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EUROPEAN GROUPAGE NETWORK

Case: DSV Daily Pallet

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ABSTRACT

This thesis deals with the European road freight transport market, more precisely, groupage networks. The goal of the thesis was to determine an optimum location for an additional hub and a new network structure for Daily Pallet and furthermore to the European wide groupage network of DSV, one of the top three European road freight companies within which Daily Pallet product operates.

The theoretical part of the thesis is divided into the European road freight transport market and into the Hub-and-Spoke design of the groupage networks. The European road freight market part goes through current issues of the industry and provides the reader a better understanding of the scope of the thesis. The Hub-and-Spoke design part includes an explanation of the configuration of the design and its different protocol opportunities. Data for the theoretical part was gathered from primary and secondary sources in forms of published sources such as books and articles, as well as from the Internet.

In the empirical part, both qualitative and quantitative research methods were exploited and data was gathered in a form of a half-structured interview of a company representative, as well as in a form of statistics from the company's database. Firstly, Daily Pallet and its characteristics are compared to the market conditions and then afterwards compared simultaneously to the Hub-and-Spoke design, while going through the Hub-and-Spoke configuration in the second theoretical part of the study.

The results of the study indicate that the European road freight transport market is experiencing a transformation towards more Just-in-Time production orientation which is desirable for products such as Daily Pallet. Furthermore the results indicate that an optimum location for the additional Daily Pallet hub is situated in North-Germany, Hamburg, and the new network structure should consist of fully interconnected hubs, a possibility for multiple connections between a single node and multiple hubs as well as possibilities for direct connections between different nodes. Additionally, the thesis proposes future research to find a location for a third hub for DSV's groupage network and to determine again a new network structure to further develop DSV's groupage network.

Key words: DSV, groupage network, hub, Hub-and-Spoke, road freight

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TIIVISTELMÄ

Tämä opinnäytetyö käsittelee Euroopan maantierahtimarkkinoita ja sen kappaletavaraverkostoja. Opinnäytetyön tarkoituksena oli määrittää uusi verkostomalli sekä sijainti lisäristeysasemalle DSV:n kappaletavaraverkostolle, sekä Daily Pallet-tuotteelle. DSV on yksi Euroopan kolmesta suurimmasta maantierahtiyrityksestä ja yrityksen kappaletavaraverkosto kattaa koko Euroopan.

Opinnäytetyön teoriaosa jakautuu Euroopan maantierahtimarkkinoihin ja kappaletavaraverkostomallin eri variaatioihin. Euroopan maantierahtimarkkinaosuudessa opinnäytetyö käy läpi alan tämänhetkisiä ilmiöitä mahdollistaen lukijalle paremman ymmärryksen opinnäytetyön aihealueesta. Kappaletavaraverkostomallin eri variaatiot-osuus määrittelee mallin rakenteen ja käy läpi sen eri variaatiomahdollisuudet. Opinnäytetyön teoriaosuuden tieto kerättiin ensisijaisista ja toissijaisista lähteistä, julkaistujen lähteiden kuten kirjojen ja artikkeleiden muodossa, sekä internetistä.

Opinnäytetyön empiirisessä osiossa käytettiin sekä kvalitatiivista että kvantitatiivista tutkimusmenetelmiä. Tiedonkeruumenetelminä käytettiin puoli-strukturoitua haastattelua, jossa haastateltavana toimi yrityksen edustaja, sekä tilastojen keräämistä yrityksen tietokannasta. Empiirisessä osiossa Daily Pallettia ja sen ominaisuuksia verrataan ensimmäisessä teoriaosuudessa kuvattuihin markkinaolosuhteisiin, jonka jälkeen tuotetta verrataan yhdenaikaisesti toisen teoriaosuuden kanssa kappaletavaraverkostomallin rakenteisiin.

Tulokset osoittavat Euroopan maantierahtimarkkinoiden elävän Daily Palletin tapaisille tuotteille ihanteellista muunnosta kohti Just-in-Time-orientoituneempaa tuotantomallia. Tulokset osoittavat ihanteellisen lisäristeysaseman sijainniksi Pohjois-Saksan kaupungin Hampurin. Lisäksi tulokset osoittavat uuden ihanteellisen kappaletavaraverkostomallin koostuvan kahdesta täysin toisiinsa yhteydessä olevasta risteysasemasta, mahdollisuudesta yhteyksiin yhden solmukohtan ja usean risteysaseman välillä, sekä suorista yhteyksistä solmukohtien välillä. Lopuksi opinnäytetyö ehdottaa jatkotutkimusaiheiksi kolmannen lisäristeysaseman sijainnin paikantamista sekä uuden verkostomallin rakenteen määrittämistä DSV:n kappaletavaraverkoston kehittämiseksi.

Asiasanat: DSV, kappaletavaraverkosto, maantierahti, risteysasema, verkostomalli

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1 INTRODUCTION

1.1 Background and problem definition

European road freight transport services sector has experienced challenging times starting from the year 2008, and not least as a result of the current global economic crisis. Due to a strong dependency, the economic crisis dramatically slowed down the demand for road freight transport services. After a serious global decrease of 20-30% in road freight output in tonnes in the year 2009, followed by additional bad years, the industry has recently experienced signs of recovery. Nevertheless, in the year 2011 Europe was still 40% behind in vehicle registrations from the year 2008 records, when the financial slow down started. (IRU 2013a.)

Development and invention of new technologies has also lead to a situation, through a minimum need for capital investments and manpower, where a threat of new entrants to the market is very likely (DSV 2013a). In addition, new trends are appearing when considering the industry and customers. There is an increasing demand within the industry for frequent and small-sized deliveries, as well as a desire to control and monitor the shipments in transit, in order to match the industry's internal need to save in storage and inventory costs of manufacturing process. Nowadays Europeans expect rapid on-time deliveries directly from manufacturer or wholesaler to end consumers. (DSV 2013b.)

Modern European transportation businesses are making an effort to remain flexible and cost-efficient in order to keep up in this challenging and constantly changing environment by adjusting their processes and creating new products to the market. An implementation of groupage network based on the Hub-and-Spoke principle, which reaches throughout the Europe, has seemed to be one of those solutions of which these major market players have seen to be the most suitable. Network designed according to the Hub-and-Spoke principle replace many direct connections between the shipper and the receiver by fewer indirect connections. Additionally, shipments are grouped and re-organized, or cross-docked, in hubs which function as central depots or transit terminals of the network, according to a

several criteria, but as a cornerstone according to the final destination of the shipments. (Miller & O'Kelly 1994, 31-40.)

One of the above mentioned companies that has implemented such a network based on the Hub-and-Spoke principle, is a Danish forwarding company, DSV A/S. With subsidiaries in more than 70 countries and close to 22,000 employees worldwide, DSV holds remarkable global position in transport and logistics solutions. (DSV 2013c.)

Nevertheless, with their recently launched product sold to the customers by the name of DSV Daily Pallet, the company has not yet established themselves a competitive advantage compared to their main competitors. This is due to a fact that other major players in the European groupage market such as DHL, DB Schenker and Dachser have already launched similar groupage network products based on the Hub-and-Spoke principle. Now DSV still needs to compete and beat the competitors in such factors as lead-time, price, frequency and product features.

Currently DSV's international groupage network, within which Daily Pallet operates, has been built upon one already existing Euro-hub in Schwieberdingen, South-Germany. Figure 1 illustrates the current network structure and the location of the hub in Schwieberdingen.



FIGURE 1. Current structure of DSV's groupage network. (DSV 2013b).

To outperform their main competitors, the company still has to develop the structure of their international groupage network. With an impeccably positioned additional hub inside Europe, DSV would be able to cut down the costs of their manufacturing process and furthermore lower the price of their product for the customers and gain additional benefits of improved lead-time and higher frequency.

1.2 Objective and research question

The objective of the thesis is to determine the impeccable location for the additional hub and further to determine the new network structure for DSV's international groupage network as well as to the company's commercial groupage product, Daily Pallet, which is designed for palletized groupage shipments only, for goods that can be loaded and shipped on pallets. In order to do so, first the European road freight transport market will be examined in order to draw a conclusion of the overall market situation and conditions, which is essential for the study. Furthermore, DSV Daily Pallet will be examined and compared to the market conditions and to the Hub-and-Spoke configuration. As a result of the comparison, the thesis provides an answer to the following research question and its sub-question:

What is the optimum location for the additional hub for DSV Daily Pallet and what should be the new network structure?

- What is the current situation on the European road freight transport market?

1.3 Limitations

The thesis seeks the answer to the research question based on statistics of shipment flows in and out thru the hub in Schwieberdingen and based on the theoretical framework of the thesis. The study is limited to Europe, as the case company's groupage network consists of the European continent only. Macro-environmental factors such as environmental, legal and political are not taken under consideration. Figure 2 illustrates with blue color what factors of the macro-environment are at least partly taken under consideration in the thesis.

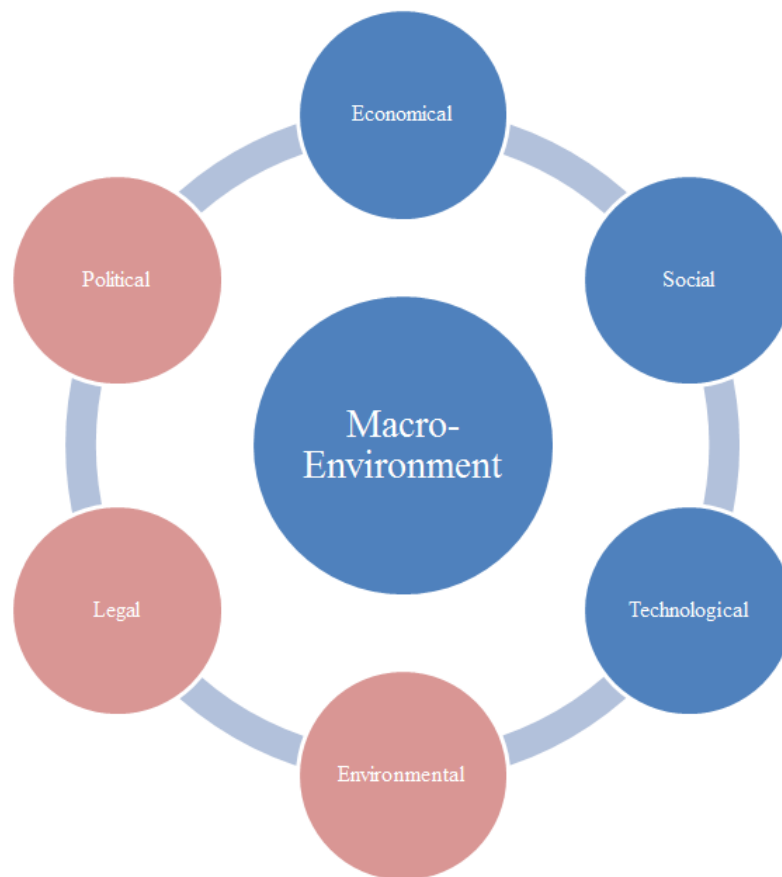


FIGURE 2. Macro-environmental factors under consideration in the thesis.

Economic factors are taken under consideration as part of the thesis deals with the correlation between the European GDP growth and road freight output measured in tonnes. Social factors on the other hand, are considered while the thesis studies a shift in the society towards more Just-in-Time oriented production. Finally, technological factors are considered as the thesis examines new products, such as Daily Pallet, offered to the market by major market players forced by the changing market conditions.

The thesis does not take under considerations any environmental changes that may occur in the future. Neither it does not consider any legal factors such as labor laws, which although play a major role within the transport industry. Any political decisions are not considered, even though the transport industry is characterized by such changing factors as CO₂ reduction and cabotage rules.

Factors of infrastructure such as existing road connections or capital investments of establishing the hub are not taken into consideration, when seeking the impeccable hub location. Also as a result of small players controlling a large market share of the groupage market with their Less-Than-Truckload (LTL) shipping services, players that are not seen as the main competitors of DSV, the thesis compares DSV only to similar large international freight forwarders and therefore examines not just the groupage market, but the overall European road freight transport market, although the main structure of the study is limited to road freight groupage.

1.4 Research methods

Commonly two different types of methods are exploited in studies: quantitative and qualitative research. Generalizing, quantitative research uses data from large samples to count and quantify. Questions such as *how much?* and *why?* are used in data collection in order to test an established theory or hypothesis. As its name states, it offers a quantitative description and answer to the topic at hand. Qualitative research methods on the other hand, are mostly exploited in social sciences. Questions such as *what?* and *how?* are used in order to establish a deeper understanding of a phenomenon. Compared to quantitative research, in qualitative research smaller samples are adequate. Suitable data gathering methods are interviews and observations which are used in order to understand the phenomenon and establish a theory. Additionally, qualitative research offers a possibility for more specified and deepened follow-up questions, opposite from quantitative research. (Strauss & Corbin 1998, 10-11; Töttö 1999, 280-286.)

In order to be able to answer the research question, in the empirical part data in a form of most recent statistics were gathered from DSV's database. Additionally DSV Road Oy's responsible person for Daily Pallet, Traffic Manager Maija Naumanen, was interviewed 1st of March 2013 in a form of half-structured interview, in order to establish a better understanding of the product itself. Therefore, this thesis uses both quantitative and qualitative research methods. For the theoretical part data was collected using primary and secondary sources from books, articles and the Internet.

1.5 Thesis structure

The structure of the thesis is shown in figure 3. The thesis consists of five chapters and a summary in chapter 6. Chapter 2 is the first theoretical part and chapter 4 is a combination of the second theoretical part and the empirical part of the thesis.

