Outbound Logistics of the Non Board Business, at Sonae Indústria

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Master dissertation

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Abstract

The theme Outbound Logistics of the Non Board Business arises from the need to address certain inefficiencies identified in this scope and also in order to generate and develop synergies between the different units of the Sonae Indústria group.

Sonae Indústria de Revestimentos has limitations in terms of containerization of ISO containers, resorting often the outsourcing of this activity. Nevertheless, this company has the infrastructure and equipment necessary to achieve a procedure to perform this process with the efficiency required. The strapping is not standardized, therefore the need of a study over the various types of straps also arises.

At the group level, each company independently manages its logistics operators, which is a practice that leads to inefficiencies. Subsequently, two needs emerge: to assess the logistics operators in order to make a proper selection and to make consolidations of cargo between companies of the group.

Details of various equipment for containerization were analyzed and compared in terms of profitability and viability of these devices for the company. A study on the various types of commonly used straps and an analysis of its material costs was made.

Several indicators to evaluate the performance of logistics operators were collected and a methodology was developed in order to identify and define the features that best serve the company and that should be used when assessing contract terms and comparing these partners.

Finally, a methodology was developed for identifying flows that enable cargo consolidation

The final outputs are a solution for containerization, a contract term sheet that allows an easy comparison of the logistics operators and an identification and validation of potential consolidations.

Keywords: Logistics, outbound Logistics , cargo consolidation, evaluation of logistic operators.

Logística Exterior do Negócio *Non Board*

Resumo

O tema Logística Exterior do Negócio Non Board surge da necessidade de colmatar determinadas ineficiências identificadas neste âmbito e de modo a gerar e desenvolver sinergias entre as diferentes empresas do grupo Sonae Indústria.

A Sonae Indústria de Revestimentos tem limitações em termos de contentorização de contentores marítimos, recorrendo frequentemente ao *outsourcing* desta atividade. No entanto, acredita-se que empresa tem as infraestruturas e equipamentos necessários para efetuar este processo com a eficiência requerida. A cintagem não está padronizada, portanto a necessidade de um estudo sobre as cintas mais usadas também surge.

Ao nível do grupo, cada empresa gere os seus operadores logísticos independentemente, o que é uma prática que conduz à ocorrência de ineficiências. Consequentemente surgem duas necessidades: avaliar os operadores logísticos de modo a que se faça uma seleção fidedigna e efetuarem-se consolidações de cargas de empresas do grupo.

Detalhes de vários equipamentos de contentorização foram analisados e comparados em termos de rentabilidade e viabilidade. Um estudo foi realizado sobre os vários tipos de cinta e foi realizada uma análise sobre a sua estrutura de custos do material comparativamente com a situação actual.

Diversos indicadores de avaliação de performance de operadores logísticos foram recolhidos e foi desenvolvida uma metodologia com o intuito de identificar e definir quais as condições que melhor explicitam as características da empresa e que devem ser usadas como referência para comparação entre os diversos operadores.

Por último, foi desenvolvida uma metodologia para identificação de fluxos que apresentam características que possibilitam consolidações de carga.

A nível de conclusões, foi desenvolvida uma solução para a contentorização, desenvolvido um contrato que permitirá avaliar e comparar operadores logísticos e validadas algumas das consolidações propostas.

Palavras-chave: Logística, Logística exterior, consolidação de cargas, avaliação de operadores logísticos.

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Index

Figures index

Tables index

Acronyms

3PL	–	Third Party Logistics
BB	–	Board Business
DE	–	German market
ES	–	Spanish market
FR	–	French market
GHP	–	Glunz Horn AG
GB	–	United kingdom market
Gw	–	Grade in terms of weight or volume
Gt	–	Grade in terms of total transportation cost
Gn	–	Grade in terms of number of deliveries
HPL	–	High Pressure Laminates
IT	–	Italian market
MDF	–	Medium Density Fibreboard
MP	–	Movelpartes
NL	–	Dutch market
NBB	–	Non Board Business
OSB	–	Oriented Stand Board
PT	–	Portuguese market
PL	–	Polish market
Rw	–	Rank in terms of weight or volume
Rt	–	Rank in terms of total transportation cost
Rn	–	Rank in terms of number of deliveries
SIR	–	Sonae Indústria de Revestimentos
TTC	–	Total Transportation Cost

1 Introduction

The present dissertation was made in business environment at Sonae Indústria, SGPS, SA in order to analyse and to study improvement opportunities in the Outbound Logistics of the Non Board Business units of the group.

1.1 Company presentation

Sonae Indústria was founded in 1959 in Maia to produce wood-based products, more precisely high pressure laminates.

Over the years, Sonae Indústria expanded its business through acquisitions, including AGLOMA, Siaf, Paivopan, Spanboard, Tafisa, among many others (Indústria, 2012).

Currently, the business of Sonae Indústria is wood-based panels and it is present in Portugal, Spain, France, Germany, United Kingdom, Canada, Netherlands, Switzerland and South Africa. It is one of the largest producers in the world employing 4800 employees scattered in 27 sites across 3 continents (Indústria, 2012). The portfolio of products is diverse and includes:

- Particleboard;
- Medium density fibreboard (MDF);
- Hardboard;
- Oriented stand board (OSB);
- Components;
- High pressure laminates (HPL);
- Chemical products;
- Others value added products and services.

In 2010, the consolidated turnover of Sonae Indústria totalled 1293 million euros.

The vision of the company is "to be recognised as a sustainable world leader in the wood-based panels industry" and the mission is "to deliver the full potential of wood-based panels for the benefit of our customers, shareholders, employees and society", (Indústria, 2012).

The long-term strategy of the group is to protect the market shares and profitability in Iberia, to increase profitability in Central Europe and to grow in the most profitable markets. In the short term, due the economical crisis context in some markets, the strategy is to increase profitability by reducing fixed costs and increasing the efficiency (Indústria, 2011).

Due to the large diversity of the products, they were divided by category, more precisely: non board business (NBB) and board business (BB). As the title reveals itself, the scope of this dissertation is over the NBB.

1.2 Non Board Business

The products that are included in the NBB are:

- Resins
- Impregnated paper

- HPL
- Worktops
- Components

As the name reveals itself, the products from NBB are the products non board.

There are 6 sites belonging to this category, 4 located in Portugal and the remaining in Germany. The following image reveals the geographical location of the sites.

Figure 1 - Geographic location of the NBB sites.

In Maia, Sonae Indústria de Revestimentos produces high pressure laminates (HPL). Its markets are all over Europe and South Africa. The main costumers are in Norway, United Kingdom and Iberia.

In Alcanede and Vilela are located the sites of Movelpartes. This company produces and assembles furniture kits at Alcanede and components at Vilela. The market is mainly Portuguese and consists of outsourced production for IKEA, MaxMat, Leroy Merlin, among others. These sites also export to the Spain and Vilela has also an internal costumer from BB at Germany.

At Sines, Euroresinas produces resins and impregnates kraft and decorative paper. This site has an important role for Sonae Indústria business, both NBB and BB, since the wood-based panels require many products from Euroresinas for several different activities. The costumers of Euroresinas are mainly internal, most located in Iberia and some at Germany.

At Kaisersesch and Horn are located two sites from GLUNZ belonging to the NBB. The Horn factory belongs either to NBB and BB and produces particle board, melamine faced board, HPL, components and continuous pressure laminates. Obviously, only the NBB products will be taken into consideration. The Kaisersesch factory makes impregnation of decorative papers. Their markets are mainly in Central Europe.

1.3 Scope of the dissertation

The scope of this dissertation is restricted to Outbound Logistics more precisely to some activities related to transportation, such as: strapping, containerisation, carriers analysis and cargo consolidations.

The costs of transportation represents today over 40% of Logistics expenditures for most industries (Frazelle, 2002). Consequently, it is always a main subject to be studied and analysed.

The company identified that it would be in the transportation area where it could be possible to create and develop with higher relevance synergies within the enterprises of the group. In order to improve the service level and to minimize costs.

The strapping process at Sonae Indústria de Revestimentos is not standardized, there is no control regarding the costs and the company has curiosity about the viability and profitability of other types of straps.

There are inefficiencies regarding the containerisation of ISO containers at Sonae Indústria de Revestimentos. This company outsources often this activity, however the managers of the enterprise believe that there are conditions both in term of infrastructures and equipment to perform this activity with the efficiency required.

The companies of Sonae Indústria group manage individually their carriers, which leads often to inefficiencies in overall terms. This management should be done across all divisions and units.

There are some common costumers among companies of NBB, therefore it should be done cargo consolidations every time it is possible.

1.4 Origin and motivations of the dissertation

As already mentioned before, the Sonae Indústria was founded in 1959 at Maia, thus it is an industry with a considerable age and with a certain degree of maturity. Consequently, it is a company that already crossed many different management paradigms, as many others companies that evolved from mass production and standardized products to variety, flexibility and customization (Sinha & Kumar, 2012). Obviously, this transition had influence not only in Production area, but in all fields of management. On the other hand, Logistics is an area that only gained higher relevance in the last few decades (Silva, 2008). This can be explained by the fact that Logistics activities were not considered core, however Logistics, who saw their costs grow exponentially due to the paradigms change, became a main field to be well analysed and studied.

Sonae Indústria made many acquisitions in a period when Logistics had not such a relevant role consequently some cautions about this area were not taken into consideration, which led to a non-integration of the supply chain along the various acquisitions. Hence, in Logistics terms, each site is independently managed leading to an absence of synergy among the Sonae Indústria group. These conditions gave origin to some of the challenges studied in this dissertation, namely the requirement to assess of carriers and the cargo consolidations.

1.5 Objectives of the dissertation

The objectives were defined in order to tackle the subjects mentioned in the scope of the dissertation. Consequently, two groups of goal were defined: general and specific.

In the general intents, it can be highlighted:

- To create and to develop the synergy among the NBB sites;
- To improve Logistics efficiency by reducing the costs of Transportation;
- To increase the service level to the costumer.

In the specific intents group are included:

- To improve the loading and packing methods;
- To develop a methodology to assess the carriers so the selection of a core group can be made properly;
- To identify flows of the NBB sites that can be consolidated;
- To quantify and to measure the economic effects of the consolidations;

The general objectives are connected to each other's. The increase of the synergy will require a higher cooperation between the NBB sites. This cooperation can enable some cargo consolidations that should result in an improvement of the Logistics efficiency through the reduction of the costs.

1.6 Adopted methodology

In order to achieve the objectives referred, four distinct problem areas were studied and analysed.

The first problem area defined was "Packing" and it studies the strapping process at SIR.

The second problem area was the "Loading" which refers to loading of the ISO containers.

The third problem area is "Carriers Analysis". In this scope indicators were collected to assess the carriers performance also as the best practices to manage the contracts. A methodology was developed to identify and define the specific features of a contract in terms of outbound transportation so that the logistics operators can be compared based on a term sheet with the conditions that are effectively essential to that particular site.

Last but not least, to analyse the fourth problem area, "Cargo Consolidation", was developed a methodology of identification of the flows that could be aggregated, and then quantified the potential benefits of each consolidation.

1.7 Structure of the dissertation

The traditional structure, to have Description of the problem, Methodology and Results as chapters, was not adopted due to the fact that there are four problem areas to analyse, therefore it was considered that exposing the problems from beginning to end would ease the comprehension.

In the chapter "State of the art" is reviewed the areas of knowledge of interesting in order to provide a vision about the subjects under study.

At the sub chapters “Description of the problem2 of each problem area is described the currents status of that area at Sonae Indústria.

In the sub chapters “Approach” is exposed the methodologies developed to analyse and study the areas under examination.

The sub chapters “Results” exhibit the results obtained from the implementation of the Approach for each problem area.

In the chapter “Conclusions” is mentioned limitations that were felt, critics about some considerations adopted, conclusions and future perspectives.

2 State of the art

Historically, there was an association of Logistics to supply capacity in the various scenarios of military actions, always underpinning strategies.

