A DECISION SUPPORT SYSTEM FOR REDUCING EMPTY RUN COSTS IN A LOGISTIC SERVICE PROVIDER COMPANY

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A DECISION SUPPORT SYSTEM FOR REDUCING EMPTY RUN COSTS IN A LOGISTIC SERVICE PROVIDER COMPANY

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DECLARATION OF ORIGINALITY

I, Murat Turan, certify that

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ABSTRACT

A Decision Support System for Reducing Empty Run Costs

in a Logistic Service Provider Company

Two of the most important key performance indicators (KPI) in logistic service provider (LSP) companies are the cost of empty trailer transportations and the cost of outsourced trailer. Manufacturing companies are mostly cost-oriented while they are outsourcing their international transportation activities to the third-party logistic companies. This behavior of the manufacturers causes high demand fluctuations on the LSP company side. On the other hand, the volume of exports and imports are often imbalanced for an LSP. Hence the LSPs need to transport empty trailers between countries, or outsource trailers to fulfill the transportation needs in export and import directions. Within the scope of this study, a decision support system (DSS) is proposed for an LSP company to decrease the empty trailer movements and the number of outsourced trailers so that the total transportation cost is reduced. The generated model considers intermodal transportation of orders internationally. The DSS is implemented in one of the largest LSP companies in Turkey. The performance of the DSS is tested to show that it improves the effectiveness, efficiency, and the flexibility of the decision-making environment in logistic planning.

ÖZET

Lojistik Servis Sağlayıcı Firmada Boş Taşıma Maliyetlerinin Azaltılması İçin Bir Karar Destek Sistemi

Lojistik hizmet sağlayıcı firmalardaki en önemli anahtar performans göstergelerinden ikisi boş araç taşımalarının ve dış kaynaklı araç kullanımının maliyetidir. İmalat şirketleri, uluslararası taşımacılık faaliyetlerini üçüncü parti lojistik şirketlerine yaptırırken çoğunlukla maliyet odaklı olmaktadırlar. Üreticilerin bu davranışı, lojistik hizmet sağlayıcısı şirket tarafında talep dalgalanmalarına neden olmaktadır. Ayrıca, bir lojistik şirketi için, ihracat ve ithalat hacimleri genellikle dengesizdir. Bu nedenle, lojistik şirketinin boş araçlarını ülkeler arasında hareket ettirerek ya da dış kaynaklı araç kullanımı yaparak ithalat ve ihracat yönlerindeki taşıma ihtiyaçlarını karşılaması gerekir. Bu çalışma kapsamında, bir lojistik hizmet sağlayıcı firmaya boş araç hareketlerini ve dış kaynaklı araç sayısını azaltmak ve böylece toplam maliyetini azaltmak için bir karar destek sistemi önerilmiştir. Geliştirilen model, uluslararası siparişlerin intermodal taşımacılığını göz önüne almaktadır. Karar destek sistemi, Türkiye'deki en büyük lojistik şirketlerinden birine uygulanmaktadır. Önerilen sistemin performansı, lojistik planlamada karar verme ortamının etkinliğini, verimliliğini ve esnekliğini geliştirdiğini göstermek için test edilmiştir.

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ABBREVIATIONS

FTL	Full Truck Load
GUI	Graphical User Interface
LSP	Logistic Service Provider
LTL	Less than a Truck Load
MAD	Mean Absolute Deviation
MAPE	Mean Absolute Percentage Errors
MS	Microsoft
MSE	Mean Squared Errors
VBA	Visual Basic for Applications
VRP	Vehicle Routing Problem

CHAPTER 1

INTRODUCTION

Five actors form a traditional supply chain: Supplier, Manufacturer, Distributer, Retailer, and Customer. Whether it is a pull or push system, these actors are almost same in every supply chain. Many studies have been completed to improve the material and information flow between these actors. As usually the manufacturer is responsible from the performance of the supply chain, most of these studies are made with the perspective of a manufacturer.

Logistic services are becoming more important in parallel with the Supply Chain Management. Nowadays most of the organizations deliver their logistic activities to third party LSPs. This means that the performance of the LSP in a supply chain will directly affect the overall success of the supply chain.

Intermodal freight transport is the transportation of goods by using at least two modes of transportation without changing the transportation unit called a trailer (see Figure 1 for a standard trailer). In the Illustrated Glossary for Transport Statistics published in 2009 by United Nations Economic Commission for Europe (UNECE, 2009, p.157), intermodal transportation is described as “Multimodal transport of goods, in one and same intermodal transport unit (trailer, container etc.) by successive modes of transport (road, seaways, railways or airways) without handling of the goods themselves when changing modes”.

For example, a full trailer of goods loaded from Turkey can be transferred to Europe by using road, seaway and even railway while the goods are in the same trailer end-to-end. In other words, the goods are always kept in the same trailer,

however the trailer might be transferred between different vehicles such as trucks, ships, or trains during end-to-end transportation.

Figure 1. A standard trailer

Intermodal transportation uses special trailers which allow the goods to be switched from one transportation mode to the other, while eliminating the necessity for the goods to be removed from the trailer. Intermodal (or multimodal) transportation gives efficiency, reliability, flexibility, and sustainability to the LSP companies. Considering the economies of scale, combining different transportation modes give logistic company to use its resources (led by vehicles and capital) more efficiently.

Intermodal transportation allows the company to increase the tour ratio, (an indicator of the service level of the logistic company) which means they can circulate the vehicles faster. That leads to an increase in the total transported volume which also means an increase in revenue. So, the company can generate more revenue with the same depreciation cost.

As transportation units are mostly carried by vessels or train, the usage of road transportation is least and thus the fuel consumption and carbon dioxide emission is much lower compared with the road transportation. Also since seaway and railway shipments are cheaper than road transportation, the variable costs of the

LSP company is lower than the rivals who are using traditional transportation methods.

By using intermodal transportation, logistic company avoids the traffic complexity, road bans, long queues on the highway customs gates, weather conditions like snow and icing on the roads, accidents, stolen and loss freights, which mostly results in an increased transit time than planned, and late deliveries.

Intermodal freight transport has received increased attention due to problems of road congestion, environmental concerns, and traffic safety. A growing recognition of the strategic importance of speed and agility in the supply chain is forcing firms to reconsider traditional logistic services and seek for more flexible forms of transportation. Therefore, research interest in intermodal freight transportation problems is growing.

Independently from the size of the trailer fleet, it is very important for an LSP company to balance the number of tours of its own trailers in export and import directions. When this balance is not sustained the empty trailers should wait in their transient locations at excessive costs, since the empty return costs are even higher. The allocation of the trailers cannot be optimized and thus results in decreases in the utilization of the trailer fleet, measured by the KPI called ‘tour ratio’. Accordingly, the KPI for on-time pick-up performance, which is the collection of goods in a certain amount of time after they are ready for dispatch, will also decrease.

To overcome the unavailability of a trailer when needed, the company may try to outsource some trailers in the last moment with a higher price than the marketplace. This unplanned outsourcing decrease both the outsourcing profitability and the gross profit of the company.

The company may follow another strategy as to buy more trailers to decrease the outsourcing cost. But this increases the depreciation cost that results in lower profits.

Finally, the company may choose neither to outsource nor to own more trailers. This will result as a loss in sales, which leads to a lower revenue and customer satisfaction. The company may lose its reputation, customer goodwill and market share.

Alternatively, company may choose to get back its trailers unloaded which is called as ‘empty run’. Then empty miles which is a basic KPI in transportation will increase. This will cause the company to end up with huge costs. They cannot charge this cost to any customer. Then the gross profit will decrease again.

In all the alternatives discussed above, the company loses profit. Consequently, the on-time delivery performance will decrease eventually as well as the on-time pick-up performance which results as a customer dissatisfaction. This dissatisfaction leads to losing customers and decrease in retention rate as the company cannot build a sustainable business with the customers. So, the company starts to shrink and eventually it may go bankrupt.

The best choice in the discussed scenario is to balance the demand in export with the demand in import. Even though this balancing is theoretically possible, it is very hard to achieve in real life due to the dynamic structure of the sector. Some territories have import transportation needs while some others have export transportation needs. Even if the LSP company is successful in balancing the total import demand with the total export demand, there will still be some empty movements between certain regions due to the opposite needs of these regions. So, the company can only balance the export and import in an aggregated level.

Especially the LSP companies which own a big trailer fleet, like the one studied in this thesis, lose so much profit because of this inevitable empty run cost. As seen in Figure 2, as the total volume of export and import transportations (gray bars with the right axis) has increased over the years, the difference between the import and export volumes (blue line with the left axis) which is called as imbalance and the number of empty runs (orange line with the left axis) have increased with high fluctuations. Almost same fluctuations both on volume of imbalance and empty run and high empty run cost force us to seek opportunities for better planning and control.

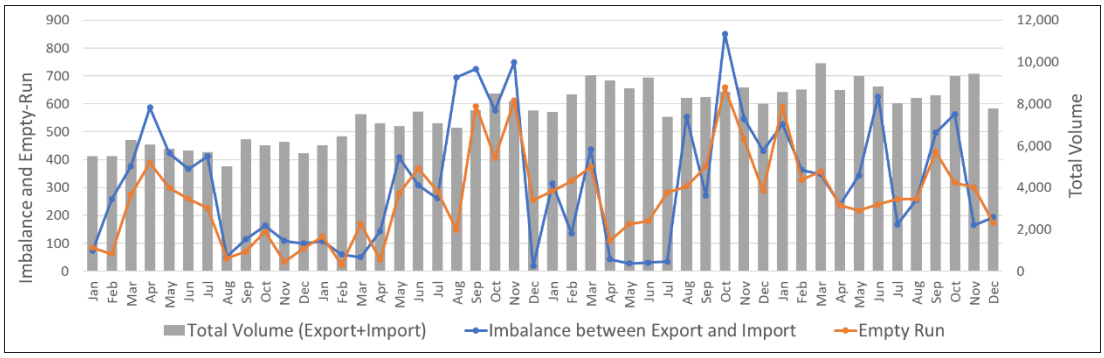

Figure 2. Total volume, imbalance, and empty run figures in last three years

The company owns the largest fleet in Turkey with more than 4,500 trailers. At a single point of time, the empty trailers are spread out the European countries and Turkey, and the company can easily locate the trailers by its tracking devices. However, the demand and the price of a specific route are highly volatile in the sector. Even if the LSP company have some contracted customers, there is no guarantee that this customer will always transport its goods with its contracted LSP. The customer might choose to work with another LSP when its price is lower than its contracted price. Therefore, most of the time, the customers do not place their orders on the LSP until their goods are ready for dispatch. So, the customers ask the LSP company to pick up the goods very shortly after they place the order. This forces the

LSP company to forecast the demand very accurately and update regularly at the beginning of each month.

In this study, we developed a model to match the empty trailers with the forecasted demands aggregated for each country. By doing this, we expect to decrease the number of total empty runs, and their cost to the company. This will also help to decrease the need for outsourced trailers. So, the company can lower the costs to obtain higher gross profit. First, we will try to develop a daily demand forecasting model by using the past volume data of the company. Next, we try to match these demand with the empty trailers by sustaining least cost. This will help the company to distribute their empty trailers to the demand points more efficiently and reduce their empty runs and outsourced trailer need which will result in an increase in their profit and a better utilization of trailers.

The organization of the rest of this thesis is as follows. In the second chapter we give the literature survey on the existing studies in freight imbalance and empty vehicle problems in logistic. In the third chapter, we presented a brief company profile. In the fourth chapter, problem definition is provided. In the fifth chapter, we generate a DSS for our problem. We develop a daily forecasting model and propose a heuristic model for matching empty trailers with the forecasted demand. Then the DSS is designed with its user interface, it is tested with different scenarios and feedbacks are obtained from users. In the sixth chapter we provided the assessment results of our questionnaire and interviews among the DSS users. In the last chapter, we conclude and provide future research areas.

CHAPTER 2

LITERATURE REVIEW

In this section, the current related literature is analyzed in three different aspects. First, the studies that focus on the freight imbalance are presented. Then, the studies that focus on collaboration to overcome freight imbalance are presented. Next, the studies that discuss empty run of vehicles are explored. Finally, the aim of this study is emphasized by identifying the gaps in the literature.

2.1 Freight imbalance

In this section, we will first define resource utilization in freight transportation according to the literature and then focus on how the freight imbalance is handled.

In its most basic form, resource utilization is the proportion of the utilized load capacity to available load capacity and shows to what degree the potential of the company is used (Lumsden, 2007). For profitability, the resource utilization should be as high as possible. Logistic providers use four different measures: ton-kilometers where actual ton-km is divided by the maximum ton-km capacity (European Environment Agency, 2010); weight-based fill rate which is calculated as the ratio of the actual goods carried to the maximum weight that can be carried (McKinnon, 2010); volume-based fill rate which is calculated in a similar way to weight-based fill rate whereas volume is used instead of weight (McKinnon & Edwards, 2010); number of pallets which refers to the ratio of the number the maximum capacity of the vehicle (McKinnon, 2010, McKinnon & Edwards, 2010).

Regardless of the definition adapted, companies aim for the higher utilization rates. However, an imbalance in freight distribution results in a low resource

utilization and low profits. In addition, this costly imbalance may even create threats for slowing down the supply chain (Cassidy, 2018). As a result, there are numerous studies in the literature to reduce (and if possible eliminate) the freight imbalance.

We see in the analyzed studies that freight imbalance is addressed for different industries. In addition to studies that address imbalance issues related with maritime transport (Cheung and Chen, 1998; Crainic et al.,1993) the effects of imbalance in the rail industry are also studied in the literature (Sherali and Suharko, 1998). Engel (1998) states that about 75% of all freight in the distribution chain is handled by trucks, either completely or partially. This shows the high importance of the imbalances in the trucking industry.

There are several reasons behind freight imbalance. Hall (1999), Bean and Joubert (2010) and List et al. (2003) focus on the stochasticity due to the uncertainty in the demand while Powell (1996), Godfrey and Powell (2000) discuss the fluctuations due to seasonal volumes. One of the most common addressed reason behind imbalances is the difference in the inbound and outbound flows (Friesz et al., 1983; Taylor, 2003, Taylor et al., 2009). Domicile issues related to the drivers are also reported as one of the reasons of freight imbalance (Taylor and Whicker, 2002; Cole, 2018) as they affect the turnover rates of the drivers.

A relatively new aspect, even though not in trucking industry, belongs to Demirel et al. (2010) who analyze the effects of the climate change on the freight imbalance discussing how the transport moves on the rivers are affected by the climate changes.

A comprehensive discussion of truckload freight imbalances as well as a review on how these are handled is provided in Taylor (2003). He states that to deal with freight imbalance, three primary areas, for which a detailed literature is

provided, should be focused on. The first area is finding additional freight in backhaul markets, that is on the way back to the origin. Second area is finding and exploiting freight density using alternative strategies to dispatch the vehicles. Taylor (2008) defines dense freight nodes, which can be either origin or destination, as the nodes where the total freight flow is high even though individual freight demands do not exhibit a high flow pattern. He further states that when freight density and corresponding lanes are found on a network, economies of scale can be utilized by combining less than a truck loads (LTL) to full truck loads (FTL) or even using alternative transportation modes (such as trains) to decrease transportation charges.

The third and the last area is developing strategies in order to assist freight management when faced with imbalance such as using effective marketing or revenue management strategies to either promote or discourage freight into a particular region to create freight balance (Taylor, 2008).

The solution approaches for reducing and overcoming freight imbalance can be grouped under two main categories; collaboration and repositioning of empty vehicles. The corresponding literature on collaboration and repositioning can be found in Section 2.2 and Section 2.3 respectively.

2.2 Collaboration to reduce freight imbalance

Collaboration among companies may result in a decrease in the number of necessary trips, an increase in the efficiency and finally a decrease in freight imbalance for all the parties. In the most extreme scenario, the freight imbalance can be totally prevented theoretically. Assume that there are two customers (say customer A and B) with two truckloads of demand each. The demand of customer A is from Germany to Italy while the demand of customer B is from Italy to Germany. Further assume that

two separate LSP companies residing in Germany and Italy are serving these customers. In the non-collaboration case, the demand of customer A and customer B should be handled by two round trips by each LSP company. However, collaboration results in a save of one trip per LSP as the first LSP will handle one truckload freight demand of the second LSP and vice versa.

Even though a theoretical gain of this size is not reached in practice, the benefits of collaboration to handle freight imbalance is clearly addressed in the literature. By collaboration, we refer to horizontal cooperation which is defined as combining the similar or complementary transportation requirements of companies which are on the same level of the supply chain mostly by using load consolidation centers and joint route planning (Cruijssen et al., 2007). According to Perez-Bernabeu et al. (2015), horizontal cooperation is not only a way to reduce costs; it is essential to give satisfactory services to the customers.

Caputo and Mininno (1996) discuss the effect of aggregating suppliers to the same logistic company to improve levels of service and reduce costs and examine various policies in the Italian grocery industry.

Ballot and Fontane (2010) analyzed the benefits of combining warehouses or distribution centers together to reduce the number of deliveries as well as greenhouse gas emissions. A real case study is included where two supply chains in France are merged. A similar approach in terms of horizontal cooperation was also presented previously in Nadarajah (2008).

One of the important aspects in horizontal collaboration is the allocation of the costs. Audy et al. (2011) presents guidelines for the allocation of cost to the parties in collaboration and proposes a model for quantifying the cooperation between the parties. In addition, allocating cost in a fair way is handled by many

other studies in the literature (Dai and Chen, 2012; Guajardo and Rönnqvist, 2016; Gansterer and Hartl, 2018). Scott (2015) emphasizes the value of information sharing for truckload shippers and proposes an analytical method that utilizes this information for the estimation of truckload market prices.

Focusing on how to integrate collaborative transportation planning, Özener et al. (2011) develop exchange mechanisms with various levels of information sharing requirements. A multicriteria approach is also analyzed in the literature (Bahinipati et al., 2009; Arshinder et al., 2011; Soosay and Hyland, 2015). These studies mostly emphasize the difficulty of evaluating the preference of different partners on multiple evaluation criteria most of which are subjective. They propose hierarchical methods such as Analytic Hierarchy Process to provide the partners pair-wise comparisons of multiple criteria to make collaborative integration more successful.

In a recent study, Perez-Bernabeu et al. (2015) analyzes different scenarios in horizontal cooperation to compare the savings in route costs. The savings are reported as reduced delivery costs and greenhouse gas emissions. A detailed numerical analysis on benchmark problems from the Multi-Depot Vehicle Routing Problem (VRP) literature proved that horizontal cooperation can reduce not only the distribution costs but also delivery times and greenhouse gas emissions.

For a detailed review on horizontal cooperation in logistic, we refer the reader to Cruijssen et al. (2007) and Soosay and Hyland (2015).

2.3 Empty vehicle repositioning

The reduction of freight imbalance via collaboration is possible as presented in the previous section. However, the focus of this study will be repositioning empty vehicles in an environment where collaboration is not possible. In other words, the

company will act as the single party to meet the demand of customers geographically dispersed through working environment.

Repositioning of empty containers is also studied very often in the literature (Zheng et al., 2015; Xie et al., 2017; Kuzmicz and Pesch, 2019). However, we will focus on the literature on empty positioning and backhaul of vehicles in this section. Empty vehicle repositioning is also defined as one of the important problems of multiple depot service systems along with fleet-sizing (Crainic, 2000).

According to European Commission (2011) approximately 25% of road transportation activities corresponds to empty backhauls. Therefore, there exists regulations to enable the trucks to pick up loads from the countries different from the one where the truck is registered on their return trip (Bayliss, 2012). This is referred to as cabotage and helps to reduce the empty trips and freight imbalance in parallel (European Commission, 2007).

The problem of empty vehicle repositioning has been examined by several authors. One of the earliest studies belong to Cundill and Hull (1979) who examine the economics of backhauling or return loading. They further present how much empty running might be reduced. They claim that two main reasons behind the empty runs and flow imbalances are not having a proper information system to match the supply and demand and unwillingness of the operators to carry return loads.

Beaujon and Turnquist (1991) formulated the allocation of the vehicles to the depots under consideration as well as determining the fleet size. The objective was set as maximizing the total profit of the operations. Any unsatisfied demand was calculated as a cost in addition to the routing cost. Cheung and Powell (1996) also considered maximizing total profits. However, any unsatisfied demand was evaluated as a lost demand. They tried to assign both empty end loaded vehicles in the fleet to

the depots in the current network. Also, no stochasticity was included in the study as all the travel times were assumed as deterministic.

Repositioning of empty vehicles in a hub and spoke network was studied in Du and Hall (1997) who also analyzed the best fleet size composition. Their work was extended in Hall and Zhong (2002) who generalized the network structure under consideration.

In their survey paper, Arcelus et al. (1998) focused on the empty flows and fleet management models in freight transportation and presented a review of the literature some decades ago.

Metaheuristic methods were also applied within empty vehicle positioning. To maximize the average profit, Kochel et al. (2003) used a Genetic Algorithm based approach and solved the repositioning problem of vehicles.

Song and Earl (2008) analyzed the problem from a perspective of a two-depot service system. The minimized objective function included empty vehicle repositioning, vehicle maintenance and vehicle leasing. An earlier study Jordan and Burns (1984) examined two-terminal networks. The study was extended to multiple terminals later in Jordan (1987).

Holguin-Veras and Thorson (2003) took complementary empty trips into account in a commodity based model. They also say that making a correct estimation of empty trips is very important for transportation planning purposes as having incorrect estimates will in turn lead to severe directional errors in the estimation of vehicle traffic.

McKinnon and Ge (2006) reviewed the literature for estimating the potential for reducing empty running. They reported that the proportion of empty runs had steadily declined in the UK in the last 30 years at the time of the study. Nevertheless,

they claimed that it would never be possible to completely eliminate the empty runs due to geographical imbalances in traffic flow, non-transparent road freight market and vehicles and loads being incompatible.

Peetijade and Bangviwat (2012) focused on the manufacturers in Bangkok area and reported that 85.75% of the backhauls were empty. The total distance of these empty trips was reported to be 210,193 km per week and created a waste of 37.42% of the expense for fuel. In addition to an analysis from a single manufacturer point of view, a matching process to reduce approximately 15% of the total distance was also presented.

In a recent study, Koch et al. (2018) deal with a special variant of VRP where the backhauls are also considered. The real life corresponding industry for the problem is reported to be the retail sector. The simultaneous pickup and deliveries allow to reduce the total number of empty trips.

Although there exist numerous studies on empty vehicle repositioning in the literature, the number of studies offering a decision support tool for the end users is very low. Some of these studies propose a DSS only for either car sharing (Kek et al., 2009; Willing et al., 2017) or bike sharing (Caggiani and Ottomanelli, 2012) which are out of context of this study. In addition, there exist studies offering a decision support tool for the repositioning of empty containers (Shen and Khoong, 1995; Banderia et al., 2009) rather than the vehicles.

In summary, there is a gap in the literature in terms of a DSS to reposition the vehicles. This study aims to fill this gap by proposing a decision support tool to reposition the vehicles in the fleet of the inspected LSP company to minimize the freight imbalance and the empty run cost in parallel. This study will also contribute to the literature by presenting a real-life case implementation.

CHAPTER 3

BACKGROUND: COMPANY PROFILE

The company in this study is the fastest growing Turkish logistic corporation in Europe which was founded in 1990. It provides service in Germany, Romania, Italy, Bosnia, France, Greece, Hungary, Spain, Poland, Bulgaria, Czechia, Ukraine, Slovenia, and Sweden with its over 1,000,000 square meter own warehouse. Figure 3 shows the main countries that the company has consolidation centers and offices in. It boasts a fleet of over 4,500 trailers and over 1,000 trucks and a multi-national workforce of over 7,000 employees. The company realizes over 10,000 trips consisting of more than 32,000 orders per month between Turkey and Europe and between European countries.

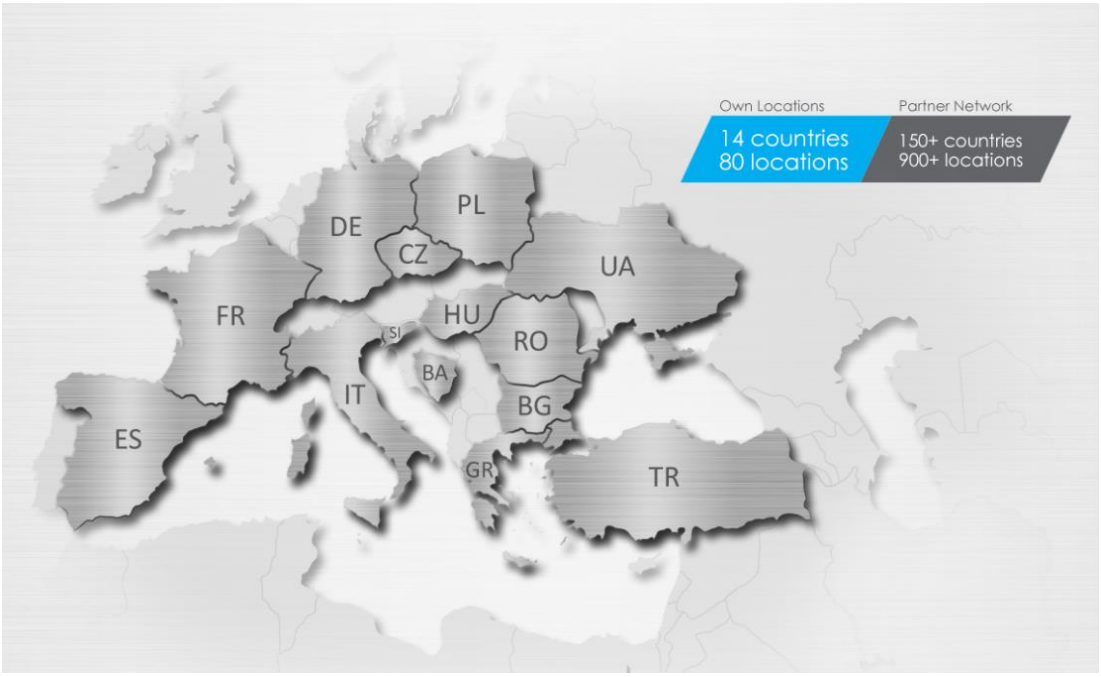

Figure 3. Company locations

The company's revenue (see Figure 4), investments (see Figure 5) and growth ratios (see Figure 6) over the years show us that the company has been growing for the last five years.

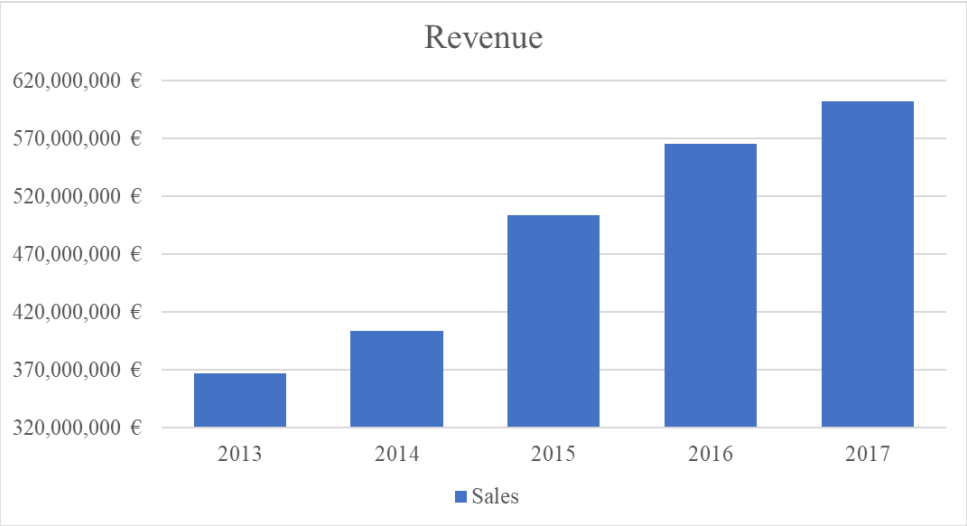

Figure 4. Company revenue between 2013 and 2017

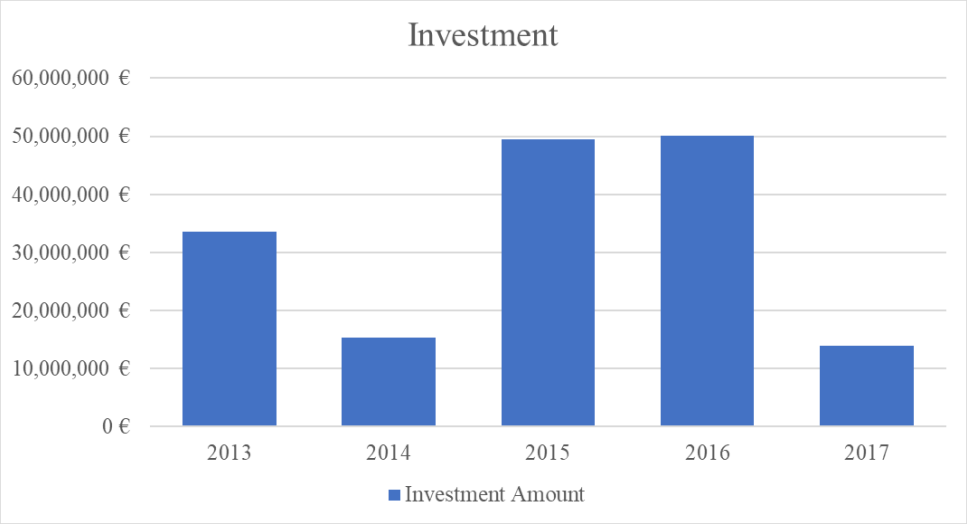

Figure 5. Company investments between 2013 and 2017

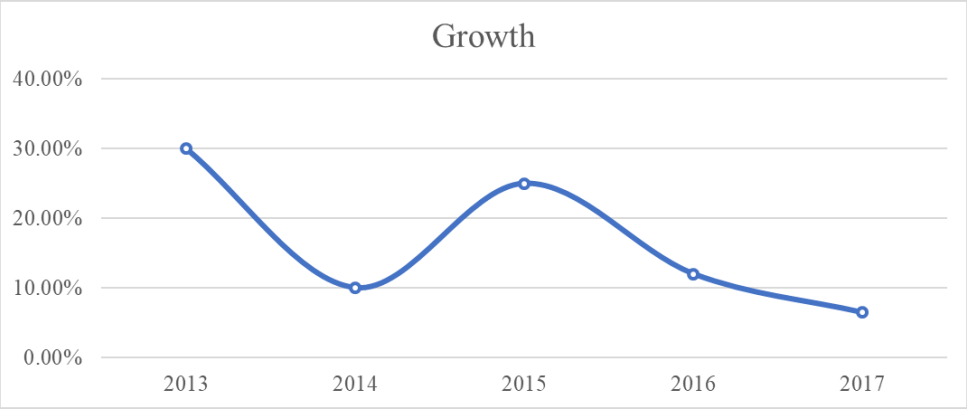

Figure 6. Company growth between 2013 and 2017

The company's latest investment was to build its own seaport at Yalova in 2015 to be used in intermodal operations starting from 2017. Yalova Seaport is one of the 63 customs gates of Turkey.

The company provides intermodal services and intercontinental logistic solutions including maritime routes and railways to a large majority of the best known global firms and brands all around the world by carrying thousands of trailers full of materials, finished products, industrial and consumer goods. Although each sector has different logistic requirements, the company offers customized transportation solutions for various sectors. Also, the company not just offers international road transportation to its customers. It offers end-to-end logistic services including Contract Logistic (Warehousing and Bonded Warehousing Services), Domestic Distribution (in Turkey and in Europe), Customs Clearance Services (as authorized customs broker) and Freight Forwarding Services. The total revenue of the company with respect to the different logistic services is shown on Figure 7. Accordingly, road freight has the highest portion on annual revenue with 57%. The above logistic services are offered to various sectors.

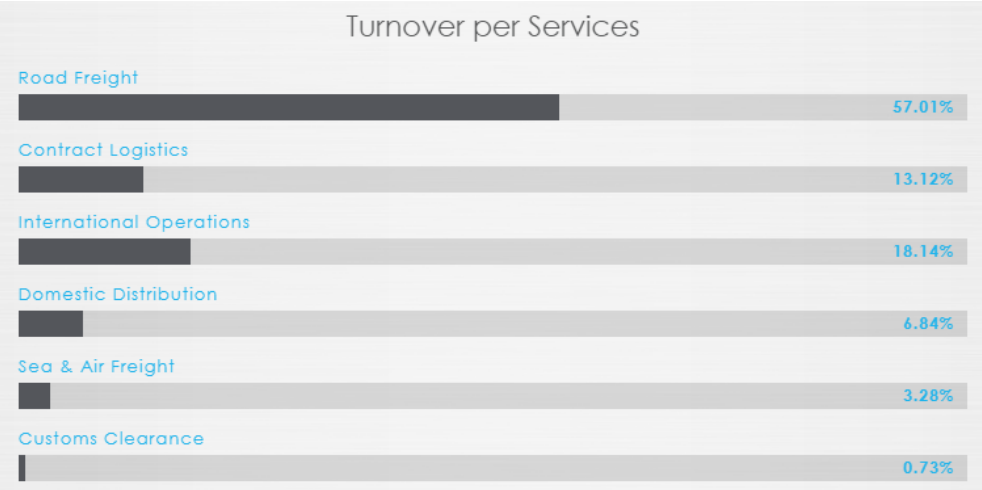

Figure 7. Revenue by services

Figure 8 shows revenue portions of the main sectors that the company serves. Automotive, Service, Textile, and Manufacturing (where company grouped the manufacturers other than Automotive, Textile, FMCG and Healthcare) are the leading sectors.

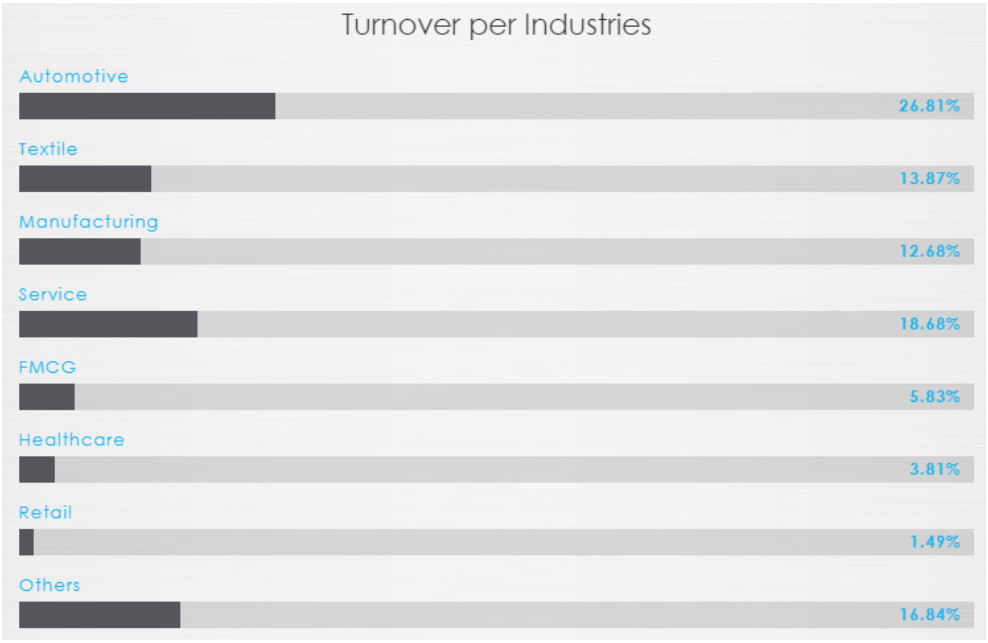

Figure 8. Revenue by sectors

Company has an in-house developed transaction management system which was launched in 2003. It has been integrated to the ERP tool SAP which was implemented in 2007. Figure 9 shows the detail of the information system software used in the company as well as the corresponding operations that they are used for. Although company have these improved information systems, the transaction management system is not integrated with neither the vehicle routing planning nor optimization of empty runs. Since it is designed just to handle the operation of the daily transactions, its planning module does not contain the optimizations like this. So, this causes effectiveness in planning.

The company established the first R&D Center in 2012 in the Turkish logistic market which was approved by the Ministry of Science, Industry, and Technology.

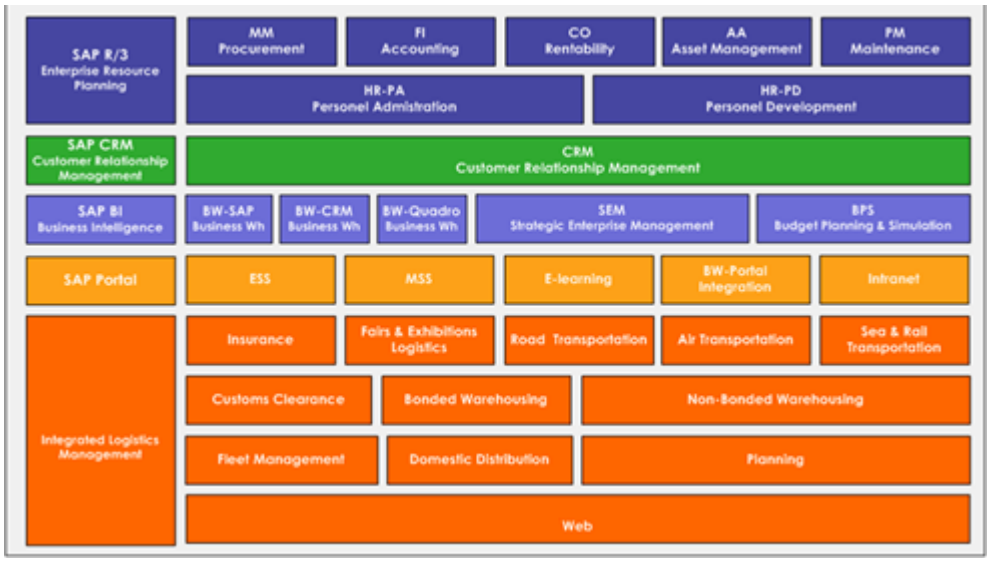

Figure 9. Information system of the company

The company's intermodal transportation system is based on the shipments of loaded trailers without its truck (Figure 10 shows a standard truck, Figure 11 shows a standard trailer with its truck) from İstanbul, İzmir and Mersin seaports to the seaports of Trieste (Italy), Lavrio (Greece) or Sete (France) via company owned Ro-Ro vessels (See Figure 12 for a Ro-Ro vessel while transporting trailers). The trailers arriving by the company owned Ro-Ro vessels are loaded to the dedicated trains by the cranes in the seaport (See Figure 13 for trailers loading to a dedicated train in the seaport by a crane, see Figure 14 for a dedicated train while transporting trailers). Arriving trailers are unloaded from the dedicated trains and transported via road freight transportation to the Ostrava (Czechia), Cologne (Germany), Ludwigshafen (Germany), Karlsruhe (Germany), Kiel (Germany), Paris (France) and Zeebrugge (Belgium) consolidation centers or to the final unloading destination (consignee's warehouse etc.). In the same manner, the loads are brought via road transport to Ostrava, Cologne, Ludwigshafen, Karlsruhe, Kiel, Paris or Zeebrugge stations and consolidated there for being transferred to Trieste seaport via railways; and then brought into Turkish seaports via the company owned Ro-Ro vessels. Figure 15 shows the configuration of the company's intermodal logistic network.

Figure 10. A standard truck

Figure 11. A standard trailer with its truck

Figure 12. Roro vessel transports trailers

Figure 13. Trailers loading to dedicated train in the seaport by a crane

Figure 14. Dedicated train transports trailers

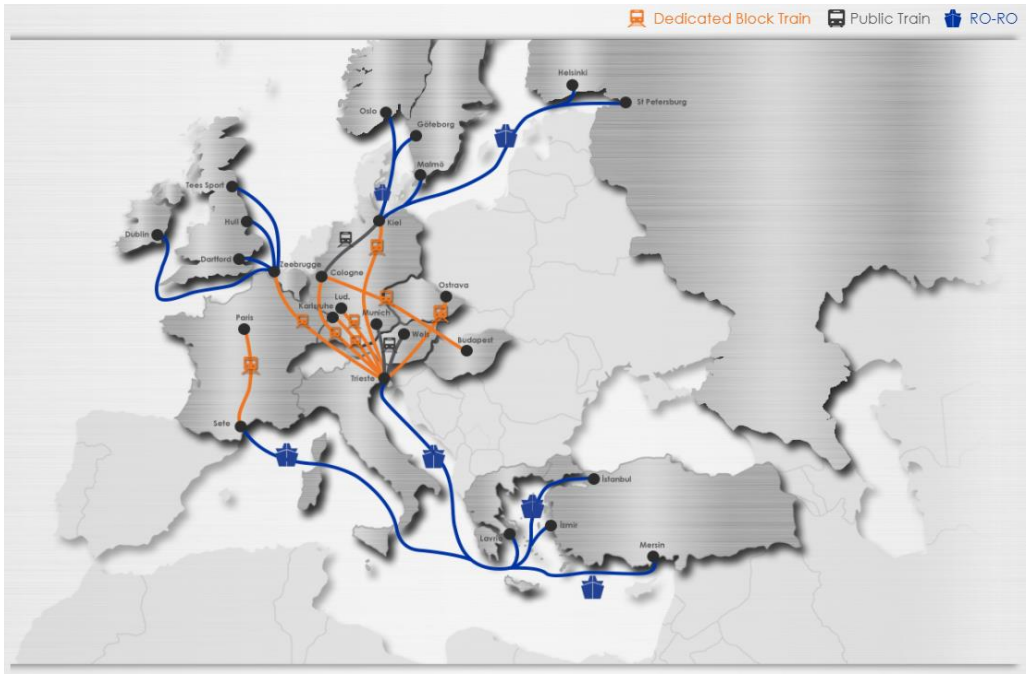

Figure 15. Intermodal network of the company

The company has been operating its own Ro-Ro vessels since 2013 and now, four round trips per week take place between Yalova seaport and Trieste port of Italy. Each trip's duration is about 72 hours and trips are realized with four company owned Ro-Ro vessels which are equipped with state-of-the-art technology. Two vessels have a capacity of 240 trailers and the other two vessels have a capacity of 280 trailers.

Two round trips per week have been taking place between Alsancak Port of Izmir and Sete port of France since 2014. Each trip's duration is about 50 hours and trips are realized with two company owned Ro-Ro vessel one of which is the fastest Ro-Ro in the world and has a capacity of 155 trailers. The other vessel has a capacity of 240 trailers.

Dedicated train service was started with a single line in 2008 and now each weekday, the company runs dedicated trains within Europe with transit time of one day. There are six lines from Trieste port that four to Köln, Mannheim, Karlsruhe, and Kiel Terminals in Germany, one to Zeebrugge Terminal in Belgium and one to Ostrava Terminal in Czechia. Also, there is another line between Sete port and Paris Noisy terminal in France. Train transportation can save many liters of diesel fuels and reduce carbon dioxide emissions compared to the truck consumptions in road freight transportation. The transportation capacity of a dedicated train is 32 trailers per train. The LSP company performs 46 train services on average each week.

Despite the tough rivalry in the market, the company has a high market share in Turkey which is over 10%. Figure 16 shows the changes on the market share of the company over years.

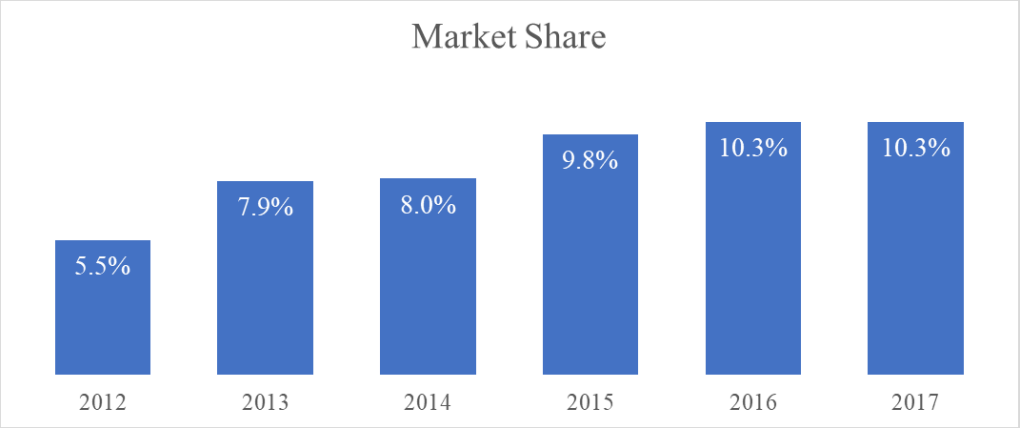

Figure 16. Market share of the company between 2012 and 2017

CHAPTER 4

PROBLEM DEFINITION AND METHODOLOGY

4.1 Problem definition

According to the UND (International Transport Association) there are over 1,100 international transportation companies in Turkey registered to their association. Most of the transportation companies in this sector have small fleet sizes. However, since outsourcing trailers from other transportation companies is very common, small logistic companies can generate transportation proposals for large shipments of manufacturing companies. The common use of outsourcing transportation activities between small LSPs introduces a fierce competition among all LSPs in the market irrespective of their fleet sizes.

The inspected company transports about 90% of its total volume with its owned fleet with more than 4,500 trailers, 1,000 trucks, 6 ships, 7 lines of dedicated train services. This ratio is about 10% in other LSP companies. To choose to be an asset heavy company has a lot of benefits while it introduces several problems too.

As the company has many assets, customers feel themselves safer, since they know that the company can always fulfill their needs in terms of time and volume of items to be transported. Additionally, the customers are confident that the company will be able solve any problem easily, since high fleet size provides more flexibility. Controllability, security, insurance, and accessibility are very important concerns for large manufacturing customers and the logistic company performs well in all these needs. High reliability that comes with all these features provides a competitive advantage to this company and allows it to offer higher transportation prices than its rivals.

As the number of owned trailers is increased, the amount of fixed costs is increasing, too. When the fleet size is high, fixed costs like depreciation of trailers, driver salaries, fixed storage, and parking costs of trailers are high, regardless of the number of total transportation realized in a month. So, the company has to offer higher prices than its rivals in order to ensure its profitability. But, as the number of the competitors is high and most of the manufacturer companies are price-oriented in selecting their LSPs, logistic service providing is a challenging sector for high fleet sized LSPs.

The company may decrease the high fixed costs of assets by using new business strategies such as outsourcing the trailers, ships and train lines or collaborating with the competitors. But the current company business strategy is to keep a growing market share and have a high control over operations of end-to-end transportation. Also, the LSPs in Turkey are not ready to build alliances in international transportation since this requires sharing of resources and information. Moreover, the LSP company does not want to take service level risks that arise from outsourcing and collaboration.

In the light of these explanations, we see that it is not possible to decrease the high fixed costs of the company by decreasing its large number of assets. In order to preserve profitability of the transportation operations, the company may think of decreasing its variable transportation costs by increasing its total transportation volume. This can be done by generating promotions with attractive price deals to its customers. However, it should be noted that as the total transportation volume rises, the imbalance between the export and import increases in many countries which further increases variable costs.