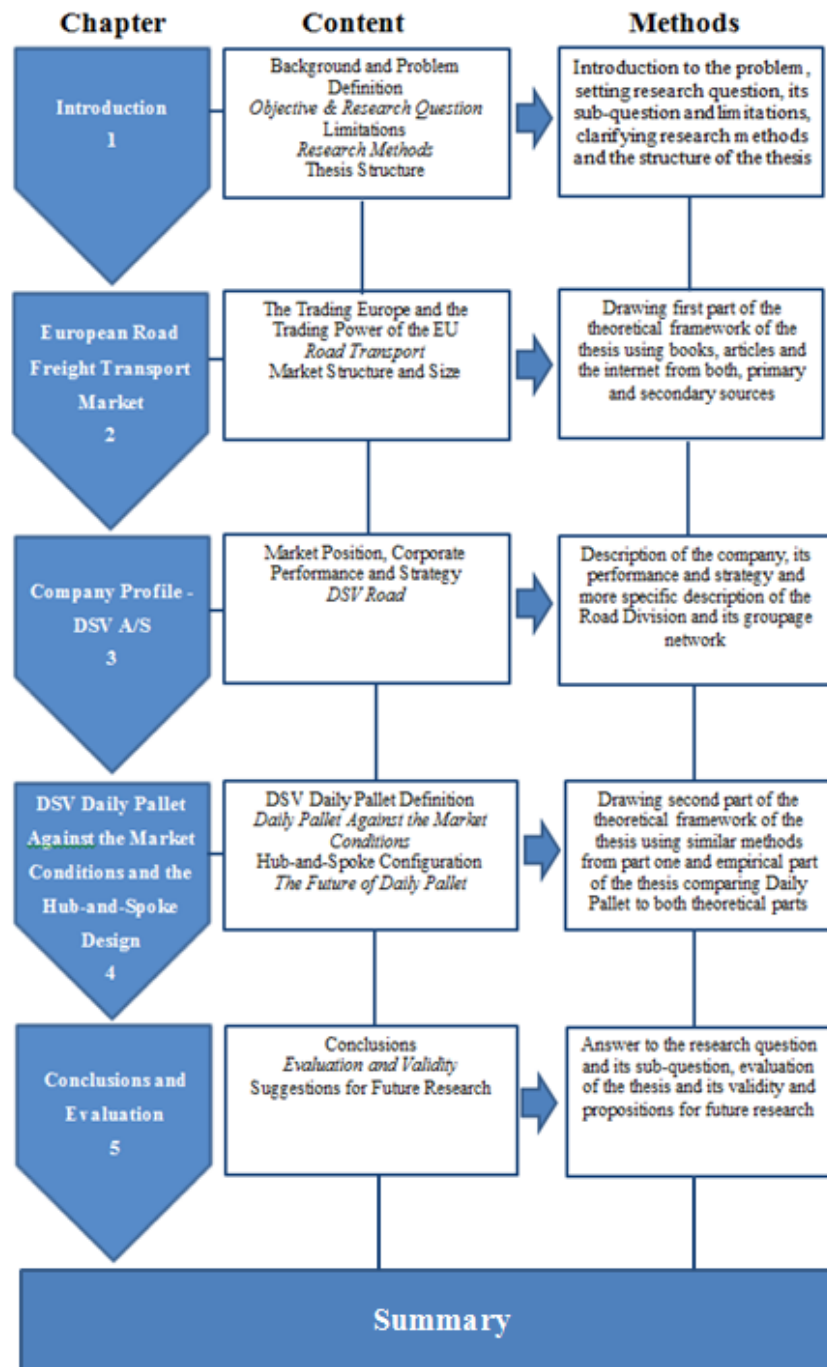


FIGURE 3. Thesis structure.

Chapter 2 will introduce the reader to the European road freight transport market. Understanding the industry of which the thesis deals with and its current trends is essential in order to be able to understand the product Daily Pallet itself and its characteristics. Chapter 2 will draw the first part of the theoretical framework of the thesis and will set up a basis to provide an answer to the sub-question in chapter 5.

Chapter 3 will provide a general company introduction of the whole corporation and a closer introduction of the Road Division, since the scope of the thesis is on road freight and more specific on groupage shipments. Additionally, Road Division's groupage network within Daily Pallet operates, will be described.

Chapter 4 defines the product Daily Pallet and its characteristics and compares it to the theory from chapter 2. Furthermore, chapter 4 forms the second theoretical part of the thesis going over the Hub-and-Spoke configuration while simultaneously comparing Daily Pallet's characteristics to the configuration. Chapter 4 will also go over Daily Pallet's performance and shipment flow statistics in order to enable precise answer to the research question in chapter 5. Therefore chapter 4 also forms the study of the thesis.

Chapter 5 provides a conclusion and will go over the author's own findings from the study. Based on the findings, chapter 5 will provide an answer to the sub-question and moreover to the research question itself. Additionally, reliability and validity of the thesis will be evaluated and suggestions for future research will be made. Chapter 6 is a summary of the thesis.

2 EUROPEAN ROAD FREIGHT TRANSPORT MARKET

The following chapter defines the current situation in the European road freight transport market. The aim is to help the reader to draw a better general view of the industry and the scope of the thesis and furthermore enable more precise, strict and understandable answer to the research question in chapter 5.

2.1 The trading Europe and the trading power of the EU

In the modern world economy it is relatively difficult, especially for smaller economies, to be separated from the surrounding countries and yet still manage to stay on the path of economic growth (Browne, Cooper & Peters 1994, 4).

Increasing international trade, among many others, is one recognizable characteristic of the economic integration inside the Europe, especially the European Union. Liberalization of the Europe's internal trade has built a bond between former enemies and has unified the nations, allowing the old continent once again to challenge the USA in trade negotiations. (Kalypso & Meunier 2006, 906-925.)

As a trading bloc, the European Single Market, or the European economic area, is unique. With its long, over forty-year-old traditions of negotiating trade agreements and with its effective institutions, it is not far-fetched to say that the EU is actually the most powerful trading bloc in the world. Although, as the power is measured by the size of the market as well as by the overall performance of the economy, the EU as a trading bloc has experienced recent setbacks caused by the current economic crisis. (Kalypso & Meunier 2006, 906-908.)

According to Kalypso and Meunier (2006, 911-912), there are three different types of trade power that are exercised and can be found inside Europe. Table 1 illustrates three different types of trade power; bilateral, regional and global, and furthermore illustrates how the different types of trade power are used and what are their benefits.

TABLE 1. Forms of the EU's trade power (Kalypso & Meunier 2006, 910).

<i>Nature of trading relations</i>	<i>Power in trade Exporting goods, services and capital</i>	<i>Power through trade Exporting standards and norms</i>
Bilateral	– symmetric and asymmetric bargaining power over market access	– democratization, development, governance and adoption of standards
Regional	– reciprocal market access	– exporting EU single market rules and broader governance tools to other regions
Global	– multilateral bargaining, specific and diffuse reciprocity	– shaping the multilateral system through deep trade agenda

Firstly, the power is exercised at the bilateral level through agreements consisting of tariffs, quotas or technical barriers. These agreements allow European nations to gain access to other markets, like Australia, and in exchange allow access to its own market. Secondly at the regional level, as a result of more and more countries globally joining different trading blocs, the EU is aiming for bloc-to-bloc deals in order to cash in the benefits of economies of scale. Last but not least, at the global level, it has been the role for the rest of the world to serve as a witness for the battle between the two giants, the EU and the USA, as these two trade powers alternately try to restore a balance of market access to the other side.

The importance of international trade to the logistics sector is enormous, since in most of the cases when goods are sold or traded, they also need to be transported. As international trade played a role of 13% of the GDP in the year of 2009, of the nations belonging to the EU, its influence to the everyday lives of European citizens is undisputable. During the same year, European companies exported EUR 1.6 trillion worth of goods and services making the EU the biggest player of global international trade. Meanwhile as thirty-six million jobs in Europe today depend directly or indirectly on trade, it is crucial for the performance of the European economy to maintain its position as a top player of the international trade, the fact why trade policy has been chosen to be a core component of the EU's 2020 strategy. Furthermore, to enhance its global bargaining position, the

EU member states have accepted to follow a mutual policy on international trade, which allows the nations to speak as common voice. (European Commission 2013a.)

2.2 Road transport

In the year 2010, 45.8% of goods being transported inside the EU were done via road haulage, or road freight transportation. Correspondingly in the year 2009 Gross Value Added (GVA) by the transport and storage services sector estimated around EUR 533 billion. (European Commission 2012a.) These figures indicate the remarkable size of the industry.

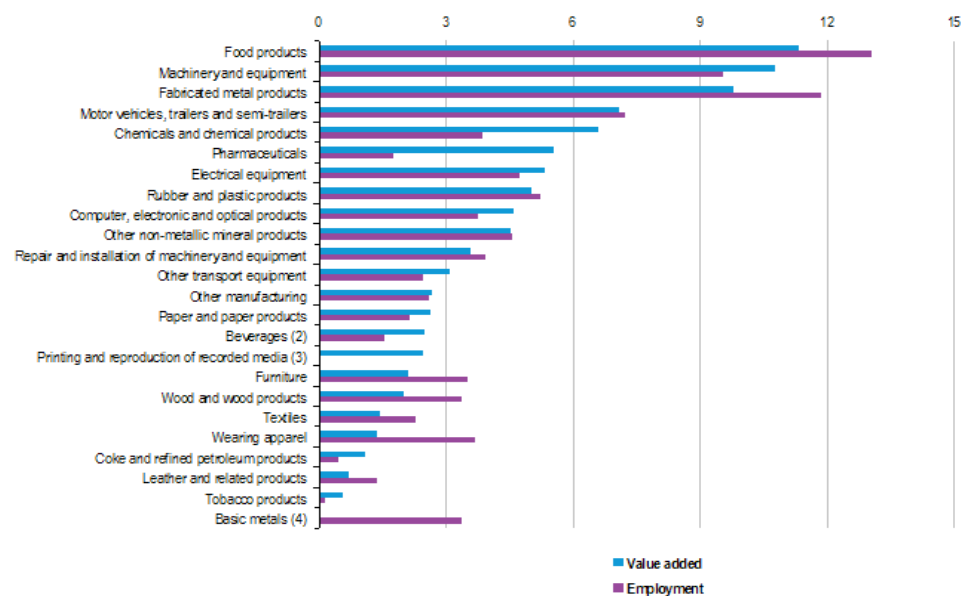
Due to its entry costs which have always been low, the road freight sector is highly accessible. As a result of the low entry costs, when only a price of a truck is enough to establish a business, in fact many companies within the industry have started from a small, maybe a one-man business. Meanwhile when these small companies have grown bigger and bigger, they have formed a distinctive style of management, depending on the working background of the owner. (Browne, Cooper & Peters 1994, 149.)

Flexibility, easy accessibility and cost efficiency are the main characteristics which make the road transport such a conventional mode of transport. The actual freight forwarding process is highly dependent on time and space, the factors where other means of transports are more limited (Praveen & Sathikumar 2009). In addition as the industry is characterized by increasing acquisitions and mergers, large corporations have challenged themselves to offer more diverse variety of services and to cover a larger geographical area, as a result of their increasing market dominance (Browne, Cooper & Peters 1994, 21).

2.2.1 Transport demand for goods

Browne, Cooper and Peters (1994, 21) state that manufacturers and retailers, the main users of logistics services, in fact play a major role in shaping the actual services. As the European manufacturing changes, so does the type of demand for transportation, since different types of goods need different transportation

methods. During past decades, a shift of balance between manufacturing sector and service sector inside the Europe towards more service-oriented society has also had its impact on the demand for transport services. Despite the fact, great European manufacturing economies such as Germany, France, Italy and UK still remain as major forces in global comparison. (Browne, Cooper & Peters 1994, 22-24.) Figure 4 illustrates a percentage proportion of different goods that are manufactured inside the EU and furthermore what are their influences to the employment situation of the EU countries.



(1) Ranked on value added.

(2) Excluding the manufacture of other non-distilled fermented beverages (Class 11.04).

(3) Employment, not available.

(4) Value added, not available.

FIGURE 4. Sectoral breakdown of manufacturing inside EU-27 in the year 2009 (Eurostat 2013).

When examining the need for international transportation of goods inside the EU, few industry sectors stand out, as seen in figure 4. It is obvious that the food sector has its major role in creating transport demand, but in addition industry sectors such as; machinery, metal, motor vehicles, chemicals, pharmaceuticals and electrical equipment also generate large portions of the European manufacturing

and furthermore create demand for transportation. It is also proven that national demand can be driven by large corporations if the industry sector of the corporation is exceptionally strong within the country. To generalize, the demand of transport and logistics services in country-specific is driven by two categories; external forces such as Single European Market (SEM) in which free trade within the EU has been created in order to shape the whole Europe into a single economy, and internal forces such as mergers and acquisitions as top European manufacturers increase their market dominance and power. (Browne, Cooper & Peters 1994, 23-29.)

2.2.2 Logistics service patterns

When observing logistics as a concept, there is no doubt that it is truly multidimensional. As a matter of fact, reportedly supply chains usually vary from one company to another considerably. This is a result from a fact that the products produced by manufacturers differentiate from their nature; some products require only a low level of customer service, some in the other hand high level, as well as some products need to be delivered only monthly when others require a daily delivery. (Browne, Cooper & Peters 1994, 164.)

