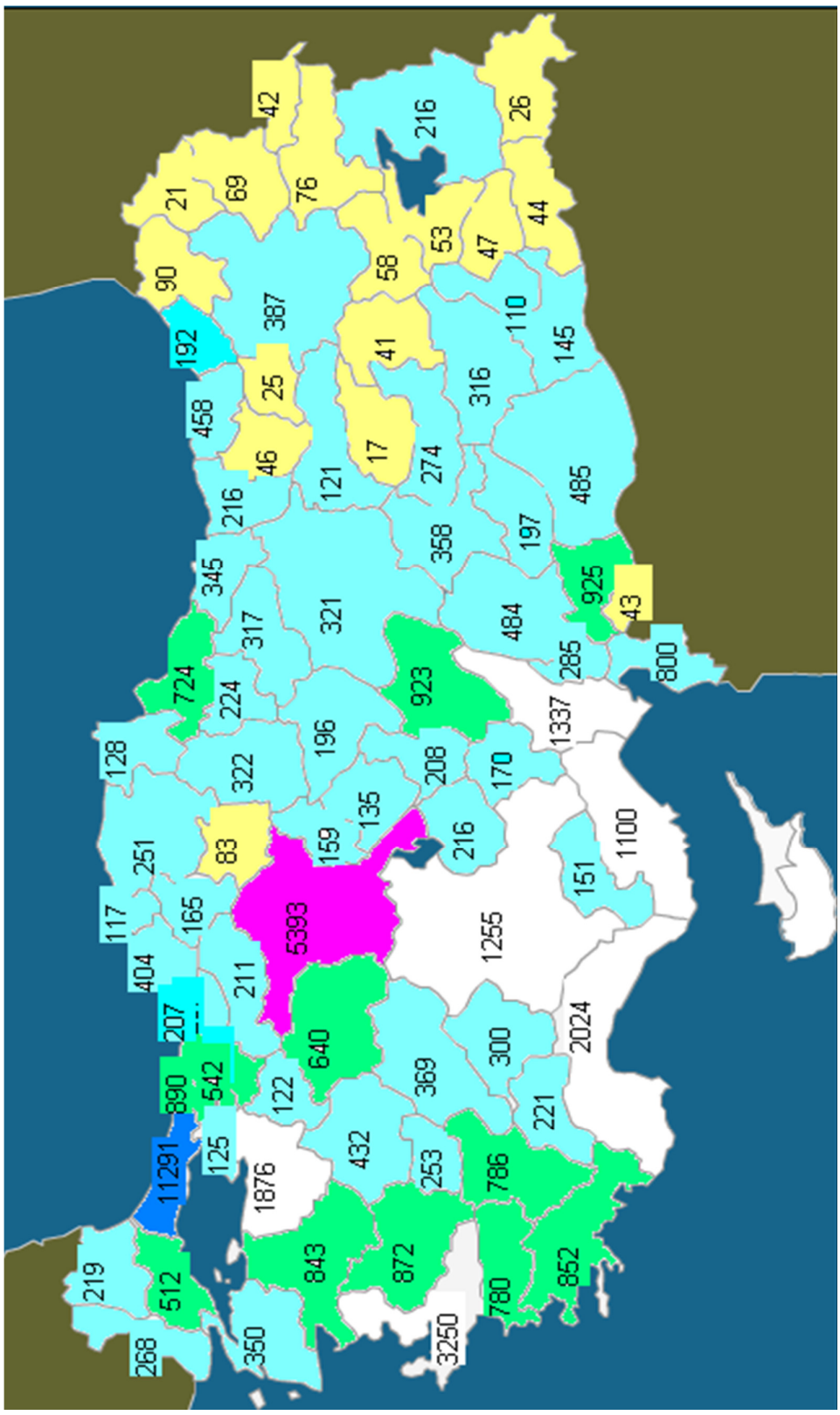

Figure 5.2 Number of vehicles deregistered

Table 5.2 Cost and incomes calculated

Cost / Income	Parameter Set 1	Parameter Set 2	Parameter Set 3
Transportation cost from PD to TSA	1,219,860.6	1,268,194.0	1,250,183.5
Transportation cost from TSA to APF	0	333,896.8	965,168.7
Income from reuse in APFs	0	-2,596,174.6	-7,788,523.7
Transportation cost from TSA to ARS	4,328,211.6	2,744,698	2,703,327.1
Income from reuse in ARSs	-10,384,698.4	-6,490,436.5	-6,490,436.4
Transportation cost from TSA to PC	1,090,443	1,562,578	1,226,706.4
Income from recycling in PCs	-10,383,660	-15,575,490	-12,979,575
Transportation cost from TSA to DC	634,033,2	322,070	316,108.4
Disposal cost for materials sent from TSA	494,460	247,230	247,230.0
Cost of operations in TSAs	10,878,120	10,878,120	10,878,120
Transportation cost from PC to DC	539,328.8	268,131.6	264,704.3
Disposal cost for materials sent from PC	618,075	247,230	247,230
Cost of operations in PCs	6,427,980	6,427,980	6,427,980
Total	5,462,153,6	-361,972.7	-2,731,776.7

Figure 5.6, Figure 5.7 and Figure 5.8 shows vehicle quantities after the program has been executed for the second parameter set. Figure 5.6 shows vehicle quantities in temporary storage areas after the place of deliveries have been assigned to them. Figure 5.7 shows vehicle quantities in process centers after the temporary storage areas have been assigned to them. And Figure 5.8 shows vehicle quantities in disposal centers after the temporary storage areas and process centers have been assigned to them.

Figure 5.9, Figure 5.10 and Figure 5.11 shows vehicle quantities after the program has been executed for the third parameter set. Figure 5.9 shows vehicle quantities in temporary storage areas after the place of deliveries have been assigned to them. Figure 5.10 shows vehicle quantities in process centers after the temporary storage areas have been assigned to them. And Figure 5.11 shows vehicle quantities in disposal centers

after the temporary storage areas and process centers have been assigned to them. This parameter set has the biggest reuse ratio by the automotive production plants; this made some places of delivery to be assigned to Bursa city which has the greatest vehicle production ratio among other cities in Turkey.

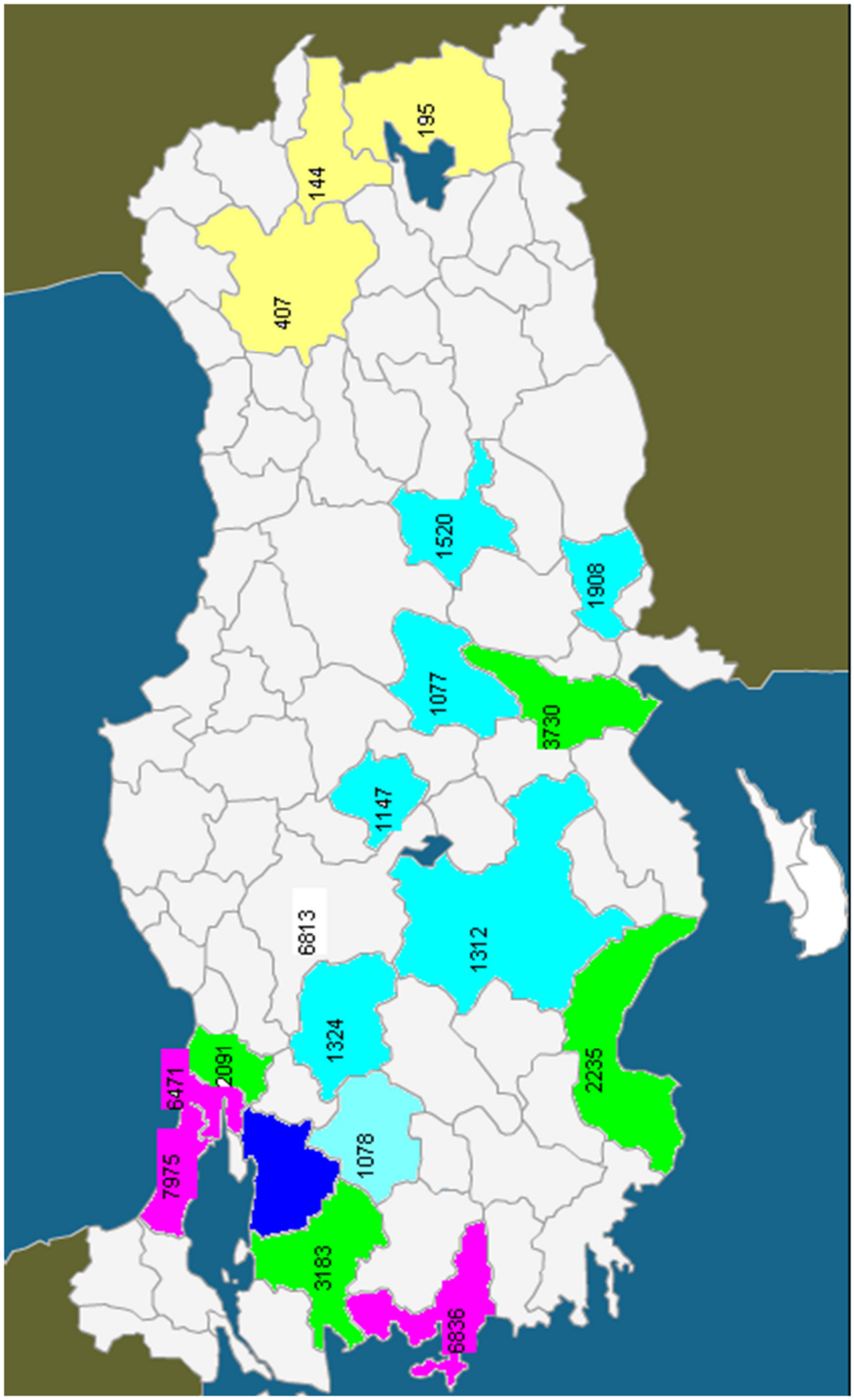

Figure 5.3 Vehicle amounts in temporary storage areas for the first parameter row

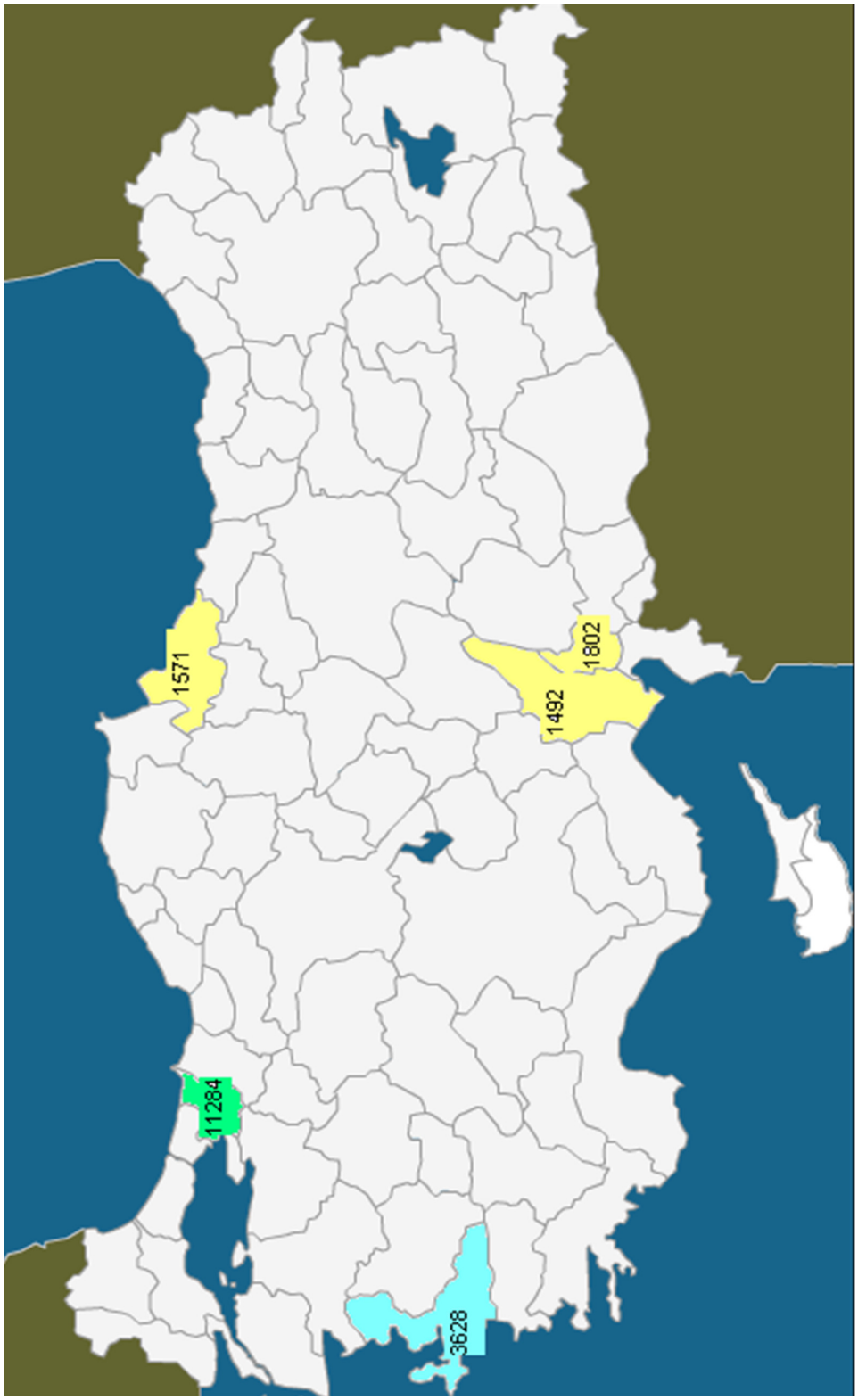

Figure 5.4 Vehicle amounts in process centers for the first parameter row

Figure 5.5 Vehicle amounts in disposal centers for the first parameter row

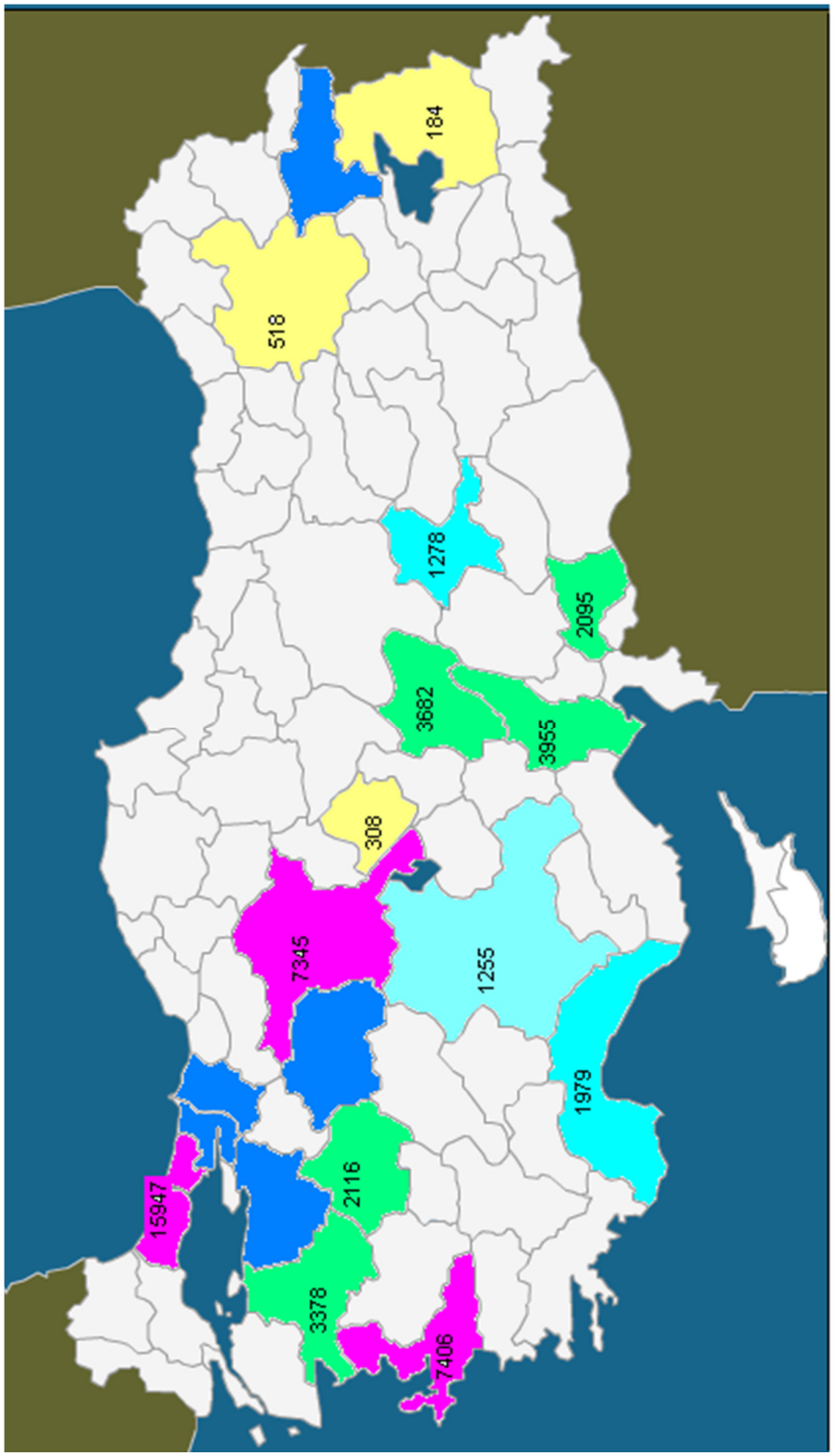

Figure 5.6 Vehicle amounts in temporary storage areas for the second parameter row