More specifically, if a region has more exports than imports, the number of trailers entering to that region will not be enough to fulfill its export transportations needs and that region will always lack for trailers for exporting. One way of tackling with imbalance problem is to generate more sales activities to increase import transportations to that region, but this is not always possible due to global market conditions. Instead, most of the time the LSP company chooses to move some empty trailers to that exporter region from the regions where imports are higher than exports. This is referred to as an empty run or empty transportation.

The analysis of variable costs of the company shows that the empty transportations of trailers realize the highest costs. Since there are no customer goods in an empty run, the cost of that empty movement is charged to the LSP company. The costs of an empty trailer moving is almost the same with the costs of a loaded trailer in the same route. An empty trailer can have a lower cost in terms of fuel consumption, roro cost and customs cost, while the fixed costs like depreciation, driver salary, transitional documents are totally the same with a loaded trailer. To give an impression of this fact, in a given year, total cost of the empty runs may correspond to half of the gross profit of the company.

With this point of view, the number of empty runs can never be zero, but it can be reduced by better planning. So, the company has to decide on how to allocate empty runs among several countries while satisfying customer needs in every location.

Hence, we provide our research problem as:

To generate a better empty trailer allocation plan to decrease the empty run costs while satisfying customer needs in every location.

Next, we explore the decision-making environment of the company for this problem. The company does not have a computer aided decision-making environment for this planning problem. The empty run plans are generated daily in the planning department by manual analysis. In the current setting, the planning department includes regional sub-divisions controlled by allocated planning staff. During planning, the regional planning staff need to consult with each other and need to contact with the tradeline manager in many phone calls. This manual process takes a significant working time of about four hours each day and causes delays in implementing the operations. It is observed that the planning process is very inefficient since it takes a long time and requires several staff involved.

As a remedy to the problems highlighted above, in this study, it is aimed to generate a DSS environment to increase the efficiency of the planning environment by decreasing the planning duration and by decreasing the amount of staff involved. The DSS will improve the effectiveness of decision making environment by generating better plans with lower costs at high customer satisfaction.

4.2 Methodology

In the thesis study, two heuristic mathematical models are generated to i) forecast the daily demand, and ii) to reduce the empty runs by matching the daily forecasted demand with the empty trailers in various locations. We gather all the necessary input data for costs, empty trailer locations, monthly forecast and past daily volume data from the company. The mathematical models are developed in Microsoft (MS) Excel by using its Solver Optimization Module. Here, MS Excel is chosen for its practical usage and the company restrictions for a software cost effective solution. The model is integrated with the Google maps API as well as the Oracle Database

used in the company. Next, the model base is embedded into a DSS by developing its graphical user interfaces (GUI) which is generated in MS Excel by VBA. The DSS is implemented; its performance is tested and evaluated among its users by a survey on the effectiveness, efficiency and flexibility obtained in the decision environment.

CHAPTER 5

DEVELOPMENT OF THE DSS

A DSS is composed of a model base, a database, and a graphical user interface. In this chapter we develop a DSS with all its components and evaluate its performance.

5.1 Model base

The model base of our DSS includes two models. The first one is a forecasting model developed to estimate the daily trailer demands in a country. The second one is a heuristic model developed to identify the number of empty trailers to depart from each location daily as well as the number of outsourced trailers to decrease the total transportation cost.

5.1.1 The Forecasting model

5.1.1.1 Analysis of past data for forecasting the daily demand

In order to match the empty trailers with the demand, first we need to know the demand in daily basis. Most of the customers place their orders within the same day with the requested collection day. So, we need the forecasts for daily demands aggregated in the country level and service direction (import or export) levels.

In practice, at the beginning of each month the company obtains the monthly demand forecasts from the sales team in each country for each service direction. We start to analyze the accuracy of these forecasts, by first checking the accuracy of the aggregated monthly demands for all countries and for all service directions. Table 1 shows the actual and the forecasted aggregated demands in a previous year as an

example. Here, we see that monthly forecasts aggregated in service direction and country provide a high accuracy; lowest accuracy being 90% and the average is 97%.

Table 1. Monthly Actual Demands and Forecasts Aggregated in Service Direction and Country, and Accuracy in a Previous Year
(Accuracy=1-|Actual-Forecast|/Actual)

Months	Actual (a)	Forecast (b)	Abs Error |a-b| (c)	Accuracy (1-c/a)
Jan	8,555	8,528	27	100%
Feb	8,675	8,944	269	97%
Mar	9,947	9,196	750	92%
Apr	8,651	9,193	542	94%
May	9,349	9,369	19	100%
Jun	8,826	9,081	254	97%
Jul	8,031	8,059	28	100%
Aug	8,289	8,051	238	97%
Sep	8,418	9,249	831	90%
Oct	9,348	9,504	157	98%
Nov	9,441	9,446	5	100%
Dec	7,785	8,044	259	97%
Total	**105,316**	**106,666**	**3,381**	**97%**

We observe similar high precision levels for the aggregated demand forecasts in the last five years. So, in the next step we check the forecast accuracy of the monthly forecasts aggregated for all countries in each service directions (see Table 2). It follows that aggregated monthly forecasts in each service direction provide a high accuracy; lowest accuracy being 86% for both and the average is 89% and 90% for export and import volumes respectively.

We need to note that the high forecast accuracies in the aggregated country demand levels would not be possible unless similar high forecast accuracies exist in each country respectively. This is due to the fact that, the accuracy in Table 2 is measured by aggregating the absolute error terms in each country, i.e., $\text{Accuracy}=1-\sum|\text{Actual}-\text{Forecast}|/\sum\text{Actual}$.

Table 2. Monthly Actual Demands and Forecasts Aggregated for All Countries in Each Service Directions, and Accuracy in a Previous Year (Accuracy=1-∑|Actual-Forecast|/∑Actual)

Months	Export				Import				Total			
	Actual (a)	Forecast (b)	∑(Abs Err) (c)	Accuracy (1-c/a)	Actual (a)	Forecast (b)	∑(Abs Err) (c)	Accuracy (1-c/a)	Actual (a)	Forecast (b)	∑(Abs Err) (c)	Accuracy (1-c/a)
Jan	4,173	4,305	387	91%	4,382	4,223	433	90%	8,555	8,528	820	90%
Feb	4,054	4,403	441	89%	4,621	4,541	399	91%	8,675	8,944	840	90%
Mar	4,863	4,442	575	88%	5,084	4,754	509	90%	9,947	9,196	1,084	89%
Apr	4,287	4,505	424	90%	4,364	4,688	597	86%	8,651	9,193	1,021	88%
May	4,435	4,695	368	92%	4,914	4,674	533	89%	9,349	9,369	901	90%
Jun	4,206	4,460	478	89%	4,620	4,621	376	92%	8,826	9,081	854	90%
Jul	4,068	4,008	538	87%	3,963	4,051	297	92%	8,031	8,059	835	90%
Aug	4,335	3,920	582	87%	3,954	4,130	529	87%	8,289	8,051	1,111	87%
Sep	4,053	4,562	580	86%	4,365	4,687	476	89%	8,418	9,249	1,056	87%
Oct	4,601	4,931	448	90%	4,746	4,574	280	94%	9,348	9,504	729	92%
Nov	4,470	4,846	514	89%	4,971	4,600	414	92%	9,441	9,446	928	90%
Dec	3,825	4,195	536	86%	3,960	3,849	464	88%	7,785	8,044	1,000	87%
Total	**51,371**	**53,274**	**5,869**	**89%**	**53,945**	**53,392**	**5,309**	**90%**	**105,316**	**106,666**	**11,178**	**89%**

So, seeing that monthly aggregated forecasts for import and export quantities are quite accurate for each country respectively, we decide to use these accurate monthly forecasts to generate the forecasts in each day in a month.

In the next step, we need to observe the behavior of the monthly demand in three consecutive years. Figure 17 shows that there is an increasing trend in the monthly demand in these years. More over the monthly demand shows a seasonal pattern in each year. High seasons are encountered in March, October, and November; low seasons are encountered in January, February, July, August, and December, and the rest of the seasons are moderate.

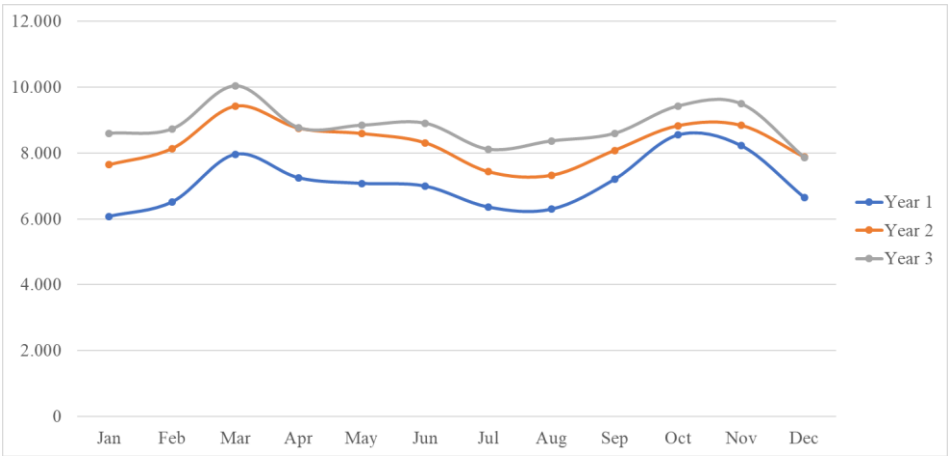

Figure 17. Aggregated monthly actual demands for all countries and service direction in three consecutive years

Now, we analyze the behavior of the daily actual data to see if we can identify a daily or weekly pattern in a month. For this purpose, we analyze every month of a selected previous year in a daily basis. Figure 18, Figure 19, and Figure 20 are the examples of the daily demands in a high, moderate, and low season month respectively. We find that there is a weekly seasonality in every month while there is not a significant trend observed within the days or weeks of the same month.

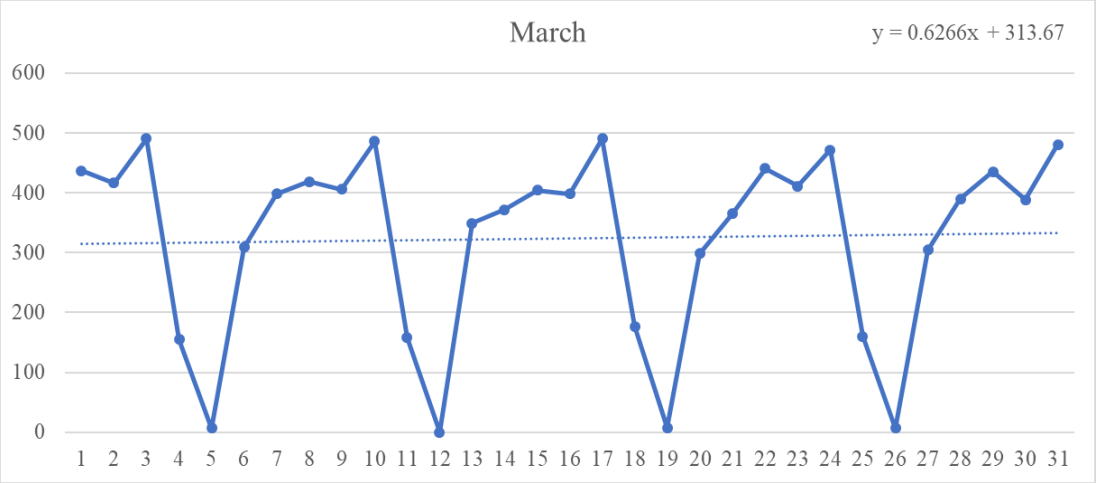

Figure 18. Daily aggregated volumes for all countries and service directions in a high demand season-month in a previous year

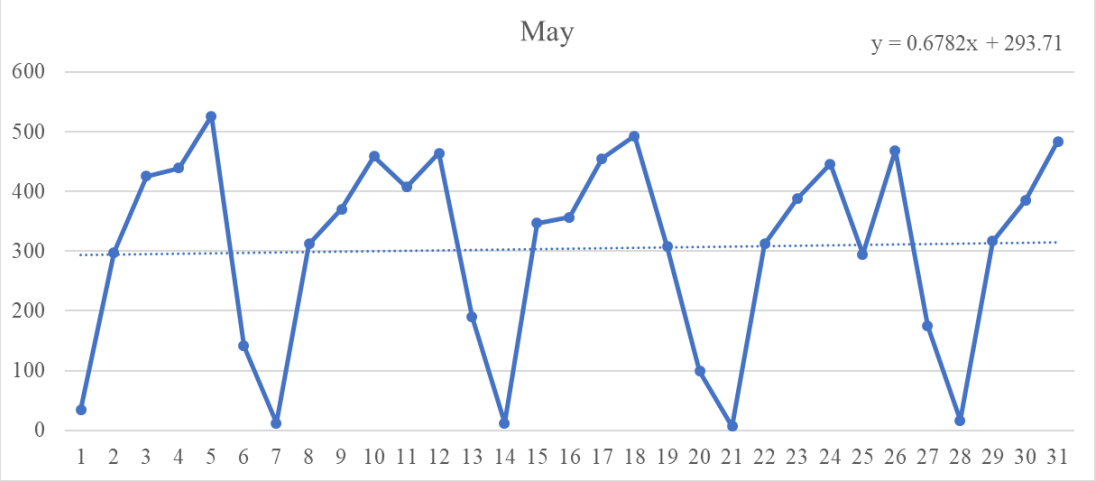

Figure 19. Daily aggregated volumes for all countries and service directions in a moderate demand season-month in a previous year

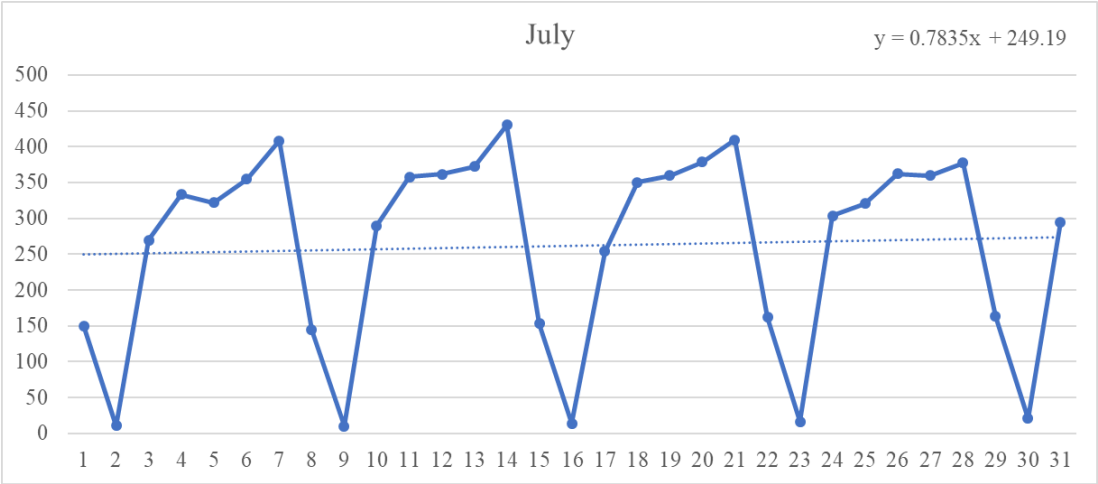

Figure 20. Daily aggregated volumes for all countries and service directions in a low demand season-month in a previous year

At this stage, we are confident about the accuracy of monthly forecasts obtained for each country in each service direction. Furthermore, we see that there is a weekly seasonality observed in each month for the aggregated demand for all countries in each service directions.

Next, we need to see which previous week is the best on representing today's forecast. So, we prepared a lagged correlation model to find the best lagged day(s) for daily forecast. We calculate the lagged correlations for the daily actual demands in a previous year. We use lags beginning from one day to 30 days. Next, we repeated the calculation of lagged correlations for each month (see Table 3). We calculate the lower and upper bounds for 95% confidence level and checked each entry in Table 3 whether it is included in this confidence interval. The green cells show that for the lag day on the same line, the lagged correlation on that month is included in the confidence interval of that lagged day, while the orange ones represent that the value is out of the confidence interval. Since most of the values are included in confidence interval, we are able to compare the lagged days by their averages.

Table 3. Lagged Correlation Coefficients of Daily Demands in Each Month

Lagged Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Lower Confidence Bound	Upper Confidence Bound	Standard Deviation	Average
1 day Lag	0.393	0.397	0.401	0.392	0.395	0.393	0.393	0.393	0.379	0.385	0.395	0.393	0.389	0.396	0.006	0.392
2 days Lag	-0.357	-0.331	-0.33	-0.304	-0.3	-0.325	-0.328	-0.326	-0.331	-0.271	-0.305	-0.265	-0.331	-0.298	0.027	-0.314
3 days Lag	-0.456	-0.452	-0.456	-0.453	-0.456	-0.457	-0.464	-0.459	-0.455	-0.459	-0.462	-0.456	-0.459	-0.455	0.003	-0.457
4 days Lag	-0.477	-0.464	-0.452	-0.473	-0.471	-0.467	-0.468	-0.472	-0.462	-0.483	-0.464	-0.467	-0.473	-0.463	0.008	-0.468
5 days Lag	-0.254	-0.338	-0.277	-0.296	-0.287	-0.287	-0.304	-0.302	-0.288	-0.285	-0.293	-0.293	-0.304	-0.280	0.019	-0.292
6 days Lag	0.336	0.311	0.331	0.342	0.329	0.31	0.326	0.34	0.341	0.344	0.327	0.372	0.324	0.344	0.016	0.334
7 days Lag	0.893	0.893	0.9	0.912	0.903	0.914	0.894	0.9	0.947	0.951	0.875	0.901	0.893	0.921	0.022	0.907
8 days Lag	0.4144	0.332	0.3396	0.4167	0.3406	0.3581	0.2312	0.2917	0.3112	0.3193	0.3321	0.4677	0.306	0.386	0.063	0.346
9 days Lag	-0.303	-0.321	-0.322	-0.314	-0.361	-0.262	-0.308	-0.276	-0.316	-0.367	-0.302	-0.328	-0.334	-0.296	0.030	-0.315
10 days Lag	-0.477	-0.458	-0.446	-0.476	-0.47	-0.473	-0.463	-0.438	-0.464	-0.518	-0.495	-0.467	-0.484	-0.457	0.021	-0.470
11 days Lag	-0.555	-0.592	-0.543	-0.478	-0.555	-0.587	-0.49	-0.497	-0.495	-0.547	-0.543	-0.34	-0.561	-0.476	0.067	-0.519
12 days Lag	-0.236	-0.368	-0.431	-0.25	-0.307	-0.233	-0.241	-0.264	-0.24	-0.193	-0.239	-0.258	-0.314	-0.229	0.066	-0.272
13 days Lag	0.303	0.377	0.35	0.321	0.374	0.339	0.47	0.24	0.31	0.321	0.351	0.378	0.309	0.380	0.055	0.345
14 days Lag	0.786	0.852	0.988	0.851	0.867	0.772	0.83	0.851	0.859	0.87	0.862	0.844	0.819	0.886	0.053	0.853
15 days Lag	0.416	0.329	0.473	0.449	0.428	0.406	0.422	0.368	0.384	0.424	0.424	0.285	0.367	0.434	0.052	0.401
16 days Lag	-0.373	-0.343	-0.316	-0.262	-0.357	-0.117	-0.491	-0.37	-0.201	-0.379	-0.418	-0.23	-0.387	-0.256	0.103	-0.321
17 days Lag	-0.466	-0.454	-0.583	-0.491	-0.404	-0.427	-0.484	-0.515	-0.474	-0.47	-0.511	-0.599	-0.526	-0.454	0.057	-0.490
18 days Lag	-0.472	-0.494	-0.386	-0.53	-0.605	-0.487	-0.447	-0.516	-0.514	-0.512	-0.502	-0.523	-0.532	-0.466	0.052	-0.499
19 days Lag	-0.331	-0.357	-0.404	-0.335	-0.063	-0.449	-0.303	-0.321	-0.262	-0.321	-0.338	-0.44	-0.390	-0.264	0.100	-0.327
20 days Lag	0.315	0.329	0.38	0.323	0.316	0.357	0.341	0.252	0.308	0.452	0.308	0.455	0.307	0.382	0.059	0.345
21 days Lag	0.878	0.964	0.834	0.844	0.886	0.817	0.833	0.84	0.883	0.872	0.811	0.837	0.832	0.885	0.042	0.858
22 days Lag	0.305	0.333	0.313	0.329	0.329	0.327	0.319	0.228	0.468	0.257	0.318	0.292	0.282	0.354	0.057	0.318
23 days Lag	-0.35	-0.376	-0.317	-0.34	-0.295	-0.087	-0.468	-0.315	-0.236	-0.359	-0.469	-0.26	-0.388	-0.257	0.103	-0.323
24 days Lag	-0.475	-0.439	-0.451	-0.412	-0.568	-0.426	-0.436	-0.453	-0.419	-0.434	-0.455	-0.425	-0.476	-0.423	0.041	-0.449
25 days Lag	-0.551	-0.612	-0.526	-0.533	-0.384	-0.491	-0.51	-0.537	-0.493	-0.547	-0.505	-0.563	-0.556	-0.486	0.055	-0.521
26 days Lag	-0.372	-0.334	-0.408	-0.348	-0.12	-0.485	-0.265	-0.379	-0.282	-0.253	-0.301	-0.446	-0.395	-0.271	0.098	-0.333
27 days Lag	0.315	0.294	0.304	0.228	0.353	0.34	0.347	0.328	0.452	0.46	0.322	0.342	0.300	0.381	0.063	0.340
28 days Lag	0.889	0.908	0.907	0.888	0.858	0.947	0.866	0.914	0.913	0.887	0.897	0.906	0.883	0.913	0.023	0.898
29 days Lag	0.3431	0.3357	0.3728	0.3722	0.2959	0.457	0.2208	0.3331	0.3302	0.3596	0.2778	0.4462	0.304	0.387	0.066	0.345
30 days Lag	-0.284	-0.412	-0.299	-0.345	-0.315	-0.105	-0.464	-0.314	-0.316	-0.279	-0.435	-0.271	-0.379	-0.261	0.093	-0.320

Figure 21 shows the plot of average lagged correlation coefficients for each lag in a month. We can easily capture that seven-day lag has the highest correlation showing that the period repeats weekly. Obviously, it follows that the period repeats in the multiples of the week as well. For operational purposes we take the period of seasonality to be 4 weeks instead of a single week. This is due to the fact that in application the actual daily data is not available for the past one or two weeks. Hence, we are obliged to use longer period than two weeks. Figure 21 shows that the largest lagged correlation larger than two weeks occur at lag=28 days. So, we decide to use 28 days period for further analysis.

Having observed the behavior of the monthly and daily aggregated demands in the above analysis, now we develop two different models to forecast the daily demand.

These are:

i. Forecasting daily demands with daily seasonal index model

ii. Forecasting daily demands with seasonality and weights assigned to the actual daily proportions in the previous years

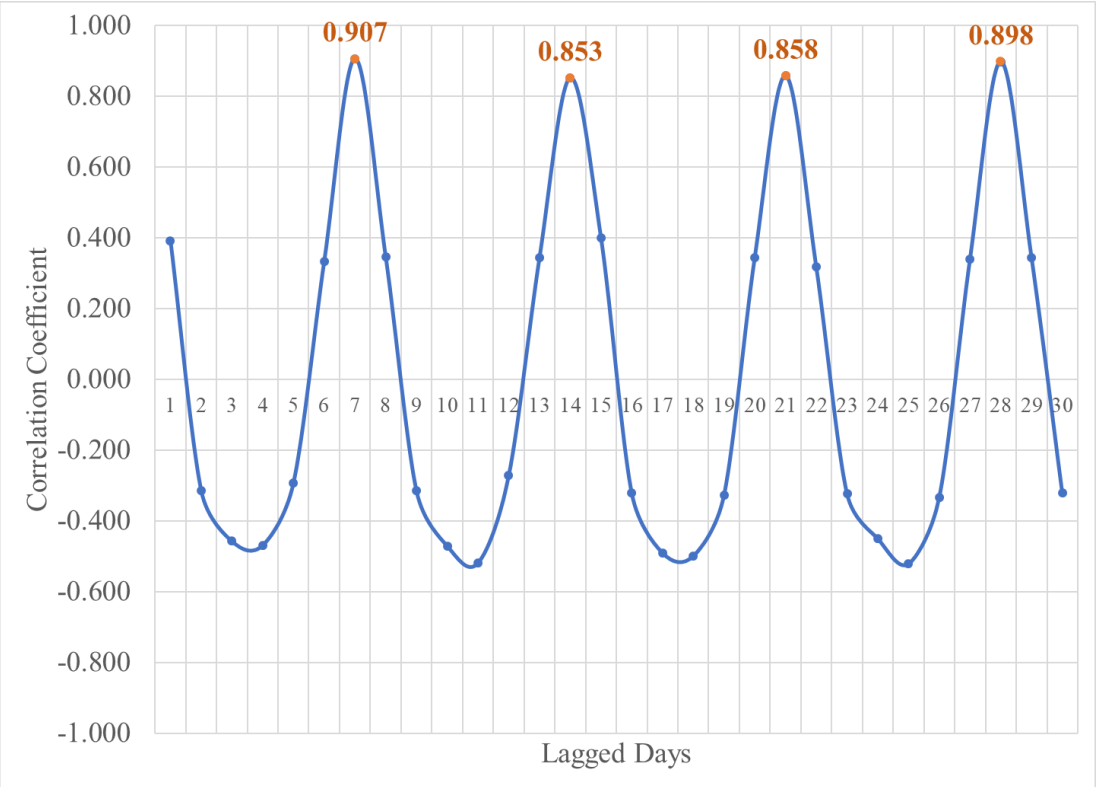

Figure 21. Plot of the average lagged correlation coefficients by lagged days

We compared the two models with respect to their forecast accuracies, mean absolute deviation (MAD), mean squared errors (MSE), and mean absolute percentage errors (MAPE) to see which model have better results. The best performing model is used in the model base of the DSS.

5.1.1.2 Development and comparison of the forecasting models

Forecast Model 1

In the first forecasting model we use seasonal index method. Since, we have weekly fluctuations and monthly seasonality we try to calculate a seasonal index for each

weekday of every month by using the actual daily volume data of the past three years. Table 4 shows the calculated seasonal indices for a month of a selected year (see Appendix A for full table).

Table 4. Seasonal Indices

Month	Weekday	Total Daily Actual Demand in a Weekday			Weekday Average	Daily Average	Seasonal Index
		Year 1	Year 2	Year 3			
1	Mon	764	759	1,026	850	910	0.933
1	Tue	872	1,007	1,224	1,034	910	1.136
1	Wed	1,012	1,020	1,501	1,177	910	1.294
1	Thu	1,046	1,143	1,450	1,213	910	1.332
1	Fri	1,315	1,433	1,752	1,500	910	1.648
1	Sat	483	625	606	571	910	0.628
1	Sun	8	30	42	27	910	0.029

Let;

Y_t = Actual demand in day t of a given month, where t=1, 2, ..., 31

Y_k^i = Sum of the daily actual demands for weekday k in a given month for year i, where k=1, 2, …, 7 and i=1, 2, 3

S_k= Seasonal index for the weekday k, where k=1, 2, …, 7

In Table 4, the sum of the daily actual demands in all Mondays (where k=1) in the given month are Y_1^1=764, Y_1^2=759 and Y_1^3=1,026 for year 1, year 2 and year 3 respectively. The weekday average in column six, $Z_k = \frac{\sum_{i=1}^{3} Y_k^i}{3}$ is calculated for each weekday, where k=1, 2, …, 7. The daily average in column seven, $D = \frac{\sum_{k=1}^{7} Z_k}{7}$ is 910 for the given month. Accordingly, the seasonal index, S_k, for each weekday of a given month is calculated as $S_k = Z_k/D$ which can be followed in the last column in Table 4.

Then, we test the results for calculated seasonal indices for the 12 previous months. Table 5 shows the daily forecasts with the seasonal indices (see Appendix B for full table).

Table 5. Forecast with Seasonal Index

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	1	Sun	275	0.029	8	2	-6	6	37	3.032
2	1	Mon	275	0.933	257	134	-123	123	15087	0.917
3	1	Tue	275	1.136	313	242	-70	70	4922	0.289
4	1	Wed	275	1.294	356	311	-45	45	1987	0.143
5	1	Thu	275	1.332	366	368	2	2	3	0.005
6	1	Fri	275	1.648	453	375	-79	79	6189	0.210
7	1	Sat	275	0.628	173	57	-116	116	13427	2.040
8	1	Sun	275	0.029	8	0	-8	8	65	1.000
9	1	Mon	275	0.933	257	271	14	14	206	0.053
10	1	Tue	275	1.136	313	302	-11	11	120	0.036
…	…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…	…
30	1	Mon	275	0.933	257	324	67	67	4516	0.207
31	1	Tue	275	1.136	313	403	90	90	8102	0.224
Average							**9**	**43**	**3,116**	**0.435**

t_k= The weekday that corresponds to day t in given month, where *t*=1, 2, …, 31

t_k= 1, 2, …, 7, where Monday=1, Tuesday=2, …, Sunday=7

For example, if day *t* is Monday then t_k=1 or if day *t* is Wednesday then t_k=3 or if day *t* is Saturday then t_k=6.

$\hat{Y}_t$ = Forecasted demand in day t of a given month, where *t*=1, 2, …, 31

α = Forecasted monthly demand of the company

n = The number of days in a given month

The generated forecast model is:

$$\hat{Y}_t = \frac{\alpha}{n} S_k$$

Table 6 shows the summarized performance measures for daily forecasting with seasonal index. As seen in the Table 5, we observe more errors than the average

of the month in some days. This leads us that it is possible to get better performance results in all measures with further improvements on the model.

Table 6. The Performance Measures for Daily Forecasts with Seasonal Indices

Months	Avg. BIAS	Avg. MAD	Avg. MSE	Avg. MAPE
1	9	43	3,116	0.435
2	-10	21	773	0.488
3	14	24	1,213	0.176
4	-4	28	1,720	0.208
5	-7	48	5,603	0.417
6	-16	36	3,280	0.180
7	12	26	1,097	0.117
8	1	35	2,049	0.155
9	-28	38	5,535	0.507
10	4	24	958	0.140
11	-7	26	1,675	0.107
12	0	38	3,095	0.271
Average	**-3**	**32**	**2,510**	**0.267**

Forecast Model 2

In the second forecasting approach, we conduct a multiple regression model with weights assigned to the actual volumes in the previous years.

First, we need to choose four actual past data that do not include any seasonality. From our previous analysis we know that the period of the seasonality is 28 days. Hence, we take the actual daily volumes with 28 days lag (which corresponds to the previous month), 56 days lag (corresponding to the two months before), 364 days lag (corresponds to the same month of the previous year), and 728 days lag (corresponding to the same month of the two years before) as the independent variables in our multiple regression analysis.

The weights are calculated to minimize the mean absolute deviation (MAD) which is calculated based on the daily forecasts generated in that selected month.

Hence, the regression model needs four months of input daily data to generate the weights for the regression model for a selected month.

The forecasting model determines these weights by minimizing MAD instead of MSE in the regression analysis. Doing this provides us a more robust forecast for the daily volume. This is due to the fact that the actual volumes might include significantly high or low values in some special days like holidays. Noting that MAD is less sensitive than MSE to the outliers in the actual data, generating a daily forecast by optimizing MAD is more appropriate for us. Hence, the weights of these four daily actual volumes are optimized with MS Excel Solver to minimize the mean absolute deviation of the daily forecasts.

The multiple regression approach explained above does not make use of the monthly estimate of the total volume obtained from the sales team of the company. However, as we analyze in the previous section, this estimate is very reliable since it also considers the deviations in the monthly volumes with respect to environmental and economic changes as well. Hence, we decide to incorporate this parameter to our multiple regression analysis. We do this by changing the independent variable from actual daily volume to its proportion to the actual monthly demand.

The forecast model is introduced below:

Let $X_t = Y_t / \sum_{t=1}^{n} Y_t$ be the proportion of actual daily demand in a particular month. Furthermore, let $\hat{X}_t$ be its forecast. Then we write the regression equation as:

$$\hat{X}_t = w_1 X_{t-28} + w_2 X_{t-56} + w_3 X_{t-364} + w_4 X_{t-728} \quad (1)$$

where;

w_i = weight for the proportion of actual demand in the past period, i =1, 2, 3, 4

It follows that $\hat{Y}_t = \hat{X}_t \alpha$

It should be noted that when the above model forecasts the daily proportions of volumes, their sum will not add up to 1 in a month. So, before calculating the daily forecast by using the above equation 1 we normalize the X_t , t=1, 2, …, 31 in the selected month. Table 7 shows the actual daily proportions of volumes and normalized volumes in columns '%Vol' and 'Normalized %Vol' respectively for the selected month (see Appendix C for daily detailed calculation table of the entire year). On the upper left corner of Table 7, the weights for each lag days and the MAD result that are optimized by MS Solver are presented. It also shows the performance measures of Model 2, on the far-right columns.

w1	0%
w2	32%
w3	43%
w4	24%

Solver Solutions for Weights

1 => Calculated proportions of days with calculated weights
2 => Normalized proportions of days
3 => Forcested Daily Volumes of Selected Month
4 => Actual Daily Volumes of Selected Month

MAD	26

MAD Optimized by Solver

Past Actual Daily Volumes for Each Lagged Days

Performance Measures of Model 2

			ACTUAL VOLUME																Monthly	Daily Forecast			Actual				
			28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag				Company		Normalized				Abs	Squared	Abs Percent
Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	%Vol	Vol	Volume	Error	Error	Error	Error
Y 3	Jan	1	Y 2	Dec	4	0%	Y 2	Nov	6	0%	Y 2	Jan	3	0%	Y 1	Jan	4	0%	8.528	0%	0%	3	2	-1	1	1	0,535
Y 3	Jan	2	Y 2	Dec	5	4%	Y 2	Nov	7	3%	Y 2	Jan	4	2%	Y 1	Jan	5	2%	8.528	2%	2%	204	134	-70	70	4856	0,520
Y 3	Jan	3	Y 2	Dec	6	4%	Y 2	Nov	8	4%	Y 2	Jan	5	3%	Y 1	Jan	6	3%	8.528	3%	3%	278	242	-35	35	1234	0,145
Y 3	Jan	4	Y 2	Dec	7	5%	Y 2	Nov	9	4%	Y 2	Jan	6	4%	Y 1	Jan	7	3%	8.528	4%	4%	312	311	0	0	0	0,001
Y 3	Jan	5	Y 2	Dec	8	4%	Y 2	Nov	10	4%	Y 2	Jan	7	4%	Y 1	Jan	8	4%	8.528	4%	4%	331	368	37	37	1349	0,100
Y 3	Jan	6	Y 2	Dec	9	5%	Y 2	Nov	11	5%	Y 2	Jan	8	5%	Y 1	Jan	9	5%	8.528	5%	5%	406	375	-31	31	958	0,083
Y 3	Jan	7	Y 2	Dec	10	2%	Y 2	Nov	12	1%	Y 2	Jan	9	1%	Y 1	Jan	10	2%	8.528	2%	2%	133	57	-76	76	5743	1,334
Y 3	Jan	8	Y 2	Dec	11	0%	Y 2	Nov	13	0%	Y 2	Jan	10	0%	Y 1	Jan	11	0%	8.528	0%	0%	6	0	-6	6	36	1,000
Y 3	Jan	9	Y 2	Dec	12	4%	Y 2	Nov	14	4%	Y 2	Jan	11	4%	Y 1	Jan	12	3%	8.528	4%	4%	300	271	-28	28	808	0,105
Y 3	Jan	10	Y 2	Dec	13	4%	Y 2	Nov	15	4%	Y 2	Jan	12	4%	Y 1	Jan	13	4%	8.528	4%	4%	341	302	-39	39	1532	0,130
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Y 3	Jan	30	Y 3	Jan	2	2%	Y 2	Dec	5	4%	Y 2	Feb	1	3%	Y 1	Feb	2	3%	8.528	4%	3%	290	324	34	34	1141	0,104
Y 3	Jan	31	Y 3	Jan	3	3%	Y 2	Dec	6	4%	Y 2	Feb	2	4%	Y 1	Feb	3	4%	8.528	4%	4%	322	403	80	80	6467	0,200
																			MONTH TOTAL					BIAS	MAD	MSE	MAPE
																			8.528	104%	100%	8.528	8.555	1	26	1245	0,355

Figure 22. Forecast with the model 2

Table 8 shows the summarized performance measures for daily forecasting with Model 2.

As we mentioned above we compared the MAD results of the two models (see Figure 22). The first model has better MAD only in March and September. Also, MSE and MAPE are higher in the first model as shown in Table 6 and Table 8. So, we decide to continue with the Model 2.

Table 7. The Performance Measures for Daily Forecasts with Model 2

Months	Avg. BIAS	Avg. MAD	Avg. MSE	Avg. MAPE
Jan	1	26	1,245	0.355
Feb	-10	20	582	0.403
Mar	24	25	1,148	0.153
Apr	-18	28	2,408	0.195
May	-1	41	4,467	0.408
Jun	-8	36	2,681	0.168
Jul	-1	23	965	0.128
Aug	8	25	1,394	0.128
Sep	-28	44	6,175	0.516
Oct	-5	20	821	0.154
Nov	0	24	1,569	0.096
Dec	-8	29	1,688	0.226
Average	**-4**	**28**	**2,095**	**0.244**

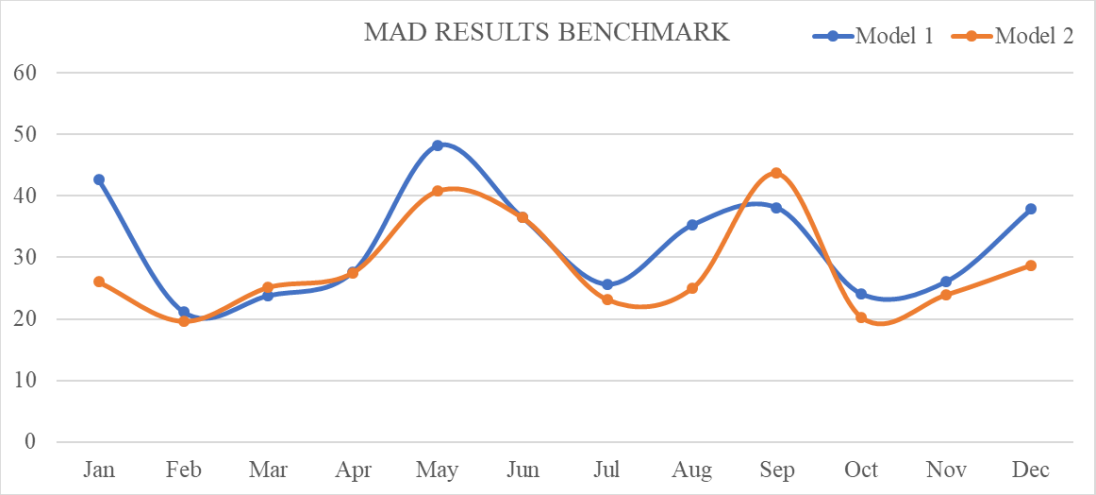

Figure 23. Benchmark of the two models based on MAD results

5.1.1.3 Implementation of the daily forecasting model in the DSS

We implement the daily forecasting model developed in the above section for each country and for each service direction in MS Excel environment. We use MS Excel Solver to optimize the weights of the regression function. In the DSS environment we generate the forecasts for daily demands in a specific month for every selected country and service direction. The VBA code that updates the Solver parameters for each selected country and service direction is provided in Appendix D. Figure 23

presents the data sheet where weights for the daily forecasts in month March of year 3 are calculated for the selected country, Germany, and service direction, Export. The input data used and the resulting optimal weights of the forecast model are highlighted. Figure 24 represents the MS Solver screen for objective and constraints.

Country	Germany
Service	Export

Selected Country and Service Direction

w1	39%
w2	12%
w3	40%
w4	9%
Total	100%
MAD	7

Solver Solution for Weights to get the lowest MAD Value

Minimized MAD Value by Solver

			ACTUAL VOLUME																Monthly	Daily Forecast							
			28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag				Company		Normali		Actual		Abs	Squared	Abs
Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	zed	Vol	Volume	Error	Error	Error	Percent Error
Y 3	Mar	1	Y 3	Feb	1	5%	Y 3	Jan	4	4%	Y 2	Mar	2	5%	Y 1	Mar	4	4%	1.415	5%	4%	62	63	1	1	1	0,014
Y 3	Mar	2	Y 3	Feb	2	4%	Y 3	Jan	5	4%	Y 2	Mar	3	3%	Y 1	Mar	5	4%	1.415	4%	4%	51	42	-8	8	68	-0,194
Y 3	Mar	3	Y 3	Feb	3	5%	Y 3	Jan	6	6%	Y 2	Mar	4	5%	Y 1	Mar	6	5%	1.415	5%	5%	67	71	5	5	21	0,064
Y 3	Mar	4	Y 3	Feb	4	3%	Y 3	Jan	7	1%	Y 2	Mar	5	2%	Y 1	Mar	7	3%	1.415	2%	2%	31	44	13	13	163	0,292
Y 3	Mar	5	Y 3	Feb	5	0%	Y 3	Jan	8	0%	Y 2	Mar	6	0%	Y 1	Mar	8	0%	1.415	0%	0%	1	2	1	1	2	0,663
Y 3	Mar	6	Y 3	Feb	6	3%	Y 3	Jan	9	4%	Y 2	Mar	7	3%	Y 1	Mar	9	3%	1.415	3%	3%	41	42	1	1	1	0,028
Y 3	Mar	7	Y 3	Feb	7	4%	Y 3	Jan	10	2%	Y 2	Mar	8	3%	Y 1	Mar	10	5%	1.415	3%	3%	45	57	11	11	131	0,202
Y 3	Mar	8	Y 3	Feb	8	4%	Y 3	Jan	11	4%	Y 2	Mar	9	5%	Y 1	Mar	11	4%	1.415	4%	4%	56	69	13	13	171	0,190
Y 3	Mar	9	Y 3	Feb	9	5%	Y 3	Jan	12	6%	Y 2	Mar	10	3%	Y 1	Mar	12	4%	1.415	4%	4%	56	56	0	0	0	0,000
Y 3	Mar	10	Y 3	Feb	10	7%	Y 3	Jan	13	6%	Y 2	Mar	11	4%	Y 1	Mar	13	4%	1.415	6%	5%	74	74	0	0	0	0,000
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Y 3	Mar	30	Y 3	Mar	2	3%	Y 3	Feb	2	4%	Y 2	Mar	31	4%	Y 1	Apr	2	4%	1.415	4%	3%	48	41	-7	7	46	-0,164
Y 3	Mar	31	Y 3	Mar	3	5%	Y 3	Feb	3	5%	Y 2	Apr	1	5%	Y 1	Apr	3	5%	1.415	5%	5%	64	79	15	15	228	0,191
																			MONTH TOTAL					BIAS	MAD	MSE	MAPE
																			1.415	104%	100%	1.415	1.514	3	7	78	0,129

Figure 24. Solver optimization and parameters

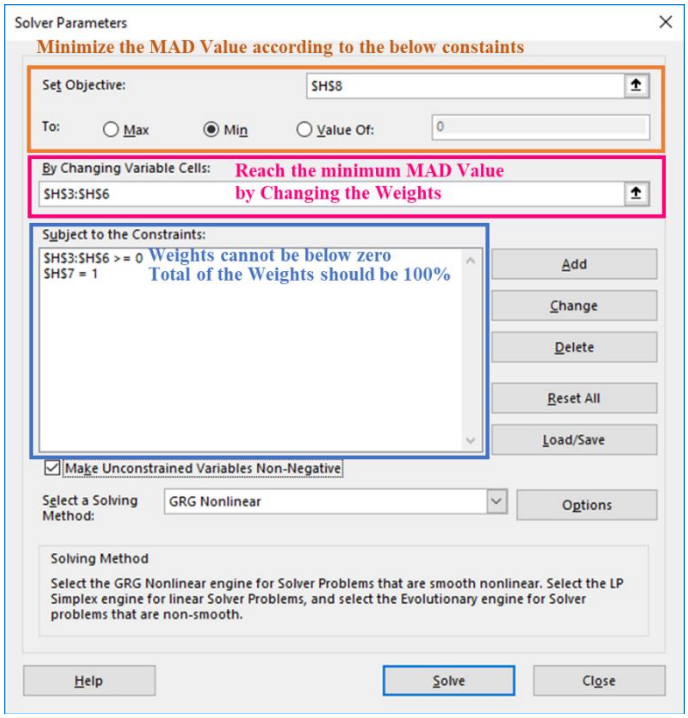

Figure 25. Solver objective and constraints

The DSS is designed to include the top 17 countries which cover 97% of the total volume of transportation. The daily forecasts generated by these weights are provided in Appendix E for each country in the selected month March in year 3.

5.1.2 The Heuristic model to match empty trailers with demand

Given the daily forecasts obtained in the above section for each country and service direction, now we develop a heuristic model to allocate the empty trailers and outsourced trailers so that the total costs are minimized. The generated model is a centralized approach that considers transportations in all countries and service directions.

5.1.2.1 Development of the heuristic model

To generate a centralized model of all transportations we need the following input parameters of the company for i) unit cost per kilometer of a single empty run between countries, ii) cost of transporting a trailer from country *i* to country *j* by an owned trailer, and iii) cost of transporting a trailer from country *i* to country *j* by an outsourced trailer. The above parameters obtained manually from the operations department of the company.

We obtain some input parameters from the database of the company. These are the live locations of each trailer, status of each trailer being empty or loaded, and the destination location and estimated arrival time for unloading of each loaded trailer. It is assumed that the status of loaded trailer becomes empty on the next day of their estimated time for unloading.

Furthermore, we need the distance matrix showing the distances between country *i* and country *j*, *i*, *j*=1, 2, …, 17. We obtain these parameters by building a

separate VBA code which uses Google Map API to connect to the Google Maps (see Appendix F for VBA code).

We build a VBA code to find the match between forecasted daily demands and empty trailers by using the input parameters described above (see Appendix G for the VBA code).

The Heuristic Algorithm

The process map of the proposed logistic planning system is provided in Figure 25. The central planning department gets the daily empty trailer demand of the current country which is selected from the list of countries, sorted in descending order of their monthly volumes. Then it is checked if daily demand can be fully satisfied with the empty trailers in the current country. If there remain unfulfilled demands, first the feasible countries from which an empty trailer can be shipped in one day are identified. Next, the feasible countries are filtered to see if the cost of sending an empty trailer from a feasible country to the current country and then using the loaded trailer until the final destination is less than the cost of using an outsourced trailer until the final destination.