The Logistics Service Heptagon in figure 5 represents attribute classes of logistics services and their characteristics. The heptagon comprise of seven vector sectors: space, capacity, management, activity, customer service, information technology and logistics function. Each vector sector has a number of options to describe the characteristics of the logistics service in question. The heptagon enables more closer examination of possible different alternatives for any logistics service and also can be used as a management tool when a company is unsure of its logistics strategy or the strategy is in design-phase. It is clear that logistics managers working in large international freight forwarding companies must be up-to-date of the market conditions in order to steer the company towards the right direction. (Browne Cooper & Peters 1994, 163-169.)

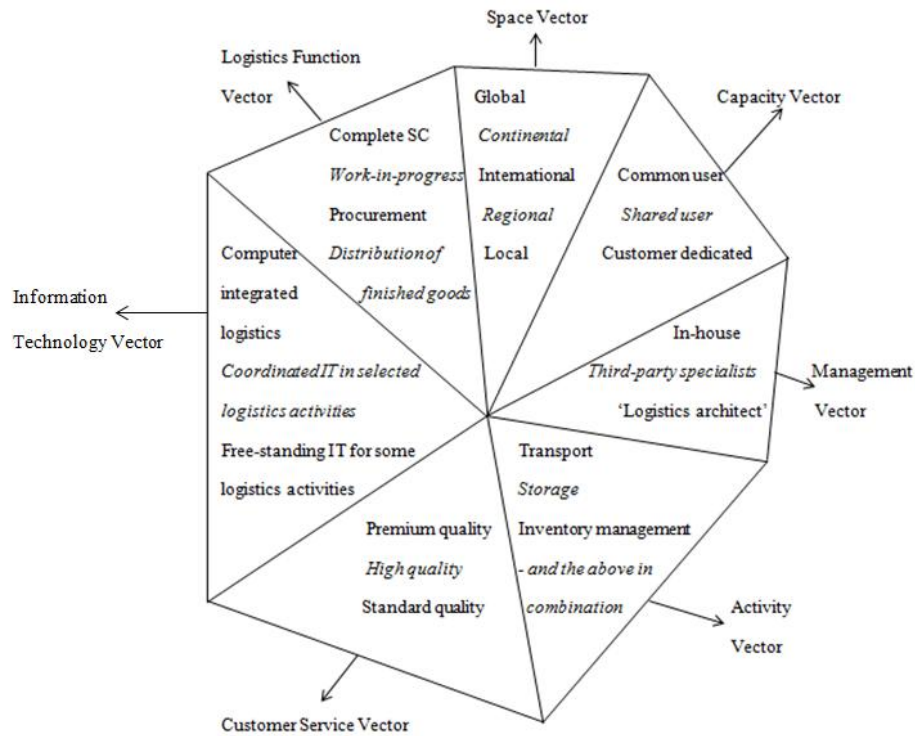


FIGURE 5. The Logistics Service Heptagon (Browne, Cooper & Peters 1994, 164).

As discussed earlier in sub-chapter 2.2.1 products manufactured inside the European single market play a major role in shaping the logistics services produced by service providers. When the infrastructure inside the Europe develops and so influences and changes the market conditions, we move along on the heptagon to the direction of the change. In other words as an example, if the manufacturing inside the Europe changes towards more premium quality products (Customer Service Vector) or the European economic slow down decreases international trade (Space Vector) and forces companies to manage with regional trade and perhaps create new products for their domestic markets, it is reasonable to assume that the demand of logistics services, as transport for such products, is expected to increase.

2.2.3 Road transport shipment types

The costs to the environment and to the economy from goods being transported on road would be significantly smaller if all trucks would run fully loaded. In addition, large benefits for logistics service providers, as well as to individuals and communities, could be exploited by utilizing the vehicle capacity. (McKinnon 2010, 284.) As a result of the wide extension of different types of products that are in the need of being transported, logistics service providers have developed different methods to handle different kind of goods. According to the size of the shipment, they are divided into three different categories: groupage, Less-Than-Truckload (LTL) and Full Load (FTL). Figure 6 illustrates typical phases of an international road transport handling shipments from three different categories and points out the main difference between these categories.

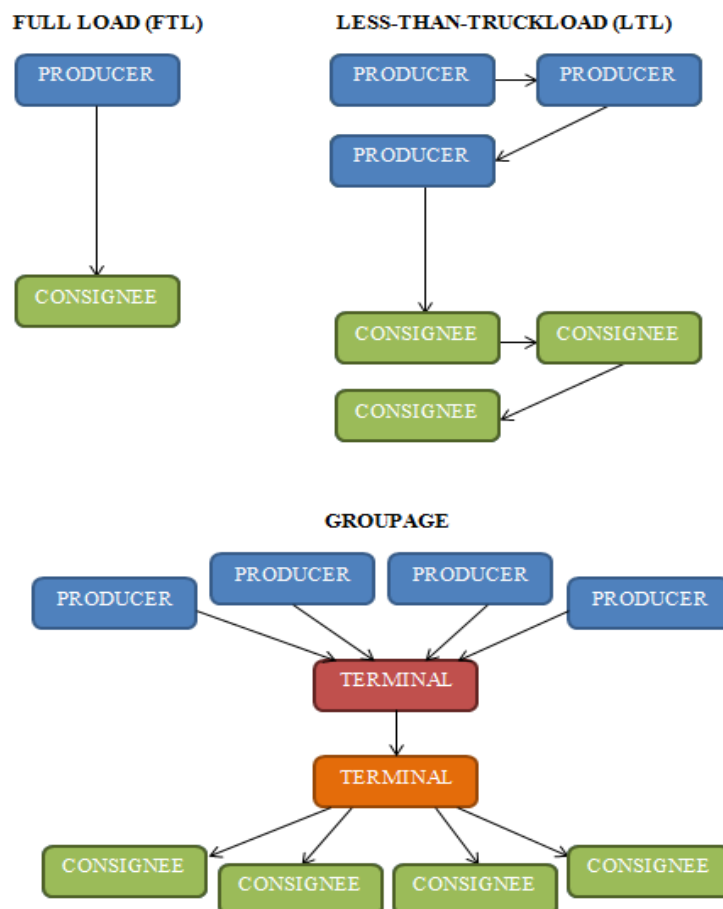


FIGURE 6. Typical phases of international FTL, LTL and groupage shipments.

For the groupage shipments, freight forwarders have a few different definitions for the exact measurements. Altogether, groupage implies a small shipment that does not require its own container and usually the shipment will only fill up a small portion of a container or a trailer. Products from different producers are loaded into large trucks and delivered to a terminal, grouped together with other similar cargo according to the volume, condition and final destination of the product in order to allow cost savings, and afterwards shipped to a distribution terminal and finally from the distribution terminal to the final destination with distribution trucks. Cost of the transport is distributed among the shipments according to the volume of the shipment in question. (CargoMaster Abouzeid Group 2013.) DSV (2013b) defines groupage shipments as goods up to 1 500 kg and Daily Pallet groupage as goods up to 3 500 kg.

Top European road freight forwarders such as DSV, DHL, DB Schenker and Dachser that handle groupage, have established European wide groupage networks. These networks allow service providers offer to their customers reliable door-to-door lead times, daily departures, which is one of the factors that especially larger companies truly appreciate since it enables superior warehouse utilization and faster delivery of products to their customers (Naumanen 2013), and in addition online track and trace for the shipments (DHL 2013).

Less-Than-Truckload, or part load, is a shipment type larger than groupage (3 500 kg), but still does not require a full container or trailer and generally the same truck picks up, transports and delivers LTL's often without terminal handling. Furthermore this decreases the possibility of something going wrong or the shipment getting damaged on the way, as it is moved in and out of the truck less frequently. In addition, in international transports, the delivery time is usually approximately a day shorter than with groupage, due to a fact that the transport does not involve handling in a distribution terminal. (DSV 2013d.)

The main advantage of LTL to the shipper compared to FTL is that it is considerably cheaper if the trailer is fully loaded. Again as with groupage, cost of the transport is distributed among the shipments inside the container or trailer, based on the volume of the shipment in question. It is not rare that inside the trailer there are groupage and LTL after the trailer is loaded ready at the dispatch

terminal. (Murray 2013.) According to Weinstein (2006, 31), the shipping costs per kilogram are also lower for LTL than groupage, also as result of less shifting of goods needed to be done.

Weinstein (2006, 33) states that groupage and LTL can be broken down into following three cost categories:

- Distance costs
- Access and handling costs
- Premium fee

Compared to FTL, shipping of groupage and LTL is considerably more complicated. This is a result from a need of consideration not only about the distance, but also loading factors. The main cost drivers for groupage and LTL are weight and volume of the shipment as well as the distance, but the freight forwarders also charge so called premium fees to cover the risk of not a completely fully loaded trailer. (Weinstein 2006, 33-34.)

Full Load (FTL) is the third category into which the road transport shipments are divided. FTL is used when a producer is in the need of a full trailer or container for the goods being produced and transported. The function of FTL is notably simpler than with the two other shipment categories. The goods are loaded into a trailer at the producer's premises and delivered straight to the consignee, no shifting of goods or terminal handling is needed.

2.2.4 Transport utilization and Just-in-Time delivery

The European freight forwarders struggle today with the issue of how to avoid the scenario of trucks running with only a small quantity of cargo or even empty. In fact, approximately a third of kilometers during a typical vehicle haul are run with no cargo. The main factor causing the empty running scenario is the fluctuations in demand as large manufacturing companies require a steady and reliable schedules from the logistics service providers when in the meanwhile their own need for transportation fluctuates according to the demand and manufacturing of their own products. (McKinnon 2010, 285-287.)

Within industries characterized by Just-in-Time (JIT) delivery the empty running scenario is quite usual. Among the companies operating in such industries, it is typical that manufacturers accept the extra costs, added to the price by the freight forwarders, of a partly loaded trailer as a result from savings in inventory, warehousing and other benefits of the JIT production. (McKinnon 2010, 288.) Additionally, as the Internet has provided us the instant access to information, it has revolutionized the ways of doing business and increased JIT production, which is expected to increase even more in the future. Nowadays there is a need for an immediate availability of products and services and this has created a demand for such transport services, characterized by high frequency and small-sized shipments, which fit these purposes. (DSV 2013a.)

The vehicle utilization is not the only factor considered important from the freight forwarders' perspective, since the high productivity of a truck does not always mean a fully loaded trailer. Some trucks can haul heavier cargo than the others, which is also one of the factors that productivity is measured by. (McKinnon 2010, 285.) Table 3 compares two different types of trucks, the first weighting 32 tonnes fully loaded and the second 40 tonnes according to different criteria of productivity and utilization measures and illustrates the difference in their productivity.

TABLE 2. Comparison of different vehicle utilization and productivity criteria between two types of trucks (McKinnon 2010, 285).

Gross weight	Max payload (tonnes)	Annual distance travelled (km)	Average load tonnes	Productivity Tonne-km/veh/year	% Capacity utilization Actual t-km/Max t-km
32 tonnes	20	100,000	16	1,600,000	80%
40 tonnes	26	100,000	18	1,800,000	69%

Table 2 shows that even though the truck weighting 32 tonnes has a higher capacity utilization percentage of 80% than the truck weighting 40 tonnes with the utilization

percentage of 69%, its productivity measured in tonnes per year is actually smaller, since its average loading weight is 2 tonnes smaller as a result of the size of the truck, as it is rare that trucks can be loaded up to their maximum weight capacity because of several reasons such as shipment dimensions or speed deliveries (Hassler & Talbot 1990, 289-292).

2.3 Road freight market structure and size

When comparing different transport modes within the EU, it is clear that the road transport holds the most dominant position when tonne-km transported is used as criteria. Figure 7 demonstrates percentage shares of different transport modes within the inland EU of the total tonne-km generated during the year 2010.

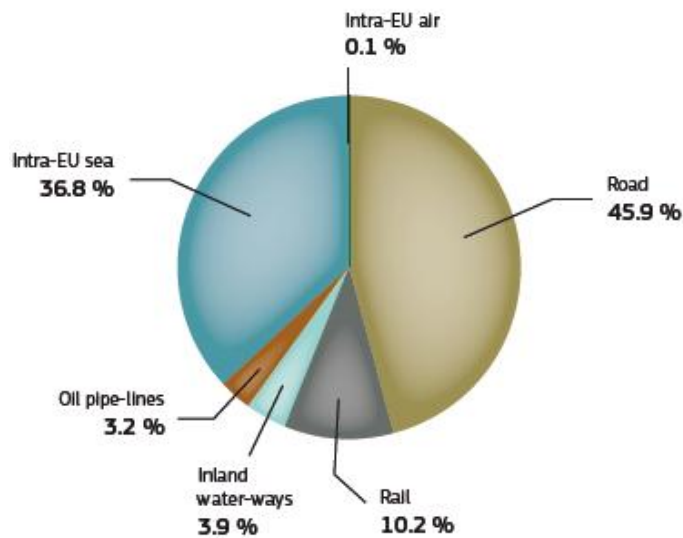


FIGURE 7. Modal split of goods being transported inside the EU in the year 2010 (European Commission 2013b).

The total amount of goods being transported within the EU during the year 2010 is estimated at 3831 billion tonne-km, leaving the road sector with a share of 1758 billion tonne-km (European Commission 2012a). Measured in revenue, the European road freight market's value in the year 2012 was estimated at EUR

283.2 billion (DSV 2013b). In addition, the market is under control of small operators, leaving the market share of top 10 European road transport agencies with a market share of 13 %. (The High Level Group 2012.)