Since ancient times, there are examples where Logistics was predominant in the final outcomes. Portuguese examples can also be referred, when in the decades of the 60'ies and 70'ies the country was involved in three battlefields far away from each other, which resulted in huge Logistics stress.

If over time logistics has been established as essential at the military level, the same can be said for business maneuvers, in which some analogies can be made: "war" of beer, "war" of coke, "war" of burgers. (Dias, 2005)

Logistics is a term constantly evolving. The development and application of the term logistics in modern business world is far from the first used by Greek philosophers, including Aristotle's school, which associated the term with speech, reason, ratio, rationality, language and sentence. (Carvalho, Faustino, & Féliz, 2000)

The definition presented by Frazelle is quite simple. This author states that in the Logistics area there is still no consensus on its definition, arguing that many professionals confuse logistics with some of its activities. He also defends that much of the failure of logistics strategies is due to the fact that a definition is not well defined previously, as neither is its scope: what is Logistics, what is its scope, its purpose and the activities it comprehends. For him "Logistics is the flow of material, information and money between consumers and suppliers" (Frazelle, 2002).

The lack of consensus just referred can be verified in the Oxford English Dictionary, that defines Logistics as: "the branch of military science relating to procuring, maintaining and transporting material, personnel and facilities." The New Oxford American Dictionary defines logistics as "the detailed coordination of a complex operation involving many people, facilities, or supplies" and the Oxford Dictionary online defines it as, "the detailed organization and implementation of a complex operation". Whatsoever, one thing is certain, it is easy to confirm that Logistics today is more than physical distribution, as it was in the past. It is more than material management and (re)supply. It is all flow of information, in order to integrate both streams, physical and informational. (Carvalho et al., 2000)

2.1 Logistics background

In the past, Logistics professionals were at the bottom of the hierarchy with a very low relevance, but today "we are having our day". This is very much due to the large increase in Logistics costs which have occurred over time and to the complexity of competencies needed to manage all variables. Some companies are spending between 8-15% of sales in Logistics activities, so they cannot be ignored anymore. (Frazelle, 2002)

Logistics was recognized as one of the areas through which can be increased the profitability of the enterprises. In some organizations where Production, Marketing, Quality, and other areas are already highly optimized, now is time to achieve the same level in terms of Logistics. At Coca-Cola, for example, the product is the same for more than 100 years, its

Marketing is one of the most globally recognized, therefore Logistics is an area essential to the efficiency and profitability of the brand. (Frazelle, 2002)

One of the problems of Logistics, which derives from the fact that for too long it was not given the real value, is that Logistics professionals often have no training in the area. It is relatively usual to allocate professionals with other backgrounds, which leads to those professionals practicing an activity for which they are not suitably qualified. In addition, there are a large number of software and Logistics operators, each one providing different services, due to the fact that they have developed their own logistical language without a consensus. This leads to an even more complicated endeavor when trying to improve the efficiency in this area. Many of these software and third-party Logistics providers are not matching the complexity increase of the challenges of the new reality (Frazelle, 2002).

Moreover, Logistics has the distinction of being often undetectable. It is easy to recognize when something goes wrong in Logistics activities: stock-outs, sales orders mistaken, low levels of service, placement out of time, among others. When something goes wrong it is easy to use Logistics as an excuse, on the other hand, when things go well, among the causes exposed logistics is rarely mentioned, although often it should be an obligatory reference. (Carvalho et al., 2000)

2.2 Globalization and Global Logistics

It was the Portuguese who, for over 500 years, from Europe began the process of globalization when brought into contact with cultures and civilizations at the time unknown. They were able to internationalize trade, establishing contacts and making connections. They were carriers of religious values that they learned to associate with the market. They took and brought information by communicating with others. (Dias, 2003)

More recently, in the twentieth century, events such as the transmission of voice and image distance, the wars which are no longer local, intercontinental travels now reduced to a few hours of travel, the possibility of being able to do business in local markets or far, the Internet, have turned the planet into a "global world" where everything is increasingly interconnected. The fact that we are ever fewer foreigners in this world has caused many revolutions at all levels. Very recently with revolutions that were due to the new technologies and the new opportunities to share information, including social networking, as it was the case of Egypt and other countries. It has been noticed an evolution in terms of conditions and quality of life, evolution of paradigms in several areas, such as politics, economy and many others. All this reality has led to laws to become simpler across borders, leading to companies seeking outsourcing or decentralization and internationalization. This whole event had an impact in several areas, and perhaps even greater importance, in terms of Logistics. (Dias, 2003)

Consequently, Global Logistics flows have amplified intensely during the last decades due to globalization in the world economy and global access to web sites for buying and selling merchandise. Global Logistics is much more complex now than local Logistics due to a greater diversity of agents and facts involved. (Frazelle, 2002)

Logistics had to adapt to this reality. How much in the past, customers were a local company, today, customers are international and Logistics has to deliver the products to those same customers. It also has to be responsible to create conditions to allow the circulation around the planet of commodities, products, information and capital.

The strategies of companies have become global and local simultaneously. Logistics had, has and will have a leading role in the business world as we know today. (Dias, 2003)

2.3 Value Chain

The concept of Value Chain was introduced by Michael Porter at 1985 and represents the set of activities performed by an organization from relationships with suppliers, cycles of production and sales until the distribution phase. By decomposing an organization in its activities of strategic importance, it becomes possible to analyze the behavior of costs and existing sources, as well as potential differentiation, optimizing the value of the product to the final customer. The leadership per cost and / or differentiation through quality are essential for companies to achieve a competitive advantage. This advantage is often the result of the capabilities of effectiveness and efficiency with which organizations manage the entire system. (Dias, 2005)

For the company to be able to achieve effectiveness and efficiency described above the value chain is essential as it allows the comprehension of the flow of value added to the final consumer, through the portrait of the activity chain. (Braga, 2010)

The general chain of Porter is composed of sets of primary activities and support activities performed by an organization and by a margin of value added in each of the activities and by the relations established between them.

The following image exposes the primary activities and the support activities defined by Porter.

Figure 2 – Porter Value Chain. Source: (Logistics, 2009)

A brief description of the primary activities is made just below.

- Inbound Logistics: Reception, storage and distribution of inputs to products.
- Operations: Activities related to the transformation of raw materials into components or finished products.
- Outbound Logistics: Collecting, storing and physically distributing the product to customers.
- Marketing and Sales: Marketing and product promotion.
- Service: Activities aftermarket.

The activities of the Value Chain can also be considered:

- Strategic activity: activities that are essential for the implementation of the strategy as it directly affects the company's performance in the critical success factors of the business. So they should have all the features required, both in quantity and quality.
- Tactical activity: activities that are necessary but not sufficient to implement the strategy. They should be secured in a perspective of optimizing the cost / benefit ratio.
- Operational activity: activities that are necessary to run the company, but that have little impact on their competitive performance. To the desired level of quality, they should be ensured with the minimum cost.

The value chain activities have a link between each other. This link can be:

- Horizontal link: relation between activities or business processes of an organization. The activities are not isolated, they are interdependent. The way an activity is performed affects the other.
- Vertical link: An organization may have a competitive advantage when it has a good relationship with their suppliers and distributors.

An analysis of the value chain can be made in order to understand the sources of competitive advantage, to review business practices in order to anticipate new trends, to promote the organization's business rules, to promote progress in the performance of processes of the organization, to provide a complete view of information flow and relationships between all processes.

Regardless of the organizational model adopted, building and using a value chain implies:

- Analysis of the internal Value Chain
- Chain analysis of cost drivers
- Control of costs drivers

2.4 Packing and Loading

This area had a remarkable development in terms of innovation of methods and equipment. A search of the solutions and the innovations that are relevant for the NBB products identified the following issues:

Packing (Maxfit, 2010)

Regarding to the packing, various kinds of straps are available:

Steel straps are suitable for heavy loads. These straps have a very low elongation, between 2-9% depending on the quality. It fits tight to the volumes, but it may not withstand a more sudden impact. Usually they are not greasy.

Polyester straps are lightweight, suffer no corrosion, are safe to handle and can replace steel strapping due to its high tensile strength, even at angles of 90 °. They are not affected by humidity and temperature variations (from -10 ° C to 70 ° C). The elongation is low (13-15% maximum), yet sufficiently elastic to absorb shock during the transportation.

Polypropylene straps are economical and easy to use. They are often the ideal solution for various types of packing from various industrial areas. They can sustain high levels of

tension, always ensuring a high reliability. Theses straps are 100% recyclable and they are easy to eliminate, because as waste materials they have no heavy metals, therefore they are not harmful to the environment. They are also flexible, elastic and maneuverable, adapting to any type of packages without deteriorating it. Polypropylene straps are rot proof, withstand variations in temperature and they do not rust.

Textile straps have limited tensile strength, do not damage the load and provide complete safety use. They do not fibrillate and remain insensitive to weather conditions.

Finally, the straps of adhesive textile are often safer and more economical for the shipment of heavy cargo by land, ocean and air. They are very lightweight, flexible and maneuverable for strapping parts of all forms. They are very resistant to climatic conditions (-40 º to 135 º C) and rot proof. They are composed of polyester fibers of high toughness and hot melt.

Loading

As mentioned before, a lack of efficiency was noticed regarding the containerization of ISO containers, the description of this matter status will be properly described in the appropriate chapter. A review of the innovative loading equipment that is likely to adapt to the reality of Sonae Indústria highlighted the following solutions:

The Loadplate is the most expensive solution. This equipment consists of a platform involving a conveyor belt which makes the cargo slide automatically into the container or truck. The advantages of this equipment are to allow the loading of long goods without high efforts, excellent utilization of space, fast container and trailer loading, gentle cargo loading and handling, easy load forming, labor costs reduced, among others. (ACTIW, 2012)

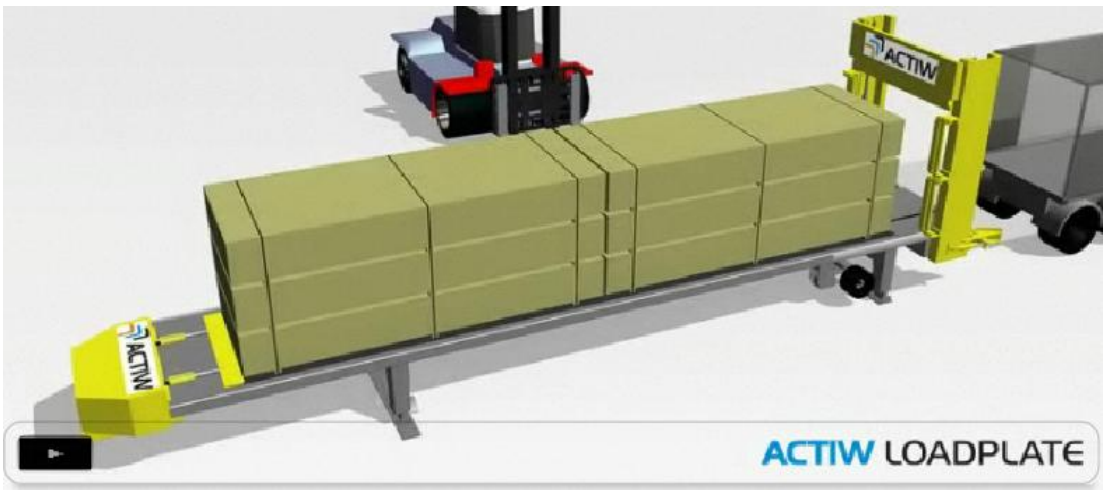


Figure 3 – Loadplate. Source: ACTIW

Another interesting equipment is the Rollerfork, which is basically a standard forklift equipped with a bearing system in the forks, that allows the sliding of the same under the cargo, making it easier to pick up the goods and unload them. The advantages of this equipment are no hydraulics needed on the Rollerforks or lift truck, the weight is almost the same as in the standard forklift, the drivers visibility is not obstructed, products can easily be placed on a pallet, the loading and unloading time is faster. The investment cost is relatively low. (Forks, 2012)

Figure 4 – Rollerforks. Source: Rollerforks

Another interesting system of loading and unloading large volumes of cargo, based on the principles of roll in and roll out, is a metallic platform where the cargo is carried. Through the use of a forklift, the cargo and the platform are pushed into the container and pulled for the unloading. The advantages of this advice are similar to those mentioned above, however it should be noted that this one has a disadvantage that others do not have. This equipment needs to travel with the cargo during the journey and therefore it is necessary to assure that later it will return to the origin, so it is necessary to manage the reverse logistics of these platforms.