Transferring empty trailers from a nearby country is not straightforward; a control is needed to make sure that the feasible country does not encounter any shortages if it transfers some of its empty trailers to the current country. Hence the number of empty trailers to be transferred to the current country is determined so that the feasible country does not encounter any trailer shortages in the current day and next days during which it can transfer empty trailers from its nearby countries. This procedure is repeated until the trailer demand is fully satisfied at the current country. In case, it is not possible to fulfill the whole requirements by making empty transfers

from the feasible nearby countries, the order is fulfilled by outsourcing trailers in the current country. The resulting logistic operations plan is updated every day on a rolling horizon basis.

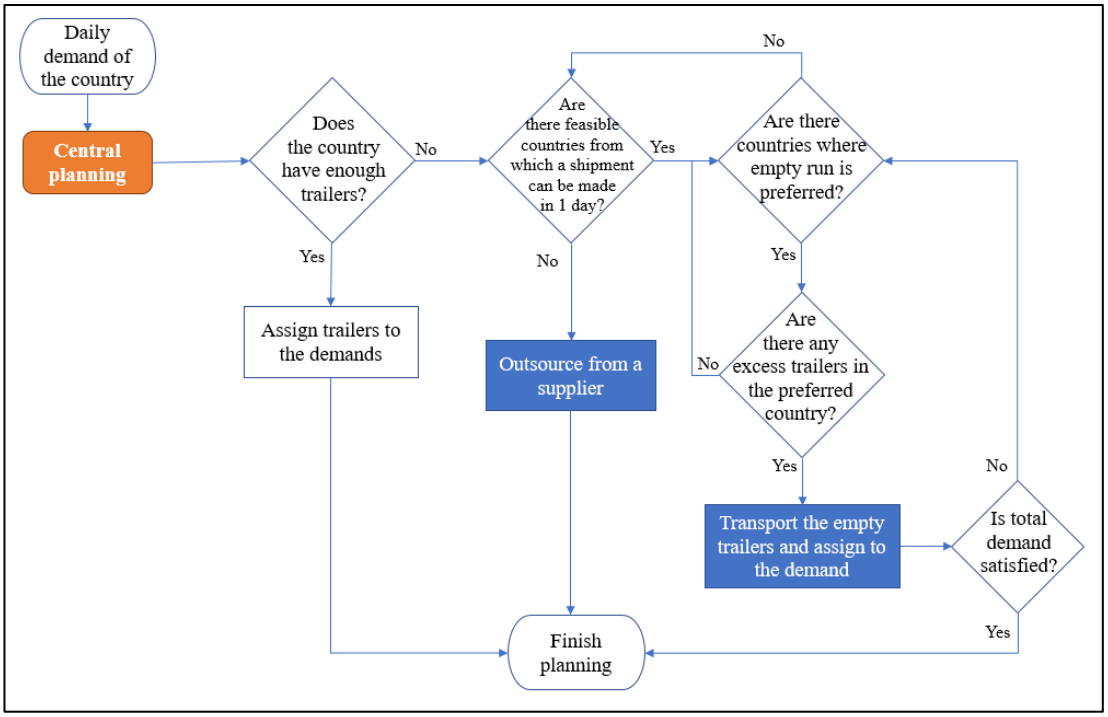

Figure 26. Process flow of the heuristic model

Now the heuristic algorithm is explained on a sample scenario. We start by sorting the countries according to their monthly total volumes in descending order. Germany is usually the first country in the list since it holds the largest proportion of total transportation of the company. In the morning of the first day of March, Germany has 90 empty trailers which are ready to load goods to Turkey as can be followed in Figure 26. There are 39 trailers in Germany that were unloaded in the previous day and going to be available for loading today. These are referred as 'to be empty trailers'. So, the total number of empty trailers in Germany is 90+39=129. The demand forecast for today from Germany to Turkey is 86 trailers. At the end of day one, daily demand of 86 is fully satisfied and the empty trailer stock level in Germany is going to be 43 which can be used to satisfy the demand tomorrow. Note

that, since the end of day stock level is positive there is no need to transport any trailer to Germany from a nearby country or to outsource any trailers from suppliers to satisfy the demand of current day.

Days of March	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Germany																
Empty Trailers	90	43	123	228	295	307	585	626	600	562	593	651	610	569	543	490
To Be Empty Trailers	39	157	114	67	75	362	128	75	60	43	58	43	55	80	46	4
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	86	77	9	0	63	84	87	101	98	12	0	84	96	106	99	94
Emptyrun to Other Countries																
End of Day Stock	43	123	228	295	307	585	626	600	562	593	651	610	569	543	490	400
France																
Empty Trailers	44	33	93	128	154	158	215	238	234	236	260	280	286	301	308	288
To Be Empty Trailers	12	76	39	26	17	75	48	25	20	28	20	26	37	33	13	1
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	23	16	4	0	13	18	25	29	18	4	0	20	22	26	33	17
Emptyrun to Other Countries																
End of Day Stock	33	93	128	154	158	215	238	234	236	260	280	286	301	308	288	272
Italy																
Empty Trailers	8	0	41	73	94	103	128	138	142	142	159	176	188	185	175	165
To Be Empty Trailers	5	57	33	21	19	35	19	19	20	18	17	20	11	1	5	11
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	13	16	1	0	10	10	9	15	20	1	0	8	14	11	15	19
Emptyrun to Other Countries																
End of Day Stock	0	41	73	94	103	128	138	142	142	159	176	188	185	175	165	157
Poland																
Empty Trailers	14	3	37	62	75	72	79	85	79	70	84	96	98	84	82	71
To Be Empty Trailers	8	48	26	13	12	24	26	18	6	15	12	14	7	16	7	1
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	19	14	1	0	15	17	20	24	15	1	0	12	21	18	18	18
Emptyrun to Other Countries																
End of Day Stock	3	37	62	75	72	79	85	79	70	84	96	98	84	82	71	54
England																
Empty Trailers	0	-9	-5	0	4	6	33	55	73	87	86	91	90	94	102	110
To Be Empty Trailers	0	13	9	5	8	31	33	26	23	3	7	9	12	18	16	13
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	9	9	4	1	6	4	11	8	9	4	2	10	8	10	8	7
Emptyrun to Other Countries																
End of Day Stock	-9	-5	0	4	6	33	55	73	87	86	91	90	94	102	110	116
Belgium																
Empty Trailers	12	-3	-8	0	7	-4	-10	-12	-18	-31	-30	-26	-39	-50	-53	-64
To Be Empty Trailers	4	6	10	7	9	10	13	11	4	5	4	10	6	17	4	1
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	19	11	2	0	20	16	15	17	17	4	0	23	17	20	15	20
Emptyrun to Other Countries																
End of Day Stock	-3	-8	0	7	-4	-10	-12	-18	-31	-30	-26	-39	-50	-53	-64	-83
Netherlands																
Empty Trailers	6	10	5	6	6	5	6	6	1	-3	-4	0	-3	-3	-2	-3
To Be Empty Trailers	7	3	6	5	4	9	6	3	4	3	4	5	6	5	5	4
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	3	8	5	5	5	8	6	8	8	4	0	8	6	4	6	5
Emptyrun to Other Countries																
End of Day Stock	10	5	6	6	5	6	6	1	-3	-4	0	-3	-3	-2	-3	-4

Figure 27. Logistic operations plan

Each country in the sorted list of descending total volume is evaluated consecutively by controlling their end of day stock level for the first day of March. As seen on Figure 26, France, Italy, and Poland have positive end of day stock levels but England is lacking trailers. It has a daily demand forecast of nine trailers however it has no empty or to be empty trailers. There are two ways to satisfy this unsatisfied demand in England. We can transport any owned trailers from another country or we can outsource these transportations from a supplier.

We first check if we have available owned trailers in another country that can be transported to England today. To evaluate this option, we need to generate a list which shows the empty run costs for one trailer and transit times between the countries.

The list for England is prepared and sorted in ascending order of total empty cost for one trailer that appears in the fifth column of Figure 27. Also, it shows the transit times between countries in the fourth column.

Departure	Arrival	Distance (km)	Duration (days)	Empty Transfer Cost (€/trailer)	Loaded Transfer Cost (€/trailer)	Rental Cost (€)	Status
Belgium	England	400	1	440	440		Ok
Netherlands	England	520	1	572	572		Ok
France	England	973	1	1.070	1.070		Ok
Germany	England	1.020	2	1.122	1.122		Not Ok
Switzerland	England	1.192	3	1.311	1.311		Not Ok
Czechia	England	1.514	4	1.665	1.665		Not Ok
Austria	England	1.526	4	1.679	1.679		Not Ok
Poland	England	1.639	4	1.803	1.803		Not Ok
Slovenia	England	1.747	4	1.922	1.922		Not Ok
England	Turkey	440	12	1.922	2.172	4.284	Not Ok
Spain	England	1.866	4	2.053	2.053		Not Ok
Hungary	England	1.916	4	2.108	2.108		Not Ok
Slovakia	England	1.970	4	2.167	2.167		Not Ok
Italy	England	2.017	5	2.219	2.219		Not Ok
Sweden	England	2.144	5	2.358	2.358		Not Ok
Romania	England	2.507	6	2.758	2.758		Not Ok
Greece	England	3.112	7	3.423	3.423		Not Ok

Figure 28. Empty run costs to England from other countries

For instance, we can transport an empty trailer from Belgium to England in one day as seen on the forth column and this makes Belgium a feasible country in terms of transit time.

Then it should be controlled whether Belgium is a preferred country in terms of cost. Transporting an empty trailer from Belgium to England costs 440€. Loading a trailer from England and transporting it to Turkey costs 2,172€ as seen on the 'Loaded Cost' column. So, the total transportation cost in the Belgium-England-Turkey route will be 2,612€ with an owned trailer.

Alternatively, outsourcing a trailer from a supplier to transport from England to Turkey costs 4,284€ as given in Figure 27. Since the total transportation cost of an owned trailer from Belgium is smaller than the cost of an outsourced trailer from England to Turkey, it is more favorable to use owned trailer. So, Belgium is marked as "Ok" in the status column because it is feasible in terms of transit time and a preferred country in terms of cost.

All the countries in the list of Figure 27 are evaluated in the same way. The countries that are both feasible in terms of transit time and preferred in terms of cost are marked as "Ok" in the status column. In the sample scenario, there are three countries in the list which are marked as "Ok"; Belgium, the Netherlands, and France. Next, we need to make a second feasibility check to see if the number of available trailers in these countries is enough to satisfy the demand in England. Hence, starting from Belgium which has the least empty run cost, we need to check if there are excess trailers.

Accordingly, we need to check the feasibility of transporting nine empty trailers from Belgium in one day. We see in Figure 26 that the end of day stock in Belgium is -3 showing that there are no available trailers in Belgium in the current day. So, Belgium is not an option.

Similarly, the Netherlands has end of day stock of 10 empty trailers (see Figure 26) which is enough to fulfill the demand of England.

However, if we transport nine trailers from the Netherlands to England then the Netherlands may end up with negative end of day stocks in the next days. Hence it will need to transport empty trailers from other countries or it will outsource its transportation from suppliers to fulfill the daily transportation demand from the Netherlands to other countries. This will not only increase the complexity of the solution but may also increase the total costs of transportation from all countries. For this reason, we provide the following assumption in the algorithm.

Assumption: An empty trailer can be transported from a country if that country will not face a trailer stock out for the number of days during which it can ask for new empty trailers from a nearby country.

Accordingly, empty trailers can be transported from the Netherlands to England if this does not cause any trailer stock outs in the Netherlands in the next three days, which is the average transportation time to the Netherlands from nearby countries like Germany, Belgium, Luxemburg, and France. With this approach, we check the end of day stock of the Netherlands for today and the upcoming three days. The least end of day stock in the next three days is five. This means if we transport five trailers from the Netherlands to England, it does not create a stock out of empty trailers in the Netherlands neither today nor in the next three days. So, these five trailers are transferred to England.

Next, we should find four more trailers from the last country, France. The average transportation time from nearby countries to France is four days. Since France has 33 empty trailers (see Figure 26), it can fulfill the remaining trailer requirement of England without having stock outs in the next four days after today. So, four trailers are transported from France to England. Hence, the total demand of

England is totally satisfied by making five empty-runs from the Netherlands and four empty-runs from France.

The next country with the negative end of day stock level is Belgium in Figure 26. Belgium needs three trailers. It is evaluated in the same way with England. The feasible countries in terms of transit time and also preferred countries in terms of cost for Belgium are the Netherlands, England, and Germany sorted in ascending order of their costs. Netherlands and England already have insufficient trailers. But Germany can supply all three trailers since it has plenty of trailer stock in hand.

The updated logistic operations plan is provided in Figure 28 and it is implemented for the first day of March. The resulting logistic operations plan is updated every day on a rolling horizon basis. End of day stocks of countries is used to plan the operations in the next day.

This procedure is repeated for all countries listed in the descending order of their total monthly volumes. Let us note here that changing the evaluation order of the countries may affect the resulting logistic plan. So, when this problem is solved optimally the solution might be different than the heuristic solution. However, we show in the rest of thesis that we obtain substantial cost savings with the heuristic algorithm.

The above heuristic algorithm is coded in VBA. The related lines of code as well as their explanations are provided in Appendix G.

Days of March	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Germany																
Empty Trailers	90	40	120	225	292	304	582	623	597	559	590	648	607	566	540	487
To Be Empty Trailers	39	157	114	67	75	362	128	75	60	43	58	43	55	80	46	4
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	86	77	9	0	63	84	87	101	98	12	0	84	96	106	99	94
Emptyrun to Other Countries	3	3 Trailers sent to Belgium														
End of Day Stock	40	120	225	292	304	582	623	597	559	590	648	607	566	540	487	397
France																
Empty Trailers	44	29	89	124	150	154	211	234	230	232	256	276	282	297	304	284
To Be Empty Trailers	12	76	39	26	17	75	48	25	20	28	20	26	37	33	13	1
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	23	16	4	0	13	18	25	29	18	4	0	20	22	26	33	17
Emptyrun to Other Countries	4	4 Trailers sent to England														
End of Day Stock	29	89	124	150	154	211	234	230	232	256	276	282	297	304	284	268
Italy																
Empty Trailers	8	0	41	73	94	103	128	138	142	142	159	176	188	185	175	165
To Be Empty Trailers	5	57	33	21	19	35	19	19	20	18	17	20	11	1	5	11
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	13	16	1	0	10	10	9	15	20	1	0	8	14	11	15	19
Emptyrun to Other Countries																
End of Day Stock	0	41	73	94	103	128	138	142	142	159	176	188	185	175	165	157
Poland																
Empty Trailers	14	3	37	62	75	72	79	85	79	70	84	96	98	84	82	71
To Be Empty Trailers	8	48	26	13	12	24	26	18	6	15	12	14	7	16	7	1
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	19	14	1	0	15	17	20	24	15	1	0	12	21	18	18	18
Emptyrun to Other Countries																
End of Day Stock	3	37	62	75	72	79	85	79	70	84	96	98	84	82	71	54
England																
Empty Trailers	0	0	4	9	13	15	42	64	82	96	95	100	99	103	111	119
To Be Empty Trailers	0	13	9	5	8	31	33	26	23	3	7	9	12	18	16	13
Emptyrun From Other Countries	9	5 Trailers from the Netherlands and 4 Trailers from France														
Outsourced Trailers																
Demand Forecast	9	9	4	1	6	4	11	8	9	4	2	10	8	10	8	7
Emptyrun to Other Countries																
End of Day Stock	0	4	9	13	15	42	64	82	96	95	100	99	103	111	119	125
Belgium																
Empty Trailers	12	0	-5	3	10	-1	-7	-9	-15	-28	-27	-23	-36	-47	-50	-61
To Be Empty Trailers	4	6	10	7	9	10	13	11	4	5	4	10	6	17	4	1
Emptyrun From Other Countries	3	3 Trailers from Germany														
Outsourced Trailers																
Demand Forecast	19	11	2	0	20	16	15	17	17	4	0	23	17	20	15	20
Emptyrun to Other Countries																
End of Day Stock	0	-5	3	10	-1	-7	-9	-15	-28	-27	-23	-36	-47	-50	-61	-80
Netherlands																
Empty Trailers	6	5	0	1	1	0	1	1	-4	-8	-9	-5	-8	-8	-7	-8
To Be Empty Trailers	7	5	6	5	4	9	6	3	4	3	4	5	6	5	5	4
Emptyrun From Other Countries																
Outsourced Trailers																
Demand Forecast	3	8	5	5	5	8	6	8	8	4	0	8	6	4	6	5
Emptyrun to Other Countries	5	5 Trailers sent to England														
End of Day Stock	5	0	1	1	0	1	1	-4	-8	-9	-5	-8	-8	-7	-8	-9

Figure 29. Logistic operations plan (after the first day cycle)

5.1.2.2 Implementation of the heuristic model in the DSS

The suggested model is run every day by considering every day's actual empty trailers data. This plan is called "The Proposed Plan" since it includes the daily demand forecast that we developed. During application, the first day plan is implemented and the proposed model is updated the next day before application. An implementation of proposed plan for March can be followed in Appendix H for all countries.

Figure 29 shows the cost comparison between the proposed plan implementation and the actual results in March. It can be seen that in the proposed plan, the number of empty runs and outsourced trailers are decreased. The related costs for empty runs and outsourced trailers are decreased by 81% and 37% which further leads to 39% decrease in the total cost.

MARCH	ACTUAL			PROPOSED PLAN		
	Empty Run	Outsourced	Total	Empty Run	Outsourced	Total
Unit	331	1,477	1,808	97	914	1,011
Cost (€)	228,404 €	3,571,682 €	3,800,086 €	42,488 €	2,263,631 €	2,306,119 €
Cost Improvement				**81%**	**37%**	**39%**

Figure 30. Actual vs developed model results for March

Next, we repeat the comparison analysis for April. Figure 30 shows the compared number of trailers and cost results. In the proposed plan, the related costs for empty runs and outsourced trailers are decreased by 88% and 53% which further leads to 58% decrease in the total cost.

APRIL	ACTUAL			PROPOSED PLAN		
	Empty Run	Outsourced	Total	Empty Run	Outsourced	Total
Unit	470	1,238	1,708	125	611	736
Cost (€)	480,687 €	3,000,093 €	3,480,780 €	57,294 €	1,413,044 €	1,470,338 €
Cost Improvement				**88%**	**53%**	**58%**

Figure 31. Actual vs developed model results for April

5.2 Data source structure of the DSS

The generated DSS extracts data from various sources. Figure 31 represents the basic data connections of the DSS.

Daily actual volume per country and per service direction data is in a restricted area in the company's database management system and it is not allowed to be integrated to our DSS. So, the DSS user extracts the daily actual volume per country and per service direction from the Company's transaction management system every day and saves them into an MS Excel file. This file is uploaded to the DSS every time the logistic forecasting system is run.

Monthly volume forecasts per country and per service direction are built and archived in MS Excel and it is not kept in the company's database. This file also is uploaded to the DSS every time the logistic forecasting system is run.

The upload screen for these two files will be further explained in the next subsection.

Unit costs for train and roro transportation are the parameters that are not kept in the company's database. We provided a cost data entry screen in the DSS to gather these data from the DSS users, which will be further explained in the next subsection.

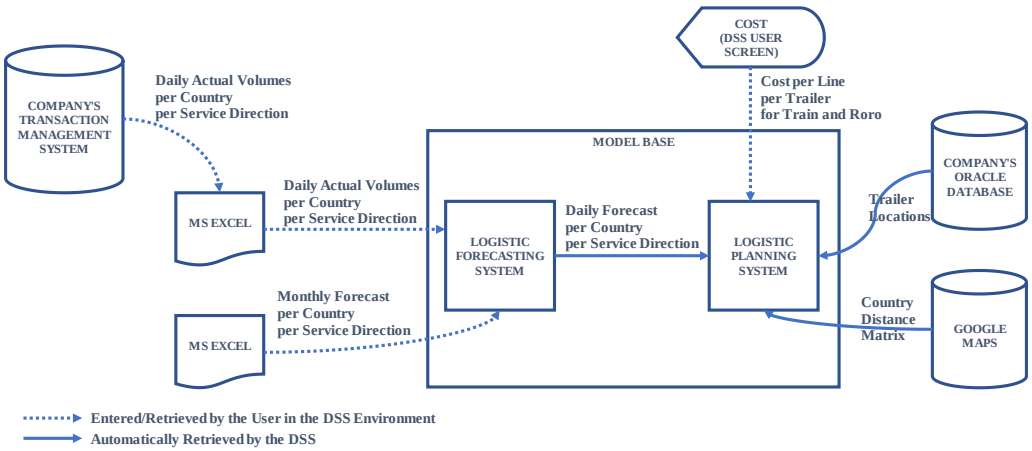

Figure 32. Data sources of the generated DSS

We get the live locations of the empty trailers in each country by building an external connection to the related table on the Oracle Database of the Company. Figure 32 shows the connection properties of this connection. This connection retrieves the current locations every time the Logistic Planning System of the DSS is run.

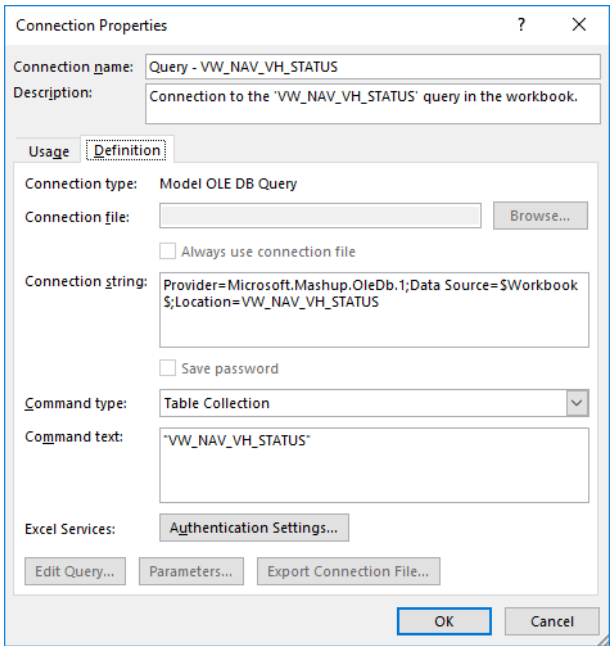

Figure 33. External connection properties to related table in the Oracle database of the company

To find the distances between each country we build a code that gets the distances from Google Maps by using its API. The related VBA code is provided in Appendix F. The code should be run if a new country is added to the company's current network.

5.3 User interface design

We designed user interfaces for two user roles, i) the Logistic Forecasting Team and ii) the Logistic Planning Team. The logistic forecasting team is responsible for running the Logistic Forecasting System, while the logistic planning team are the

users of the Logistic Planning System. Everyone in these roles enters the system with a user name and password (see Figure 33). Users are able to choose their names from the combo box in the ‘User Name’ field and enter their user specific password to the ‘Password’ field. While they enter their user names and passwords they may choose to skip the instructions about the screen they are directed by selecting the “Skip Instructions” option on the page. Instructions are the explanations for the users about how they should use the screen they are directed (see Figure 34 for the instructions for the Logistic Forecasting Team screen). We suggest users to take a look to these instructions in a couple of month until they get used to the DSS. By clicking the “Info” button they can view a brief information about the DSS (see Figure 35) or close the DSS via exit button. After a user enters his/her user name and password and click the ‘Login’ button, he/she will be directed to a screen related with his/her role. It is not allowed users to switch a screen which is not related with their role.

Figure 34. User log on screen to the proposed DSS model

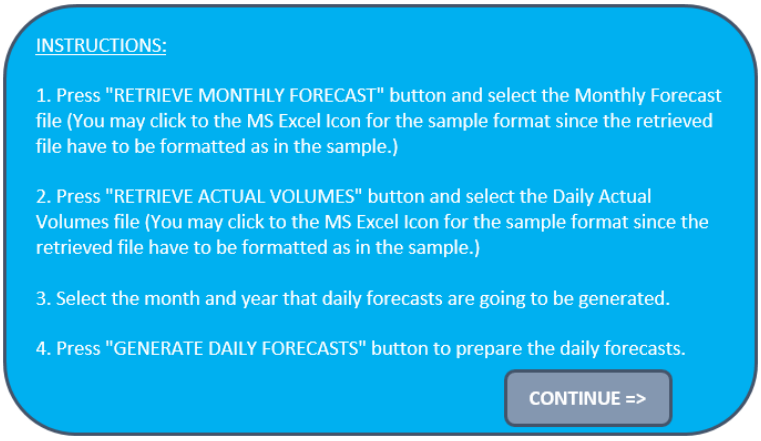

Figure 35. Instructions for the logistic forecasting team role

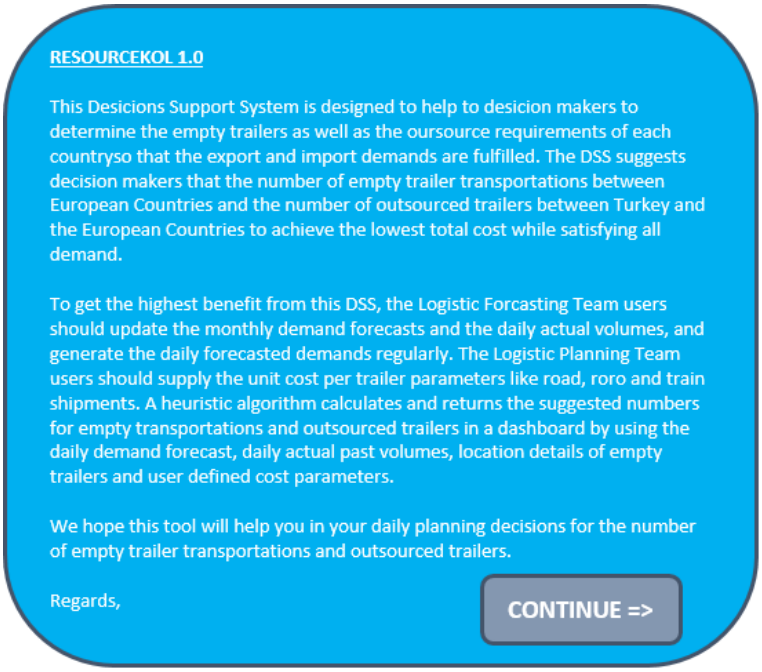

Figure 36. Info button detail

The Logistic Forecasting Team users are two employees from the information systems department of the company. They collect the monthly demand forecasts from the sales team and prepare the daily forecast reports for the top management based on the actual volume data. In our proposed DSS environment their roles are to upload the monthly demand forecast per country and per service direction and the daily actual volumes per country per service direction in MS Excel file format to the proposed DSS. Additionally, they have the responsibility to generate the daily forecasts in the DSS and to make updates such as adding a new country in the Excel

file of the DSS, since they have highly experienced in forecasting and MS Excel applications.

Figure 36 shows the Logistic Forecasting System screen. An authorized user may load the file for the monthly forecasts per country per service direction to the DSS in MS Excel by clicking the 'Retrieve Monthly Forecasts' button. A sample format of the file that is going to be uploaded can be seen by clicking on the MS Excel icon beneath the 'Retrieve Monthly Forecasts' button. The monthly forecast file must be formatted precisely as on the sample format.

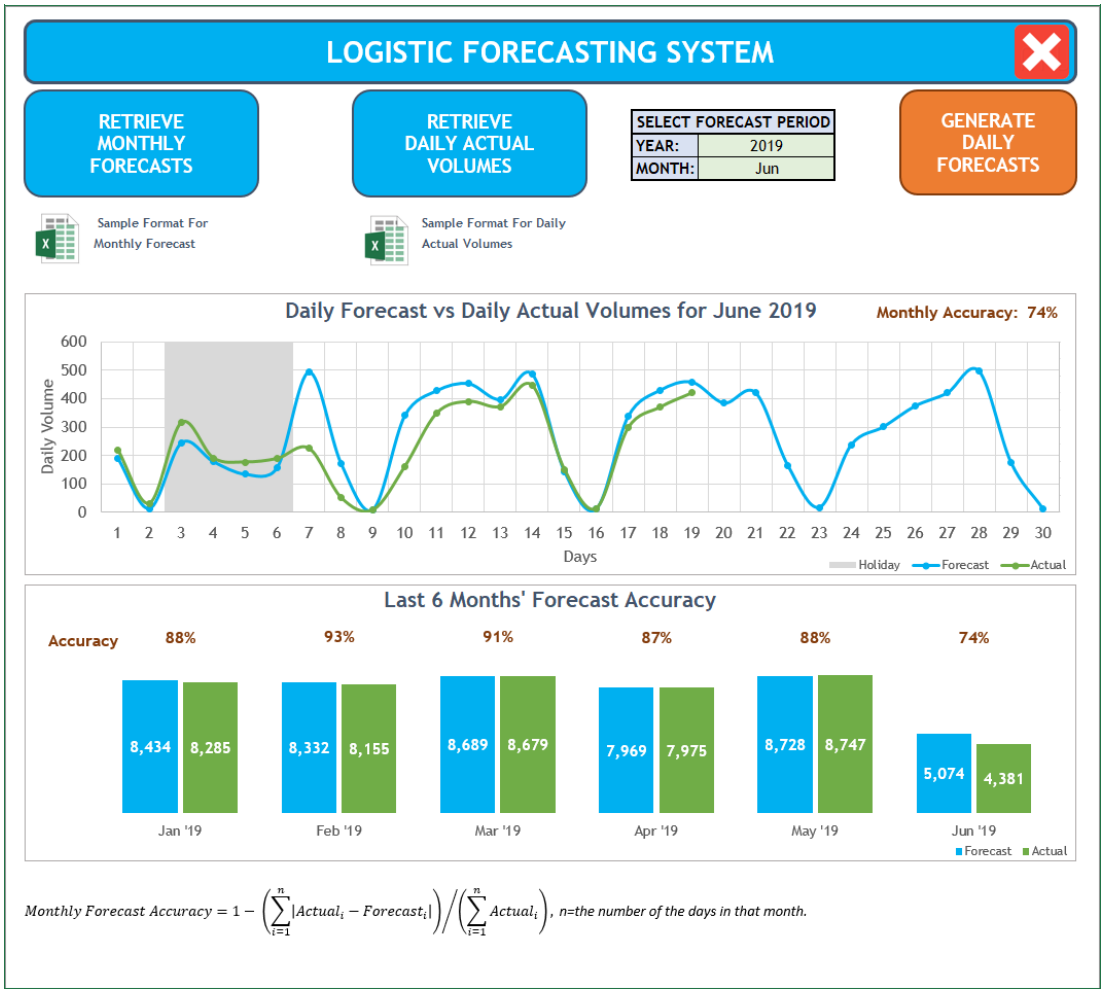

Figure 37. Logistic forecasting system screen

The authorized user may also load the daily actual volumes per country and per service direction to DSS in MS Excel by clicking the 'Retrieve Actual Volumes'

button. A sample format of the file that is going to be uploaded can also be seen by clicking the MS Excel icon beneath the ‘Retrieve Actual Volumes’ button. The daily actual volumes file must be formatted precisely as on the sample format.

Via the ‘Generate Daily Forecasts’ button, the authorized user generates the daily forecasts after selecting the year and month from the combo boxes.

According to the year and month choices, users can follow the daily forecasted and actual volumes as plotted in a chart in the middle of the screen. The chart on the bottom of the screen shows the monthly aggregated forecasts and the actual volumes for all countries and for all service directions as well as the forecast accuracies for the last six months. So, the users are able to track the forecast accuracy in daily and monthly bases and figure out whether the forecasts are accurate enough or they should update the forecasts with the sales team. The monthly forecast accuracy equation is represented at the bottom of the screen.

Logistic Planning Team users are the employees of the central planning department. Their responsibilities in the proposed DSS are i) to manage the cost related parameters such as unit costs per trailer for train or roro, and the unit cost per km for road transportations, ii) generate and manage the action plans for empty runs and outsourcing, iii) announce these plans to the related staff in tradeline planning, supplier relations and performance management.

Logistic Planning Team users also need to enter the system with their user name and user specific password. Figure 37 shows the Logistic Planning System screen. On the upper left side of the page, user may redefine the unit costs for train, roro, and road. User may reset the values to their default values by pressing ‘Reset Values’ button or may replace the default values with the new values entered by pressing ‘Save Values’ button. Then the user should press the ‘Generate Logistic

Plan' button to run the developed heuristic model and obtain the total costs of the proposed plan as tabulated in Figure 37. On the right side of the panel, a map of Europe is placed where the user can follow the total number of empty trailers and the demand forecasts in each country on the analysis date. Here the total number of empty trailers is calculated as the sum of the empty trailers and to-be-empty trailers. On the bottom of the screen, user may select a country to see its logistic operations plan for the next 15 days. The logistic operations plan includes the number of empty runs and outsourced trailers, as well as the direction of their movements. Finally, the user can also see the destinations and the source locations of empty trailer movements.

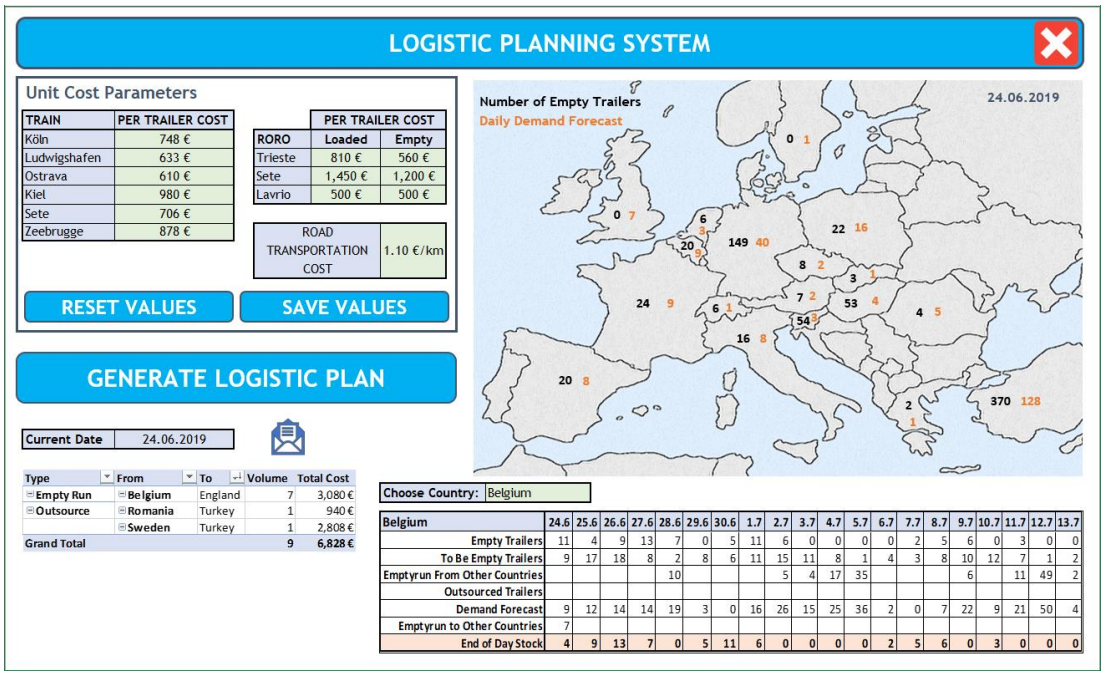

Figure 38. Logistic planning screen

The table on the bottom left of Figure 37 shows the details of the empty runs and outsourced trailers in the current day. It follows that there are seven empty runs from Belgium to other countries. We can see that all these seven empty trailers are planned to be transported from Belgium to England. The table also shows the

outsourcing plan in the current day. It follows that two trailers are needed to be outsourced, one from Romania and the other from Sweden to Turkey.

After the logistic plan is generated, the user can distribute this plan to the related employees in various departments including tradeline planning, supplier relations, central planning and performance management by pressing the electronic mail icon.

CHAPTER 6

EVALUATION OF THE DSS ENVIRONMENT

6.1 Results

The DSS environment contributes both to the logistic operations processes and to the logistic planning processes by increasing their effectiveness, efficiency, and flexibility.

The logistic operations processes use resources like trailers, man-hours, locations, and cash. Scenario analysis in section 5.1.2.2 shows that we are able to reduce the total number of empty-runs and the number of outsources trailers that further decrease the total transportation cost by at least 40%. So, our DSS improves the efficiency of the logistic operations process by better use of the resources and decreased costs.

The planning process of these logistic operations are carried out by the regional planning staff. The output of the planning process is a logistic operations plan which constitutes an input for the logistic operations processes that come after. Using the DSS environment, the logistic planning process which usually takes four hours is shortened significantly, resulting in increased efficiency in the planning processes. Moreover, the proposed DSS model provides the number and the allocation of empty-runs and outsourced trailers not for a single region, but for all regions that the company operates in. This brings the company the opportunity to see the big picture of its logistic operations. So, better planning decreases the costs, resulting in a more effective planning output. Hence, we suggest that the new model should be used by the central planning unit, not by the regional planning staff. Indeed, this further provides opportunities for the regional planning staff to be

employed in areas where they can be more productive, increasing the efficiency of the planning processes and the effectiveness of related processes.

Noting that the overall effectiveness and efficiency of the logistic planning process and logistic operations process are increased, the proposed DSS, contributes to the total productivity of these processes. The implications of the increased productivity are certainly realized in increased profits and customer satisfaction.

Despite its several benefits mentioned above, the DSS has some improvement areas. The current DSS connects to the database and retrieves the updated data for locations of trailers every time the proposed model is run. The user can manage and view the resulting train and roro costs of each transportation line. However, the updates for the input parameters such as the unit transportation costs of train, roro, or the monthly volume forecasts are obtained from the sales department are entered to the DSS manually by the user. This lack of integration leads to lower efficiency in logistic planning processes. As the company place these data on their information system available for other applications, a fully integrated DSS can be generated in the future.

6.2 Assessment of the DSS by the users

It is not very easy to control a fleet over 4,500 trailers and about 10,000 movements in a month without the use of a computer aided system. The company in this study struggles with this situation very deeply. Even though load planning and vehicle planning needs different expertise, these two are now handled by the same planning staff in the company. While load planning deals with single orders and their assignments to the trailers, vehicle planning is concerned with the transportation operations of the trailers independent of the loads inside the trailer. So, these two

have different and sometimes conflicting performance goals. Additionally, as mentioned above, since each region is managed by separate departments, inherently they have different departmental goals. When having different personal and departmental performance targets, the silo effect, which refers to the lack of communication and cross-departmental support, is inevitable.

With the proposed DSS, the current planning staff can concentrate totally on the loading planning since the empty run and outsourcing costs will not be their responsibility anymore. So, they will only have performance targets for load planning. The proposed DSS may radically change the way the planning and operational processes for logistic are performed. Additionally, nowadays the company builds a central planning department where the logistic planning processes will be performed on the generated DSS. By doing this, issues involving multiple departments will be handled by central planning and inter-departmental conflictions will be less. This will change the organizational structure and help to overcome the silo effect.

With these motivations we now ask the potential users of the generated DSS to evaluate its planning environment. Since this is a new information system its acceptance is subject to several factors that have been studied in the literature for a long time. We review the Technology Acceptance Models (TAM) below to base the questions of our questionnaire.

Technology Acceptance Models

Earlier studies have found several factors that affect users' behavior while using new technologies such as a mobile application, a web site or a DSS (Abdullah and Ward, 2016). To identify and analyze these factors, researchers have often used

the Technology Acceptance Model (TAM) (Sumak et al., 2011, p.2068). TAM was adapted from the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1977) by Davis in 1986. Figure 38 shows the classical TAM model. This model is widely used to explain technology adoption behavior of the users. TAM assumes that there are two main perceptions of users. These are perceived ease of use (PEOU) and perceived usefulness (PU). These perceptions affect users' positive or negative attitudes towards using, behavioral intention to use and finally actual use of the new technology (Abdullah and Ward, 2016). There are also external variables. These external variables are used measure the external factors' effects on PEOU and PU.

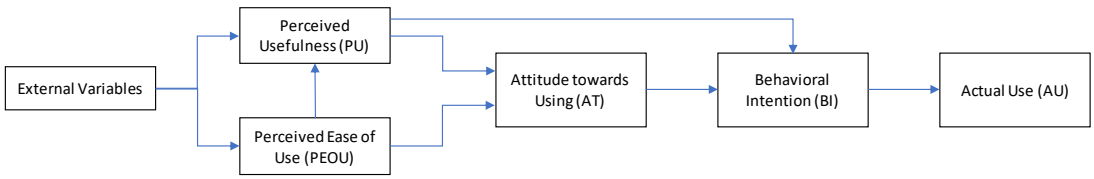

Figure 39. Technology acceptance model (Davis, 1986)

Many external factors have been studied in various research in the literature. Abdullah and Ward (2016) analyzed 107 recent research papers about e-learning acceptance or use by extending TAM with a range of external factors. They found that self-efficacy (SE) is the first most commonly used external factor. It was used in 51 studies and 45 of them had confirmed its relationship with the TAM. Hosseini et al. (2014) also reported that SE was an important external factor in influencing knowledge sharing in e-learning systems. Additionally Chow et al. (2012) reported that computer self-efficacy (CSE) is affecting the decision of the users to use a new learning system. Various studies which are the examples of SE in TAM models reported the positive results (Chen & Tseng, 2012; Holden & Rada, 2011; van Dinther et al., 2013; Yuen & Ma, 2008).

SE refers to an individual's judgment of his or her own capability to perform a specific task (Bandura, 1982, p.391). In context of computer usage, CSE is defined as one's belief about his/her ability to accomplish a particular task using a computer (Shen & Eder, 2009, p.226; Strong et al., 2006, p.105). CSE can affect people's behavioral intentions to use computers, because people who consider computers too complex and believe that they do not have the ability to use computers will avoid them (Igbaria & Iivari, 1995, p.590). In contrast, “the higher the individual's CSE, the higher his/her use of computers” (Compeau & Higgins, 1995, p.196). Higher SE leads to easier use and lower resistance while using a computer or an application. (Balapour et al., 2019).

We also analyzed ten studies between 2015 and 2019 that used extended TAM models. Six of them studied the impact of SE on both PEOU and PU (Abdullah and Ward, 2016, Alalwan et al., 2016, Fathema et al., 2015, Isaac et al., 2017, Prieto et al., 2016 and, Scherer et al., 2019) while three of them studied the impact of SE only on PEOU (Öztürk et al., 2016, Prieto et al., 2017 and Zhang et al., 2017) and only one studied the impact of SE directly to intention to use (Balapour et al., 2019). Except Öztürk et al. (2016), rest of the studies found significant impact of SE on PEOU and/or PU or intention to use.

Öztürk et al. (2016) found that the confidence level of users about their capability to use mobile hotel booking technology does not affect their perception of how easy the mobile hotel booking system will be to use. This finding contradicted with the results of past studies. And they thought that this is possibly due to their sample combination. About 78% of their sample was less than 45 years old. They thought that this age group is already tech-savvy and have the knowledge and the skills in mobile hotel booking systems.

In the light of the above theoretical explanations, in our DSS assessment, we use the conceptual TAM model in Figure 39.

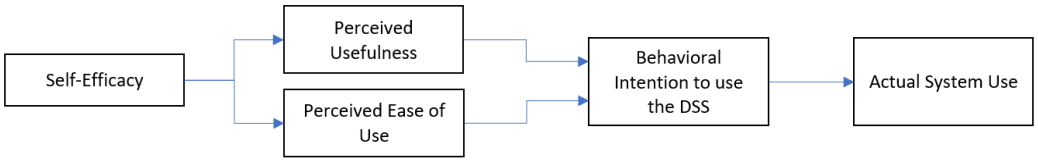

Figure 40. Conceptual model

The Questionnaire

Now we prepare a questionnaire with 40 questions to investigate the effectiveness (4 questions), efficiency (6 questions), flexibility (4 questions) of the DSS environment. We also measure the acceptance level of the DSS by its users. Based on the TAM in Figure 39, the questions are prepared for SE of the users (3 questions), PU of the DSS (3 questions), PEOU of the DSS (3 questions), users' behavioral intention (BI) to use the DSS (3 questions) and users' actual system use (3 questions). We also ask 8 questions to get the thoughts of the users for the overall assessment of the DSS. We measure all by using five-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. There are also two demographical questions, i.e., one question for the department of the users (measured by nominal scale) and one question for the age group of the users (measured by ordinal scale). The resulting questionnaire is in Appendix I.

Next, we conduct the questionnaire to 16 key personnel of the company (7 tradeline planning staff, 4 central planning staff, 1 performance management staff, 2 information systems staff and 2 supplier relations staff) who will be using the DSS in the new planning department. These respondents include senior staff as well as junior staff. Table 9 shows the classifications of the respondents by age groups. Table 10 shows the average, minimum and maximum scores of the questions that appear in the

questionnaire. The original scores are summarized in Appendix J. We notably observe that the average scores for all questions are above 4 (‘Agree’) out of 5. Only one low score 2 appears in question 28, showing that this user does not find the DSS easy to use, although his/her CSE is not low. We tend to consider this reply as an outliner, however we note its textual remarks for further improvement.

These results prove that the developed DSS meets our expectations for effectiveness, efficiency, and flexibility. It is also perceived as a useful, and easy to use system. Hence, we do not expect a resistance for acceptance among the daily users of the DSS.

Table 8. Age Groups of the Respondents in the Questionnaire

Age Group	**# of Respondents**
<30	4
31-35	6
36-40	4
41-50	2
>50	0
Total	**16**

Table 9. The Average, Minimum and Maximum Scores of the Questions in the Questionnaire

Attributes	**Average Score**	**Min**	**Max**
Effectiveness	4.36	3	5
Efficiency	4.19	3	5
Flexibility	4.31	3	5
Overall	4.42	3	5
Perceived Usefulness	4.42	3	5
Perceived Ease of Use	4.27	2	5
Self-Efficacy	4.27	3	5
Behavioral Intention to use the DSS	4.40	3	5
Actual System Use	4.33	3	5

We also receive some comments about the improvement areas of the DSS in the last question. As we expect some users criticize that the DSS is not fully integrated to the company’s information system. Furthermore, the development

environment (MS Excel) is also criticized for its low reliability and low scalability. These two criticisms are quite right. However, those cannot be improved unless they are supported by the improvements in the underlying information systems structure of the company. Hence, they are left as the improvement areas on this study. Last but not the least, one user warns about the cultural resistance in the company. Face-to-face interviews further explore cultural readiness.

Structured Interviews

We also conducted structured interviews with three selected key users from the company (see Appendix K for a full version of conducted interviews). We realize that everyone in the company is aware of the huge costs encountered by empty trailer movements and outsourcing. Most of the employees agree that this is an important problem which needs to be solved. Although they think that the problem is not an easy one to solve, they believe that it has a solution. Also, many state that the management does not very clearly announce their priorities between reducing costs and increasing customer satisfaction. Most of time an effort to lower the costs by reducing empty movements results in inferior customer satisfaction. The interviewed managers complain that whichever goal they prioritize, they are questioned about why not prioritizing the other one.