Past the last decade, mostly as a result of the EU's free trade policy, there have been signs of tightening competition inside Europe. Boundaries for market entrance have diminished as well as price-consciousness of the customers has increased, leading to a hardening competition of cost and price level between large transport operators. As a result, to maintain cost-efficiency, a visible trend within the market has been a certain profiling of some the large operators. Some operators have chosen to concentrate mostly on the groupage shipments, some on Full Loads. (Naumanen 2013.)

The road freight sector is closely related to the GDP growth of Europe (IRU 2013a) and the recent negative development of the GDP during the years 2008 and 2009 has left its mark on the industry. Figure 8 illustrates the percentage change in the European GDP growth and its influence to the road freight output measured in tonnes between the years 2005 and 2012.

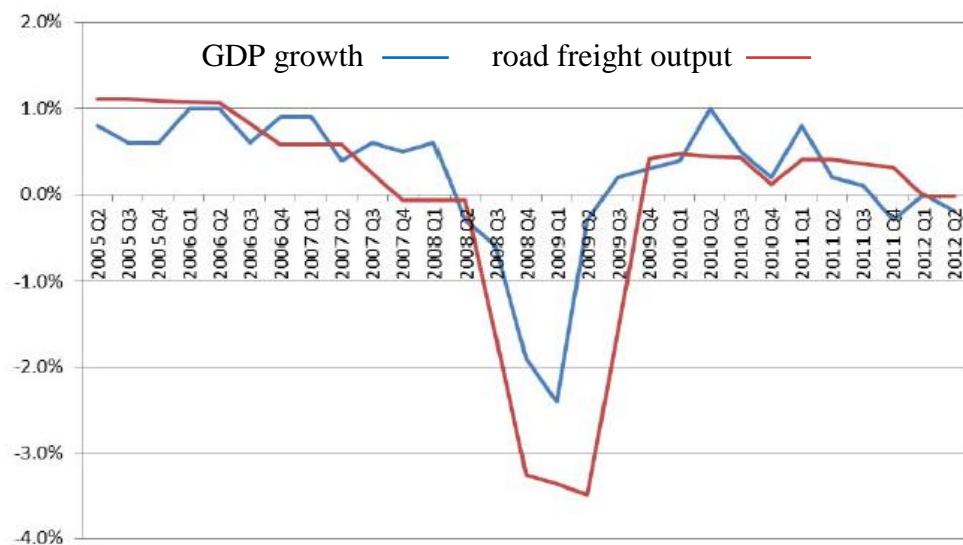


FIGURE 8. The European GDP growth compared to road freight output in tonnes (Transport Intelligence 2013).

Figure 8 indicates that especially during the last half of the year 2008, the decrease in GDP growth had severe consequences to the European transport industry. Although, in the near future the EU's GDP is estimated slightly to increase and this has led to positive expectations for the similar scenario to happen on the transport market. Figure 9 represents future estimations of the EU's GDP growth and its influences to the road freight sector. From the year 2013 the index of the GDP growth is estimated to increase by approximately 2 points leading to corresponding increase in the road freight sector.

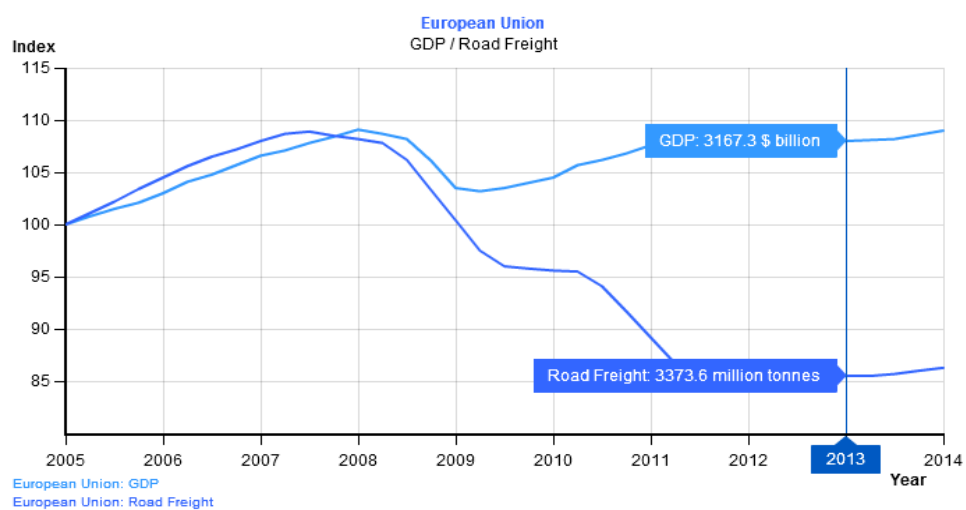


FIGURE 9. The EU's estimated GDP growth compared to road freight output tonnes (IRU 2013c).

The correlation of the GDP growth and the road freight sector is a result of trucks being a vital link between manufacturers and customers almost on every industry sector. At some point almost every product needs to be transported and distributed and even every other transport mode is at some point dependent on the road transport in order to operate efficiently, as a result of the fact that most factories and stores can only be reached by trucks and due to their flexibility that allows to transport variety of products from different sorts and sizes. (IRU 2013b.)

2.4 European groupage market

Since the research question of the thesis is interrelated with the groupage market, closer examination of this market dimension is seen as essential.

As discussed in sub-chapter 2.2.4, there has been a change in production methodology within the European manufacturers towards the Just-in-Time-strategy. With decreasing cargo sizes and increasing delivery frequency, more and more products are handled as groupage. At the moment the groupage market is estimated to cover around 20% of the total European road transport market summing up to EUR 57.2 billion measured in revenue (DSV 2013b).

Within Europe, 97% of customers are in the need of groupage transportation and in addition, 50% of the customers require steady daily departures for similar products (DSV 2013b). Correspondingly the amount of groupage shipments is expected to increase in the near future as the customers are seeking for more efficient packaging methods and more reasonable transport models to increase their own cost-efficiency (Naumanen 2013). Furthermore, more and more companies decide to choose groupage shipping, as it allows to ship cargo with other shippers leading to cost-effective solutions. Improved cost-control, flexibility and efficiency, not least as a consequence of the groupage networks, are the main reasons for the expected increase of the groupage shipping. (KLG 2013.)

As mentioned in sub-chapter 2.3, the road freight market is under control of small operators, which is also an existing factor within the European groupage market (The High Level Group 2012). Even the economic slow down has not held down new small operators entering the market with rather big risks. The sophisticated European groupage networks, that are one characteristic of the industry, enable manufacturers to ship their groupage via express overnight delivery or slower 48-hour delivery with more reasonable price. (Baker 2013.)

Further examination of the groupage industry is not made, as the groupage industry is highly characterized by small operators which are not seen as main competitors of the case company, as also mentioned in the thesis limitations.

3 COMPANY PROFILE – DSV A/S

DSV A/S is a Danish freight forwarding company that offers global transport and logistics services. The company has offices in over 70 countries, as illustrated in figure 10 by blue color, and is represented almost all over the world excluding parts of Africa, Middle East and a few additional countries. Furthermore, the company is approaching up to 22,000 employees, the facts that make DSV a remarkable global market player. DSV's head office locates in Copenhagen, Denmark and the company is listed on NASDAQ QMX Copenhagen stock exchange and holds position of one of the 20 most traded stocks. (DSV 2013e.)

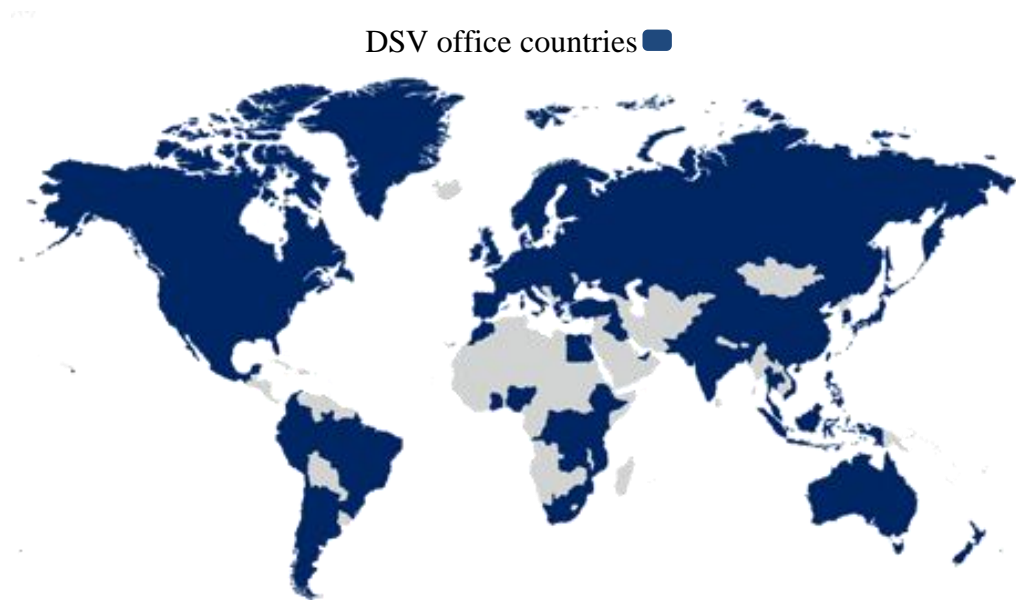


FIGURE 10. Global geographical display of DSV's office countries (DSV 2013f).

The company is divided into three divisions; DSV Air & Sea, DSV Solutions and DSV Road of which all are contributing a positive mark to the company's financial statement. Since Road and Solutions divisions are currently only operating inside the Europe, making the Air & Sea the only global division, it is reasonable to state that the Europe is DSV's main market. (DSV 2013e.) Figure 11 illustrates DSV's management structure and shows how responsibilities are distributed among the organization.

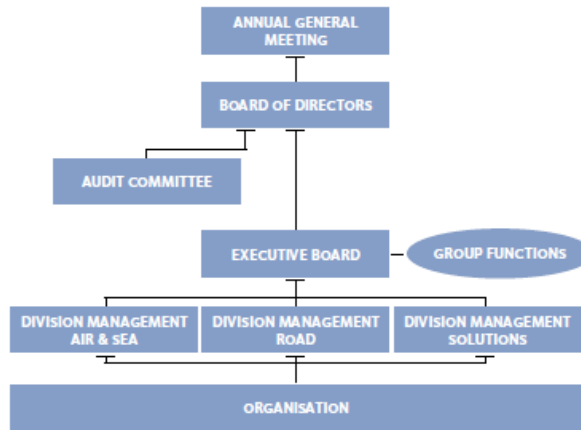


FIGURE 11. DSV management structure (DSV 2013e).

As figure 11 illustrates, shareholders possess the ultimate power through the annual general meeting, while the development of the organization is supervised by the Board of Directors.

3.1 Market position, corporate performance and strategy

In the year 2012, DSV reached EUR 6,018 million in revenue against EUR 5,837 million from the year 2011. Comparably the gross profit climbed from EUR 1,315 million to EUR 1,347 million in the year 2012. Using revenue as criteria, DSV held rank number six in the year 2011 among the world’s largest freight forwarders. (DSV 2013e.) Figure 12 points out DSV’s market share to be approximately 2% in global revenue comparison.

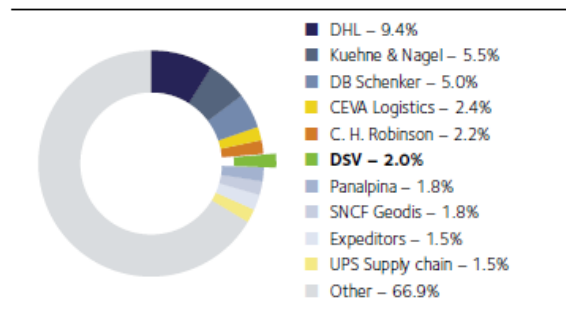


FIGURE 12. Market shares of the largest global freight forwarders (DSV 2013e).

In order to maintain a key position in the global freight forwarding industry since DSV's establishment in 1976, core elements of the corporate strategy have been mergers and acquisition. Acquisition of DFDS Dan Transport Group in 2000 launched a new era and strategy thru the company's biggest step in the history with remarkably strengthened global network and new segments from the USA and Asia Pacific. Followed by acquisitions of J.H. Bachmann in 2005, Frans Maas 2006 and ABX LOGISTICS in 2008, DSV took large further steps to strengthen its position in the industry by yet again expanding their network and gaining new segments from the market. (DSV 2013g.) Figure 13 represents five core elements of DSV's corporate strategy; already mentioned growth, customer focus, organization, asset light and business processes.



FIGURE 13. The five core elements of the DSV Strategy. (DSV 2013e).

Despite DSV's strongly growing organization, the company has been able to constantly add value to its customers' supply chains through quality services at competitive price. Due to DSV's flat and decentralized organization structure, the company is able act according to national consideration of culture, language and market conditions. Another core element of the corporate strategy has been light assets. With minimum investments in fixed assets and widest extent of operational leases, DSV has managed to keep its business model flexible. The fifth element shown in figure 13 of the corporate strategy has been named as business processes. In the industry characterized by low margins and high competition, it has proved out to be remarkably important to keep the manufacturing processes as

effective and efficient as possible, in which DSV has performed well. (DSV 2013e.)

Yet another aspect of DSV's strategy has been the company's dedication to Corporate Social Responsibility (CSR), especially in CSR issue areas such as human rights, labor standards, environment and anti-corruption. As a result of these factors, DSV has embraced universal principles of the United Nations Global Compact since the year 2009. As a result of DSV's role as a major global logistics player, while the company operates in countries of many different culture areas with different religions and political views, it has been seen inside the company that a common set of rules, standards and principles is highly recommendable. (DSV 2013hi).