Figure 5 - Containers Load System. Source: CLS International

2.5 Carriers analysis

In the last decades, there has been a growth in the outsourcing of various Logistics activities. This occurred for several reasons, including the fact that the market has ceased to be local and therefore, for companies to maintain their service level without making huge investments, they outsourced Third Party Logistics (3PL) so they could devote all the resources to their core activities. In addition, these 3PL companies are experts in those activities, or so it should be, and therefore they have a greater know-how comparing to companies whose core business does not focus on these logistics activities. Thus, it is a smart strategy to take advantage of this knowledge making certain activities more flexible.

Regarding this matter, best practices were surveyed for the management of carriers and the key performance indicators of carriers were collected.

Best practices of the carriers management (Cubitt, 2002)

- Implement a core carrier program

To have contracts with a small group of carriers reduces administrative costs, enhances and facilitates communication, lead to a better integration, better relations, among others benefits. "When it comes to carriers, less is more".

- Solidify your rate / Tariff administration

A good contract helps to document and control costs. It also helps to avoid inflation of some costs that are typically poorly managed and validated in advance, such as extra services. It is therefore essential to have well-defined contracts so that all trips are made at the lowest possible cost.

- Reduce administrative costs

Often, the internal administrative costs are not considered, because they are forgotten or just considered not important and no optimization of these processes is made. This leads to a situation of having more employees than necessary, overly bureaucratic processes and more time consuming than strictly necessary. There are many companies that handle these activities automatically, use web-based tracking and tracing shipments, systems that measure the carrier performance, invoice-less freight payment, proactive transit damage programs, among others.

- Optimize mode selection.

Each transport mode has its advantages and disadvantages, depending on the distance traveled, the value of goods transported and the time available to perform the delivery. Today it is easier to use inter-modality, depending on the characteristics of the business in question. Even if this hypothesis was never pondered in the past, a study over this subject may reveal interesting opportunities.

- Maximize equipment use.

Full use of the available space or available capacity leads to the optimization of costs. To make the planning of proper equipment for each case and negotiate with the carriers those conditions is also a best practice. Therefore, negotiate the proper equipment and plan to maximize its capacity.

- Bid lanes / Freight

A well-conceived and fairly-executed freight bid, whether an annual or daily bid for the excess freight is something that should complement the carrier core program. This practice avoids confusion and promotes harmonious relationships.

- Manage import / Export operations

Today firms are often importing and exporting. Consequently, if the company does not have the know-how about the globalization, to find a partner with this knowledge can be critical in order to help navigate the new waters.

- Optimize the inbound freight

The companies have to be aware that many vendors try to make a profit-center through the delivery of raw materials, so it is not at all a priority for them to minimize these costs. Therefore, to analyze and to study methods to make better inbound management is essential. Often making fewer requests of complete trucks helps reducing costs.

- Use a Transport Management System to optimize mode and carrier selection

Transportation Management System is a management system currently implemented for many years, yet the successful implementation thereof is reduced. However, when well-established the system may decrease 10-15% of the transportation costs.

- Leverage partner capabilities

It is fundamental to stop considering the logistics operators as competitors and start seeing them as key partners for the company's strategy. The ideal is to grow together through a pleasant relationship.

- Manage freight globally across all plants and divisions

For companies with multiple geographically dispersed sites, it is essential that logistics management is done by looking at the system as a whole. It is also crucial not to optimize individually each site, because the local optimization often does not lead to the general optimization that is the most important. Consequently, the objectives should be to consolidate cargo, to ascertain and to identify ways to eliminate wastes, to identify core carriers among the sites, to check for possible aggregation of routes between sites and to look at the whole supply chain as an opportunity to optimize various activities.

Carriers performance indicators

For the evaluation of the carriers there is a large variety of methods, some more precise and complex, as heuristics, and others more simple and straightforward as the case of the collection of indicators for the assessment of the carriers performance.

According to Sonae Indústria goals regarding this subject, it is not necessary to implement a heuristic due to the complexity of practical implementation, so the collected bibliographic references concerning this matter are about indicators of performance analysis.

Thus, the objective is to survey the indicators accepted by experts as those that evaluate more effectively the carriers.

Keebler and Plank, the Supply Chain Consortium and Frazelle identified indicators they consider the most relevant and effective for the evaluation of the carriers.

The indicators described in the study of Gunasekaran, Patel and McGaughey were first ranked according to the importance given by a set of companies in the United Kingdom. The opinion was collected through surveys.

In the following table are the indicators collected by the authors mentioned. Those identified by McGaughey et al that were ranked, are described by descending order of importance.

Table 1 – Indicators to assess the carriers. (Consortium, 2011; Frazelle, 2002; Gunasekaran, Patel, & McGaughey, 2003; Keebler & Plank, 2009)

Keebler and Plank	*Gunasekaran, Patel and McGaughey*	*Supply Chain Consortium*	*Frazelle*
Customers complaints	Quality of delivered goods	On time delivery	On-time arrival percentage
On-time delivery	On time delivery of goods	On time pickup	Damage percentage
Over / short / damaged	Flexibility of the service to meet customer needs	Proof of delivery	Claims-free shipment percentage
Returns and allowances	Effectiveness of enterprise distribution planning schedule	Billing error rate	Miles between accidents
Order cycle time	Effectiveness of delivery invoice methods	Claims incident rate	In-transit time
Overall customer satisfaction	Number of faultless delivery notes invoiced	Claims response days	
Days sales outstanding	Percentage of urgent deliveries	Electronic status update	
Forecast accuracy	Information richness in carrying out delivery	Capacity utilization of the containers	
Invoice accuracy	Percentage of finished goods in transit		
Perfect order fulfillment	Delivery reliability performance		
Inquiry response time			

2.6 Cargo consolidation

Transportation is a key activity in the supply chain. It is the one that allows physical distribution of finished products. It is also the activity that many people confuse with Logistics, however Logistics is a universe of activities far beyond that. (Carvalho, 2002)

According to Frazelle the purpose of transportation is to connect the dots of pick-up and deliver-to within the period of pre-established time, taking into account all the limitations of infrastructure and equipment, at least possible cost, which led to a study of cargo consolidations.

The cargo consolidation is a practice done by Logistics operators in order to reduce the cost of transport of goods, so it can be possible to provide better prices to customers, as well as an internal optimization of transport. This process involves collecting fractional loads of different companies and consolidate those that have the same destination or flow, so that the transport is done with full load instead of several trips with fractional cargo.

The cargo consolidation increases the efficiency of transportation through the optimization of the space available, since for a given flow, if it is done with full load, the cost per volume or per weight will be lower than in the case of fractional cargo.

The Logistics operators have greater ease in doing this process since they have several costumers and therefore they can consolidate fractional loads of these same customers. In turn, other companies have difficulty in doing this activity, which is why the use of outsourcing is often ideal because it is very difficult for companies to compete in terms of transportation costs with companies that are able to do cargo consolidations.

The following figure clarifies a vision of consolidation.

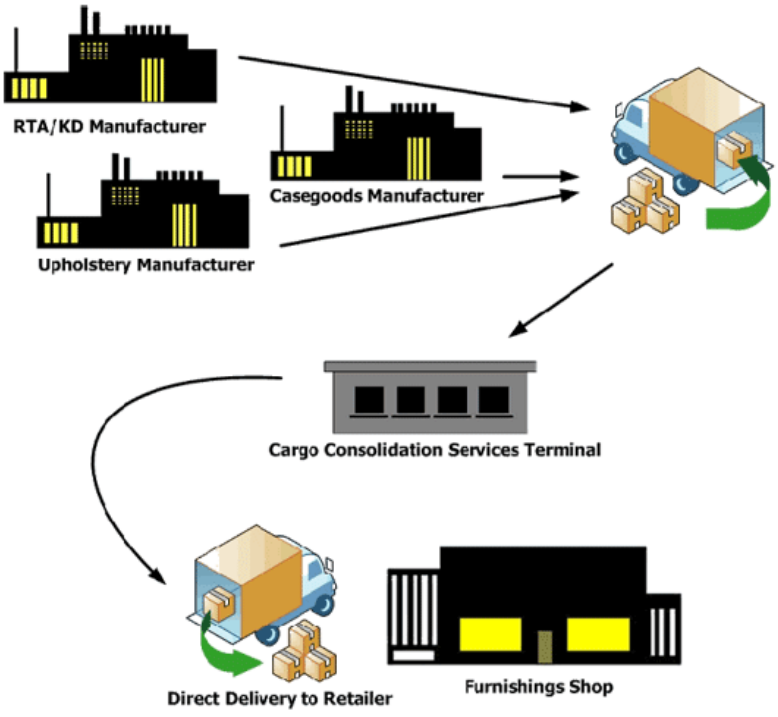


Figure 6 – Schematization of an example of cargo consolidation. Source: (Fowewarders, 2011)

3 Packing

3.1 Description of the problem

This problem area is particular to the Sonae Indústria de Revestimentos (SIR).

The straps used in SIR are steel straps. Strapping requires a device that increases the tension of the strap by pressing so it can be fit to the material. In the company there are two types of equipment to perform this operation, one automatic and another manual. The manual is the older equipment, the automatic was adopted in order to reduce the strapping time that on average reduces to half the process time. The latest is a pneumatic equipment, which was chosen after being approved by the factory operators, however, due to its weight, it is not always used. This equipment fits very well the strap to the package, stresses the strap ensuring the ideal tension and it does not need staples, since it has a bending system that holds the strap in place. The manual device is slower, the strap is pressed according to the intuition of the operator and it still requires a staple to hold the strap in place.

Theoretically, the pneumatic device is the one that should always be preferred: it is faster, inserts the ideal tension and attaches the strap without staples. In practice the two devices are used in the same proportion.

The process of strapping with the steel straps is an operation with which the workers feel comfortable and adapted. Polyester straps have been used, however they were abandoned after the occurrence of a certain number of times of the cargo reaching the customer with broken straps.

Relatively to the costs, a coil of steel strap (1 ton) costs 960 euros. In order to provide more plausible and perceptible values, the material costs of strapping were calculated having as reference an ISO container to South Africa and a truck for Fibotrespo[1].

These references were chosen for the following reasons: the ISO container because the packaging uses a wooden box, which has been adopted in order to better protect the cargo, since the transport has more oscillations than the land transport; the truck for Fibotrespo, because the pallets have often the most common dimensions and because it is one of the most frequent flows of the company.

[1] Fibotrespo is a Norwich company and it is one of the most important costumers of SIR.

Figure 7 – Wooden box used for the transportation in the ISO containers

Figure 8 – Pallets for Fibotrespo

The wooden boxes for the ISO containers have bigger dimensions, consequently each strap used has also a higher length comparing to the length of the straps for the most common pallets. In addition, in the wooden boxes are used 6 straps and in the ordinary pallets are used only 4.

As can be seen in figure 7, the wooden boxes do not have all the same dimensions. The one in the bottom is taller than the others. To standardize the values, the costs presented in the following analysis are for the following dimensions: wood box with 20 centimetres of height and 147 centimetres of width and the truck pallets with 28 centimetres of height and 127 centimetres of width.

Below, the material costs of the strapping are presented for both references and for both tension equipment.