Unclear targets for the strategical goals constitute a gap in the company strategy. Obviously, one cannot expect to retain any operational or tactical success when the company strategy is unclear. We need to state that a clear strategy is a key for the success of the change management for the introduction of the DSS environment.

Finally, the interviewed managers note the difficulties of restructuring the planning team. In the proposed organization, the logistic planning processes will be managed by the central planning department that includes empty trailer movements, outsourcing strategy, roro, and train service scheduling. Several old staff will need to be reallocated in other departments. Management of this change is yet another factor in the success of the new logistic planning processes.

CHAPTER 7

CONCLUSION

In today's business world, LSP companies have to bear with high costs. Cost-driven behavior of the customers, high competition and lack of collaboration between the LSP companies can be considered as the reasons for these high costs. However, among all these reasons, imbalanced export and import transportations are the most important reasons for the LSP companies to work with high costs and low profits. Because of this imbalance, the LSP companies have to carry out more empty-run and use more outsourcing. Therefore, in this study, we develop a DSS that reduces the costs of empty transportations and outsourcing with better planning. Then, we apply this DSS in one of largest LSP companies in Turkey.

The suggested DSS includes two underlying decision models, i) Logistic Forecasting System that generates the daily demand forecast per country per service direction, ii) Logistic Planning System that prepares a transaction plan for both empty runs and outsourced trailers to achieve lower costs.

The proposed DSS is considered as a useful, easy to use, and fast running tool by the users leading to the conclusion that its acceptance is high in the LSP company.

The DSS contributes to the decision-making environment in several ways. Firstly, the number of the people involved in the logistic planning processes and the total man-hour spent on generating the plan are significantly decreased; hence the DSS improves the efficiency of the decision-making processes.

Secondly, the proposed DSS is considered as a flexible tool by the users; it allows them to easily change the unit cost parameters, or add a new country to the logistic operations. Furthermore, the users may change or update the daily forecasts

easily in case an unexpected development occurs like a significant change in the national or international economy, or a change in the international transportation agreements.

Finally, the proposed DSS significantly reduces the total number of empty runs and outsourced trailers which may lead to 40% to 60% decreases in total costs. Hence the DSS contributes to the effectiveness of the decision-making process by increasing the quality of its output. Nevertheless, the improvement of the logistic planning processes enhances the performance of the logistic operations processes that follow it. Since the application of this better logistic plan will be less costly, the efficiency of the logistic operations processes that follow the planning process will be improved as well.

In the future, the logistic forecasting system in the proposed DSS can be improved by integrating it with the company's information system, so that the monthly forecasts data and daily actual volumes data can be retrieved directly from the company's database. Moreover, the forecasting model can be enhanced to include the effects of environmental conditions like the state of the economy, or it may be updated to include important calendar events.

The logistic planning system of the DSS can also be improved. Noting that the key account customers of the company have high and more stable demands, a smart planning system can be developed to handle the logistic planning of these customers separately. Doing this would lower the complexity of the daily planning process and would decrease the human-based errors. Furthermore, it would contribute to the number of planning staff required. Another idea is to increase the validity of the logistic plan by allowing the users to change all parameters when needed, especially the outsourcing costs in different countries.

APPENDIX A

SEASONAL INDICES FOR A PREVIOUS YEAR

Month	Weekday	Total Daily Actual			Weekday Average	Daily Average	Seasonal Index
		Year 1	Year 2	Year 3			
1	Mon	764	759	1,026	850	910	0.933
1	Tue	872	1,007	1,224	1,034	910	1.136
1	Wed	1,012	1,020	1,501	1,177	910	1.294
1	Thu	1,046	1,143	1,450	1,213	910	1.332
1	Fri	1,315	1,433	1,752	1,500	910	1.648
1	Sat	483	625	606	571	910	0.628
1	Sun	8	30	42	27	910	0.029
2	Mon	753	867	1,442	1,021	972	1.050
2	Tue	936	1,148	1,327	1,137	972	1.169
2	Wed	1,134	1,121	1,727	1,327	972	1.365
2	Thu	879	1,197	1,529	1,202	972	1.236
2	Fri	1,197	1,469	1,792	1,486	972	1.528
2	Sat	586	622	616	608	972	0.625
2	Sun	11	30	36	26	972	0.026
3	Mon	1,070	1,173	1,071	1,105	1,102	1.002
3	Tue	939	1,586	1,741	1,422	1,102	1.290
3	Wed	1,129	1,209	2,168	1,502	1,102	1.363
3	Thu	1,087	1,343	2,086	1,505	1,102	1.366
3	Fri	1,309	1,511	1,670	1,497	1,102	1.358
3	Sat	705	629	597	644	1,102	0.584
3	Sun	24	63	32	40	1,102	0.036
4	Mon	738	777	1,303	939	1,059	0.887
4	Tue	1,184	1,187	1,562	1,311	1,059	1.238
4	Wed	1,384	1,550	1,614	1,516	1,059	1.432
4	Thu	992	1,646	1,659	1,432	1,059	1.353
4	Fri	1,222	1,316	2,142	1,560	1,059	1.473
4	Sat	517	581	789	629	1,059	0.594
4	Sun	24	21	29	25	1,059	0.023
5	Mon	652	831	1,496	993	1,025	0.969
5	Tue	930	1,138	1,831	1,300	1,025	1.268
5	Wed	1,140	1,318	1,826	1,428	1,025	1.394
5	Thu	880	1,275	1,214	1,123	1,025	1.096
5	Fri	1,503	1,594	1,733	1,610	1,025	1.571
5	Sat	721	728	608	686	1,025	0.669
5	Sun	30	38	32	33	1,025	0.032
6	Mon	841	1,316	1,260	1,139	1,078	1.057
6	Tue	902	1,511	1,406	1,273	1,078	1.181
6	Wed	1,160	1,410	2,083	1,551	1,078	1.439
6	Thu	989	1,157	2,034	1,393	1,078	1.292
6	Fri	1,260	1,580	1,779	1,540	1,078	1.428
6	Sat	580	617	658	618	1,078	0.573
6	Sun	26	37	33	32	1,078	0.030

Month	Weekday	Total Daily Actual			Weekday Average	Daily Average	Seasonal Index
		Year 1	Year 2	Year 3			
7	Mon	650	857	1,069	859	960	0.895
7	Tue	990	1,070	1,152	1,070	960	1.115
7	Wed	1,103	1,704	1,326	1,378	960	1.435
7	Thu	1,072	1,433	1,225	1,243	960	1.296
7	Fri	1,336	1,581	1,816	1,578	960	1.644
7	Sat	519	412	695	542	960	0.565
7	Sun	37	23	85	48	960	0.050
8	Mon	588	1,183	1,352	1,041	959	1.085
8	Tue	858	1,073	1,425	1,118	959	1.166
8	Wed	840	1,265	1,896	1,334	959	1.390
8	Thu	950	1,223	1,364	1,179	959	1.229
8	Fri	1,193	1,412	1,664	1,423	959	1.483
8	Sat	558	674	551	594	959	0.619
8	Sun	26	26	30	27	959	0.028
9	Mon	964	1,080	1,130	1,058	1,065	0.993
9	Tue	1,316	1,659	1,305	1,427	1,065	1.340
9	Wed	1,025	1,844	1,447	1,439	1,065	1.351
9	Thu	1,085	1,174	1,672	1,311	1,065	1.230
9	Fri	1,277	1,425	2,050	1,584	1,065	1.487
9	Sat	590	500	665	585	1,065	0.549
9	Sun	39	45	74	53	1,065	0.049
10	Mon	699	1,147	1,405	1,084	1,099	0.986
10	Tue	871	1,347	1,435	1,218	1,099	1.108
10	Wed	1,054	1,487	1,639	1,393	1,099	1.267
10	Thu	1,449	1,619	1,551	1,540	1,099	1.401
10	Fri	1,451	1,990	1,722	1,721	1,099	1.566
10	Sat	471	858	782	704	1,099	0.640
10	Sun	26	36	44	35	1,099	0.032
11	Mon	788	1,474	1,228	1,163	1,101	1.057
11	Tue	1,076	1,302	1,612	1,330	1,101	1.209
11	Wed	1,023	1,539	1,981	1,514	1,101	1.376
11	Thu	1,152	1,450	1,558	1,387	1,101	1.260
11	Fri	1,307	1,739	1,761	1,602	1,101	1.456
11	Sat	783	595	616	665	1,101	0.604
11	Sun	51	50	25	42	1,101	0.038
12	Mon	920	1,066	1,120	1,035	1,016	1.019
12	Tue	1,184	1,559	1,245	1,329	1,016	1.308
12	Wed	985	1,720	1,425	1,377	1,016	1.355
12	Thu	965	1,407	1,751	1,375	1,016	1.352
12	Fri	1,135	1,442	1,863	1,480	1,016	1.456
12	Sat	440	469	586	499	1,016	0.491
12	Sun	17	31	13	20	1,016	0.020

APPENDIX B

FORECASTING WITH SEASONAL INDICES

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	1	Sun	275	0.029	8	2	-6	6	37	3.032
2	1	Mon	275	0.933	257	134	-123	123	15087	0.917
3	1	Tue	275	1.136	313	242	-70	70	4922	0.289
4	1	Wed	275	1.294	356	311	-45	45	1987	0.143
5	1	Thu	275	1.332	366	368	2	2	3	0.005
6	1	Fri	275	1.648	453	375	-79	79	6189	0.210
7	1	Sat	275	0.628	173	57	-116	116	13427	2.040
8	1	Sun	275	0.029	8	0	-8	8	65	1.000
9	1	Mon	275	0.933	257	271	14	14	206	0.053
10	1	Tue	275	1.136	313	302	-11	11	120	0.036
11	1	Wed	275	1.294	356	399	43	43	1879	0.109
12	1	Thu	275	1.332	366	449	82	82	6753	0.183
13	1	Fri	275	1.648	453	473	19	19	371	0.041
14	1	Sat	275	0.628	173	150	-23	23	514	0.151
15	1	Sun	275	0.029	8	2	-6	6	34	2.626
16	1	Mon	275	0.933	257	350	93	93	8703	0.266
17	1	Tue	275	1.136	313	377	64	64	4122	0.170
18	1	Wed	275	1.294	356	431	75	75	5674	0.175
19	1	Thu	275	1.332	366	409	43	43	1811	0.104
20	1	Fri	275	1.648	453	448	-5	5	25	0.011
21	1	Sat	275	0.628	173	151	-22	22	465	0.143
22	1	Sun	275	0.029	8	5	-3	3	10	0.660
23	1	Mon	275	0.933	257	296	39	39	1555	0.133
24	1	Tue	275	1.136	313	342	30	30	889	0.087
25	1	Wed	275	1.294	356	421	65	65	4234	0.155
26	1	Thu	275	1.332	366	436	70	70	4836	0.159
27	1	Fri	275	1.648	453	454	0	0	0	0.001
28	1	Sat	275	0.628	173	164	-8	8	71	0.051
29	1	Sun	275	0.029	8	9	1	1	1	0.118
30	1	Mon	275	0.933	257	324	67	67	4516	0.207
31	1	Tue	275	1.136	313	403	90	90	8102	0.224
Average							**9**	**43**	**3,116**	**0.435**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	2	Wed	319	1.365	436	429	-7	7	47	0.016
2	2	Thu	319	1.236	395	401	6	6	33	0.014
3	2	Fri	319	1.528	488	441	-48	48	2258	0.108
4	2	Sat	319	0.625	200	157	-42	42	1795	0.269
5	2	Sun	319	0.026	8	3	-5	5	29	1.805
6	2	Mon	319	1.050	335	298	-37	37	1371	0.124
7	2	Tue	319	1.169	374	374	1	1	0	0.001
8	2	Wed	319	1.365	436	424	-12	12	134	0.027
9	2	Thu	319	1.236	395	410	16	16	244	0.038
10	2	Fri	319	1.528	488	468	-20	20	416	0.044
11	2	Sat	319	0.625	200	134	-66	66	4372	0.495
12	2	Sun	319	0.026	8	1	-7	7	51	5.739
13	2	Mon	319	1.050	335	331	-5	5	23	0.014
14	2	Tue	319	1.169	374	370	-3	3	11	0.009
15	2	Wed	319	1.365	436	424	-13	13	157	0.030
16	2	Thu	319	1.236	395	436	41	41	1705	0.095
17	2	Fri	319	1.528	488	497	9	9	81	0.018
18	2	Sat	319	0.625	200	139	-61	61	3666	0.435
19	2	Sun	319	0.026	8	2	-6	6	41	3.208
20	2	Mon	319	1.050	335	309	-27	27	705	0.086
21	2	Tue	319	1.169	374	407	33	33	1101	0.082
22	2	Wed	319	1.365	436	404	-32	32	1018	0.079
23	2	Thu	319	1.236	395	411	16	16	267	0.040
24	2	Fri	319	1.528	488	487	-2	2	3	0.004
25	2	Sat	319	0.625	200	164	-35	35	1250	0.215
26	2	Sun	319	0.026	8	5	-3	3	9	0.567
27	2	Mon	319	1.050	335	349	14	14	201	0.041
28	2	Tue	319	1.169	374	399	25	25	650	0.064
Average							**-10**	**21**	**773**	**0.488**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	3	Wed	297	1.363	404	437	33	33	1084	0.075
2	3	Thu	297	1.366	405	415	10	10	91	0.023
3	3	Fri	297	1.358	403	484	82	82	6647	0.168
4	3	Sat	297	0.584	173	153	-20	20	417	0.134
5	3	Sun	297	0.036	11	7	-4	4	14	0.536
6	3	Mon	297	1.002	297	304	6	6	42	0.021
7	3	Tue	297	1.290	383	395	13	13	158	0.032
8	3	Wed	297	1.363	404	415	11	11	112	0.025
9	3	Thu	297	1.366	405	403	-2	2	4	0.005
10	3	Fri	297	1.358	403	480	77	77	5989	0.161
11	3	Sat	297	0.584	173	157	-16	16	262	0.103
12	3	Sun	297	0.036	11	0	-11	11	116	1.000
13	3	Mon	297	1.002	297	349	52	52	2693	0.149
14	3	Tue	297	1.290	383	367	-16	16	263	0.044
15	3	Wed	297	1.363	404	397	-7	7	52	0.018
16	3	Thu	297	1.366	405	392	-13	13	162	0.032
17	3	Fri	297	1.358	403	482	79	79	6195	0.163
18	3	Sat	297	0.584	173	177	3	3	12	0.019
19	3	Sun	297	0.036	11	8	-3	3	8	0.355
20	3	Mon	297	1.002	297	297	0	0	0	0.000
21	3	Tue	297	1.290	383	365	-18	18	328	0.050
22	3	Wed	297	1.363	404	441	36	36	1313	0.082
23	3	Thu	297	1.366	405	410	5	5	23	0.012
24	3	Fri	297	1.358	403	471	68	68	4573	0.144
25	3	Sat	297	0.584	173	155	-18	18	321	0.115
26	3	Sun	297	0.036	11	4	-7	7	46	1.689
27	3	Mon	297	1.002	297	301	4	4	17	0.014
28	3	Tue	297	1.290	383	387	4	4	16	0.010
29	3	Wed	297	1.363	404	431	26	26	686	0.061
30	3	Thu	297	1.366	405	385	-20	20	386	0.051
31	3	Fri	297	1.358	403	478	75	75	5584	0.156
Average							**14**	**24**	**1,213**	**0.176**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	4	Sat	306	0.594	182	162	-20	20	414	0.126
2	4	Sun	306	0.023	7	6	-1	1	1	0.157
3	4	Mon	306	0.887	272	287	15	15	228	0.053
4	4	Tue	306	1.238	379	351	-29	29	831	0.082
5	4	Wed	306	1.432	439	408	-30	30	928	0.075
6	4	Thu	306	1.353	415	417	2	2	6	0.006
7	4	Fri	306	1.473	451	467	16	16	252	0.034
8	4	Sat	306	0.594	182	137	-45	45	2000	0.326
9	4	Sun	306	0.023	7	3	-4	4	17	1.364
10	4	Mon	306	0.887	272	338	67	67	4434	0.197
11	4	Tue	306	1.238	379	404	24	24	592	0.060
12	4	Wed	306	1.432	439	464	26	26	656	0.055
13	4	Thu	306	1.353	415	423	9	9	74	0.020
14	4	Fri	306	1.473	451	350	-102	102	10368	0.291
15	4	Sat	306	0.594	182	169	-13	13	163	0.075
16	4	Sun	306	0.023	7	6	-1	1	1	0.182
17	4	Mon	306	0.887	272	127	-145	145	21085	1.147
18	4	Tue	306	1.238	379	341	-38	38	1470	0.112
19	4	Wed	306	1.432	439	454	15	15	227	0.033
20	4	Thu	306	1.353	415	426	11	11	122	0.026
21	4	Fri	306	1.473	451	454	3	3	9	0.007
22	4	Sat	306	0.594	182	166	-16	16	269	0.099
23	4	Sun	306	0.023	7	17	10	10	108	0.594
24	4	Mon	306	0.887	272	315	43	43	1828	0.136
25	4	Tue	306	1.238	379	358	-21	21	454	0.060
26	4	Wed	306	1.432	439	454	15	15	223	0.033
27	4	Thu	306	1.353	415	407	-7	7	56	0.018
28	4	Fri	306	1.473	451	515	64	64	4042	0.123
29	4	Sat	306	0.594	182	207	24	24	596	0.118
30	4	Sun	306	0.023	7	19	12	12	142	0.627
Average							**-4**	**28**	**1,720**	**0.208**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	5	Mon	302	0.969	293	35	-258	258	66540	7.394
2	5	Tue	302	1.268	383	297	-86	86	7449	0.291
3	5	Wed	302	1.394	421	426	5	5	22	0.011
4	5	Thu	302	1.096	331	437	106	106	11168	0.242
5	5	Fri	302	1.571	475	523	48	48	2304	0.092
6	5	Sat	302	0.669	202	140	-62	62	3843	0.442
7	5	Sun	302	0.032	10	12	2	2	5	0.183
8	5	Mon	302	0.969	293	307	14	14	196	0.046
9	5	Tue	302	1.268	383	368	-16	16	245	0.043
10	5	Wed	302	1.394	421	453	31	31	981	0.069
11	5	Thu	302	1.096	331	406	75	75	5626	0.185
12	5	Fri	302	1.571	475	461	-13	13	181	0.029
13	5	Sat	302	0.669	202	181	-21	21	457	0.118
14	5	Sun	302	0.032	10	12	2	2	4	0.172
15	5	Mon	302	0.969	293	346	53	53	2813	0.153
16	5	Tue	302	1.268	383	357	-26	26	692	0.074
17	5	Wed	302	1.394	421	454	33	33	1062	0.072
18	5	Thu	302	1.096	331	489	157	157	24758	0.322
19	5	Fri	302	1.571	475	307	-168	168	28201	0.547
20	5	Sat	302	0.669	202	99	-103	103	10692	1.046
21	5	Sun	302	0.032	10	7	-3	3	9	0.427
22	5	Mon	302	0.969	293	312	19	19	351	0.060
23	5	Tue	302	1.268	383	387	4	4	16	0.010
24	5	Wed	302	1.394	421	440	19	19	349	0.042
25	5	Thu	302	1.096	331	291	-41	41	1643	0.139
26	5	Fri	302	1.571	475	455	-20	20	401	0.044
27	5	Sat	302	0.669	202	173	-30	30	880	0.172
28	5	Sun	302	0.032	10	15	5	5	22	0.326
29	5	Mon	302	0.969	293	316	23	23	517	0.072
30	5	Tue	302	1.268	383	378	-5	5	24	0.013
31	5	Wed	302	1.394	421	469	48	48	2257	0.101
Average							**-7**	**48**	**5,603**	**0.417**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	6	Thu	303	1.292	391	411	20	20	397	0.048
2	6	Fri	303	1.428	432	450	18	18	322	0.040
3	6	Sat	303	0.573	174	166	-7	7	54	0.044
4	6	Sun	303	0.030	9	12	3	3	7	0.227
5	6	Mon	303	1.057	320	180	-140	140	19510	0.775
6	6	Tue	303	1.181	357	344	-13	13	170	0.038
7	6	Wed	303	1.439	436	398	-37	37	1374	0.093
8	6	Thu	303	1.292	391	379	-13	13	158	0.033
9	6	Fri	303	1.428	432	470	38	38	1442	0.081
10	6	Sat	303	0.573	174	179	5	5	25	0.028
11	6	Sun	303	0.030	9	8	-1	1	1	0.114
12	6	Mon	303	1.057	320	342	22	22	492	0.065
13	6	Tue	303	1.181	357	407	50	50	2468	0.122
14	6	Wed	303	1.439	436	414	-21	21	461	0.052
15	6	Thu	303	1.292	391	345	-46	46	2144	0.134
16	6	Fri	303	1.428	432	438	5	5	28	0.012
17	6	Sat	303	0.573	174	163	-10	10	110	0.064
18	6	Sun	303	0.030	9	12	3	3	9	0.253
19	6	Mon	303	1.057	320	339	19	19	362	0.056
20	6	Tue	303	1.181	357	358	1	1	0	0.002
21	6	Wed	303	1.439	436	456	20	20	420	0.045
22	6	Thu	303	1.292	391	435	44	44	1955	0.102
23	6	Fri	303	1.428	432	472	40	40	1603	0.085
24	6	Sat	303	0.573	174	142	-32	32	993	0.222
25	6	Sun	303	0.030	9	19	10	10	91	0.514
26	6	Mon	303	1.057	320	180	-139	139	19438	0.773
27	6	Tue	303	1.181	357	196	-161	161	25954	0.821
28	6	Wed	303	1.439	436	304	-131	131	17251	0.432
29	6	Thu	303	1.292	391	360	-31	31	977	0.087
30	6	Fri	303	1.428	432	446	13	13	180	0.030
Average							**-16**	**36**	**3,280**	**0.180**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	7	Sat	260	0.565	147	149	2	2	4	0.014
2	7	Sun	260	0.050	13	11	-2	2	4	0.185
3	7	Mon	260	0.895	233	268	36	36	1277	0.133
4	7	Tue	260	1.115	290	332	42	42	1796	0.128
5	7	Wed	260	1.435	373	322	-51	51	2638	0.160
6	7	Thu	260	1.296	337	348	11	11	120	0.031
7	7	Fri	260	1.644	427	400	-27	27	731	0.068
8	7	Sat	260	0.565	147	143	-3	3	11	0.023
9	7	Sun	260	0.050	13	10	-3	3	10	0.312
10	7	Mon	260	0.895	233	290	57	57	3263	0.197
11	7	Tue	260	1.115	290	354	64	64	4094	0.181
12	7	Wed	260	1.435	373	360	-13	13	165	0.036
13	7	Thu	260	1.296	337	371	34	34	1166	0.092
14	7	Fri	260	1.644	427	421	-6	6	41	0.015
15	7	Sat	260	0.565	147	152	6	6	30	0.036
16	7	Sun	260	0.050	13	14	1	1	1	0.065
17	7	Mon	260	0.895	233	253	20	20	398	0.079
18	7	Tue	260	1.115	290	347	57	57	3261	0.165
19	7	Wed	260	1.435	373	356	-18	18	307	0.049
20	7	Thu	260	1.296	337	372	35	35	1205	0.093
21	7	Fri	260	1.644	427	404	-23	23	535	0.057
22	7	Sat	260	0.565	147	162	15	15	219	0.092
23	7	Sun	260	0.050	13	16	3	3	10	0.196
24	7	Mon	260	0.895	233	298	65	65	4246	0.219
25	7	Tue	260	1.115	290	318	28	28	780	0.088
26	7	Wed	260	1.435	373	360	-13	13	175	0.037
27	7	Thu	260	1.296	337	355	18	18	318	0.050
28	7	Fri	260	1.644	427	369	-58	58	3351	0.157
29	7	Sat	260	0.565	147	163	16	16	267	0.100
30	7	Sun	260	0.050	13	21	8	8	63	0.377
31	7	Mon	260	0.895	233	292	59	59	3519	0.203
Average							**12**	**26**	**1,097**	**0.117**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	8	Tue	260	1.166	303	287	-15	15	232	0.053
2	8	Wed	260	1.390	361	323	-38	38	1418	0.116
3	8	Thu	260	1.229	319	336	17	17	303	0.052
4	8	Fri	260	1.483	385	347	-39	39	1494	0.112
5	8	Sat	260	0.619	161	148	-13	13	173	0.089
6	8	Sun	260	0.028	7	7	-1	1	1	0.107
7	8	Mon	260	1.085	282	229	-52	52	2752	0.229
8	8	Tue	260	1.166	303	254	-49	49	2379	0.192
9	8	Wed	260	1.390	361	307	-54	54	2963	0.178
10	8	Thu	260	1.229	319	375	56	56	3086	0.148
11	8	Fri	260	1.483	385	396	11	11	125	0.028
12	8	Sat	260	0.619	161	139	-22	22	490	0.160
13	8	Sun	260	0.028	7	5	-2	2	6	0.479
14	8	Mon	260	1.085	282	264	-17	17	300	0.066
15	8	Tue	260	1.166	303	255	-47	47	2230	0.185
16	8	Wed	260	1.390	361	310	-51	51	2579	0.164
17	8	Thu	260	1.229	319	383	64	64	4090	0.167
18	8	Fri	260	1.483	385	403	18	18	333	0.045
19	8	Sat	260	0.619	161	180	19	19	356	0.105
20	8	Sun	260	0.028	7	12	5	5	22	0.390
21	8	Mon	260	1.085	282	297	15	15	225	0.051
22	8	Tue	260	1.166	303	328	26	26	657	0.078
23	8	Wed	260	1.390	361	414	53	53	2795	0.128
24	8	Thu	260	1.229	319	378	59	59	3483	0.156
25	8	Fri	260	1.483	385	421	36	36	1304	0.086
26	8	Sat	260	0.619	161	177	16	16	252	0.090
27	8	Sun	260	0.028	7	10	3	3	8	0.275
28	8	Mon	260	1.085	282	306	25	25	610	0.081
29	8	Tue	260	1.166	303	445	142	142	20228	0.320
30	8	Wed	260	1.390	361	284	-77	77	5988	0.273
31	8	Thu	260	1.229	319	268	-51	51	2625	0.191
Average							**1**	**35**	**2,049**	**0.155**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	9	Fri	308	1.487	459	182	-276	276	76414	1.518
2	9	Sat	308	0.549	169	27	-142	142	20250	5.269
3	9	Sun	308	0.049	15	3	-12	12	150	4.076
4	9	Mon	308	0.993	306	136	-170	170	28928	1.249
5	9	Tue	308	1.340	413	236	-177	177	31218	0.748
6	9	Wed	308	1.351	416	394	-22	22	503	0.057
7	9	Thu	308	1.230	379	391	12	12	136	0.030
8	9	Fri	308	1.487	459	423	-36	36	1284	0.085
9	9	Sat	308	0.549	169	176	7	7	47	0.039
10	9	Sun	308	0.049	15	10	-5	5	30	0.562
11	9	Mon	308	0.993	306	314	8	8	62	0.025
12	9	Tue	308	1.340	413	370	-43	43	1869	0.117
13	9	Wed	308	1.351	416	433	17	17	278	0.039
14	9	Thu	308	1.230	379	395	15	15	240	0.039
15	9	Fri	308	1.487	459	463	4	4	19	0.009
16	9	Sat	308	0.549	169	202	33	33	1072	0.162
17	9	Sun	308	0.049	15	9	-6	6	40	0.713
18	9	Mon	308	0.993	306	306	0	0	0	0.000
19	9	Tue	308	1.340	413	387	-26	26	686	0.068
20	9	Wed	308	1.351	416	418	2	2	3	0.004
21	9	Thu	308	1.230	379	377	-2	2	5	0.006
22	9	Fri	308	1.487	459	426	-33	33	1091	0.078
23	9	Sat	308	0.549	169	173	3	3	11	0.019
24	9	Sun	308	0.049	15	15	0	0	0	0.011
25	9	Mon	308	0.993	306	299	-7	7	54	0.025
26	9	Tue	308	1.340	413	389	-24	24	596	0.063
27	9	Wed	308	1.351	416	436	20	20	394	0.046
28	9	Thu	308	1.230	379	385	6	6	31	0.014
29	9	Fri	308	1.487	459	450	-8	8	66	0.018
30	9	Sat	308	0.549	169	193	24	24	579	0.124
Average							**-28**	**38**	**5,535**	**0.507**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	10	Sun	307	0.032	10	15	5	5	30	0.359
2	10	Mon	307	0.986	302	302	0	0	0	0.000
3	10	Tue	307	1.108	340	315	-25	25	604	0.078
4	10	Wed	307	1.267	389	403	14	14	200	0.035
5	10	Thu	307	1.401	429	397	-32	32	1041	0.081
6	10	Fri	307	1.566	480	411	-69	69	4789	0.168
7	10	Sat	307	0.640	196	173	-23	23	541	0.134
8	10	Sun	307	0.032	10	21	11	11	125	0.533
9	10	Mon	307	0.986	302	316	14	14	196	0.044
10	10	Tue	307	1.108	340	388	48	48	2295	0.124
11	10	Wed	307	1.267	389	403	15	15	221	0.037
12	10	Thu	307	1.401	429	433	3	3	9	0.007
13	10	Fri	307	1.566	480	463	-17	17	296	0.037
14	10	Sat	307	0.640	196	207	11	11	118	0.052
15	10	Sun	307	0.032	10	20	11	11	113	0.521
16	10	Mon	307	0.986	302	336	33	33	1109	0.099
17	10	Tue	307	1.108	340	398	59	59	3430	0.147
18	10	Wed	307	1.267	389	427	39	39	1509	0.091
19	10	Thu	307	1.401	429	374	-56	56	3082	0.148
20	10	Fri	307	1.566	480	458	-22	22	490	0.048
21	10	Sat	307	0.640	196	203	7	7	51	0.035
22	10	Sun	307	0.032	10	7	-3	3	10	0.473
23	10	Mon	307	0.986	302	305	2	2	6	0.008
24	10	Tue	307	1.108	340	409	70	70	4841	0.170
25	10	Wed	307	1.267	389	435	47	47	2171	0.107
26	10	Thu	307	1.401	429	421	-8	8	69	0.020
27	10	Fri	307	1.566	480	456	-24	24	567	0.052
28	10	Sat	307	0.640	196	173	-23	23	551	0.136
29	10	Sun	307	0.032	10	19	9	9	79	0.476
30	10	Mon	307	0.986	302	288	-14	14	197	0.049
31	10	Tue	307	1.108	340	370	31	31	945	0.083
Average							**4**	**24**	**958**	**0.140**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	11	Wed	315	1.376	433	261	-172	172	29745	0.661
2	11	Thu	315	1.260	397	370	-26	26	699	0.071
3	11	Fri	315	1.456	458	443	-15	15	224	0.034
4	11	Sat	315	0.604	190	165	-25	25	613	0.150
5	11	Sun	315	0.038	12	18	6	6	36	0.333
6	11	Mon	315	1.057	333	331	-2	2	4	0.006
7	11	Tue	315	1.209	381	414	33	33	1091	0.080
8	11	Wed	315	1.376	433	416	-18	18	315	0.043
9	11	Thu	315	1.260	397	391	-6	6	37	0.016
10	11	Fri	315	1.456	458	407	-51	51	2627	0.126
11	11	Sat	315	0.604	190	183	-7	7	47	0.038
12	11	Sun	315	0.038	12	11	-1	1	1	0.094
13	11	Mon	315	1.057	333	304	-29	29	857	0.096
14	11	Tue	315	1.209	381	423	42	42	1789	0.100
15	11	Wed	315	1.376	433	452	18	18	336	0.041
16	11	Thu	315	1.260	397	384	-13	13	171	0.034
17	11	Fri	315	1.456	458	422	-37	37	1340	0.087
18	11	Sat	315	0.604	190	160	-30	30	898	0.187
19	11	Sun	315	0.038	12	12	0	0	0	0.003
20	11	Mon	315	1.057	333	318	-14	14	209	0.045
21	11	Tue	315	1.209	381	438	57	57	3304	0.131
22	11	Wed	315	1.376	433	424	-9	9	83	0.021
23	11	Thu	315	1.260	397	409	12	12	153	0.030
24	11	Fri	315	1.456	458	480	21	21	451	0.044
25	11	Sat	315	0.604	190	168	-22	22	485	0.131
26	11	Sun	315	0.038	12	9	-3	3	10	0.349
27	11	Mon	315	1.057	333	320	-13	13	173	0.041
28	11	Tue	315	1.209	381	438	58	58	3340	0.132
29	11	Wed	315	1.376	433	440	6	6	41	0.015
30	11	Thu	315	1.260	397	431	34	34	1167	0.079
Average							**-7**	**26**	**1,675**	**0.107**

Days	Month	Weekday	α/n	Seasonal Index	Daily Forecast	Actual	BIAS	MAD	MSE	MAPE
1	12	Fri	259	1.456	378	351	-27	27	712	0.076
2	12	Sat	259	0.491	127	174	47	47	2181	0.268
3	12	Sun	259	0.020	5	10	5	5	28	0.505
4	12	Mon	259	1.019	264	291	27	27	710	0.092
5	12	Tue	259	1.308	339	418	78	78	6120	0.187
6	12	Wed	259	1.355	351	425	74	74	5465	0.174
7	12	Thu	259	1.352	351	408	57	57	3260	0.140
8	12	Fri	259	1.456	378	400	22	22	488	0.055
9	12	Sat	259	0.491	127	159	31	31	975	0.197
10	12	Sun	259	0.020	5	5	0	0	0	0.028
11	12	Mon	259	1.019	264	267	3	3	10	0.012
12	12	Tue	259	1.308	339	396	57	57	3226	0.143
13	12	Wed	259	1.355	351	393	41	41	1712	0.105
14	12	Thu	259	1.352	351	369	18	18	335	0.050
15	12	Fri	259	1.456	378	358	-20	20	415	0.057
16	12	Sat	259	0.491	127	106	-21	21	436	0.196
17	12	Sun	259	0.020	5	3	-2	2	5	0.714
18	12	Mon	259	1.019	264	243	-21	21	452	0.088
19	12	Tue	259	1.308	339	334	-6	6	33	0.017
20	12	Wed	259	1.355	351	371	20	20	382	0.053
21	12	Thu	259	1.352	351	384	33	33	1119	0.087
22	12	Fri	259	1.456	378	394	17	17	273	0.042
23	12	Sat	259	0.491	127	174	47	47	2217	0.270
24	12	Sun	259	0.020	5	3	-2	2	5	0.714
25	12	Mon	259	1.019	264	89	-176	176	30878	1.984
26	12	Tue	259	1.308	339	194	-146	146	21250	0.753
27	12	Wed	259	1.355	351	347	-5	5	23	0.014
28	12	Thu	259	1.352	351	316	-35	35	1245	0.112
29	12	Fri	259	1.456	378	270	-108	108	11602	0.399
30	12	Sat	259	0.491	127	113	-14	14	202	0.126
31	12	Sun	259	0.020	5	19	14	14	199	0.733
Average							**0**	**38**	**3,095**	**0.271**

APPENDIX C

LAGGED CORRELATION WITH WEIGHTED AVERAGES DAILY DISTRIBUTION OF COMPANY FORECASTS

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag						Norm.					
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	%Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	0%	Year 3	Jan	1	Year 2	Dec	4	0%	Year 2	Nov	6	0%	Year 2	Jan	3	0%	Year 1	Jan	4	0%	8.528	0%	0%	3	2	-1	1	1	0,535
w2	32%	Year 3	Jan	2	Year 2	Dec	5	4%	Year 2	Nov	7	3%	Year 2	Jan	4	2%	Year 1	Jan	5	2%	8.528	2%	2%	204	134	-70	70	4856	0,520
w3	43%	Year 3	Jan	3	Year 2	Dec	6	4%	Year 2	Nov	8	4%	Year 2	Jan	5	3%	Year 1	Jan	6	3%	8.528	3%	3%	278	242	-35	35	1234	0,145
w4	24%	Year 3	Jan	4	Year 2	Dec	7	5%	Year 2	Nov	9	4%	Year 2	Jan	6	4%	Year 1	Jan	7	3%	8.528	4%	4%	312	311	0	0	0	0,001
		Year 3	Jan	5	Year 2	Dec	8	4%	Year 2	Nov	10	4%	Year 2	Jan	7	4%	Year 1	Jan	8	4%	8.528	4%	4%	331	368	37	37	1349	0,100
MAD	26	Year 3	Jan	6	Year 2	Dec	9	5%	Year 2	Nov	11	5%	Year 2	Jan	8	5%	Year 1	Jan	9	5%	8.528	5%	5%	406	375	-31	31	958	0,083
		Year 3	Jan	7	Year 2	Dec	10	2%	Year 2	Nov	12	1%	Year 2	Jan	9	1%	Year 1	Jan	10	2%	8.528	2%	2%	133	57	-76	76	5743	1,334
		Year 3	Jan	8	Year 2	Dec	11	0%	Year 2	Nov	13	0%	Year 2	Jan	10	0%	Year 1	Jan	11	0%	8.528	0%	0%	6	0	-6	6	36	1,000
		Year 3	Jan	9	Year 2	Dec	12	4%	Year 2	Nov	14	4%	Year 2	Jan	11	4%	Year 1	Jan	12	3%	8.528	4%	4%	300	271	-28	28	808	0,105
		Year 3	Jan	10	Year 2	Dec	13	4%	Year 2	Nov	15	4%	Year 2	Jan	12	4%	Year 1	Jan	13	4%	8.528	4%	4%	341	302	-39	39	1532	0,130
		Year 3	Jan	11	Year 2	Dec	14	5%	Year 2	Nov	16	5%	Year 2	Jan	13	5%	Year 1	Jan	14	4%	8.528	5%	4%	381	399	19	19	344	0,046
		Year 3	Jan	12	Year 2	Dec	15	5%	Year 2	Nov	17	4%	Year 2	Jan	14	5%	Year 1	Jan	15	5%	8.528	5%	5%	384	449	65	65	4179	0,144
		Year 3	Jan	13	Year 2	Dec	16	4%	Year 2	Nov	18	5%	Year 2	Jan	15	6%	Year 1	Jan	16	6%	8.528	6%	5%	455	473	17	17	304	0,037
		Year 3	Jan	14	Year 2	Dec	17	1%	Year 2	Nov	19	2%	Year 2	Jan	16	2%	Year 1	Jan	17	2%	8.528	2%	2%	152	150	-2	2	3	0,011
		Year 3	Jan	15	Year 2	Dec	18	0%	Year 2	Nov	20	0%	Year 2	Jan	17	0%	Year 1	Jan	18	0%	8.528	0%	0%	14	2	-12	12	137	5,266
		Year 3	Jan	16	Year 2	Dec	19	3%	Year 2	Nov	21	3%	Year 2	Jan	18	4%	Year 1	Jan	19	3%	8.528	3%	3%	282	350	68	68	4573	0,193
		Year 3	Jan	17	Year 2	Dec	20	4%	Year 2	Nov	22	4%	Year 2	Jan	19	4%	Year 1	Jan	20	5%	8.528	4%	4%	354	377	23	23	525	0,061
		Year 3	Jan	18	Year 2	Dec	21	4%	Year 2	Nov	23	4%	Year 2	Jan	20	5%	Year 1	Jan	21	5%	8.528	5%	5%	397	431	34	34	1179	0,080
		Year 3	Jan	19	Year 2	Dec	22	5%	Year 2	Nov	24	5%	Year 2	Jan	21	5%	Year 1	Jan	22	5%	8.528	5%	5%	413	409	-4	4	13	0,009
		Year 3	Jan	20	Year 2	Dec	23	5%	Year 2	Nov	25	6%	Year 2	Jan	22	6%	Year 1	Jan	23	6%	8.528	6%	5%	455	448	-6	6	39	0,014
		Year 3	Jan	21	Year 2	Dec	24	2%	Year 2	Nov	26	2%	Year 2	Jan	23	2%	Year 1	Jan	24	2%	8.528	2%	2%	176	151	-25	25	605	0,163
		Year 3	Jan	22	Year 2	Dec	25	0%	Year 2	Nov	27	0%	Year 2	Jan	24	0%	Year 1	Jan	25	0%	8.528	0%	0%	6	5	-1	1	1	0,219
		Year 3	Jan	23	Year 2	Dec	26	2%	Year 2	Nov	28	4%	Year 2	Jan	25	4%	Year 1	Jan	26	4%	8.528	4%	4%	309	296	-13	13	169	0,044
		Year 3	Jan	24	Year 2	Dec	27	3%	Year 2	Nov	29	4%	Year 2	Jan	26	4%	Year 1	Jan	27	5%	8.528	4%	4%	355	342	-12	12	154	0,036
		Year 3	Jan	25	Year 2	Dec	28	4%	Year 2	Nov	30	5%	Year 2	Jan	27	6%	Year 1	Jan	28	5%	8.528	5%	5%	422	421	-1	1	1	0,002
		Year 3	Jan	26	Year 2	Dec	29	3%	Year 2	Dec	1	4%	Year 2	Jan	28	5%	Year 1	Jan	29	5%	8.528	5%	5%	396	436	40	40	1598	0,092
		Year 3	Jan	27	Year 2	Dec	30	3%	Year 2	Dec	2	6%	Year 2	Jan	29	6%	Year 1	Jan	30	6%	8.528	6%	6%	479	454	-25	25	639	0,056
		Year 3	Jan	28	Year 2	Dec	31	1%	Year 2	Dec	3	2%	Year 2	Jan	30	2%	Year 1	Jan	31	3%	8.528	2%	2%	164	164	0	0	0	0,000
		Year 3	Jan	29	Year 3	Jan	1	0%	Year 2	Dec	4	0%	Year 2	Jan	31	0%	Year 1	Feb	1	0%	8.528	0%	0%	12	9	-2	2	6	0,270
		Year 3	Jan	30	Year 3	Jan	2	2%	Year 2	Dec	5	4%	Year 2	Feb	1	3%	Year 1	Feb	2	3%	8.528	4%	3%	290	324	34	34	1141	0,104
		Year 3	Jan	31	Year 3	Jan	3	3%	Year 2	Dec	6	4%	Year 2	Feb	2	4%	Year 1	Feb	3	4%	8.528	4%	4%	322	403	80	80	6467	0,200

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag											
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	Norm. %Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	27%	Year 3	Feb	1	Year 3	Jan	4	4%	Year 2	Dec	7	5%	Year 2	Feb	3	5%	Year 1	Feb	4	4%	8.944	4%	5%	429	429	0	0	0	0,001
w2	0%	Year 3	Feb	2	Year 3	Jan	5	4%	Year 2	Dec	8	4%	Year 2	Feb	4	4%	Year 1	Feb	5	5%	8.944	4%	5%	407	401	-6	6	36	0,015
w3	57%	Year 3	Feb	3	Year 3	Jan	6	4%	Year 2	Dec	9	5%	Year 2	Feb	5	5%	Year 1	Feb	6	6%	8.944	4%	5%	441	441	0	0	0	0,000
w4	9%	Year 3	Feb	4	Year 3	Jan	7	1%	Year 2	Dec	10	2%	Year 2	Feb	6	2%	Year 1	Feb	7	2%	8.944	1%	1%	129	157	28	28	807	0,181
		Year 3	Feb	5	Year 3	Jan	8	0%	Year 2	Dec	11	0%	Year 2	Feb	7	0%	Year 1	Feb	8	0%	8.944	0%	0%	9	3	-6	6	41	2,127
MAD	20	Year 3	Feb	6	Year 3	Jan	9	3%	Year 2	Dec	12	4%	Year 2	Feb	8	3%	Year 1	Feb	9	3%	8.944	3%	3%	306	298	-8	8	65	0,027
		Year 3	Feb	7	Year 3	Jan	10	4%	Year 2	Dec	13	4%	Year 2	Feb	9	4%	Year 1	Feb	10	5%	8.944	3%	4%	340	374	34	34	1151	0,091
		Year 3	Feb	8	Year 3	Jan	11	5%	Year 2	Dec	14	5%	Year 2	Feb	10	5%	Year 1	Feb	11	4%	8.944	5%	5%	455	424	-30	30	928	0,072
		Year 3	Feb	9	Year 3	Jan	12	5%	Year 2	Dec	15	5%	Year 2	Feb	11	4%	Year 1	Feb	12	5%	8.944	4%	5%	437	410	-27	27	721	0,065
		Year 3	Feb	10	Year 3	Jan	13	6%	Year 2	Dec	16	4%	Year 2	Feb	12	5%	Year 1	Feb	13	5%	8.944	5%	5%	490	468	-22	22	503	0,048
		Year 3	Feb	11	Year 3	Jan	14	2%	Year 2	Dec	17	1%	Year 2	Feb	13	2%	Year 1	Feb	14	2%	8.944	2%	2%	171	134	-37	37	1382	0,278
		Year 3	Feb	12	Year 3	Jan	15	0%	Year 2	Dec	18	0%	Year 2	Feb	14	0%	Year 1	Feb	15	0%	8.944	0%	0%	6	1	-5	5	23	3,859
		Year 3	Feb	13	Year 3	Jan	16	4%	Year 2	Dec	19	3%	Year 2	Feb	15	4%	Year 1	Feb	16	3%	8.944	4%	4%	349	331	-19	19	353	0,057
		Year 3	Feb	14	Year 3	Jan	17	4%	Year 2	Dec	20	4%	Year 2	Feb	16	4%	Year 1	Feb	17	4%	8.944	4%	4%	385	370	-14	14	203	0,039
		Year 3	Feb	15	Year 3	Jan	18	5%	Year 2	Dec	21	4%	Year 2	Feb	17	5%	Year 1	Feb	18	4%	8.944	5%	5%	452	424	-28	28	807	0,067
		Year 3	Feb	16	Year 3	Jan	19	5%	Year 2	Dec	22	5%	Year 2	Feb	18	4%	Year 1	Feb	19	4%	8.944	4%	5%	414	436	22	22	474	0,050
		Year 3	Feb	17	Year 3	Jan	20	5%	Year 2	Dec	23	5%	Year 2	Feb	19	6%	Year 1	Feb	20	6%	8.944	5%	6%	511	497	-13	13	181	0,027
		Year 3	Feb	18	Year 3	Jan	21	2%	Year 2	Dec	24	2%	Year 2	Feb	20	2%	Year 1	Feb	21	3%	8.944	2%	2%	181	139	-42	42	1756	0,301
		Year 3	Feb	19	Year 3	Jan	22	0%	Year 2	Dec	25	0%	Year 2	Feb	21	0%	Year 1	Feb	22	0%	8.944	0%	0%	6	2	-4	4	14	1,857
		Year 3	Feb	20	Year 3	Jan	23	3%	Year 2	Dec	26	2%	Year 2	Feb	22	3%	Year 1	Feb	23	3%	8.944	3%	3%	308	309	1	1	1	0,003
		Year 3	Feb	21	Year 3	Jan	24	4%	Year 2	Dec	27	3%	Year 2	Feb	23	4%	Year 1	Feb	24	5%	8.944	4%	4%	386	407	21	21	436	0,051
		Year 3	Feb	22	Year 3	Jan	25	5%	Year 2	Dec	28	4%	Year 2	Feb	24	5%	Year 1	Feb	25	5%	8.944	5%	5%	463	404	-59	59	3462	0,146
		Year 3	Feb	23	Year 3	Jan	26	5%	Year 2	Dec	29	3%	Year 2	Feb	25	5%	Year 1	Feb	26	6%	8.944	5%	5%	450	411	-39	39	1536	0,095
		Year 3	Feb	24	Year 3	Jan	27	5%	Year 2	Dec	30	3%	Year 2	Feb	26	6%	Year 1	Feb	27	6%	8.944	5%	6%	508	487	-22	22	482	0,045
		Year 3	Feb	25	Year 3	Jan	28	2%	Year 2	Dec	31	1%	Year 2	Feb	27	2%	Year 1	Feb	28	3%	8.944	2%	2%	182	164	-17	17	302	0,106
		Year 3	Feb	26	Year 3	Jan	29	0%	Year 3	Jan	1	0%	Year 2	Feb	28	0%	Year 1	Mar	1	0%	8.944	0%	0%	14	5	-9	9	73	1,587
		Year 3	Feb	27	Year 3	Jan	30	4%	Year 3	Jan	2	2%	Year 2	Feb	29	4%	Year 1	Mar	2	3%	8.944	3%	4%	333	349	17	17	287	0,048
		Year 3	Feb	28	Year 3	Jan	31	5%	Year 3	Jan	3	3%	Year 2	Mar	1	4%	Year 1	Mar	3	4%	8.944	4%	4%	383	399	16	16	266	0,041