Sub-chapter 3.2 takes a deeper look at Road Division and its importance to the whole organization. Since the main focus of the thesis is built upon groupage networks and road freight, deeper undergoing through Air & Sea and Solutions divisions is seen as redundant.

3.2 DSV Road

Even though affected by the economic crisis, DSV Road Division has maintained its position among Europe's top three transport agencies. Road Division has a complete road network over the Europe, approximately 10,000 employees and more than 200 terminals all across the continent. The Road Division offers three different types of transports to its customers; domestic and international groupage shipments, Less-Than-Truckload (LTL) shipments and Full Load (FTL) shipments all over The Europe. (DSV 2013e.)

Since the whole revenue of the division is produced in Europe, there is a strong correlation how the European economy is performing. During the year 2012 the Europe experienced market decline of the Southern Europe and a stagnation of the Northern and the Eastern Europe, influenced by the lost momentum of such key markets as Germany and Sweden. Operating in such a declining market with tough competition, Road Division still managed to reach positive development during the year 2012, as the division revenue EUR 3039 million from the year

2011 developed to EUR 3040 million in the year 2012, leaving the organic growth at the level of 0.6%. (DSV 2013e.) Figure 14 represents the Road Division's revenue distribution among the European sub-regions according to DSV's sub-region definition.

Revenue distribution

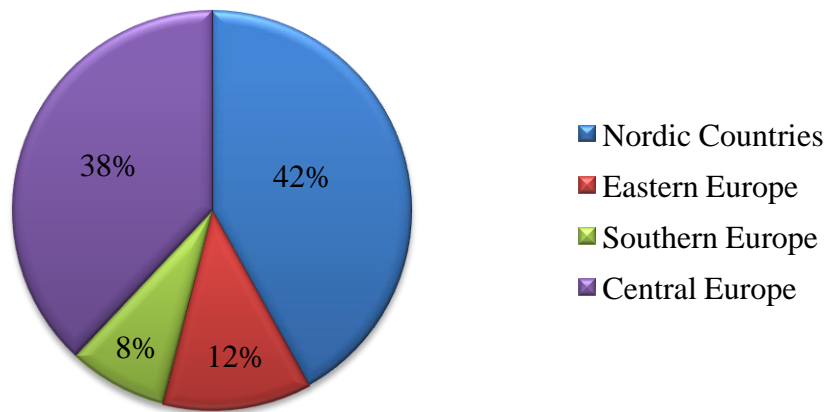


FIGURE 14. Division revenue broken down by geographical areas (Naumanen 2013).

Figure 14 indicates that a large portion, approximately 42%, of the Road Division's revenue is generated from the Nordic countries; Denmark, Finland, Norway and Sweden. Correspondingly Eastern Europe has only a share of 12% and Southern Europe a share of 8% of the revenue leaving the Central Europe with a share of 38%.

3.2.1 Strategy and financial targets of the Road Division

Operating in such a declining market with fierce competition, the Road Division still managed to reach positive development during the year 2012. Furthermore the Road Division stayed on the path of growth by acquiring AWT Cechofracht to strengthen its position in the Czech market (Cargo 2012, 8). Table 3 compares the

Road Division's growth to the growth of the total European road freight market. Table 3 indicates that the number of consignments of Road Division in the year 2012 increased by 1 % from the previous year, when in the meantime the market experienced a decrease of 1-3 % in the number of consignments.

TABLE 3. Growth in freight volumes (DSV 2013e).

	Q4 2012 DSV	Q4 2012 Market	2012 DSV	2012 Market
Consignments	1%	-2-3%	1%	-1-3%

Market growth rates are based on own estimates.

The Road Division's future goal is to strengthen its position in the European road freight market, especially in groupage shipments. This was proven in the year 2012 when DSV internally launched a new product for groupage shipments, DSV Daily Pallet, which is expected to start output results during the year 2103 when the external launch of the product will take place. The product itself, Daily Pallet, will be introduced in chapter 4. The Road Division has set long-term financial targets to strengthen its performance by aiming at 5% EBITA level from present 4.1% and to 25% ROIC level from present 24.8% (DSV 2013e), even though the road transport market is expected only to increase slightly as previously discussed in sub-chapter 2.3 and shown in table 4.

3.2.2 International groupage network

As previously mentioned in introduction, DSV has established an international groupage network that reaches throughout the Europe. The groupage network is DSV's answer to the changing market conditions caused by more Just-in-Time oriented manufacturing within the Single European Market, as discussed in sub-chapters 2.2.4 and 2.4. Furthermore, as also mentioned in introduction and shown in figure 1, the current network structure consists of a single hub in

Schwieberdingen. Each DSV country sends their groupage cargo to Schwieberdingen where it will be cross-docked and shipped towards the destination country.

Figure 15 demonstrates typical phases of groupage shipments that are shipped using DSV's groupage network. First the goods are collected from the customers and delivered to national terminal, there goods heading towards Schwieberdingen are cross-docked to same trailer and shipped to Schwieberdingen. In Schwieberdingen the cargo is unloaded and grouped again according to the final destination of the goods and shipped to the final destination country. The truck that deliver the goods from the national terminal to Schwieberdingen, receives a new load from Schwieberdingen which it hauls back to its native national terminal.



FIGURE 15. Phases of groupage shipments shipped thru DSV's groupage network from collection points to their final destinations (DSV 2013b).

In chapter 4, DSV's commercial product Daily Pallet will be introduced. Daily Pallet operates within DSV's international groupage network, but the network itself can be used for additional purposes as shipping different types of goods, since Daily Pallet is designed for palletized groupage shipments only, for goods that can be loaded and shipped on pallets.

4 DSV DAILY PALLET AGAINST THE MARKET CONDITIONS AND THE HUB-AND-SPOKE DESIGN

The following chapter consists of the second theory part as well as the empirical part of the thesis. The chapter will define DSV Daily Pallet, DSV's solution to the increasing demand of transport of groupage shipments inside the Europe, and compare it to the market conditions previously discussed in chapter 2.

Furthermore, the product will be compared to the theory of the Hub-and-Spoke design and Daily Pallet's performance will be examined.

4.1 DSV Daily Pallet definition

As previously discussed in chapter 2, the market conditions of the European Single Market are transforming towards more groupage oriented. As an answer to the phenomenon, DSV has launched a commercial groupage product DSV Daily Pallet. Daily Pallet is operated within the company's European wide groupage network and the product itself is based on the Hub-and-Spoke principle. DSV defines Daily Pallet:

DSV Daily Pallet is a standardised and competitively priced product delivering high predictability, daily frequency, short door-to-door transportation times and on-time delivery of palletised loads up to 3,500 kg all over Europe – all offered through a simple and time-saving booking portal (DSV 2013b).

The company has clearly realized the meaning of the transforming market conditions discussed in chapter 2, as the product itself is designed for the following purposes (DSV 2013b):

- To meet current and potential customer requirements
- To grow in the European groupage market
- To provide same frequency between all European countries
- To strengthen the connections to smaller DSV countries
- To capture revenue which have not yet been obtained
- To offer a competitive and standardized product

4.2 Daily Pallet against the market conditions

As previously discussed in sub-chapter 2.2, the European road freight market is characterized by a high threat of new entrants and tough competition.

Furthermore the European GDP growth and the road freight output are estimated only to increase slightly during the year 2013. To face the problem, DSV has made an effort to stand out positively and to differentiate from its main competitors, by offering new features and possibilities through Daily Pallet to strengthen the company's market position especially in the groupage market. Table 4 illustrates the key features of Daily Pallet and points out its value addition to the customers.

TABLE 4. DSV Daily Pallet key messages and customer value (DSV 2013a).

Coverage all over Europe	Easy Online Booking	Daily Pick-Up and Departure	On-Time Delivery
32 European countries	One-stop shopping	Daily pick-up and departure to any destination	Fixed time schedule
From anywhere to anywhere	Competitive rates	Simple and flexible planning	Track & Trace and IOD
More than 200 offices and locations	Total transport cost reduction	Internal cost savings	Keeping your business up to speed
DSV European Road Network	Pick-up and delivery day available upon booking	Shorter transportation time	Pre-alert (upcoming 2013)
Because reach and flexibility count	Because quality service cuts administration to the bone	Because reliability and predictability count	Because service quality counts

As seen in table 4, with the European wide coverage, Daily Pallet aims to provide reachability and flexibility to the customers, by eventually linking all of the European countries to the Daily Pallet network. Also to allow customers save in administration costs, Daily Pallet is offered in competitive price with the possibility to see pick-up date and delivery date upon booking the shipment online. Appreciation from the customers is guaranteed with a daily pick-up and

departure as it simplifies planning and provides reliability and predictability. Furthermore, to truly stand out from its main competitors with similar products, Daily Pallet does not only offer a fixed time schedule, but also an unique feature *pre-alert* (DSV 2013a). As its name states, pre-alert will be used to automatically alert the customers if for some reason the shipment will be delayed, a feature that none of the biggest road freight forwarders offer with their similar products so far (Naumanen 2013).

The final Daily Pallet product is established in waves, and still it is not finished yet. Figure 16 demonstrates those three launch waves and what they consist of.

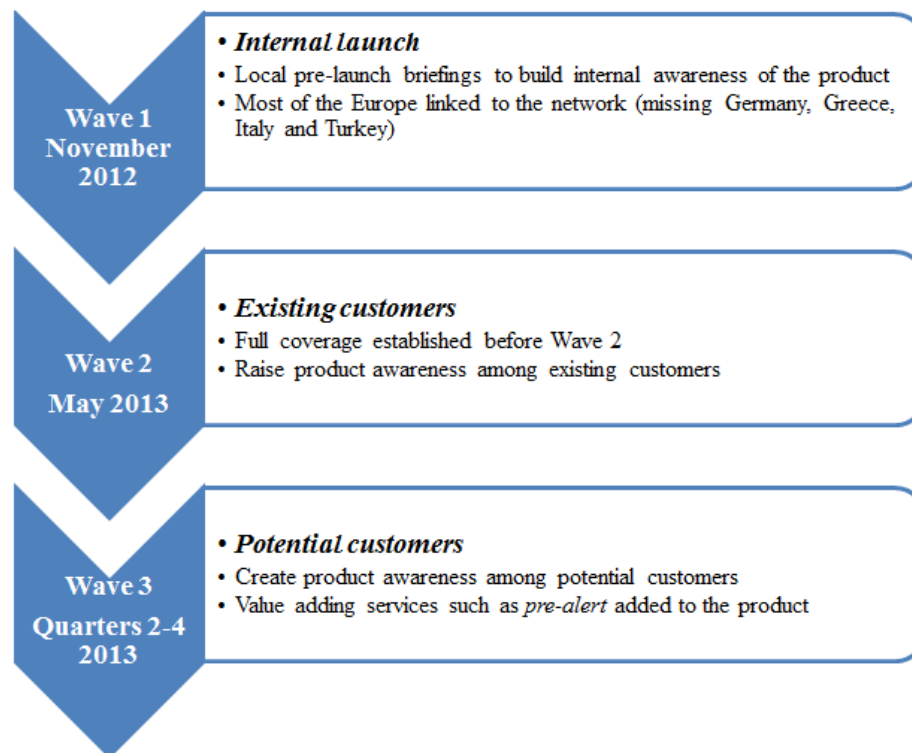


FIGURE 16. Daily Pallet establishment waves.

As figure 16 illustrates, Wave 1 took place in November 2012 and served as an internal launch for the product itself. Internal awareness of the product was built in pre-launch briefings to ensure quality of the product. Also most of the European countries were linked to the network; only Germany, Greece, Italy and

Turkey were still missing. Wave 2 in May 2013 will serve as an external launch and furthermore the missing 4 European countries will be linked to the network before Wave 2 takes place. Product awareness and understanding the product benefits will be increased among the existing customers. Also additional features such as fixed time schedule, do-it-yourself labeling, online booking and insurance possibilities will be added to the product. In addition, Russia will also be linked to the network. Wave 3 will take place during quarters 2-4 of the year 2013. As the main goal of creating Daily Pallet is to capture new market revenue and new customers (DSV 2013b), during Wave 3 the product awareness among potential customers will be raised in order to reach the target. Also earlier mentioned pre-alert and possible additional value adding services will be added to the product.

As previously discussed in sub-chapter 2.2.4, the JIT production and trucks running with a little cargo, are typical phenomena within Europe. By cross-docking the goods in Schwieberdingen, appearing of the scenario of trucks running empty is limited to minimum. The shipments heading to the same final destination are all gathered from around the Europe to Schwieberdingen and grouped together into a same trailer. Afterwards the same trucks that delivered the goods in question to Schwieberdingen are loaded with backload to the origin destinations of the trucks, again gathered around the Europe, so that the trucks return home with full cargo. Furthermore, pointing out to the discussion in sub-chapters 2.2.1 and 2.2.4, as the amount of demand for different types of transportation and the amount demand for transportation overall changes, it is likely to cause situations in which from one country to another there are often not enough shipments to fill in the trailer when delivered directly without cross-docking. With cross-docking this problem is avoided, since the trailer heading to Schwieberdingen also carries shipments to multiple destinations until it is unloaded and cross-docked in Schwieberdingen.