960 € for 1 $ton\ of\ steel\ strap$

0,96 € / Kg

217,8 € for 7200 $staples$

0,03025 € / $staple$

***Sea container* (24 *boxes*):**

With automatic equipment

6 $straps$

0,23 Kg / $strap$

Per box

$Total\ cost\ per\ container$ = 31,80 €

With manual equipment

6 $straps$

0,23 Kg / $strap$

6 $staples$

Per box

$Total\ cost\ per\ container$ = 36,15 €

***Truck for Fibotrespo* (23 *pallets*):**

With automatic equipment

4 $straps$

0,201 Kg / $strap$

Per pallet

$Total\ cost\ per\ truck$ = 17,75 €

With manual equipment

4 $straps$

0,201 Kg / $strap$

4 $staples$

Per pallet

$Total\ cost\ per\ truck$ = 20,53 €

3.2 Approach

As revealed in the description of the problem, there are inefficiencies in the process of strapping. In a first instance, the operators are allowed to use either the manual or the automatic device, without any control from the perspective of registering how often they use one or another, and depending solely of the discretion of the person that performs the operation. Therefore it is not possible to get a real sense of the costs of the process of strapping, since, as already stated, it is not made a survey of cases in which the operation is done with pneumatic equipment or with the manual. Thus, there is a necessity of standardizing the process. At the same time, an analysis of what kind of strap best suits the reality of SIR was made, with the respective material cost study.

Subsequent to the study of the characteristics of each type of strap described in the State of the art and presented to the company, those that were considered more appropriate, in convergence with the opinion collected at Nefab[2], was the adhesive textile strap. It was considered the one that best suited the requirements and characteristics of the products of the company, being safe and economical for the maritime and land transport of heavy loads. They are lightweight, flexible, manoeuvrable, weather resistant, rot proof and recyclable. However, it must be ascertained first if they are economically competitive.

The methodology to validate the economic viability was to calculate the material costs of strapping of the two references listed in the description of the problem: an ISO container load and a truck load for Fibotrespo. Studies were performed on three different widths, 19 mm, 16 mm and 13 mm, since they are all capable of safely support the weight of the cargo. These costs then were compared with the best current solution, which is the strapping using only the pneumatic equipment. This scenario is not real, as already described, but it represents the best achievable solution in terms of material costs, so this was the basis of comparison for the evaluation. If the adhesive textile straps are more advantageous economically, taking also in consideration the inherent advantages of the material type, these straps will then be proposed to the company. Subsequently, a procedure for the strapping process should be developed, in order to prevent the current wastes identified. Strapping is considered an operational activity, according the Porter Value Chain, therefore the standardization of the process is something easy to define. The biggest problem resides in the fact that, having two different equipment on site, the human resources tend to use both and introduce variability.

3.3 Results

The costs of the equipments required to do the strapping with adhesive textile straps are the follwoing (all the values were given by the supplier Nefab):

$Tensioner - 135{,}71\ €$

$Strap\ conductor - 24{,}16\ €$

$Coil\ support - 94{,}29\ €$

The costs of the textile straps for each thickness under analysis are:

[2] Nefab is a global Indústrial packaging company offering custom packaging solutions.

19 *mm*:

49,78 € for 600 $meters$

30,42 € for 500 $staples$

16 *mm*:

70,00 € for 850 $meters$

39,08 € for 1000 $staples$

13 *mm*:

58,31 € for 1100 $meters$

32,46 € for 1000 $staples$

As explained in the solutions, the material costs of strapping, which includes the straps and the stapples needed, were calculated for 2 references: ISO container and truck for Fibotrespo. These costs are going to be compared with the values of strapping with steel straps using the pneumatic equipment for this same references.

The total costs of strapping with steel straps are:

Steel straps:

$Total\ cost\ of\ strapping\ for\ a\ truck\ \ for\ Fibotrespo =$ 17,75 €

$Total\ cost\ of\ strapping\ for\ a\ sea\ container =$ 31,80 €

Finally, the costs and the difference between costs for each thickness of adhesive textile strap are:

19 *mm*:

$Total\ cost\ of\ strapping\ for\ a\ truck\ for\ Fibotrespo =$ 29,26 €

$It\ is$ 65% $more\ expensive\ than\ the\ steel\ straps.More$ 11,51 € $per\ truck\ for\ Fibotrespo$

$Total\ cost\ of\ strapping\ for\ sea\ container =$ 48,66 €

$It\ is$ 53% $more\ expensive\ than\ the\ steel\ straps.More$ 16,87 € $per\ sea\ container$

16 *mm*:

$Total\ cost\ of\ strapping\ for\ a\ truck\ for\ Fibotrespo =$ 27,08 €

$It\ is$ 53% $more\ expensive\ than\ the\ steel\ straps.More$ 9,33 € $per\ truck\ for\ Fibotrespo$

$Total\ cost\ of\ strapping\ for\ sea\ container =$ 38,62 €

$It\ is$ 21% $more\ expensive\ than\ the\ steel\ straps.More$ 6,83 € $per\ sea\ container$

13 *mm*:

$Total\ cost\ of\ strapping\ for\ a\ truck\ for\ Fibotrespo =$ 18,10 €

$It\ is$ 2% $more\ expensive\ than\ the\ steel\ straps.\ More$ 0,35 € $per\ truck\ for\ Fibotrespo$

$Total\ cost\ of\ strapping\ for\ sea\ container =$ 30,17 €

$It\ is$ 5% $cheaper\ than\ the\ steel\ straps.\ Less$ 1,63 € $per\ sea\ container$

4 Loading

4.1 Description of the problem

This problem area is particular to the Sonae Indústria de Revestimentos (SIR).

SIR often outsources the containerization of ISO containers, more precisely subcontracts the company SPC multi usos located in Valongo. Nevertheless, it also makes this type of loading internally in its premises. However, when the containerization is made at SIR, there are a wide range of factors that influence this activity and contribute to a considerable inefficiency, because it is not made under the best conditions and it is not possible to use the total capacity of the container.

As a first factor, SIR does not have a device to move containers, so the loadings have to be done with the container on the truck. For the amount of the ocean deliveries it is not justified to have that kind of equipment, and, since the facilities do not have dockings that allow level loading of the container, the loading is done at a level above the ground which implies using a ramp. The existing ramp is narrow and its location is on the outside of the warehouse so that its use disrupts the incoming and outgoing traffic of goods and vehicles and, on the other hand, it is only partially covered. This factor seems minor, but because of it, in days of heavy rain and strong wind, it is not possible to make loads safely.

Other limitations are related to the capacity of the forklifts. The wooden boxes for shipping have a length of 3.660 meters, in addition they have to be transported longitudinally, in order to fit into the container, as exposed in Figure 7.

The forks of the forklifts available in the company are relatively small in length and therefore they can only carry out one box at a time due to the length of the forks, as exposed at the Figure 9, which implies a waste of time to perform the containerisation. In addition, when the forklift is within the container by the fact that it only carries one box at a time, it is not possible to stack boxes to the top leading to a waste, in average, of 3 tonnes of capacity per container.

In comparison with the company SPC, this enterprise has an equipment that moves containers, thus it can place the container anywhere in the ground, allowing the loading at any broad space without the need of a ramp. In addition, their forklifts can carry two boxes each time.

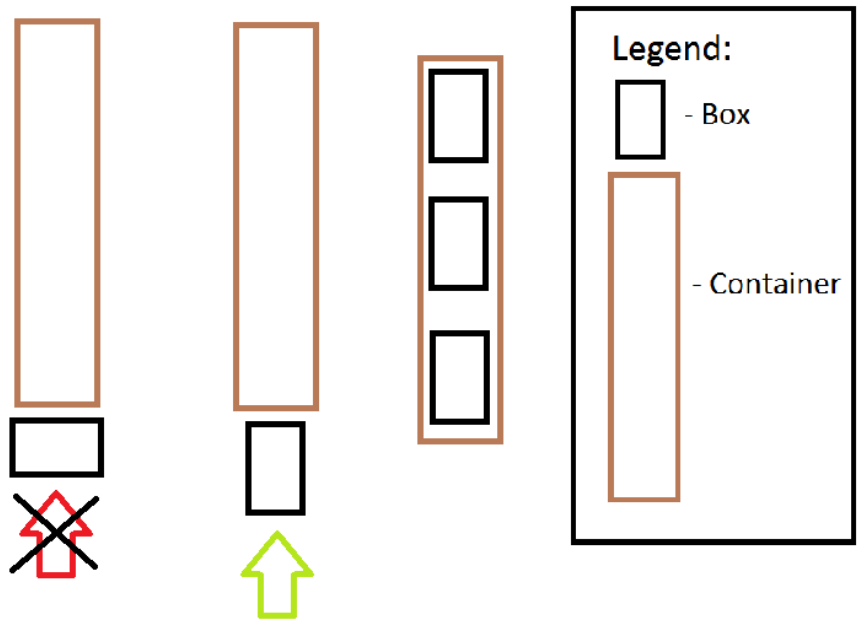


Figure 9 – Schematization of the containerisation

Figure 10 – Stacking of the wooden boxes one by one

The costs are described just below.

Containerisation outsourcing costs

$Transportation\ of\ the\ wooden\ boxes\ from\ Maia\ to\ Valongo\ =\ 118\ €$

1 $liftfork$
1 $driver$
1 $supervisor$

1 hour and 30 minutes to load the truck

$Containerisation\ at\ SPC\ =\ 146{,}50\ €$

$Transportation\ of\ the\ container\ from\ Valongo\ to\ Porto\ Leixões\ =\ 97{,}43\ €$

$Total\ cost = 361.93\ €$

***Containerisation costs* at SIR**

$Transportation\ of\ the\ wooden\ boxes\ from\ Maia\ to\ Porto\ Leixões\ =\ 118\ €$

1 $liftfork$
1 $driver$
2 $operators$
1 $supervisor$

2 hours to load the ISO container

4.2 Approach

According to the information provided by Sonae Indústria, the volume of deliveries to South Africa will increase significantly, therefore it is urgent to eliminate the inefficiencies found in the containerisation, when carried out on the company facilities. If a viable, competent and economically advantageous solution is developed the outsourcing could also be reduced.

From the equipment described in the State of the art the Loadplate is possibly suitable for a business whose core activity is the loading of containers. In the case of SIR that is not the case and, beyond that, such a large investment (about 200.000 €) would take too much time to be amortized, an issue that would go against the current policy of the company that states that all non-strategic investments must be amortized from 1 year and a half to 2 years max.

The Rollerforks would be an interesting solution to be analysed, but it is an equipment that has a limitation that preclude their use for the case in question, which is its capacity. The forks only withstand loads up to 3 tonnes, and each stack of wooden boxes for ISO containers weights approximately 8 tonnes.

Hence, the solutions collected in the State of the art were considered inappropriate, however they gave ideas and concepts to create other proposals.

Solution 1

Based on the Loadplate principle, a solution was developed with compact slats to serve as rails in order to make the stacked wooden boxes to slide into the container. Thus, the idea is to stack the boxes over the compact rails outside the container and subsequently to push with a forklift the stack into the container, as shown in the scheme of the following figure.

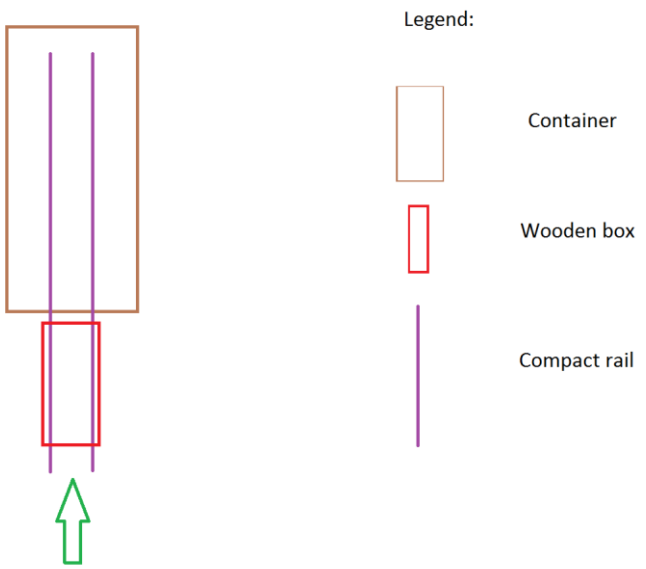


Figure 11 – Schematization of the compact rail solution

This solution would be very economical even using new compact rails every containerisation because the compact is produced at GHP.