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag						Norm.					
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	%Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	45%	Year 3	Mar	1	Year 3	Feb	1	5%	Year 3	Jan	4	4%	Year 2	Mar	2	4%	Year 1	Mar	4	4%	9.196	5%	4%	386	437	51	51	2581	0,116
w2	7%	Year 3	Mar	2	Year 3	Feb	2	5%	Year 3	Jan	5	4%	Year 2	Mar	3	5%	Year 1	Mar	5	4%	9.196	5%	4%	395	415	19	19	373	0,047
w3	49%	Year 3	Mar	3	Year 3	Feb	3	5%	Year 3	Jan	6	4%	Year 2	Mar	4	5%	Year 1	Mar	6	5%	9.196	5%	5%	415	484	69	69	4756	0,142
w4	0%	Year 3	Mar	4	Year 3	Feb	4	2%	Year 3	Jan	7	1%	Year 2	Mar	5	2%	Year 1	Mar	7	2%	9.196	2%	1%	136	153	17	17	280	0,109
		Year 3	Mar	5	Year 3	Feb	5	0%	Year 3	Jan	8	0%	Year 2	Mar	6	0%	Year 1	Mar	8	0%	9.196	0%	0%	4	7	3	3	6	0,363
MAD	25	Year 3	Mar	6	Year 3	Feb	6	3%	Year 3	Jan	9	3%	Year 2	Mar	7	3%	Year 1	Mar	9	3%	9.196	3%	3%	291	304	13	13	176	0,044
		Year 3	Mar	7	Year 3	Feb	7	4%	Year 3	Jan	10	4%	Year 2	Mar	8	4%	Year 1	Mar	10	4%	9.196	4%	4%	342	395	53	53	2825	0,134
		Year 3	Mar	8	Year 3	Feb	8	5%	Year 3	Jan	11	5%	Year 2	Mar	9	4%	Year 1	Mar	11	4%	9.196	5%	4%	400	415	15	15	226	0,036
		Year 3	Mar	9	Year 3	Feb	9	5%	Year 3	Jan	12	5%	Year 2	Mar	10	4%	Year 1	Mar	12	4%	9.196	4%	4%	382	403	21	21	460	0,053
		Year 3	Mar	10	Year 3	Feb	10	5%	Year 3	Jan	13	6%	Year 2	Mar	11	5%	Year 1	Mar	13	5%	9.196	5%	5%	444	480	36	36	1295	0,075
		Year 3	Mar	11	Year 3	Feb	11	2%	Year 3	Jan	14	2%	Year 2	Mar	12	2%	Year 1	Mar	14	2%	9.196	2%	2%	141	157	16	16	252	0,101
		Year 3	Mar	12	Year 3	Feb	12	0%	Year 3	Jan	15	0%	Year 2	Mar	13	0%	Year 1	Mar	15	0%	9.196	0%	0%	7	0	-7	7	45	1,000
		Year 3	Mar	13	Year 3	Feb	13	4%	Year 3	Jan	16	4%	Year 2	Mar	14	3%	Year 1	Mar	16	3%	9.196	4%	3%	308	349	41	41	1701	0,118
		Year 3	Mar	14	Year 3	Feb	14	4%	Year 3	Jan	17	4%	Year 2	Mar	15	4%	Year 1	Mar	17	4%	9.196	4%	4%	345	367	22	22	468	0,059
		Year 3	Mar	15	Year 3	Feb	15	5%	Year 3	Jan	18	5%	Year 2	Mar	16	4%	Year 1	Mar	18	4%	9.196	5%	4%	397	397	0	0	0	0,000
		Year 3	Mar	16	Year 3	Feb	16	5%	Year 3	Jan	19	5%	Year 2	Mar	17	4%	Year 1	Mar	19	5%	9.196	5%	4%	397	392	-4	4	20	0,011
		Year 3	Mar	17	Year 3	Feb	17	6%	Year 3	Jan	20	5%	Year 2	Mar	18	5%	Year 1	Mar	20	5%	9.196	5%	5%	447	482	35	35	1215	0,072
		Year 3	Mar	18	Year 3	Feb	18	2%	Year 3	Jan	21	2%	Year 2	Mar	19	2%	Year 1	Mar	21	2%	9.196	2%	1%	138	177	39	39	1533	0,222
		Year 3	Mar	19	Year 3	Feb	19	0%	Year 3	Jan	22	0%	Year 2	Mar	20	0%	Year 1	Mar	22	0%	9.196	0%	0%	3	8	5	5	24	0,622
		Year 3	Mar	20	Year 3	Feb	20	4%	Year 3	Jan	23	3%	Year 2	Mar	21	3%	Year 1	Mar	23	3%	9.196	3%	3%	292	297	6	6	33	0,019
		Year 3	Mar	21	Year 3	Feb	21	5%	Year 3	Jan	24	4%	Year 2	Mar	22	4%	Year 1	Mar	24	4%	9.196	4%	4%	365	365	0	0	0	0,001
		Year 3	Mar	22	Year 3	Feb	22	5%	Year 3	Jan	25	5%	Year 2	Mar	23	5%	Year 1	Mar	25	4%	9.196	5%	4%	408	441	32	32	1030	0,073
		Year 3	Mar	23	Year 3	Feb	23	5%	Year 3	Jan	26	5%	Year 2	Mar	24	5%	Year 1	Mar	26	4%	9.196	5%	4%	410	410	0	0	0	0,000
		Year 3	Mar	24	Year 3	Feb	24	6%	Year 3	Jan	27	5%	Year 2	Mar	25	4%	Year 1	Mar	27	5%	9.196	5%	4%	392	471	78	78	6106	0,166
		Year 3	Mar	25	Year 3	Feb	25	2%	Year 3	Jan	28	2%	Year 2	Mar	26	2%	Year 1	Mar	28	2%	9.196	2%	2%	149	155	6	6	36	0,039
		Year 3	Mar	26	Year 3	Feb	26	0%	Year 3	Jan	29	0%	Year 2	Mar	27	0%	Year 1	Mar	29	0%	9.196	0%	0%	7	4	-3	3	6	0,632
		Year 3	Mar	27	Year 3	Feb	27	4%	Year 3	Jan	30	4%	Year 2	Mar	28	2%	Year 1	Mar	30	3%	9.196	3%	3%	240	301	62	62	3826	0,205
		Year 3	Mar	28	Year 3	Feb	28	5%	Year 3	Jan	31	5%	Year 2	Mar	29	3%	Year 1	Mar	31	4%	9.196	4%	4%	343	387	43	43	1874	0,112
		Year 3	Mar	29	Year 3	Mar	1	4%	Year 3	Feb	1	5%	Year 2	Mar	30	5%	Year 1	Apr	1	4%	9.196	5%	5%	421	431	10	10	91	0,022
		Year 3	Mar	30	Year 3	Mar	2	4%	Year 3	Feb	2	5%	Year 2	Mar	31	5%	Year 1	Apr	2	5%	9.196	4%	4%	378	385	7	7	55	0,019
		Year 3	Mar	31	Year 3	Mar	3	5%	Year 3	Feb	3	5%	Year 2	Apr	1	5%	Year 1	Apr	3	3%	9.196	5%	4%	412	478	65	65	4282	0,137

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag											
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	Norm. %Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	126%	Year 3	Apr	1	Year 3	Mar	4	2%	Year 3	Feb	4	2%	Year 2	Apr	2	1%	Year 1	Apr	4	2%	9.193	2%	2%	157	162	5	5	27	0,032
w2	0%	Year 3	Apr	2	Year 3	Mar	5	0%	Year 3	Feb	5	0%	Year 2	Apr	3	0%	Year 1	Apr	5	0%	9.193	0%	0%	7	6	0	0	0	0,069
w3	27%	Year 3	Apr	3	Year 3	Mar	6	3%	Year 3	Feb	6	3%	Year 2	Apr	4	4%	Year 1	Apr	6	1%	9.193	5%	4%	323	287	-36	36	1320	0,127
w4	0%	Year 3	Apr	4	Year 3	Mar	7	4%	Year 3	Feb	7	4%	Year 2	Apr	5	4%	Year 1	Apr	7	4%	9.193	6%	5%	415	351	-64	64	4096	0,183
		Year 3	Apr	5	Year 3	Mar	8	4%	Year 3	Feb	8	5%	Year 2	Apr	6	4%	Year 1	Apr	8	4%	9.193	6%	5%	433	408	-25	25	601	0,060
MAD	28	Year 3	Apr	6	Year 3	Mar	9	4%	Year 3	Feb	9	5%	Year 2	Apr	7	4%	Year 1	Apr	9	5%	9.193	6%	5%	420	417	-3	3	11	0,008
		Year 3	Apr	7	Year 3	Mar	10	5%	Year 3	Feb	10	5%	Year 2	Apr	8	5%	Year 1	Apr	10	5%	9.193	7%	5%	492	467	-25	25	608	0,053
		Year 3	Apr	8	Year 3	Mar	11	2%	Year 3	Feb	11	2%	Year 2	Apr	9	2%	Year 1	Apr	11	2%	9.193	2%	2%	164	137	-27	27	716	0,195
		Year 3	Apr	9	Year 3	Mar	12	0%	Year 3	Feb	12	0%	Year 2	Apr	10	0%	Year 1	Apr	12	0%	9.193	0%	0%	1	3	2	2	4	0,664
		Year 3	Apr	10	Year 3	Mar	13	4%	Year 3	Feb	13	4%	Year 2	Apr	11	4%	Year 1	Apr	13	3%	9.193	5%	4%	365	338	-27	27	704	0,078
		Year 3	Apr	11	Year 3	Mar	14	4%	Year 3	Feb	14	4%	Year 2	Apr	12	5%	Year 1	Apr	14	4%	9.193	6%	4%	394	404	10	10	104	0,025
		Year 3	Apr	12	Year 3	Mar	15	4%	Year 3	Feb	15	5%	Year 2	Apr	13	5%	Year 1	Apr	15	4%	9.193	6%	5%	420	464	44	44	1940	0,095
		Year 3	Apr	13	Year 3	Mar	16	4%	Year 3	Feb	16	5%	Year 2	Apr	14	5%	Year 1	Apr	16	5%	9.193	6%	5%	415	423	8	8	59	0,018
		Year 3	Apr	14	Year 3	Mar	17	5%	Year 3	Feb	17	6%	Year 2	Apr	15	5%	Year 1	Apr	17	5%	9.193	7%	5%	493	350	-144	144	20661	0,411
		Year 3	Apr	15	Year 3	Mar	18	2%	Year 3	Feb	18	2%	Year 2	Apr	16	2%	Year 1	Apr	18	2%	9.193	3%	2%	181	169	-11	11	132	0,068
		Year 3	Apr	16	Year 3	Mar	19	0%	Year 3	Feb	19	0%	Year 2	Apr	17	0%	Year 1	Apr	19	0%	9.193	0%	0%	9	6	-3	3	7	0,454
		Year 3	Apr	17	Year 3	Mar	20	3%	Year 3	Feb	20	4%	Year 2	Apr	18	3%	Year 1	Apr	20	3%	9.193	5%	3%	315	127	-188	188	35494	1,489
		Year 3	Apr	18	Year 3	Mar	21	4%	Year 3	Feb	21	5%	Year 2	Apr	19	4%	Year 1	Apr	21	4%	9.193	6%	4%	386	341	-45	45	2022	0,132
		Year 3	Apr	19	Year 3	Mar	22	4%	Year 3	Feb	22	5%	Year 2	Apr	20	4%	Year 1	Apr	22	4%	9.193	7%	5%	449	454	5	5	26	0,011
		Year 3	Apr	20	Year 3	Mar	23	4%	Year 3	Feb	23	5%	Year 2	Apr	21	5%	Year 1	Apr	23	3%	9.193	6%	5%	433	426	-7	7	56	0,018
		Year 3	Apr	21	Year 3	Mar	24	5%	Year 3	Feb	24	6%	Year 2	Apr	22	5%	Year 1	Apr	24	5%	9.193	7%	5%	483	454	-29	29	817	0,063
		Year 3	Apr	22	Year 3	Mar	25	2%	Year 3	Feb	25	2%	Year 2	Apr	23	2%	Year 1	Apr	25	2%	9.193	2%	2%	166	166	0	0	0	0,000
		Year 3	Apr	23	Year 3	Mar	26	0%	Year 3	Feb	26	0%	Year 2	Apr	24	0%	Year 1	Apr	26	0%	9.193	0%	0%	6	17	12	12	143	0,684
		Year 3	Apr	24	Year 3	Mar	27	3%	Year 3	Feb	27	4%	Year 2	Apr	25	3%	Year 1	Apr	27	3%	9.193	5%	3%	318	315	-4	4	14	0,012
		Year 3	Apr	25	Year 3	Mar	28	4%	Year 3	Feb	28	5%	Year 2	Apr	26	4%	Year 1	Apr	28	5%	9.193	6%	4%	400	358	-42	42	1775	0,118
		Year 3	Apr	26	Year 3	Mar	29	4%	Year 3	Mar	1	4%	Year 2	Apr	27	5%	Year 1	Apr	29	5%	9.193	7%	5%	447	454	7	7	45	0,015
		Year 3	Apr	27	Year 3	Mar	30	4%	Year 3	Mar	2	4%	Year 2	Apr	28	5%	Year 1	Apr	30	6%	9.193	6%	4%	411	407	-4	4	15	0,009
		Year 3	Apr	28	Year 3	Mar	31	5%	Year 3	Mar	3	5%	Year 2	Apr	29	5%	Year 1	May	1	1%	9.193	7%	5%	493	515	22	22	500	0,043
		Year 3	Apr	29	Year 3	Apr	1	2%	Year 3	Mar	4	2%	Year 2	Apr	30	2%	Year 1	May	2	2%	9.193	3%	2%	192	207	15	15	214	0,071
		Year 3	Apr	30	Year 3	Apr	2	0%	Year 3	Mar	5	0%	Year 2	May	1	0%	Year 1	May	3	0%	9.193	0%	0%	7	19	12	12	144	0,631

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag											
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	Norm. %Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	1%	Year 3	May	1	Year 3	Apr	3	3%	Year 3	Mar	6	3%	Year 2	May	2	3%	Year 1	May	4	3%	9.369	3%	3%	291	35	-256	256	65503	7,336
w2	87%	Year 3	May	2	Year 3	Apr	4	4%	Year 3	Mar	7	4%	Year 2	May	3	4%	Year 1	May	5	4%	9.369	4%	4%	372	297	-75	75	5640	0,253
w3	18%	Year 3	May	3	Year 3	Apr	5	5%	Year 3	Mar	8	4%	Year 2	May	4	5%	Year 1	May	6	5%	9.369	5%	4%	406	426	19	19	376	0,046
w4	0%	Year 3	May	4	Year 3	Apr	6	5%	Year 3	Mar	9	4%	Year 2	May	5	3%	Year 1	May	7	5%	9.369	4%	4%	363	437	74	74	5537	0,170
		Year 3	May	5	Year 3	Apr	7	5%	Year 3	Mar	10	5%	Year 2	May	6	4%	Year 1	May	8	5%	9.369	5%	5%	446	523	76	76	5851	0,146
MAD	41	Year 3	May	6	Year 3	Apr	8	2%	Year 3	Mar	11	2%	Year 2	May	7	2%	Year 1	May	9	2%	9.369	2%	2%	147	140	-7	7	47	0,049
		Year 3	May	7	Year 3	Apr	9	0%	Year 3	Mar	12	0%	Year 2	May	8	0%	Year 1	May	10	0%	9.369	0%	0%	1	12	11	11	122	0,922
		Year 3	May	8	Year 3	Apr	10	4%	Year 3	Mar	13	4%	Year 2	May	9	4%	Year 1	May	11	3%	9.369	4%	4%	337	307	-30	30	929	0,099
		Year 3	May	9	Year 3	Apr	11	5%	Year 3	Mar	14	4%	Year 2	May	10	4%	Year 1	May	12	5%	9.369	4%	4%	355	368	12	12	151	0,033
		Year 3	May	10	Year 3	Apr	12	5%	Year 3	Mar	15	4%	Year 2	May	11	5%	Year 1	May	13	5%	9.369	4%	4%	392	453	61	61	3697	0,134
		Year 3	May	11	Year 3	Apr	13	5%	Year 3	Mar	16	4%	Year 2	May	12	4%	Year 1	May	14	4%	9.369	4%	4%	379	406	27	27	755	0,068
		Year 3	May	12	Year 3	Apr	14	4%	Year 3	Mar	17	5%	Year 2	May	13	5%	Year 1	May	15	5%	9.369	5%	5%	461	461	0	0	0	0,001
		Year 3	May	13	Year 3	Apr	15	2%	Year 3	Mar	18	2%	Year 2	May	14	2%	Year 1	May	16	2%	9.369	2%	2%	166	181	15	15	227	0,083
		Year 3	May	14	Year 3	Apr	16	0%	Year 3	Mar	19	0%	Year 2	May	15	0%	Year 1	May	17	0%	9.369	0%	0%	8	12	3	3	12	0,291
		Year 3	May	15	Year 3	Apr	17	1%	Year 3	Mar	20	3%	Year 2	May	16	2%	Year 1	May	18	4%	9.369	3%	3%	267	346	78	78	6150	0,227
		Year 3	May	16	Year 3	Apr	18	4%	Year 3	Mar	21	4%	Year 2	May	17	4%	Year 1	May	19	3%	9.369	4%	4%	347	357	10	10	102	0,028
		Year 3	May	17	Year 3	Apr	19	5%	Year 3	Mar	22	4%	Year 2	May	18	6%	Year 1	May	20	4%	9.369	5%	5%	436	454	18	18	329	0,040
		Year 3	May	18	Year 3	Apr	20	5%	Year 3	Mar	23	4%	Year 2	May	19	3%	Year 1	May	21	5%	9.369	4%	4%	371	489	118	118	13885	0,241
		Year 3	May	19	Year 3	Apr	21	5%	Year 3	Mar	24	5%	Year 2	May	20	5%	Year 1	May	22	6%	9.369	5%	5%	449	307	-142	142	20070	0,462
		Year 3	May	20	Year 3	Apr	22	2%	Year 3	Mar	25	2%	Year 2	May	21	2%	Year 1	May	23	2%	9.369	2%	2%	149	99	-50	50	2543	0,510
		Year 3	May	21	Year 3	Apr	23	0%	Year 3	Mar	26	0%	Year 2	May	22	0%	Year 1	May	24	0%	9.369	0%	0%	3	7	4	4	13	0,530
		Year 3	May	22	Year 3	Apr	24	4%	Year 3	Mar	27	3%	Year 2	May	23	4%	Year 1	May	25	2%	9.369	3%	3%	297	312	14	14	206	0,046
		Year 3	May	23	Year 3	Apr	25	4%	Year 3	Mar	28	4%	Year 2	May	24	4%	Year 1	May	26	4%	9.369	4%	4%	369	387	18	18	332	0,047
		Year 3	May	24	Year 3	Apr	26	5%	Year 3	Mar	29	4%	Year 2	May	25	5%	Year 1	May	27	5%	9.369	5%	4%	418	440	22	22	469	0,049
		Year 3	May	25	Year 3	Apr	27	5%	Year 3	Mar	30	4%	Year 2	May	26	3%	Year 1	May	28	5%	9.369	4%	4%	356	291	-65	65	4237	0,224
		Year 3	May	26	Year 3	Apr	28	6%	Year 3	Mar	31	5%	Year 2	May	27	5%	Year 1	May	29	6%	9.369	5%	5%	455	455	0	0	0	0,001
		Year 3	May	27	Year 3	Apr	29	2%	Year 3	Apr	1	2%	Year 2	May	28	2%	Year 1	May	30	3%	9.369	2%	2%	178	173	-5	5	24	0,029
		Year 3	May	28	Year 3	Apr	30	0%	Year 3	Apr	2	0%	Year 2	May	29	0%	Year 1	May	31	0%	9.369	0%	0%	7	15	7	7	51	0,489
		Year 3	May	29	Year 3	May	1	0%	Year 3	Apr	3	3%	Year 2	May	30	4%	Year 1	Jun	1	3%	9.369	4%	3%	316	316	0	0	0	0,000
		Year 3	May	30	Year 3	May	2	3%	Year 3	Apr	4	4%	Year 2	May	31	5%	Year 1	Jun	2	4%	9.369	4%	4%	390	378	-12	12	136	0,031
		Year 3	May	31	Year 3	May	3	5%	Year 3	Apr	5	5%	Year 2	Jun	1	4%	Year 1	Jun	3	5%	9.369	5%	5%	436	469	33	33	1085	0,070

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag											
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	Norm. %Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	0%	Year 3	Jun	1	Year 3	May	4	5%	Year 3	Apr	6	5%	Year 2	Jun	2	4%	Year 1	Jun	4	3%	9.081	4%	4%	368	411	43	43	1831	0,104
w2	27%	Year 3	Jun	2	Year 3	May	5	6%	Year 3	Apr	7	5%	Year 2	Jun	3	5%	Year 1	Jun	5	5%	9.081	5%	5%	451	450	-1	1	0	0,001
w3	51%	Year 3	Jun	3	Year 3	May	6	2%	Year 3	Apr	8	2%	Year 2	Jun	4	2%	Year 1	Jun	6	2%	9.081	2%	2%	162	166	4	4	15	0,023
w4	24%	Year 3	Jun	4	Year 3	May	7	0%	Year 3	Apr	9	0%	Year 2	Jun	5	0%	Year 1	Jun	7	0%	9.081	0%	0%	9	12	3	3	9	0,263
		Year 3	Jun	5	Year 3	May	8	3%	Year 3	Apr	10	4%	Year 2	Jun	6	4%	Year 1	Jun	8	3%	9.081	4%	4%	327	180	-147	147	21693	0,818
MAD	36	Year 3	Jun	6	Year 3	May	9	4%	Year 3	Apr	11	5%	Year 2	Jun	7	4%	Year 1	Jun	9	4%	9.081	4%	4%	358	344	-13	13	178	0,039
		Year 3	Jun	7	Year 3	May	10	5%	Year 3	Apr	12	5%	Year 2	Jun	8	5%	Year 1	Jun	10	5%	9.081	5%	5%	434	398	-35	35	1237	0,088
		Year 3	Jun	8	Year 3	May	11	4%	Year 3	Apr	13	5%	Year 2	Jun	9	4%	Year 1	Jun	11	4%	9.081	5%	4%	398	379	-19	19	364	0,050
		Year 3	Jun	9	Year 3	May	12	5%	Year 3	Apr	14	4%	Year 2	Jun	10	5%	Year 1	Jun	12	5%	9.081	5%	5%	416	470	55	55	2983	0,116
		Year 3	Jun	10	Year 3	May	13	2%	Year 3	Apr	15	2%	Year 2	Jun	11	2%	Year 1	Jun	13	2%	9.081	2%	2%	158	179	20	20	403	0,112
		Year 3	Jun	11	Year 3	May	14	0%	Year 3	Apr	16	0%	Year 2	Jun	12	0%	Year 1	Jun	14	0%	9.081	0%	0%	7	8	1	1	2	0,166
		Year 3	Jun	12	Year 3	May	15	4%	Year 3	Apr	17	1%	Year 2	Jun	13	3%	Year 1	Jun	15	4%	9.081	3%	3%	263	342	79	79	6271	0,232
		Year 3	Jun	13	Year 3	May	16	4%	Year 3	Apr	18	4%	Year 2	Jun	14	4%	Year 1	Jun	16	4%	9.081	4%	4%	343	407	64	64	4085	0,157
		Year 3	Jun	14	Year 3	May	17	5%	Year 3	Apr	19	5%	Year 2	Jun	15	5%	Year 1	Jun	17	4%	9.081	5%	5%	414	414	0	0	0	0,000
		Year 3	Jun	15	Year 3	May	18	5%	Year 3	Apr	20	5%	Year 2	Jun	16	4%	Year 1	Jun	18	4%	9.081	4%	4%	383	345	-38	38	1429	0,110
		Year 3	Jun	16	Year 3	May	19	3%	Year 3	Apr	21	5%	Year 2	Jun	17	5%	Year 1	Jun	19	5%	9.081	5%	5%	445	438	-8	8	61	0,018
		Year 3	Jun	17	Year 3	May	20	1%	Year 3	Apr	22	2%	Year 2	Jun	18	2%	Year 1	Jun	20	2%	9.081	2%	2%	154	163	10	10	91	0,059
		Year 3	Jun	18	Year 3	May	21	0%	Year 3	Apr	23	0%	Year 2	Jun	19	0%	Year 1	Jun	21	0%	9.081	0%	0%	7	12	5	5	22	0,394
		Year 3	Jun	19	Year 3	May	22	3%	Year 3	Apr	24	4%	Year 2	Jun	20	3%	Year 1	Jun	22	3%	9.081	3%	3%	301	339	38	38	1447	0,112
		Year 3	Jun	20	Year 3	May	23	4%	Year 3	Apr	25	4%	Year 2	Jun	21	4%	Year 1	Jun	23	4%	9.081	4%	4%	360	358	-2	2	5	0,006
		Year 3	Jun	21	Year 3	May	24	5%	Year 3	Apr	26	5%	Year 2	Jun	22	5%	Year 1	Jun	24	5%	9.081	5%	5%	419	456	37	37	1333	0,080
		Year 3	Jun	22	Year 3	May	25	3%	Year 3	Apr	27	5%	Year 2	Jun	23	4%	Year 1	Jun	25	4%	9.081	5%	4%	391	435	44	44	1963	0,102
		Year 3	Jun	23	Year 3	May	26	5%	Year 3	Apr	28	6%	Year 2	Jun	24	5%	Year 1	Jun	26	5%	9.081	5%	5%	458	472	15	15	211	0,031
		Year 3	Jun	24	Year 3	May	27	2%	Year 3	Apr	29	2%	Year 2	Jun	25	2%	Year 1	Jun	27	2%	9.081	2%	2%	194	142	-52	52	2696	0,365
		Year 3	Jun	25	Year 3	May	28	0%	Year 3	Apr	30	0%	Year 2	Jun	26	0%	Year 1	Jun	28	0%	9.081	0%	0%	16	19	3	3	8	0,153
		Year 3	Jun	26	Year 3	May	29	3%	Year 3	May	1	0%	Year 2	Jun	27	3%	Year 1	Jun	29	4%	9.081	3%	2%	222	180	-42	42	1753	0,232
		Year 3	Jun	27	Year 3	May	30	4%	Year 3	May	2	3%	Year 2	Jun	28	3%	Year 1	Jun	30	5%	9.081	4%	4%	323	196	-127	127	16043	0,645
		Year 3	Jun	28	Year 3	May	31	5%	Year 3	May	3	5%	Year 2	Jun	29	5%	Year 1	Jul	1	5%	9.081	5%	4%	406	304	-102	102	10394	0,335
		Year 3	Jun	29	Year 3	Jun	1	5%	Year 3	May	4	5%	Year 2	Jun	30	5%	Year 1	Jul	2	4%	9.081	5%	4%	406	360	-46	46	2139	0,128
		Year 3	Jun	30	Year 3	Jun	2	5%	Year 3	May	5	6%	Year 2	Jul	1	6%	Year 1	Jul	3	5%	9.081	6%	5%	488	446	-42	42	1751	0,094

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag											
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	Norm. %Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	0%	Year 3	Jun	1	Year 3	May	4	5%	Year 3	Apr	6	5%	Year 2	Jun	2	4%	Year 1	Jun	4	3%	9.081	4%	4%	368	411	43	43	1831	0,104
w2	27%	Year 3	Jun	2	Year 3	May	5	6%	Year 3	Apr	7	5%	Year 2	Jun	3	5%	Year 1	Jun	5	5%	9.081	5%	5%	451	450	-1	1	0	0,001
w3	51%	Year 3	Jun	3	Year 3	May	6	2%	Year 3	Apr	8	2%	Year 2	Jun	4	2%	Year 1	Jun	6	2%	9.081	2%	2%	162	166	4	4	15	0,023
w4	24%	Year 3	Jun	4	Year 3	May	7	0%	Year 3	Apr	9	0%	Year 2	Jun	5	0%	Year 1	Jun	7	0%	9.081	0%	0%	9	12	3	3	9	0,263
		Year 3	Jun	5	Year 3	May	8	3%	Year 3	Apr	10	4%	Year 2	Jun	6	4%	Year 1	Jun	8	3%	9.081	4%	4%	327	180	-147	147	21693	0,818
MAD	36	Year 3	Jun	6	Year 3	May	9	4%	Year 3	Apr	11	5%	Year 2	Jun	7	4%	Year 1	Jun	9	4%	9.081	4%	4%	358	344	-13	13	178	0,039
		Year 3	Jun	7	Year 3	May	10	5%	Year 3	Apr	12	5%	Year 2	Jun	8	5%	Year 1	Jun	10	5%	9.081	5%	5%	434	398	-35	35	1237	0,088
		Year 3	Jun	8	Year 3	May	11	4%	Year 3	Apr	13	5%	Year 2	Jun	9	4%	Year 1	Jun	11	4%	9.081	5%	4%	398	379	-19	19	364	0,050
		Year 3	Jun	9	Year 3	May	12	5%	Year 3	Apr	14	4%	Year 2	Jun	10	5%	Year 1	Jun	12	5%	9.081	5%	5%	416	470	55	55	2983	0,116
		Year 3	Jun	10	Year 3	May	13	2%	Year 3	Apr	15	2%	Year 2	Jun	11	2%	Year 1	Jun	13	2%	9.081	2%	2%	158	179	20	20	403	0,112
		Year 3	Jun	11	Year 3	May	14	0%	Year 3	Apr	16	0%	Year 2	Jun	12	0%	Year 1	Jun	14	0%	9.081	0%	0%	7	8	1	1	2	0,166
		Year 3	Jun	12	Year 3	May	15	4%	Year 3	Apr	17	1%	Year 2	Jun	13	3%	Year 1	Jun	15	4%	9.081	3%	3%	263	342	79	79	6271	0,232
		Year 3	Jun	13	Year 3	May	16	4%	Year 3	Apr	18	4%	Year 2	Jun	14	4%	Year 1	Jun	16	4%	9.081	4%	4%	343	407	64	64	4085	0,157
		Year 3	Jun	14	Year 3	May	17	5%	Year 3	Apr	19	5%	Year 2	Jun	15	5%	Year 1	Jun	17	4%	9.081	5%	5%	414	414	0	0	0	0,000
		Year 3	Jun	15	Year 3	May	18	5%	Year 3	Apr	20	5%	Year 2	Jun	16	4%	Year 1	Jun	18	4%	9.081	4%	4%	383	345	-38	38	1429	0,110
		Year 3	Jun	16	Year 3	May	19	3%	Year 3	Apr	21	5%	Year 2	Jun	17	5%	Year 1	Jun	19	5%	9.081	5%	5%	445	438	-8	8	61	0,018
		Year 3	Jun	17	Year 3	May	20	1%	Year 3	Apr	22	2%	Year 2	Jun	18	2%	Year 1	Jun	20	2%	9.081	2%	2%	154	163	10	10	91	0,059
		Year 3	Jun	18	Year 3	May	21	0%	Year 3	Apr	23	0%	Year 2	Jun	19	0%	Year 1	Jun	21	0%	9.081	0%	0%	7	12	5	5	22	0,394
		Year 3	Jun	19	Year 3	May	22	3%	Year 3	Apr	24	4%	Year 2	Jun	20	3%	Year 1	Jun	22	3%	9.081	3%	3%	301	339	38	38	1447	0,112
		Year 3	Jun	20	Year 3	May	23	4%	Year 3	Apr	25	4%	Year 2	Jun	21	4%	Year 1	Jun	23	4%	9.081	4%	4%	360	358	-2	2	5	0,006
		Year 3	Jun	21	Year 3	May	24	5%	Year 3	Apr	26	5%	Year 2	Jun	22	5%	Year 1	Jun	24	5%	9.081	5%	5%	419	456	37	37	1333	0,080
		Year 3	Jun	22	Year 3	May	25	3%	Year 3	Apr	27	5%	Year 2	Jun	23	4%	Year 1	Jun	25	4%	9.081	5%	4%	391	435	44	44	1963	0,102
		Year 3	Jun	23	Year 3	May	26	5%	Year 3	Apr	28	6%	Year 2	Jun	24	5%	Year 1	Jun	26	5%	9.081	5%	5%	458	472	15	15	211	0,031
		Year 3	Jun	24	Year 3	May	27	2%	Year 3	Apr	29	2%	Year 2	Jun	25	2%	Year 1	Jun	27	2%	9.081	2%	2%	194	142	-52	52	2696	0,365
		Year 3	Jun	25	Year 3	May	28	0%	Year 3	Apr	30	0%	Year 2	Jun	26	0%	Year 1	Jun	28	0%	9.081	0%	0%	16	19	3	3	8	0,153
		Year 3	Jun	26	Year 3	May	29	3%	Year 3	May	1	0%	Year 2	Jun	27	3%	Year 1	Jun	29	4%	9.081	3%	2%	222	180	-42	42	1753	0,232
		Year 3	Jun	27	Year 3	May	30	4%	Year 3	May	2	3%	Year 2	Jun	28	3%	Year 1	Jun	30	5%	9.081	4%	4%	323	196	-127	127	16043	0,645
		Year 3	Jun	28	Year 3	May	31	5%	Year 3	May	3	5%	Year 2	Jun	29	5%	Year 1	Jul	1	5%	9.081	5%	4%	406	304	-102	102	10394	0,335
		Year 3	Jun	29	Year 3	Jun	1	5%	Year 3	May	4	5%	Year 2	Jun	30	5%	Year 1	Jul	2	4%	9.081	5%	4%	406	360	-46	46	2139	0,128
		Year 3	Jun	30	Year 3	Jun	2	5%	Year 3	May	5	6%	Year 2	Jul	1	6%	Year 1	Jul	3	5%	9.081	6%	5%	488	446	-42	42	1751	0,094

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag											
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	Norm. %Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	49%	Year 3	Jul	1	Year 3	Jun	3	2%	Year 3	May	6	2%	Year 2	Jul	2	3%	Year 1	Jul	4	2%	8.059	2%	2%	165	149	-16	16	247	0,106
w2	29%	Year 3	Jul	2	Year 3	Jun	4	0%	Year 3	May	7	0%	Year 2	Jul	3	1%	Year 1	Jul	5	0%	8.059	0%	0%	19	11	-8	8	66	0,735
w3	25%	Year 3	Jul	3	Year 3	Jun	5	2%	Year 3	May	8	3%	Year 2	Jul	4	4%	Year 1	Jul	6	3%	8.059	3%	3%	235	268	33	33	1117	0,125
w4	0%	Year 3	Jul	4	Year 3	Jun	6	4%	Year 3	May	9	4%	Year 2	Jul	5	2%	Year 1	Jul	7	4%	8.059	4%	4%	296	332	36	36	1301	0,109
		Year 3	Jul	5	Year 3	Jun	7	5%	Year 3	May	10	5%	Year 2	Jul	6	2%	Year 1	Jul	8	5%	8.059	4%	4%	338	322	-16	16	264	0,050
MAD	23	Year 3	Jul	6	Year 3	Jun	8	4%	Year 3	May	11	4%	Year 2	Jul	7	2%	Year 1	Jul	9	4%	8.059	4%	4%	324	348	24	24	569	0,069
		Year 3	Jul	7	Year 3	Jun	9	5%	Year 3	May	12	5%	Year 2	Jul	8	3%	Year 1	Jul	10	5%	8.059	5%	5%	387	400	13	13	169	0,033
		Year 3	Jul	8	Year 3	Jun	10	2%	Year 3	May	13	2%	Year 2	Jul	9	1%	Year 1	Jul	11	2%	8.059	2%	2%	147	143	-4	4	13	0,025
		Year 3	Jul	9	Year 3	Jun	11	0%	Year 3	May	14	0%	Year 2	Jul	10	0%	Year 1	Jul	12	0%	8.059	0%	0%	8	10	2	2	5	0,225
		Year 3	Jul	10	Year 3	Jun	12	4%	Year 3	May	15	4%	Year 2	Jul	11	3%	Year 1	Jul	13	3%	8.059	4%	4%	302	290	-12	12	149	0,042
		Year 3	Jul	11	Year 3	Jun	13	5%	Year 3	May	16	4%	Year 2	Jul	12	4%	Year 1	Jul	14	4%	8.059	4%	5%	366	354	-12	12	135	0,033
		Year 3	Jul	12	Year 3	Jun	14	5%	Year 3	May	17	5%	Year 2	Jul	13	6%	Year 1	Jul	15	6%	8.059	5%	5%	417	360	-56	56	3172	0,156
		Year 3	Jul	13	Year 3	Jun	15	4%	Year 3	May	18	5%	Year 2	Jul	14	4%	Year 1	Jul	16	3%	8.059	5%	5%	371	371	0	0	0	0,000
		Year 3	Jul	14	Year 3	Jun	16	5%	Year 3	May	19	3%	Year 2	Jul	15	6%	Year 1	Jul	17	2%	8.059	5%	5%	391	421	30	30	892	0,071
		Year 3	Jul	15	Year 3	Jun	17	2%	Year 3	May	20	1%	Year 2	Jul	16	2%	Year 1	Jul	18	0%	8.059	2%	2%	130	152	22	22	490	0,145
		Year 3	Jul	16	Year 3	Jun	18	0%	Year 3	May	21	0%	Year 2	Jul	17	0%	Year 1	Jul	19	0%	8.059	0%	0%	11	14	3	3	9	0,214
		Year 3	Jul	17	Year 3	Jun	19	4%	Year 3	May	22	3%	Year 2	Jul	18	4%	Year 1	Jul	20	3%	8.059	4%	4%	313	253	-60	60	3616	0,238
		Year 3	Jul	18	Year 3	Jun	20	4%	Year 3	May	23	4%	Year 2	Jul	19	5%	Year 1	Jul	21	3%	8.059	4%	4%	358	347	-11	11	125	0,032
		Year 3	Jul	19	Year 3	Jun	21	5%	Year 3	May	24	5%	Year 2	Jul	20	5%	Year 1	Jul	22	5%	8.059	5%	5%	422	356	-66	66	4420	0,187
		Year 3	Jul	20	Year 3	Jun	22	5%	Year 3	May	25	3%	Year 2	Jul	21	5%	Year 1	Jul	23	4%	8.059	5%	5%	370	372	2	2	3	0,005
		Year 3	Jul	21	Year 3	Jun	23	5%	Year 3	May	26	5%	Year 2	Jul	22	5%	Year 1	Jul	24	5%	8.059	5%	5%	435	404	-31	31	945	0,076
		Year 3	Jul	22	Year 3	Jun	24	2%	Year 3	May	27	2%	Year 2	Jul	23	2%	Year 1	Jul	25	2%	8.059	2%	2%	147	162	15	15	211	0,090
		Year 3	Jul	23	Year 3	Jun	25	0%	Year 3	May	28	0%	Year 2	Jul	24	0%	Year 1	Jul	26	0%	8.059	0%	0%	17	16	-1	1	0	0,037
		Year 3	Jul	24	Year 3	Jun	26	2%	Year 3	May	29	3%	Year 2	Jul	25	4%	Year 1	Jul	27	3%	8.059	3%	3%	241	298	56	56	3185	0,189
		Year 3	Jul	25	Year 3	Jun	27	2%	Year 3	May	30	4%	Year 2	Jul	26	4%	Year 1	Jul	28	4%	8.059	3%	3%	266	318	52	52	2660	0,162
		Year 3	Jul	26	Year 3	Jun	28	3%	Year 3	May	31	5%	Year 2	Jul	27	5%	Year 1	Jul	29	4%	8.059	4%	4%	360	360	0	0	0	0,000
		Year 3	Jul	27	Year 3	Jun	29	4%	Year 3	Jun	1	5%	Year 2	Jul	28	5%	Year 1	Jul	30	4%	8.059	5%	5%	371	355	-17	17	274	0,047
		Year 3	Jul	28	Year 3	Jun	30	5%	Year 3	Jun	2	5%	Year 2	Jul	29	5%	Year 1	Jul	31	5%	8.059	5%	5%	429	369	-60	60	3582	0,162
		Year 3	Jul	29	Year 3	Jul	1	2%	Year 3	Jun	3	2%	Year 2	Jul	30	2%	Year 1	Aug	1	2%	8.059	2%	2%	166	163	-3	3	9	0,019
		Year 3	Jul	30	Year 3	Jul	2	0%	Year 3	Jun	4	0%	Year 2	Jul	31	0%	Year 1	Aug	2	0%	8.059	0%	0%	12	21	9	9	84	0,436
		Year 3	Jul	31	Year 3	Jul	3	3%	Year 3	Jun	5	2%	Year 2	Aug	1	3%	Year 1	Aug	3	3%	8.059	3%	3%	245	292	47	47	2216	0,161

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag											
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	Norm. %Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	17%	Year 3	Aug	1	Year 3	Jul	4	4%	Year 3	Jun	6	4%	Year 2	Aug	2	3%	Year 1	Aug	4	4%	8.051	3%	4%	284	287	3	3	11	0,011
w2	0%	Year 3	Aug	2	Year 3	Jul	5	4%	Year 3	Jun	7	5%	Year 2	Aug	3	5%	Year 1	Aug	5	4%	8.051	4%	4%	294	323	30	30	886	0,092
w3	0%	Year 3	Aug	3	Year 3	Jul	6	4%	Year 3	Jun	8	4%	Year 2	Aug	4	4%	Year 1	Aug	6	4%	8.051	4%	4%	315	336	22	22	476	0,065
w4	73%	Year 3	Aug	4	Year 3	Jul	7	5%	Year 3	Jun	9	5%	Year 2	Aug	5	5%	Year 1	Aug	7	5%	8.051	5%	5%	375	347	-29	29	836	0,083
		Year 3	Aug	5	Year 3	Jul	8	2%	Year 3	Jun	10	2%	Year 2	Aug	6	1%	Year 1	Aug	8	1%	8.051	1%	1%	110	148	38	38	1460	0,259
MAD	25	Year 3	Aug	6	Year 3	Jul	9	0%	Year 3	Jun	11	0%	Year 2	Aug	7	0%	Year 1	Aug	9	0%	8.051	0%	0%	5	7	1	1	2	0,206
		Year 3	Aug	7	Year 3	Jul	10	4%	Year 3	Jun	12	4%	Year 2	Aug	8	3%	Year 1	Aug	10	3%	8.051	3%	3%	225	229	4	4	14	0,017
		Year 3	Aug	8	Year 3	Jul	11	4%	Year 3	Jun	13	5%	Year 2	Aug	9	3%	Year 1	Aug	11	4%	8.051	4%	4%	292	254	-38	38	1442	0,150
		Year 3	Aug	9	Year 3	Jul	12	4%	Year 3	Jun	14	5%	Year 2	Aug	10	4%	Year 1	Aug	12	4%	8.051	4%	4%	319	307	-12	12	148	0,040
		Year 3	Aug	10	Year 3	Jul	13	5%	Year 3	Jun	15	4%	Year 2	Aug	11	4%	Year 1	Aug	13	4%	8.051	4%	4%	324	375	50	50	2543	0,135
		Year 3	Aug	11	Year 3	Jul	14	5%	Year 3	Jun	16	5%	Year 2	Aug	12	5%	Year 1	Aug	14	5%	8.051	5%	5%	377	396	20	20	396	0,050
		Year 3	Aug	12	Year 3	Jul	15	2%	Year 3	Jun	17	2%	Year 2	Aug	13	1%	Year 1	Aug	15	2%	8.051	2%	2%	154	139	-15	15	238	0,111
		Year 3	Aug	13	Year 3	Jul	16	0%	Year 3	Jun	18	0%	Year 2	Aug	14	0%	Year 1	Aug	16	0%	8.051	0%	0%	6	5	-1	1	1	0,204
		Year 3	Aug	14	Year 3	Jul	17	3%	Year 3	Jun	19	4%	Year 2	Aug	15	2%	Year 1	Aug	17	3%	8.051	3%	3%	246	264	18	18	321	0,068
		Year 3	Aug	15	Year 3	Jul	18	4%	Year 3	Jun	20	4%	Year 2	Aug	16	3%	Year 1	Aug	18	4%	8.051	3%	4%	282	255	-27	27	703	0,104
		Year 3	Aug	16	Year 3	Jul	19	4%	Year 3	Jun	21	5%	Year 2	Aug	17	4%	Year 1	Aug	19	5%	8.051	4%	4%	357	310	-47	47	2171	0,150
		Year 3	Aug	17	Year 3	Jul	20	5%	Year 3	Jun	22	5%	Year 2	Aug	18	4%	Year 1	Aug	20	4%	8.051	4%	4%	337	383	46	46	2159	0,121
		Year 3	Aug	18	Year 3	Jul	21	5%	Year 3	Jun	23	5%	Year 2	Aug	19	5%	Year 1	Aug	21	5%	8.051	5%	5%	402	403	1	1	2	0,003
		Year 3	Aug	19	Year 3	Jul	22	2%	Year 3	Jun	24	2%	Year 2	Aug	20	2%	Year 1	Aug	22	2%	8.051	2%	2%	151	180	29	29	841	0,161
		Year 3	Aug	20	Year 3	Jul	23	0%	Year 3	Jun	25	0%	Year 2	Aug	21	0%	Year 1	Aug	23	0%	8.051	0%	0%	6	12	7	7	43	0,543
		Year 3	Aug	21	Year 3	Jul	24	4%	Year 3	Jun	26	2%	Year 2	Aug	22	4%	Year 1	Aug	24	4%	8.051	4%	4%	294	297	3	3	8	0,009
		Year 3	Aug	22	Year 3	Jul	25	4%	Year 3	Jun	27	2%	Year 2	Aug	23	4%	Year 1	Aug	25	4%	8.051	4%	4%	327	328	1	1	2	0,004
		Year 3	Aug	23	Year 3	Jul	26	4%	Year 3	Jun	28	3%	Year 2	Aug	24	5%	Year 1	Aug	26	5%	8.051	5%	5%	394	414	20	20	396	0,048
		Year 3	Aug	24	Year 3	Jul	27	4%	Year 3	Jun	29	4%	Year 2	Aug	25	4%	Year 1	Aug	27	5%	8.051	4%	4%	359	378	19	19	377	0,051
		Year 3	Aug	25	Year 3	Jul	28	5%	Year 3	Jun	30	5%	Year 2	Aug	26	6%	Year 1	Aug	28	5%	8.051	4%	5%	374	421	48	48	2284	0,113
		Year 3	Aug	26	Year 3	Jul	29	2%	Year 3	Jul	1	2%	Year 2	Aug	27	2%	Year 1	Aug	29	2%	8.051	2%	2%	177	177	0	0	0	0,000
		Year 3	Aug	27	Year 3	Jul	30	0%	Year 3	Jul	2	0%	Year 2	Aug	28	0%	Year 1	Aug	30	0%	8.051	0%	0%	15	10	-5	5	25	0,489
		Year 3	Aug	28	Year 3	Jul	31	4%	Year 3	Jul	3	3%	Year 2	Aug	29	4%	Year 1	Aug	31	4%	8.051	4%	4%	306	306	0	0	0	0,000
		Year 3	Aug	29	Year 3	Aug	1	3%	Year 3	Jul	4	4%	Year 2	Aug	30	3%	Year 1	Sep	1	4%	8.051	4%	4%	300	445	145	145	21003	0,326
		Year 3	Aug	30	Year 3	Aug	2	4%	Year 3	Jul	5	4%	Year 2	Aug	31	5%	Year 1	Sep	2	5%	8.051	4%	4%	331	284	-48	48	2280	0,168
		Year 3	Aug	31	Year 3	Aug	3	4%	Year 3	Jul	6	4%	Year 2	Sep	1	4%	Year 1	Sep	3	4%	8.051	4%	4%	314	268	-46	46	2143	0,173