4.3 Hub-and-Spoke configuration

As an answer to the customers' requests discussed in chapter 2, the top European freight forwarders have established groupage networks, based on the Hub-and-Spoke design, to serve the needs of the customers. Miller and O'Kelly, the early

pioneers in the field of study of the Hub-and Spoke design, define the Hub-and-Spoke design:

Hub-and-Spoke configurations reduce and simplify network construction costs, centralize commodity handling and sorting, and allow carriers to take advantage of scale of economies through consolidation of flows (Miller & O'Kelly 1994, 31).

Furthermore, according to Miller and O'Kelly (1994, 31), when the network is being designed or assessed, there are three essential design questions that need to be considered and answered:

- Are the nodes in the network assigned exclusively to a single hub?
- Are direct node-to-node linkages permitted to bypass the hub facilities?
- Are the hub facilities fully interconnected?

Capability to answer the general questions of the hub network design problem require undergoing thru (1) search for the optimal locations of the hub facilities, (2) forming a linkage between dispatch depots and destination depots to the hub, (3) forming a linkage between different hubs and (4) forming the flow routes thru the network (Miller & O'Kelly 1994, 32).

4.3.1 Facility Locating Problem (FLP)

Facility Locating Problem is a type of a scenario in which there is a search for a location of a hub which would best serve its customers, or so called nodes. In groupage networks the nodes are national terminals shown in figure 15. The hub location can be evaluated by costs savings, time savings or both. The hub itself can be understood as a central warehouse, facility or depot located in the demand center of a certain areas (Miller & O'Kelly 1994, according to Minas & Mitten 1954; Goldman 1969; Campbell 1991).

The hub network, as shown in figure 17, is designed for the *many-to-many* distribution problem, in which products from multiple primary sources are delivered to multiple customers (Miller & O'Kelly 1994, 31). Figure 17 expresses a hub network which consists of 4 primary nodes, 4 hubs and 4 customer nodes.

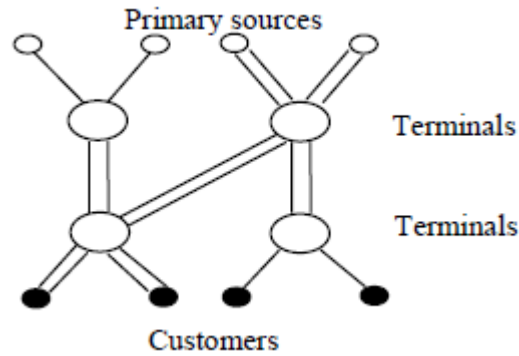


FIGURE 17. Many-to-many distribution design (Kohani 2006, 136).

The idea behind the hub network, or many-to-many distribution system, is to concentrate the flow of goods from producers to customers in terminals, to create a bigger flow between those terminals. The concentration is done in order to replace multiple direct connection pairs between producers and customers by fewer indirect connections. (Kohani 2006, 135.) Although, with several facility and warehouse location models, research for the hub location is a field of study which has received a limited amount of attention (Campbell, 1994, 388).

DSV's solution to the FLP was to place their Euro-hub in Schwieberdingen, Southern Germany, and so far the company's hub network design consists of a single hub. Locating the single hub in Schwieberdingen seems reasonable for several reasons, when observing it from the company's point of view. Firstly, as discussed in sub chapter 2.2.1, the manufacturing of products has its role in creating demand for transportation. With respect to the fact it is clear that Germany is the transportation center of the Europe as it is the biggest economy (Econtrader 2013) and exporter of the continent (WTO 2011). Furthermore the third busiest port of the Europe locates in Germany, Hamburg (Europeish 2013).

Furthermore, as Schwieberdingen is located in Central Europe, measured by length, the line hauls to the depots, or nodes, across Europe are kept reasonable even to the fringe countries and locations of the continent. Additionally, as the hub was located in Schwieberdingen, the line haul network could be based upon

DSV's extensive road freight network which is seen competitive compared to DSV's main competitors in the European groupage market. (DSV 2013b.)

Since there is only one hub in DSV's network, all the existing nodes of the network are connected and signed exclusively to it. Furthermore, as mentioned earlier in sub-chapters 3.2.2 and 4.1, Daily Pallet is so far tailored for palletized products only. In other words, the goods must be loaded on to pallets to be accepted as a Daily Pallet product. There are several possibilities for different dimension for different types of pallets accepted in Daily Pallet product, but the goods must be loaded so that a single pallet will not exceed the size of an industrial pallet with dimensions of 120 x 120 x 230 cm and cannot weight over 1 050 kg. (DSV 2013b.) If the product is not loaded accordingly, it is not an acceptable shipment for Daily Pallet.

As a result of the fact that all goods manufactured cannot be loaded on to pallets (Naumanen 2013), direct node-to-node linkages in DSV's groupage network are allowed to bypass the hub facilities even if the goods would by their dimensions match the definition of a groupage. Now the goods are only shipped and sold outside Daily Pallet just as normal groupage and are not cross-docked in Schwieberdingen. In other words, DSV's groupage network can be used for non-palletized products also, but the commercial product Daily Pallet, is only for palletized products. Furthermore, if it is a Daily Pallet shipment in question, the bypassing of the hub is not allowed per se, since all Daily Pallet shipments are cross-docked in Schwieberdingen. To clarify, Daily Pallet products are transported using DSV's international groupage network, but the actual network is used for additional purposes and all groupage shipments booked by customers are not Daily Pallet products and are often transported directly from dispatch country to destination country without cross-docking in Schwieberdingen. In some rare occasions even Daily Pallet shipments are forced to be transported directly using node-to-node links. (Naumanen 2103.)

4.3.2 Vehicle Routing Problem (VRP)

The Traveling Salesman Problem (TSP), on which the Vehicle Routing Problem (VRP) is based, is a classical problem studied for over 50 years. Shortly, in TSP

with a known origin point, a salesman is given several locations he must visit before returning to the origin destination. The idea is to find the cheapest or shortest way to visit all of the locations before returning to the origin point. (TSP 2013.) When designing international groupage networks, the problem is quite similar. In addition, there exists challenging factors of multiple origin points and the fact that the demand of shipments being transported is likely to vary.

When designing international groupage networks, the freight forwarders are trying to find a solution to the problem caused by VRP, how to establish optimal spokes (routes) between origin nodes, destination nodes and hubs. While defining the spokes, the designers must consider the facts that the demand for cargo being transported may vary, each destination should be visited only once and that the optimal solution chosen minimizes the costs measured in monetary costs, time and distance. (Skipper 2002.)

As illustrated in table 5, Miller and O’Kelly (1994) have established eight (8) design protocols for different possible solutions for the Hub-and-Spoke design.

TABLE 5. Hub network design protocols (Miller & O’Kelly 1994, 38).

Design Class	Design Variables	Empirical Examples	Diagram	
Protocol A	Hub Location Node-Single Hub Assignment	Interplant communications		
Protocol B	Hub Location Node-Single Hub Assignment Hub-Hub Links	Satellite Communications		
Protocol C	Hub Location Node-Single Hub Assignment Node-Node Links	Financial Networks		
Protocol D	Hub Location Node-Single Hub Assignment Node-Node Links	Financial Networks		
Protocol E	Hub Location Node-Multiple Hub Assignments	Air Passenger Networks		
Protocol F	Hub Location Node-Multiple Hub Assignments Hub-Hub Links	Ground Delivery Service		
Protocol G	Hub Location Node-Multiple Hub Assignment Node-Node Links	Air Passenger Networks		
Protocol H	Hub Location Node-Multiple Hub Assignment Hub-Hub Links Node-Node Links	Air Passenger Networks		

In table 5, Protocol A consists of a single link between each node and a hub, all the hubs are fully interconnected and there are non-intermodal node-to-node links. Protocol B consists of similar components but all the hubs are not fully interconnected. Protocol C has similar features to Protocol A, but there also exists direct node-to-node links. Again Protocol D is similar to Protocol B with direct node-to-node links. In Protocol E the hubs are again fully interconnected and none intermodal node-to-node links exist, but there are multiple links from one node to several hubs. In Protocol F the situation is similar to Protocol E, but all of the hubs are not fully interconnected. In Protocol G all the hubs are fully interconnected, there are multiple links between a single node to several hubs as well as direct node-to-node links exist. Protocol H is similar to G except all of the hubs are again not fully interconnected.

As mentioned in sub-chapter 4.3, there are four (4) steps the designers must undergo when choosing the correct model. When designing the hub network it is notable that each network scenario is a unique one and none of the protocols fit every scenario. Finding a correct amount of hubs with right locations and carefully estimating would the design become too complex, if there were direct linkages between the nodes, are basic examples of the questions the designers must face. Furthermore, the network can also be designed to borrow features from different protocols when there is a change in operating surroundings. (Miller & O'Kelly 1994, 31-39.)

Sub-chapter 4.3.1 pointed out previously the fact that DSV's network model, which Daily Pallet uses, consists of a single hub with a link between every node and the hub and per se without intermodal links between different nodes. Such a protocol does not exist in the theory created by Miller and O'Kelly (1994, 31-39) since all of the protocols consist of multiple hubs, but it is closest to the protocols A and B. The current network structure of DSV's international groupage network, even if the hub in Schwieberdingen is by its location would excellent for several reasons as pointed out in sub-chapter 4.3.1, is not flawless, since the structure does not serve all of the nodes, in this case depots in different countries, equally. (Naumanen 2012.) Next sub-chapter 4.4 will go over Daily Pallet's performance and point out the network imbalances.

4.4 Daily Pallet performance

As previously mentioned in sub-chapter 4.3.2, DSV's current groupage network structure has imbalances. According to Naumanen (2013), sending shipments through the hub, using Finland as an example, is beneficial roughly to half of the Daily Pallet countries such as France, Spain, Portugal, Switzerland, Austria, Italy, Czech Republic, Slovakia and additional South-Eastern countries of the Europe. For the rest of the Europe the hub is not considered beneficial from Finland's point of view. As two of the main value additions of Daily Pallet, discussed in sub-chapter 4.2, to the customers as well as to DSV were cost savings and fast delivery, directing traffic flows from Finland on the way to UK or Norway through Schwieberdingen in South-Germany would cause an opposite result due to considerably lengthened distances. (Naumanen 2103.)

Latest Daily Pallet shipment flow statistics (see appendix 1 and 2) shown in figure 18, from December 2012 illustrate that the top 8 countries out of 23 that were linked to the hub (Spain, UK, France, Poland, Hungary, Sweden, Czech Republic and Austria) during that time contributed 75% of the total number of shipments exported to the hub and 69% of the imported shipments from the hub.

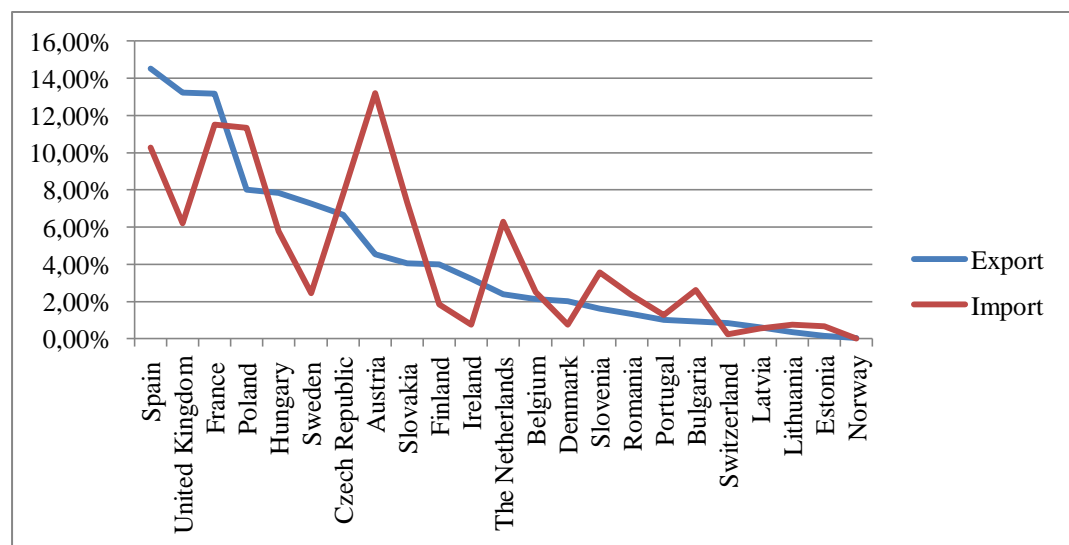


FIGURE 18. Percentage of Daily Pallet shipments exported to Schwieberdingen and imported from Schwieberdingen by each DSV country in December 2012 (DSV 2013j).

Still, there are more reasons for the scenario, not just the location of the hub. The type of goods produced and packaging methods of the country in question, as mentioned in sub-chapter 4.3.1, are also factors affecting to the number of shipments shipped through Daily Pallet. (Naumanen 2013.)

As an example, figure 19 illustrates with light green color the countries beneficial for DSV UK to send shipments through Schwieberdingen, countries with blue color are seen as non-beneficial due to a considerably lengthened distances.



FIGURE 19. Possible advantages for DSV UK to cross-dock in Schwieberdingen (DSV 2013b).

Despite the fact that the hub does not serve all nodes equally, Daily Pallet as a product is sold to every DSV European country. As mentioned in sub-chapter 4.3.1, per se Daily Pallet shipments are cross-docked in Schwieberdingen, but in some rare occasions DSV representatives from different countries use bilateral

agreements to organize the promised Daily Pallet product and bypass the hub in Schwieberdingen to optimize the cost structure and furthermore maintain the promised schedule. (Naumanen 2013.)