The compact is a product with a reasonable thickness, enough to create an empty space between the stack and the floor so the forks of the forklifts can be placed and subsequently to allow the pushing of the load. In addition, the compact is a material whose surface presents a low friction which facilitates the sliding. In order to assure a better sliding, at the bottom of the first box of each stack it has to be affixed other compact strips, so that the sliding can be made over the contact between two surfaces with low friction. Last but not least, to assure a lower friction, a component was searched to decrease the friction, with the aim of decreasing the force that is needed to push the 8 tonnes into the container, so it can be possible for the forklifts available at the company to push such a heavy cargo. It was found the Teflon (PTFE) that is a spray that reduces the friction (Weicon, 2012), the objective is to cover the rails with this component so the slide can be made without problems.

Solution 2

An alternative solution was constructed based on the Rollerforks and the main idea is the use of sliding bases similar to the one exposed in the following figure.

Figure 12 – Sliding base. Source: (Manutan, 2012)

These bases can withstand load up to 12 tonnes. The concept is the same as the previous solution. The loading is made over the bases and it takes place outside the container, afterwards it is pushed into the container.

This solution has two disadvantages compared with the previous one. It is necessary to make an investment in the purchase of the sliding bases (about 500 euros each) and reverse logistics has to be ensured in order to recover the bases.

After consultation with the logistic service provider DB Schenker, the advice was to make the return of the bases once a month by shipping, since by airplane would be an excessive cost (4300 euros per trip). The ocean transportation is more economical (460 euros per trip) but has the disadvantage that, for being fractional charge, the transit time may be longer than one month. This factor can lead to problems in the activity cycle, more precisely it can provoke a situation that could lead to a non-availability of sliding bases at SIR for the loading of ISO containers, unless the company had sliding bases in stock.

Solution 3

The last solution proposed is based on the solution of the sliding bases and it tries to tackle the disadvantage of the need for reverse logistics.

The only reason the sliding bases travel with the cargo is because, in a first instance, it seems not possible to remove them from the container as these are at the bottom of each stack of wooden boxes. However, it was thought about an idea that could allow the removal of the sliding bases so they could be always available at SIR.

The proposal is to use hydraulic jacks. After the load is within the container, through the use of the hydraulic jacks the stack of wooden boxes is lifted so it can be possible to remove the sliding bases from the bottom. Once these are removed, the hydraulic jacks lay down the cargo on the container floor and afterwards they are also removed.

The hydraulic jacks in question can handle loads until 10 tonnes, thus they are suitable for the SIR reality (Manutan, 2011).

The following figure presents the schematization of the process just described.

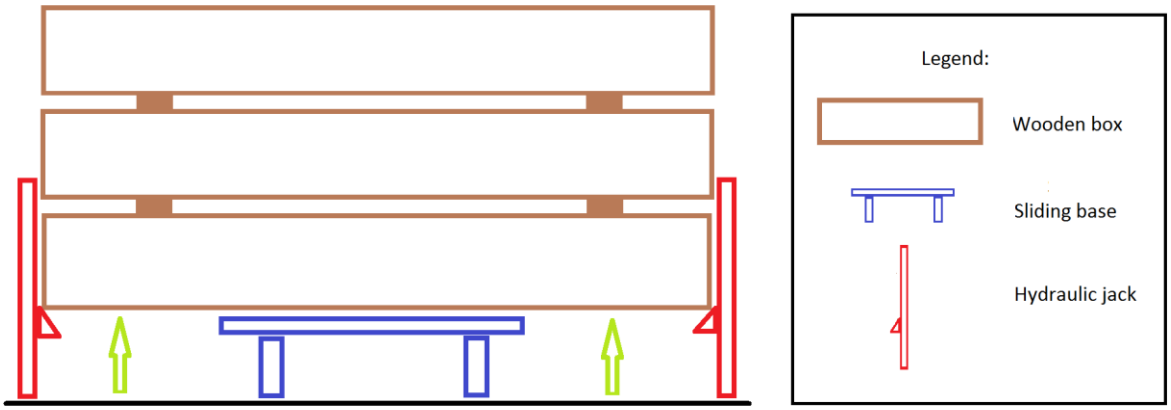


Figure 13 – Schematization of the use of the hydraulic jacks to remove the sliding bases.

4.3 Results

In this section are only described the costs, because the measurement of the real time to perform the activity was not possible to do due to the fact that the proposals were not yet tested. However, it is something that in the future should be taken into consideration.

In order to simplify comparison between the costs of the various proposals, the cost of outsource the containerisation is reminded below.

$Cost\ of\ outsource\ the\ containerisation = 361.93\ €$

The costs for each of the proposals mentioned in the Approach are, starting with the first proposal that is the one that uses the compact rails and the Teflon PTFE.

$Teflon\ PTFE - 12{,}06\ €\ per\ spray\ can$

$Compact\ with\ 13\ mm\ of\ thickness - 22{,}00\ €\ per\ m^2$

It is estimated that a spray Teflon PTFE can lasts 10 applications, so the cost is € 1.206 for containerisation. In terms of compact, after conducting the calculations, it is necessary 0.4066 m^2. The costs per containerisation are:

$Teflon\ PTFE = 1{,}206\ €$

$Compact\ cost = 8{,}95€$

$Transportation\ of\ the\ wooden\ boxes\ from\ Maia\ to\ Porto\ Leixões = 118\ €$

$Total\ containerisation\ cost = 128{,}16\ €$

Considering now the second proposal. Each sliding base costs € 519. By the fact this solution requires reverse logistics, considering a weekly trip from Maia to South Africa, 36 sliding bases are necessary, as explained in the forward figure, to ensure the activity cycle, since the transit time is 4 weeks by ocean. The cost of the return trip is € 460.

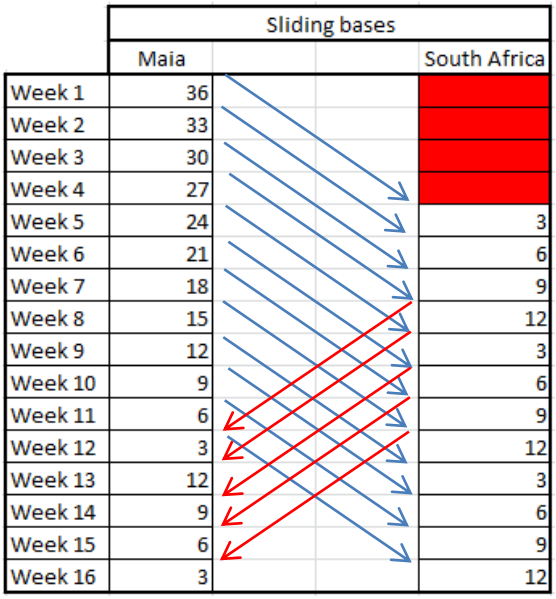


Figure 14 – Schematization of the sliding bases logistics

In short, the costs are:

$Initial\ investment\ on\ sliding\ bases = 18684\ €$

$Annual\ cost\ of\ sea\ reverse\ trips = 5520\ €$

$Annual\ cost\ of\ the\ trips\ from\ Maia\ to\ Porto\ Leixões = 5664\ €$

$Annual\ cost\ of\ outsource\ the\ containerisation = 17373\ €$

$Time\ to\ recover\ the\ investment - 37\ months$

The third proposal is going to be described in terms of costs and time to recover the investment. This proposal just requires 3 sliding bases, each one costs 519 €. In addition, it requires 4 hydraulic jacks that, 10 tonnes of capacity, that cost 737 €. In short, the results are:

$Initial\ investment\ on\ sliding\ bases\ and\ hydraulic\ jacks = 5024\ €$

$Annual\ cost\ of\ the\ trips\ from\ Maia\ to\ Porto\ Leixões = 5664\ €$

$Annual\ cost\ of\ outsource\ the\ containerisation = 17373\ €$

$Time\ to\ recover\ the\ investment - 5\ months$

5 Carriers analysis

5.1 Description of the problem

The following table gives a brief idea of the weight of the Outbound Logistics costs in the NBB by site, showing Total Transportation Cost (TTC), the Turnover and the ratio TTC / Turnover.

Table 2 – Structure of the Transportation costs

	SIR	*MP - Vilela*	*MP - Alcanede*	*Euroresinas Impregnation*	*Impaper*	*GHP*
TTC (€)	206.300	87.070	207.749	347.707	1.108.350	815.850
Turnover (€)	24.309.717	2.519.883	3.409.438	11.490.269	53.376.520	28.409.720
TTC / Turnover	1,07 %	3,46 %	5,95 %	3,03 %	2,08 %	3,15 %

SIR has a ratio TTC / Turnover relatively low, compared with the rest of the sites of the NBB group, however it must be considered that its main costumer, Fibotrespo, pays for the transportation of the deliveries. If these costs were borne by the company it would be expected for the ratio to increase to values similar to the other sites.

Actually any evaluation or analysis is made to the carriers. It should be done in order to rank the players so it would be possible to know which ones have the best levels of performance according the characteristics of each company.

In practice, the selection of carriers depends on the skill of the person responsible for the expedition. They select the operators for each market due to the experience they have. Thus, selection is made based on the price proposed by inquired transporters and on the reliability of their track record.

In the case of SIR, for example, the person in charge of expedition knows that for Central Europe he can choose between 2 or 3 carriers that, although being more expensive than other operators, assure a better service without unexpected surprises.

There is no methodology in place regarding the evaluation of the carriers. In the contracts the only factor that matters is the prices of each player for all the locations available.

Taking as reference the best practices outlined in the state of the art, it can be noticed that some of them are not being applied and used in the NBB.

In a first instance the carriers are not being managed globally across all plants and divisions. Each site manages its individual operators, and may not take advantage of potential synergies between the companies.

As described at the State of the art, the management of carriers considering the global supply chain provides opportunities regarding the aggregation and consolidation of cargo, the

identification of core carriers for specific routes, a combination of routes between companies and other opportunities in order to eliminate waste.

This is a verification of the old paradigm of the functional silos, where each department sought to optimize locally their activities in order to exhibit the best performance. However, often the local optimum does not guarantee the global optimum. This last optimum can be achieved through the creation of synergy among the companies and overall management.

In a second instance, another best practice that is being poorly practiced in the NBB is the creation of a core group of carriers across all sites. This practice helps reduce administrative costs, facilitate communication, improve the mesh between companies and creates a closer relationship between the entities based on the optics of the partnership.

This core group of carriers should be managed on a global level and therefore it should be done the selection of a group of carriers to carry out the transportation of the NBB. Also at a local level this practice should be considered, at least, and in order to not create conflicts with the global interests, while global overall management of the carriers is not made. In fact, surely that would facilitate the selection of carriers on a global level, after doing a study and a local selection of those who are the most prevalent carriers for each site.

As can be seen in the following table this practice is adopted in some of the companies of the NBB, but the most important sites, in terms of turnover, are on the verge of have too many logistics operators. The table 3 exposes the number of carriers that each site has outsourced at 2011, the number of costumers and the ratio between the number of carriers and number of costumers.

Table 3 – Carriers outsourced information in 2011 per each site

Site	*Nr of carriers*	*Nr of costumers*	*Ratio*
SIR	13	190	0,068
MP – Vilela	4	71	0,056
MP – Alcanede	3	135	0,022
Euroresinas - Impregnation	1	4	0,25
Impaper	42	34	1,235
GHP	101	292	0,346

The ratio is an important indicator to understand if there are too many carriers for the number of costumers. As can be checked on the table, GHP is the company with the higher number of carriers, so in absolute terms it is the enterprise that on a first sight seems to have too many logistics operators subcontracted, however is the Impaper that has the higher ratio and even higher than 1, which means that it has an higher number of carriers than costumers, so maybe it is this site that is executing the management of carriers poorly.

The Movelpartes makes use of the best practice described above in a prudent manner, maintaining the transport activity focused between 3-4 operators.

In the case of Euroresinas, the fact of working with one carrier only can lead to a situation of dependence. However, it also should be noted that this company in the past worked with a

large group of operators and deliberately reduced the number to one carrier to benefit from the advantages described in best practice.