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag						Norm.					
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	%Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	5%	Year 3	Sep	1	Year 3	Aug	4	4%	Year 3	Jul	7	5%	Year 2	Sep	2	5%	Year 1	Sep	4	5%	9.249	6%	5%	464	182	-282	282	79501	1,548
w2	81%	Year 3	Sep	2	Year 3	Aug	5	2%	Year 3	Jul	8	2%	Year 2	Sep	3	2%	Year 1	Sep	5	2%	9.249	2%	2%	173	27	-146	146	21184	5,389
w3	15%	Year 3	Sep	3	Year 3	Aug	6	0%	Year 3	Jul	9	0%	Year 2	Sep	4	0%	Year 1	Sep	6	0%	9.249	0%	0%	11	3	-8	8	59	2,569
w4	19%	Year 3	Sep	4	Year 3	Aug	7	3%	Year 3	Jul	10	4%	Year 2	Sep	5	4%	Year 1	Sep	7	4%	9.249	4%	4%	335	136	-199	199	39649	1,463
		Year 3	Sep	5	Year 3	Aug	8	3%	Year 3	Jul	11	4%	Year 2	Sep	6	4%	Year 1	Sep	8	4%	9.249	5%	4%	399	236	-162	162	26316	0,686
MAD	**44**	Year 3	Sep	6	Year 3	Aug	9	4%	Year 3	Jul	12	4%	Year 2	Sep	7	4%	Year 1	Sep	9	5%	9.249	6%	5%	429	394	-35	35	1253	0,090
		Year 3	Sep	7	Year 3	Aug	10	5%	Year 3	Jul	13	5%	Year 2	Sep	8	5%	Year 1	Sep	10	5%	9.249	6%	5%	435	391	-44	44	1931	0,112
		Year 3	Sep	8	Year 3	Aug	11	5%	Year 3	Jul	14	5%	Year 2	Sep	9	5%	Year 1	Sep	11	6%	9.249	6%	5%	495	423	-72	72	5194	0,171
		Year 3	Sep	9	Year 3	Aug	12	2%	Year 3	Jul	15	2%	Year 2	Sep	10	3%	Year 1	Sep	12	2%	9.249	2%	2%	189	176	-12	12	153	0,070
		Year 3	Sep	10	Year 3	Aug	13	0%	Year 3	Jul	16	0%	Year 2	Sep	11	0%	Year 1	Sep	13	0%	9.249	0%	0%	17	10	-7	7	47	0,700
		Year 3	Sep	11	Year 3	Aug	14	3%	Year 3	Jul	17	3%	Year 2	Sep	12	2%	Year 1	Sep	14	4%	9.249	4%	3%	294	314	20	20	410	0,064
		Year 3	Sep	12	Year 3	Aug	15	3%	Year 3	Jul	18	4%	Year 2	Sep	13	2%	Year 1	Sep	15	4%	9.249	5%	4%	370	370	0	0	0	0,000
		Year 3	Sep	13	Year 3	Aug	16	4%	Year 3	Jul	19	4%	Year 2	Sep	14	2%	Year 1	Sep	16	5%	9.249	5%	4%	395	433	38	38	1436	0,087
		Year 3	Sep	14	Year 3	Aug	17	5%	Year 3	Jul	20	5%	Year 2	Sep	15	2%	Year 1	Sep	17	4%	9.249	5%	4%	399	395	-4	4	20	0,011
		Year 3	Sep	15	Year 3	Aug	18	5%	Year 3	Jul	21	5%	Year 2	Sep	16	4%	Year 1	Sep	18	5%	9.249	6%	5%	460	463	3	3	7	0,006
		Year 3	Sep	16	Year 3	Aug	19	2%	Year 3	Jul	22	2%	Year 2	Sep	17	1%	Year 1	Sep	19	2%	9.249	2%	2%	176	202	26	26	668	0,128
		Year 3	Sep	17	Year 3	Aug	20	0%	Year 3	Jul	23	0%	Year 2	Sep	18	0%	Year 1	Sep	20	0%	9.249	0%	0%	20	9	-11	11	127	1,270
		Year 3	Sep	18	Year 3	Aug	21	4%	Year 3	Jul	24	4%	Year 2	Sep	19	3%	Year 1	Sep	21	4%	9.249	4%	4%	342	306	-36	36	1279	0,117
		Year 3	Sep	19	Year 3	Aug	22	4%	Year 3	Jul	25	4%	Year 2	Sep	20	4%	Year 1	Sep	22	5%	9.249	5%	4%	394	387	-7	7	48	0,018
		Year 3	Sep	20	Year 3	Aug	23	5%	Year 3	Jul	26	4%	Year 2	Sep	21	5%	Year 1	Sep	23	4%	9.249	5%	5%	418	418	0	0	0	0,001
		Year 3	Sep	21	Year 3	Aug	24	5%	Year 3	Jul	27	4%	Year 2	Sep	22	5%	Year 1	Sep	24	2%	9.249	5%	4%	377	377	0	0	0	0,000
		Year 3	Sep	22	Year 3	Aug	25	5%	Year 3	Jul	28	5%	Year 2	Sep	23	5%	Year 1	Sep	25	2%	9.249	5%	4%	405	426	20	20	401	0,047
		Year 3	Sep	23	Year 3	Aug	26	2%	Year 3	Jul	29	2%	Year 2	Sep	24	2%	Year 1	Sep	26	0%	9.249	2%	2%	171	173	2	2	3	0,010
		Year 3	Sep	24	Year 3	Aug	27	0%	Year 3	Jul	30	0%	Year 2	Sep	25	0%	Year 1	Sep	27	0%	9.249	0%	0%	21	15	-6	6	40	0,421
		Year 3	Sep	25	Year 3	Aug	28	4%	Year 3	Jul	31	4%	Year 2	Sep	26	4%	Year 1	Sep	28	3%	9.249	4%	4%	337	299	-39	39	1488	0,129
		Year 3	Sep	26	Year 3	Aug	29	5%	Year 3	Aug	1	3%	Year 2	Sep	27	5%	Year 1	Sep	29	4%	9.249	5%	4%	360	389	29	29	843	0,075
		Year 3	Sep	27	Year 3	Aug	30	3%	Year 3	Aug	2	4%	Year 2	Sep	28	5%	Year 1	Sep	30	5%	9.249	5%	4%	401	436	35	35	1212	0,080
		Year 3	Sep	28	Year 3	Aug	31	3%	Year 3	Aug	3	4%	Year 2	Sep	29	4%	Year 1	Oct	1	4%	9.249	5%	4%	379	385	6	6	36	0,016
		Year 3	Sep	29	Year 3	Sep	1	2%	Year 3	Aug	4	4%	Year 2	Sep	30	6%	Year 1	Oct	2	5%	9.249	5%	4%	414	450	36	36	1302	0,080
		Year 3	Sep	30	Year 3	Sep	2	0%	Year 3	Aug	5	2%	Year 2	Oct	1	2%	Year 1	Oct	3	2%	9.249	2%	2%	168	193	26	26	654	0,132

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag						Norm.					
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	%Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	43%	Year 3	Oct	1	Year 3	Sep	3	0%	Year 3	Aug	6	0%	Year 2	Oct	2	0%	Year 1	Oct	4	0%	9.504	0%	0%	5	15	10	10	99	0,650
w2	4%	Year 3	Oct	2	Year 3	Sep	4	2%	Year 3	Aug	7	3%	Year 2	Oct	3	3%	Year 1	Oct	5	3%	9.504	3%	3%	238	302	64	64	4118	0,212
w3	0%	Year 3	Oct	3	Year 3	Sep	5	3%	Year 3	Aug	8	3%	Year 2	Oct	4	5%	Year 1	Oct	6	4%	9.504	3%	3%	318	315	-3	3	7	0,008
w4	56%	Year 3	Oct	4	Year 3	Sep	6	5%	Year 3	Aug	9	4%	Year 2	Oct	5	5%	Year 1	Oct	7	4%	9.504	5%	4%	419	403	-16	16	270	0,041
		Year 3	Oct	5	Year 3	Sep	7	5%	Year 3	Aug	10	5%	Year 2	Oct	6	5%	Year 1	Oct	8	4%	9.504	4%	4%	397	397	0	0	0	0,000
MAD	20	Year 3	Oct	6	Year 3	Sep	8	5%	Year 3	Aug	11	5%	Year 2	Oct	7	5%	Year 1	Oct	9	5%	9.504	5%	5%	459	411	-48	48	2272	0,116
		Year 3	Oct	7	Year 3	Sep	9	2%	Year 3	Aug	12	2%	Year 2	Oct	8	2%	Year 1	Oct	10	2%	9.504	2%	2%	191	173	-18	18	331	0,105
		Year 3	Oct	8	Year 3	Sep	10	0%	Year 3	Aug	13	0%	Year 2	Oct	9	0%	Year 1	Oct	11	0%	9.504	0%	0%	7	21	14	14	186	0,651
		Year 3	Oct	9	Year 3	Sep	11	4%	Year 3	Aug	14	3%	Year 2	Oct	10	3%	Year 1	Oct	12	3%	9.504	4%	4%	338	316	-22	22	482	0,069
		Year 3	Oct	10	Year 3	Sep	12	4%	Year 3	Aug	15	3%	Year 2	Oct	11	4%	Year 1	Oct	13	4%	9.504	4%	4%	397	388	-9	9	80	0,023
		Year 3	Oct	11	Year 3	Sep	13	5%	Year 3	Aug	16	4%	Year 2	Oct	12	4%	Year 1	Oct	14	5%	9.504	5%	5%	461	403	-58	58	3311	0,143
		Year 3	Oct	12	Year 3	Sep	14	5%	Year 3	Aug	17	5%	Year 2	Oct	13	4%	Year 1	Oct	15	4%	9.504	5%	5%	429	433	4	4	16	0,009
		Year 3	Oct	13	Year 3	Sep	15	5%	Year 3	Aug	18	5%	Year 2	Oct	14	5%	Year 1	Oct	16	5%	9.504	5%	5%	481	463	-18	18	328	0,039
		Year 3	Oct	14	Year 3	Sep	16	2%	Year 3	Aug	19	2%	Year 2	Oct	15	2%	Year 1	Oct	17	2%	9.504	2%	2%	219	207	-12	12	133	0,056
		Year 3	Oct	15	Year 3	Sep	17	0%	Year 3	Aug	20	0%	Year 2	Oct	16	0%	Year 1	Oct	18	0%	9.504	0%	0%	15	20	5	5	28	0,257
		Year 3	Oct	16	Year 3	Sep	18	4%	Year 3	Aug	21	4%	Year 2	Oct	17	3%	Year 1	Oct	19	3%	9.504	4%	3%	332	336	3	3	10	0,009
		Year 3	Oct	17	Year 3	Sep	19	5%	Year 3	Aug	22	4%	Year 2	Oct	18	4%	Year 1	Oct	20	4%	9.504	4%	4%	409	398	-11	11	125	0,028
		Year 3	Oct	18	Year 3	Sep	20	5%	Year 3	Aug	23	5%	Year 2	Oct	19	5%	Year 1	Oct	21	5%	9.504	5%	5%	454	427	-27	27	726	0,063
		Year 3	Oct	19	Year 3	Sep	21	4%	Year 3	Aug	24	5%	Year 2	Oct	20	4%	Year 1	Oct	22	4%	9.504	5%	4%	422	374	-48	48	2314	0,129
		Year 3	Oct	20	Year 3	Sep	22	5%	Year 3	Aug	25	5%	Year 2	Oct	21	5%	Year 1	Oct	23	5%	9.504	5%	5%	461	458	-3	3	9	0,007
		Year 3	Oct	21	Year 3	Sep	23	2%	Year 3	Aug	26	2%	Year 2	Oct	22	2%	Year 1	Oct	24	2%	9.504	2%	2%	179	203	24	24	592	0,120
		Year 3	Oct	22	Year 3	Sep	24	0%	Year 3	Aug	27	0%	Year 2	Oct	23	0%	Year 1	Oct	25	0%	9.504	0%	0%	13	7	-6	6	40	0,954
		Year 3	Oct	23	Year 3	Sep	25	4%	Year 3	Aug	28	4%	Year 2	Oct	24	4%	Year 1	Oct	26	4%	9.504	4%	4%	345	305	-41	41	1641	0,133
		Year 3	Oct	24	Year 3	Sep	26	5%	Year 3	Aug	29	5%	Year 2	Oct	25	4%	Year 1	Oct	27	4%	9.504	5%	4%	417	409	-7	7	56	0,018
		Year 3	Oct	25	Year 3	Sep	27	5%	Year 3	Aug	30	3%	Year 2	Oct	26	5%	Year 1	Oct	28	4%	9.504	5%	5%	435	435	0	0	0	0,000
		Year 3	Oct	26	Year 3	Sep	28	5%	Year 3	Aug	31	3%	Year 2	Oct	27	5%	Year 1	Oct	29	3%	9.504	4%	4%	340	421	81	81	6504	0,191
		Year 3	Oct	27	Year 3	Sep	29	5%	Year 3	Sep	1	2%	Year 2	Oct	28	4%	Year 1	Oct	30	5%	9.504	5%	5%	456	456	0	0	0	0,000
		Year 3	Oct	28	Year 3	Sep	30	2%	Year 3	Sep	2	0%	Year 2	Oct	29	1%	Year 1	Oct	31	2%	9.504	2%	2%	207	173	-34	34	1147	0,196
		Year 3	Oct	29	Year 3	Oct	1	0%	Year 3	Sep	3	0%	Year 2	Oct	30	0%	Year 1	Nov	1	0%	9.504	0%	0%	11	19	8	8	67	0,437
		Year 3	Oct	30	Year 3	Oct	2	3%	Year 3	Sep	4	2%	Year 2	Oct	31	3%	Year 1	Nov	2	3%	9.504	3%	3%	299	288	-11	11	116	0,037
		Year 3	Oct	31	Year 3	Oct	3	3%	Year 3	Sep	5	3%	Year 2	Nov	1	2%	Year 1	Nov	3	4%	9.504	4%	4%	349	370	21	21	442	0,057

					ACTUAL VOLUME														Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag											
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	Norm. %Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	0%	Year 3	Nov	1	Year 3	Oct	4	4%	Year 3	Sep	6	5%	Year 2	Nov	2	4%	Year 1	Nov	4	5%	9.446	5%	4%	408	261	-148	148	21762	0,566
w2	38%	Year 3	Nov	2	Year 3	Oct	5	4%	Year 3	Sep	7	5%	Year 2	Nov	3	4%	Year 1	Nov	5	4%	9.446	5%	4%	391	370	-21	21	435	0,056
w3	36%	Year 3	Nov	3	Year 3	Oct	6	4%	Year 3	Sep	8	5%	Year 2	Nov	4	5%	Year 1	Nov	6	5%	9.446	5%	5%	442	443	1	1	2	0,003
w4	33%	Year 3	Nov	4	Year 3	Oct	7	2%	Year 3	Sep	9	2%	Year 2	Nov	5	2%	Year 1	Nov	7	2%	9.446	2%	2%	163	165	2	2	6	0,015
		Year 3	Nov	5	Year 3	Oct	8	0%	Year 3	Sep	10	0%	Year 2	Nov	6	0%	Year 1	Nov	8	0%	9.446	0%	0%	13	18	5	5	27	0,291
MAD	24	Year 3	Nov	6	Year 3	Oct	9	3%	Year 3	Sep	11	4%	Year 2	Nov	7	3%	Year 1	Nov	9	4%	9.446	4%	3%	314	331	17	17	280	0,051
		Year 3	Nov	7	Year 3	Oct	10	4%	Year 3	Sep	12	4%	Year 2	Nov	8	4%	Year 1	Nov	10	4%	9.446	4%	4%	368	414	46	46	2110	0,111
		Year 3	Nov	8	Year 3	Oct	11	4%	Year 3	Sep	13	5%	Year 2	Nov	9	4%	Year 1	Nov	11	4%	9.446	5%	4%	406	416	10	10	94	0,023
		Year 3	Nov	9	Year 3	Oct	12	5%	Year 3	Sep	14	5%	Year 2	Nov	10	4%	Year 1	Nov	12	4%	9.446	5%	4%	398	391	-7	7	56	0,019
		Year 3	Nov	10	Year 3	Oct	13	5%	Year 3	Sep	15	5%	Year 2	Nov	11	5%	Year 1	Nov	13	6%	9.446	6%	5%	464	407	-56	56	3181	0,138
		Year 3	Nov	11	Year 3	Oct	14	2%	Year 3	Sep	16	2%	Year 2	Nov	12	1%	Year 1	Nov	14	2%	9.446	2%	2%	175	183	9	9	77	0,048
		Year 3	Nov	12	Year 3	Oct	15	0%	Year 3	Sep	17	0%	Year 2	Nov	13	0%	Year 1	Nov	15	0%	9.446	0%	0%	6	11	5	5	21	0,418
		Year 3	Nov	13	Year 3	Oct	16	4%	Year 3	Sep	18	4%	Year 2	Nov	14	4%	Year 1	Nov	16	4%	9.446	4%	4%	333	304	-29	29	866	0,097
		Year 3	Nov	14	Year 3	Oct	17	4%	Year 3	Sep	19	5%	Year 2	Nov	15	4%	Year 1	Nov	17	4%	9.446	5%	4%	380	423	43	43	1838	0,101
		Year 3	Nov	15	Year 3	Oct	18	5%	Year 3	Sep	20	5%	Year 2	Nov	16	5%	Year 1	Nov	18	5%	9.446	5%	5%	432	452	20	20	390	0,044
		Year 3	Nov	16	Year 3	Oct	19	4%	Year 3	Sep	21	4%	Year 2	Nov	17	4%	Year 1	Nov	19	5%	9.446	5%	4%	402	384	-18	18	335	0,048
		Year 3	Nov	17	Year 3	Oct	20	5%	Year 3	Sep	22	5%	Year 2	Nov	18	5%	Year 1	Nov	20	5%	9.446	6%	5%	463	422	-41	41	1688	0,097
		Year 3	Nov	18	Year 3	Oct	21	2%	Year 3	Sep	23	2%	Year 2	Nov	19	2%	Year 1	Nov	21	2%	9.446	2%	2%	165	160	-5	5	27	0,032
		Year 3	Nov	19	Year 3	Oct	22	0%	Year 3	Sep	24	0%	Year 2	Nov	20	0%	Year 1	Nov	22	0%	9.446	0%	0%	13	12	-1	1	1	0,063
		Year 3	Nov	20	Year 3	Oct	23	3%	Year 3	Sep	25	4%	Year 2	Nov	21	3%	Year 1	Nov	23	3%	9.446	4%	3%	310	318	9	9	75	0,027
		Year 3	Nov	21	Year 3	Oct	24	4%	Year 3	Sep	26	5%	Year 2	Nov	22	4%	Year 1	Nov	24	4%	9.446	5%	4%	384	438	54	54	2915	0,123
		Year 3	Nov	22	Year 3	Oct	25	5%	Year 3	Sep	27	5%	Year 2	Nov	23	4%	Year 1	Nov	25	5%	9.446	5%	5%	438	424	-14	14	188	0,032
		Year 3	Nov	23	Year 3	Oct	26	5%	Year 3	Sep	28	5%	Year 2	Nov	24	5%	Year 1	Nov	26	5%	9.446	5%	4%	410	409	-1	1	1	0,003
		Year 3	Nov	24	Year 3	Oct	27	5%	Year 3	Sep	29	5%	Year 2	Nov	25	6%	Year 1	Nov	27	5%	9.446	6%	5%	480	480	0	0	0	0,000
		Year 3	Nov	25	Year 3	Oct	28	2%	Year 3	Sep	30	2%	Year 2	Nov	26	2%	Year 1	Nov	28	2%	9.446	2%	2%	187	168	-19	19	366	0,114
		Year 3	Nov	26	Year 3	Oct	29	0%	Year 3	Oct	1	0%	Year 2	Nov	27	0%	Year 1	Nov	29	0%	9.446	0%	0%	9	9	0	0	0	0,036
		Year 3	Nov	27	Year 3	Oct	30	3%	Year 3	Oct	2	3%	Year 2	Nov	28	4%	Year 1	Nov	30	4%	9.446	4%	3%	320	320	0	0	0	0,000
		Year 3	Nov	28	Year 3	Oct	31	4%	Year 3	Oct	3	3%	Year 2	Nov	29	4%	Year 1	Dec	1	4%	9.446	4%	4%	340	438	98	98	9596	0,223
		Year 3	Nov	29	Year 3	Nov	1	3%	Year 3	Oct	4	4%	Year 2	Nov	30	5%	Year 1	Dec	2	5%	9.446	5%	4%	418	440	21	21	456	0,049
		Year 3	Nov	30	Year 3	Nov	2	4%	Year 3	Oct	5	4%	Year 2	Dec	1	4%	Year 1	Dec	3	5%	9.446	5%	4%	414	431	17	17	290	0,039

					ACTUAL VOLUME																Company	Daily Forecast			Actual				
					28 Days Lag				56 Days Lag				364 Days Lag				728 Days Lag						Norm.					
		Year	Mo	Day	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Year	Mo	Day	%Vol	Forecast	%Vol	%Vol	Vol	Volume	BIAS	MAD	MSE	MAPE
w1	31%	Year 3	Dec	1	Year 3	Nov	3	5%	Year 3	Oct	6	4%	Year 2	Dec	2	6%	Year 1	Dec	4	6%	8.044	6%	5%	439	351	-88	88	7702	0,250
w2	0%	Year 3	Dec	2	Year 3	Nov	4	2%	Year 3	Oct	7	2%	Year 2	Dec	3	2%	Year 1	Dec	5	2%	8.044	2%	2%	145	174	29	29	867	0,169
w3	74%	Year 3	Dec	3	Year 3	Nov	5	0%	Year 3	Oct	8	0%	Year 2	Dec	4	0%	Year 1	Dec	6	0%	8.044	0%	0%	6	10	4	4	18	0,405
w4	1%	Year 3	Dec	4	Year 3	Nov	6	4%	Year 3	Oct	9	3%	Year 2	Dec	5	4%	Year 1	Dec	7	4%	8.044	4%	4%	342	291	-51	51	2643	0,177
		Year 3	Dec	5	Year 3	Nov	7	4%	Year 3	Oct	10	4%	Year 2	Dec	6	4%	Year 1	Dec	8	4%	8.044	4%	4%	346	418	71	71	5094	0,171
MAD	29	Year 3	Dec	6	Year 3	Nov	8	4%	Year 3	Oct	11	4%	Year 2	Dec	7	5%	Year 1	Dec	9	5%	8.044	5%	5%	408	425	18	18	320	0,042
		Year 3	Dec	7	Year 3	Nov	9	4%	Year 3	Oct	12	5%	Year 2	Dec	8	4%	Year 1	Dec	10	5%	8.044	5%	4%	360	408	48	48	2314	0,118
		Year 3	Dec	8	Year 3	Nov	10	4%	Year 3	Oct	13	5%	Year 2	Dec	9	5%	Year 1	Dec	11	6%	8.044	5%	5%	426	400	-26	26	688	0,066
		Year 3	Dec	9	Year 3	Nov	11	2%	Year 3	Oct	14	2%	Year 2	Dec	10	2%	Year 1	Dec	12	2%	8.044	2%	2%	139	159	19	19	373	0,122
		Year 3	Dec	10	Year 3	Nov	12	0%	Year 3	Oct	15	0%	Year 2	Dec	11	0%	Year 1	Dec	13	0%	8.044	0%	0%	5	5	0	0	0	0,018
		Year 3	Dec	11	Year 3	Nov	13	3%	Year 3	Oct	16	4%	Year 2	Dec	12	4%	Year 1	Dec	14	4%	8.044	4%	4%	329	267	-61	61	3742	0,229
		Year 3	Dec	12	Year 3	Nov	14	4%	Year 3	Oct	17	4%	Year 2	Dec	13	4%	Year 1	Dec	15	4%	8.044	5%	5%	364	396	32	32	1014	0,080
		Year 3	Dec	13	Year 3	Nov	15	5%	Year 3	Oct	18	5%	Year 2	Dec	14	5%	Year 1	Dec	16	4%	8.044	5%	5%	382	393	11	11	124	0,028
		Year 3	Dec	14	Year 3	Nov	16	4%	Year 3	Oct	19	4%	Year 2	Dec	15	5%	Year 1	Dec	17	4%	8.044	5%	5%	366	369	3	3	12	0,009
		Year 3	Dec	15	Year 3	Nov	17	4%	Year 3	Oct	20	5%	Year 2	Dec	16	4%	Year 1	Dec	18	4%	8.044	5%	5%	368	358	-11	11	114	0,030
		Year 3	Dec	16	Year 3	Nov	18	2%	Year 3	Oct	21	2%	Year 2	Dec	17	1%	Year 1	Dec	19	1%	8.044	2%	2%	121	106	-15	15	227	0,142
		Year 3	Dec	17	Year 3	Nov	19	0%	Year 3	Oct	22	0%	Year 2	Dec	18	0%	Year 1	Dec	20	0%	8.044	0%	0%	6	3	-3	3	9	1,023
		Year 3	Dec	18	Year 3	Nov	20	3%	Year 3	Oct	23	3%	Year 2	Dec	19	3%	Year 1	Dec	21	3%	8.044	4%	4%	283	243	-40	40	1586	0,164
		Year 3	Dec	19	Year 3	Nov	21	5%	Year 3	Oct	24	4%	Year 2	Dec	20	4%	Year 1	Dec	22	4%	8.044	5%	4%	351	334	-17	17	295	0,051
		Year 3	Dec	20	Year 3	Nov	22	4%	Year 3	Oct	25	5%	Year 2	Dec	21	4%	Year 1	Dec	23	4%	8.044	5%	4%	356	371	15	15	228	0,041
		Year 3	Dec	21	Year 3	Nov	23	4%	Year 3	Oct	26	5%	Year 2	Dec	22	5%	Year 1	Dec	24	3%	8.044	5%	5%	397	384	-12	12	148	0,032
		Year 3	Dec	22	Year 3	Nov	24	5%	Year 3	Oct	27	5%	Year 2	Dec	23	5%	Year 1	Dec	25	3%	8.044	5%	5%	388	394	7	7	45	0,017
		Year 3	Dec	23	Year 3	Nov	25	2%	Year 3	Oct	28	2%	Year 2	Dec	24	2%	Year 1	Dec	26	2%	8.044	2%	2%	134	174	40	40	1614	0,230
		Year 3	Dec	24	Year 3	Nov	26	0%	Year 3	Oct	29	0%	Year 2	Dec	25	0%	Year 1	Dec	27	0%	8.044	0%	0%	5	3	-2	2	4	0,696
		Year 3	Dec	25	Year 3	Nov	27	3%	Year 3	Oct	30	3%	Year 2	Dec	26	2%	Year 1	Dec	28	3%	8.044	3%	2%	196	89	-108	108	11590	1,216
		Year 3	Dec	26	Year 3	Nov	28	5%	Year 3	Oct	31	4%	Year 2	Dec	27	3%	Year 1	Dec	29	4%	8.044	4%	4%	294	194	-101	101	10161	0,521
		Year 3	Dec	27	Year 3	Nov	29	5%	Year 3	Nov	1	3%	Year 2	Dec	28	4%	Year 1	Dec	30	4%	8.044	4%	4%	347	347	0	0	0	0,000
		Year 3	Dec	28	Year 3	Nov	30	5%	Year 3	Nov	2	4%	Year 2	Dec	29	3%	Year 1	Dec	31	1%	8.044	4%	4%	313	316	2	2	6	0,008
		Year 3	Dec	29	Year 3	Dec	1	5%	Year 3	Nov	3	5%	Year 2	Dec	30	3%	Year 2	Jan	1	0%	8.044	4%	4%	304	270	-34	34	1146	0,125
		Year 3	Dec	30	Year 3	Dec	2	2%	Year 3	Nov	4	2%	Year 2	Dec	31	1%	Year 2	Jan	2	1%	8.044	2%	1%	119	113	-6	6	39	0,055
		Year 3	Dec	31	Year 3	Dec	3	0%	Year 3	Nov	5	0%	Year 3	Jan	1	0%	Year 2	Jan	3	0%	8.044	0%	0%	5	19	15	15	214	0,760

APPENDIX D

MS SOLVER OPTIMIZATION CODE FOR THE WEIGHTS OF LAGS ON COUNTRY AND SERVICE LEVEL

```
Sub ulke_ağırlıkları_hesapla()
If ActiveSheet.Shapes("Admin_Info").Visible = True Then Exit Sub
Set Tahmin = Sheets("Tahmin Dağılım")
Set agırlık = Sheets("Weight Calculation")
Tahmin.Visible = True
agırlık.Visible = True

For i = 11 To 47
   If Tahmin.Cells(i, 2) = "" Then GoTo devam

   sıra = Tahmin.Cells(i, 2)
   servis = Tahmin.Cells(i, 1)
   ay1 = Tahmin.Cells(9, 4)
   ay2 = Tahmin.Cells(9, 5)

   agırlık.Select
   ActiveSheet.PivotTables("PivotTable1").PivotFields("Ülke Sıra").ClearAllFilters
   ActiveSheet.PivotTables("PivotTable1").PivotFields("Ülke Sıra").CurrentPage =
sıra
   ActiveSheet.PivotTables("PivotTable1").PivotFields("Servis").ClearAllFilters
   ActiveSheet.PivotTables("PivotTable1").PivotFields("Servis").CurrentPage =
servis

   Range("I7") = ay1
   Range("AJ7") = ay2
   Range("Q1:Q4") = 0.25
   Range("AR1:AR4") = 0.25

   Calculate
   SolverReset
   SolverAdd CellRef:="$Q$1:$Q$4", Relation:=3, FormulaText:="0"
   SolverAdd CellRef:="$Q$5", Relation:=2, FormulaText:="1"
   SolverOk SetCell:="$M$2", MaxMinVal:=1, ValueOf:=0,
ByChange:="$Q$1:$Q$4", Engine:=1, EngineDesc:="GRG Nonlinear"
   SolverSolve True
   Calculate
   SolverReset
   SolverAdd CellRef:="$AR$1:$AR$4", Relation:=3, FormulaText:="0"
   SolverAdd CellRef:="$AR$5", Relation:=2, FormulaText:="1"
   SolverOk SetCell:="$AN$2", MaxMinVal:=1, ValueOf:=0,
ByChange:="$AR$1:$AR$4", Engine:=1, EngineDesc:="GRG Nonlinear"
   SolverSolve True
```

```
    Calculate
    w1_1 = Range("Q1")
    w1_2 = Range("Q2")
    w1_3 = Range("Q3")
    w1_4 = Range("Q4")

    w2_1 = Range("AR1")
    w2_2 = Range("AR2")
    w2_3 = Range("AR3")
    w2_4 = Range("AR4")

    Tahmin.Select
    Cells(i, 305) = w1_1
    Cells(i, 340) = w1_2
    Cells(i, 375) = w1_3
    Cells(i, 445) = w1_4

    Cells(i, 143) = w2_1
    Cells(i, 306) = w2_2
    Cells(i, 411) = w2_3
    Cells(i, 481) = w2_4

devam:
Next i

Tahmin.Visible = False
agırlık.Visible = False

End Sub
```

APPENDIX E

DAILY FORECASTS PRODUCTION SHEET

Service	No	Country	Company Forecast for March Year 4	DAILY FORECASTED VOLUMES FOR MARCH YEAR 4																																
				Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Export	1	Germany	1.586	44	75	46	2	35	55	61	60	78	50	0	46	62	73	64	80	49	1	59	63	70	59	71	33	2	39	56	71	60	79	44
Export	2	France	584	23	29	17	1	23	16	28	17	29	12	0	14	11	30	29	31	15	0	17	27	23	25	25	9	1	22	20	29	23	25	11
Export	3	Italy	374	13	19	8	0	4	11	17	16	18	10	0	9	14	16	17	17	10	0	8	11	18	14	22	11	2	8	16	18	15	22	11
Export	4	Poland	316	11	11	6	2	8	12	19	11	11	8	1	11	14	15	12	13	10	1	9	12	15	12	14	7	2	8	14	17	11	14	7
Export	5	England	328	18	16	11	0	6	9	15	13	17	10	0	7	8	12	11	19	12	0	6	10	14	15	15	14	0	8	9	12	13	15	13
Export	6	Belgium	226	6	20	4	1	4	9	10	4	11	8	0	6	8	11	6	12	5	0	7	5	8	12	16	5	0	5	8	8	7	12	6
Export	7	Spain	321	4	18	26	0	4	8	8	5	13	22	3	2	7	11	14	20	29	1	3	8	13	11	13	19	0	3	6	7	11	11	20
Export	8	Sweden	86	4	4	2	0	1	4	3	4	3	3	0	2	3	2	3	5	2	0	2	3	5	4	4	2	0	3	3	5	3	4	2
Export	9	Netherlands	102	4	2	7	0	2	3	1	5	8	3	1	1	3	3	7	6	2	0	1	4	4	6	5	2	0	3	3	5	3	6	2
Export	10	Hungary	93	3	3	1	0	2	5	7	5	5	1	0	4	5	5	4	4	1	0	2	3	5	4	3	1	0	5	3	4	3	4	1
Export	11	Czechia	134	5	6	2	0	2	5	6	5	6	1	0	4	5	8	2	6	1	0	3	5	8	8	6	3	0	4	7	10	7	6	4
Export	12	Slovenia	148	8	7	1	0	4	4	9	5	8	0	0	4	6	3	5	6	1	0	9	7	7	7	7	1	0	7	6	6	5	7	6
Export	13	Austria	80	4	3	1	0	1	4	5	3	3	2	0	3	3	2	3	4	2	0	2	3	3	4	3	3	0	2	5	3	4	2	2
Export	14	Switzerland	82	5	4	1	1	1	2	4	1	3	4	1	1	2	4	5	5	1	0	2	4	5	4	4	3	0	1	2	3	3	4	3
Export	15	Greece	38	3	2	0	0	0	2	2	2	2	0	0	1	2	1	0	2	3	0	1	0	2	2	3	1	0	0	0	0	2	2	1
Export	16	Romania	52	2	2	2	0	0	3	2	1	1	4	0	2	0	4	2	2	3	0	1	1	3	1	3	2	0	2	1	2	2	2	2
Export	17	Slovakia	31	2	1	0	0	1	1	1	1	2	1	0	0	1	1	2	1	1	0	0	1	1	2	2	1	0	0	1	1	2	2	1
Export	Other	Others	126	5	6	4	0	1	4	6	4	4	8	0	3	3	5	5	5	7	0	2	4	3	6	6	7	0	3	4	4	5	6	5
Export Total			**4.708**	**162**	**229**	**140**	**8**	**100**	**157**	**204**	**162**	**223**	**147**	**6**	**121**	**157**	**208**	**191**	**235**	**154**	**5**	**134**	**173**	**209**	**194**	**220**	**125**	**8**	**123**	**164**	**207**	**176**	**224**	**142**
Import	1	Germany	1.974	82	107	9	0	66	80	87	95	103	10	0	90	87	103	78	83	12	0	76	87	89	94	85	13	0	67	92	84	108	75	11
Import	2	France	506	22	16	3	0	17	18	27	29	16	3	0	21	19	24	32	14	6	0	19	28	28	28	20	4	0	16	19	27	25	18	5
Import	3	Italy	276	12	15	0	0	7	9	8	14	20	1	0	8	13	11	13	17	1	0	10	10	11	16	15	1	0	8	12	10	16	17	1
Import	4	Poland	373	17	13	1	0	8	10	14	24	17	0	0	13	20	20	23	19	0	0	17	18	20	19	17	0	0	12	20	16	20	14	0
Import	5	England	199	10	7	5	0	7	2	12	6	7	4	3	10	8	10	6	5	2	1	4	8	11	12	14	5	0	7	8	5	10	8	3
Import	6	Belgium	375	18	11	2	0	18	16	14	17	17	2	0	24	17	19	17	19	2	1	14	16	19	18	17	2	0	14	13	11	18	15	2
Import	7	Spain	191	14	10	1	0	5	7	7	9	7	1	0	7	6	6	17	8	0	0	9	10	10	6	4	0	0	6	10	15	8	6	1
Import	8	Sweden	108	6	7	0	0	2	5	7	8	4	0	0	2	4	6	7	3	0	0	2	3	5	4	5	0	0	0	6	10	4	5	0
Import	9	Netherlands	164	9	7	1	0	5	7	6	7	6	2	0	6	8	10	6	9	1	0	5	7	9	8	7	1	0	4	7	7	8	7	1
Import	10	Hungary	102	7	8	0	0	1	3	4	5	6	0	0	4	4	4	5	5	0	0	5	4	8	3	5	0	0	3	4	4	4	6	0
Import	11	Czechia	72	5	3	0	0	1	2	2	4	2	0	0	1	3	4	5	5	0	0	3	3	3	3	4	0	0	1	3	5	5	2	0
Import	12	Slovenia	50	3	4	0	0	1	4	2	1	2	0	0	1	3	4	1	2	0	0	2	3	2	0	3	0	0	2	2	1	2	4	0
Import	13	Austria	32	1	1	0	0	2	0	2	1	2	0	0	1	1	1	1	2	0	0	3	2	2	1	3	0	0	0	2	2	1	2	0
Import	14	Switzerland	31	1	2	0	0	1	1	0	2	1	1	0	1	1	0	1	2	1	0	1	2	1	2	1	1	0	2	1	2	2	1	1
Import	15	Greece	34	3	4	0	0	0	0	2	2	1	0	0	1	3	1	2	1	0	0	1	0	2	2	0	0	0	1	1	5	1	0	0
Import	16	Romania	27	2	2	0	0	0	0	0	2	2	0	0	1	1	1	2	2	0	0	1	2	2	1	2	0	0	1	0	0	2	2	0
Import	17	Slovakia	26	1	0	0	0	0	0	2	3	1	0	0	1	3	3	3	1	0	0	0	1	1	1	0	0	0	1	1	1	1	1	0
Import	Other	Others	96	5	3	0	0	1	4	3	4	3	0	0	4	7	6	4	2	0	0	2	4	10	5	7	0	0	5	3	5	5	5	0
Import Total			**4.635**	**217**	**222**	**23**	**0**	**144**	**168**	**201**	**232**	**217**	**25**	**3**	**198**	**207**	**232**	**222**	**199**	**26**	**2**	**175**	**207**	**233**	**224**	**210**	**28**	**0**	**151**	**205**	**210**	**240**	**190**	**26**
Grand Total			**9.343**	**379**	**451**	**163**	**8**	**244**	**326**	**405**	**394**	**440**	**172**	**9**	**319**	**363**	**440**	**412**	**434**	**179**	**7**	**308**	**380**	**442**	**418**	**430**	**153**	**8**	**274**	**369**	**417**	**416**	**414**	**168**

Service	No	Country	Company Forecast for March Year 4	NORMALIZED FORECASTED DAILY VOLUME PROPORTIONS FOR MARCH YEAR 4																														
				Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Export	1	Germany	1.586	3%	5%	3%	0%	2%	3%	4%	4%	5%	3%	0%	3%	4%	5%	4%	5%	3%	0%	4%	4%	4%	4%	4%	2%	0%	2%	4%	4%	4%	5%	3%
Export	2	France	584	4%	5%	3%	0%	4%	3%	5%	3%	5%	2%	0%	2%	2%	5%	5%	5%	3%	0%	3%	5%	4%	4%	4%	2%	0%	4%	4%	5%	4%	4%	2%
Export	3	Italy	374	4%	5%	2%	0%	1%	3%	5%	4%	5%	3%	0%	2%	4%	4%	4%	4%	3%	0%	2%	3%	5%	4%	6%	3%	0%	2%	4%	5%	4%	6%	3%
Export	4	Poland	316	3%	4%	2%	1%	2%	4%	6%	3%	3%	2%	0%	4%	5%	5%	4%	4%	3%	0%	3%	4%	5%	4%	5%	2%	1%	2%	4%	5%	3%	4%	2%
Export	5	England	328	5%	5%	3%	0%	2%	3%	4%	4%	5%	3%	0%	2%	2%	4%	3%	6%	4%	0%	2%	3%	4%	5%	5%	4%	0%	2%	3%	4%	4%	5%	4%
Export	6	Belgium	226	3%	9%	2%	0%	2%	4%	5%	2%	5%	4%	0%	3%	4%	5%	3%	5%	2%	0%	3%	2%	4%	5%	7%	2%	0%	2%	4%	4%	3%	5%	3%
Export	7	Spain	321	1%	6%	8%	0%	1%	2%	2%	1%	4%	7%	1%	1%	2%	3%	4%	6%	9%	0%	1%	3%	4%	4%	4%	6%	0%	1%	2%	2%	3%	3%	6%
Export	8	Sweden	86	4%	5%	3%	0%	1%	5%	3%	5%	4%	3%	0%	3%	4%	2%	3%	5%	2%	0%	2%	4%	6%	4%	5%	3%	0%	4%	4%	6%	3%	5%	2%
Export	9	Netherlands	102	4%	2%	6%	0%	2%	2%	1%	5%	8%	3%	1%	1%	3%	3%	7%	6%	2%	0%	1%	4%	4%	6%	5%	2%	0%	3%	3%	5%	3%	6%	2%
Export	10	Hungary	93	3%	4%	1%	0%	2%	6%	8%	5%	6%	1%	0%	4%	5%	6%	4%	4%	1%	0%	3%	3%	5%	4%	3%	1%	0%	5%	3%	4%	3%	4%	1%
Export	11	Czechia	134	3%	5%	2%	0%	2%	4%	4%	3%	5%	1%	0%	3%	3%	6%	2%	5%	1%	0%	2%	4%	6%	6%	4%	2%	0%	3%	5%	8%	5%	4%	3%
Export	12	Slovenia	148	5%	5%	1%	0%	3%	2%	6%	4%	5%	0%	0%	3%	4%	2%	4%	4%	1%	0%	6%	5%	5%	5%	5%	1%	0%	5%	4%	4%	3%	5%	4%
Export	13	Austria	80	5%	4%	2%	0%	2%	5%	6%	4%	4%	3%	0%	3%	3%	3%	4%	4%	2%	0%	2%	3%	4%	5%	3%	3%	0%	2%	6%	4%	5%	3%	3%
Export	14	Switzerland	82	6%	5%	1%	1%	1%	3%	5%	1%	4%	4%	1%	1%	2%	5%	6%	6%	1%	0%	2%	5%	6%	4%	5%	4%	0%	1%	3%	4%	3%	5%	4%
Export	15	Greece	38	8%	6%	1%	0%	0%	6%	5%	6%	6%	1%	0%	2%	5%	2%	1%	5%	7%	0%	2%	1%	5%	5%	7%	2%	0%	1%	1%	1%	6%	6%	1%
Export	16	Romania	52	3%	3%	4%	0%	0%	5%	3%	3%	2%	8%	0%	4%	0%	9%	4%	4%	5%	0%	1%	2%	6%	3%	5%	4%	0%	4%	2%	3%	4%	5%	4%
Export	17	Slovakia	31	5%	5%	0%	1%	3%	4%	5%	3%	5%	4%	0%	1%	3%	4%	7%	4%	3%	0%	0%	3%	4%	5%	7%	2%	0%	1%	2%	3%	6%	8%	2%
Export	Other	Others	126	4%	4%	4%	0%	1%	3%	4%	3%	3%	6%	0%	2%	2%	4%	4%	4%	5%	0%	2%	3%	3%	5%	5%	5%	0%	2%	3%	3%	4%	5%	4%
Export Total			**4.708**																															
Import	1	Germany	1.974	4%	5%	0%	0%	3%	4%	4%	5%	5%	0%	0%	5%	4%	5%	4%	4%	1%	0%	4%	4%	5%	5%	4%	1%	0%	3%	5%	4%	5%	4%	1%
Import	2	France	506	4%	3%	1%	0%	3%	4%	5%	6%	3%	1%	0%	4%	4%	5%	6%	3%	1%	0%	4%	5%	5%	5%	4%	1%	0%	3%	4%	5%	5%	4%	1%
Import	3	Italy	276	4%	5%	0%	0%	3%	3%	3%	5%	7%	0%	0%	3%	5%	4%	5%	6%	0%	0%	4%	4%	4%	6%	5%	0%	0%	3%	4%	4%	6%	6%	0%
Import	4	Poland	373	4%	4%	0%	0%	2%	3%	4%	7%	5%	0%	0%	3%	5%	5%	6%	5%	0%	0%	5%	5%	5%	5%	4%	0%	0%	3%	5%	4%	5%	4%	0%
Import	5	England	199	5%	4%	2%	0%	3%	1%	6%	3%	4%	2%	1%	5%	4%	5%	3%	3%	1%	0%	2%	4%	5%	6%	7%	2%	0%	4%	4%	3%	5%	4%	1%
Import	6	Belgium	375	5%	3%	0%	0%	5%	4%	4%	5%	5%	1%	0%	7%	4%	5%	4%	5%	1%	0%	4%	4%	5%	5%	4%	1%	0%	4%	4%	3%	5%	4%	1%
Import	7	Spain	191	7%	5%	0%	0%	3%	3%	4%	5%	4%	1%	0%	4%	3%	3%	9%	4%	0%	0%	5%	5%	5%	3%	2%	0%	0%	3%	5%	8%	4%	3%	1%
Import	8	Sweden	108	6%	7%	0%	0%	2%	4%	6%	8%	4%	0%	0%	2%	4%	6%	6%	3%	0%	0%	2%	3%	5%	4%	5%	0%	0%	0%	5%	9%	4%	5%	0%
Import	9	Netherlands	164	6%	4%	1%	0%	3%	4%	4%	4%	4%	1%	0%	4%	5%	6%	4%	6%	1%	0%	3%	4%	5%	5%	4%	1%	0%	3%	4%	4%	5%	4%	1%
Import	10	Hungary	102	6%	8%	0%	0%	1%	3%	4%	5%	5%	0%	0%	4%	4%	4%	5%	5%	0%	0%	5%	4%	8%	3%	5%	0%	0%	3%	4%	4%	4%	6%	0%
Import	11	Czechia	72	7%	5%	1%	0%	1%	2%	3%	6%	3%	0%	0%	2%	4%	6%	7%	7%	0%	0%	4%	5%	5%	5%	6%	0%	0%	2%	4%	7%	6%	3%	0%
Import	12	Slovenia	50	6%	9%	0%	0%	2%	8%	5%	1%	3%	0%	0%	1%	6%	9%	3%	4%	0%	0%	5%	6%	4%	1%	7%	0%	0%	4%	4%	1%	4%	8%	0%
Import	13	Austria	32	3%	5%	1%	0%	7%	1%	5%	3%	6%	0%	0%	5%	2%	2%	2%	5%	0%	0%	9%	5%	5%	2%	8%	0%	0%	0%	7%	6%	4%	6%	0%
Import	14	Switzerland	31	5%	7%	1%	0%	2%	3%	1%	6%	3%	2%	0%	3%	4%	2%	3%	5%	2%	0%	3%	5%	5%	5%	3%	2%	0%	7%	4%	6%	6%	4%	2%
Import	15	Greece	34	8%	12%	0%	0%	0%	1%	6%	5%	4%	0%	0%	4%	8%	2%	6%	2%	0%	0%	2%	1%	6%	6%	1%	0%	0%	3%	3%	14%	4%	1%	0%
Import	16	Romania	27	9%	6%	0%	0%	0%	0%	0%	7%	6%	0%	0%	2%	4%	5%	7%	6%	0%	0%	2%	6%	6%	5%	7%	0%	0%	4%	0%	0%	8%	7%	0%
Import	17	Slovakia	26	5%	1%	0%	0%	1%	2%	9%	11%	3%	0%	0%	2%	10%	10%	11%	2%	0%	0%	0%	3%	6%	4%	1%	0%	0%	3%	4%	3%	5%	3%	0%
Import	Other	Others	96	5%	3%	0%	0%	2%	4%	3%	4%	3%	0%	0%	4%	7%	6%	4%	2%	0%	0%	2%	4%	10%	5%	7%	0%	0%	5%	3%	6%	5%	6%	0%
Import Total			**4.635**																															
Grand Total			**9.343**																															