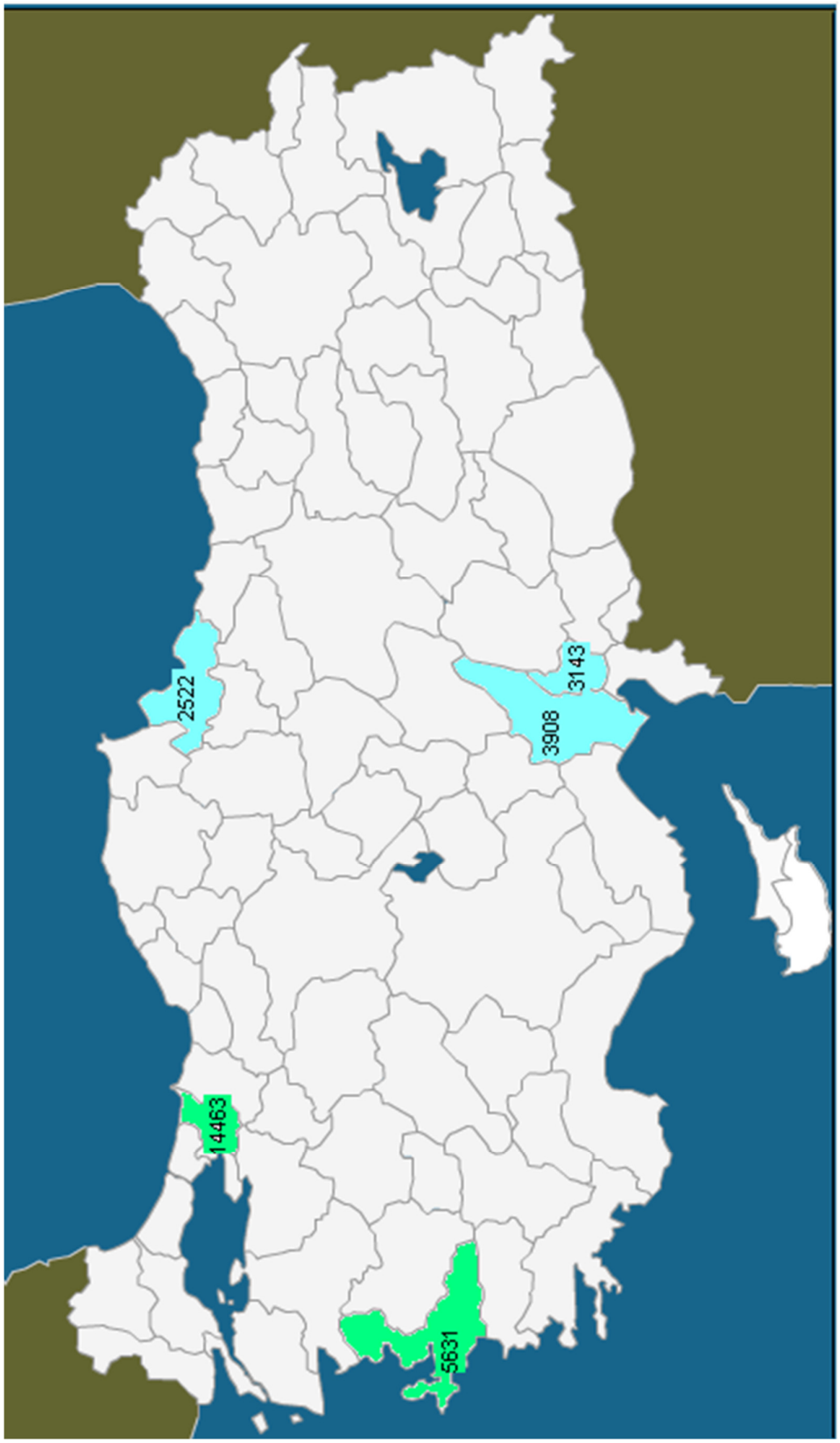

Figure 5.7 Vehicle amounts in process centers for the second parameter row

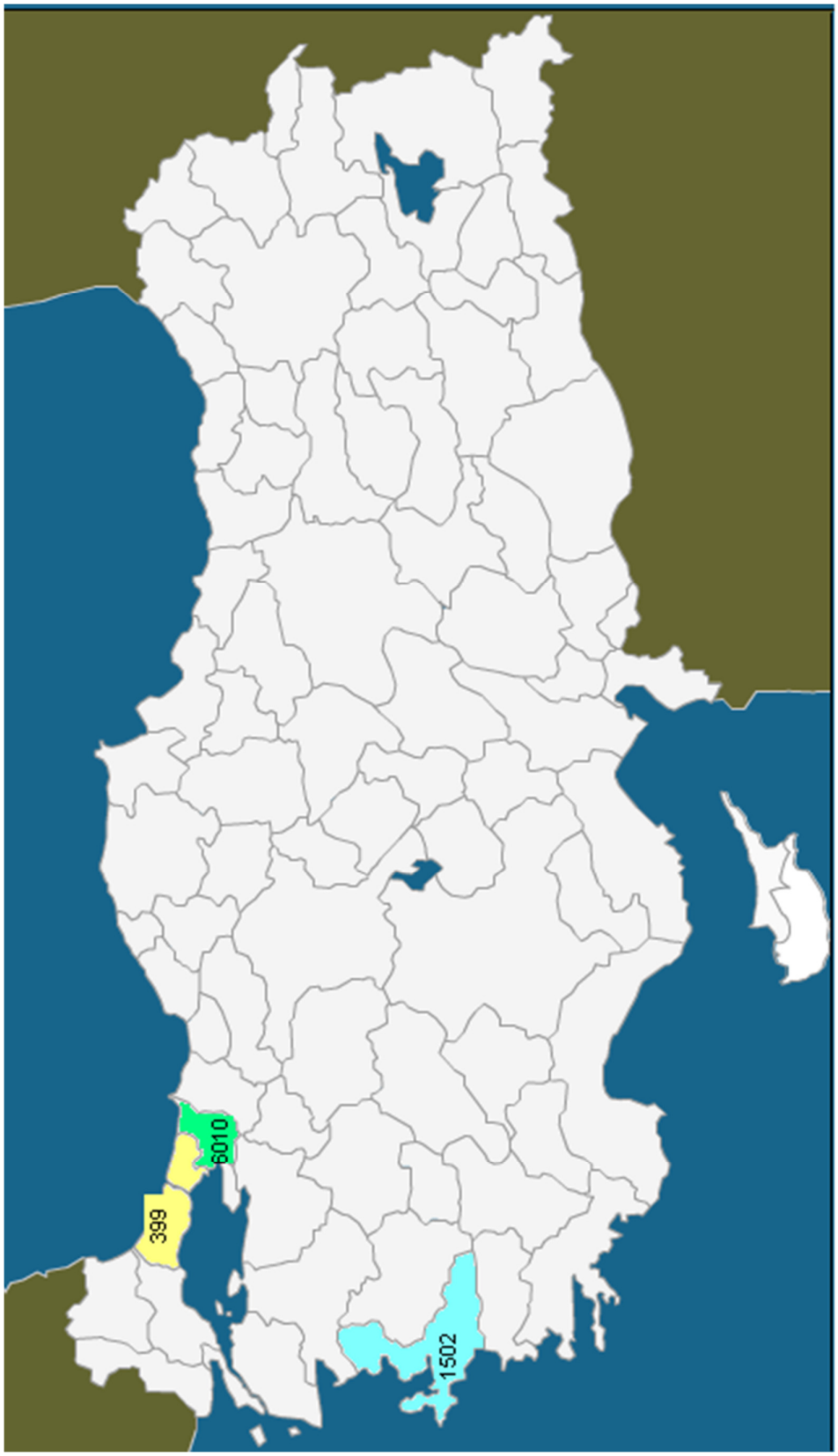

Figure 5.8 Vehicle amounts in disposal centers for the second parameter row

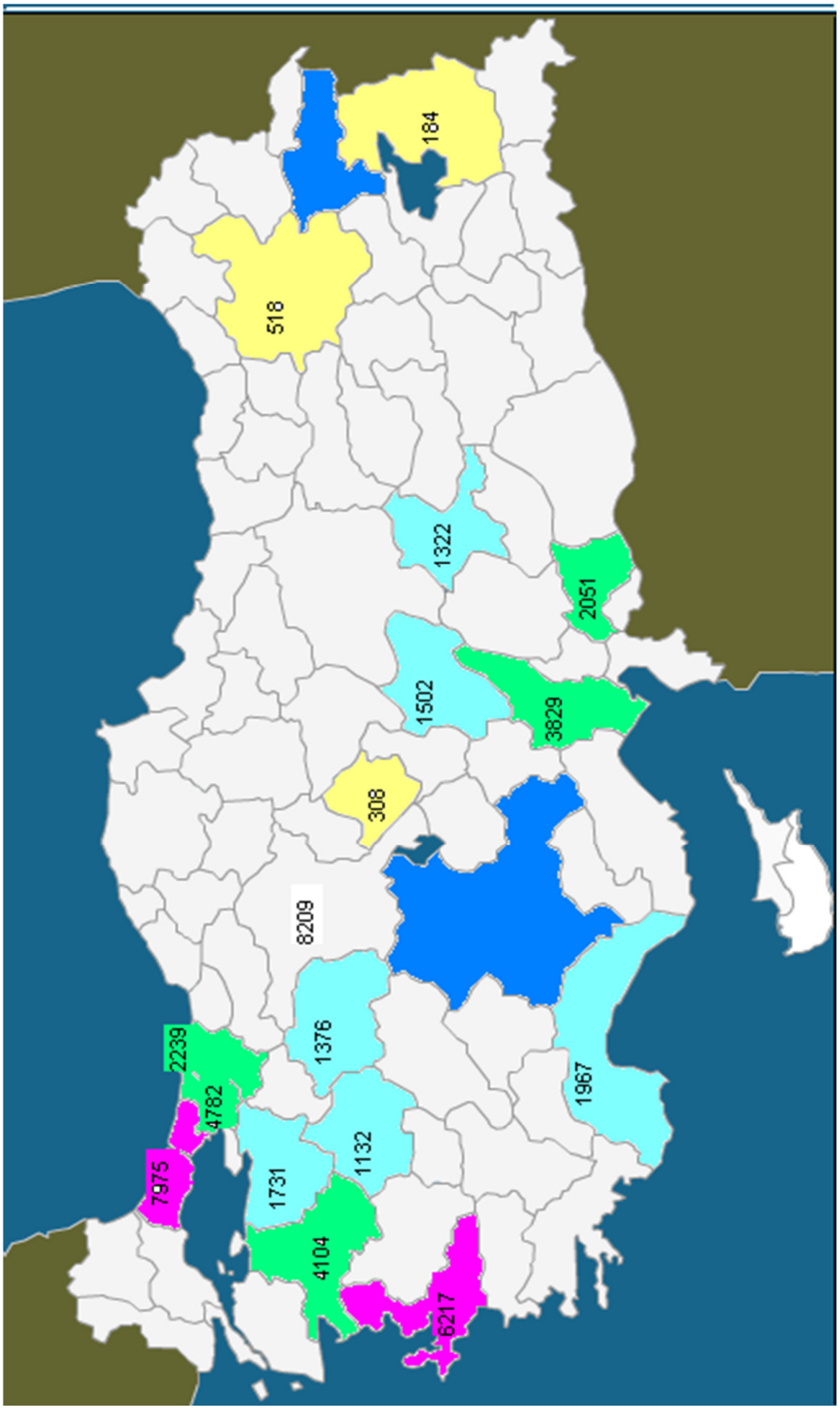

Figure 5.9 Vehicle amounts in temporary storage areas for the third parameter row

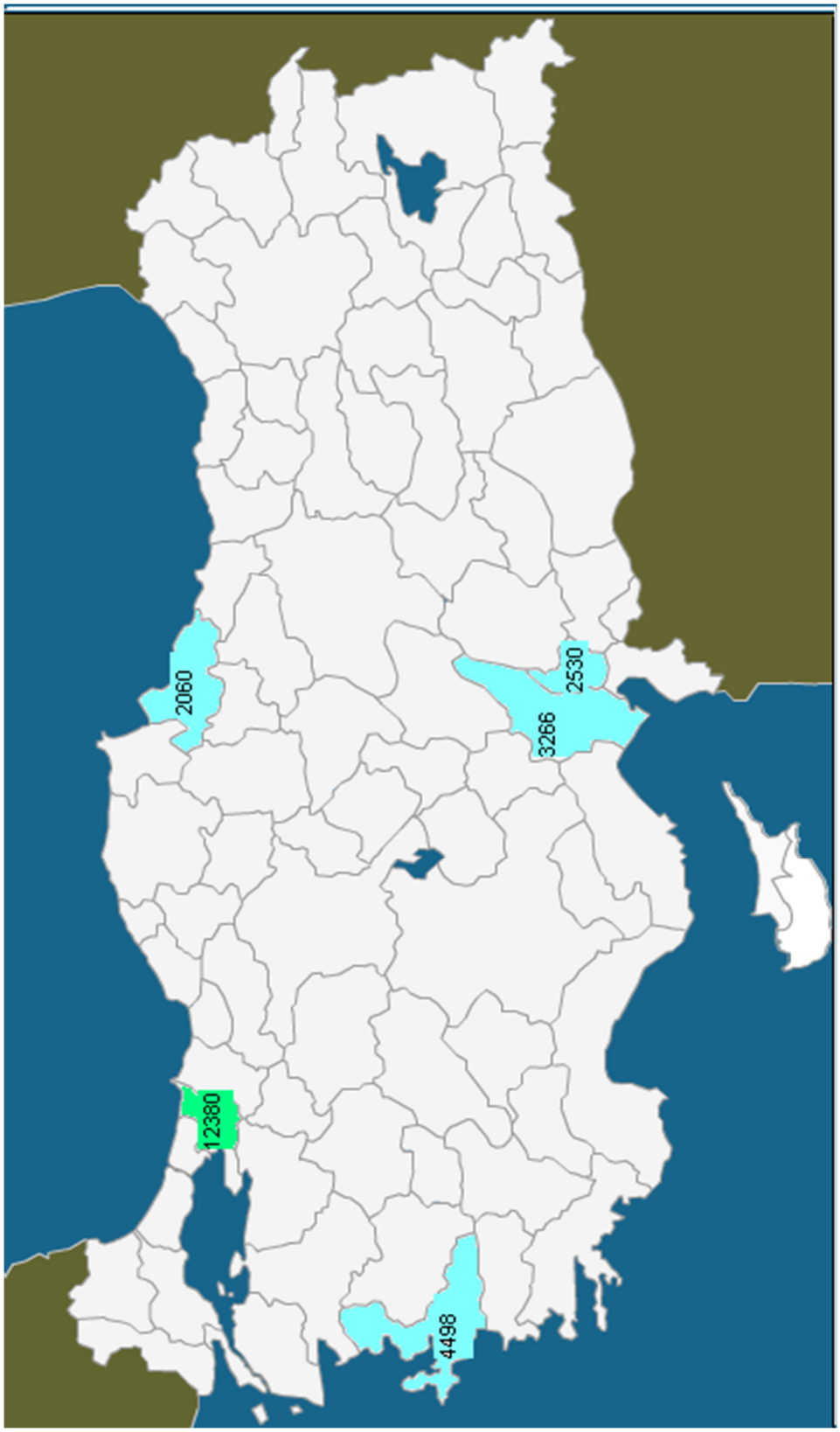

Figure 5.10 Vehicle amounts in process centers for the third parameter row

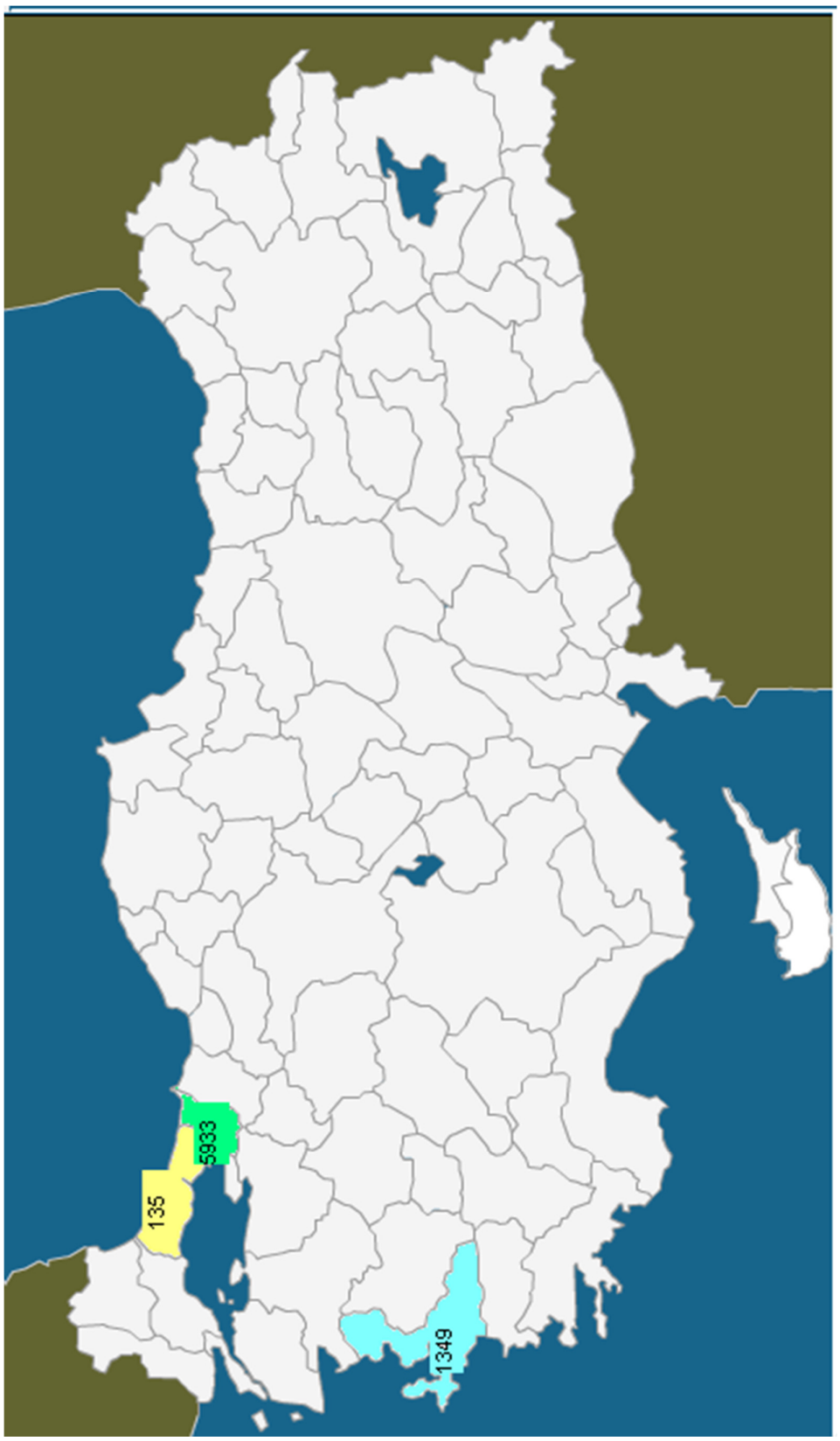

Figure 5.11 Vehicle amounts in disposal centers for the third parameter row

6 DISCUSSION AND LIMITATIONS

In this study, a model has been presented to minimize costs of ELV reverse logistics activities. Model decides which facilities should be opened and assignment of a facility to another one in the next level in reverse logistics network. Since there are a lot of facilities opened in current situation, the problem has been reduced to assignment of facilities to each other. When investigating number of vehicles deregistered for the last 12 years, it is seen that the average of numbers is about 50,000, so while solving problem, 50,000 has been accepted as number of vehicles deregistered. Also, processing centers that are already open are integrated facilities which mean that they operate like both processing and recycling centers. This has been reflected to the model solved. Since the model has been solved over the facilities that are already open, facility opening costs are also excluded from the model solved.

Locations of facilities are not exact locations, latitude and longitude information of facilities are found nearly from their addresses. Number of vehicles deregistered is distributed to cities right proportional to the vehicle numbers in these cities. Then these numbers are distributed to places of deliveries randomly which decreases certainty of results.

In this study, ELV management in Turkey has been analyzed over the open facilities and nearly values for number of deregistered vehicles. Study can be expanded to solving model presented in Section 5.2 to see the effectiveness of current situation, facility opening decisions can be compared with currently open decisions and costs can be compared with current costs. Also new candidate facility locations can be added to analyze whether any improvement can be done or not by opening new facilities.

Program written in *Lingo 9*® contains 47,343 variables, 47,270 of them are integer variables and 605 of them are nonlinear variables. Program contains 928 constraints, 9 of them are nonlinear constraints. Because of the numbers of variables and constraints,

problem requires long solution times. Solution times for each parameter set are 29 hours, 6.5 hours and 9 hours in order.

7 CONCLUSION

Products are produced by using raw materials. These produced products are delivered to final customers and after their useful lives, they should be collected from end customers and should be treated properly. This will prevent material loss by increasing reuse and recycling and will prevent environment by disposing materials that can't be recovered properly. End of life vehicles are cars and light trucks that are considered waste and that must be disposed of. They will cause material loss, environmental pollution and will affect human health negatively if they are not treated properly. Countries those are aware of these dangers made their laws to obligate producers to obligate producers to collect and treat ELVs properly based on the 'Extended Producer Responsibility' principle. ELV Directive in Turkey [1] also obligates producers to treat ELVs. They also have to open delivery places where there is no delivery place. Opening facility and transportation of vehicles, parts and materials between facilities are expensive activities and producers have to collect and treat ELVs without demanding any price from end customers, so reverse logistics activities become important for treatment of ELVs. ELV Directive also brings minimum reuse and recycling ratios for ELVs but especially reuse of parts is not an achieved goal for newly produced products. Oyak Renault states that producers beware from reusing old parts in new vehicles due to safety and brand equity considerations.

The purpose of this study is to propose a model that minimizes facility opening cost, transportation cost of ELVs between facilities and ELV processing cost based on ELV Directive in Turkey. Since there are a lot of facilities opened to treat ELVs, the problem has been reduced to assignment of a facility to another facility that is in the next level in the reverse logistics network. Also, different reuse and recycling parameters have been used to measure effect of these parameters in reverse logistics tasks.

After execution of program with different parameter sets, it is seen that increasing reuse and recycling ratios makes reverse logistics activities profitable. Profits gained from reuse and recycling are greater than the transportation costs of vehicles between facilities and operational costs in facilities. Since ELV Directive in Turkey [1] also brings minimum reuse and recycling rates for ELVs and treating ELVs properly protects environment, human health and prevents material loss, reuse and recovery rates for ELVs should be increased as much as possible.

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APPENDIX A

WASTE MANAGEMENT IN TURKEY

Rapid urbanization and population growth parallel to technological developments and industrialization is rapidly increasing the pressure of human activities on the environment in Turkey as in the whole world. By meeting unlimited human needs at higher levels with the help of the technology causes the environment and human health facing serious threats due to the destruction of natural resources and products becoming waste EoL stage. Preventing overuse of natural resources by minimizing waste generation in both production and marketing processes and recycling of waste generated at highest level possible and making them an input to the economy, in other words, sustainable waste management, is a very important element of the sustainable development approach that is increasingly adopted as a priority policy in all over the world [24].

Waste management has been the subject of legal regulations since 1930s and municipalities are entrusted as the main implementing agencies. Policy determination in national level and directing implementation tasks initial carried out by the Ministry of Health are now by the Ministry of Environment and Forestry [24].

Due to the data provided by TurkStat for 2004, the annual amount of waste collected by municipalities is 34 million tons in Turkey. In other words, 1.34 kg waste was produced per person. Waste generated by production industry, of which great portion is recycled is 17.5 million tons [63] and this makes a total of 2 kg daily waste production per person [24].

General Framework of National Waste Management Strategy

Waste prevention at source, decomposition of waste at source, gaining back the recyclable wastes to the economy and so reducing the amount of waste to be

warehoused and warehousing the wastes that cannot be recycled in a way that won't harm environment and human health are basic elements of a health waste management system. Turkey needs to work much to meet these requirements. More than half of the waste generated in Turkey is recyclable or at least can be converted to a value. By increasing recycling, cost of waste management will decrease and municipalities, which spend 40% of their income due to the data provided by the Ministry, will be able to gain profit from recycling of waste [24].

Protection of environment is an important issue for European Union. Environment, regulated about 300 directive and regulations [64], comprises one of the most comprehensive fields of acquis communitaire. The Turkey's national legislation harmonized with acquis communitaire in the framework of the projects carried out by financial and technical support of EU in nomination process. However, several difficulties are experienced in implementing these regulations due to the lack of infrastructure, institutional and technical capacity [24].

There are several factors of not having an efficient and sustainable waste management system:

- Not giving priority to waste management as a national policy.
- Not providing a qualified institutional infrastructure to waste management in national and local level.
- Not giving enough resource for waste management services.
- Pressure caused by the need of finding solution to the problems of past and meeting today's requirements.
- Being insufficient of taxes and fees collected for the services given in this field.
- Lack of adequate coordination and cooperation between the large number of state agencies and organizations which are given authorization and responsibility.
- Existing technical capacity is insufficient, infrastructure facilities are insufficient in terms of number and the vast majority of them have very primitive conditions.
- Insufficient implementation of legal regulations that fits to international standards and EU norms.

- Insufficient auditing and monitoring activities.
- Not enforcement of sanctions to the contrary behavior [24].

Waste Management in Environmental Law

The beginning of legal regulations related to waste management in Turkey started about 80 years ago. Municipality Law no. 1580 [65] came into force in 1930 and Sanitation Law no. 1593 [66] contains regulations concerning waste collection, storage of waste and taking necessary measures to protect public health. The Constitution of 1982 [67] states that "Everyone has the right to live in a healthy and balanced environment" in article 56. Environmental Law, dated 11.08.1983 and numbered 2872 [68] and which is a framework law on environmental protection brings principles and rules on environmental protection, defines responsible agencies and organizations, and identifies practical processes and punishments due to the "polluter pays" principle. Basic provisions of waste management are also included in laws regarding to municipal management. Turkey is also a party of "Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal" which includes provisions for waste management. Regulation on Solid Waste Control of 1991 [69] set out the general framework of waste management. Regulations requires reduction of waste generation as much as possible, decomposition of recyclable materials at its source, reuse of economically valuable wastes and disposal of non-recyclable wastes by environment friendly methods. Regulation on Hazardous Waste Control [70], using Environmental Law [71] and Basel Agreement [72] as basis, came into force in 1995 and this regulation has been rearranged in 2005 to comply with acquis communitaire. Separate regulations on control of packaging and packaging wastes, waste oil, medical wastes, construction and demolition wastes, used battery and accumulators and end of life tires have also been prepared. By the amendments in Environmental Law in 2006, the way financing waste services has been changed. Scope of penalties for practices that causes environmental pollution has been expanded and penalty amounts have been increased considerably. Severe penalties have been stipulated for municipalities that do not fulfill their obligations [24].

Waste Management in National Plan and Programs

First five five-year development plans put into effect since 1963 [73] provided environmental issues increasingly but they didn't contain separate heading about waste management. In the sixth five-year development plan (1990-1994) [74], waste management had a separate heading and it had been stated that the municipalities would be supported to compose common solid waste disposal facilities, landfill locations and their operational basics would be specified, medical wastes would be disposed separately and storage tanks would be ordered for liquid parts of nuclear wastes . In the seventh plan [75], policies about the preparation of the national environmental strategy, harmonization of environmental legislation to the EU and other international standards, providing support to local governments, supporting waste minimization and recycling efforts and preventing the importation of all kinds of waste have been adopted. It has also been specified that capacity will be incremented about waste management. In the eighth plan (2001-2005) [76], principles and policies about waste separation at source, households' awareness, renewal of legislation, increasing environment cleaning tax to a level to meet the costs, planning and implementing waste management from a single source in metropole municipalities have been adopted [24].

Waste Management Policies and Achievement in Application

Rapid growth of urban population and changes in the consumption patterns leads to a rapid increase in the amount of waste that should be managed in urban areas. Waste management costs are increasing day by day due to the growth of cities, new landfill areas that are far from city, increasing traffic congestion and so on. Increase in industrial and marketing activities also increases the pressure of waste generated at production, marketing and consumption stages on environment. Waste management principles should be effectively implemented in order to reduce these pressures and preventing wastes from being a problem and making wastes economically valuable [24].

Waste Prevention Policies

Waste prevention includes decreasing amount of waste and dangerousness level of waste. Waste prevention is the most effective way of preventing the loss of energy resources and natural resources. It is also the basic factor of environment protection and sustainable use of natural resources. Due to these facts, waste prevention (or waste minimization) has the highest priority in Environmental Law and in other regulations about waste management. Although it has the highest priority in regulations, it has not been clearly stated how to achieve this. Disposal policies have more importance in regulations about implementing waste management. Amount of waste generated is directly related with production processes and quality of technology used in production. Waste minimization can be achieved by changes that can be implemented at small costs. Improvement of the public and consumer awareness has a vital role in the success of waste prevention policies. Using environment friendly technologies, adopting a clean production policy in national level and implementing this policy, fulfilling international obligations on environment will strengthen the place of Turkey in world and increase the portion of Turkey in world trade [24].

Waste Recovery Policies

Recovering waste by reuse, recycling, composting and energy producing methods decreases production costs by letting use of economically valuable materials and decreasing disposal costs. By increasing the ratio of recovered materials in production, pressure of economical activities on natural resources and pressure of wastes on environment will decrease. Separation of wastes at source is the most important factor in recovery. Recycling not only saves natural resources but also decreases energy consumption. Due to results of scientific searches, energy consumed in recovery of metal and plastic packaging is 5% of the energy used in their production. For these reasons, recovery has been encouraged in legislations of Turkey and regulated by fixed standards. Producers of packaging have to meet recycling quota specified. In this context, there are foundations and organizations established by producers and distributers. In fact, current legislation has installed the responsibility of decomposition to production, distribution and sales units including households and provides criminal

sanctions for contrary behavior. Even, by prohibiting the acceptance of waste except organic wastes to landfill areas, made recycling obligatory. Recycling is a commercial activity in Turkey since 1950s, especially for glass and paper wastes. But decomposition operation has been performed by individual collectors or "street collectors". This is the most common method in Turkey and researches requested by the Ministry shows that 25-30% of recycled materials are recovered in this way. In addition, a very limited amount of recycling activity is organized by the municipalities [24].

Wastes from houses are directly transferred to landfill areas by municipalities without any decomposition operation. Lack of infrastructure to collect and transfer wastes separately causes wastes not to be decomposed in houses although it is a legal obligation. The other implementation problem is about the producers and distributers. Foundations and associations established by them to decompose, transfer and recycle wastes pay for the amount of waste collected by the "street collectors" and take a voucher for these wastes to fulfill their obligatory instead of establishing reverse logistics network. Deregistration of recovery sector is a problem for recovery operation, also [24].