The ratio of SIR seems well comparing to Movelpartes.

It seems that Impaper and GHP have too many logistics operators having as base the number of costumers.

Independently of the number of costumers, the number of carriers should be low for the reasons mentioned in the State of the art. Depending on the number of costumers, the logistics operators that should be subcontracted must be companies that are appropriate to the amount of customers and their geographic dispersion.

5.2 Approach

The proposed methodology for this theme was built with the aim of addressing the main points mentioned in the description of this problem, which are: companies of the group have a high number of logistics operators with whom they work with, it is not made any kind of validation of the carriers and the contracts with them do not safeguard cost control of variables and the conditions effectively relevant to the companies.

Each company of the group should be able to present to carriers a term sheet stating the conditions that best describe the company's needs, a document that validates some performance indicators and that provides the information required to make a convenient selection of a core group of carriers.

The current contracts with the carriers are defined based only on the price for the standard destinations provided by logistic operators. However, the ideal is to present a contract with the conditions that benefit better the company, otherwise it can be presented by the carriers good conditions but that are not at all interesting for the company.

For example, an operator can submit the best overall price, however for a particular market it does not have competitive prices and that same market[3] can be a key market for the company. If all the carriers selected have this deficiency, then, although they presented a good overall prices, the company will be harmed by the fact that it did not guaranteed a carrier with good prices for that key market.

Another type of situation that it is to be avoided is that a carrier may have great prices for a market of interest to the company, but for loads without interest. For example, the operator may have exceptional prices for a full truck, but for that marketplace, what matters for the company are the prices for less than truckload.

Therefore the aim is to identify the conditions that most interest the company in question, i.e., which are its main markets, core costumers and which loads are more frequent and common. This information will be used for bids of carriers and to compare their proposals, so a proper assessment of the operators is made and, eventually, a selection of the core carriers.

The Approach proposed must be applied annually so it can consider updated conditions, because they can change often. In this dissertation, the methodology was applied for 2011.

[3] In this dissertation, markets are considered geographic markets, more precisely, countries.

General activity profiling of the carriers

The proposed approach begins with the activity profiling of the carriers at a general level. This activity profiling is based on the ranking of carriers depending on the number of trips made for the company under review.

This step provides a perspective of which are the operators who generally work more with the company. This perspective can be important so later it can be available information about which operators the company is used to deal.

This will be stated in a table with the percentages of activity of each carrier, depending on the number of trips that they have been contracted to perform.

Identification of the core markets

The first step was to define the parameters that allow the identification of the core markets. According to the guidelines given by Sonae Indústria, the parameters that were taken into consideration are: volume of traffic in terms of weight or volume, total transportation cost (TTC) and number of deliveries. Each parameter was given equal weight.

The principle is to make a rank of the markets for each parameter defined. For each one of these parameters will be a score in the market, depending on the relative position. These scores will be added up to make the final ranking.

$The\ variable\ R\ is\ the\ Ranking,$

$Rw - Rank\ in\ terms\ of\ weight\ or\ volume;$

$Rt - Rank\ in\ terms\ of\ TTC;$

$Rn - Rank\ in\ terms\ of\ number\ of\ deliveries.$

$The\ variable\ Y\ is\ the\ number\ of\ markets.$

$The\ variable\ G\ is\ the\ grade\ of\ the\ market,$

$Gw - Grade\ in\ terms\ of\ weight\ or\ volume;$

$Gt - Grade\ in\ terms\ of\ TTC;$

$Gn - Grade\ in\ terms\ of\ number\ of\ deliveries;$

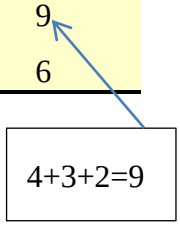
$R(n) = Number\ of\ the\ rank;$

$G(n) = Y - (R(n) - 1);\ an\ inverse\ classification\ is\ done.$

For each parameter and each market, a grade will be obtained. Afterwards, the three grades are added up to find the final rank of the markets. The following table has an illustrative example to ease the comprehension about the final grade.

Table 4 – Illustrative example concerning the core markets

Market	*Weight*	*Rw*	*Gw*	*TTC*	*Rt*	*Gt*	*Nr. Trips*	*Rn*	*Gn*	*Final grade*
PT	5000	2	3	4000	4	1	50	1	4	8
ES	3000	3	2	5000	3	2	40	2	3	7
GB	10000	1	4	10000	2	3	30	3	2	9
DE	2000	4	1	15000	1	4	20	4	1	6



In draw case, the better Rw makes the untie.

On the preview example, GB is the most important market in outbound Logistics terms and DE is the less one.

The managers of the site shall define core markets using this approach.

Activity profiling of the carriers per market

The activity profiling of the carriers for the core markets should be made in order to identify which are most outsourced for specific locations.

To have an idea which carriers the company is more used to work with in terms of deliveries is essential because there may be a carrier that in a general level is the most used, however for a given market that is very important, the site outsources more often another carrier. So it is relevant to do this analysis in order that later there is detailed and unambiguous information enough to define the core group of carriers.

As for the general perspective, results shall be presented a chart with the percentages of activity of each carrier for each core market, depending on the number of trips that they have been contracted to perform.

Identification of the core costumers per market

In order to identify the most important costumers per market a hierarchy of customers should be made for each of the core markets.

This analysis is important in the perspective of later provide an analysis and a study of the characteristics in terms of deliveries to these customers in order to better define the contract to the carriers.

To proceed to the prioritization of costumers for each core market the approach used in the identification of the core markets should be used. Therefore for each costumer a grading of the flows in terms of weight / volume, TTC and number of trips should be made.

It is again up to managers of the company to give the final verdict in the definition of the core costumers after being provided the ranking of customers in terms of Outbound Logistics.

Identification of the most frequent cargo per core costumer

After the identification of the main markets, and within those markets which are the customers more prevalent in terms of logistics flows, it is time to understand which are the load values more frequent in terms of weight (kg) or volume (m^3), as the unit of measure used by the company under review depending on the type of product.

The purpose of this analysis derives from the fact that an operator can have good prices for the location of a particular customer, but to load specific quantities that are never sent by the company and therefore without any interest.

The methodology for identifying which loads are the most common for the core costumers is through the use of Pareto diagrams. This is a bar graph showing the frequency of occurrences ordered from largest to smallest, allowing the prioritizing of problems, in this case of the loads. It is necessary to create load intervals so it can be possible to record the occurrence of those ranges. The intervals must be set according to the flow being analysed. If a flow has very similar loads, then the intervals must have reduced amplitude, for dispersed values of loads, the intervals can and should have higher amplitude.

After presentation of the Pareto diagrams for each customer, company managers must determine which are the most common cargo volumes for each core costumer.

Definition of the indicators to assess the carriers performance

Taking into account the indicators presented in the State of the art, it was noted that there are four that are practically common to the various authors:

- Claim-free shipment percentage;
- Damage-free shipment percentage;
- On-time arrival percentage;
- Distance between accidents.

The indicators just described were the ones selected to be included in the process of assessing the carrier's performance. It is debatable whether there should be included other indicators, but from a more practical point of view and in accordance with the guidelines given by the company, they must be simple to measure and relevant, therefore it was proposed that these were the most significant to be analysed.

Term sheet

In order to create a core group of carriers and to make an assessment to the various carriers, a term sheet that covers the issues critical to the company in question should be presented for quote to the carriers, so that their quotes can be compared. This term sheet also must include the performance indicators so they can also be taken into consideration.

The term sheet must contain overall performance indicators of the carrier and the same indicators for the various core markets of the company, the transit time and the frequency of service to the core markets presented. Then, for each core costumer of each core market, quotes should be asked for the cargos identified as the most common.

5.3 Results

Due to reasons of limitations of time, this analysis was limited to SIR according to the indications received by the Sonae Indústria.

Below, the results of the methodology proposed will be shown for Sonae Indústria de Revestimentos for the year of 2011.

General activity profiling of the carriers

The following chart expose the percentage of trips per carrier.

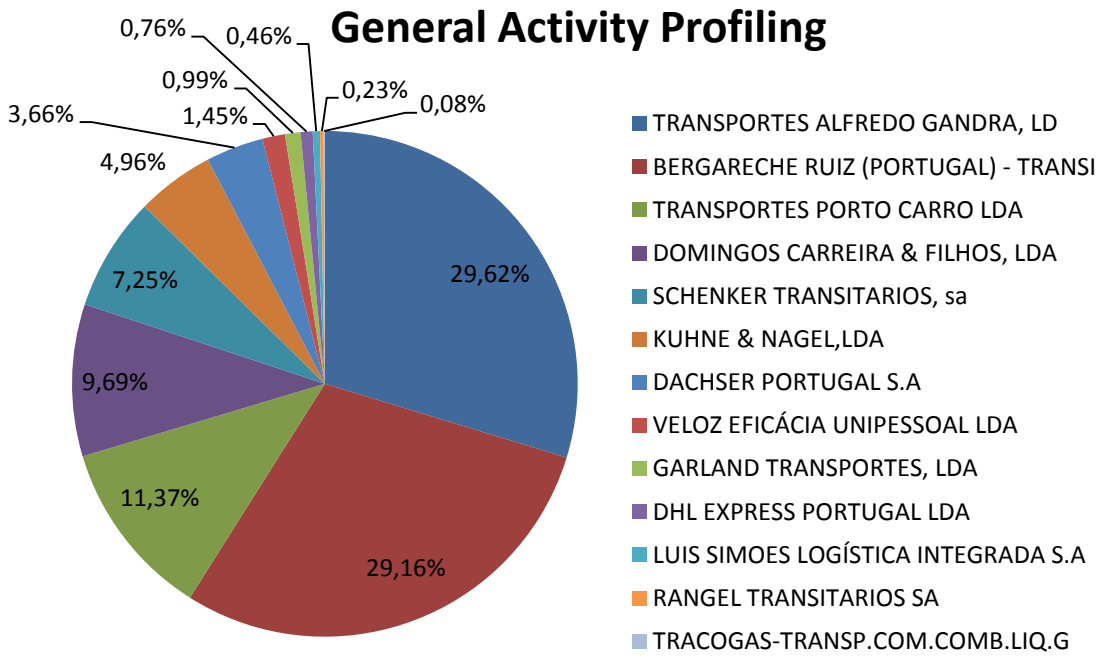


Figure 15 – General activity profiling

Identification of the core markets

The next table, reveals the grades and ranking for each market.

Table 5 – Analysis of the core markets

Market	*Weight (Kg)*	*Rw*	*Gw*	*TTC (€)*	*Rt*	*Gt*	*Nr. of trips*	*Rn*	*Gn*	*Grade*	*Rank*
ES	726341	1	8	64253	1	8	533	2	7	23	1
PT	278812	2	7	18586	4	5	542	1	8	20	2
FR	220782	3	6	24805	3	6	96	3	6	18	3
GB	175140	4	5	29151	2	7	69	4	5	17	4
DE	54608	5	4	8018	6	3	28	5	4	11	5
PL	19692	6	3	8324	5	4	10	7	2	9	6
IT	15778	7	2	2668	7	2	20	6	3	7	7
NL	6556	8	1	1196	8	1	8	8	1	3	8

According the approach, the final decision on which are the effectivly the core makets lies with company managers. They agreed with the rank of the analysis and selected the first 5 makets as the main: ES, PT, FR, GB and DE.

Activity profiling of the carriers per market

The following chart presents the example of the activity profiling in the ES market, in order to give a perceptible view so it can be identified if the carriers more often outsourced in the general perspective coincide with the activity profiling per market. In the Annex A can be seen the activity profiling of all markets.