Service	No	Country	Company Forecast for March Year 4	FORECASTED DAILY VOLUME PROPORTIONS FOR MARCH YEAR 4																														
				Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Export	1	Germany	1.586	3%	5%	3%	0%	2%	3%	4%	4%	5%	3%	0%	3%	4%	5%	4%	5%	3%	0%	4%	4%	4%	4%	4%	2%	0%	2%	4%	4%	4%	5%	3%
Export	2	France	584	4%	5%	3%	0%	4%	3%	5%	3%	5%	2%	0%	3%	2%	6%	5%	6%	3%	0%	3%	5%	4%	5%	5%	2%	0%	4%	4%	5%	4%	5%	2%
Export	3	Italy	374	4%	5%	2%	0%	1%	3%	5%	4%	5%	3%	0%	2%	4%	4%	5%	5%	3%	0%	2%	3%	5%	4%	6%	3%	1%	2%	4%	5%	4%	6%	3%
Export	4	Poland	316	4%	4%	2%	1%	3%	4%	6%	3%	3%	2%	0%	4%	5%	5%	4%	4%	3%	0%	3%	4%	5%	4%	5%	2%	1%	2%	4%	5%	3%	4%	2%
Export	5	England	328	6%	5%	4%	0%	2%	3%	5%	4%	6%	3%	0%	2%	3%	4%	4%	6%	4%	0%	2%	3%	5%	5%	5%	5%	0%	3%	3%	4%	4%	5%	4%
Export	6	Belgium	226	3%	9%	2%	0%	2%	4%	5%	2%	5%	4%	0%	3%	4%	5%	3%	5%	2%	0%	3%	2%	4%	5%	7%	2%	0%	2%	4%	4%	3%	5%	3%
Export	7	Spain	321	1%	6%	9%	0%	1%	3%	3%	2%	4%	8%	1%	1%	2%	4%	5%	7%	10%	1%	1%	3%	4%	4%	4%	7%	0%	1%	2%	3%	4%	4%	7%
Export	8	Sweden	86	4%	5%	3%	0%	1%	5%	3%	5%	4%	3%	0%	3%	4%	2%	3%	5%	2%	0%	2%	4%	6%	4%	5%	3%	0%	4%	4%	5%	3%	5%	2%
Export	9	Netherlands	102	4%	3%	7%	0%	2%	3%	2%	6%	9%	3%	1%	1%	3%	3%	7%	7%	2%	0%	1%	5%	5%	6%	6%	2%	0%	3%	3%	5%	3%	6%	3%
Export	10	Hungary	93	3%	4%	1%	0%	3%	6%	8%	5%	6%	1%	0%	5%	6%	6%	4%	4%	1%	0%	3%	3%	5%	4%	3%	1%	0%	6%	4%	5%	3%	4%	1%
Export	11	Czechia	134	3%	5%	2%	0%	2%	3%	4%	3%	5%	1%	0%	3%	3%	6%	2%	5%	1%	0%	2%	4%	6%	6%	4%	2%	0%	3%	5%	8%	5%	4%	3%
Export	12	Slovenia	148	6%	5%	1%	0%	3%	3%	6%	4%	6%	0%	0%	3%	5%	2%	4%	4%	1%	0%	6%	5%	5%	5%	5%	1%	0%	5%	4%	5%	3%	5%	4%
Export	13	Austria	80	5%	4%	2%	0%	2%	5%	6%	4%	4%	3%	0%	3%	3%	3%	4%	4%	2%	0%	2%	3%	4%	5%	3%	3%	0%	2%	6%	4%	5%	3%	3%
Export	14	Switzerland	82	7%	5%	1%	2%	1%	3%	5%	1%	5%	5%	1%	1%	3%	5%	6%	6%	1%	0%	3%	6%	6%	5%	5%	4%	0%	1%	3%	4%	3%	5%	4%
Export	15	Greece	38	9%	7%	1%	0%	1%	7%	6%	6%	6%	1%	0%	2%	5%	2%	1%	6%	8%	0%	2%	1%	6%	5%	8%	2%	0%	1%	1%	1%	7%	7%	2%
Export	16	Romania	52	3%	3%	4%	0%	0%	5%	3%	3%	2%	8%	0%	3%	0%	8%	4%	4%	5%	0%	1%	2%	5%	2%	5%	4%	0%	4%	2%	3%	3%	4%	4%
Export	17	Slovakia	31	5%	5%	0%	1%	3%	4%	5%	3%	6%	4%	0%	1%	3%	4%	7%	4%	3%	0%	0%	3%	4%	5%	7%	2%	0%	2%	2%	3%	6%	8%	2%
Export	Other	Others	126	5%	5%	4%	0%	1%	4%	5%	3%	4%	7%	0%	3%	2%	5%	5%	5%	6%	0%	2%	3%	3%	5%	5%	6%	0%	2%	3%	4%	4%	5%	5%
Export Total			**4.708**																															
Import	1	Germany	1.974	4%	5%	0%	0%	3%	4%	4%	5%	5%	0%	0%	4%	4%	5%	4%	4%	1%	0%	4%	4%	4%	5%	4%	1%	0%	3%	4%	4%	5%	4%	1%
Import	2	France	506	5%	3%	1%	0%	4%	4%	6%	6%	3%	1%	0%	4%	4%	5%	7%	3%	1%	0%	4%	6%	6%	6%	4%	1%	0%	3%	4%	6%	5%	4%	1%
Import	3	Italy	276	4%	6%	0%	0%	3%	3%	3%	5%	7%	0%	0%	3%	5%	4%	5%	6%	1%	0%	4%	4%	4%	6%	6%	0%	0%	3%	5%	4%	6%	6%	0%
Import	4	Poland	373	4%	4%	0%	0%	2%	3%	4%	6%	5%	0%	0%	3%	5%	5%	6%	5%	0%	0%	5%	5%	5%	5%	4%	0%	0%	3%	5%	4%	5%	4%	0%
Import	5	England	199	5%	4%	2%	0%	4%	1%	7%	3%	4%	2%	1%	6%	4%	5%	3%	3%	1%	0%	2%	4%	6%	7%	8%	3%	0%	4%	4%	3%	5%	4%	2%
Import	6	Belgium	375	5%	3%	0%	0%	5%	4%	4%	5%	5%	1%	0%	7%	5%	5%	5%	5%	1%	0%	4%	5%	5%	5%	5%	1%	0%	4%	4%	3%	5%	4%	1%
Import	7	Spain	191	7%	5%	0%	0%	3%	3%	4%	4%	4%	1%	0%	4%	3%	3%	9%	4%	0%	0%	4%	5%	5%	3%	2%	0%	0%	3%	5%	7%	4%	3%	1%
Import	8	Sweden	108	6%	7%	0%	0%	2%	5%	7%	8%	4%	0%	0%	2%	4%	6%	7%	3%	0%	0%	2%	3%	5%	4%	5%	0%	0%	0%	6%	10%	4%	5%	0%
Import	9	Netherlands	164	6%	4%	1%	0%	3%	4%	4%	4%	4%	1%	0%	4%	5%	6%	4%	6%	1%	0%	3%	4%	5%	5%	4%	1%	0%	3%	4%	4%	5%	4%	1%
Import	10	Hungary	102	6%	8%	0%	0%	1%	3%	4%	5%	5%	0%	0%	4%	4%	4%	5%	4%	0%	0%	5%	4%	7%	3%	5%	0%	0%	2%	4%	4%	4%	5%	0%
Import	11	Czechia	72	7%	4%	1%	0%	1%	2%	3%	5%	3%	0%	0%	1%	4%	5%	7%	7%	0%	0%	4%	4%	4%	4%	6%	0%	0%	2%	4%	6%	6%	3%	0%
Import	12	Slovenia	50	6%	10%	0%	0%	2%	9%	5%	1%	4%	0%	0%	1%	6%	9%	3%	4%	0%	0%	5%	6%	5%	1%	8%	0%	0%	4%	5%	2%	4%	9%	0%
Import	13	Austria	32	3%	4%	1%	0%	6%	1%	5%	3%	5%	0%	0%	4%	2%	2%	2%	5%	0%	0%	8%	5%	5%	2%	8%	0%	0%	0%	6%	5%	3%	5%	0%
Import	14	Switzerland	31	4%	6%	1%	0%	2%	3%	1%	6%	3%	2%	0%	3%	4%	1%	3%	5%	2%	0%	3%	5%	4%	5%	3%	2%	0%	6%	4%	6%	6%	4%	2%
Import	15	Greece	34	8%	12%	0%	0%	0%	1%	7%	5%	4%	0%	0%	5%	8%	2%	6%	2%	0%	0%	2%	1%	6%	6%	1%	0%	0%	3%	3%	14%	4%	1%	0%
Import	16	Romania	27	9%	7%	0%	0%	0%	0%	0%	7%	7%	0%	0%	2%	4%	5%	7%	6%	0%	0%	2%	6%	6%	5%	7%	0%	0%	4%	0%	0%	8%	8%	0%
Import	17	Slovakia	26	5%	1%	0%	0%	1%	2%	9%	11%	3%	0%	0%	2%	11%	10%	12%	2%	0%	0%	0%	3%	6%	4%	1%	0%	0%	4%	4%	3%	5%	4%	1%
Import	Other	Others	96	5%	3%	0%	0%	2%	4%	3%	4%	3%	0%	0%	4%	7%	6%	4%	2%	0%	0%	2%	4%	10%	5%	7%	0%	0%	5%	3%	6%	5%	6%	0%
Import Total			**4.635**																															
Grand Total			**9.343**																															

Service	No	Country	Company Forecast for March Year 4	ACTUAL DAILY VOLUME PROPORTIONS FOR FEBRUARY YEAR 4																													
				Weight 1	Σ	Thu 1	Fri 2	Sat 3	Sun 4	Mon 5	Tue 6	Wed 7	Thu 8	Fri 9	Sat 10	Sun 11	Mon 12	Tue 13	Wed 14	Thu 15	Fri 16	Sat 17	Sun 18	Mon 19	Tue 20	Wed 21	Thu 22	Fri 23	Sat 24	Sun 25	Mon 26	Tue 27	Wed 28
Export	1	Germany	1.586	0%	1.521	4%	5%	3%	1%	3%	5%	5%	4%	5%	3%	1%	2%	4%	4%	4%	6%	3%	0%	3%	4%	5%	5%	5%	4%	0%	3%	5%	4%
Export	2	France	584	81%	491	4%	6%	3%	0%	5%	3%	6%	3%	5%	2%	0%	3%	2%	6%	6%	6%	3%	0%	3%	5%	4%	5%	5%	2%	0%	4%	4%	6%
Export	3	Italy	374	33%	345	5%	6%	3%	0%	2%	4%	5%	5%	5%	3%	0%	2%	4%	3%	6%	4%	4%	0%	1%	3%	6%	6%	6%	3%	0%	2%	6%	6%
Export	4	Poland	316	38%	287	3%	3%	2%	1%	3%	6%	7%	2%	4%	4%	0%	5%	5%	7%	3%	5%	3%	0%	3%	4%	5%	4%	5%	3%	0%	3%	5%	5%
Export	5	England	328	61%	285	6%	5%	3%	0%	2%	3%	5%	4%	6%	3%	0%	3%	3%	4%	3%	7%	4%	0%	2%	4%	5%	6%	5%	5%	0%	3%	4%	4%
Export	6	Belgium	226	2%	163	1%	10%	3%	0%	1%	4%	7%	2%	8%	1%	0%	4%	3%	9%	6%	4%	2%	0%	1%	4%	7%	2%	4%	4%	2%	2%	2%	7%
Export	7	Spain	321	76%	205	0%	7%	10%	0%	1%	3%	3%	1%	4%	8%	1%	0%	2%	4%	5%	8%	12%	0%	1%	3%	5%	4%	5%	7%	0%	1%	2%	2%
Export	8	Sweden	86	7%	56	4%	7%	1%	0%	2%	12%	3%	3%	7%	4%	0%	7%	1%	7%	4%	6%	1%	0%	0%	6%	8%	1%	2%	0%	0%	2%	6%	3%
Export	9	Netherlands	102	83%	85	4%	2%	8%	0%	2%	3%	1%	6%	9%	3%	1%	1%	3%	3%	8%	7%	2%	1%	0%	5%	4%	7%	5%	2%	0%	3%	3%	5%
Export	10	Hungary	93	69%	81	4%	3%	0%	0%	2%	7%	7%	5%	7%	1%	0%	5%	8%	6%	5%	3%	1%	0%	3%	4%	5%	5%	3%	0%	0%	7%	3%	5%
Export	11	Czechia	134	3%	106	3%	5%	0%	0%	3%	6%	6%	1%	6%	1%	0%	7%	4%	7%	3%	7%	2%	0%	4%	3%	8%	5%	4%	5%	0%	4%	4%	5%
Export	12	Slovenia	148	67%	123	7%	4%	2%	0%	5%	2%	6%	5%	5%	0%	0%	3%	6%	2%	4%	5%	0%	0%	7%	6%	6%	5%	6%	0%	0%	6%	5%	6%
Export	13	Austria	80	28%	61	8%	3%	0%	0%	1%	4%	6%	5%	4%	3%	0%	3%	4%	7%	7%	4%	2%	0%	2%	1%	7%	4%	3%	4%	2%	4%	11%	2%
Export	14	Switzerland	82	62%	55	8%	4%	0%	2%	1%	4%	7%	1%	5%	7%	2%	0%	2%	7%	7%	5%	0%	0%	3%	8%	7%	6%	5%	4%	0%	0%	1%	2%
Export	15	Greece	38	29%	55	7%	5%	4%	0%	0%	11%	15%	5%	5%	4%	0%	0%	5%	0%	4%	2%	0%	0%	5%	0%	13%	7%	4%	0%	0%	2%	2%	0%
Export	16	Romania	52	0%	31	3%	2%	3%	0%	3%	6%	3%	6%	6%	6%	0%	0%	3%	5%	6%	6%	2%	0%	7%	0%	5%	6%	3%	5%	0%	0%	7%	6%
Export	17	Slovakia	31	47%	48	2%	6%	0%	1%	4%	4%	8%	2%	4%	8%	0%	2%	3%	6%	8%	4%	4%	0%	0%	2%	7%	4%	6%	3%	0%	1%	4%	3%
Export	Other	Others	126	62%	100	4%	7%	4%	0%	1%	5%	4%	2%	4%	8%	0%	3%	3%	5%	3%	4%	6%	0%	2%	3%	3%	7%	6%	6%	0%	2%	4%	4%
Export Total			**4.708**		**4.097**																												
Import	1	Germany	1.974	0%	1.644	5%	3%	0%	0%	4%	5%	6%	6%	5%	1%	0%	5%	5%	5%	5%	5%	1%	0%	5%	5%	5%	5%	5%	1%	0%	5%	5%	5%
Import	2	France	506	67%	493	4%	3%	0%	0%	4%	4%	6%	7%	3%	1%	0%	5%	3%	5%	8%	2%	1%	0%	4%	7%	6%	6%	4%	1%	0%	4%	3%	6%
Import	3	Italy	276	25%	356	5%	5%	0%	0%	3%	3%	3%	8%	8%	0%	0%	3%	5%	5%	6%	8%	0%	0%	4%	5%	6%	8%	7%	0%	0%	2%	2%	3%
Import	4	Poland	373	27%	320	6%	3%	0%	0%	5%	6%	5%	9%	4%	0%	0%	3%	5%	6%	5%	6%	0%	0%	5%	5%	5%	6%	4%	0%	0%	3%	5%	5%
Import	5	England	199	89%	185	6%	4%	3%	0%	4%	1%	7%	3%	4%	2%	2%	6%	4%	5%	3%	3%	1%	1%	2%	4%	6%	7%	8%	3%	0%	4%	4%	3%
Import	6	Belgium	375	54%	314	6%	3%	1%	0%	6%	4%	5%	5%	4%	1%	0%	6%	5%	6%	4%	6%	0%	1%	4%	5%	6%	5%	6%	1%	0%	4%	4%	3%
Import	7	Spain	191	9%	196	7%	4%	0%	1%	8%	2%	4%	7%	1%	0%	1%	4%	2%	3%	7%	6%	1%	2%	2%	5%	6%	4%	1%	1%	1%	2%	10%	9%
Import	8	Sweden	108	79%	46	7%	8%	0%	0%	3%	5%	8%	9%	4%	0%	0%	3%	4%	7%	7%	2%	0%	0%	2%	2%	4%	3%	5%	0%	0%	0%	6%	10%
Import	9	Netherlands	164	27%	156	6%	3%	2%	0%	4%	4%	3%	5%	3%	3%	0%	3%	5%	6%	4%	6%	1%	0%	5%	3%	6%	5%	5%	2%	0%	5%	6%	6%
Import	10	Hungary	102	7%	122	6%	7%	0%	0%	5%	3%	4%	6%	4%	0%	0%	2%	5%	6%	6%	6%	0%	0%	5%	8%	8%	5%	3%	0%	0%	2%	5%	3%
Import	11	Czechia	72	1%	99	7%	7%	0%	0%	3%	4%	2%	8%	9%	0%	0%	3%	4%	7%	7%	1%	0%	0%	4%	5%	5%	6%	1%	0%	0%	3%	6%	8%
Import	12	Slovenia	50	70%	42	7%	10%	0%	0%	2%	12%	6%	0%	3%	0%	0%	0%	7%	12%	2%	4%	0%	0%	5%	8%	5%	0%	7%	0%	0%	5%	5%	0%
Import	13	Austria	32	0%	40	8%	5%	0%	0%	5%	0%	5%	6%	3%	0%	0%	5%	5%	3%	8%	5%	0%	0%	8%	10%	5%	6%	5%	0%	0%	8%	0%	3%
Import	14	Switzerland	31	10%	28	13%	1%	0%	0%	4%	13%	8%	1%	5%	1%	0%	8%	1%	4%	1%	8%	0%	0%	8%	5%	1%	6%	2%	1%	0%	0%	3%	5%
Import	15	Greece	34	76%	40	10%	15%	0%	0%	0%	0%	5%	5%	2%	0%	0%	2%	10%	2%	7%	2%	0%	0%	0%	0%	7%	7%	0%	0%	0%	2%	3%	17%
Import	16	Romania	27	7%	24	4%	8%	4%	0%	0%	0%	6%	12%	8%	0%	0%	0%	0%	3%	16%	4%	0%	0%	0%	0%	0%	12%	16%	0%	0%	0%	0%	4%
Import	17	Slovakia	26	71%	41	4%	2%	0%	0%	1%	3%	11%	16%	2%	0%	0%	3%	10%	10%	15%	2%	0%	0%	1%	0%	5%	5%	0%	0%	0%	5%	3%	2%
Import	Other	Others	96	24%	96	6%	4%	0%	0%	4%	8%	3%	6%	2%	0%	0%	5%	10%	9%	5%	1%	0%	0%	2%	5%	3%	9%	4%	0%	0%	7%	2%	6%
Import Total			**4.635**		**4.243**																												
Grand Total			**9.343**		**8.340**																												

Service	No	Country	Company Forecast for March Year 4	ACTUAL DAILY VOLUME PROPORTIONS FOR JANUARY YEAR 4																																		
				Weight 2	Σ	Mon 1	Tue 2	Wed 3	Thu 4	Fri 5	Sat 6	Sun 7	Mon 8	Tue 9	Wed 10	Thu 11	Fri 12	Sat 13	Sun 14	Mon 15	Tue 16	Wed 17	Thu 18	Fri 19	Sat 20	Sun 21	Mon 22	Tue 23	Wed 24	Thu 25	Fri 26	Sat 27	Sun 28	Mon 29	Tue 30	Wed 31
Export	1	Germany	1.586	20%	1.465	0%	2%	3%	3%	5%	3%	0%	2%	3%	5%	4%	5%	3%	0%	3%	5%	5%	4%	5%	4%	0%	3%	4%	4%	4%	6%	2%	0%	2%	7%	5%
Export	2	France	584	0%	561	0%	3%	6%	4%	7%	2%	0%	3%	3%	5%	3%	5%	2%	0%	3%	4%	4%	3%	5%	4%	1%	2%	4%	5%	3%	5%	2%	1%	3%	4%	5%
Export	3	Italy	374	27%	359	0%	1%	4%	3%	6%	2%	0%	4%	4%	6%	4%	5%	3%	0%	3%	2%	5%	3%	5%	2%	0%	2%	4%	4%	3%	6%	4%	2%	3%	4%	5%
Export	4	Poland	316	26%	315	0%	1%	5%	4%	5%	2%	0%	3%	3%	3%	4%	4%	1%	0%	3%	3%	5%	5%	3%	3%	0%	1%	5%	6%	5%	4%	3%	1%	3%	9%	5%
Export	5	England	328	7%	267	0%	1%	4%	6%	5%	5%	0%	2%	2%	4%	5%	5%	5%	0%	2%	3%	5%	3%	5%	6%	0%	2%	2%	4%	2%	6%	6%	0%	2%	3%	5%
Export	6	Belgium	226	0%	169	0%	2%	4%	3%	4%	1%	0%	1%	4%	6%	5%	5%	3%	0%	3%	6%	6%	4%	4%	1%	0%	3%	5%	5%	2%	5%	3%	1%	2%	4%	7%
Export	7	Spain	321	10%	222	0%	2%	4%	4%	5%	7%	0%	0%	2%	4%	5%	7%	8%	0%	1%	1%	2%	4%	6%	8%	1%	0%	1%	3%	5%	3%	8%	2%	0%	2%	4%
Export	8	Sweden	86	36%	78	0%	4%	4%	4%	4%	4%	0%	2%	6%	1%	6%	1%	4%	0%	4%	2%	6%	4%	3%	2%	0%	6%	5%	7%	3%	5%	3%	0%	2%	2%	6%
Export	9	Netherlands	102	10%	75	0%	1%	5%	8%	7%	1%	0%	1%	3%	4%	5%	4%	2%	0%	2%	4%	10%	2%	6%	3%	1%	0%	5%	3%	2%	9%	3%	2%	2%	4%	3%
Export	10	Hungary	93	0%	96	0%	1%	5%	5%	5%	0%	0%	6%	6%	6%	2%	8%	2%	0%	4%	5%	3%	3%	3%	2%	1%	3%	6%	5%	3%	2%	1%	0%	2%	6%	5%
Export	11	Czechia	134	16%	123	0%	7%	2%	4%	5%	2%	1%	3%	4%	7%	4%	4%	2%	0%	2%	7%	4%	0%	4%	3%	0%	4%	2%	6%	3%	4%	3%	0%	0%	4%	10%
Export	12	Slovenia	148	33%	137	0%	3%	7%	4%	8%	0%	0%	4%	3%	4%	3%	7%	0%	0%	4%	5%	4%	4%	4%	3%	0%	4%	3%	2%	5%	3%	3%	0%	3%	6%	5%
Export	13	Austria	80	33%	58	0%	4%	5%	3%	3%	2%	0%	2%	5%	3%	3%	2%	4%	0%	2%	7%	2%	2%	4%	3%	0%	2%	3%	6%	9%	3%	4%	0%	0%	3%	11%
Export	14	Switzerland	82	11%	43	0%	1%	2%	0%	7%	2%	0%	3%	4%	0%	0%	5%	2%	0%	2%	3%	7%	2%	9%	5%	2%	0%	7%	8%	2%	3%	9%	0%	3%	5%	8%
Export	15	Greece	38	28%	70	0%	0%	3%	7%	14%	0%	0%	7%	9%	3%	1%	1%	0%	0%	1%	1%	3%	0%	11%	17%	0%	0%	3%	1%	3%	6%	3%	0%	1%	0%	3%
Export	16	Romania	52	57%	32	0%	0%	6%	5%	2%	3%	0%	3%	0%	8%	5%	0%	10%	0%	2%	0%	3%	0%	4%	7%	0%	6%	3%	3%	4%	3%	5%	0%	6%	2%	9%
Export	17	Slovakia	31	0%	33	0%	1%	1%	10%	4%	1%	0%	0%	3%	2%	12%	9%	0%	0%	3%	2%	4%	10%	0%	3%	1%	1%	3%	3%	9%	9%	1%	0%	0%	7%	1%
Export	Other	Others	126	27%	108	0%	2%	6%	6%	1%	4%	0%	2%	0%	4%	7%	3%	5%	0%	1%	4%	3%	8%	4%	6%	0%	3%	2%	2%	2%	4%	7%	1%	3%	5%	4%
Export Total			**4.708**		**4.211**																															
Import	1	Germany	1.974	25%	1.649	0%	2%	3%	3%	3%	0%	0%	4%	5%	6%	5%	5%	1%	0%	4%	5%	6%	5%	5%	1%	0%	4%	5%	4%	5%	5%	0%	0%	5%	5%	5%
Import	2	France	506	8%	533	0%	3%	3%	5%	3%	1%	0%	3%	5%	5%	6%	3%	1%	0%	4%	3%	6%	7%	3%	1%	0%	3%	6%	5%	5%	4%	1%	0%	5%	4%	6%
Import	3	Italy	276	20%	277	0%	1%	1%	4%	1%	0%	0%	4%	5%	4%	8%	8%	1%	0%	6%	4%	5%	4%	6%	1%	0%	3%	4%	4%	7%	8%	0%	0%	1%	5%	5%
Import	4	Poland	373	58%	345	0%	1%	3%	3%	4%	0%	0%	4%	5%	6%	6%	5%	0%	0%	5%	5%	6%	7%	5%	0%	0%	3%	6%	3%	5%	5%	0%	0%	4%	5%	5%
Import	5	England	199	11%	197	0%	1%	3%	3%	3%	2%	0%	5%	4%	7%	2%	3%	2%	0%	5%	6%	3%	6%	5%	0%	0%	3%	4%	4%	3%	4%	1%	1%	7%	5%	7%
Import	6	Belgium	375	0%	351	0%	3%	4%	5%	7%	1%	0%	3%	4%	4%	4%	3%	1%	0%	4%	4%	5%	3%	4%	1%	0%	5%	4%	4%	4%	5%	1%	0%	6%	5%	5%
Import	7	Spain	191	0%	206	0%	3%	6%	5%	3%	1%	0%	3%	5%	6%	7%	5%	1%	1%	3%	4%	3%	6%	4%	1%	1%	3%	4%	4%	6%	2%	0%	1%	3%	3%	2%
Import	8	Sweden	108	21%	61	0%	3%	3%	4%	3%	0%	0%	2%	3%	3%	5%	6%	0%	0%	3%	5%	7%	7%	8%	0%	0%	2%	3%	9%	7%	5%	0%	0%	3%	5%	3%
Import	9	Netherlands	164	32%	133	0%	3%	3%	7%	4%	0%	0%	2%	6%	8%	2%	4%	0%	0%	2%	6%	6%	4%	6%	1%	0%	3%	4%	2%	4%	5%	0%	0%	6%	8%	4%
Import	10	Hungary	102	79%	107	0%	3%	4%	6%	8%	0%	0%	5%	4%	4%	4%	6%	0%	0%	5%	4%	8%	4%	4%	0%	0%	3%	4%	4%	3%	5%	0%	0%	2%	8%	5%
Import	11	Czechia	72	26%	117	0%	0%	5%	6%	3%	0%	0%	2%	6%	5%	7%	3%	0%	0%	1%	5%	8%	7%	5%	0%	0%	3%	5%	6%	4%	6%	0%	0%	1%	9%	3%
Import	12	Slovenia	50	21%	61	0%	0%	3%	5%	13%	0%	0%	5%	5%	5%	3%	5%	0%	0%	5%	3%	4%	5%	4%	0%	0%	2%	4%	5%	3%	9%	0%	0%	0%	3%	8%
Import	13	Austria	32	0%	31	0%	0%	3%	0%	10%	0%	0%	3%	0%	10%	0%	0%	0%	0%	3%	5%	0%	6%	6%	1%	0%	6%	6%	10%	2%	3%	0%	0%	10%	3%	11%
Import	14	Switzerland	31	27%	38	0%	0%	0%	3%	7%	0%	0%	0%	1%	3%	9%	4%	3%	0%	3%	2%	5%	5%	3%	1%	0%	1%	3%	2%	14%	8%	6%	0%	3%	6%	11%
Import	15	Greece	34	0%	31	0%	0%	0%	23%	3%	0%	0%	3%	3%	13%	3%	3%	0%	0%	3%	2%	7%	3%	0%	3%	0%	0%	3%	0%	7%	0%	0%	0%	0%	13%	7%
Import	16	Romania	27	58%	29	0%	0%	0%	7%	10%	0%	0%	3%	3%	0%	7%	10%	0%	0%	3%	3%	3%	3%	10%	0%	0%	7%	0%	0%	3%	10%	0%	0%	0%	3%	10%
Import	17	Slovakia	26	21%	27	0%	0%	5%	8%	0%	0%	0%	0%	18%	11%	1%	4%	0%	0%	0%	11%	12%	4%	1%	0%	0%	0%	8%	5%	1%	4%	0%	0%	1%	5%	1%
Import	Other	Others	96	55%	122	0%	2%	2%	5%	3%	0%	0%	4%	8%	6%	3%	3%	0%	0%	1%	4%	15%	3%	2%	0%	0%	6%	3%	6%	4%	9%	0%	0%	5%	2%	5%
Import Total			**4.635**		**4.315**																															
Grand Total			**9.343**		**8.526**																															

Service	No	Country	Company Forecast for March Year 4	ACTUAL DAILY VOLUME PROPORTIONS FOR MARCH YEAR 3																																
				Weight 3	Σ	Wed 1	Thu 2	Fri 3	Sat 4	Sun 5	Mon 6	Tue 7	Wed 8	Thu 9	Fri 10	Sat 11	Sun 12	Mon 13	Tue 14	Wed 15	Thu 16	Fri 17	Sat 18	Sun 19	Mon 20	Tue 21	Wed 22	Thu 23	Fri 24	Sat 25	Sun 26	Mon 27	Tue 28	Wed 29	Thu 30	Fri 31
Export	1	Germany	1.586	80%	1.514	4%	3%	5%	3%	0%	3%	4%	5%	4%	5%	3%	0%	3%	4%	4%	4%	5%	3%	0%	4%	4%	4%	4%	4%	2%	0%	2%	3%	3%	3%	5%
Export	2	France	584	13%	512	4%	4%	5%	3%	0%	3%	4%	4%	3%	5%	2%	0%	3%	3%	4%	4%	5%	2%	0%	3%	4%	5%	4%	5%	2%	0%	3%	3%	3%	4%	6%
Export	3	Italy	374	41%	453	5%	3%	4%	2%	0%	1%	4%	4%	4%	5%	3%	0%	2%	4%	4%	5%	5%	3%	0%	2%	3%	5%	4%	7%	3%	0%	2%	4%	5%	3%	4%
Export	4	Poland	316	21%	327	5%	4%	5%	2%	0%	5%	3%	4%	5%	3%	2%	0%	4%	4%	3%	4%	4%	4%	1%	2%	4%	5%	3%	4%	1%	1%	2%	4%	5%	2%	4%
Export	5	England	328	14%	456	4%	5%	5%	3%	0%	2%	3%	5%	4%	3%	3%	0%	2%	2%	4%	5%	6%	3%	0%	2%	4%	3%	5%	5%	3%	0%	2%	3%	6%	3%	5%
Export	6	Belgium	226	83%	226	4%	3%	9%	2%	0%	2%	3%	5%	2%	5%	4%	0%	3%	4%	4%	2%	4%	2%	0%	3%	2%	3%	6%	7%	2%	0%	2%	3%	4%	4%	6%
Export	7	Spain	321	0%	234	3%	3%	4%	6%	0%	0%	3%	4%	5%	6%	6%	0%	2%	1%	4%	3%	5%	8%	1%	1%	2%	3%	3%	5%	9%	0%	0%	1%	4%	3%	6%
Export	8	Sweden	86	42%	203	3%	4%	5%	2%	0%	2%	5%	2%	3%	5%	2%	0%	3%	2%	5%	2%	7%	2%	0%	2%	4%	5%	6%	3%	2%	0%	3%	3%	4%	5%	5%
Export	9	Netherlands	102	7%	104	6%	2%	6%	4%	0%	5%	4%	1%	2%	6%	1%	0%	5%	5%	6%	3%	4%	3%	0%	3%	0%	5%	1%	4%	4%	0%	3%	4%	3%	6%	4%
Export	10	Hungary	93	31%	134	12%	2%	5%	3%	0%	3%	3%	7%	5%	4%	1%	0%	4%	1%	5%	2%	5%	2%	1%	1%	2%	4%	1%	4%	3%	0%	3%	4%	6%	4%	4%
Export	11	Czechia	134	51%	130	5%	2%	3%	1%	0%	2%	2%	5%	3%	4%	1%	0%	2%	3%	7%	2%	5%	0%	0%	2%	3%	10%	8%	3%	1%	0%	3%	6%	8%	5%	3%
Export	12	Slovenia	148	0%	28	7%	4%	4%	1%	0%	0%	0%	7%	4%	7%	7%	0%	0%	0%	7%	4%	7%	4%	0%	0%	0%	7%	4%	10%	3%	0%	0%	0%	4%	4%	7%
Export	13	Austria	80	34%	74	7%	6%	3%	2%	0%	4%	7%	0%	4%	7%	0%	0%	5%	1%	5%	3%	4%	1%	0%	3%	3%	5%	3%	3%	2%	0%	1%	6%	7%	0%	8%
Export	14	Switzerland	82	18%	76	1%	6%	7%	2%	0%	2%	3%	3%	3%	3%	1%	0%	2%	3%	5%	6%	8%	0%	0%	2%	4%	6%	3%	9%	2%	0%	3%	5%	4%	3%	4%
Export	15	Greece	38	43%	81	2%	11%	2%	1%	0%	1%	9%	4%	10%	10%	0%	0%	0%	2%	2%	0%	5%	7%	0%	0%	2%	1%	5%	12%	2%	0%	1%	0%	1%	2%	4%
Export	16	Romania	52	0%	48	4%	7%	5%	0%	0%	2%	2%	5%	3%	3%	1%	0%	1%	4%	4%	5%	4%	3%	0%	2%	4%	2%	3%	3%	4%	0%	2%	8%	8%	6%	2%
Export	17	Slovakia	31	46%	79	2%	8%	4%	1%	0%	1%	4%	2%	4%	7%	1%	0%	0%	4%	2%	6%	5%	2%	0%	0%	4%	4%	7%	7%	2%	0%	2%	1%	4%	11%	7%
Export	Other	Others	126	11%	184	3%	5%	5%	4%	1%	1%	2%	6%	3%	4%	2%	0%	3%	4%	2%	3%	6%	5%	0%	2%	3%	4%	4%	5%	2%	0%	3%	3%	6%	6%	6%
Export Total			**4.708**		**4.864**																															
Import	1	Germany	1.974	64%	1.778	5%	4%	6%	0%	0%	4%	5%	5%	4%	5%	0%	0%	5%	4%	4%	3%	4%	1%	0%	3%	4%	4%	4%	4%	1%	0%	4%	4%	4%	5%	5%
Import	2	France	506	19%	685	5%	4%	3%	1%	0%	4%	4%	5%	4%	4%	1%	0%	3%	6%	5%	4%	5%	1%	0%	3%	3%	4%	5%	4%	1%	0%	4%	5%	5%	3%	4%
Import	3	Italy	276	50%	436	3%	4%	8%	0%	0%	3%	4%	4%	3%	7%	0%	0%	3%	4%	3%	4%	6%	0%	0%	3%	4%	4%	5%	4%	1%	0%	4%	6%	5%	3%	6%
Import	4	Poland	373	14%	413	5%	5%	4%	0%	0%	4%	4%	4%	5%	3%	0%	0%	3%	6%	5%	4%	4%	0%	0%	4%	5%	6%	5%	4%	0%	0%	3%	4%	4%	4%	4%
Import	5	England	199	0%	216	4%	7%	6%	1%	1%	3%	3%	2%	3%	7%	1%	0%	4%	2%	3%	4%	4%	1%	0%	3%	5%	5%	5%	4%	1%	0%	2%	5%	7%	5%	3%
Import	6	Belgium	375	28%	383	2%	4%	2%	0%	0%	3%	5%	3%	4%	5%	0%	0%	8%	5%	4%	7%	5%	1%	0%	3%	4%	3%	4%	3%	0%	0%	6%	3%	3%	6%	4%
Import	7	Spain	191	23%	175	4%	5%	3%	1%	0%	3%	2%	2%	6%	1%	2%	0%	4%	1%	5%	7%	5%	0%	0%	4%	5%	4%	3%	9%	0%	0%	6%	3%	3%	4%	6%
Import	8	Sweden	108	0%	143	7%	11%	4%	0%	0%	3%	5%	3%	3%	1%	0%	0%	5%	5%	2%	3%	7%	0%	0%	2%	5%	4%	3%	8%	0%	0%	2%	4%	3%	4%	6%
Import	9	Netherlands	164	14%	182	4%	5%	4%	0%	0%	2%	5%	6%	4%	5%	2%	0%	7%	3%	2%	4%	6%	1%	0%	3%	3%	5%	4%	4%	0%	0%	3%	5%	5%	4%	2%
Import	10	Hungary	102	0%	136	6%	6%	3%	0%	0%	2%	5%	4%	4%	6%	0%	0%	4%	2%	1%	9%	5%	0%	0%	5%	2%	6%	3%	6%	0%	0%	4%	2%	4%	3%	8%
Import	11	Czechia	72	73%	137	3%	7%	5%	1%	0%	2%	3%	5%	4%	3%	0%	0%	1%	3%	3%	7%	8%	0%	0%	5%	4%	7%	4%	6%	0%	0%	1%	3%	3%	7%	7%
Import	12	Slovenia	50	9%	46	5%	3%	4%	0%	0%	4%	2%	2%	9%	7%	0%	0%	2%	4%	6%	1%	4%	0%	0%	4%	2%	6%	4%	6%	0%	0%	2%	4%	6%	4%	5%
Import	13	Austria	32	65%	31	3%	2%	6%	0%	0%	6%	0%	3%	3%	6%	0%	0%	6%	0%	3%	0%	3%	0%	0%	10%	3%	7%	0%	10%	0%	0%	0%	10%	3%	7%	6%
Import	14	Switzerland	31	47%	44	0%	3%	7%	3%	0%	2%	1%	0%	4%	0%	2%	0%	3%	5%	5%	2%	6%	3%	0%	4%	7%	8%	0%	1%	0%	0%	13%	5%	13%	3%	1%
Import	15	Greece	34	24%	35	11%	3%	3%	0%	0%	0%	3%	0%	6%	9%	0%	0%	11%	3%	3%	3%	0%	0%	0%	9%	6%	3%	3%	6%	0%	0%	6%	6%	9%	0%	0%
Import	16	Romania	27	0%	29	0%	3%	7%	0%	0%	0%	0%	0%	7%	20%	0%	0%	0%	3%	0%	3%	10%	0%	0%	0%	6%	0%	10%	3%	0%	0%	1%	3%	4%	7%	10%
Import	17	Slovakia	26	0%	50	5%	4%	2%	2%	0%	0%	6%	2%	8%	12%	0%	0%	4%	0%	2%	3%	5%	0%	0%	2%	2%	5%	4%	10%	2%	0%	2%	4%	1%	8%	4%
Import	Other	Others	96	21%	164	5%	6%	2%	0%	0%	3%	4%	2%	5%	5%	0%	0%	3%	2%	6%	3%	6%	0%	0%	4%	4%	6%	4%	4%	0%	0%	4%	5%	7%	3%	4%
Import Total			**4.635**		**5.084**																															
Grand Total			**9.343**		**9.948**																															