One of the methods to be applied to recover waste is the composting of organic wastes. Wastes in Turkey are eligible to compose because of their high organic material content. By composting, 65% of organic wastes can be converted to humus and this will provide a longer life to landfill areas. Compost obtained can be used for enrichment of soil in agricultural productions areas or preventing erosion [24].

Waste Transportation and Storage Policies

Transportation of domestic and medical wastes and excavation and construction ruins are in the responsibility of municipalities and this is usually realized by private sector by the auction method. Hazardous and specific wastes should be transferred by vehicles that meet specified standards and have transfer license. Municipalities are also the main responsible for landfilling. But achievement of municipalities in collecting and transferring waste cannot be realized in disposal of wastes. The most common for

disposal of wastes in Turkey is the storage of them irregularly in a suitable area. Regular storage, composting, incineration and recovery are not very common. Wastes are not treated separately due to their types, also. Facility location for landfilling is another problem. Errors in selecting facility location and operational conditions cause problems that increase day by day. But facility location problem has been solved by studies in scope of circular numbered 2003 / 8 about 78-80% percent [24].

Hazardous and Medical Waste Control Policies

Pressure of wastes on environment is mostly caused by rapid growth of industry and energy sectors. Disposal of hazardous wastes mostly requires special technologies but cost of these technologies and insufficient legal obligations let these wastes to be leaved to nature or storage areas with other types of waste. Turkey, which is a country surrounded by three seas, faces the problems of hazardous barrels left to coasts and chemicals poured into the sea after ship accidents. These threats both environment and human health. After Basel Convention came into force, foreign-based pollution has decreased and Turkey became the owner of more powerful tools for waste management [24].

Medical waste is a source of infection and communicable diseases such as hepatitis and AIDS carry the high risk of contamination. Because of this, medical wastes should be decomposed from other types of wastes and it needs special requirements in decomposition, temporary storage, transfer and disposal stages. Special pricing system is applied for medical system and charges are determined by Local Environment Committees each year. Medical waste is the only field to which the “polluter pays” principle has been applied. Number of municipalities that have suitable medical waste incineration or storage facility is yet nine. According to the Ministry of Environment and Forestry, medical wastes are regularly stored in Ankara, Bursa, Izmir, Gaziantep, Denizli, Malatya and Erzincan and incinerated in Istanbul and Kocaeli. 29% percent of medical wastes are generated in these cities in Turkey. Hazardous and medical wastes left to natural environments unconsciously interferes to ground-water and pollutes it. This type of pollutants, by entering into the plants and animal bodies in various ways,

goes through human organism that is last link of food chain and threatens human health [24].

According to the calculations of the Ministry of Environment and Forestry by using several data sources, unit cost of collection and disposal of domestic wastes in medium term is 40 $ / year. However, the accrued tax per household is 15 $. If it is assumed that each household produces 1.5 ton wastes each year, 10 $ is collected per ton. In small municipalities, this ratio decreases. It is not possible to finance waste management investments by these taxes that correspond to a small fraction of operational costs for most of the municipalities [24].

Waste Control Financing Policies

Hazardous waste incineration plants cost 853 million € and the construction of hazardous waste storage areas costs 110 million € by prices of 2004. An investment of 74 million € has been foreseen for the construction of transfer stations. Investment cost of 35 solid waste incineration facilities has been calculated as 2.8 billion €. Total amount of investment needed to comply with EU environmental directives has been calculated as 60 billion € [24].

APPENDIX B

List of Places of Delivery

City	Latitude	Longitude	Vehicle Count
Adana	36.5950	35.1150	111
Adana	36.5924	35.1828	136
Adana	36.5926	35.2132	25
Adana	36.5949	35.1626	109
Adana	36.5950	35.1150	140
Adana	37.0041	35.1502	98
Adana	36.5913	35.1516	34
Adana	36.5950	35.1150	51
Adana	36.5912	35.1517	45
Adana	36.5950	35.1150	72
Adana	36.5950	35.1150	1
Adana	36.5954	35.1924	14
Adana	36.5950	35.1150	25
Adana	36.5933	35.1052	64
Adana	36.5833	35.2325	60
Adana	36.5901	35.2237	126
Adana	36.5918	35.1600	105
Adana	36.5950	35.1150	13
Adana	36.5901	35.2237	108
Adıyaman	37.4646	37.3801	1
Adıyaman	37.4411	38.1328	56
Adıyaman	37.4503	38.0252	46
Adıyaman	37.4411	38.1328	94
Afyonkarahisar	38.4447	30.1446	30
Afyonkarahisar	38.0400	30.1000	38
Afyonkarahisar	38.4631	30.3554	3
Afyonkarahisar	38.0400	30.1000	10
Afyonkarahisar	38.4620	30.3309	21
Afyonkarahisar	38.4609	30.3334	36
Afyonkarahisar	38.4500	30.3337	48
Afyonkarahisar	38.4609	30.3334	46
Afyonkarahisar	38.2708	30.1548	52
Afyonkarahisar	38.4535	30.3327	26
Afyonkarahisar	38.4535	30.3327	2
Afyonkarahisar	37.4511	30.3215	23

City	Latitude	Longitude	Vehicle Count
Afyonkarahisar	38.4605	30.3147	34
Ağrı	39.3250	44.0321	30
Ağrı	39.5420	41.1625	43
Ağrı	39.3250	44.0321	2
Ağrı	39.5430	41.1758	1
Aksaray	38.2336	34.0144	46
Aksaray	38.2230	33.5947	15
Aksaray	38.2101	33.5745	36
Aksaray	38.2230	33.5947	40
Aksaray	38.2230	33.5947	1
Aksaray	38.2210	33.5937	5
Aksaray	33.2207	34.0225	10
Aksaray	38.2453	34.0226	36
Aksaray	38.2252	34.0147	27
Amasya	40.4357	35.4626	3
Amasya	40.3940	35.5037	49
Amasya	40.3903	35.5001	67
Amasya	40.3907	35.4959	88
Amasya	40.4608	35.3341	17
Ankara	39.5657	32.3957	226
Ankara	40.0003	32.4525	25
Ankara	39.5559	32.4245	178
Ankara	39.5559	32.4245	202
Ankara	39.5704	32.5036	144
Ankara	39.5605	32.5013	249
Ankara	40.2745	32.3903	108
Ankara	39.5749	32.4520	147
Ankara	40.0057	32.4541	76
Ankara	40.0057	32.4541	259
Ankara	37.5749	32.4505	281
Ankara	37.5749	32.4505	250
Ankara	37.5749	32.4505	295
Ankara	37.5749	32.4505	140
Ankara	39.5559	32.4245	144
Ankara	40.0057	32.4541	185
Ankara	40.0057	32.4541	65
Ankara	37.5749	32.4505	80
Ankara	40.0156	32.5543	121
Ankara	37.5749	32.4505	200
Ankara	39.5631	32.4247	142
Ankara	40.0057	32.4541	304
Ankara	39.5818	32.4600	37
Ankara	39.5559	32.4245	278

City	Latitude	Longitude	Vehicle Count
Ankara	39.5633	32.5305	96
Ankara	39.5740	32.4609	213
Ankara	39.5302	32.5005	29
Ankara	39.5113	32.5051	290
Ankara	39.5302	32.5005	17
Ankara	39.5703	32.4728	201
Ankara	39.5302	32.5005	47
Ankara	39.5708	32.4757	90
Ankara	40.0213	32.5341	273
Ankara	39.5703	32.4728	1
Antalya	36.5116	30.3739	45
Antalya	37.0400	30.1202	111
Antalya	36.5513	30.4717	147
Antalya	36.5517	30.3832	36
Antalya	36.5517	30.3832	152
Antalya	36.5359	30.4024	39
Antalya	36.2040	30.1655	19
Antalya	36.5517	30.3832	83
Antalya	36.5517	30.3832	63
Antalya	36.5517	30.3832	77
Antalya	36.3218	32.0206	57
Antalya	36.5517	30.3832	122
Antalya	36.5417	30.4141	101
Antalya	36.5517	30.3832	1
Antalya	36.5513	30.4717	161
Antalya	36.5513	30.4717	44
Antalya	36.5517	30.3832	24
Antalya	36.5513	30.4717	104
Antalya	36.5513	30.4717	88
Antalya	36.5421	30.4639	151
Antalya	36.5413	30.3819	83
Antalya	36.5507	30.4603	148
Antalya	36.5117	30.3740	130
Antalya	36.5531	30.4444	29
Antalya	36.5322	30.4457	9
Ardahan	41.0638	42.4221	4
Ardahan	41.0637	42.4139	17
Artvin	41.1504	42.2142	5
Artvin	41.1059	41.4923	29
Artvin	41.1059	41.4923	30
Artvin	41.1059	41.4923	26
Aydın	39.1512	27.5013	38
Aydın	37.5219	27.3606	121

City	Latitude	Longitude	Vehicle Count
Aydın	37.5034	27.4839	143
Aydın	37.4508	27.2417	16
Aydın	37.5024	27.1545	49
Aydın	37.5346	28.1833	64
Aydın	37.5000	27.4843	128
Aydın	37.5016	27.4739	107
Aydın	37.4857	27.5018	77
Aydın	37.4412	27.1727	1
Aydın	37.4857	27.5018	36
Balıkesir	40.0647	37.3833	172
Balıkesir	39.3908	27.5454	3
Balıkesir	40.1921	38.0035	248
Balıkesir	39.3739	27.5324	80
Balıkesir	39.3555	27.5558	245
Balıkesir	39.3824	27.5511	95
Bartın	41.3510	32.3826	30
Bartın	41.3749	32.2053	9
Bartın	41.3828	32.2015	56
Bartın	41.3828	32.2015	4
Bartın	41.3828	32.2015	18
Batman	37.5232	41.1039	32
Batman	37.5528	41.0758	6
Batman	37.5248	41.2005	11
Batman	37.5250	41.0859	13
Batman	37.5528	41.0758	22
Batman	37.5348	41.0852	26
Bayburt	40.1515	40.1258	21
Bayburt	40.1607	40.1352	4
Bilecik	40.3029	30.1031	19
Bilecik	39.5427	30.0212	16
Bilecik	40.1041	29.5757	28
Bilecik	40.0902	29.5807	23
Bilecik	39.5413	30.0300	0
Bilecik	39.5407	30.0355	36
Bingöl	38.5310	40.2957	2
Bingöl	38.5303	40.2942	22
Bingöl	38.5307	40.2954	17
Bitlis	38.2658	42.0840	22
Bitlis	38.4307	42.2517	20
Bitlis	38.3119	42.1741	11
Bolu	40.4332	31.3643	14
Bolu	40.4616	32.1426	38
Bolu	40.4421	31.4257	50

City	Latitude	Longitude	Vehicle Count
Bolu	40.4421	31.4257	45
Bolu	40.4414	31.3817	5
Bolu	40.4357	31.3654	59
Burdur	37.1600	30.3007	12
Burdur	37.2810	30.3351	56
Burdur	37.4456	30.1848	51
Burdur	37.0918	29.4148	9
Burdur	37.2211	29.4912	49
Burdur	37.4456	30.1848	8
Burdur	37.3818	30.2638	7
Burdur	37.2724	30.3454	29
Bursa	40.1354	28.5048	63
Bursa	40.1330	28.5734	208
Bursa	40.1122	29.0313	174
Bursa	40.1146	29.0605	42
Bursa	40.1215	29.0410	20
Bursa	40.1311	28.5925	94
Bursa	40.1206	29.0245	35
Bursa	40.0215	28.2710	110
Bursa	40.1759	29.0332	86
Bursa	40.1037	29.0636	161
Bursa	40.1759	29.0332	76
Bursa	40.0444	29.3112	148
Bursa	40.1441	39.0424	145
Bursa	40.1231	28.5636	8
Bursa	40.1713	29.0150	0
Bursa	40.1315	29.0343	72
Bursa	40.1134	29.0338	49
Bursa	40.1246	29.0417	140
Bursa	40.1315	29.0343	113
Bursa	40.1315	29.0343	132
Çanakkale	40.2443	26.4032	28
Çanakkale	40.1402	27.1444	2
Çanakkale	40.0847	26.2523	82
Çanakkale	40.0847	26.2523	89
Çanakkale	40.0847	26.2523	97
Çanakkale	40.0903	26.2451	52
Çankırı	40.3608	33.3706	83
Çorum	40.3352	34.5049	33
Çorum	40.3216	34.5654	3
Çorum	40.2901	34.5331	18
Çorum	40.3229	34.5635	4
Çorum	40.3216	34.5553	16

City	Latitude	Longitude	Vehicle Count
Çorum	40.3300	35.0456	16
Çorum	40.2901	34.5331	29
Çorum	40.3122	34.5654	24
Çorum	40.3216	34.5553	27
Çorum	40.3122	34.5654	22
Çorum	40.3122	34.5654	35
Çorum	40.2901	34.5331	35
Çorum	40.3122	34.5654	11
Çorum	40.3317	34.5519	7
Çorum	40.3122	34.5654	23
Çorum	40.2901	34.5331	19
Denizli	37.4836	29.0716	60
Denizli	37.4834	29.0401	14
Denizli	37.4846	29.1650	2
Denizli	37.4824	29.2322	54
Denizli	37.4623	29.0438	38
Denizli	37.4846	29.1650	103
Denizli	37.4729	29.0512	85
Denizli	37.4757	29.0617	137
Denizli	37.4729	29.0512	0
Denizli	37.4808	29.0514	130
Denizli	37.4824	29.2322	36
Denizli	37.4824	29.2322	127
Diyarbakır	37.5548	40.1100	64
Diyarbakır	38.0856	40.5953	90
Diyarbakır	37.5613	40.1212	4
Diyarbakır	37.5544	40.1130	17
Diyarbakır	37.5548	40.1100	74
Diyarbakır	37.5536	40.1139	25
Diyarbakır	38.1047	39.5824	42
Düzce	40.4638	31.1811	74
Düzce	40.4638	31.1811	96
Düzce	40.4255	30.3048	25
Düzce	40.4828	31.1510	12
Edirne	41.4037	26.3141	43
Edirne	41.4008	26.3354	81
Edirne	41.3936	26.3453	70
Edirne	41.4050	26.3124	3
Edirne	41.3237	26.4911	70
Edirne	41.4050	26.3124	1
Elazığ	38.4054	39.1334	6
Elazığ	38.4015	39.1335	41
Elazığ	38.3700	39.1609	37

City	Latitude	Longitude	Vehicle Count
Elazığ	38.4153	39.1718	7
Elazığ	38.4015	39.1335	1
Elazığ	38.2829	38.5735	18
Elazığ	38.2829	38.5735	17
Elazığ	38.2829	38.5735	34
Elazığ	38.2829	38.5735	29
Elazığ	38.2829	38.5735	46
Elazığ	38.2829	38.5735	2
Elazığ	38.2829	38.5735	33
Elazığ	38.2829	38.5735	2
Elazığ	38.3958	39.1321	1
Erzincan	39.4506	39.3257	67
Erzincan	39.4429	39.2934	12
Erzincan	39.4351	39.3114	16
Erzincan	39.4351	39.3114	26
Erzurum	39.4351	39.3114	23
Erzurum	39.5528	41.1651	65
Erzurum	39.5528	41.1651	7
Erzurum	39.5528	41.1651	15
Erzurum	39.5528	41.1651	25
Erzurum	39.5528	41.1651	4
Erzurum	39.5528	41.1651	65
Erzurum	39.5645	41.0619	1
Erzurum	39.5528	41.1651	82
Eskişehir	39.4432	30.3616	114
Eskişehir	39.4417	30.3743	31
Eskişehir	39.4417	30.3743	29
Eskişehir	39.4432	30.3616	6
Eskişehir	39.4414	30.3713	71
Eskişehir	39.4417	30.3743	82
Eskişehir	39.4554	30.3311	95
Eskişehir	39.4653	30.3031	103
Eskişehir	39.4743	30.2803	45
Eskişehir	39.4458	30.3310	64
Gaziantep	37.0302	37.2517	18
Gaziantep	36.5827	36.5758	125
Gaziantep	37.0445	37.2552	153
Gaziantep	37.0445	37.2552	175
Gaziantep	37.0456	37.2749	13
Gaziantep	37.0428	37.2314	52
Gaziantep	37.0428	37.2314	85
Gaziantep	37.0538	37.2456	135
Gaziantep	37.0428	37.2314	169

City	Latitude	Longitude	Vehicle Count
Giresun	40.5428	38.0602	29
Giresun	40.5348	38.1516	60
Giresun	40.5348	38.1516	8
Giresun	41.0040	38.3709	84
Giresun	40.5606	38.1245	35
Gümüşhane	40.2753	39.3448	36
Gümüşhane	40.0738	39.4453	10
Hakkari	37.3347	43.4328	4
Hakkari	37.3404	44.1701	5
Hakkari	37.3404	44.1701	3
Hakkari	37.3404	44.1701	7
Hakkari	37.3418	43.4430	7
Hakkari	37.3418	43.4430	0
Hatay	36.5208	36.0947	25
Hatay	36.3527	36.1424	133
Hatay	36.1404	36.3950	107
Hatay	36.1404	36.3950	8
Hatay	36.1404	36.3950	148
Hatay	36.3507	36.1106	48
Hatay	36.1404	36.3950	33
Hatay	36.4232	36.1307	90
Hatay	36.4232	36.1307	75
Hatay	36.3150	36.1000	133
Iğdır	39.5630	43.5933	3
Iğdır	39.5539	44.0135	21
Iğdır	39.5547	44.0330	16
Iğdır	39.5541	44.0408	2
Isparta	37.4727	30.3423	51
Isparta	37.4812	30.3225	84
Isparta	37.4631	30.3429	31
Isparta	37.4812	30.3225	38
Isparta	37.4811	30.3215	45
Isparta	37.4604	30.3423	0
İstanbul	41.0133	29.0656	340
İstanbul	41.0434	28.4909	77
İstanbul	41.0029	28.5059	151
İstanbul	41.0338	28.5916	177
İstanbul	41.0534	28.5757	127
İstanbul	41.0416	28.4957	304
İstanbul	41.0626	28.5919	257
İstanbul	40.5845	29.0359	22
İstanbul	40.5757	29.0643	10
İstanbul	40.5431	29.1138	143

City	Latitude	Longitude	Vehicle Count
İstanbul	41.0101	29.1116	166
İstanbul	41.0548	28.5958	154
İstanbul	41.0734	29.0214	289
İstanbul	41.0106	28.5438	270
İstanbul	40.5317	29.1558	35
İstanbul	40.5615	29.0734	288
İstanbul	41.0041	28.4807	310
İstanbul	41.0006	29.0205	291
İstanbul	41.0321	29.0035	28
İstanbul	41.0657	29.0118	10
İstanbul	40.5352	29.2209	181
İstanbul	41.0108	29.1013	203
İstanbul	41.0448	28.4239	155
İstanbul	41.0320	28.5815	333
İstanbul	41.0106	28.5438	277
İstanbul	41.0559	29.0029	49
İstanbul	41.0048	28.4825	29
İstanbul	41.0315	28.4827	169
İstanbul	41.0235	28.5504	9
İstanbul	40.5317	29.1202	142
İstanbul	40.5708	29.0735	132
İstanbul	40.5445	29.1052	300
İstanbul	41.0808	29.0336	161
İstanbul	41.0154	29.1015	332
İstanbul	40.5912	28.5425	284
İstanbul	40.5249	29.1417	305
İstanbul	40.5920	28.4352	79
İstanbul	41.0235	28.5504	23
İstanbul	41.0113	28.4110	194
İstanbul	41.0655	29.0021	175
İstanbul	40.5937	28.4946	318
İstanbul	40.5901	29.0434	150
İstanbul	41.0056	29.0639	321
İstanbul	41.0320	29.1034	273
İstanbul	40.5525	29.0915	37
İstanbul	41.0429	29.0405	18
İstanbul	41.0106	28.4842	162
İstanbul	41.0311	28.5227	184
İstanbul	41.0655	29.0021	164
İstanbul	41.0113	28.4110	307
İstanbul	40.5428	29.0651	181
İstanbul	40.5612	29.0758	352
İstanbul	41.0506	28.5902	304

City	Latitude	Longitude	Vehicle Count
İstanbul	40.5931	28.5314	327
İstanbul	40.5915	28.5230	314
İstanbul	41.0719	28.5038	50
İstanbul	40.5901	29.0434	29
İstanbul	41.0320	29.1034	171
İstanbul	40.5942	28.5551	151
İstanbul	41.0257	28.4748	182
İstanbul	41.0031	28.4815	315
İzmir	38.2531	27.0815	196
İzmir	38.2534	27.2522	14
İzmir	38.2512	27.0922	72
İzmir	37.5649	27.2208	182
İzmir	38.2803	27.0638	202
İzmir	38.2642	27.1214	89
İzmir	37.5649	27.2208	217
İzmir	38.2627	27.1042	180
İzmir	38.2521	27.1148	285
İzmir	38.2238	27.0832	273
İzmir	38.2638	27.1139	83
İzmir	38.2719	27.1036	72
İzmir	38.2650	27.1103	173
İzmir	38.2735	27.1320	56
İzmir	38.2656	27.1311	157
İzmir	38.2534	27.2522	151
İzmir	38.2617	27.1233	256
İzmir	38.2755	27.1148	219
İzmir	38.2131	27.0809	56
İzmir	38.2659	27.1711	18
İzmir	38.2131	27.0809	145
İzmir	38.2608	27.0951	4
İzmir	38.2131	27.0809	25
İzmir	38.2131	27.0809	125
Kahramanmaraş	37.2859	37.1800	59
Kahramanmaraş	37.3342	37.1034	19
Kahramanmaraş	37.3342	37.1034	7
Kahramanmaraş	38.1342	36.5828	54
Kahramanmaraş	37.1843	37.0021	38
Kahramanmaraş	38.0311	36.2848	47
Kahramanmaraş	37.3342	37.1034	31
Kahramanmaraş	37.3342	37.1034	88
Kahramanmaraş	37.3326	36.5723	42
Kahramanmaraş	37.3348	36.5256	99
Karabük	41.1217	32.3808	6

City	Latitude	Longitude	Vehicle Count
Karabük	41.1200	32.3800	37
Karabük	41.1432	32.4043	52
Karabük	41.1200	32.3800	61
Karabük	41.0933	32.3839	9
Karaman	37.1051	33.1604	17
Karaman	37.1107	33.1413	48
Karaman	37.1112	33.1253	31
Karaman	37.5358	32.2951	25
Karaman	37.1103	33.1440	30
Kars	40.3527	43.0526	6
Kars	40.3630	43.0531	30
Kars	40.3534	43.0437	27
Kars	40.3632	43.0604	6
Kastamonu	41.2630	33.5946	58
Kastamonu	41.2213	33.4625	7
Kastamonu	41.2337	33.4735	77
Kastamonu	41.2307	33.4705	31
Kastamonu	41.2339	33.4649	20
Kastamonu	41.2339	33.4649	58
Kayseri	38.4511	35.2340	66
Kayseri	38.4410	35.2621	40
Kayseri	38.4410	35.2621	33
Kayseri	38.4410	35.2621	65
Kayseri	38.4410	35.2621	54
Kayseri	38.4431	35.1458	61
Kayseri	38.4431	35.1458	50
Kayseri	38.4402	35.2749	91
Kayseri	38.4326	35.2824	81
Kayseri	38.4410	35.2621	19
Kayseri	38.4657	35.3503	17
Kayseri	38.4410	35.2621	49
Kayseri	38.4410	35.2621	39
Kayseri	38.4410	35.2621	80
Kayseri	38.4405	35.2611	44
Kayseri	38.4513	35.2040	50
Kayseri	38.4405	35.2611	84
Kırıkkale	39.5044	33.3108	34
Kırıkkale	39.5142	33.2904	59
Kırıkkale	39.5035	33.3118	66
Kırklareli	41.4401	27.1320	53
Kırklareli	41.2358	27.2315	104
Kırklareli	41.4523	27.1249	62
Kırşehir	39.0919	34.3004	27