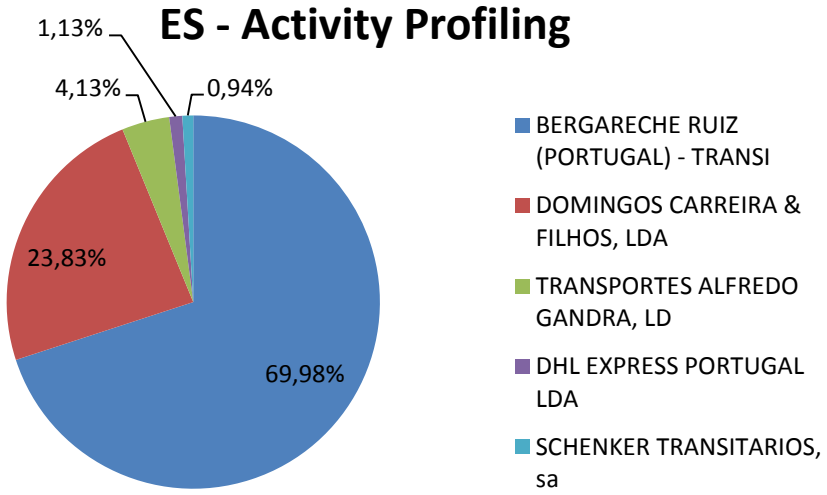


Figure 16 – ES Activity profiling

Identification of the core costumers per market

This analysis has the purpose of providing a rank of the costumers per market in order to give a perspective about some variables so the managers can take an upheld decision. The next table shows the rank of the top 10 costumers of the ES market that was considered the most relevant market to SIR. The ranks of all costumers for each market are shown in Annex B.

Table 6 – Rank of the costumers of the ES market

Costumers	*Weight (Kg)*	*R w*	*G w*	*TTC (€)*	*R t*	*G t*	*Nr. of trips*	*R n*	*G n*	*Grade*	*Rank*
TAFISA	213717	1	10	5900	2	9	24	4	7	26	2
PRIFORM, S.A.(BARC	88917	2	9	5869	3	8	40	2	9	26	3
COMPOSITES GUREA, S.A.	87198	3	8	3246	5	6	8	9	2	16	5
GPO.ALVIC FR MOBILIARIO S.L.	75123	4	7	9923	1	10	43	1	10	27	1
POMA S.A.	29172	5	6	4830	4	7	35	3	8	21	4
SANTOS COCINA Y BA\O, S.L. TEF	28937	6	5	2170	8	3	12	7	4	12	8
POSTFORMADOS SALAS S.A.L.	21582	7	4	2713	7	4	18	6	5	13	7
MADERAS LAMELAS, S.L. TEL	14805	8	3	2965	6	5	20	5	6	14	6

MAMPAR S.A.	12485	9	2	938	10	1	8	10	1	4	10
INDÚSTRIAS LOSAN, S.A.	12146	10	1	2060	9	2	10	8	3	6	9

According to the approach, the managers had the last word about the core costumers for each market. Having as base these analysis made to the costumers of each market, they decided that the core costumers for ES market are the ones described in the next table.

Table 7 – Core costumers for each market

Market	*Core costumers*
ES	GPO Alvic; Tafisa; Priform; Poma; Composites Gurea.
PT	Iberoperfil; Aguedaplaca; Mobapec; J.P. Leitão; Tecniwood.
FR	Isoroy; Comey; Jeld-Wen.
GB	Armitage; Arnold; Carella.
DE	Nettgau AG

As can be verified, the core costumers coincide with the top costumers of the ranks made.

Identification of the most frequent cargo quantity per core costumer

For the definition of the most frequent cargo quantity per core costumer Pareto diagrams were used. For each core costumer of each core market this analysis was made. The following chart presents the GPO Alvic cargo analysis, in the abscissa axis is the weigth of cargo in Kg and in the ordinate abscissa is represented the number of occurrences for each cargo. The cargo analysis for all costumers can be viewed in the Annex C.

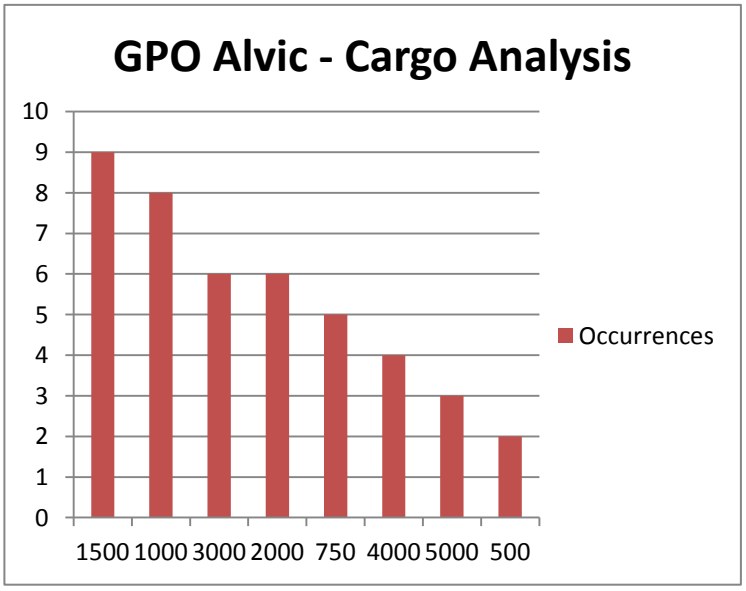


Figure 17 – Cargo analysis of the GPO Alvic

Once again, the last decision was up to managers. With the support of this information, they decided the most frequent cargos for each core costumer. The final veredict is reveled in the following table.

Table 8 – Most frequent cargo quantities per core costumer

Costumer	*Most frequent cargos (Kg)*
GPO Alvic	3000 | 2000 | 1500 | 1000 | 750
Tafisa	20000 | 15000 | 10000 | 4000
Priform	4000 | 3000 | 1500 | 1000
Poma	1500 | 1000 | 750 | 500
Composites Gurea	15000
Iberoperfil	3000 | 2000 | 1500 | 1000 | 500
Aguedaplaca	3000 | 1500 | 1000 | 500 | 200
J. P. Leitão	1500 | 1000 | 750 | 500
Mobapec	3000 | 500 | 250 | 150
Tecniwood	1500 | 750 | 500 | 250
Isoroy	10000 | 4000 | 3000 | 1500
Comey	5000 | 4000 | 3000 | 1500
Jeld-Wen	2000 | 1500 | 750
Armitage	10000 | 4000 | 3000 | 2000 | 750
Arnold	3000 | 2000 | 1000
Carella	3000
Nettgau AG	10000 | 4000 | 3000 | 2000 | 1000

Term sheet

After all the above analysis, it was possible to create a term sheet in order to request quotes for logistics operators to conditions that will effectively interest SIR.

The term sheet to be provided to the carriers is shown in Annex D.

Carriers must meet all these references, then the comparison between operators should be taken based on this document.

It is believed that after the exposition of the data studied, the managers of the company will have proper information to proceed to the core carriers selection.

6 Cargo consolidation

6.1 Description of the problem

The subject cargo consolidation arises from the absence of synergy mentioned before.

If the global supply chain had been analysed as a whole and if partnerships had been made with a core group of logistic operators on a global level, it would be their responsibility to combine and analyse this kind of consolidation in order to present better contracts than the competition. Beyond that, as Transportation is their core activity, they often possess Information Systems for flows optimization and consolidation that facilitate this kind of analysis.

As mentioned in the State of the art, the concept of consolidation refers to the possibility of aggregating cargos from separate companies of the group so that the cost of transportation can be cheaper. Obviously, these consolidations can only be applied if they are more profitable and when transports previously used did not maximize weight and volume paid for. Otherwise, it is advantageous to individually send the orders to be performed without any aggregation.

Currently, there are three consolidations being made, but with a very low frequency. Once again this activity is made due to the professional experience of the expedition professionals, that try to identify when it is possible or not to make the consolidation. However, as already discussed in the State of the art, this type of problem has a set of constraints which have to be satisfied so it can be possible to do the consolidation, therefore it is hard to recognize and to identify only by the experience of the expedition professional when it should be made.

The main flows of the NBB sites have to be considered so that standard and frequent consolidations can be identified. After this study, it would be useful to define guidelines to ease the communication between the sites and in order to facilitate the identification of possible consolidations.

There is a flow of reverse logistics of pallets between SIR and Euroresinas, 3 times a week. Therefore this flow could be used to send cargos to Euroresinas from SIR without any additional transport costs, if reverse logistics do not fully use weight and volume capacity. This could be advantageous since Euroresinas is on average sending cargos to GHP 2 times a week and using an average of 22 tonnes of 24 tonnes of the truck capacity. This flow also has no extra cost, since it is being paid full truck and therefore there is no difference in terms of costs to send 22 or 24 tonnes. As GHP and SIR have some costumers in common, numerous consolidations may be possible.

Currently, the consolidations that are being made are for the following customers: Armitage from United Kingdom, Juan from Poland and Nettgau - Glunz AG from Germany. The next figure illustrates these consolidations.

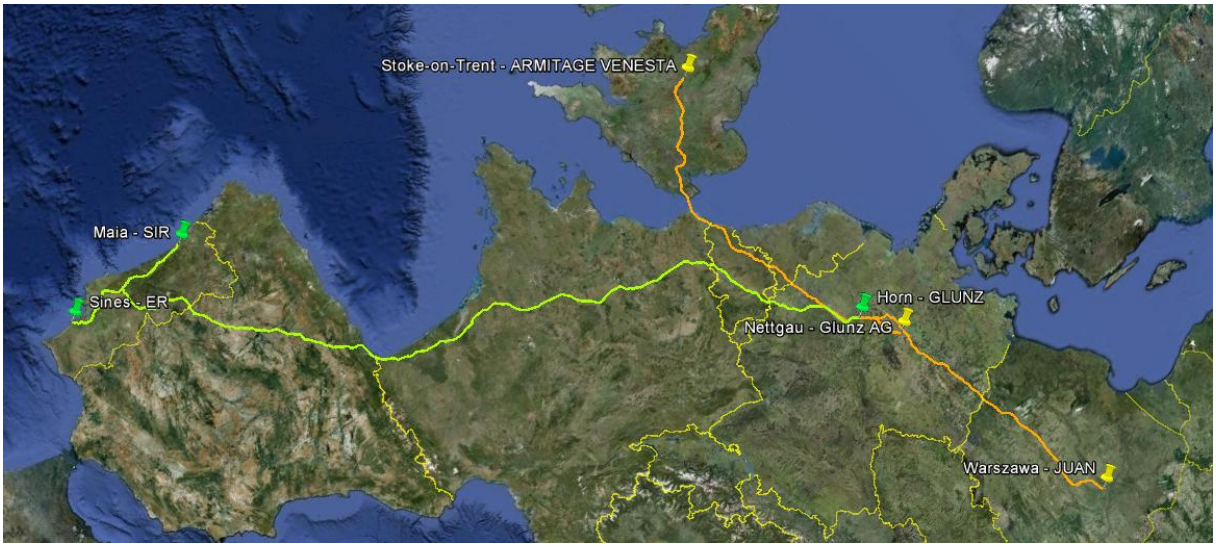


Figure 18 – Current consolidations

6.2 Approach

A evaluation of a heuristic could be made in this dissertation, however according to the indications given by the company, the application of a heuristic is only justified at a later stage. The objectives are to study and identify consolidations and afterwards to verify which ones are profitable for the group Sonae Indústria. The proposed approach was then constructed according to the indications and necessities outlined by the company.

The first step of this approach was to collect all the information of outside transportation flows of all the companies of the group. To have access to this information is essential so that the flows can be identified and presented the particular features. As was the case for the carrier's analysis, this methodology should be made periodically to check if the conditions had remained or changed.

Once collected the information of the flows, the routes of all companies of the group were traced on Google Earth so that later it could be possible to identify which ones are overlapping and therefore to recognize those that may potentially be consolidated. It should be noted that the assumption of the routes traced on the Google Earth imply that the shortest routes between the destinations are used. However as the group companies outsource transportation for deliveries of fractionated loads, nothing guarantees that the carriers actually make the pathways obtained. Whatsoever, the view that Google Earth provides of the flows allow an easier identification of routes that may be consolidated.

The following figure shows the main flows of each site of the NBB.