In table 6, statistics from DSV's database were used to calculate each Daily Pallet country's total activity contribution to the hub in Schwieberdingen. Since the hub is located in Central Europe, large economies located close to the hub such as: Spain, France, United Kingdom and Poland seem to be the ones having the best opportunities benefitting from the hub according to the statistics.

TABLE 6. Percentage of Daily Pallet shipments send to and from Schwieberdingen in December 2012 by each Daily Pallet country (DSV 2013j).

Country	Export to hub	Import from hub	Total Activity
Spain	14,52 %	10,28 %	12,40 %
France	13,18 %	11,51 %	12,35 %
United Kingdom	13,22 %	6,21 %	9,72 %
Poland	8,01 %	11,35 %	9,68 %
Austria	4,53 %	13,21 %	8,87 %
Czech Republic	6,67 %	7,79 %	7,23 %
Hungary	7,84 %	5,77 %	6,81 %
Slovakia	4,04 %	7,32 %	5,68 %
Sweden	7,28 %	2,45 %	4,87 %
The Netherlands	2,39 %	6,29 %	4,34 %
Finland	4,00 %	1,86 %	2,93 %
Slovenia	1,62 %	3,56 %	2,59 %
Belgium	2,14 %	2,49 %	2,32 %
Ireland	3,23 %	0,75 %	1,99 %
Romania	1,33 %	2,33 %	1,83 %
Bulgaria	0,93 %	2,61 %	1,77 %
Denmark	2,02 %	0,75 %	1,39 %
Portugal	1,01 %	1,27 %	1,14 %
Latvia	0,61 %	0,55 %	0,58 %
Lithuania	0,36 %	0,75 %	0,56 %
Switzerland	0,85 %	0,24 %	0,55 %
Estonia	0,16 %	0,67 %	0,42 %
Norway	0,04 %	0,00 %	0,02 %
Total	100,00 %	100,00 %	100,00 %

In figure 20, the total hub activity percentage of Daily Pallet countries is divided between the European sub-regions defined by the United Nations (2013). According to the definition countries linked to Daily Pallet network can be divided into following sub-regions:

- **Northern Europe:** Denmark, Finland, Ireland, Norway, Sweden and United Kingdom
- **Eastern Europe:** Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia
- **Southern Europe:** Portugal, Slovenia and Spain
- **Western Europe:** Austria, Belgium, France, Switzerland and the Netherlands

Total hub activity between UN sub-regions

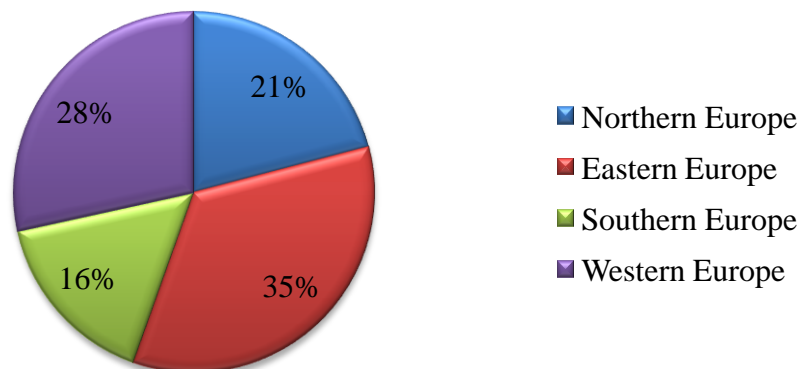


FIGURE 20. Total Daily Pallet hub activity between the European sub-regions defined by the United Nations (DSV 2013j).

In figure 21, the total hub activity contribution percentages of Daily Pallet countries are divided using the same European sub-regions as were used in figure 14 in sub-chapter 3.2 to illustrate the Road Division's revenue distribution.

Total hub activity using DSV's sub-region definition

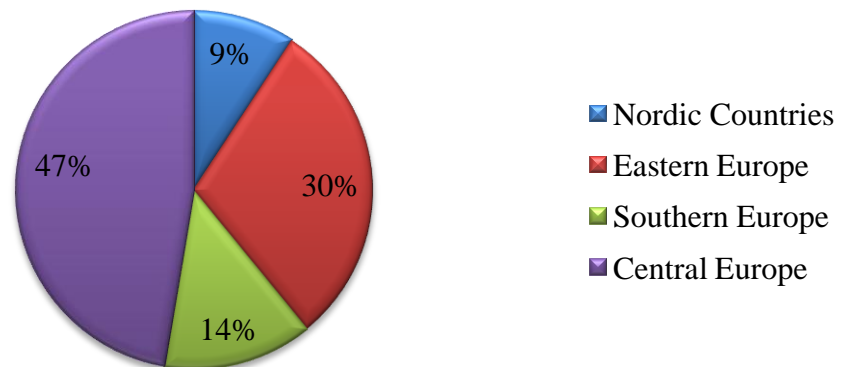


FIGURE 21. The total Daily Pallet hub activity divided between the European sub-regions using DSV's sub-region definition (DSV 2013j).

Although, as seen in figure 20, the Northern Europe contributes 21% of the total hub activity, the contribution of Daily Pallet Nordic countries (Mapes 2013); Denmark, Finland, Norway and Sweden is only at the level of 9%, as illustrated in figure 21, leaving the share of United Kingdom and Ireland to 12%. As previously discussed in sub-chapter 3.2 and shown in figure 14, the Nordic countries contribute 42% of Road Division's revenue, number that is significantly larger than the total hub activity contribution of the corresponding countries, the fact which indicates a severe imbalance between the two factors.

4.5 The future of Daily Pallet

The long-term goal of Daily Pallet for DSV is to cut down the operating costs of the network by 20% while creating new possibilities by expanding the network and increasing efficiency, both by 20% (DSV 2013b). Additionally, Daily Pallet is designed to be a long-term sort of a premium product and increasingly capture market revenue, as the product offers such a competitive schedule, prices and features that have not yet been seen in the European groupage market (Naumanen 2013).

As pointed out through the Vehicle Routing Problem in sub-chapter 4.3.2, DSV's international groupage network structure is not flawless and causes imbalances between the nodes, in this case dispatch depots or national terminals of different DSV countries, which is also shown through statistics in sub-chapter 4.4. In order to reach the above mentioned targets, the network structure needs to be enhanced and extended to reach the next performance and productivity level. Furthermore, to balance the trade flows between different countries and increase the total trade flows of Daily Pallet thru the network, at least one additional hub is essential, or Daily Pallet product could be sold using direct line hauls, leaving it to the dispatch country's responsibility to ensure promised transit times. (DSV 2013b.)

According to DSV's strategy, the next step in developing the company's international groupage network structure is to add an additional hub to the network (Naumanen 2013). As the location still remains under debate, in chapter 5 the author will use the findings from the study to propose a location for the additional hub and give a suggestion for the new network structure.

5 CONCLUSIONS AND EVALUATION

In this chapter the author will answer the sub-question and the primary research question of the thesis, by comparing the theories from chapters 2 and 4 to Daily Pallet and to the shipment flow calculations based on statistics gathered from DSV's database. Furthermore reliability and validity of the thesis will be evaluated and suggestions for future research will be made.

5.1 Conclusions

As the study in chapter 2 indicates, the European manufacturing is changing towards JIT production, while the producers are also aiming to decrease the warehouse shelf life of their products. To stay efficient, a variety of producers in the European Economic Area (EEA) have re-engineered their business processes towards flexible manufacturing systems. In order to do so, the producers are now increasingly requesting frequent deliveries of small-sized shipments, as well as accessorial services from the European freight forwarders. Freight forwarders up to the task, have now established European wide groupage networks to match their customers' requests.

As a result of its flexibility, easy accessibility and cost efficiency, in the author's opinion, it is expected that the road haulage will still remain as the main transport mode in the European logistics industry, while the other transport modes lack such factors as time and space. Also as the European GDP growth is expected to increase slightly and pull along the European logistics industry, it is advisable for the freight forwarders to constantly remain awake and stay ready and willing to respond to the changing market conditions, caused by the change in the European manufacturing, by offering new products and services which match the characteristics of the new market conditions.

One of the top European freight forwarders, which have, in the author's opinion, taken a step towards the right direction by launching a commercial groupage product, Daily Pallet, to match these above mentioned market conditions, is the case company of the thesis, DSV. As the product itself is still under construction and Daily Pallet network is still not connected to all European countries, it is clear

that DSV is in a hurry to catch up with its main competitors, who already have established similar networks with total European coverage, by connecting the remaining countries to the network and by further developing the network structure in order to smoothen the network imbalances pointed out in sub-chapter 4.4.

As the next step of DSV's strategy in developing the company's groupage network structure is to add an additional hub to the network, finding an impeccable location for the hub and a correct network structure is essential in order to reach the next performance and productivity level. As pointed out in sub-chapter 4.4, it seems that the countries suffering the most diseconomies from the imbalanced network structure are the Nordic countries, when they contribute only 9% of Daily Pallet activity when in the meanwhile they contribute 42% of the company's revenue. This is so, even after it seems that the network would be balanced when looking at the figure 20, since according to UN's sub-region definition all of the four sub-regions have a share of 16-35% of the total hub activity.

In the author's opinion, one additional hub is not enough to solve all of the network structure imbalances. The author suggests that in order to gain maximum benefits, the additional hub and the new network structure aims to solve the problem of the Nordic countries as they contribute such a large portion of the revenue. As a result, the Nordic countries also maintain the most potential of gaining more activity for Daily Pallet and so increase product awareness among existing and potential customers.

The main problem for the Nordic countries of the current hub located in Schwieberdingen is its long distance. It is clear that it makes no sense to ship goods from Finland or Sweden, as an example, to North-Germany or UK, not to mention Eastern Europe, thru Schwieberdingen in South-Germany. To reach its target, it would be advisable that the additional hub is located near all of the Nordic countries. Also if the additional hub would be located close to the current hub, or within reasonable distance, and there would be an interconnection between the hubs, the additional hub could in some cases make redundant the use of the current hub. This would lead to savings in running time and costs, as some Daily

Pallet countries could still be linked to only one hub even after the additional hub is merged to the network, since there would possibly be no need to travel to the further hub any longer.

As previously mentioned, one additional hub is most likely not enough to solve all of the network imbalances caused by the long distance of the hub. In order to reach the current maximum capacity in Daily Pallet activity, the author further suggests that those countries still suffering from imbalances, could use direct deliveries to those countries that are located in such locations that shipping thru the hubs would be unbeneficial. To sum up and furthermore to answer to the three network design questions of Miller and O’Kelly pointed out in sub-chapter 4.3, the author suggests that the additional hub location and the new network structure should consist of the following factors:

- The additional hub is be located near to the Nordic countries
- The additional hub is located within a close distance to the current hub
- There should be an interconnection between the two hubs
- Direct deliveries between the network nodes should be allowed
- Multiple connections between a single node and hubs should exist

According to these criteria the new network structure is closest to the protocol G shown in table 5 and explained in sub-chapter 4.3.2. Figure 22 represents the suggested network structure, Protocol G, according to the theory of Hub-and-Spoke configuration from chapter 4.

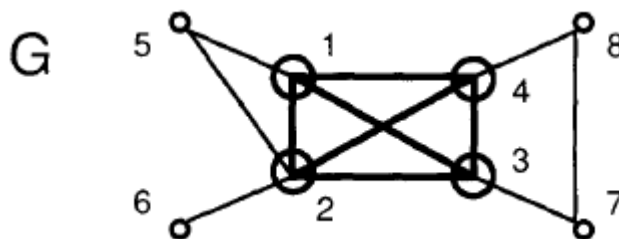


FIGURE 22. The suggested network structure, Protocol G, according to the theory of Hub-and-Spoke configuration by Miller and O’Kelly (1994).

As previously explained in sub-chapter 4.3.2 and seen in figure 22, the Protocol G consists of multiple fully interconnected hubs, possible direct linkages between different nodes and possibilities for multiple connections between a single node and multiple hubs. Criteria that fully support the above mentioned factors proposed by the author.

To ensure a smooth and high quality performance between the two interconnected hubs, the author sees that the additional hub should be located in such a place that the hubs are capable of bilateral communication without exploiting any other transport means than the road haulage. Placing the hub in a location that would separate the two hubs with water, would make the interconnection linkage and the bilateral communication considerably harder and would most likely to cause an increase in the lead and cycle times of the shipments in transit. Therefore the author sees that a good location according to the mentioned criteria would be located in North-Germany, also pointing out to the previous discussion in sub-chapter 4.3.1 of Germany's position as the European economic driver and the transportation center. The author sees that a prime location for the additional hub according to all of the mentioned criteria would be the city of Hamburg in Northern Germany, also not least because of Hamburg's reachability as a result of having the third largest port in Europe as mentioned in sub-chapter 4.3.1. To point out, the additional hub is chosen to be located in Hamburg for the following purposes:

- Hamburg is located in North-Germany, close to the Nordic countries
- Distance to the hub in Schwieberdingen is reasonable
- Possibilities for independent bilateral communication thru road haulage and clear interconnection between the two hubs

Furthermore the proposed network structure according to Protocol G is chosen for the following purposes:

- One additional hub is most likely insufficient solution to all of the network imbalances
- To allow widest possible coverage without any unbeneficial routes the nodes must be allowed to communicate bilaterally by bypassing the hubs

As an example, figure 23 compares DSV UK's network coverage after a deployment of the new proposed network structure and the additional hub in Hamburg to the coverage in figure 19 on page 40 in sub-chapter 4.4. Furthermore it uses Finland as an example to demonstrate that by locating the additional hub in Hamburg, the current hub in Schwieberdingen would now be useless as the traffic flow on the way to Southern Europe could also be hauled from Hamburg to Schwieberdingen as it would not considerably lengthen the transit distances and furthermore would not cause any extra costs. The countries marked with green are seen as beneficial for DSV UK to send shipments thru the new proposed network. Compared to figure 19 the network coverage of DSV UK would be considerably wider, also a result of using direct line hauls and bypassing the hubs with traffic on its way to Southern Europe.