City	Latitude	Longitude	Vehicle Count
Kırşehir	39.0712	34.1048	16
Kırşehir	39.0936	34.0917	9
Kırşehir	39.0712	34.1048	26
Kırşehir	39.0919	34.3004	21
Kırşehir	39.0741	34.1112	36
Kilis	36.4319	37.1256	4
Kilis	36.4224	37.1059	13
Kilis	36.4224	37.1059	26
Kocaeli	40.4747	29.2757	38
Kocaeli	40.4519	29.5721	118
Kocaeli	40.4809	29.2538	107
Kocaeli	40.4603	29.5635	16
Kocaeli	40.4424	29.5633	108
Kocaeli	40.4505	29.5705	28
Kocaeli	40.4733	29.2539	10
Kocaeli	40.4256	29.5432	72
Kocaeli	40.4424	29.5633	54
Kocaeli	40.4922	29.1403	115
Kocaeli	40.4603	29.5635	101
Kocaeli	40.4708	29.5907	108
Kocaeli	40.4651	29.5719	15
Konya	37.5544	32.3050	5
Konya	37.5101	32.2435	38
Isparta	37.5220	32.2856	51
Konya	37.5352	32.2930	5
Konya	37.5440	32.3219	38
Konya	37.3616	32.0322	90
Konya	37.3616	32.0322	86
Konya	37.5352	32.2849	145
Konya	39.0521	33.0450	76
Konya	37.3634	32.0322	138
Konya	37.5358	32.2951	71
Konya	37.5422	32.2958	136
Konya	37.5409	32.2946	130
Konya	37.5145	32.3027	17
Konya	37.5520	32.3031	13
Konya	37.5526	32.3042	72
Konya	37.5426	32.3028	66
Konya	37.5329	32.3002	129
Kütahya	39.2832	30.0207	22
Kütahya	39.2521	29.5850	76
Kütahya	39.2321	30.0638	96
Kütahya	39.5502	30.1539	106

City	Latitude	Longitude	Vehicle Count
Kütahya	39.5502	30.1539	132
Malatya	38.2255	38.1629	41
Malatya	38.2123	38.1930	53
Malatya	38.2022	38.1400	61
Malatya	38.2105	38.1815	1
Malatya	38.2022	38.1400	36
Malatya	38.2022	38.1400	45
Malatya	38.2018	38.1313	49
Malatya	38.2018	38.1313	39
Malatya	38.2116	38.1842	13
Malatya	38.2018	38.1313	20
Manisa	38.3653	27.2343	122
Manisa	38.3653	27.2343	73
Manisa	38.3650	27.2255	90
Manisa	38.3130	27.5619	130
Manisa	38.5221	28.0926	19
Manisa	38.3653	27.2343	126
Manisa	38.3653	27.2343	77
Manisa	38.3728	27.2408	28
Manisa	38.3656	27.2220	65
Manisa	38.5039	27.2301	84
Manisa	38.2926	28.0820	58
Mardin	37.1807	40.4553	33
Mardin	37.1036	40.5401	42
Mardin	37.1322	40.3759	9
Mardin	37.1640	40.4137	40
Mardin	37.1352	40.5401	13
Mardin	37.2009	40.4150	8
Mersin	36.4740	34.3551	179
Mersin	37.2009	40.4150	12
Mersin	36.5012	34.3946	19
Mersin	36.5509	34.5333	87
Mersin	36.4443	34.3157	7
Mersin	36.5058	34.4351	143
Mersin	36.4443	34.3157	167
Mersin	37.2009	40.4150	85
Mersin	36.4443	34.3157	106
Mersin	36.4443	34.3157	128
Mersin	36.4647	34.3504	167
Muğla	36.3927	29.1237	114
Muğla	36.5120	28.1555	90
Muğla	36.4600	28.4800	45
Muğla	37.0653	27.1839	29

City	Latitude	Longitude	Vehicle Count
Muğla	37.1244	28.1915	39
Muğla	37.1846	27.4655	20
Muğla	37.1308	28.1450	83
Muğla	37.1257	28.2224	67
Muğla	37.1257	28.2224	116
Muğla	36.5033	28.3130	114
Muğla	37.1257	28.2224	20
Muğla	36.3900	29.0755	15
Muğla	37.1152	27.3924	67
Muğla	36.3729	29.0802	12
Muğla	36.3729	29.0802	21
Muş	38.4426	41.3208	32
Muş	38.4359	41.3336	26
Nevşehir	38.3748	34.5455	45
Nevşehir	38.3727	34.4326	39
Nevşehir	38.3720	34.4342	37
Nevşehir	38.3720	34.4342	46
Nevşehir	38.3720	34.4342	37
Nevşehir	38.3720	34.4342	4
Niğde	37.5817	34.4134	11
Niğde	37.5743	34.4035	32
Niğde	37.5803	34.4147	32
Niğde	37.5803	34.4147	28
Niğde	37.5803	34.4147	11
Niğde	37.5752	34.4057	11
Niğde	37.5250	34.3327	15
Niğde	37.5803	34.4147	30
Ordu	40.5830	37.5334	68
Ordu	40.5836	03.7418	37
Ordu	40.5814	37.5555	27
Ordu	40.5855	37.5330	64
Ordu	40.5722	37.5400	52
Ordu	40.5722	37.5400	97
Osmaniye	37.0342	36.1436	84
Osmaniye	37.0342	36.1436	18
Osmaniye	37.0401	36.1001	183
Rize	41.0042	40.2143	50
Rize	41.0129	40.3144	65
Rize	41.0233	40.3503	21
Rize	41.0244	40.3600	12
Rize	41.0140	40.3050	44
Sakarya	40.4831	30.2419	32
Sakarya	40.4425	30.2404	80

City	Latitude	Longitude	Vehicle Count
Sakarya	40.4411	30.2424	131
Sakarya	40.4416	30.2437	112
Sakarya	40.4344	30.2426	19
Sakarya	40.4416	30.2437	1
Sakarya	40.4416	30.2437	61
Sakarya	40.4425	30.0651	1
Sakarya	40.4344	30.2426	62
Sakarya	40.4548	30.2337	43
Samsun	40.4426	30.2317	13
Samsun	41.1746	36.2005	31
Samsun	41.1623	36.2133	63
Samsun	41.1623	36.2133	35
Samsun	41.1623	36.2133	66
Samsun	41.1508	36.2316	31
Samsun	41.1623	36.2133	60
Samsun	41.1508	36.2316	58
Samsun	41.1418	36.2528	2
Samsun	41.1508	36.2316	84
Samsun	41.1508	36.2316	28
Samsun	41.1508	36.2316	19
Samsun	41.1626	36.2138	56
Samsun	41.1333	36.2440	46
Samsun	41.1508	36.2316	51
Samsun	41.1549	36.2126	81
Siirt	37.5503	42.0144	14
Siirt	37.5611	41.5550	13
Siirt	37.5635	41.4447	20
Sinop	41.5931	35.0242	118
Sinop	41.4952	35.1756	10
Sivas	39.4245	37.0132	5
Sivas	39.4338	37.0003	24
Sivas	39.4440	37.0045	61
Sivas	39.4458	36.5938	53
Sivas	39.4338	37.0003	61
Sivas	39.4440	37.0045	1
Sivas	39.4442	37.0228	34
Sivas	40.1816	37.4100	42
Sivas	39.4442	37.0228	40
Şanlıurfa	37.0947	38.4907	9
Şanlıurfa	37.1345	39.4445	23
Şanlıurfa	37.3518	38.5720	57
Şanlıurfa	37.0846	38.4437	47
Şanlıurfa	37.0846	38.4437	78

City	Latitude	Longitude	Vehicle Count
Şanlıurfa	37.0957	38.4756	68
Şanlıurfa	37.0846	38.4437	20
Şanlıurfa	37.0919	38.4711	4
Şanlıurfa	37.1228	39.0130	38
Şanlıurfa	37.1228	39.0130	28
Şanlıurfa	37.0947	38.4907	61
Şanlıurfa	37.1331	39.2622	52
Şırnak	37.1202	42.3059	4
Şırnak	37.2000	42.1005	8
Şırnak	37.1614	42.1346	9
Şırnak	37.1614	42.1346	6
Şırnak	37.1630	42.1946	17
Tekirdağ	41.1202	28.1532	46
Tekirdağ	40.5402	27.0917	76
Tekirdağ	40.5813	27.2908	80
Tekirdağ	40.5813	27.2908	43
Tekirdağ	40.5322	27.0448	53
Tekirdağ	41.0936	27.5657	58
Tekirdağ	41.0919	27.4900	77
Tekirdağ	41.0936	27.5657	6
Tekirdağ	41.0936	27.5657	18
Tekirdağ	41.0957	27.5736	2
Tekirdağ	40.5914	27.3524	53
Tokat	40.4000	36.3400	80
Tokat	40.1952	36.3234	16
Tokat	40.1905	36.3451	7
Tokat	40.3444	36.5544	42
Tokat	40.1957	36.3231	38
Tokat	40.2004	36.3052	72
Tokat	40.1945	36.3242	62
Trabzon	40.5629	40.0307	46
Trabzon	41.0008	39.4645	66
Trabzon	40.5936	39.4500	68
Trabzon	40.5939	39.4508	42
Trabzon	40.5959	39.4511	42
Trabzon	40.5922	39.4454	53
Trabzon	41.0040	39.3534	59
Trabzon	41.0011	39.3723	23
Trabzon	41.0051	39.3606	26
Trabzon	40.5629	40.0307	33
Tunceli	41.0018	39.4353	17
Uşak	38.3038	39.4403	20
Uşak	38.3038	39.4403	10

City	Latitude	Longitude	Vehicle Count
Uşak	38.4011	29.2622	33
Uşak	38.4422	29.4608	26
Uşak	38.4020	29.2632	48
Uşak	38.4100	29.2649	46
Uşak	38.4022	29.2503	6
Uşak	38.4015	29.2430	52
Uşak	38.4412	29.4335	12
Van	38.3122	43.2134	25
Van	38.3435	43.2321	8
Van	39.0119	43.1837	21
Van	38.3210	43.2023	23
Van	38.3435	43.2321	24
Van	38.3435	43.2321	6
Van	38.3043	43.2144	9
Van	38.3435	43.2321	25
Van	39.0059	43.2253	26
Van	38.3043	43.2144	27
Van	38.3435	43.2321	22
Yalova	40.3909	29.1453	68
Yalova	40.3724	29.1621	7
Yalova	40.3724	29.1621	29
Yalova	40.3724	29.1621	21
Yozgat	39.3843	34.1533	18
Yozgat	39.4845	34.3639	39
Yozgat	39.4845	34.3639	40
Yozgat	39.4926	34.4915	23
Yozgat	39.4815	34.4656	25
Yozgat	39.4859	34.4803	28
Yozgat	39.1138	35.145	23
Zonguldak	41.0916	32.5958	55
Zonguldak	41.2715	31.5446	20
Zonguldak	41.2715	31.5446	32
Zonguldak	41.2715	31.5446	50
Zonguldak	41.2701	31.4919	57
Zonguldak	41.1508	31.2545	52
Zonguldak	41.1624	31.2646	67
Zonguldak	41.1624	31.2646	11
Zonguldak	41.1606	31.2635	20
Zonguldak	41.1619	31.2626	40

Temporary Storage Areas

City	Latitude	Longitude
Adana	36.5949	35.1524
Adana	36.5950	35.1150
Adana	36.5949	35.1524
Ağrı	39.5430	41.1758
Ankara	39.5752	32.4509
Ankara	40.0057	32.4541
Ankara	37.5749	32.4505
Ankara	40.0057	32.4541
Ankara	40.0057	32.4541
Ankara	40.0057	32.4541
Ankara	37.5749	32.4505
Ankara	37.5749	32.4505
Ankara	37.5749	32.4505
Ankara	37.5749	32.4505
Ankara	40.0057	32.4541
Ankara	40.0057	32.4541
Ankara	40.0057	32.4541
Ankara	40.0057	32.4541
Ankara	37.5749	32.4505
Ankara	39.5727	32.4514
Ankara	37.5749	32.4505
Ankara	37.5749	32.4505
Ankara	37.5749	32.4505
Ankara	37.5749	32.4505
Ankara	37.5749	32.4505
Ankara	37.5749	32.4505
Ankara	40.0158	32.3708
Ankara	37.5749	32.4505
Ankara	37.5749	32.4505
Antalya	36.5517	30.3832
Balıkesir	39.3922	27.5254
Balıkesir	40.1921	38.0035
Bursa	40.1135	29.0938
Erzurum	39.5613	41.1714
Erzurum	39.5613	41.1714
Erzurum	39.5613	41.1714
Eskişehir	39.4404	30.3727
Eskişehir	39.4404	30.3727
Gaziantep	37.0433	37.2233
İstanbul	40.5757	29.0643
İstanbul	40.5757	29.0643

City	Latitude	Longitude
İstanbul	41.0521	28.4753
İstanbul	40.5757	29.0643
İstanbul	40.5757	29.0643
İstanbul	41.0437	28.3733
İstanbul	40.5823	29.0338
İzmir	38.2755	27.0756
İzmir	38.2307	27.0341
Kayseri	38.4446	35.2555
Kayseri	38.4333	35.2659
Kayseri	38.4326	35.2824
Kayseri	38.4402	35.2749
Kırşehir	39.0712	34.1048
Kırşehir	39.0712	34.1048
Kocaeli	40.4709	29.2556
Konya	37.5800	32.4200
Konya	37.5800	32.4200
Kütahya	39.2502	29.5906
Kütahya	39.2602	29.5845
Kütahya	39.5502	30.1539
Malatya	38.2132	38.1777
Malatya	38.2123	38.1930
Malatya	38.2123	38.1930
Sakarya	40.4426	30.2317
Van	38.3435	43.2321

Process Centers

City	Latitude	Longitude
Adana	36.5931	35.0801
İzmir	38.2717	27.0149
Kocaeli	40.4204	30.0522
Osmaniye	37.0401	36.1001
Samsun	41.1730	36.1952

Disposal Centers

City	Latitude	Longitude
İstanbul	41.1016	29.2741
İzmit	40.4710	29.4707
İzmir	38.4743	27.0213

APPENDIX C

Table 0.1 Assignment of PDs to TSAs and vehicle counts sent from PDs

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
1	2	Adana	Adana	111
2	1	Adana	Adana	136
3	1	Adana	Adana	25
4	1	Adana	Adana	109
5	2	Adana	Adana	140
6	2	Adana	Adana	98
7	1	Adana	Adana	34
8	2	Adana	Adana	51
9	1	Adana	Adana	45
10	2	Adana	Adana	72
11	2	Adana	Adana	1
12	1	Adana	Adana	14
13	2	Adana	Adana	25
14	2	Adana	Adana	64
15	1	Adana	Adana	60
16	1	Adana	Adana	126
17	1	Adana	Adana	105
18	2	Adana	Adana	13
19	1	Adana	Adana	108
20	39	Adıyaman	Gaziantep	1
21	39	Adıyaman	Gaziantep	56
22	39	Adıyaman	Gaziantep	46
23	39	Adıyaman	Gaziantep	94
24	38	Afyonkarahisar	Eskişehir	30
25	38	Afyonkarahisar	Eskişehir	38
26	37	Afyonkarahisar	Eskişehir	3
27	38	Afyonkarahisar	Eskişehir	10
28	37	Afyonkarahisar	Eskişehir	21
29	37	Afyonkarahisar	Eskişehir	36
30	38	Afyonkarahisar	Eskişehir	48
31	37	Afyonkarahisar	Eskişehir	46
32	37	Afyonkarahisar	Eskişehir	52
33	37	Afyonkarahisar	Eskişehir	26
34	37	Afyonkarahisar	Eskişehir	2
35	37	Afyonkarahisar	Eskişehir	23
36	37	Afyonkarahisar	Eskişehir	34

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
37	36	Ağrı	Erzurum	30
38	4	Ağrı	Ağrı	43
39	36	Ağrı	Erzurum	2
40	4	Ağrı	Ağrı	1
41	54	Aksaray	Kırşehir	46
42	54	Aksaray	Kırşehir	15
43	54	Aksaray	Kırşehir	36
44	54	Aksaray	Kırşehir	40
45	54	Aksaray	Kırşehir	1
46	54	Aksaray	Kırşehir	5
47	2	Aksaray	Adana	10
48	54	Aksaray	Kırşehir	36
49	54	Aksaray	Kırşehir	27
50	54	Amasya	Kırşehir	3
51	54	Amasya	Kırşehir	49
52	54	Amasya	Kırşehir	67
53	54	Amasya	Kırşehir	88
54	16	Amasya	Ankara	17
55	20	Ankara	Ankara	226
56	16	Ankara	Ankara	25
57	20	Ankara	Ankara	178
58	20	Ankara	Ankara	202
59	20	Ankara	Ankara	144
60	20	Ankara	Ankara	249
61	16	Ankara	Ankara	108
62	20	Ankara	Ankara	147
63	16	Ankara	Ankara	76
64	16	Ankara	Ankara	259
65	12	Ankara	Ankara	281
66	12	Ankara	Ankara	250
67	12	Ankara	Ankara	295
68	12	Ankara	Ankara	140
69	20	Ankara	Ankara	144
70	16	Ankara	Ankara	185
71	16	Ankara	Ankara	65
72	12	Ankara	Ankara	80
73	16	Ankara	Ankara	121
74	19	Ankara	Ankara	200
75	20	Ankara	Ankara	142
76	16	Ankara	Ankara	304
77	20	Ankara	Ankara	37
78	20	Ankara	Ankara	278

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
79	20	Ankara	Ankara	96
80	20	Ankara	Ankara	213
81	20	Ankara	Ankara	29
82	20	Ankara	Ankara	290
83	20	Ankara	Ankara	17
84	20	Ankara	Ankara	201
85	20	Ankara	Ankara	47
86	20	Ankara	Ankara	90
87	16	Ankara	Ankara	273
88	20	Ankara	Ankara	1
89	30	Antalya	Antalya	45
90	30	Antalya	Antalya	111
91	30	Antalya	Antalya	147
92	30	Antalya	Antalya	36
93	30	Antalya	Antalya	152
94	30	Antalya	Antalya	39
95	30	Antalya	Antalya	19
96	30	Antalya	Antalya	83
97	30	Antalya	Antalya	63
98	30	Antalya	Antalya	77
99	56	Antalya	Konya	57
100	30	Antalya	Antalya	122
101	30	Antalya	Antalya	101
102	30	Antalya	Antalya	1
103	30	Antalya	Antalya	161
104	30	Antalya	Antalya	44
105	30	Antalya	Antalya	24
106	30	Antalya	Antalya	104
107	30	Antalya	Antalya	88
108	30	Antalya	Antalya	151
109	30	Antalya	Antalya	83
110	30	Antalya	Antalya	148
111	30	Antalya	Antalya	130
112	30	Antalya	Antalya	29
113	30	Antalya	Antalya	9
114	32	Ardahan	Balıkesir	4
115	32	Ardahan	Balıkesir	17
116	32	Artvin	Balıkesir	5
117	32	Artvin	Balıkesir	29
118	32	Artvin	Balıkesir	30
119	32	Artvin	Balıkesir	26
120	47	Aydın	İzmir	38

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
121	47	Aydın	İzmir	121
122	47	Aydın	İzmir	143
123	47	Aydın	İzmir	16
124	47	Aydın	İzmir	49
125	47	Aydın	İzmir	64
126	47	Aydın	İzmir	128
127	47	Aydın	İzmir	107
128	47	Aydın	İzmir	77
129	47	Aydın	İzmir	1
130	47	Aydın	İzmir	36
131	32	Balıkesir	Balıkesir	172
132	47	Balıkesir	İzmir	3
133	32	Balıkesir	Balıkesir	248
134	47	Balıkesir	İzmir	80
135	47	Balıkesir	İzmir	245
136	47	Balıkesir	İzmir	95
137	64	Bartın	Sakarya	30
138	64	Bartın	Sakarya	9
139	64	Bartın	Sakarya	56
140	64	Bartın	Sakarya	4
141	64	Bartın	Sakarya	18
142	61	Batman	Malatya	32
143	61	Batman	Malatya	6
144	61	Batman	Malatya	11
145	61	Batman	Malatya	13
146	61	Batman	Malatya	22
147	61	Batman	Malatya	26
148	32	Bayburt	Balıkesir	21
149	32	Bayburt	Balıkesir	4
150	64	Bilecik	Sakarya	19
151	60	Bilecik	Kütahya	16
152	64	Bilecik	Sakarya	28
153	64	Bilecik	Sakarya	23
154	3	Bilecik	Adana	0
155	60	Bilecik	Kütahya	36
156	61	Bingöl	Malatya	2
157	61	Bingöl	Malatya	22
158	61	Bingöl	Malatya	17
159	4	Bitlis	Ağrı	22
160	4	Bitlis	Ağrı	20
161	4	Bitlis	Ağrı	11
162	64	Bolu	Sakarya	14

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
163	16	Bolu	Ankara	38
164	64	Bolu	Sakarya	50
165	64	Bolu	Sakarya	45
166	64	Bolu	Sakarya	5
167	64	Bolu	Sakarya	59
168	30	Burdur	Antalya	12
169	30	Burdur	Antalya	56
170	37	Burdur	Eskişehir	51
171	30	Burdur	Antalya	9
172	59	Burdur	Kütahya	49
173	37	Burdur	Eskişehir	8
174	38	Burdur	Eskişehir	7
175	30	Burdur	Antalya	29
176	55	Bursa	Kocaeli	63
177	55	Bursa	Kocaeli	208
178	55	Bursa	Kocaeli	174
179	55	Bursa	Kocaeli	42
180	55	Bursa	Kocaeli	20
181	55	Bursa	Kocaeli	94
182	55	Bursa	Kocaeli	35
183	55	Bursa	Kocaeli	110
184	55	Bursa	Kocaeli	86
185	55	Bursa	Kocaeli	161
186	55	Bursa	Kocaeli	76
187	55	Bursa	Kocaeli	148
188	32	Bursa	Balıkesir	145
189	55	Bursa	Kocaeli	8
190	3	Bursa	Adana	0
191	55	Bursa	Kocaeli	72
192	55	Bursa	Kocaeli	49
193	55	Bursa	Kocaeli	140
194	55	Bursa	Kocaeli	113
195	55	Bursa	Kocaeli	132
196	55	Çanakkale	Kocaeli	28
197	55	Çanakkale	Kocaeli	2
198	47	Çanakkale	İzmir	82
199	47	Çanakkale	İzmir	89
200	47	Çanakkale	İzmir	97
201	47	Çanakkale	İzmir	52
202	16	Çankırı	Ankara	83
203	16	Çorum	Ankara	33
204	16	Çorum	Ankara	3

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
205	16	Çorum	Ankara	18
206	16	Çorum	Ankara	4
207	16	Çorum	Ankara	16
208	16	Çorum	Ankara	16
209	16	Çorum	Ankara	29
210	16	Çorum	Ankara	24
211	16	Çorum	Ankara	27
212	16	Çorum	Ankara	22
213	16	Çorum	Ankara	35
214	16	Çorum	Ankara	35
215	16	Çorum	Ankara	11
216	16	Çorum	Ankara	7
217	16	Çorum	Ankara	23
218	16	Çorum	Ankara	19
219	47	Denizli	İzmir	60
220	47	Denizli	İzmir	14
221	59	Denizli	Kütahya	2
222	59	Denizli	Kütahya	54
223	47	Denizli	İzmir	38
224	59	Denizli	Kütahya	103
225	47	Denizli	İzmir	85
226	47	Denizli	İzmir	137
227	3	Denizli	Adana	0
228	47	Denizli	İzmir	130
229	59	Denizli	Kütahya	36
230	59	Denizli	Kütahya	127
231	61	Diyarbakır	Malatya	64
232	61	Diyarbakır	Malatya	90
233	61	Diyarbakır	Malatya	4
234	61	Diyarbakır	Malatya	17
235	61	Diyarbakır	Malatya	74
236	61	Diyarbakır	Malatya	25
237	61	Diyarbakır	Malatya	42
238	64	Düzce	Sakarya	74
239	64	Düzce	Sakarya	96
240	64	Düzce	Sakarya	25
241	64	Düzce	Sakarya	12
242	45	Edirne	İstanbul	43
243	45	Edirne	İstanbul	81
244	45	Edirne	İstanbul	70
245	45	Edirne	İstanbul	3
246	45	Edirne	İstanbul	70