Service	No	Country	Company Forecast for March Year 4	ACTUAL DAILY VOLUME PROPORTIONS FOR MARCH YEAR 2																																		
				Weight 4	Σ	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Export	1	Germany	1.586	0%	1.536	4%	5%	3%	5%	2%	0%	3%	3%	5%	3%	4%	3%	0%	3%	4%	4%	3%	5%	3%	0%	3%	3%	5%	3%	5%	3%	0%	3%	3%	6%	4%
Export	2	France	584	7%	555	3%	3%	5%	4%	1%	0%	4%	3%	3%	5%	6%	2%	0%	3%	4%	3%	4%	5%	2%	0%	3%	4%	4%	5%	4%	2%	0%	4%	3%	5%	5%
Export	3	Italy	374	0%	507	3%	4%	4%	4%	2%	0%	3%	3%	5%	4%	6%	3%	0%	2%	3%	4%	2%	4%	3%	0%	3%	2%	5%	5%	6%	2%	0%	3%	3%	6%	5%
Export	4	Poland	316	15%	260	5%	7%	2%	1%	2%	0%	3%	5%	4%	4%	3%	1%	1%	2%	4%	7%	3%	4%	2%	0%	4%	3%	6%	2%	4%	2%	0%	4%	3%	10%	2%
Export	5	England	328	17%	357	2%	5%	5%	4%	4%	1%	3%	2%	4%	4%	4%	3%	0%	1%	2%	5%	4%	5%	5%	0%	2%	2%	5%	4%	4%	3%	0%	2%	2%	6%	6%
Export	6	Belgium	226	15%	214	7%	6%	3%	6%	1%	0%	2%	3%	4%	2%	4%	1%	0%	2%	4%	3%	3%	8%	3%	0%	3%	6%	3%	3%	4%	3%	0%	3%	5%	4%	3%
Export	7	Spain	321	14%	280	3%	3%	4%	4%	7%	0%	3%	2%	6%	3%	4%	6%	2%	3%	2%	3%	3%	4%	5%	0%	2%	3%	4%	3%	3%	5%	0%	1%	3%	4%	4%
Export	8	Sweden	86	16%	140	5%	2%	5%	5%	3%	0%	2%	4%	2%	5%	6%	3%	0%	2%	5%	7%	4%	6%	2%	0%	1%	2%	6%	3%	8%	3%	0%	1%	1%	2%	5%
Export	9	Netherlands	102	0%	92	4%	5%	2%	5%	2%	0%	4%	8%	5%	4%	5%	5%	0%	1%	3%	8%	0%	3%	4%	0%	2%	1%	7%	4%	6%	2%	0%	3%	1%	4%	3%
Export	10	Hungary	93	0%	113	5%	4%	8%	4%	2%	0%	3%	4%	4%	4%	6%	2%	0%	4%	4%	4%	3%	4%	0%	0%	1%	2%	7%	3%	7%	1%	2%	3%	3%	4%	2%
Export	11	Czechia	134	30%	111	4%	3%	6%	6%	3%	0%	2%	3%	5%	3%	6%	0%	0%	4%	3%	5%	3%	3%	1%	0%	4%	5%	4%	5%	6%	3%	0%	3%	4%	5%	3%
Export	12	Slovenia	148	0%	9	11%	0%	11%	0%	6%	0%	2%	0%	11%	0%	12%	0%	0%	11%	0%	0%	0%	7%	0%	0%	0%	0%	11%	0%	2%	11%	0%	0%	0%	6%	0%
Export	13	Austria	80	5%	56	7%	2%	5%	11%	4%	0%	2%	2%	5%	2%	3%	7%	0%	0%	2%	5%	2%	10%	4%	0%	0%	0%	5%	4%	2%	2%	0%	2%	2%	7%	4%
Export	14	Switzerland	82	9%	105	0%	4%	5%	7%	2%	0%	5%	4%	5%	1%	3%	3%	0%	1%	2%	5%	3%	3%	4%	0%	3%	6%	6%	1%	5%	3%	0%	1%	7%	7%	5%
Export	15	Greece	38	0%	59	5%	3%	17%	2%	0%	0%	2%	3%	0%	2%	7%	2%	0%	7%	3%	0%	10%	0%	0%	0%	0%	5%	0%	14%	7%	1%	0%	7%	2%	1%	0%
Export	16	Romania	52	43%	25	11%	0%	0%	4%	6%	0%	0%	0%	9%	0%	4%	5%	0%	4%	4%	8%	8%	3%	2%	0%	0%	0%	3%	0%	8%	3%	0%	0%	0%	2%	14%
Export	17	Slovakia	31	7%	67	3%	5%	10%	4%	2%	0%	5%	1%	5%	5%	5%	1%	0%	3%	1%	3%	5%	5%	2%	0%	0%	2%	2%	3%	10%	1%	0%	0%	3%	5%	10%
Export	Other	Others	126	0%	142	4%	3%	5%	5%	2%	0%	1%	5%	3%	1%	4%	4%	0%	3%	2%	4%	3%	8%	3%	0%	2%	5%	4%	3%	5%	3%	0%	4%	3%	6%	5%
Export Total			**4.708**		**4.628**																															
Import	1	Germany	1.974	10%	1.893	4%	4%	5%	5%	0%	0%	4%	5%	5%	5%	5%	0%	0%	4%	5%	5%	5%	5%	0%	0%	4%	5%	5%	7%	0%	0%	0%	0%	4%	6%	5%
Import	2	France	506	6%	508	3%	4%	6%	4%	1%	0%	4%	3%	5%	5%	5%	1%	0%	4%	4%	3%	5%	4%	1%	0%	4%	4%	5%	5%	3%	2%	0%	0%	5%	5%	5%
Import	3	Italy	276	5%	419	4%	3%	4%	6%	1%	0%	4%	6%	4%	5%	7%	0%	0%	3%	3%	2%	6%	7%	1%	0%	2%	4%	6%	4%	7%	1%	0%	0%	3%	5%	4%
Import	4	Poland	373	1%	380	4%	3%	4%	7%	0%	0%	4%	5%	4%	4%	4%	1%	0%	4%	4%	5%	4%	4%	1%	0%	3%	6%	5%	5%	3%	0%	0%	0%	4%	6%	6%
Import	5	England	199	0%	150	4%	5%	4%	5%	0%	1%	2%	3%	3%	6%	5%	0%	1%	4%	3%	7%	3%	3%	0%	1%	6%	8%	4%	6%	2%	1%	1%	1%	3%	5%	4%
Import	6	Belgium	375	18%	369	4%	4%	5%	3%	0%	0%	5%	4%	6%	6%	5%	0%	0%	7%	4%	4%	4%	4%	0%	0%	4%	4%	2%	7%	3%	1%	0%	0%	6%	4%	4%
Import	7	Spain	191	68%	213	4%	3%	8%	6%	0%	0%	2%	4%	4%	3%	5%	0%	0%	3%	5%	5%	9%	3%	0%	0%	5%	5%	8%	3%	0%	0%	0%	2%	4%	4%	4%
Import	8	Sweden	108	0%	97	2%	2%	4%	2%	0%	0%	3%	7%	2%	5%	6%	0%	0%	3%	3%	4%	4%	5%	0%	0%	3%	2%	12%	3%	1%	0%	0%	1%	5%	10%	8%
Import	9	Netherlands	164	27%	154	6%	6%	4%	5%	1%	0%	6%	5%	3%	7%	5%	1%	0%	5%	4%	5%	3%	4%	0%	0%	4%	3%	3%	7%	4%	0%	0%	0%	2%	3%	4%
Import	10	Hungary	102	13%	116	3%	3%	10%	9%	1%	0%	5%	5%	4%	5%	4%	0%	0%	0%	0%	2%	5%	9%	1%	0%	2%	3%	3%	3%	8%	0%	0%	0%	0%	8%	8%
Import	11	Czechia	72	0%	117	2%	5%	5%	5%	0%	0%	4%	4%	3%	5%	8%	0%	0%	4%	4%	4%	6%	4%	0%	0%	3%	5%	7%	9%	0%	0%	0%	0%	3%	6%	4%
Import	12	Slovenia	50	0%	25	4%	16%	0%	0%	1%	0%	4%	0%	4%	0%	2%	0%	0%	2%	0%	8%	0%	0%	0%	0%	12%	8%	4%	8%	14%	0%	0%	0%	12%	0%	0%
Import	13	Austria	32	35%	35	3%	9%	6%	0%	2%	0%	6%	6%	0%	3%	3%	0%	0%	0%	9%	8%	6%	8%	0%	0%	6%	0%	3%	6%	3%	0%	0%	0%	6%	0%	9%
Import	14	Switzerland	31	15%	31	5%	1%	8%	7%	1%	0%	4%	7%	2%	9%	7%	3%	0%	3%	4%	5%	4%	5%	0%	0%	1%	6%	6%	5%	3%	0%	0%	0%	2%	1%	4%
Import	15	Greece	34	0%	19	0%	0%	5%	26%	0%	0%	0%	5%	0%	5%	5%	0%	0%	0%	0%	11%	5%	11%	0%	0%	0%	0%	11%	0%	0%	0%	0%	0%	11%	5%	0%
Import	16	Romania	27	35%	16	0%	0%	13%	0%	0%	0%	0%	6%	12%	6%	0%	0%	0%	0%	12%	12%	12%	0%	0%	0%	0%	0%	0%	6%	0%	0%	0%	0%	0%	6%	12%
Import	17	Slovakia	26	8%	28	1%	7%	11%	1%	0%	0%	7%	5%	12%	0%	9%	3%	0%	4%	4%	2%	7%	2%	0%	0%	0%	3%	7%	11%	0%	0%	0%	0%	0%	4%	0%
Import	Other	Others	96	0%	167	5%	6%	5%	6%	1%	0%	5%	1%	1%	2%	5%	1%	0%	4%	4%	3%	5%	7%	0%	0%	2%	4%	3%	3%	5%	0%	1%	3%	4%	7%	6%
Import Total			**4.635**		**4.738**																															
Grand Total			**9.343**		**9.365**																															

APPENDIX F

DISTANCE CALCULATION CODE WITH GOOGLE MAPS API

```
Sub Mesafe_Hesaplama()
Dim murat As XmlMap
For r = 2 To Sheets("Mesafeler").Range("A1").End(xlDown).Row

   For Each murat In Excel.Application.ActiveWorkbook.XmlMaps
      On Error Resume Next
      murat.Delete
   Next
   ActiveWorkbook.XmlImport Url:= _
      "http://maps.googleapis.com/maps/api/distancematrix/xml?origins=|" & Cells(r,
1) & "&destinations=|" & Cells(r, 2) & " &mode=driving&language=Eng-
ENG&sensor=false" _
      , ImportMap:=Nothing, Overwrite:=True,
Destination:=Sheets("Mesafeler").Range("$R$2")

   Cells(r, 3).Select
   Cells(r, 3) = Range("Y2").Value

Next r
End Sub
```

APPENDIX G

CODE FOR OPTIMUM PLANNING FOR MATCHING THE EMPTY TRAILERS

WITH THE DEMANDS

```
Sub Planlama_yap()

Set plan = Sheets("Plan")
Set mesafe = Sheets("Mesafeler")
Set shmaliyet = Sheets("Maliyetler")

plan.Visible = True
mesafe.Visible = True
shmaliyet.Visible = True

For j = 15 To 45
   plan.Select
   Cells(199, j - 1) = ""
   Cells(199, j) = "x"
   tarih = Format(Cells(200, j), "dd.mm.yyyy")
   For i = 207 To 343 Step 8
      plan.Select
      Cells(i, j).Select
      ihtiyac = Cells(i, j)
      If ihtiyac < 0 Then
         ülke = Cells(i - 6, 2)

         If ülke = "Turkey" Then
            Range(Cells(70, j), Cells(86, j)).Select
            Selection.Copy
            mesafe.Select
            Range("AT2").Select
            Selection.PasteSpecial Paste:=xlPasteValues
            Range("AW3") = Abs(ihtiyac)
            Range("AR2:AR18") = 0
         End If

         mesafe.Select
         If Range("U2") <> ülke Then
            Range("U2") = ülke
            Call Oto_Filtre
         End If

         kalan_ihtiyac = ihtiyac
         For k = 2 To mesafe.Range("W1").End(xlDown).Row
            If mesafe.Cells(1, 32) = 0 Then Exit For
            If mesafe.Cells(k, 31) = "Ok" Then
```

```
                ülke2 = mesafe.Cells(k, 24)
                süre = mesafe.Cells(k, 27)
                maliyet = mesafe.Cells(k, 28)
                kiralık = mesafe.Cells(k, 30)

                plan.Select
                Range("B201:B343").Select
                satır = Selection.Find(What:=ülke2, After:=ActiveCell,
LookIn:=xlFormulas, _
LookAt:=xlPart, SearchOrder:=xlByRows, SearchDirection:=xlNext, _
MatchCase:=False, SearchFormat:=False).Row

                If süre = 1 Then
                   sutun = j
                ElseIf j - süre >= 3 Then
                   sutun = j - süre
                Else
                   If ülke <> "Turkey" Then
                      Range("B91:B108").Select
                      spotsatır = Selection.Find(What:=ülke, After:=ActiveCell,
LookIn:=xlFormulas, _
LookAt:=xlPart, SearchOrder:=xlByRows, SearchDirection:=xlNext, _
MatchCase:=False, SearchFormat:=False).Row
                      Cells(spotsatır, j) = Abs(kalan_ihtiyac)
                   Else
                      mesafe.Select
                      Call optimum_spot_belirle
                      Range("AP2:AP18").Copy
                      plan.Select
                      Cells(113, j).Select
                      Selection.PasteSpecial Paste:=xlPasteValues
                      shmaliyet.Select
                      If Range("A2") = "" Then
                         maliyetsatır = 2
                      Else
                         maliyetsatır = Range("A1").End(xlDown).Row + 1
                      End If
                      Cells(maliyetsatır, 5).Select
                      Selection.PasteSpecial Paste:=xlPasteValues

                      Range(Cells(maliyetsatır, 1), Cells(maliyetsatır + 16, 1)) = tarih
                      Range(Cells(maliyetsatır, 2), Cells(maliyetsatır + 16, 2)) =
"Rented"
                      Range(Cells(maliyetsatır, 3), Cells(maliyetsatır + 16, 3)) =
"Turkey"
                      plan.Range("B113:B129").Copy
                      Cells(maliyetsatır, 4).Select
                      Selection.PasteSpecial Paste:=xlPasteValues

                      mesafe.Range("AN2:AN18").Copy
```

```
                Cells(maliyetsatır, 6).Select
                Selection.PasteSpecial Paste:=xlPasteValues

                Range(Cells(maliyetsatır, 7), Cells(maliyetsatır + 16, 7)) = "=RC[-
2]*RC[-1]"
                If mesafe.Range("AO20") > 0 Then
                   For mt = 2 To 18
                      mesafe.Select
                      If Cells(mt, 41) > 0 Then
                         transferülke = Cells(mt, 36)
                         transfersüre = Cells(mt, 37)
                         transferadet = Cells(mt, 41)
                         transfermaliyet = Cells(mt, 38)
                         plan.Select
                         Range("B201:B343").Select
                         transfersatır = Selection.Find(What:=transferülke,
After:=ActiveCell, LookIn:=xlFormulas, _
LookAt:=xlPart, SearchOrder:=xlByRows, SearchDirection:=xlNext, _
MatchCase:=False, SearchFormat:=False).Row
                         Cells(transfersatır + 5, j - transfersüre) = transferadet
                         Cells(341, j) = Cells(341, j) + transferadet
                         shmaliyet.Select
                         If Range("A2") = "" Then
                            maliyetsatır = 2
                         Else
                            maliyetsatır = Range("A1").End(xlDown).Row + 1
                         End If
                         Cells(maliyetsatır, 1) = Format(plan.Cells(200, j -
transfersüre), "dd.mm.yyyy")
                         Cells(maliyetsatır, 2) = "Empty Run"
                         Cells(maliyetsatır, 3) = transferülke
                         Cells(maliyetsatır, 4) = "Turkey"
                         Cells(maliyetsatır, 5) = transferadet
                         Cells(maliyetsatır, 6) = transfermaliyet
                         Cells(maliyetsatır, 7) = "=RC[-2]*RC[-1]"
                      End If
                   Next mt
                End If

                If Cells(i, j) = 0 Then
                   GoTo devam
                Else
                   MsgBox "hata..."
                End If
             End If
             Exit For
          End If

          ileri = Cells(satır, 46)
          If süre > ileri Then ileri = süre
```

```
            ülkedeki_gelecek_min = WorksheetFunction.Min(Range(Cells(satır + 6,
sutun), Cells(satır + 6, sutun + ileri)))
            If ülkedeki_gelecek_min > 0 Then
               ilave = WorksheetFunction.Min(ülkedeki_gelecek_min,
Abs(kalan_ihtiyac))

               If ülke <> "Turkey" Then
                  Cells(satır + 5, sutun) = Cells(satır + 5, sutun) + ilave
                  Cells(i - 2, j) = Cells(i - 2, j) + ilave
                  shmaliyet.Select
                  If Range("A2") = "" Then
                     maliyetsatır = 2
                  Else
                     maliyetsatır = Range("A1").End(xlDown).Row + 1
                  End If

                  If süre = 1 Then
                     Cells(maliyetsatır, 1) = tarih
                  Else
                     Cells(maliyetsatır, 1) = Format(plan.Cells(200, j - süre),
"dd.mm.yyyy")
                  End If

                  Cells(maliyetsatır, 2) = "Empty Run"
                  Cells(maliyetsatır, 3) = ülke2
                  Cells(maliyetsatır, 4) = ülke
                  Cells(maliyetsatır, 5) = ilave
                  Cells(maliyetsatır, 6) = maliyet
                  Cells(maliyetsatır, 7) = ilave * maliyet
               Else
                  mesafe.Select
                  Cells(plan.Cells(satır, 1) + 1, 44) = m
               End If

               plan.Select
               kalan_ihtiyac = kalan_ihtiyac + ilave

               If kalan_ihtiyac = 0 Then
                  GoTo devam
               End If

            End If
         End If
      Next k

      If kalan_ihtiyac <> 0 And ülke <> "Turkey" Then
         plan.Select
         Range("B91:B108").Select
         spotsatır = Selection.Find(What:=ülke, After:=ActiveCell,
LookIn:=xlFormulas, _
```

```
            LookAt:=xlPart, SearchOrder:=xlByRows, SearchDirection:=xlNext, _
            MatchCase:=False, SearchFormat:=False).Row
          Cells(spotsatır, j) = Abs(kalan_ihtiyac)
          shmaliyet.Select
          If Range("A2") = "" Then
            maliyetsatır = 2
          Else
            maliyetsatır = Range("A1").End(xlDown).Row + 1
          End If
          Cells(maliyetsatır, 1) = tarih
          Cells(maliyetsatır, 2) = "Rented"
          Cells(maliyetsatır, 3) = ülke
          Cells(maliyetsatır, 4) = "Turkey"
          Cells(maliyetsatır, 5) = Abs(kalan_ihtiyac)
          Cells(maliyetsatır, 6) = plan.Cells(spotsatır, 48)
          Cells(maliyetsatır, 7) = "=RC[-2]*RC[-1]"
        End If
      End If
devam:
      If ülke = "Turkey" And plan.Cells(343, j) <> 0 Then
        mesafe.Select
        Call optimum_spot_belirle
        Range("AP2:AP18").Copy
        plan.Select
        Cells(113, j).Select
        Selection.PasteSpecial Paste:=xlPasteValues
        shmaliyet.Select
        If Range("A2") = "" Then
          maliyetsatır = 2
        Else
          maliyetsatır = Range("A1").End(xlDown).Row + 1
        End If
        Cells(maliyetsatır, 5).Select
        Selection.PasteSpecial Paste:=xlPasteValues
        Range(Cells(maliyetsatır, 1), Cells(maliyetsatır + 16, 1)) = tarih
        Range(Cells(maliyetsatır, 2), Cells(maliyetsatır + 16, 2)) = "Rented"
        Range(Cells(maliyetsatır, 3), Cells(maliyetsatır + 16, 3)) = "Turkey"
        plan.Range("B113:B129").Copy
        Cells(maliyetsatır, 4).Select
        Selection.PasteSpecial Paste:=xlPasteValues
        mesafe.Range("AN2:AN18").Copy
        Cells(maliyetsatır, 6).Select
        Selection.PasteSpecial Paste:=xlPasteValues

        Range(Cells(maliyetsatır, 7), Cells(maliyetsatır + 16, 7)) = "=RC[-2]*RC[-
1]"
        If mesafe.Range("AO20") > 0 Then
          For t = 2 To 18
            mesafe.Select
            If Cells(t, 41) > 0 Then
```

```
                    transferülke = Cells(t, 36)
                    transfersüre = Cells(t, 37)
                    transferadet = Cells(t, 41)
                    transfermaliyet = Cells(t, 38)
                    plan.Select
                    Range("B201:B343").Select
                    transfersatır = Selection.Find(What:=transferülke,
After:=ActiveCell, LookIn:=xlFormulas, _
                        LookAt:=xlPart, SearchOrder:=xlByRows,
SearchDirection:=xlNext, _
                        MatchCase:=False, SearchFormat:=False).Row
                    Cells(transfersatır + 5, j - transfersüre) = transferadet
                    Cells(341, j) = Cells(341, j) + transferadet
                    shmaliyet.Select
                    If Range("A2") = "" Then
                       maliyetsatır = 2
                    Else
                       maliyetsatır = Range("A1").End(xlDown).Row + 1
                    End If
                    Cells(maliyetsatır, 1) = DateValue(tarih) - süre
                    Cells(maliyetsatır, 2) = "Empty Run"
                    Cells(maliyetsatır, 3) = transferülke
                    Cells(maliyetsatır, 4) = "Turkey"
                    Cells(maliyetsatır, 5) = transferadet
                    Cells(maliyetsatır, 6) = transfermaliyet
                    Cells(maliyetsatır, 7) = "=RC[-2]*RC[-1]"
                End If
             Next t
          End If
       End If
       ülke = Empty
    Next i
Next j
plan.Visible = False
mesafe.Visible = False
shmaliyet.Visible = False

End Sub
-----------------------------------------------------------------------------------------------------

Sub optimum_spot_belirle()
    SolverReset
    SolverAdd CellRef:="$AO$2:$AP$18", Relation:=4, FormulaText:="integer"
    SolverAdd CellRef:="$AS$2:$AS$18", Relation:=3, FormulaText:=0
    SolverAdd CellRef:="$AQ$20", Relation:=2, FormulaText:="$AW$3"
    SolverAdd CellRef:="$AO$2", Relation:=1, FormulaText:="$AR$2"
    SolverAdd CellRef:="$AO$3", Relation:=1, FormulaText:="$AR$3"
    SolverAdd CellRef:="$AO$4", Relation:=1, FormulaText:="$AR$4"
    SolverAdd CellRef:="$AO$5", Relation:=1, FormulaText:="$AR$5"
    SolverAdd CellRef:="$AO$6", Relation:=1, FormulaText:="$AR$6"
```

```
    SolverAdd CellRef:="$AO$7", Relation:=1, FormulaText:="$AR$7"
    SolverAdd CellRef:="$AO$8", Relation:=1, FormulaText:="$AR$8"
    SolverAdd CellRef:="$AO$9", Relation:=1, FormulaText:="$AR$9"
    SolverAdd CellRef:="$AO$10", Relation:=1, FormulaText:="$AR$10"
    SolverAdd CellRef:="$AO$11", Relation:=1, FormulaText:="$AR$11"
    SolverAdd CellRef:="$AO$12", Relation:=1, FormulaText:="$AR$12"
    SolverAdd CellRef:="$AO$13", Relation:=1, FormulaText:="$AR$13"
    SolverAdd CellRef:="$AO$14", Relation:=1, FormulaText:="$AR$14"
    SolverAdd CellRef:="$AO$15", Relation:=1, FormulaText:="$AR$15"
    SolverAdd CellRef:="$AO$16", Relation:=1, FormulaText:="$AR$16"
    SolverAdd CellRef:="$AO$17", Relation:=1, FormulaText:="$AR$17"
    SolverAdd CellRef:="$AO$18", Relation:=1, FormulaText:="$AR$18"
    SolverOk SetCell:="$AW$1", MaxMinVal:=2, ValueOf:=0,
ByChange:="$AO$2:$AP$18", Engine:=1, EngineDesc:="Simplex LP"
    SolverSolve True
End Sub
```

```
Sub Oto_Filtre()
    Application.CutCopyMode = False
    Sheets("Mesafeler").Select
    Range("Distances[#All]").AdvancedFilter Action:=xlFilterCopy,
CriteriaRange:=Range("U1:U2"), CopyToRange:=Range("W1:AD1"),
Unique:=False
    Columns("W:AD").Select
    Columns("W:AD").EntireColumn.AutoFit
    ActiveWorkbook.Worksheets("Mesafeler").Sort.SortFields.Clear
    ActiveWorkbook.Worksheets("Mesafeler").Sort.SortFields.Add Key:=Range( _
    "AB2:AB1000"), SortOn:=xlSortOnValues, Order:=xlAscending, DataOption:= _
        xlSortNormal
    With ActiveWorkbook.Worksheets("Mesafeler").Sort
        .SetRange Range("W1:AD1000")
        .Header = xlYes
        .MatchCase = False
        .Orientation = xlTopToBottom
        .SortMethod = xlPinYin
        .Apply
    End With
End Sub
```

Explanation of the code lines

The VBA code first takes the number of empty trailers on each country on the date of application executed by refreshing the external connection to the Oracle Database. and their demand forecasts both for export and import directions. Next, the code starts to loop between the departure countries by looking if the first country has

enough empty trailers for satisfying its import demand. If number of empty trailers are higher than its import demand (in terms of trailers), all the import demands are considered as satisfied and the remaining empty trailers are added to the number of empty trailers on next day. If the number of empty trailers are lower than its import demand, the code starts to search for empty trailers in other countries and check if they have any excess trailers considering their import demands in upcoming days (as the transit time from other European countries except Turkey to that country) to prevent them not to fall into an insufficient trailer situation. While doing this, the code starts to loop other countries beginning from the country that has the lowest empty run cost. This empty run cost should not be higher than the difference of the outsourcing cost from Turkey to that country and a loaded owned trailer cost from that country to Turkey. Otherwise, it is preferred to outsource the trailer. If the missing trailers can be supplied from eligible countries, these trailers are transferred to that country. If no eligible country is found, the number of the needed empty trailers are outsourced from a supplier company.

While looping between the origin countries, Turkey has an exception. Because as an origin country, Turkey sends goods to several destination countries in Europe. If Turkey is lacking trailers considered with the total demand of other countries from Turkey, the model first figures out the available number of empty run from each other countries by a loop, but not assign them yet. Then it prepares a separate Solver optimization model that decides the best empty run and outsourced trailers mixture with the lowest cost by constrained with the available number of empty run from each country.

After supplying all the demand for all the countries for the first analysis date, the upper loop continues to the next day with the same method.

APPENDIX H

IMPLEMENTATION OF PROPOSED PLAN FOR MARCH

TYPE	FROM COUNTRY	TO COUNTRY	DAYS OF MARCH																													TOTAL
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Empty Run	Belgium	England			2							1														2		4	6	5			4	24
	Germany	Netherlands	7					1		5				4	1									1					4					23
	Germany	Belgium	3	1				3		1					4			5							5									22
	Slovenia	Austria	1	1			1							2		1					2		2							1				11
	Belgium	Germany																												6				6
	Belgium	Netherlands										1																2						3
	Netherlands	Belgium																				1			2									3
	Netherlands	Germany																					3											3
	Austria	Czechia									1																							1
	Austria	Slovenia																										1						1
Empty Run Total			**11**	**2**	**2**	**0**	**1**	**4**	**0**	**6**	**1**	**2**	**0**	**6**	**5**	**1**	**0**	**5**	**0**	**0**	**2**	**1**	**5**	**1**	**7**	**2**	**0**	**7**	**10**	**12**	**0**	**0**	**4**	**97**
Outsourced	Turkey	Germany		60							76							39														12		187
	England	Turkey	9	9	2	1	6	4	11	8	8			5	6	6	4				4	3	8	6	8				1		2	7		118
	Turkey	Italy		20							18							16							10							22		86
	Turkey	Poland	8	16							12						3	13							14							15		81
	Sweden	Turkey	2	1				2	4	6	6			2	3	1	2	4			2		2	3	4				4	10	3	5		66
	Germany	Turkey									19					13							15								2	13		62
	Poland	Turkey		3						7	7				3								4	4	9					10	3	7		57
	Turkey	Slovenia		5							10							9							9							8		41
	Netherlands	Turkey		5							7					4		8												2	4	5		35
	Turkey	Hungary	4	5						2	5						3	5							5							4		33
	Turkey	Czechia		6							7							7														6		26
	Turkey	Romania	3	2						2	2						2	3							3							3		20
	Turkey	Greece	3	3						2	2						1	2							2							3		18
	Turkey	Slovakia	2	2							2						3	1							3							3		16
	Belgium	Turkey		2							3							6														3		14
	Turkey	Austria		3							4							4														3		14
	Slovakia	Turkey						2							1	1	2						1		1				1	2	1			12
	Spain	Turkey		6							2							1														2		11
	Switzerland	Turkey	1	3							2							1							1									8
	Czechia	Turkey		3																											1			4
	Greece	Turkey	2	1																														3
	Hungary	Turkey																														1		1
	Romania	Turkey																				1												1
Outsourced Total			**34**	**155**	**2**	**1**	**6**	**8**	**15**	**27**	**192**	**0**	**0**	**7**	**13**	**25**	**20**	**119**	**0**	**0**	**6**	**4**	**30**	**13**	**69**	**0**	**0**	**0**	**6**	**24**	**16**	**122**	**0**	**914**
GRAND TOTAL			**45**	**157**	**4**	**1**	**7**	**12**	**15**	**33**	**193**	**2**	**0**	**13**	**18**	**26**	**20**	**124**	**0**	**0**	**8**	**5**	**35**	**14**	**76**	**2**	**0**	**7**	**16**	**36**	**16**	**122**	**4**	**1,011**

APPENDIX I

QUESTIONNAIRE

No	Question	Answers				
1	Departmant	Tradeline Planning	Central Planning	Performance Management	Information Systems	Supplier Relations
2	Age	<30	31-35	36-40	41-50	>50

	Effectiveness	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
3	The DSS gives the recommendations for empty run planning as I expected.					
4	The DSS gives the recommendations for outsourcing planning as I expected.					
5	I believe that the DSS significantly decreases the total number of empty vehicle transportation and number of outsourcing vehicles.					
6	I believe that the DSS significantly decreases the total empty run and outsourcing costs.					

	Efficiency	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
7	The time for loading the actuals and forecasts file are short.					
8	Total run time of the DSS is shorter than I expected.					
9	The DSS does not ask for any unnecessary info.					
10	The DSS significantly decrease the total man-hour spending for planning the empty run.					
11	The DSS decreases the cost of preparing the empty run plans					
12	The DSS decreases the cost of preparing outsource plans.					

	Flexibility	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
13	The unit costs can be easily changed in the DSS when necessary.					
14	The DSS allows users to make scenario analysis based on the changing forecasts.					
15	The DSS allows users to make scenario analysis based on the changing vehicle locations.					
16	The DSS allows users to make scenario analysis based on the changing unit costs.					

	Overall	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
17	I am satisfied with the overall results of the DSS.					
18	I am satisfied with the overall run time performance of the DSS.					
19	I like that the DSS allows the users to change some parameters.					
20	I am satisfied with the ease of use of the DSS.					
21	I am satisfied with the overall reliability of the DSS.					
22	I am satisfied with the overall performance of the DSS.					
23	I am satisfied with the usability of the DSS.					
24	The DSS is appropriate for collaborative decision making that includes different functional divisions.					

	Perceived Usefulness	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
25	Using DSS can increase my efficiency in planning.					
26	Using DSS can increase my productivity in planning.					
27	Using DSS helps me to make error-free planning.					

No	Question	Answers				
	Perceived Ease of Use	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
28	It is easy to learn how to use the DSS					
29	Interaction with the DSS is clear and understandable.					
30	It is easy to start using the DSS.					

	Self-Efficacy	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
31	I am very curious of how things work.					
32	I like to experiment with new ways of doing things.					
33	I can learn how things work on my own.					

	Behavioral Intention to use the DSS	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
34	I think using a DSS is a clever idea.					
35	I think using the DSS is beneficial to company.					
36	I have a positive feeling about using the new DSS.					

	Actual System Use	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
37	I feel that a user-friendly DSS system will influence me to adopt the new system					
38	I intent to use the DSS when its available.					
39	I will recommend others to use the DSS.					

40	Do you have any thoughts on how to improve this software?

APPENDIX J

THE RESULTING QUESTIONNAIRE

	Respondents																					
Questions	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**R15**	**R16**	**Avg**	**Min**	**Max**	**Group Avg.**	**Group Min**	**Group Max**
Q1	1	2	3	1	1	1	1	1	2	1	4	4	5	2	2	5						
Q2	1	1	2	1	4	3	2	3	2	2	3	4	2	2	1	3						
Effectiveness																						
Q3	4	4	5	5	4	5	4	5	5	5	4	5	3	4	4	4	4,375	3	5	4,36	3,00	5,00
Q4	4	4	5	5	4	5	4	5	5	5	4	5	3	4	4	4	4,375	3	5			
Q5	4	5	5	4	4	5	5	5	5	4	5	4	4	3	5	3	4,375	3	5			
Q6	3	5	5	4	4	5	5	5	5	4	5	4	4	3	5	3	4,313	3	5			
Efficiency																						
Q7	4	4	5	3	4	5	4	5	5	4	5	3	4	5	4	4	4,250	3	5	4,19	3,00	5,00
Q8	4	4	5	3	4	4	4	5	5	4	5	3	4	5	4	4	4,188	3	5			
Q9	3	4	3	3	3	4	4	5	4	4	5	4	5	4	4	4	3,938	3	5			
Q10	4	4	5	3	4	4	4	5	5	5	5	3	4	5	3	4	4,188	3	5			
Q11	5	4	4	4	4	5	4	4	4	4	5	4	5	4	5	4	4,313	4	5			
Q12	5	4	4	4	4	5	4	4	4	4	5	4	5	3	5	4	4,250	3	5			
Flexibility																						
Q13	4	5	5	5	3	4	5	5	5	4	5	4	5	5	5	5	4,625	3	5	4,31	3,00	5,00
Q14	4	4	4	4	3	4	5	5	5	3	5	3	5	4	5	4	4,188	3	5			
Q15	4	4	4	4	3	4	5	5	5	3	5	3	5	4	5	4	4,188	3	5			
Q16	4	4	4	4	3	4	5	5	5	4	5	3	5	4	5	4	4,250	3	5			
Overall																						
Q17	5	5	5	4	4	5	4	5	5	5	5	4	5	5	4	4	4,625	4	5	4,42	3,00	5,00
Q18	4	4	4	5	3	5	4	5	5	4	5	4	4	5	5	5	4,438	3	5			
Q19	4	4	4	5	3	3	4	5	5	4	5	4	4	5	5	5	4,313	3	5			
Q20	3	5	4	4	4	4	4	5	5	4	5	4	3	5	4	5	4,250	3	5			
Q21	5	5	4	4	4	5	4	5	5	4	5	4	5	5	4	4	4,500	4	5			
Q22	4	5	5	4	4	5	4	5	5	5	5	4	5	5	5	4	4,625	4	5			
Q23	3	5	4	4	4	4	4	5	5	4	5	4	3	5	4	5	4,250	3	5			
Q24	5	5	4	4	4	4	4	5	5	4	5	4	4	5	4	4	4,375	4	5			

	Respondents																					
Questions	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**	**R12**	**R13**	**R14**	**R15**	**R16**	**Avg**	**Min**	**Max**	**Group Avg.**	**Group Min**	**Group Max**
Perceived Usefulness																						
Q25	5	3	5	4	4	4	5	5	5	5	5	4	4	4	5	4	4,438	3	5			
Q26	5	3	5	4	4	4	5	5	5	5	5	4	4	4	5	4	4,438	3	5	4,42	3,00	5,00
Q27	5	3	5	4	4	4	5	5	4	5	5	4	4	4	5	4	4,375	3	5			
Perceived Ease of Use																						
Q28	5	4	5	4	2	3	4	5	4	4	5	5	5	5	5	4	4,313	2	5			
Q29	4	4	4	4	3	3	4	4	3	4	5	5	5	5	5	4	4,125	3	5	4,27	2,00	5,00
Q30	5	4	5	4	3	3	4	5	4	4	5	5	5	5	5	4	4,375	3	5			
Self-Efficacy																						
Q31	4	4	5	5	3	3	4	5	4	5	4	5	5	5	4	4	4,313	3	5			
Q32	4	4	5	5	3	3	3	5	4	5	4	5	5	4	4	4	4,188	3	5	4,27	3,00	5,00
Q33	4	4	5	5	3	3	4	5	4	5	4	5	5	5	4	4	4,313	3	5			
Behavioral Intention to use the DSS																						
Q34	4	4	4	4	3	5	4	4	4	3	4	4	5	5	5	3	4,063	3	5			
Q35	5	5	4	4	5	4	5	5	5	5	5	5	4	5	4	5	4,688	4	5	4,40	3,00	5,00
Q36	5	5	5	4	5	4	5	5	3	5	4	4	4	5	4	4	4,438	3	5			
Actual System Use																						
Q37	5	5	3	3	5	4	5	4	5	5	4	4	5	4	5	4	4,375	3	5			
Q38	4	5	5	4	4	4	4	5	4	5	4	4	4	5	4	5	4,375	4	5	4,33	3,00	5,00
Q39	4	5	4	4	5	4	5	5	4	4	4	4	3	5	4	4	4,250	3	5			
Q40		I am not sure that the company culture will allow us to use this tool.	We have to measure that how much the suggested plan is realized.		Could run faster				Should not be developed in MS Excel.		Demand Forecasts and Actuals should be gained from the information systems.	It's not fully integrated with the company's transaction management system.		It is surprising to see the possibility of decreasing costs this much.							

APPENDIX K

INTERVIEWS WITH THE COMPANY EMPLOYEES

Interview with the Tradeline Planning Specialist

Murat Turan (MT): How long have you been in this position?

Tradeline Planning Specialist (TPS): About 2.5 years.

MT: Could you describe your decision-making process for an empty trailer in your region?

TPS: Orders are not certain in advance. When I come to work in the morning, I will review the orders that are waiting for loading on that day. However, all orders are not limited with these. During the day, we also receive orders that need to be loaded on that day. I calculate how much trucks I need to be able to get the known orders. I have an Excel file that I have created for planning. In this file I can know my empty trucks and trucks to unload on that day according to my previous plans. If I have enough trailer, I can wait for more new orders in the day. If there is an inquiry for empty trailers from other tradelines, I keep some trucks for the new orders that may occur in my region and give the rest to the other tradelines. If I do not have enough trucks, I ask my friends from other tradelines if they have excessive trucks they can give me. If I cannot fulfill my lack of trailers from other lines, I get in touch with the supplier relations team and send my internal order to outsource the trailers I need. So, I try to complete all my insufficiencies.

MT: Can you follow the empty and to be empty trailers through the system?

TPS: I mean, I can look through the system, but that part is a little troublesome. I need to control every truck one by one. It also comes with a lot of unnecessary detailed information. We wanted to develop a more basic summary screen that we

could follow up on a regional basis from IT Department. That is why I also have to keep an Excel. My friends in other tradelines are likewise. Thus, we easily follow the trailers we have loaded, estimated unloading dates, unloading sub-region etc.

MT: How long does this process take on average per day?

TPS: This process is almost intermittent throughout the day, of course. However, if I have more trucks than I need on that day, my work will be easy. I will spend 1-1.5 hours in total. But this is not the situation we often encounter. I am usually in a trailer shortage in at least one of the three countries I am responsible for. In this case, I should talk with other tradelines, or with the fleet team for the pool trailers and then with the supplier relations unit if necessary. That also takes time. We have to wait for each unit to collect and evaluate the requests they received. Additionally, often we also apply to our line manager for support. In the case of lacking trailer, about half of the day passes without any other work. So, I can say about four hours in average.

MT: How do you choose between two different tradelines that request a vacant trailer when you have some empty trailer?

TPS: I am a sharing. If I have excessive trailers, I will give it to the first requester.

MT: How important is the cost to you in making decisions in this process?

TPS: Cost is of course important. On the basis that we do not want to move no trailer empty. However, there is an instruction from the management that we should satisfy the customers. And in the past, we criticized that when we had to wait to load an empty trailer, why did not we get it empty and load the customer's goods. Therefore, we decide to take the customer's load on time even if it costs a little.

MT: Do you need a better system for planning empty and outsourced trailers?

TPS: If there is such a system, of course we use it. But I do not know how it will be possible when we say a better system.

MT: What features do you think this new system should have?

TPS: First, it should be fast. It must be easy to use. It would be nice to do automatic planning. But then when we act according to it, the management should not criticize us by saying why did you do in this way? The biggest hardship for us is that after the planning, the management always warn us why there is so much empty-runs. If we did not move the trailer empty then they say why we caused customer complaints. So, we are getting confused. I do not know if there is a system that can get us out of this trouble, but it would be great.

Interview with the Tradeline Manager

MT: How long have you been in this position?

Tradeline Manager (TM): Approximately four years.

MT: Can you tell us about your decision-making process for an empty trailer in your region?

TM: We are having trouble managing empty trailers. Our planning specialists on the team are redirecting the unloaded trailers to the nearest order point or warehouse. However, because our region is an export intensive region, empty trailers are accumulating in our region. Compared to other regions, we have an advantage that the region that is closest to us is an import intensive region. Thus, we are moving the empty trailers accumulated in our region quickly to there. So, we have several advantages. First, we support that region for loading their import orders without delay. Since the distance between the two regions is not too far away, we do not create much cost. In addition, as we are able to turn the trailers quickly, we contribute to the increase of the tour rate. Since we are able to create such a regular flow between the two regions, we also provide ease of planning and staff efficiency.

MT: How do you use the company's information systems when managing this process?

TM: The system tells us only the location of the trailers. Our team can already follow that, both from their preceding plans and the phone calls they made with the drivers. There are also orders entered into the system, of course, but our friends already know about them by the incoming mails before order is entered to the system. In fact, they need to know in advance to include them to the planning. Because order details not always entered to the system on time. So obviously the system shows us what we already know. Its contribution to our planning process is not so much. But then, of course, we need to make our reports based on the information in the system. So, our friends only use the information in the system when they are hesitant, need to confirm their information, and for reporting issues.

MT: How important is the cost to you in making decisions in this process?

TM: One of our most important performance indicators is our profitability. In order to achieve this, we always strive to keep our costs under control. I keep track of how many empty trailers we moved throughout the day. At the beginning of the week, we make tactical decisions in the planning meetings where all the tradelines participated. We want our team to plan the vacant movements and to organize the outsourced trailers in accordance with these decisions. In case of a situation that needs to go beyond this, we have instructed them in absolute terms to act according to our approval. In such cases, we are trying to balance the cost and the customer satisfaction. For some key customers, we need to prioritize satisfaction regardless of cost. According to the general attitude of the customer, we may choose to postpone the loading and produce alternative solutions and reduce our costs. In short, it is very

important and decisive to determine which customer's goods are in question. Unfortunately, we cannot display only and totally cost-oriented approach.

MT: Do you think there is a need for automation to plan empty movements and outsourced trailers?

TM: As an engineer, I believe that automation systems should be established in every area. And I believe that an automation system is needed to reduce the workload for empty movements and outsourcing planning. Because our friends in planning spend much work time on this issue. At the end of such a significant effort, in many cases, we cannot satisfy both internal and external customers. We are also having difficulty in providing the expected improvements in our KPIs. At the end of the prolonged and halting planning process, the customers who receive their goods late start to complain. Although we try to explain the reasons for the late delivery to friends in the sales, extra workload occurs for them since every customer complaint needs to be recorded and solved. This leads to a decrease in motivation, efficiency, and effectiveness on our planning staff. I believe that if this planning process is done with an automated system, this process will be managed in the shortest time and in the optimum way, and it will have a positive contribution for us both in terms of time management and stress management.

MT: What features this automation system should have?

TM: This system should make the big picture visible. For example, I am only planning on vacant and outsourced trailers in countries that I responsible for. But our real world is not limited to our countries. We are in touch with other tradelines naturally and it can be difficult to manage. If a system that suggests the most accurate decision for the company can be designed in a centralized structure, this will also minimize inter-departmental conflicts. There is a need for a fast, reliable system

to gain the benefits I mentioned earlier. Of course, we are obliged to use the results of this automation as a recommendation. Because we have a fast-changing structure and it is not always possible to enter all information into the system as soon as the event occurs. For example, we send a trailer to a customer for loading, but the customer keeps waiting our trailer because the materials are not yet ready for loading. Yes, in return, a waiting penalty is charging, but we need to revise the plan we are applying. Since this automation system will be run often, it should be able to give results quickly.

Interview with the Central Planning Manager

MT: How long have you been in this position?

Central Planning Manager (CPM): Approximately six months.

MT: What is your total experience in the sector and similar positions?

CPM: For more than 10 years, I have served in various positions in various logistic companies.

MT: Do you plan for empty movements and outsourcing as central planning unit?

CPM: Actually, we should do it. But we are not at that point yet. We are a newly established department and we are now working on arranging linehaul planning. In other words, we are trying to ensure that the ship and train lines are arranged according to the needs. And during the high demand periods, in fact most periods are high, we manage the effective use of capacities of ships and trains.

MT: What is your actions and timetable plan for empty movements and outsourcing planning?

CPM: Linehaul planning was done by tradelines in the process before us. Our most intensive tradeline, the Western European group, has naturally assumed the

leadership of this planning process. Obviously, our first goal is to change the culture of the past in our company and transform the central planning structure into a reliable and useful format in every field. Now, there is a need for serious improvements and developments for empty movements and outsourced trailers regarding both the resource and the system. The creation of a systematic infrastructure is a huge work and it is obvious that the IT team cannot support us in the near future due to their limited resources. An optimistic estimate seems to be that we can do something at this basic level in the next year.

MT: Do you think that the company's empty trailer movements and outsourced trailer numbers are reasonable? Is the company losing money due to these movements?

CPM: It is a fact that we have a lot of empty trailer movements. I also think that the number of outsourcing trailers is much higher than what should be. Of course, this is an improvement area. The profit margin in the sector is quite low. Significant contributions can be made to the company's profitability through the improvements in this area.

MT: What are the reasons for the number of empty trailer movements and outsourced trailers are much higher than what should be?

CPM: The most important factor is that each tradeline is planning on its own. When the integrity is lost, the overall benefit of the company is overlooked. Also, as I mentioned before, I think that we cannot support these teams sufficiently with the information systems. I guess many teams still work with the old methods. This may not be very effective if we take this planning as a central unit unless a well-designed system is developed. Our friends in planning should deal with many different issues. Among these issues, it is normal for them not to spare as much time and interest as necessary when we add empty and outsourced trailers. They also have to act without

any foresight about the demand. If there is a demand prediction even if it is not completely correct, it will be easier to manage the main planning accordingly and then manage the small deviations that will occur in the direction of this master plan. But in the current situation we are moving the trailers from there to collect the loads as soon as possible without even creating a master plan. And we can only know the results when the financial reports are announced after the end of the month.

MT: What if we tell you that we have developed a system that will match the empty trailers' locations in your system with the proper demands in the country totals and minimize the number of empty movements and outsourced trailers as well as their costs, without waiting for your IT team to spare time for it?

CPM: If such a thing is true, it will be very useful. If it is ready, I would like to review it as soon as possible. You are talking about a system that will automatically plan the number of empty and outsourced trailers according to the demand forecast. That means the current workload of the teams will significantly decrease. It will also prevent mistakes or wrong decisions. When this optimization is managed by us as central planning rather than by tradelines, the working environment based on personal relationships is also prevented. It will be an innovation that will radically change our existing structure.

After reviewing our application by the Central Planning Manager, we received his feedback:

MT: How long have you tested our new application? Can you tell us about our experience?

CPM: In the last two weeks, we have planned the empty movements and outsourced trailer needs by running the new application. Our first impressions are very positive. First, I would like to say that it works fast enough. The process that takes dozens of

man-hours will be going to decrease significantly. We did not experience any problems due to our decisions that we made according to this application. The feedback we get from the tradelines was also very positive. Except for a few setbacks, everything went under our control. All tradelines stated that there is no trailer shortage in their region. In the morning, we did the planning at the beginning of the day and we could manage the process with only small intermediate controls. The planning teams adapted to the situation quickly. A significant responsibility on them has been removed. Thus, they said that they could give the needed time and interest to their main responsibility, to plan the orders. Since we can manage the big picture from a holistic perspective, we can say that our empty movements are decreased. Of course, we will have to support this with financial results, and this will be seen in the report prepared by the finance unit at the end of the month. But I can say that non-financial results give hope.

MT: What were the problems you encountered when using the application?

CPM: I think the biggest problem of the application is working on MS Excel. I believe that using such a structure on Excel is not the right solution for a company of this size. We are a company that boasts technology, we use our own software. However, still working with Excel files in the current environment I think is lowering the business value. The main reason for this is that Excel is not a multi-user environment. If you log on with two different users at the same time, Excel only authorizes the first log-on user. Even keeping such an important file in the public folder is contrary to the rules of information security. I think that the right platform for this is our own software, but I also realize that it is difficult to implement it. Until then, which will not happen soon, we can use this platform. And even until the start of the software development project, we will have the chance to complete the

software project faster thanks to the know-how we will gain on this application. The second biggest problem is that consolidating forecasts manually by collecting from the individual sales people and somehow integrating them into this system. Of course, this also includes problems about our internal processes. These very important information about the demand must be kept in the company's database to allow further analysis. Once this is achieved, there will also be a need to develop a database connection in the application. At first, I thought we were going to run this application once in the morning, then we would not need it again. But I think our company a bit farther away from that. In the first trials, there was a need for re-running in order to be able to analyze the new situation in response to the demand that varied according to the predictions during the day. As you know in this case, we had to apply for your support. In fact, the system will be run once a day, as I told at the beginning, when the system sat down and we could better predict the demands. However, I foresee that we will need professional support in the implementation process.

MT: Considering that you will be the main user of the developed application, is it a useful product?

CPM: From the point of view of the efficiency, I think that our planning team will be more useful and provide the necessary time to fulfill the tasks that they mainly responsible for. Another benefit is that it will also increase the motivation and productivity of the team. Even during the short test period, we observed the effects. We can also say that it is flexible for changes in terms of cost items, demand forecasts and changes in empty trailer positions. When I consider all the problems mentioned, I can say that the use of this application will be beneficial for our company by increasing the customer satisfaction with the goods loaded on time and

increasing the profitability by decreasing the costs. When we evaluate the shortcomings of our current system, the new system will support decision-makers at the point of producing the best possible solution with the facilities at hand. Of course, there are some things that need to be improved. But before that we need to make some improvements in our system to support it. Thank you for bringing this system to our company. I wholeheartedly believe in your success in your later work. I want you to know that you contact us without any hesitation for anything I may help.

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