FIGURE 23. DSV UK's network coverage after the new network structure.

Therefore, in order for DSV to approach the mentioned targets in sub-chapter 4.5 the company has set for Daily Pallet, the author proposes:

- The additional hub for Daily Pallet should locate in Hamburg
- The two hubs are fully interconnected
- Direct line hauls between DSV countries are allowed in Daily Pallet
- Multiple or single connections between a node and the hubs are allowed

5.2 Reliability and validity

A natural part of the quantitative study is to consider reliability and validity of the study. The purpose of considering reliability of the study is to define whether or not the result of the study would be the same if repeated. To fulfill the requirements of testability, other researchers must be able to perform a similar study under same conditions and end up with the same results. Validity defines if the research has studied what it was intended to study and whether or not it meets the requirements of a scientific research. (Shuttleworth 2008.)

It is in author's belief that a study conducted under the same conditions would lead to the same result. However, the issue lies in the fact that as all of DSV countries are yet not linked to Daily Pallet network, the study is still on quite theoretical base, as the statistics in which the study is based on, are most likely to take an another form after such large economies as Germany, Italy, Turkey as well as Greece are linked to the network. As a result, the author has made suggestions for future research. The gathered data itself is truly reliable for present situation, as it is collected directly from DSV's database.

When considering validity, the author has researched the intended topics as well as stayed on the path guided by the scope of the thesis. The European road freight transport market was studied in order to establish general understanding of the industry, which was essential for the study. Furthermore the Hub-and-Spoke configuration was studied and the author answered the research questions by comparing Daily Pallet to the defined market conditions and the Hub-and-Spoke configuration and by using a quantitative research method when defining the performance of Daily Pallet.

5.3 Suggestions for future research

For the present situation the author proposes future research to study the direct line hauls between the nodes. It would be advisable to determine which node-to-node linkages require direct spokes in order to keep the shrinkage factor of unbeneficial routes as low as possible.

Furthermore, the author limited the research to determine location for one additional hub only, as it was according to the company's strategy to add one additional hub. Although, as mentioned, one additional hub is not enough to fix all of the network imbalances, the author proposes future research to define a location for the third hub of the network after the missing countries are linked to the network and the statistics are again more reliable. Furthermore, as the network is added an additional third hub, the structure is to be re-evaluated and re-designed, which is a topic for another advisable future research.

6 SUMMARY

The European road freight transport market is transforming. As a result of the current global economic crisis as well as the change in European manufacturing towards more Just-in-Time oriented production methods, large European freight forwarding corporations are forced to seek solutions for the increasing demand of more frequent small-sized deliveries. One solution, in which all of the main market players have reached for, has seemed to be establishing European wide groupage networks based on the Hub-and-Spoke principle, in which multiple direct connections are replaced by fewer indirect connections between the shipper and the receiver, and furthermore the shipment flows are concentrated to central depots or hubs. A Danish freight forwarder DSV, company among the top three European road freight forwarders, is one of them.

DSV's network is still under construction as the external launch for the company's commercial groupage product for palletized shipments Daily Pallet will take place in May 2013. Furthermore the network is imbalanced as it so far consists of a single hub in South-Germany, Schwieberdingen, since a single hub is not sufficient enough to serve all of the network countries equally, as a result of long distances between national depots and the hub. To face the problem, next step of DSV's strategy is to improve the current network structure by adding an additional hub to the network in order to reduce the network imbalances. As the location of the additional hub still remains under debate, the author has been determined to find an impeccable location for the hub and furthermore to define a new network structure for DSV's international groupage network. In the study the author uses a combination of quantitative and qualitative research methods to compare Daily Pallet to the current market conditions, to the theory of Hub-and-Spoke design and examines Daily Pallet's current performance to define the network imbalances and finally provides answers to the mentioned problems.

In today's world economy it is relatively difficult, if not impossible, for single economies to stay on the path of economic growth without trading with the neighbor economies. In the meanwhile international trade itself is the main singular factor generating demand for international freight forwarding services, as in most of the cases when goods are sold, they also require transportation.

Today's Europe is an unique trading block with its old traditions and negotiating institutions and furthermore measured in size and performance of the economy the Europe is actually the number one trading block in global comparison. In addition, the importance of the international trade to the European economy is undisputed, as it played the role of 13% of the countries belonging to the EU in the year 2009.

The type of goods manufactured inside the economic area is also the main factor shaping the demand of different types of freight forwarding services, as different goods require different types of transport methods. When the manufacturing changes towards more valuable products, as an example, the demand for valuable goods transports is expected to increase in the near future. As a result of its flexibility, easy accessibility and cost-efficiency, road transport holds a dominant position among the different freight forwarding types. In addition, caused by the mentioned factors, the road transport industry is characterized by though competition and low barriers for market entrance. In order to stay efficient, today's freight forwarders have also established different methods of handling different shipment sizes. If the cargo booked by the customer does not require a full trailer, it is handled as Less-Than-Truckload shipment, or if the shipment is less than 3500 kg it is handled as groupage.

One of the problems the freight forwarders face today, is how to avoid the scenario of trucks running with little cargo or even empty. Main factor causing the problem is the mentioned Just-in-Time production, which is expected to increase in the near future. Within industries characterized by the Just-in-Time production, there typically exists high demand for frequent deliveries of small-sized shipments. The road freight sector is also closely related to the GDP growth and so, caused by the current economic crisis, it has experienced recent setbacks.

One of the road freight market dimensions that are expected to raise its head in the future is the European groupage market. Also largely caused by Just-in-Time production, today 97% of the European manufacturers require groupage shipping and 50% are in the need of steady daily departures. Currently the groupage market holds 20% of the total road freight market and is worth EUR 57.2 billion measured in revenue.

As mentioned, DSV is one of the large corporations competing in the European freight forwarding market. DSV is a Danish company operating almost all over the world, it has offices in over 70 countries and is closing up to 22,000 employees. Currently DSV holds rank number six in global comparison of freight forwarders. The company is divided into three divisions: Road, Air & Sea and Solutions. The international groupage network Daily Pallet operates within is naturally under the Road Division. The Road Division's revenue on the other hand is contributed from the Europe, largely from the Nordic countries and Central Europe.

As Road Division's target is in the near future to grow especially in the groupage market, as a solution, the company has established the mentioned groupage network for palletized shipments, and the commercial product is known by the name DSV Daily Pallet. Daily Pallet uses the hub in Schwieberdingen to cross-dock and re-organize the shipments as each Daily Pallet country is responsible from its own behalf for organizing daily departures from its own national terminal to the hub and vice versa. Furthermore Daily Pallet's aims to add value to DSV's customers by providing daily departures and fast door-to-door on-time deliveries all over the Europe for palletized shipments up to 3500 kg.

Nordic countries currently contribute 42% of the Road Division's revenue, but in comparison contribute only 9% of Daily Pallet activity. The fact causing the scenario is the far distance of the hub, since the result of using the hub for Nordic countries is in most cases unbeneficial due to lengthened shipping distances; opposite from what it is designed for. To gain maximum benefits from the product, to increase the product visibility and furthermore gain new customers, the company must find an optimal network structure in order to reach the targets it has set for Daily Pallet.

To answer the problem the author proposed, according to DSV's strategy, to add an additional hub to the network and re-design the network structure. The author proposes Hamburg in North-Germany for the additional hub location based on its short distance to the Nordic countries as well as to the current hub in Schwieberdingen, in order to arrange interconnection between the two hubs to optimize the route design of the network. Additionally, in the author's opinion, a

single additional hub is not enough to solve all of the network imbalances. As a result, the author proposes that direct linkages, by bypassing the hubs, between different Daily Pallet countries would be allowed in such cases, in which countries still suffer from the imbalanced network structure even after the additional hub. It is in the author's belief that by following the proposed solutions, the benefit from a single additional hub would be maximized, Daily Pallet activity and so the product visibility could be increased and new customers would be reached, which is the ultimate goal of the product itself.

As the network structure is yet not balanced and all of the European countries are yet not linked to the network, the author proposes future research. In order to optimize the network structure, at least one additional hub has still to be added to the network. The author proposes future research to find a location for the third hub and to evaluate and re-design the new network structure after the location for the third hub has been found.

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APPENDICES

APPENDIX 1

Shipments from sending countries into hub in December 2012

December 2012

Total working days: 15

From sending country into HUB					
From	Nr of transports to HUB	Shipments	EXW	DAP	NW Pallet Type
Austria	5,88 %	4,53 %	54 %	46 %	14 %
Belgium	5,88 %	2,14 %	40 %	60 %	70 %
Bulgaria*	2,52 %	0,93 %	39 %	61 %	74 %
Czech Republic	4,62 %	6,67 %	35 %	65 %	57 %
Denmark	2,52 %	2,02 %	4 %	96 %	66 %
Estonia	0,00 %	0,16 %	0 %	100 %	50 %
Finland	3,36 %	4,00 %	10 %	90 %	42 %
France - Lesquin	6,30 %	4,61 %	5 %	95 %	74 %
France - Lyon	3,36 %	3,19 %	29 %	71 %	62 %
France - Paris	3,36 %	5,38 %	18 %	82 %	72 %
Hungary	4,62 %	7,84 %	22 %	78 %	54 %
Ireland	5,88 %	3,23 %	6 %	94 %	55 %
Latvia	0,00 %	0,61 %	6 %	94 %	93 %
Lithuania	0,00 %	0,36 %	11 %	89 %	100 %
Norway	0,00 %	0,04 %	0 %	100 %	100 %
Poland	5,88 %	8,01 %	43 %	57 %	88 %
Portugal	1,26 %	1,01 %	40 %	60 %	48 %
Romania*	4,20 %	1,33 %	42 %	58 %	58 %
Slovakia	4,62 %	4,04 %	25 %	75 %	68 %
Slovenia*	3,78 %	1,62 %	35 %	65 %	65 %
Spain - Barcelona	3,78 %	8,29 %	16 %	84 %	74 %
Spain - Irun	2,94 %	2,79 %	32 %	68 %	72 %
Spain - Madrid	2,10 %	3,44 %	31 %	69 %	99 %
Spain - Valencia	0,00 %	0,00 %	0 %	0 %	0 %
Sweden	5,46 %	7,28 %	28 %	72 %	58 %
Switzerland - Pratteln	1,68 %	0,16 %	50 %	50 %	75 %
Switzerland - Shaffhausen	4,20 %	0,69 %	35 %	65 %	76 %
The Netherlands	5,88 %	2,39 %	53 %	47 %	73 %
United Kingdom	5,88 %	13,22 %	28 %	72 %	68 %
Total	100,00 %	100,0 %	28 %	72 %	66 %

APPENDIX 2

Shipments from hub to receiving countries in December 2012

December 2012

Total working days: 15

From HUB to receiving country					
To	Nr of transports to HUB	Shipments	EXW	DAP	NW Pallet Type
Austria	6,53 %	13,21 %	9 %	91 %	64 %
Belgium	5,71 %	2,49 %	8 %	92 %	60 %
Bulgaria*	4,49 %	2,61 %	17 %	83 %	59 %
Czech Republic	4,90 %	7,79 %	35 %	65 %	71 %
Denmark	2,45 %	0,75 %	16 %	84 %	89 %
Estonia	2,04 %	0,67 %	41 %	59 %	65 %
Finland	2,86 %	1,86 %	49 %	51 %	62 %
France - Lesquin	0,00 %	0,00 %	0 %	0 %	0 %
France - Lyon	3,67 %	6,37 %	37 %	63 %	66 %
France - Paris	3,27 %	5,14 %	32 %	58 %	52 %
Hungary	6,53 %	5,77 %	21 %	79 %	75 %
Ireland	2,86 %	0,75 %	5 %	95 %	74 %
Latvia	2,86 %	0,55 %	29 %	71 %	79 %
Lithuania	0,00 %	0,75 %	72 %	28 %	74 %
Norway	0,00 %	0,00 %	0 %	0 %	0 %
Poland	6,53 %	11,35 %	65 %	35 %	76 %
Portugal	2,04 %	1,27 %	82 %	18 %	28 %
Romania*	4,49 %	2,33 %	88 %	12 %	80 %
Slovakia	6,53 %	7,32 %	81 %	19 %	65 %
Slovenia*	5,71 %	3,56 %	71 %	29 %	62 %
Spain - Barcelona	3,67 %	3,95 %	57 %	43 %	43 %
Spain - Irun	2,45 %	2,97 %	39 %	61 %	81 %
Spain - Madrid	2,45 %	3,36 %	59 %	41 %	52 %
Spain - Valencia	0,00 %	0,00 %	0 %	0 %	0 %
Sweden	4,49 %	2,45 %	83 %	17 %	60 %
Switzerland - Pratteln	0,82 %	0,08 %	100 %	0 %	100 %
Switzerland - Shaffhausen	0,82 %	0,16 %	50 %	50 %	75 %
The Netherlands	5,71 %	6,29 %	77 %	23 %	65 %
United Kingdom	6,12 %	6,21 %	75 %	25 %	72 %
Total	100,00 %	100,00 %	28 %	72 %	66 %