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
247	45	Edirne	İstanbul	1
248	61	Elazığ	Malatya	6
249	61	Elazığ	Malatya	41
250	61	Elazığ	Malatya	37
251	61	Elazığ	Malatya	7
252	61	Elazığ	Malatya	1
253	61	Elazığ	Malatya	18
254	61	Elazığ	Malatya	17
255	61	Elazığ	Malatya	34
256	61	Elazığ	Malatya	29
257	61	Elazığ	Malatya	46
258	61	Elazığ	Malatya	2
259	61	Elazığ	Malatya	33
260	61	Elazığ	Malatya	2
261	61	Elazığ	Malatya	1
262	32	Erzincan	Balıkesir	67
263	32	Erzincan	Balıkesir	12
264	32	Erzincan	Balıkesir	16
265	32	Erzincan	Balıkesir	26
266	32	Erzurum	Balıkesir	23
267	36	Erzurum	Erzurum	65
268	36	Erzurum	Erzurum	7
269	36	Erzurum	Erzurum	15
270	36	Erzurum	Erzurum	25
271	36	Erzurum	Erzurum	4
272	36	Erzurum	Erzurum	65
273	34	Erzurum	Erzurum	1
274	36	Erzurum	Erzurum	82
275	38	Eskişehir	Eskişehir	114
276	37	Eskişehir	Eskişehir	31
277	37	Eskişehir	Eskişehir	29
278	37	Eskişehir	Eskişehir	6
279	37	Eskişehir	Eskişehir	71
280	37	Eskişehir	Eskişehir	82
281	37	Eskişehir	Eskişehir	95
282	37	Eskişehir	Eskişehir	103
283	37	Eskişehir	Eskişehir	45
284	37	Eskişehir	Eskişehir	64
285	39	Gaziantep	Gaziantep	18
286	1	Gaziantep	Adana	125
287	39	Gaziantep	Gaziantep	153
288	39	Gaziantep	Gaziantep	175

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
289	39	Gaziantep	Gaziantep	13
290	39	Gaziantep	Gaziantep	52
291	39	Gaziantep	Gaziantep	85
292	39	Gaziantep	Gaziantep	135
293	39	Gaziantep	Gaziantep	169
294	32	Giresun	Balıkesir	29
295	32	Giresun	Balıkesir	60
296	32	Giresun	Balıkesir	8
297	32	Giresun	Balıkesir	84
298	32	Giresun	Balıkesir	35
299	32	Gümüşhane	Balıkesir	36
300	32	Gümüşhane	Balıkesir	10
301	65	Hakkari	Van	4
302	65	Hakkari	Van	5
303	65	Hakkari	Van	3
304	65	Hakkari	Van	7
305	65	Hakkari	Van	7
306	3	Hakkari	Adana	0
307	1	Hatay	Adana	25
308	1	Hatay	Adana	133
309	1	Hatay	Adana	107
310	1	Hatay	Adana	8
311	1	Hatay	Adana	148
312	1	Hatay	Adana	48
313	1	Hatay	Adana	33
314	1	Hatay	Adana	90
315	1	Hatay	Adana	75
316	1	Hatay	Adana	133
317	36	Iğdır	Erzurum	3
318	36	Iğdır	Erzurum	21
319	36	Iğdır	Erzurum	16
320	35	Iğdır	Erzurum	2
321	37	Isparta	Eskişehir	51
322	38	Isparta	Eskişehir	84
323	37	Isparta	Eskişehir	31
324	37	Isparta	Eskişehir	38
325	38	Isparta	Eskişehir	45
326	3	Isparta	Adana	0
327	55	İstanbul	Kocaeli	340
328	45	İstanbul	İstanbul	77
329	43	İstanbul	İstanbul	151
330	43	İstanbul	İstanbul	177

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
331	43	İstanbul	İstanbul	127
332	45	İstanbul	İstanbul	304
333	43	İstanbul	İstanbul	257
334	43	İstanbul	İstanbul	22
335	43	İstanbul	İstanbul	10
336	55	İstanbul	Kocaeli	143
337	55	İstanbul	Kocaeli	166
338	43	İstanbul	İstanbul	154
339	55	İstanbul	Kocaeli	289
340	43	İstanbul	İstanbul	270
341	55	İstanbul	Kocaeli	35
342	43	İstanbul	İstanbul	288
343	45	İstanbul	İstanbul	310
344	55	İstanbul	Kocaeli	291
345	55	İstanbul	Kocaeli	28
346	55	İstanbul	Kocaeli	10
347	55	İstanbul	Kocaeli	181
348	55	İstanbul	Kocaeli	203
349	45	İstanbul	İstanbul	155
350	43	İstanbul	İstanbul	333
351	43	İstanbul	İstanbul	277
352	55	İstanbul	Kocaeli	49
353	45	İstanbul	İstanbul	29
354	45	İstanbul	İstanbul	169
355	43	İstanbul	İstanbul	9
356	55	İstanbul	Kocaeli	142
357	43	İstanbul	İstanbul	132
358	55	İstanbul	Kocaeli	300
359	55	İstanbul	Kocaeli	161
360	55	İstanbul	Kocaeli	332
361	43	İstanbul	İstanbul	284
362	55	İstanbul	Kocaeli	305
363	43	İstanbul	İstanbul	79
364	43	İstanbul	İstanbul	23
365	45	İstanbul	İstanbul	194
366	55	İstanbul	Kocaeli	175
367	43	İstanbul	İstanbul	318
368	43	İstanbul	İstanbul	150
369	55	İstanbul	Kocaeli	321
370	55	İstanbul	Kocaeli	273
371	55	İstanbul	Kocaeli	37
372	55	İstanbul	Kocaeli	18

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
373	45	İstanbul	İstanbul	162
374	43	İstanbul	İstanbul	184
375	55	İstanbul	Kocaeli	164
376	45	İstanbul	İstanbul	307
377	55	İstanbul	Kocaeli	181
378	43	İstanbul	İstanbul	352
379	43	İstanbul	İstanbul	304
380	43	İstanbul	İstanbul	327
381	43	İstanbul	İstanbul	314
382	45	İstanbul	İstanbul	50
383	43	İstanbul	İstanbul	29
384	55	İstanbul	Kocaeli	171
385	43	İstanbul	İstanbul	151
386	45	İstanbul	İstanbul	182
387	45	İstanbul	İstanbul	315
388	47	İzmir	İzmir	196
389	47	İzmir	İzmir	14
390	47	İzmir	İzmir	72
391	47	İzmir	İzmir	182
392	47	İzmir	İzmir	202
393	47	İzmir	İzmir	89
394	47	İzmir	İzmir	217
395	47	İzmir	İzmir	180
396	47	İzmir	İzmir	285
397	47	İzmir	İzmir	273
398	47	İzmir	İzmir	83
399	47	İzmir	İzmir	72
400	47	İzmir	İzmir	173
401	47	İzmir	İzmir	56
402	47	İzmir	İzmir	157
403	47	İzmir	İzmir	151
404	47	İzmir	İzmir	256
405	47	İzmir	İzmir	219
406	47	İzmir	İzmir	56
407	47	İzmir	İzmir	18
408	47	İzmir	İzmir	145
409	47	İzmir	İzmir	4
410	47	İzmir	İzmir	25
411	47	İzmir	İzmir	125
412	39	Kahramanmaraş	Gaziantep	59
413	39	Kahramanmaraş	Gaziantep	19
414	39	Kahramanmaraş	Gaziantep	7

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
415	50	Kahramanmaraş	Kayseri	54
416	39	Kahramanmaraş	Gaziantep	38
417	50	Kahramanmaraş	Kayseri	47
418	39	Kahramanmaraş	Gaziantep	31
419	39	Kahramanmaraş	Gaziantep	88
420	39	Kahramanmaraş	Gaziantep	42
421	39	Kahramanmaraş	Gaziantep	99
422	16	Karabük	Ankara	6
423	16	Karabük	Ankara	37
424	16	Karabük	Ankara	52
425	16	Karabük	Ankara	61
426	16	Karabük	Ankara	9
427	13	Karaman	Ankara	17
428	12	Karaman	Ankara	48
429	12	Karaman	Ankara	31
430	56	Karaman	Konya	25
431	12	Karaman	Ankara	30
432	36	Kars	Erzurum	6
433	36	Kars	Erzurum	30
434	36	Kars	Erzurum	27
435	36	Kars	Erzurum	6
436	16	Kastamonu	Ankara	58
437	16	Kastamonu	Ankara	7
438	16	Kastamonu	Ankara	77
439	16	Kastamonu	Ankara	31
440	16	Kastamonu	Ankara	20
441	16	Kastamonu	Ankara	58
442	50	Kayseri	Kayseri	66
443	50	Kayseri	Kayseri	40
444	50	Kayseri	Kayseri	33
445	50	Kayseri	Kayseri	65
446	50	Kayseri	Kayseri	54
447	50	Kayseri	Kayseri	61
448	50	Kayseri	Kayseri	50
449	50	Kayseri	Kayseri	91
450	50	Kayseri	Kayseri	81
451	50	Kayseri	Kayseri	19
452	50	Kayseri	Kayseri	17
453	50	Kayseri	Kayseri	49
454	50	Kayseri	Kayseri	39
455	50	Kayseri	Kayseri	80
456	50	Kayseri	Kayseri	44

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
457	50	Kayseri	Kayseri	50
458	50	Kayseri	Kayseri	84
459	20	Kırıkkale	Ankara	34
460	20	Kırıkkale	Ankara	59
461	20	Kırıkkale	Ankara	66
462	45	Kırklareli	İstanbul	53
463	45	Kırklareli	İstanbul	104
464	45	Kırklareli	İstanbul	62
465	54	Kırşehir	Kırşehir	27
466	54	Kırşehir	Kırşehir	16
467	54	Kırşehir	Kırşehir	9
468	54	Kırşehir	Kırşehir	26
469	54	Kırşehir	Kırşehir	21
470	54	Kırşehir	Kırşehir	36
471	39	Kilis	Gaziantep	4
472	39	Kilis	Gaziantep	13
473	39	Kilis	Gaziantep	26
474	55	Kocaeli	Kocaeli	38
475	64	Kocaeli	Sakarya	118
476	55	Kocaeli	Kocaeli	107
477	64	Kocaeli	Sakarya	16
478	64	Kocaeli	Sakarya	108
479	64	Kocaeli	Sakarya	28
480	55	Kocaeli	Kocaeli	10
481	64	Kocaeli	Sakarya	72
482	64	Kocaeli	Sakarya	54
483	55	Kocaeli	Kocaeli	115
484	64	Kocaeli	Sakarya	101
485	64	Kocaeli	Sakarya	108
486	64	Kocaeli	Sakarya	15
487	56	Konya	Konya	5
488	56	Konya	Konya	38
489	56	Isparta	Konya	51
490	56	Konya	Konya	5
491	56	Konya	Konya	38
492	56	Konya	Konya	90
493	56	Konya	Konya	86
494	56	Konya	Konya	145
495	20	Konya	Ankara	76
496	56	Konya	Konya	138
497	56	Konya	Konya	71
498	56	Konya	Konya	136

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
499	56	Konya	Konya	130
500	56	Konya	Konya	17
501	56	Konya	Konya	13
502	56	Konya	Konya	72
503	56	Konya	Konya	66
504	56	Konya	Konya	129
505	60	Kütahya	Kütahya	22
506	59	Kütahya	Kütahya	76
507	60	Kütahya	Kütahya	96
508	60	Kütahya	Kütahya	106
509	60	Kütahya	Kütahya	132
510	61	Malatya	Malatya	41
511	61	Malatya	Malatya	53
512	61	Malatya	Malatya	61
513	61	Malatya	Malatya	1
514	61	Malatya	Malatya	36
515	61	Malatya	Malatya	45
516	61	Malatya	Malatya	49
517	61	Malatya	Malatya	39
518	61	Malatya	Malatya	13
519	61	Malatya	Malatya	20
520	47	Manisa	İzmir	122
521	47	Manisa	İzmir	73
522	47	Manisa	İzmir	90
523	47	Manisa	İzmir	130
524	47	Manisa	İzmir	19
525	47	Manisa	İzmir	126
526	47	Manisa	İzmir	77
527	47	Manisa	İzmir	28
528	47	Manisa	İzmir	65
529	47	Manisa	İzmir	84
530	47	Manisa	İzmir	58
531	61	Mardin	Malatya	33
532	61	Mardin	Malatya	42
533	61	Mardin	Malatya	9
534	61	Mardin	Malatya	40
535	61	Mardin	Malatya	13
536	61	Mardin	Malatya	8
537	2	Mersin	Adana	179
538	61	Mersin	Malatya	12
539	2	Mersin	Adana	19
540	2	Mersin	Adana	87

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
541	2	Mersin	Adana	7
542	2	Mersin	Adana	143
543	2	Mersin	Adana	167
544	61	Mersin	Malatya	85
545	2	Mersin	Adana	106
546	2	Mersin	Adana	128
547	2	Mersin	Adana	167
548	30	Muğla	Antalya	114
549	47	Muğla	İzmir	90
550	47	Muğla	İzmir	45
551	47	Muğla	İzmir	29
552	47	Muğla	İzmir	39
554	47	Muğla	İzmir	83
555	47	Muğla	İzmir	67
556	47	Muğla	İzmir	116
557	47	Muğla	İzmir	114
558	47	Muğla	İzmir	20
559	30	Muğla	Antalya	15
560	47	Muğla	İzmir	67
561	30	Muğla	Antalya	12
562	30	Muğla	Antalya	21
563	61	Muş	Malatya	32
564	61	Muş	Malatya	26
565	54	Nevşehir	Kırşehir	45
566	54	Nevşehir	Kırşehir	39
567	54	Nevşehir	Kırşehir	37
568	54	Nevşehir	Kırşehir	46
569	54	Nevşehir	Kırşehir	37
570	54	Nevşehir	Kırşehir	4
571	2	Niğde	Adana	11
572	2	Niğde	Adana	32
573	2	Niğde	Adana	32
574	2	Niğde	Adana	28
575	2	Niğde	Adana	11
576	2	Niğde	Adana	11
577	2	Niğde	Adana	15
578	2	Niğde	Adana	30
579	32	Ordu	Balıkesir	68
580	47	Ordu	İzmir	37
581	32	Ordu	Balıkesir	27
582	32	Ordu	Balıkesir	64
583	32	Ordu	Balıkesir	52

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
584	32	Ordu	Balıkesir	97
585	1	Osmaniye	Adana	84
586	1	Osmaniye	Adana	18
587	1	Osmaniye	Adana	183
588	32	Rize	Balıkesir	50
589	32	Rize	Balıkesir	65
590	32	Rize	Balıkesir	21
591	32	Rize	Balıkesir	12
592	32	Rize	Balıkesir	44
593	64	Sakarya	Sakarya	32
594	64	Sakarya	Sakarya	80
595	64	Sakarya	Sakarya	131
596	64	Sakarya	Sakarya	112
597	64	Sakarya	Sakarya	19
598	64	Sakarya	Sakarya	1
599	64	Sakarya	Sakarya	61
600	64	Sakarya	Sakarya	1
601	64	Sakarya	Sakarya	62
602	64	Sakarya	Sakarya	43
603	64	Samsun	Sakarya	13
604	32	Samsun	Balıkesir	31
605	32	Samsun	Balıkesir	63
606	32	Samsun	Balıkesir	35
607	32	Samsun	Balıkesir	66
608	32	Samsun	Balıkesir	31
609	32	Samsun	Balıkesir	60
610	32	Samsun	Balıkesir	58
611	32	Samsun	Balıkesir	2
612	32	Samsun	Balıkesir	84
613	32	Samsun	Balıkesir	28
614	32	Samsun	Balıkesir	19
615	32	Samsun	Balıkesir	56
616	32	Samsun	Balıkesir	46
617	32	Samsun	Balıkesir	51
618	32	Samsun	Balıkesir	81
619	61	Siirt	Malatya	14
620	61	Siirt	Malatya	13
621	61	Siirt	Malatya	20
622	16	Sinop	Ankara	118
623	16	Sinop	Ankara	10
624	32	Sivas	Balıkesir	5
625	32	Sivas	Balıkesir	24

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
626	32	Sivas	Balıkesir	61
627	50	Sivas	Kayseri	53
628	32	Sivas	Balıkesir	61
629	32	Sivas	Balıkesir	1
630	32	Sivas	Balıkesir	34
631	32	Sivas	Balıkesir	42
632	32	Sivas	Balıkesir	40
633	39	Şanlıurfa	Gaziantep	9
634	39	Şanlıurfa	Gaziantep	23
635	39	Şanlıurfa	Gaziantep	57
636	39	Şanlıurfa	Gaziantep	47
637	39	Şanlıurfa	Gaziantep	78
638	39	Şanlıurfa	Gaziantep	68
639	39	Şanlıurfa	Gaziantep	20
640	39	Şanlıurfa	Gaziantep	4
641	39	Şanlıurfa	Gaziantep	38
642	39	Şanlıurfa	Gaziantep	28
643	39	Şanlıurfa	Gaziantep	61
644	39	Şanlıurfa	Gaziantep	52
645	61	Şırnak	Malatya	4
646	61	Şırnak	Malatya	8
647	61	Şırnak	Malatya	9
648	61	Şırnak	Malatya	6
649	61	Şırnak	Malatya	17
650	45	Tekirdağ	İstanbul	46
651	43	Tekirdağ	İstanbul	76
652	43	Tekirdağ	İstanbul	80
653	43	Tekirdağ	İstanbul	43
654	43	Tekirdağ	İstanbul	53
655	45	Tekirdağ	İstanbul	58
656	45	Tekirdağ	İstanbul	77
657	45	Tekirdağ	İstanbul	6
658	45	Tekirdağ	İstanbul	18
659	45	Tekirdağ	İstanbul	2
660	43	Tekirdağ	İstanbul	53
661	32	Tokat	Balıkesir	80
662	54	Tokat	Kırşehir	16
663	54	Tokat	Kırşehir	7
664	32	Tokat	Balıkesir	42
665	54	Tokat	Kırşehir	38
666	54	Tokat	Kırşehir	72
667	54	Tokat	Kırşehir	62

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
668	32	Trabzon	Balıkesir	46
669	32	Trabzon	Balıkesir	66
670	32	Trabzon	Balıkesir	68
671	32	Trabzon	Balıkesir	42
672	32	Trabzon	Balıkesir	42
673	32	Trabzon	Balıkesir	53
674	32	Trabzon	Balıkesir	59
675	32	Trabzon	Balıkesir	23
676	32	Trabzon	Balıkesir	26
677	32	Trabzon	Balıkesir	33
678	32	Tunceli	Balıkesir	17
679	61	Uşak	Malatya	20
680	61	Uşak	Malatya	10
681	59	Uşak	Kütahya	33
682	59	Uşak	Kütahya	26
683	59	Uşak	Kütahya	48
684	59	Uşak	Kütahya	46
685	59	Uşak	Kütahya	6
686	59	Uşak	Kütahya	52
687	59	Uşak	Kütahya	12
688	65	Van	Van	25
689	65	Van	Van	8
690	4	Van	Ağrı	21
691	65	Van	Van	23
692	65	Van	Van	24
693	65	Van	Van	6
694	65	Van	Van	9
695	65	Van	Van	25
696	4	Van	Ağrı	26
697	65	Van	Van	27
698	65	Van	Van	22
699	55	Yalova	Kocaeli	68
700	55	Yalova	Kocaeli	7
701	55	Yalova	Kocaeli	29
702	55	Yalova	Kocaeli	21
703	54	Yozgat	Kırşehir	18
704	54	Yozgat	Kırşehir	39
705	54	Yozgat	Kırşehir	40
706	54	Yozgat	Kırşehir	23
707	54	Yozgat	Kırşehir	25
708	54	Yozgat	Kırşehir	28
709	54	Yozgat	Kırşehir	23

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
710	16	Zonguldak	Ankara	55
711	64	Zonguldak	Sakarya	20
712	64	Zonguldak	Sakarya	32
713	64	Zonguldak	Sakarya	50
714	64	Zonguldak	Sakarya	57
715	64	Zonguldak	Sakarya	52
716	64	Zonguldak	Sakarya	67
717	64	Zonguldak	Sakarya	11
718	64	Zonguldak	Sakarya	20
719	64	Zonguldak	Sakarya	40

Table 0.2 Assignment of TSAs to PCs and vehicle counts sent from TSAs

TSA Order	PC Order	City of TSA	City of PC	Vehicle Count Transported From TSA to PC
1	1	Adana	Adana	1,972
2	1	Adana	Adana	1,758
4	5	Ağrı	Samsun	144
12	3	Ankara	Kocaeli	1,155
13	3	Ankara	Kocaeli	17
16	3	Ankara	Kocaeli	2,475
19	3	Ankara	Kocaeli	200
20	3	Ankara	Kocaeli	2,966
30	2	Antalya	İzmir	2,235
32	5	Balıkesir	Samsun	3,183
34	5	Erzurum	Samsun	1
35	5	Erzurum	Samsun	2
36	5	Erzurum	Samsun	404
37	3	Eskişehir	Kocaeli	948
38	3	Eskişehir	Kocaeli	376
39	4	Gaziantep	Osmaniye	1,908
43	3	İstanbul	Kocaeli	5,027
45	3	İstanbul	Kocaeli	2,948
47	2	İzmir	İzmir	6,836
50	4	Kayseri	Osmaniye	1,077
54	3	Kırşehir	Kocaeli	1,147
55	3	Kocaeli	Kocaeli	6,471
56	3	Konya	Kocaeli	1,312
59	3	Kütahya	Kocaeli	670
60	3	Kütahya	Kocaeli	408
61	4	Malatya	Osmaniye	1,520
64	3	Sakarya	Kocaeli	2,091
65	5	Van	Samsun	195

Table 0.3 Assignment of TSAs to DCs and vehicle counts sent from TSAs

TSA Order	DC Order	City of TSA	City of PD	Vehicle Count Transported From TSA to DC
1	2	Adana	Kocaeli	394
2	2	Adana	Kocaeli	351
4	2	Ağrı	Kocaeli	28
12	2	Ankara	Kocaeli	231
13	2	Ankara	Kocaeli	3
16	2	Ankara	Kocaeli	495
19	2	Ankara	Kocaeli	40
20	2	Ankara	Kocaeli	593
30	3	Antalya	İzmir	447
32	2	Balıkesir	Kocaeli	636
36	2	Erzurum	Kocaeli	80
37	2	Eskişehir	Kocaeli	189
38	2	Eskişehir	Kocaeli	75
39	2	Gaziantep	Kocaeli	381
43	2	İstanbul	Kocaeli	1,005
45	1	İstanbul	İstanbul	589
47	3	İzmir	İzmir	1,367
50	2	Kayseri	Kocaeli	215
54	2	Kırşehir	Kocaeli	229
55	2	Kocaeli	Kocaeli	1,294
56	2	Konya	Kocaeli	262
59	2	Kütahya	Kocaeli	134
60	2	Kütahya	Kocaeli	81
61	2	Malatya	Kocaeli	304
64	2	Sakarya	Kocaeli	418
65	2	Van	Kocaeli	39

Table 0.4 Assignment of PCs to DCs and vehicle counts sent from PCs

PC Order	DC Order	City of PC	City of DC	Vehicle Count Transported From PC to DC
1	2	Adana	Kocaeli	932
2	3	İzmir	İzmir	2,267
3	2	Kocaeli	Kocaeli	7,052
4	2	Osmaniye	Kocaeli	1,126
5	2	Samsun	Kocaeli	982

Table 0.5 Assignment of PDs to TSAs and vehicle counts sent from PDs

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
1	2	Adana	Adana	111
2	3	Adana	Adana	136
3	3	Adana	Adana	25
4	3	Adana	Adana	109
5	2	Adana	Adana	140
6	2	Adana	Adana	98
7	3	Adana	Adana	34
8	2	Adana	Adana	51
9	3	Adana	Adana	45
10	2	Adana	Adana	72
11	2	Adana	Adana	1
12	3	Adana	Adana	14
13	2	Adana	Adana	25
14	2	Adana	Adana	64
15	3	Adana	Adana	60
16	3	Adana	Adana	126
17	3	Adana	Adana	105
18	2	Adana	Adana	13
19	3	Adana	Adana	108
20	39	Adıyaman	Gaziantep	1
21	39	Adıyaman	Gaziantep	56
22	39	Adıyaman	Gaziantep	46
23	39	Adıyaman	Gaziantep	94
24	58	Afyonkarahisar	Kütahya	30
25	58	Afyonkarahisar	Kütahya	38
26	58	Afyonkarahisar	Kütahya	3
27	58	Afyonkarahisar	Kütahya	10
28	58	Afyonkarahisar	Kütahya	21
29	58	Afyonkarahisar	Kütahya	36
30	58	Afyonkarahisar	Kütahya	48
31	58	Afyonkarahisar	Kütahya	46
32	58	Afyonkarahisar	Kütahya	52
33	58	Afyonkarahisar	Kütahya	26
34	58	Afyonkarahisar	Kütahya	2
35	58	Afyonkarahisar	Kütahya	23
36	58	Afyonkarahisar	Kütahya	34
37	34	Ağrı	Erzurum	30
38	34	Ağrı	Erzurum	43
39	34	Ağrı	Erzurum	2
40	34	Ağrı	Erzurum	1
41	49	Aksaray	Kayseri	46

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
42	49	Aksaray	Kayseri	15
43	20	Aksaray	Ankara	36
44	49	Aksaray	Kayseri	40
45	49	Aksaray	Kayseri	1
46	49	Aksaray	Kayseri	5
47	2	Aksaray	Adana	10
48	49	Aksaray	Kayseri	36
49	49	Aksaray	Kayseri	27
50	15	Amasya	Ankara	3
51	52	Amasya	Kayseri	49
52	52	Amasya	Kayseri	67
53	52	Amasya	Kayseri	88
54	15	Amasya	Ankara	17
55	5	Ankara	Ankara	226
56	15	Ankara	Ankara	25
57	20	Ankara	Ankara	178
58	20	Ankara	Ankara	202
59	5	Ankara	Ankara	144
60	20	Ankara	Ankara	249
61	15	Ankara	Ankara	108
62	5	Ankara	Ankara	147
63	15	Ankara	Ankara	76
64	15	Ankara	Ankara	259
65	11	Ankara	Ankara	281
66	11	Ankara	Ankara	250
67	11	Ankara	Ankara	295
68	11	Ankara	Ankara	140
69	20	Ankara	Ankara	144
70	15	Ankara	Ankara	185
71	15	Ankara	Ankara	65
72	11	Ankara	Ankara	80
73	5	Ankara	Ankara	121
74	11	Ankara	Ankara	200
75	5	Ankara	Ankara	142
76	5	Ankara	Ankara	304
77	5	Ankara	Ankara	37
78	20	Ankara	Ankara	278
79	5	Ankara	Ankara	96
80	5	Ankara	Ankara	213
81	20	Ankara	Ankara	29
82	20	Ankara	Ankara	290
83	20	Ankara	Ankara	17

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
84	20	Ankara	Ankara	201
85	20	Ankara	Ankara	47
86	5	Ankara	Ankara	90
87	15	Ankara	Ankara	273
88	20	Ankara	Ankara	1
89	30	Antalya	Antalya	45
90	30	Antalya	Antalya	111
91	30	Antalya	Antalya	147
92	30	Antalya	Antalya	36
93	30	Antalya	Antalya	152
94	30	Antalya	Antalya	39
95	30	Antalya	Antalya	19
96	30	Antalya	Antalya	83
97	30	Antalya	Antalya	63
98	30	Antalya	Antalya	77
99	11	Antalya	Ankara	57
100	30	Antalya	Antalya	122
101	30	Antalya	Antalya	101
102	30	Antalya	Antalya	1
103	30	Antalya	Antalya	161
104	30	Antalya	Antalya	44
105	30	Antalya	Antalya	24
106	30	Antalya	Antalya	104
107	30	Antalya	Antalya	88
108	30	Antalya	Antalya	151
109	30	Antalya	Antalya	83
110	30	Antalya	Antalya	148
111	30	Antalya	Antalya	130
112	30	Antalya	Antalya	29
113	30	Antalya	Antalya	9
114	32	Ardahan	Balıkesir	4
115	32	Ardahan	Balıkesir	17
116	32	Artvin	Balıkesir	5
117	32	Artvin	Balıkesir	29
118	32	Artvin	Balıkesir	30
119	32	Artvin	Balıkesir	26
120	47	Aydın	İzmir	38
121	48	Aydın	İzmir	121
122	48	Aydın	İzmir	143
123	48	Aydın	İzmir	16
124	48	Aydın	İzmir	49
125	47	Aydın	İzmir	64

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
126	48	Aydın	İzmir	128
127	48	Aydın	İzmir	107
128	48	Aydın	İzmir	77
129	48	Aydın	İzmir	1
130	48	Aydın	İzmir	36
131	32	Balıkesir	Balıkesir	172
132	47	Balıkesir	İzmir	3
133	32	Balıkesir	Balıkesir	248
134	47	Balıkesir	İzmir	80
135	47	Balıkesir	İzmir	245
136	47	Balıkesir	İzmir	95
137	15	Bartın	Ankara	30
138	15	Bartın	Ankara	9
139	15	Bartın	Ankara	56
140	15	Bartın	Ankara	4
141	15	Bartın	Ankara	18
142	63	Batman	Malatya	32
143	63	Batman	Malatya	6
144	63	Batman	Malatya	11
145	63	Batman	Malatya	13
146	63	Batman	Malatya	22
147	63	Batman	Malatya	26
148	32	Bayburt	Balıkesir	21
149	32	Bayburt	Balıkesir	4
150	40	Bilecik	İstanbul	19
151	58	Bilecik	Kütahya	16
152	40	Bilecik	İstanbul	28
153	40	Bilecik	İstanbul	23
154	3	Bilecik	Adana	0
155	58	Bilecik	Kütahya	36
156	63	Bingöl	Malatya	2
157	63	Bingöl	Malatya	22
158	63	Bingöl	Malatya	17
159	63	Bitlis	Malatya	22
160	34	Bitlis	Erzurum	20
161	63	Bitlis	Malatya	11
162	15	Bolu	Ankara	14
163	15	Bolu	Ankara	38
164	15	Bolu	Ankara	50
165	15	Bolu	Ankara	45
166	15	Bolu	Ankara	5
167	15	Bolu	Ankara	59

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
168	30	Burdur	Antalya	12
169	58	Burdur	Kütahya	56
170	58	Burdur	Kütahya	51
171	47	Burdur	İzmir	9
172	47	Burdur	İzmir	49
173	58	Burdur	Kütahya	8
174	58	Burdur	Kütahya	7
175	58	Burdur	Kütahya	29
176	40	Bursa	İstanbul	63
177	40	Bursa	İstanbul	208
178	40	Bursa	İstanbul	174
179	40	Bursa	İstanbul	42
180	40	Bursa	İstanbul	20
181	40	Bursa	İstanbul	94
182	40	Bursa	İstanbul	35
183	40	Bursa	İstanbul	110
184	40	Bursa	İstanbul	86
185	40	Bursa	İstanbul	161
186	40	Bursa	İstanbul	76
187	40	Bursa	İstanbul	148
188	32	Bursa	Balıkesir	145
189	40	Bursa	İstanbul	8
190	3	Bursa	Adana	0
191	40	Bursa	İstanbul	72
192	40	Bursa	İstanbul	49
193	40	Bursa	İstanbul	140
194	40	Bursa	İstanbul	113
195	40	Bursa	İstanbul	132
196	47	Çanakkale	İzmir	28
197	40	Çanakkale	İstanbul	2
198	47	Çanakkale	İzmir	82
199	47	Çanakkale	İzmir	89
200	47	Çanakkale	İzmir	97
201	47	Çanakkale	İzmir	52
202	15	Çankırı	Ankara	83
203	15	Çorum	Ankara	33
204	15	Çorum	Ankara	3
205	15	Çorum	Ankara	18
206	15	Çorum	Ankara	4
207	15	Çorum	Ankara	16
208	15	Çorum	Ankara	16
209	15	Çorum	Ankara	29

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
210	15	Çorum	Ankara	24
211	15	Çorum	Ankara	27
212	15	Çorum	Ankara	22
213	15	Çorum	Ankara	35
214	15	Çorum	Ankara	35
215	15	Çorum	Ankara	11
216	15	Çorum	Ankara	7
217	15	Çorum	Ankara	23
218	15	Çorum	Ankara	19
219	47	Denizli	İzmir	60
220	47	Denizli	İzmir	14
221	47	Denizli	İzmir	2
222	47	Denizli	İzmir	54
223	47	Denizli	İzmir	38
224	47	Denizli	İzmir	103
225	47	Denizli	İzmir	85
226	47	Denizli	İzmir	137
227	3	Denizli	Adana	0
228	47	Denizli	İzmir	130
229	47	Denizli	İzmir	36
230	47	Denizli	İzmir	127
231	63	Diyarbakır	Malatya	64
232	63	Diyarbakır	Malatya	90
233	62	Diyarbakır	Malatya	4
234	63	Diyarbakır	Malatya	17
235	63	Diyarbakır	Malatya	74
236	63	Diyarbakır	Malatya	25
237	62	Diyarbakır	Malatya	42
238	15	Düzce	Ankara	74
239	15	Düzce	Ankara	96
240	40	Düzce	İstanbul	25
241	40	Düzce	İstanbul	12
242	42	Edirne	İstanbul	43
243	42	Edirne	İstanbul	81
244	42	Edirne	İstanbul	70
245	42	Edirne	İstanbul	3
246	42	Edirne	İstanbul	70
247	42	Edirne	İstanbul	1
248	63	Elazığ	Malatya	6
249	63	Elazığ	Malatya	41
250	63	Elazığ	Malatya	37
251	63	Elazığ	Malatya	7

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
252	62	Elazığ	Malatya	1
253	63	Elazığ	Malatya	18
254	63	Elazığ	Malatya	17
255	63	Elazığ	Malatya	34
256	63	Elazığ	Malatya	29
257	63	Elazığ	Malatya	46
258	63	Elazığ	Malatya	2
259	62	Elazığ	Malatya	33
260	63	Elazığ	Malatya	2
261	63	Elazığ	Malatya	1
262	32	Erzincan	Balıkesir	67
263	32	Erzincan	Balıkesir	12
264	32	Erzincan	Balıkesir	16
265	32	Erzincan	Balıkesir	26
266	32	Erzurum	Balıkesir	23
267	34	Erzurum	Erzurum	65
268	34	Erzurum	Erzurum	7
269	34	Erzurum	Erzurum	15
270	34	Erzurum	Erzurum	25
271	34	Erzurum	Erzurum	4
272	34	Erzurum	Erzurum	65
273	34	Erzurum	Erzurum	1
274	34	Erzurum	Erzurum	82
275	58	Eskişehir	Kütahya	114
276	58	Eskişehir	Kütahya	31
277	58	Eskişehir	Kütahya	29
278	58	Eskişehir	Kütahya	6
279	58	Eskişehir	Kütahya	71
280	58	Eskişehir	Kütahya	82
281	58	Eskişehir	Kütahya	95
282	58	Eskişehir	Kütahya	103
283	58	Eskişehir	Kütahya	45
284	58	Eskişehir	Kütahya	64
285	39	Gaziantep	Gaziantep	18
286	1	Gaziantep	Adana	125
287	39	Gaziantep	Gaziantep	153
288	39	Gaziantep	Gaziantep	175
289	39	Gaziantep	Gaziantep	13
290	39	Gaziantep	Gaziantep	52
291	39	Gaziantep	Gaziantep	85
292	39	Gaziantep	Gaziantep	135
293	39	Gaziantep	Gaziantep	169

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
294	32	Giresun	Balıkesir	29
295	32	Giresun	Balıkesir	60
296	32	Giresun	Balıkesir	8
297	32	Giresun	Balıkesir	84
298	32	Giresun	Balıkesir	35
299	32	Gümüşhane	Balıkesir	36
300	32	Gümüşhane	Balıkesir	10
301	63	Hakkari	Malatya	4
302	65	Hakkari	Van	5
303	65	Hakkari	Van	3
304	65	Hakkari	Van	7
305	63	Hakkari	Malatya	7
306	3	Hakkari	Adana	0
307	3	Hatay	Adana	25
308	1	Hatay	Adana	133
309	1	Hatay	Adana	107
310	1	Hatay	Adana	8
311	1	Hatay	Adana	148
312	1	Hatay	Adana	48
313	1	Hatay	Adana	33
314	1	Hatay	Adana	90
315	1	Hatay	Adana	75
316	1	Hatay	Adana	133
317	34	Iğdır	Erzurum	3
318	34	Iğdır	Erzurum	21
319	34	Iğdır	Erzurum	16
320	34	Iğdır	Erzurum	2
321	58	Isparta	Kütahya	51
322	58	Isparta	Kütahya	84
323	58	Isparta	Kütahya	31
324	58	Isparta	Kütahya	38
325	58	Isparta	Kütahya	45
326	3	Isparta	Adana	0
327	40	İstanbul	İstanbul	340
328	42	İstanbul	İstanbul	77
329	42	İstanbul	İstanbul	151
330	40	İstanbul	İstanbul	177
331	42	İstanbul	İstanbul	127
332	42	İstanbul	İstanbul	304
333	40	İstanbul	İstanbul	257
334	40	İstanbul	İstanbul	22
335	40	İstanbul	İstanbul	10

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
336	40	İstanbul	İstanbul	143
337	40	İstanbul	İstanbul	166
338	40	İstanbul	İstanbul	154
339	40	İstanbul	İstanbul	289
340	42	İstanbul	İstanbul	270
341	40	İstanbul	İstanbul	35
342	40	İstanbul	İstanbul	288
343	42	İstanbul	İstanbul	310
344	40	İstanbul	İstanbul	291
345	40	İstanbul	İstanbul	28
346	40	İstanbul	İstanbul	10
347	40	İstanbul	İstanbul	181
348	40	İstanbul	İstanbul	203
349	42	İstanbul	İstanbul	155
350	40	İstanbul	İstanbul	333
351	42	İstanbul	İstanbul	277
352	40	İstanbul	İstanbul	49
353	42	İstanbul	İstanbul	29
354	42	İstanbul	İstanbul	169
355	42	İstanbul	İstanbul	9
356	40	İstanbul	İstanbul	142
357	40	İstanbul	İstanbul	132
358	40	İstanbul	İstanbul	300
359	40	İstanbul	İstanbul	161
360	40	İstanbul	İstanbul	332
361	40	İstanbul	İstanbul	284
362	40	İstanbul	İstanbul	305
363	40	İstanbul	İstanbul	79
364	42	İstanbul	İstanbul	23
365	42	İstanbul	İstanbul	194
366	40	İstanbul	İstanbul	175
367	40	İstanbul	İstanbul	318
368	40	İstanbul	İstanbul	150
369	40	İstanbul	İstanbul	321
370	40	İstanbul	İstanbul	273
371	40	İstanbul	İstanbul	37
372	40	İstanbul	İstanbul	18
373	42	İstanbul	İstanbul	162
374	42	İstanbul	İstanbul	184
375	40	İstanbul	İstanbul	164
376	42	İstanbul	İstanbul	307
377	40	İstanbul	İstanbul	181

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
378	40	İstanbul	İstanbul	352
379	40	İstanbul	İstanbul	304
380	40	İstanbul	İstanbul	327
381	40	İstanbul	İstanbul	314
382	42	İstanbul	İstanbul	50
383	40	İstanbul	İstanbul	29
384	40	İstanbul	İstanbul	171
385	40	İstanbul	İstanbul	151
386	42	İstanbul	İstanbul	182
387	42	İstanbul	İstanbul	315
388	47	İzmir	İzmir	196
389	47	İzmir	İzmir	14
390	47	İzmir	İzmir	72
391	48	İzmir	İzmir	182
392	47	İzmir	İzmir	202
393	47	İzmir	İzmir	89
394	48	İzmir	İzmir	217
395	47	İzmir	İzmir	180
396	47	İzmir	İzmir	285
397	48	İzmir	İzmir	273
398	47	İzmir	İzmir	83
399	47	İzmir	İzmir	72
400	47	İzmir	İzmir	173
401	47	İzmir	İzmir	56
402	47	İzmir	İzmir	157
403	47	İzmir	İzmir	151
404	47	İzmir	İzmir	256
405	47	İzmir	İzmir	219
406	48	İzmir	İzmir	56
407	47	İzmir	İzmir	18
408	48	İzmir	İzmir	145
409	47	İzmir	İzmir	4
410	48	İzmir	İzmir	25
411	48	İzmir	İzmir	125
412	39	Kahramanmaraş	Gaziantep	59
413	39	Kahramanmaraş	Gaziantep	19
414	39	Kahramanmaraş	Gaziantep	7
415	51	Kahramanmaraş	Kayseri	54
416	39	Kahramanmaraş	Gaziantep	38
417	51	Kahramanmaraş	Kayseri	47
418	39	Kahramanmaraş	Gaziantep	31
419	39	Kahramanmaraş	Gaziantep	88

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
420	39	Kahramanmaraş	Gaziantep	42
421	1	Kahramanmaraş	Adana	99
422	15	Karabük	Ankara	6
423	15	Karabük	Ankara	37
424	15	Karabük	Ankara	52
425	15	Karabük	Ankara	61
426	15	Karabük	Ankara	9
427	2	Karaman	Adana	17
428	2	Karaman	Adana	48
429	2	Karaman	Adana	31
430	57	Karaman	Konya	25
431	2	Karaman	Adana	30
432	34	Kars	Erzurum	6
433	34	Kars	Erzurum	30
434	34	Kars	Erzurum	27
435	34	Kars	Erzurum	6
436	15	Kastamonu	Ankara	58
437	15	Kastamonu	Ankara	7
438	15	Kastamonu	Ankara	77
439	15	Kastamonu	Ankara	31
440	15	Kastamonu	Ankara	20
441	15	Kastamonu	Ankara	58
442	49	Kayseri	Kayseri	66
443	49	Kayseri	Kayseri	40
444	49	Kayseri	Kayseri	33
445	49	Kayseri	Kayseri	65
446	49	Kayseri	Kayseri	54
447	49	Kayseri	Kayseri	61
448	49	Kayseri	Kayseri	50
449	52	Kayseri	Kayseri	91
450	51	Kayseri	Kayseri	81
451	49	Kayseri	Kayseri	19
452	51	Kayseri	Kayseri	17
453	49	Kayseri	Kayseri	49
454	49	Kayseri	Kayseri	39
455	49	Kayseri	Kayseri	80
456	49	Kayseri	Kayseri	44
457	49	Kayseri	Kayseri	50
458	49	Kayseri	Kayseri	84
459	5	Kırıkkale	Ankara	34
460	5	Kırıkkale	Ankara	59
461	5	Kırıkkale	Ankara	66

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
462	42	Kırklareli	İstanbul	53
463	42	Kırklareli	İstanbul	104
464	42	Kırklareli	İstanbul	62
465	54	Kırşehir	Kırşehir	27
466	54	Kırşehir	Kırşehir	16
467	54	Kırşehir	Kırşehir	9
468	54	Kırşehir	Kırşehir	26
469	54	Kırşehir	Kırşehir	21
470	54	Kırşehir	Kırşehir	36
471	39	Kilis	Gaziantep	4
472	39	Kilis	Gaziantep	13
473	39	Kilis	Gaziantep	26
474	40	Kocaeli	İstanbul	38
475	40	Kocaeli	İstanbul	118
476	40	Kocaeli	İstanbul	107
477	40	Kocaeli	İstanbul	16
478	40	Kocaeli	İstanbul	108
479	40	Kocaeli	İstanbul	28
480	40	Kocaeli	İstanbul	10
481	40	Kocaeli	İstanbul	72
482	40	Kocaeli	İstanbul	54
483	40	Kocaeli	İstanbul	115
484	40	Kocaeli	İstanbul	101
485	40	Kocaeli	İstanbul	108
486	40	Kocaeli	İstanbul	15
487	57	Konya	Konya	5
488	57	Konya	Konya	38
489	57	Isparta	Konya	51
490	57	Konya	Konya	5
491	57	Konya	Konya	38
492	57	Konya	Konya	90
493	57	Konya	Konya	86
494	57	Konya	Konya	145
495	20	Konya	Ankara	76
496	57	Konya	Konya	138
497	57	Konya	Konya	71
498	57	Konya	Konya	136
499	57	Konya	Konya	130
500	57	Konya	Konya	17
501	57	Konya	Konya	13
502	57	Konya	Konya	72
503	57	Konya	Konya	66

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
504	57	Konya	Konya	129
505	58	Kütahya	Kütahya	22
506	58	Kütahya	Kütahya	76
507	58	Kütahya	Kütahya	96
508	58	Kütahya	Kütahya	106
509	58	Kütahya	Kütahya	132
510	61	Malatya	Malatya	41
511	63	Malatya	Malatya	53
512	61	Malatya	Malatya	61
513	61	Malatya	Malatya	1
514	61	Malatya	Malatya	36
515	61	Malatya	Malatya	45
516	61	Malatya	Malatya	49
517	61	Malatya	Malatya	39
518	61	Malatya	Malatya	13
519	61	Malatya	Malatya	20
520	47	Manisa	İzmir	122
521	47	Manisa	İzmir	73
522	47	Manisa	İzmir	90
523	47	Manisa	İzmir	130
524	47	Manisa	İzmir	19
525	47	Manisa	İzmir	126
526	47	Manisa	İzmir	77
527	47	Manisa	İzmir	28
528	47	Manisa	İzmir	65
529	47	Manisa	İzmir	84
530	47	Manisa	İzmir	58
531	39	Mardin	Gaziantep	33
532	39	Mardin	Gaziantep	42
533	39	Mardin	Gaziantep	9
534	39	Mardin	Gaziantep	40
535	39	Mardin	Gaziantep	13
536	39	Mardin	Gaziantep	8
537	2	Mersin	Adana	179
538	39	Mersin	Gaziantep	12
539	2	Mersin	Adana	19
540	2	Mersin	Adana	87
541	2	Mersin	Adana	7
542	2	Mersin	Adana	143
543	2	Mersin	Adana	167
544	39	Mersin	Gaziantep	85
545	2	Mersin	Adana	106

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
546	2	Mersin	Adana	128
547	2	Mersin	Adana	167
548	47	Muğla	İzmir	114
549	48	Muğla	İzmir	90
550	48	Muğla	İzmir	45
551	48	Muğla	İzmir	29
552	48	Muğla	İzmir	39
553	48	Muğla	İzmir	20
554	48	Muğla	İzmir	83
555	48	Muğla	İzmir	67
556	48	Muğla	İzmir	116
557	48	Muğla	İzmir	114
558	48	Muğla	İzmir	20
559	48	Muğla	İzmir	15
560	48	Muğla	İzmir	67
561	48	Muğla	İzmir	12
562	48	Muğla	İzmir	21
563	63	Muş	Malatya	32
564	63	Muş	Malatya	26
565	49	Nevşehir	Kayseri	45
566	49	Nevşehir	Kayseri	39
567	49	Nevşehir	Kayseri	37
568	49	Nevşehir	Kayseri	46
569	49	Nevşehir	Kayseri	37
570	49	Nevşehir	Kayseri	4
571	2	Niğde	Adana	11
572	2	Niğde	Adana	32
573	2	Niğde	Adana	32
574	2	Niğde	Adana	28
575	2	Niğde	Adana	11
576	2	Niğde	Adana	11
577	2	Niğde	Adana	15
578	2	Niğde	Adana	30
579	32	Ordu	Balıkesir	68
580	48	Ordu	İzmir	37
581	32	Ordu	Balıkesir	27
582	32	Ordu	Balıkesir	64
583	32	Ordu	Balıkesir	52
584	32	Ordu	Balıkesir	97
585	1	Osmaniye	Adana	84
586	3	Osmaniye	Adana	18
587	1	Osmaniye	Adana	183

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
588	32	Rize	Balıkesir	50
589	32	Rize	Balıkesir	65
590	32	Rize	Balıkesir	21
591	32	Rize	Balıkesir	12
592	32	Rize	Balıkesir	44
593	40	Sakarya	İstanbul	32
594	40	Sakarya	İstanbul	80
595	40	Sakarya	İstanbul	131
596	40	Sakarya	İstanbul	112
597	40	Sakarya	İstanbul	19
598	40	Sakarya	İstanbul	1
599	40	Sakarya	İstanbul	61
600	40	Sakarya	İstanbul	1
601	40	Sakarya	İstanbul	62
602	40	Sakarya	İstanbul	43
603	40	Samsun	İstanbul	13
604	32	Samsun	Balıkesir	31
605	32	Samsun	Balıkesir	63
606	32	Samsun	Balıkesir	35
607	32	Samsun	Balıkesir	66
608	32	Samsun	Balıkesir	31
609	32	Samsun	Balıkesir	60
610	32	Samsun	Balıkesir	58
611	32	Samsun	Balıkesir	2
612	32	Samsun	Balıkesir	84
613	32	Samsun	Balıkesir	28
614	32	Samsun	Balıkesir	19
615	32	Samsun	Balıkesir	56
616	32	Samsun	Balıkesir	46
617	32	Samsun	Balıkesir	51
618	32	Samsun	Balıkesir	81
619	63	Siirt	Malatya	14
620	63	Siirt	Malatya	13
621	63	Siirt	Malatya	20
622	15	Sinop	Ankara	118
623	15	Sinop	Ankara	10
624	32	Sivas	Balıkesir	5
625	32	Sivas	Balıkesir	24
626	32	Sivas	Balıkesir	61
627	51	Sivas	Kayseri	53
628	32	Sivas	Balıkesir	61
629	32	Sivas	Balıkesir	1

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
630	32	Sivas	Balıkesir	34
631	32	Sivas	Balıkesir	42
632	32	Sivas	Balıkesir	40
633	39	Şanlıurfa	Gaziantep	9
634	39	Şanlıurfa	Gaziantep	23
635	39	Şanlıurfa	Gaziantep	57
636	39	Şanlıurfa	Gaziantep	47
637	39	Şanlıurfa	Gaziantep	78
638	39	Şanlıurfa	Gaziantep	68
639	39	Şanlıurfa	Gaziantep	20
640	39	Şanlıurfa	Gaziantep	4
641	39	Şanlıurfa	Gaziantep	38
642	39	Şanlıurfa	Gaziantep	28
643	39	Şanlıurfa	Gaziantep	61
644	39	Şanlıurfa	Gaziantep	52
645	39	Şırnak	Gaziantep	4
646	39	Şırnak	Gaziantep	8
647	39	Şırnak	Gaziantep	9
648	39	Şırnak	Gaziantep	6
649	39	Şırnak	Gaziantep	17
650	42	Tekirdağ	İstanbul	46
651	40	Tekirdağ	İstanbul	76
652	40	Tekirdağ	İstanbul	80
653	40	Tekirdağ	İstanbul	43
654	40	Tekirdağ	İstanbul	53
655	42	Tekirdağ	İstanbul	58
656	42	Tekirdağ	İstanbul	77
657	42	Tekirdağ	İstanbul	6
658	42	Tekirdağ	İstanbul	18
659	42	Tekirdağ	İstanbul	2
660	40	Tekirdağ	İstanbul	53
661	32	Tokat	Balıkesir	80
662	32	Tokat	Balıkesir	16
663	32	Tokat	Balıkesir	7
664	32	Tokat	Balıkesir	42
665	32	Tokat	Balıkesir	38
666	32	Tokat	Balıkesir	72
667	32	Tokat	Balıkesir	62
668	32	Trabzon	Balıkesir	46
669	32	Trabzon	Balıkesir	66
670	32	Trabzon	Balıkesir	68
671	32	Trabzon	Balıkesir	42

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
672	32	Trabzon	Balıkesir	42
673	32	Trabzon	Balıkesir	53
674	32	Trabzon	Balıkesir	59
675	32	Trabzon	Balıkesir	23
676	32	Trabzon	Balıkesir	26
677	32	Trabzon	Balıkesir	33
678	32	Tunceli	Balıkesir	17
679	62	Uşak	Malatya	20
680	63	Uşak	Malatya	10
681	58	Uşak	Kütahya	33
682	58	Uşak	Kütahya	26
683	58	Uşak	Kütahya	48
684	58	Uşak	Kütahya	46
685	58	Uşak	Kütahya	6
686	58	Uşak	Kütahya	52
687	58	Uşak	Kütahya	12
688	65	Van	Van	25
689	65	Van	Van	8
690	34	Van	Erzurum	21
691	65	Van	Van	23
692	65	Van	Van	24
693	65	Van	Van	6
694	65	Van	Van	9
695	65	Van	Van	25
696	34	Van	Erzurum	26
697	65	Van	Van	27
698	65	Van	Van	22
699	40	Yalova	İstanbul	68
700	40	Yalova	İstanbul	7
701	40	Yalova	İstanbul	29
702	40	Yalova	İstanbul	21
703	54	Yozgat	Kırşehir	18
704	54	Yozgat	Kırşehir	39
705	54	Yozgat	Kırşehir	40
706	54	Yozgat	Kırşehir	23
707	54	Yozgat	Kırşehir	25
708	54	Yozgat	Kırşehir	28
709	49	Yozgat	Kayseri	23
710	15	Zonguldak	Ankara	55
711	15	Zonguldak	Ankara	20
712	15	Zonguldak	Ankara	32
713	15	Zonguldak	Ankara	50

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
714	40	Zonguldak	İstanbul	57
715	40	Zonguldak	İstanbul	52
716	40	Zonguldak	İstanbul	67
717	40	Zonguldak	İstanbul	11
718	40	Zonguldak	İstanbul	20
719	40	Zonguldak	İstanbul	40

Table 0.6 Assignment of TSAs to PCs and vehicle counts sent from TSAs

TSA Order	PC Order	City of TSA	City of PC	Vehicle Count Transported From TSA to PC
1	1	Adana	Adana	1,266
2	1	Adana	Adana	1,884
3	1	Adana	Adana	805
5	3	Ankara	Kocaeli	1,679
11	1	Ankara	Adana	1,303
15	3	Ankara	Kocaeli	2,615
20	3	Ankara	Kocaeli	1,748
30	2	Antalya	İzmir	1,979
32	5	Balıkesir	Samsun	3,378
34	5	Erzurum	Samsun	518
39	4	Gaziantep	Osmaniye	2,095
40	3	İstanbul	Kocaeli	11,958
42	3	İstanbul	Kocaeli	3,989
47	2	İzmir	İzmir	4,930
48	2	İzmir	İzmir	2,476
49	4	Kayseri	Osmaniye	1,135
51	4	Kayseri	Osmaniye	252
52	4	Kayseri	Osmaniye	295
54	5	Kırşehir	Samsun	308
57	1	Konya	Adana	1,255
58	3	Kütahya	Kocaeli	2,116
61	4	Malatya	Osmaniye	305
62	4	Malatya	Osmaniye	100
63	4	Malatya	Osmaniye	873
65	4	Van	Osmaniye	184

Table 0.7 Assignment of TSAs to DCs and vehicle counts sent from TSAs

TSA Order	DC Order	City of TSA	City of PD	Vehicle Count Transported From TSA to DC
1	2	Adana	Kocaeli	126
2	2	Adana	Kocaeli	188
3	2	Adana	Kocaeli	80
5	2	Ankara	Kocaeli	167
11	2	Ankara	Kocaeli	130
15	2	Ankara	Kocaeli	261
20	2	Ankara	Kocaeli	174
30	3	Antalya	İzmir	197
32	2	Balıkesir	Kocaeli	337
34	2	Erzurum	Kocaeli	51
39	2	Gaziantep	Kocaeli	209
40	2	İstanbul	Kocaeli	1,195
42	1	İstanbul	İstanbul	398
47	3	İzmir	İzmir	493
48	3	İzmir	İzmir	247
49	2	Kayseri	Kocaeli	113
51	2	Kayseri	Kocaeli	25
52	2	Kayseri	Kocaeli	29
54	2	Kırşehir	Kocaeli	30
57	2	Konya	Kocaeli	125
58	2	Kütahya	Kocaeli	211
61	2	Malatya	Kocaeli	30
62	2	Malatya	Kocaeli	10
63	2	Malatya	Kocaeli	87
65	2	Van	Kocaeli	18

Table 0.8 Assignment of PCs to DCs and vehicle counts sent from PCs

PC Order	DC Order	City of PC	City of DC	Vehicle Count Transported From PC to DC
1	2	Adana	Kocaeli	651
2	3	İzmir	İzmir	938
3	2	Kocaeli	Kocaeli	2,410
4	2	Osmaniye	Kocaeli	523
5	2	Samsun	Kocaeli	420

Table 0.9 Assignment of PDs to TSAs and vehicle counts sent from PDs

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
1	2	Adana	Adana	111
2	1	Adana	Adana	136
3	1	Adana	Adana	25
4	1	Adana	Adana	109
5	2	Adana	Adana	140
6	2	Adana	Adana	98
7	1	Adana	Adana	34
8	2	Adana	Adana	51
9	1	Adana	Adana	45
10	2	Adana	Adana	72
11	2	Adana	Adana	1
12	1	Adana	Adana	14
13	2	Adana	Adana	25
14	2	Adana	Adana	64
15	1	Adana	Adana	60
16	1	Adana	Adana	126
17	1	Adana	Adana	105
18	2	Adana	Adana	13
19	1	Adana	Adana	108
20	39	Adıyaman	Gaziantep	1
21	39	Adıyaman	Gaziantep	56
22	39	Adıyaman	Gaziantep	46
23	39	Adıyaman	Gaziantep	94
24	37	Afyonkarahisar	Eskişehir	30
25	37	Afyonkarahisar	Eskişehir	38
26	37	Afyonkarahisar	Eskişehir	3
27	37	Afyonkarahisar	Eskişehir	10
28	37	Afyonkarahisar	Eskişehir	21
29	37	Afyonkarahisar	Eskişehir	36
30	37	Afyonkarahisar	Eskişehir	48
31	37	Afyonkarahisar	Eskişehir	46
32	37	Afyonkarahisar	Eskişehir	52
33	37	Afyonkarahisar	Eskişehir	26
34	37	Afyonkarahisar	Eskişehir	2
35	37	Afyonkarahisar	Eskişehir	23
36	37	Afyonkarahisar	Eskişehir	34
37	36	Ağrı	Erzurum	30
38	36	Ağrı	Erzurum	43
39	36	Ağrı	Erzurum	2
40	36	Ağrı	Erzurum	1
41	49	Aksaray	Kayseri	46

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
42	5	Aksaray	Ankara	15
43	5	Aksaray	Ankara	36
44	5	Aksaray	Ankara	40
45	5	Aksaray	Ankara	1
46	5	Aksaray	Ankara	5
47	2	Aksaray	Adana	10
48	49	Aksaray	Kayseri	36
49	49	Aksaray	Kayseri	27
50	27	Amasya	Ankara	3
51	27	Amasya	Ankara	49
52	27	Amasya	Ankara	67
53	27	Amasya	Ankara	88
54	27	Amasya	Ankara	17
55	5	Ankara	Ankara	226
56	27	Ankara	Ankara	25
57	5	Ankara	Ankara	178
58	5	Ankara	Ankara	202
59	5	Ankara	Ankara	144
60	5	Ankara	Ankara	249
61	27	Ankara	Ankara	108
62	5	Ankara	Ankara	147
63	27	Ankara	Ankara	76
64	27	Ankara	Ankara	259
65	13	Ankara	Ankara	281
66	26	Ankara	Ankara	250
67	13	Ankara	Ankara	295
68	26	Ankara	Ankara	140
69	5	Ankara	Ankara	144
70	27	Ankara	Ankara	185
71	27	Ankara	Ankara	65
72	13	Ankara	Ankara	80
73	27	Ankara	Ankara	121
74	26	Ankara	Ankara	200
75	5	Ankara	Ankara	142
76	27	Ankara	Ankara	304
77	5	Ankara	Ankara	37
78	5	Ankara	Ankara	278
79	5	Ankara	Ankara	96
80	5	Ankara	Ankara	213
81	5	Ankara	Ankara	29
82	5	Ankara	Ankara	290
83	5	Ankara	Ankara	17

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
84	5	Ankara	Ankara	201
85	5	Ankara	Ankara	47
86	5	Ankara	Ankara	90
87	27	Ankara	Ankara	273
88	5	Ankara	Ankara	1
89	30	Antalya	Antalya	45
90	30	Antalya	Antalya	111
91	30	Antalya	Antalya	147
92	30	Antalya	Antalya	36
93	30	Antalya	Antalya	152
94	30	Antalya	Antalya	39
95	30	Antalya	Antalya	19
96	30	Antalya	Antalya	83
97	30	Antalya	Antalya	63
98	30	Antalya	Antalya	77
99	13	Antalya	Ankara	57
100	30	Antalya	Antalya	122
101	30	Antalya	Antalya	101
102	30	Antalya	Antalya	1
103	30	Antalya	Antalya	161
104	30	Antalya	Antalya	44
105	30	Antalya	Antalya	24
106	30	Antalya	Antalya	104
107	30	Antalya	Antalya	88
108	30	Antalya	Antalya	151
109	30	Antalya	Antalya	83
110	30	Antalya	Antalya	148
111	30	Antalya	Antalya	130
112	30	Antalya	Antalya	29
113	30	Antalya	Antalya	9
114	32	Ardahan	Balıkesir	4
115	32	Ardahan	Balıkesir	17
116	32	Artvin	Balıkesir	5
117	32	Artvin	Balıkesir	29
118	32	Artvin	Balıkesir	30
119	32	Artvin	Balıkesir	26
120	31	Aydın	Balıkesir	38
121	48	Aydın	İzmir	121
122	48	Aydın	İzmir	143
123	48	Aydın	İzmir	16
124	48	Aydın	İzmir	49
125	48	Aydın	İzmir	64

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
126	48	Aydın	İzmir	128
127	48	Aydın	İzmir	107
128	48	Aydın	İzmir	77
129	48	Aydın	İzmir	1
130	48	Aydın	İzmir	36
131	32	Balıkesir	Balıkesir	172
132	31	Balıkesir	Balıkesir	3
133	32	Balıkesir	Balıkesir	248
134	31	Balıkesir	Balıkesir	80
135	31	Balıkesir	Balıkesir	245
136	31	Balıkesir	Balıkesir	95
137	64	Bartın	Sakarya	30
138	64	Bartın	Sakarya	9
139	64	Bartın	Sakarya	56
140	64	Bartın	Sakarya	4
141	64	Bartın	Sakarya	18
142	62	Batman	Malatya	32
143	62	Batman	Malatya	6
144	62	Batman	Malatya	11
145	62	Batman	Malatya	13
146	62	Batman	Malatya	22
147	62	Batman	Malatya	26
148	32	Bayburt	Balıkesir	21
149	32	Bayburt	Balıkesir	4
150	64	Bilecik	Sakarya	19
151	60	Bilecik	Kütahya	16
152	64	Bilecik	Sakarya	28
153	64	Bilecik	Sakarya	23
154	3	Bilecik	Adana	0
155	60	Bilecik	Kütahya	36
156	62	Bingöl	Malatya	2
157	62	Bingöl	Malatya	22
158	62	Bingöl	Malatya	17
159	62	Bitlis	Malatya	22
160	36	Bitlis	Erzurum	20
161	62	Bitlis	Malatya	11
162	64	Bolu	Sakarya	14
163	27	Bolu	Ankara	38
164	64	Bolu	Sakarya	50
165	64	Bolu	Sakarya	45
166	64	Bolu	Sakarya	5
167	64	Bolu	Sakarya	59

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
168	37	Burdur	Eskişehir	12
169	37	Burdur	Eskişehir	56
170	37	Burdur	Eskişehir	51
171	58	Burdur	Kütahya	9
172	58	Burdur	Kütahya	49
173	37	Burdur	Eskişehir	8
174	37	Burdur	Eskişehir	7
175	37	Burdur	Eskişehir	29
176	33	Bursa	Bursa	63
177	33	Bursa	Bursa	208
178	33	Bursa	Bursa	174
179	33	Bursa	Bursa	42
180	33	Bursa	Bursa	20
181	33	Bursa	Bursa	94
182	33	Bursa	Bursa	35
183	33	Bursa	Bursa	110
184	33	Bursa	Bursa	86
185	33	Bursa	Bursa	161
186	33	Bursa	Bursa	76
187	33	Bursa	Bursa	148
188	32	Bursa	Balıkesir	145
189	33	Bursa	Bursa	8
190	3	Bursa	Adana	0
191	33	Bursa	Bursa	72
192	33	Bursa	Bursa	49
193	33	Bursa	Bursa	140
194	33	Bursa	Bursa	113
195	33	Bursa	Bursa	132
196	31	Çanakkale	Balıkesir	28
197	31	Çanakkale	Balıkesir	2
198	31	Çanakkale	Balıkesir	82
199	31	Çanakkale	Balıkesir	89
200	31	Çanakkale	Balıkesir	97
201	31	Çanakkale	Balıkesir	52
202	27	Çankırı	Ankara	83
203	27	Çorum	Ankara	33
204	27	Çorum	Ankara	3
205	27	Çorum	Ankara	18
206	27	Çorum	Ankara	4
207	27	Çorum	Ankara	16
208	27	Çorum	Ankara	16
209	27	Çorum	Ankara	29

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
210	27	Çorum	Ankara	24
211	27	Çorum	Ankara	27
212	27	Çorum	Ankara	22
213	27	Çorum	Ankara	35
214	27	Çorum	Ankara	35
215	27	Çorum	Ankara	11
216	27	Çorum	Ankara	7
217	27	Çorum	Ankara	23
218	27	Çorum	Ankara	19
219	48	Denizli	İzmir	60
220	48	Denizli	İzmir	14
221	58	Denizli	Kütahya	2
222	58	Denizli	Kütahya	54
223	48	Denizli	İzmir	38
224	58	Denizli	Kütahya	103
225	48	Denizli	İzmir	85
226	48	Denizli	İzmir	137
227	3	Denizli	Adana	0
228	48	Denizli	İzmir	130
229	58	Denizli	Kütahya	36
230	58	Denizli	Kütahya	127
231	62	Diyarbakır	Malatya	64
232	62	Diyarbakır	Malatya	90
233	62	Diyarbakır	Malatya	4
234	62	Diyarbakır	Malatya	17
235	62	Diyarbakır	Malatya	74
236	62	Diyarbakır	Malatya	25
237	62	Diyarbakır	Malatya	42
238	64	Düzce	Sakarya	74
239	64	Düzce	Sakarya	96
240	64	Düzce	Sakarya	25
241	64	Düzce	Sakarya	12
242	45	Edirne	İstanbul	43
243	45	Edirne	İstanbul	81
244	45	Edirne	İstanbul	70
245	45	Edirne	İstanbul	3
246	45	Edirne	İstanbul	70
247	45	Edirne	İstanbul	1
248	62	Elazığ	Malatya	6
249	62	Elazığ	Malatya	41
250	62	Elazığ	Malatya	37
251	62	Elazığ	Malatya	7

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
252	62	Elazığ	Malatya	1
253	62	Elazığ	Malatya	18
254	62	Elazığ	Malatya	17
255	62	Elazığ	Malatya	34
256	62	Elazığ	Malatya	29
257	62	Elazığ	Malatya	46
258	62	Elazığ	Malatya	2
259	62	Elazığ	Malatya	33
260	62	Elazığ	Malatya	2
261	62	Elazığ	Malatya	1
262	32	Erzincan	Balıkesir	67
263	32	Erzincan	Balıkesir	12
264	32	Erzincan	Balıkesir	16
265	32	Erzincan	Balıkesir	26
266	32	Erzurum	Balıkesir	23
267	36	Erzurum	Erzurum	65
268	36	Erzurum	Erzurum	7
269	36	Erzurum	Erzurum	15
270	36	Erzurum	Erzurum	25
271	36	Erzurum	Erzurum	4
272	36	Erzurum	Erzurum	65
273	36	Erzurum	Erzurum	1
274	36	Erzurum	Erzurum	82
275	37	Eskişehir	Eskişehir	114
276	37	Eskişehir	Eskişehir	31
277	37	Eskişehir	Eskişehir	29
278	37	Eskişehir	Eskişehir	6
279	37	Eskişehir	Eskişehir	71
280	37	Eskişehir	Eskişehir	82
281	37	Eskişehir	Eskişehir	95
282	37	Eskişehir	Eskişehir	103
283	60	Eskişehir	Kütahya	45
284	37	Eskişehir	Eskişehir	64
285	39	Gaziantep	Gaziantep	18
286	1	Gaziantep	Adana	125
287	39	Gaziantep	Gaziantep	153
288	39	Gaziantep	Gaziantep	175
289	39	Gaziantep	Gaziantep	13
290	39	Gaziantep	Gaziantep	52
291	39	Gaziantep	Gaziantep	85
292	39	Gaziantep	Gaziantep	135
293	39	Gaziantep	Gaziantep	169

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
294	32	Giresun	Balıkesir	29
295	32	Giresun	Balıkesir	60
296	32	Giresun	Balıkesir	8
297	32	Giresun	Balıkesir	84
298	32	Giresun	Balıkesir	35
299	32	Gümüşhane	Balıkesir	36
300	32	Gümüşhane	Balıkesir	10
301	62	Hakkari	Malatya	4
302	65	Hakkari	Van	5
303	65	Hakkari	Van	3
304	65	Hakkari	Van	7
305	62	Hakkari	Malatya	7
306	3	Hakkari	Adana	0
307	1	Hatay	Adana	25
308	1	Hatay	Adana	133
309	1	Hatay	Adana	107
310	1	Hatay	Adana	8
311	1	Hatay	Adana	148
312	1	Hatay	Adana	48
313	1	Hatay	Adana	33
314	1	Hatay	Adana	90
315	1	Hatay	Adana	75
316	1	Hatay	Adana	133
317	36	Iğdır	Erzurum	3
318	36	Iğdır	Erzurum	21
319	36	Iğdır	Erzurum	16
320	36	Iğdır	Erzurum	2
321	37	Isparta	Eskişehir	51
322	37	Isparta	Eskişehir	84
323	37	Isparta	Eskişehir	31
324	37	Isparta	Eskişehir	38
325	37	Isparta	Eskişehir	45
326	3	Isparta	Adana	0
327	55	İstanbul	Kocaeli	340
328	44	İstanbul	İstanbul	77
329	44	İstanbul	İstanbul	151
330	44	İstanbul	İstanbul	177
331	44	İstanbul	İstanbul	127
332	44	İstanbul	İstanbul	304
333	44	İstanbul	İstanbul	257
334	44	İstanbul	İstanbul	22
335	44	İstanbul	İstanbul	10

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
336	55	İstanbul	Kocaeli	143
337	55	İstanbul	Kocaeli	166
338	44	İstanbul	İstanbul	154
339	55	İstanbul	Kocaeli	289
340	44	İstanbul	İstanbul	270
341	55	İstanbul	Kocaeli	35
342	44	İstanbul	İstanbul	288
343	44	İstanbul	İstanbul	310
344	55	İstanbul	Kocaeli	291
345	55	İstanbul	Kocaeli	28
346	55	İstanbul	Kocaeli	10
347	55	İstanbul	Kocaeli	181
348	55	İstanbul	Kocaeli	203
349	45	İstanbul	İstanbul	155
350	44	İstanbul	İstanbul	333
351	44	İstanbul	İstanbul	277
352	55	İstanbul	Kocaeli	49
353	44	İstanbul	İstanbul	29
354	44	İstanbul	İstanbul	169
355	44	İstanbul	İstanbul	9
356	55	İstanbul	Kocaeli	142
357	44	İstanbul	İstanbul	132
358	55	İstanbul	Kocaeli	300
359	55	İstanbul	Kocaeli	161
360	55	İstanbul	Kocaeli	332
361	44	İstanbul	İstanbul	284
362	55	İstanbul	Kocaeli	305
363	44	İstanbul	İstanbul	79
364	44	İstanbul	İstanbul	23
365	45	İstanbul	İstanbul	194
366	55	İstanbul	Kocaeli	175
367	44	İstanbul	İstanbul	318
368	44	İstanbul	İstanbul	150
369	55	İstanbul	Kocaeli	321
370	55	İstanbul	Kocaeli	273
371	55	İstanbul	Kocaeli	37
372	55	İstanbul	Kocaeli	18
373	44	İstanbul	İstanbul	162
374	44	İstanbul	İstanbul	184
375	55	İstanbul	Kocaeli	164
376	45	İstanbul	İstanbul	307
377	55	İstanbul	Kocaeli	181

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
378	44	İstanbul	İstanbul	352
379	44	İstanbul	İstanbul	304
380	44	İstanbul	İstanbul	327
381	44	İstanbul	İstanbul	314
382	44	İstanbul	İstanbul	50
383	44	İstanbul	İstanbul	29
384	55	İstanbul	Kocaeli	171
385	44	İstanbul	İstanbul	151
386	44	İstanbul	İstanbul	182
387	44	İstanbul	İstanbul	315
388	48	İzmir	İzmir	196
389	48	İzmir	İzmir	14
390	48	İzmir	İzmir	72
391	48	İzmir	İzmir	182
392	48	İzmir	İzmir	202
393	48	İzmir	İzmir	89
394	48	İzmir	İzmir	217
395	48	İzmir	İzmir	180
396	48	İzmir	İzmir	285
397	48	İzmir	İzmir	273
398	48	İzmir	İzmir	83
399	48	İzmir	İzmir	72
400	48	İzmir	İzmir	173
401	48	İzmir	İzmir	56
402	48	İzmir	İzmir	157
403	48	İzmir	İzmir	151
404	48	İzmir	İzmir	256
405	48	İzmir	İzmir	219
406	48	İzmir	İzmir	56
407	48	İzmir	İzmir	18
408	48	İzmir	İzmir	145
409	48	İzmir	İzmir	4
410	48	İzmir	İzmir	25
411	48	İzmir	İzmir	125
412	39	Kahramanmaraş	Gaziantep	59
413	39	Kahramanmaraş	Gaziantep	19
414	39	Kahramanmaraş	Gaziantep	7
415	51	Kahramanmaraş	Kayseri	54
416	39	Kahramanmaraş	Gaziantep	38
417	51	Kahramanmaraş	Kayseri	47
418	39	Kahramanmaraş	Gaziantep	31
419	39	Kahramanmaraş	Gaziantep	88

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
420	39	Kahramanmaraş	Gaziantep	42
421	1	Kahramanmaraş	Adana	99
422	64	Karabük	Sakarya	6
423	64	Karabük	Sakarya	37
424	64	Karabük	Sakarya	52
425	64	Karabük	Sakarya	61
426	64	Karabük	Sakarya	9
427	13	Karaman	Ankara	17
428	13	Karaman	Ankara	48
429	13	Karaman	Ankara	31
430	13	Karaman	Ankara	25
431	13	Karaman	Ankara	30
432	36	Kars	Erzurum	6
433	36	Kars	Erzurum	30
434	36	Kars	Erzurum	27
435	36	Kars	Erzurum	6
436	27	Kastamonu	Ankara	58
437	27	Kastamonu	Ankara	7
438	27	Kastamonu	Ankara	77
439	27	Kastamonu	Ankara	31
440	27	Kastamonu	Ankara	20
441	27	Kastamonu	Ankara	58
442	49	Kayseri	Kayseri	66
443	49	Kayseri	Kayseri	40
444	49	Kayseri	Kayseri	33
445	49	Kayseri	Kayseri	65
446	49	Kayseri	Kayseri	54
447	49	Kayseri	Kayseri	61
448	49	Kayseri	Kayseri	50
449	52	Kayseri	Kayseri	91
450	51	Kayseri	Kayseri	81
451	49	Kayseri	Kayseri	19
452	51	Kayseri	Kayseri	17
453	49	Kayseri	Kayseri	49
454	49	Kayseri	Kayseri	39
455	49	Kayseri	Kayseri	80
456	49	Kayseri	Kayseri	44
457	49	Kayseri	Kayseri	50
458	49	Kayseri	Kayseri	84
459	5	Kırıkkale	Ankara	34
460	5	Kırıkkale	Ankara	59
461	5	Kırıkkale	Ankara	66

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
462	45	Kırklareli	İstanbul	53
463	45	Kırklareli	İstanbul	104
464	45	Kırklareli	İstanbul	62
465	54	Kırşehir	Kırşehir	27
466	54	Kırşehir	Kırşehir	16
467	54	Kırşehir	Kırşehir	9
468	54	Kırşehir	Kırşehir	26
469	54	Kırşehir	Kırşehir	21
470	54	Kırşehir	Kırşehir	36
471	39	Kilis	Gaziantep	4
472	39	Kilis	Gaziantep	13
473	39	Kilis	Gaziantep	26
474	55	Kocaeli	Kocaeli	38
475	64	Kocaeli	Sakarya	118
476	55	Kocaeli	Kocaeli	107
477	64	Kocaeli	Sakarya	16
478	64	Kocaeli	Sakarya	108
479	64	Kocaeli	Sakarya	28
480	55	Kocaeli	Kocaeli	10
481	55	Kocaeli	Kocaeli	72
482	64	Kocaeli	Sakarya	54
483	55	Kocaeli	Kocaeli	115
484	64	Kocaeli	Sakarya	101
485	64	Kocaeli	Sakarya	108
486	64	Kocaeli	Sakarya	15
487	13	Konya	Ankara	5
488	13	Konya	Ankara	38
489	26	Isparta	Ankara	51
490	26	Konya	Ankara	5
491	13	Konya	Ankara	38
492	13	Konya	Ankara	90
493	13	Konya	Ankara	86
494	26	Konya	Ankara	145
495	5	Konya	Ankara	76
496	13	Konya	Ankara	138
497	13	Konya	Ankara	71
498	26	Konya	Ankara	136
499	26	Konya	Ankara	130
500	26	Konya	Ankara	17
501	13	Konya	Ankara	13
502	13	Konya	Ankara	72
503	13	Konya	Ankara	66

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
504	13	Konya	Ankara	129
505	60	Kütahya	Kütahya	22
506	58	Kütahya	Kütahya	76
507	60	Kütahya	Kütahya	96
508	60	Kütahya	Kütahya	106
509	60	Kütahya	Kütahya	132
510	62	Malatya	Malatya	41
511	62	Malatya	Malatya	53
512	62	Malatya	Malatya	61
513	62	Malatya	Malatya	1
514	62	Malatya	Malatya	36
515	62	Malatya	Malatya	45
516	62	Malatya	Malatya	49
517	62	Malatya	Malatya	39
518	62	Malatya	Malatya	13
519	62	Malatya	Malatya	20
520	48	Manisa	İzmir	122
521	48	Manisa	İzmir	73
522	48	Manisa	İzmir	90
523	48	Manisa	İzmir	130
524	48	Manisa	İzmir	19
525	48	Manisa	İzmir	126
526	48	Manisa	İzmir	77
527	48	Manisa	İzmir	28
528	48	Manisa	İzmir	65
529	48	Manisa	İzmir	84
530	48	Manisa	İzmir	58
531	39	Mardin	Gaziantep	33
532	39	Mardin	Gaziantep	42
533	39	Mardin	Gaziantep	9
534	39	Mardin	Gaziantep	40
535	39	Mardin	Gaziantep	13
536	39	Mardin	Gaziantep	8
537	2	Mersin	Adana	179
538	39	Mersin	Gaziantep	12
539	2	Mersin	Adana	19
540	2	Mersin	Adana	87
541	2	Mersin	Adana	7
542	2	Mersin	Adana	143
543	2	Mersin	Adana	167
544	39	Mersin	Gaziantep	85
545	2	Mersin	Adana	106

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
546	2	Mersin	Adana	128
547	2	Mersin	Adana	167
548	48	Muğla	İzmir	114
549	48	Muğla	İzmir	90
550	48	Muğla	İzmir	45
551	48	Muğla	İzmir	29
552	48	Muğla	İzmir	39
553	48	Muğla	İzmir	20
554	48	Muğla	İzmir	83
555	48	Muğla	İzmir	67
556	48	Muğla	İzmir	116
557	48	Muğla	İzmir	114
558	48	Muğla	İzmir	20
559	48	Muğla	İzmir	15
560	48	Muğla	İzmir	67
561	48	Muğla	İzmir	12
562	48	Muğla	İzmir	21
563	62	Muş	Malatya	32
564	62	Muş	Malatya	26
565	49	Nevşehir	Kayseri	45
566	49	Nevşehir	Kayseri	39
567	49	Nevşehir	Kayseri	37
568	49	Nevşehir	Kayseri	46
569	49	Nevşehir	Kayseri	37
570	49	Nevşehir	Kayseri	4
571	2	Niğde	Adana	11
572	2	Niğde	Adana	32
573	2	Niğde	Adana	32
574	2	Niğde	Adana	28
575	2	Niğde	Adana	11
576	2	Niğde	Adana	11
577	2	Niğde	Adana	15
578	2	Niğde	Adana	30
579	32	Ordu	Balıkesir	68
580	48	Ordu	İzmir	37
581	32	Ordu	Balıkesir	27
582	32	Ordu	Balıkesir	64
583	32	Ordu	Balıkesir	52
584	32	Ordu	Balıkesir	97
585	1	Osmaniye	Adana	84
586	1	Osmaniye	Adana	18
587	1	Osmaniye	Adana	183

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
588	32	Rize	Balıkesir	50
589	32	Rize	Balıkesir	65
590	32	Rize	Balıkesir	21
591	32	Rize	Balıkesir	12
592	32	Rize	Balıkesir	44
593	64	Sakarya	Sakarya	32
594	64	Sakarya	Sakarya	80
595	64	Sakarya	Sakarya	131
596	64	Sakarya	Sakarya	112
597	64	Sakarya	Sakarya	19
598	64	Sakarya	Sakarya	1
599	64	Sakarya	Sakarya	61
600	64	Sakarya	Sakarya	1
601	64	Sakarya	Sakarya	62
602	64	Sakarya	Sakarya	43
603	64	Samsun	Sakarya	13
604	32	Samsun	Balıkesir	31
605	32	Samsun	Balıkesir	63
606	32	Samsun	Balıkesir	35
607	32	Samsun	Balıkesir	66
608	32	Samsun	Balıkesir	31
609	32	Samsun	Balıkesir	60
610	32	Samsun	Balıkesir	58
611	32	Samsun	Balıkesir	2
612	32	Samsun	Balıkesir	84
613	32	Samsun	Balıkesir	28
614	32	Samsun	Balıkesir	19
615	32	Samsun	Balıkesir	56
616	32	Samsun	Balıkesir	46
617	32	Samsun	Balıkesir	51
618	32	Samsun	Balıkesir	81
619	62	Siirt	Malatya	14
620	62	Siirt	Malatya	13
621	62	Siirt	Malatya	20
622	27	Sinop	Ankara	118
623	27	Sinop	Ankara	10
624	32	Sivas	Balıkesir	5
625	51	Sivas	Kayseri	24
626	32	Sivas	Balıkesir	61
627	51	Sivas	Kayseri	53
628	51	Sivas	Kayseri	61
629	32	Sivas	Balıkesir	1

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
630	32	Sivas	Balıkesir	34
631	32	Sivas	Balıkesir	42
632	32	Sivas	Balıkesir	40
633	39	Şanlıurfa	Gaziantep	9
634	39	Şanlıurfa	Gaziantep	23
635	39	Şanlıurfa	Gaziantep	57
636	39	Şanlıurfa	Gaziantep	47
637	39	Şanlıurfa	Gaziantep	78
638	39	Şanlıurfa	Gaziantep	68
639	39	Şanlıurfa	Gaziantep	20
640	39	Şanlıurfa	Gaziantep	4
641	39	Şanlıurfa	Gaziantep	38
642	39	Şanlıurfa	Gaziantep	28
643	39	Şanlıurfa	Gaziantep	61
644	39	Şanlıurfa	Gaziantep	52
645	62	Şırnak	Malatya	4
646	62	Şırnak	Malatya	8
647	62	Şırnak	Malatya	9
648	62	Şırnak	Malatya	6
649	62	Şırnak	Malatya	17
650	45	Tekirdağ	İstanbul	46
651	44	Tekirdağ	İstanbul	76
652	44	Tekirdağ	İstanbul	80
653	44	Tekirdağ	İstanbul	43
654	44	Tekirdağ	İstanbul	53
655	45	Tekirdağ	İstanbul	58
656	45	Tekirdağ	İstanbul	77
657	45	Tekirdağ	İstanbul	6
658	45	Tekirdağ	İstanbul	18
659	45	Tekirdağ	İstanbul	2
660	44	Tekirdağ	İstanbul	53
661	32	Tokat	Balıkesir	80
662	32	Tokat	Balıkesir	16
663	32	Tokat	Balıkesir	7
664	32	Tokat	Balıkesir	42
665	32	Tokat	Balıkesir	38
666	32	Tokat	Balıkesir	72
667	32	Tokat	Balıkesir	62
668	32	Trabzon	Balıkesir	46
669	32	Trabzon	Balıkesir	66
670	32	Trabzon	Balıkesir	68
671	32	Trabzon	Balıkesir	42

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
672	32	Trabzon	Balıkesir	42
673	32	Trabzon	Balıkesir	53
674	32	Trabzon	Balıkesir	59
675	32	Trabzon	Balıkesir	23
676	32	Trabzon	Balıkesir	26
677	32	Trabzon	Balıkesir	33
678	32	Tunceli	Balıkesir	17
679	62	Uşak	Malatya	20
680	62	Uşak	Malatya	10
681	58	Uşak	Kütahya	33
682	58	Uşak	Kütahya	26
683	58	Uşak	Kütahya	48
684	58	Uşak	Kütahya	46
685	58	Uşak	Kütahya	6
686	58	Uşak	Kütahya	52
687	58	Uşak	Kütahya	12
688	65	Van	Van	25
689	65	Van	Van	8
690	36	Van	Erzurum	21
691	65	Van	Van	23
692	65	Van	Van	24
693	65	Van	Van	6
694	65	Van	Van	9
695	65	Van	Van	25
696	36	Van	Erzurum	26
697	65	Van	Van	27
698	65	Van	Van	22
699	55	Yalova	Kocaeli	68
700	55	Yalova	Kocaeli	7
701	55	Yalova	Kocaeli	29
702	55	Yalova	Kocaeli	21
703	54	Yozgat	Kırşehir	18
704	54	Yozgat	Kırşehir	39
705	54	Yozgat	Kırşehir	40
706	54	Yozgat	Kırşehir	23
707	54	Yozgat	Kırşehir	25
708	54	Yozgat	Kırşehir	28
709	49	Yozgat	Kayseri	23
710	64	Zonguldak	Sakarya	55
711	64	Zonguldak	Sakarya	20
712	64	Zonguldak	Sakarya	32
713	64	Zonguldak	Sakarya	50

PD Order	TSA Order	City of PD	City of TSA	Vehicle Count Transported From PD to TSA
714	64	Zonguldak	Sakarya	57
715	64	Zonguldak	Sakarya	52
716	64	Zonguldak	Sakarya	67
717	64	Zonguldak	Sakarya	11
718	64	Zonguldak	Sakarya	20
719	64	Zonguldak	Sakarya	40

Table 0.10 Assignment of TSAs to PCs and vehicle counts sent from TSAs

TSA Order	PC Order	City of TSA	City of PC	Vehicle Count Transported From TSA to PC
1	1	Adana	Adana	2,071
2	1	Adana	Adana	1,758
5	3	Ankara	Kocaeli	3,063
13	1	Ankara	Adana	1,610
26	1	Ankara	Adana	1,074
27	3	Ankara	Kocaeli	2,462
30	2	Antalya	İzmir	1,967
31	2	Balıkesir	İzmir	811
32	5	Balıkesir	Samsun	3,293
33	3	Bursa	Kocaeli	1,731
36	5	Erzurum	Samsun	518
37	3	Eskişehir	Kocaeli	1,376
39	4	Gaziantep	Osmaniye	2,051
44	3	İstanbul	Kocaeli	6,625
45	3	İstanbul	Kocaeli	1,350
48	2	İzmir	İzmir	6,217
49	4	Kayseri	Osmaniye	1,074
51	4	Kayseri	Osmaniye	337
52	4	Kayseri	Osmaniye	91
54	5	Kırşehir	Samsun	308
55	3	Kocaeli	Kocaeli	4,782
58	3	Kütahya	Kocaeli	679
60	3	Kütahya	Kocaeli	453
62	4	Malatya	Osmaniye	1,322
64	3	Sakarya	Kocaeli	2,239
65	4	Van	Osmaniye	184

Table 0.11 Assignment of TSAs to DCs and vehicle counts sent from TSAs

TSA Order	DC Order	City of TSA	City of PD	Vehicle Count Transported From TSA to DC
1	2	Adana	Kocaeli	207
2	2	Adana	Kocaeli	175
5	2	Ankara	Kocaeli	306
13	2	Ankara	Kocaeli	161
26	2	Ankara	Kocaeli	107
27	2	Ankara	Kocaeli	246
30	3	Antalya	İzmir	196
31	3	Balıkesir	İzmir	81
32	2	Balıkesir	Kocaeli	329
33	2	Bursa	Kocaeli	173
36	2	Erzurum	Kocaeli	51
37	2	Eskişehir	Kocaeli	137
39	2	Gaziantep	Kocaeli	205
44	2	İstanbul	Kocaeli	662
45	1	İstanbul	İstanbul	135
48	3	İzmir	İzmir	621
49	2	Kayseri	Kocaeli	107
51	2	Kayseri	Kocaeli	33
52	2	Kayseri	Kocaeli	9
54	2	Kırşehir	Kocaeli	30
55	2	Kocaeli	Kocaeli	478
58	2	Kütahya	Kocaeli	67
60	2	Kütahya	Kocaeli	45
62	2	Malatya	Kocaeli	132
64	2	Sakarya	Kocaeli	223
65	2	Van	Kocaeli	18

Table 0.12 Assignment of PCs to DCs and vehicle counts sent from PCs

PC Order	DC Order	City of PC	City of DC	Vehicle Count Transported From PC to DC
1	2	Adana	Kocaeli	651
2	3	İzmir	İzmir	899
3	2	Kocaeli	Kocaeli	2,476
4	2	Osmaniye	Kocaeli	505
5	2	Samsun	Kocaeli	411

APPENDIX D

```
MODEL:
SETS:
        PD      : pdQuantity, assignmentConstraintTSA;
        TSA     : OCtsa, tsaQuantity, assignmentConstraintPC,
                  assignmentConstraintDC1;
        PC      : pcQuantity, OCpc, assignmentConstraintDC2;
        R       : OCr;
        DC      : dQuantity, OCd;
        P       : productionRatio;
        S       : vehicleRatioByCity;
        PD_TSA(PD, TSA) : d_PD_TSA, a_PD_TSA;
        TSA_PC(TSA, PC) : d_TSA_PC, a_TSA_PC;
        TSA_P(TSA, P) :d_TSA_P;
        TSA_S(TSA, S) :d_TSA_S;
        TSA_D(TSA, DC) :d_TSA_D, a_TSA_DC;
        PC_D(TSA, DC) :d_PC_D, a_PC_DC;
        pdCost(PD, TSA);
        tsaCost(TSA);
        tsaCost1(TSA, P);
        tsaCost2(TSA, S);
        tsaCost3(TSA, PC);
        tsaCost4(TSA, DC);
        pcCost(PC, DC);
        pcCost1(PC);

ENDSETS

DATA:
```

```
tc1 = 0.40;
tc2 = 0.40;
tc3 = 0.40;
tc4 = 0.40;
tc5 = 0.40;
tc6 = 0.23;
tc7 = 0.23;
r1 = 0;
r2 = 0.4;
r3 = 0.40;
r4 = 0.25;


PD = @ODBC( 'tez', 'PLACEOFDELIVERY', 'ORDER');
TSA = @ODBC( 'tez', 'TEMPORARYSTORAGEAREA', 'ORDER');
PC = @ODBC( 'tez', 'PROCESSCENTER', 'ORDER');
DC = @ODBC( 'tez', 'DISPOSALCENTER', 'ORDER');
P = @ODBC( 'tez', 'PRODUCTIONFACILITY', 'ORDER');
S = @ODBC( 'tez', 'REPAIRSERVICES', 'ORDER');

pdQuantity = @ODBC( 'tez', 'PLACEOFDELIVERY', 'VEHICLECOUNT');

productionRatio = @ODBC( 'tez', 'PRODUCTIONFACILITY',
'PRODUCTIONRATIO');
vehicleRatioByCity = @ODBC( 'tez', 'REPAIRSERVICES', 'VEHICLERATIO');
OCtsa = @ODBC( 'tez', 'TEMPORARYSTORAGEAREA', 'OPERATIONCOST');
OCpc = @ODBC( 'tez', 'PROCESSCENTER', 'OPERATIONCOST');
OCd = @ODBC( 'tez', 'DISPOSALCENTER', 'OPERATIONCOST');

PD_TSA = @ODBC( 'tez', 'PD_TSA_DISTANCE', 'PDORDER', 'TSAORDER');
d_PD_TSA = @ODBC( 'tez', 'PD_TSA_DISTANCE', 'DISTANCE');
```

```
TSA_PC = @ODBC( 'tez', 'TSA_PC_DISTANCE', 'TSAORDER', 'PCORDER');
d_TSA_PC = @ODBC( 'tez', 'TSA_PC_DISTANCE', 'DISTANCE');

TSA_P = @ODBC( 'tez', 'TSA_APF_DISTANCE', 'TSAORDER', 'APPORDER');
d_TSA_P = @ODBC( 'tez', 'TSA_APF_DISTANCE', 'DISTANCE');

TSA_S = @ODBC( 'tez', 'TSA_ARS_DISTANCE', 'TSAORDER', 'ARSORDER');
d_TSA_S = @ODBC( 'tez', 'TSA_ARS_DISTANCE', 'DISTANCE');

TSA_D = @ODBC( 'tez', 'TSA_DC_DISTANCE', 'TSAORDER', 'DCORDER');
d_TSA_D = @ODBC( 'tez', 'TSA_DC_DISTANCE', 'DISTANCE');

PC_D = @ODBC( 'tez', 'PC_DC_DISTANCE', 'PCORDER', 'DCORDER');
d_PC_D = @ODBC( 'tez', 'PC_DC_DISTANCE', 'DISTANCE');

ENDDATA

MIN = @SUM(pdCost(i, j): pdQuantity(i) * tc1 * d_PD_TSA(i, j) * a_PD_TSA(i, j))
      + @SUM(tsaCost(j): tsaQuantity(j) * OCtsa(j))
      + @SUM(tsaCost1(i, j): tsaQuantity(i) * (tc3 * d_TSA_P(i, j) - 1050) * r1 *
productionRatio(j))
      + @SUM(tsaCost2(i, j): tsaQuantity(i) * (tc4 * d_TSA_S(i, j) - 525) * r2 *
vehicleRatioByCity(j))
      + @SUM(tsaCost3(i, j): tsaQuantity(i) * (tc5 * d_TSA_PC(i, j) - 525) * r3 *
a_TSA_PC(i, j))
      + @SUM(tsaCost4(i, j): tsaQuantity(i) * (tc6 * d_TSA_D(i, j) + 50) * (1 - r1 - r2 -
r3) * a_TSA_DC(i, j))
      + @SUM(pcCost(i, j): pcQuantity(i) * (tc7 * d_PC_D(i, j) + 50) * a_PC_DC(i, j)
* r4)
     + @SUM(pcCost1(j): pcQuantity(j) * OCpc(j));

@FOR(PD(i):assignmentConstraintTSA(i) = @SUM(TSA(j):a_PD_TSA(i, j)));
```

```
@FOR(TSA(i):assignmentConstraintPC(i) = @SUM(PC(j):a_TSA_PC(i, j)));
@FOR(TSA(i):assignmentConstraintDC1(i) = @SUM(DC(j):a_TSA_DC(i, j)));
@FOR(PC(i):assignmentConstraintDC2(i) = @SUM(DC(j):a_PC_DC(i, j)));

@FOR(PD(i):assignmentConstraintTSA(i) = 1);
@FOR(TSA(i):assignmentConstraintPC(i) = 1);
@FOR(TSA(i):assignmentConstraintDC1(i) = 1);
@FOR(PC(i):assignmentConstraintDC2(i) = 1);

@FOR(TSA(j):tsaQuantity(j) = @SUM(PD(i):pdQuantity(i) * a_PD_TSA(i, j)));
@FOR(PC(j):pcQuantity(j) = @SUM(TSA(i):tsaQuantity(i) * a_TSA_PC(i, j)));

@FOR(PD: @FOR(TSA: @BIN(a_PD_TSA)));
@FOR(TSA: @FOR(PC: @BIN(a_TSA_PC)));
@FOR(TSA: @FOR(DC: @BIN(a_TSA_DC)));
@FOR(PC: @FOR(DC: @BIN(a_PC_DC)));

END
```

BIOGRAPHICAL SKETCH

Mehmet Niziplioğlu was born in Gaziantep on December 2, 1983. He completed the high school in Şehitkamil Bayraktar High School, in 2002. He received her B. Sc. degree in Computer Engineering from Ege University, Izmir, in 2006. Since 2008, he is in the M. Sc. program in Industrial Engineering of Galatasaray University. For the completion of the program he has studied on "Reverse Logistics Network Design". He wrote her first academic article in 2011 with Assist. Prof. Müjde Erol Genevois.