Figure 19 – Main flows of all sites of the NBB

After the routes have been drawn the next step was to analyse which routes overlapped and to verify if they comply with the constraints inherent to this type of problem, namely the consolidation of loads do not exceed the capacity of the truck, 24 tonnes. To verify this restriction, the average values of the loads of the flows in analysis were considered. If the sum of the means of consolidating loads is greater than 24 tonnes, then the consolidation is considered "discarded", otherwise it is considered "accepted". It is assumed that using mean values of the loads could be risky and may lead to unrealistic values.

For example, considering one flow where half of the deliveries are made with a load of 4 tonnes, and the remaining made with loads of 24 tonnes, this leads to an average of 14 tonnes. This average value is considered by many logistic operators as equivalent to a full truck and therefore, at costs level, instead of a situation where half of the trips are made in full truck and half in less than truckload, a situation would be considered where all trips are made with full truck. Another situation inherent in this type of consideration is the fact that the average value of 14 tonnes always allows a consolidation with other loads up to 10 tonnes, when in reality half the time it is not possible to do any kind of consolidation since half of trips are made using the full capacity of the truck. Therefore, only in half of the trips it is possible to do consolidations with loads up to 20 tonnes.

In conclusion, using the mean values can lead to inadequate solutions. The solution to the conditions of the example would be to discard the trips made with 24 tonnes, since they could not be utilized to make a consolidation, thus taking into consideration only the trips with loads of 4 tonnes. A variable that would be affected by this consideration would be the number of deliveries per week, since in this case it was only considered the trips made with loads of 4 tonnes and not all trips. Therefore a decreasing of the value of deliveries per week for that pair origin-destination would be introduced.

An extra care is thus necessary when considering mean values and therefore for each flow it has to be verified if there are outliers as shown in the example.

Another important variable to consider is the number of deliveries per week. Consider the following example: company A sends to the costumer X 12 tonnes and the company B sends an average load of 12 tonnes to the same costumer. The consolidation seems to be possible, however if the number of deliveries per week in both cases is 0,25, i.e. on average every

company sends a cargo per month, consolidation would mean a decrease in customer service. Despite the fact that this consolidation seems to be profitable, the truth is that the number of deliveries per week is so low, that it can't be made. It should be considered that a consolidation can be made for deliveries that have the date of delivery in the same week.

In the following figures examples are given of a "discarded" and "accepted" consolidation.

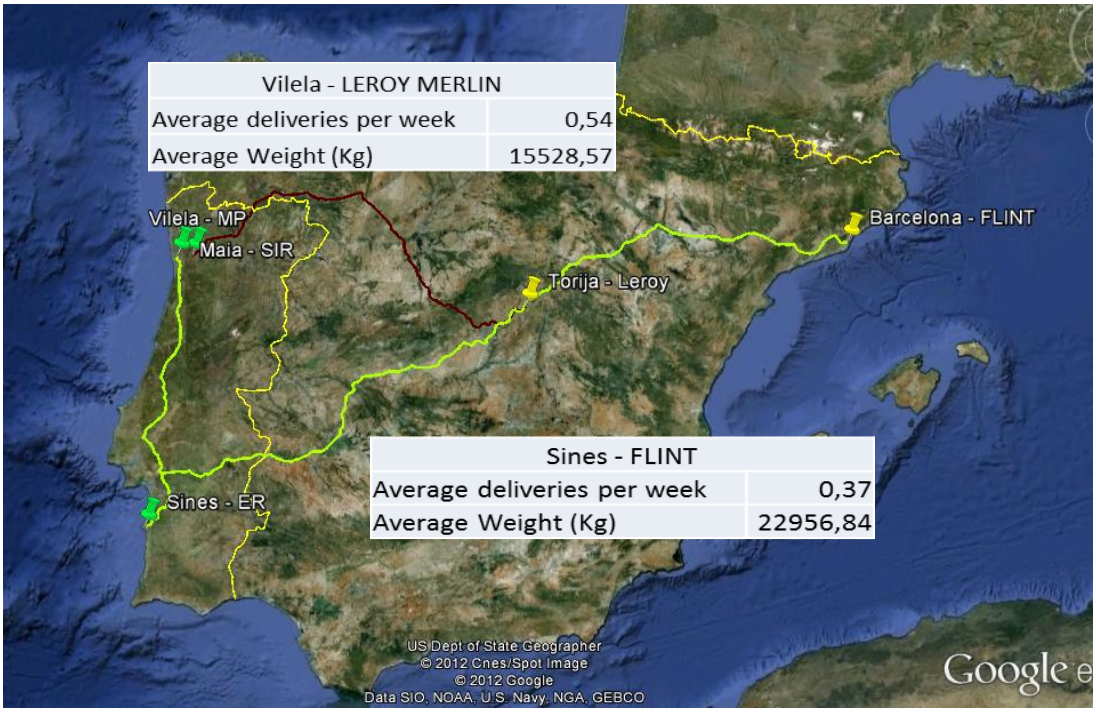


Figure 20 – Discarded consolidation: Vilela → Maia → Sines → Torija → Barcelona

In the discarded case, in which the load is carried from Vilela to Maia, the cargo would travel with the return pallets to Sines, to be consolidated with the cargo of Sines to Barcelona, making a deviation in Torija to make the deliver from Vilela. However, the consolidation is not possible because the constraint of the maximum cargo is not verified. That is the reason this consolidation was considered discarded.

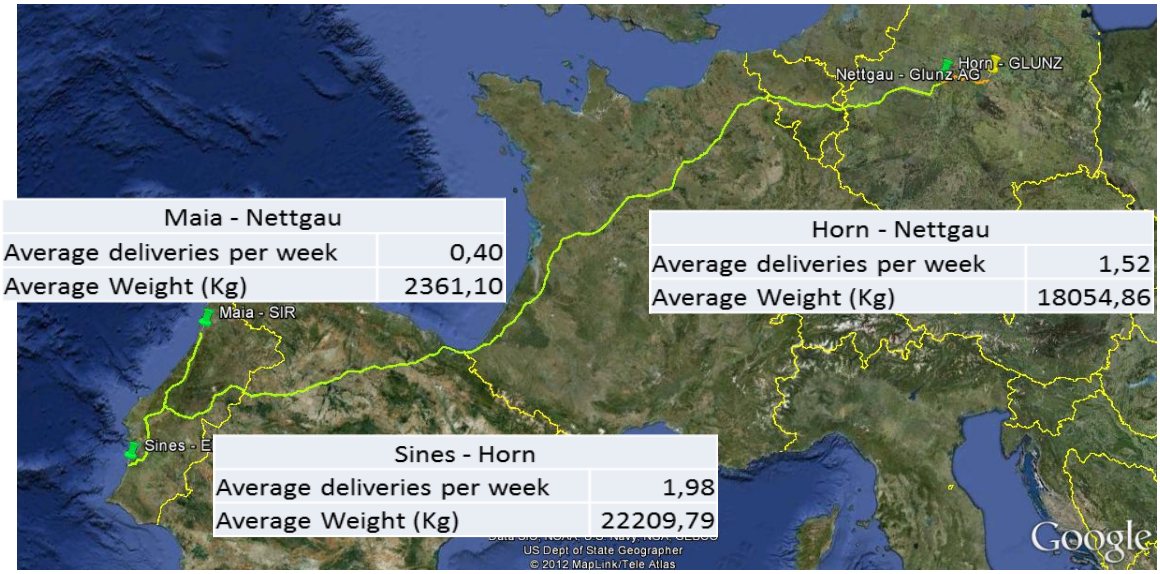


Figure 21 – Accepted consolidation: Maia → Sines → Horn → Nettgau

In the accepted example is represented a consolidation that might be interesting. The cargo from Maia to Nettgau travels with the return of pallets to Sines. Then, this load is consolidated with the cargo of Sines to Horn. Finally, arriving at Horn it is again consolidated with the cargo from Horn to Nettgau. It should be noted that in this example the first consolidation (the load from Maia to Nettgau with the load of Sines to Horn) exceeds 24 tonnes, but in the case of internal customers, the guidelines of the Sonae Indústria, in these ocurrences, allow some flexibility in the quantities from Sines to Horn in order to be able to perform the consolidation. This is because for being an internal costumer there is not a commitment to deliver exactly that amount of load. These guidelines can lead to more frequent deliveries which is not as bad as apparent, because it could allow more consolidations to be done and at GHP is possible to keep some stock if needed.

As already implied, the consolidations of cargo in Sines and Horn from Maia to common destinations are essential to obtain the desired synergy, since there are returns of pallets 2 to 3 times a week from Maia to Sines and therefore this return can be done with the cargos to customers of Maia without any additional cost. The same applies in the route of Sines to Horn due to the fact that this route is always paid as full truck and therefore carrying between 20 tonnes and 24 tonnes the price is the same.

One relevant issue to be considered in the case of a low frequency of deliveries to certain customers of the group, which, as already explained, can make consolidation unfeasible, is the possibility of sending the cargo from another group company, if it is cheaper than sending directly the delivery.

To ease the comprehension about this subject, the following example can be useful: Maia has a delivery to Warsaw in week A, therefore a consolidation can be made similar to the accepted example above. Suppose in that week, Horn does not have a delivery to that costumer. However, it could be verified if sending the cargo from Horn to Warsaw is cheaper than sending directly from Maia, since, as described in the preceding paragraph, to carry small loads twice a week from Maia to Horn can be done without any additional costs.

There is another interesting way of consolidation that was also analysed, via Vilela to Heusweiller. The details of the consolidations are set out in annexes.

In Annex E are listed the consolidations deemed acceptable. The results about their profitability are explained in the next chapter where the study for each consolidation is made.

6.3 Results

In the present sub-chapter will be exposed the results of the study over the consolidations where it was possible to collect the information needed.

In the following tables is described the costs to deliver individually, the costs of deliver through consolidations and, when suitable, the costs of sending from other company taking advantage of some previous consolidations.

Table 9 – Consolidation 1 results

Without consolidation			*With consolidation*		
Maia – Nettgau	–	352,80 €	**Maia – Sines**		0,00 €
Sines – Horn	–	2300,00 €	**Sines – Horn**	–	2300,00 €
Horn – Nettgau	-	317,47 €	**Horn – Nettgau**	–	317,47 €
Total		2970,27€	**Total**		2617,47€
			Saving		352, 8 €
			Saving %		11,88 %

Table 10 – Consolidation 2 results

Without consolidation		*With consolidation*		*Sending from Horn*	
Maia – Juan	550 €	**Maia – Sines**	0 €	**Horn (Maia) – Juan**	400 €
Sines – Horn	2300 €	**Sines – Horn**	2300 €	**Saving**	150 €
Horn - Juan	400 €	**Horn - Juan**	500 €	**Saving %**	27,35 %
Total	3250 €	**Total**	2800 €		
		Saving	450 €		
		Saving %	13,86 %		

Table 11 - Consolidation 3 results

Without consolidation			*With consolidation*		*Sending from Horn*	
Maia – Isoroy	–	241 €	**Maia – Sines**	0 €	**Horn (Maia) – Isoroy**	500 €
Sines – Horn	–	2300 €	**Sines – Horn**	– 2300 €	**Loss**	150 €
Horn – Isoroy	–	500 €	**Horn – Isoroy**	– 700 €	**Loss %**	107,19 %
Total		3041 €	**Total**	3000 €		
			Saving	41 €		
			Saving %	1,36 %		

Table 12 - Consolidation 4 results

Without consolidation		*With consolidation*		*Sending from Horn*	
Maia – Comey	227 €	**Maia – Sines**	0 €	**Horn (Maia) – Isoroy**	500 €
Sines – Horn	2300 €	**Sines – Horn**	2300 €	**Loss**	273 €
Horn – Isoroy	500 €	**Horn – Isoroy**	700 €	**Loss %**	119,78 %
Total	3027 €	**Total**	3000 €		
		Saving	27 €		
		Saving %	0,9 %		

Table 13 - Consolidation 5 results

Without consolidation		*With consolidation*	
Maia – Isoroy	241 €	**Maia – Sines**	0 €
Sines – Horn	2300 €	**Sines – Horn**	2500 €
Horn – Isoroy	500 €	**Horn – Isoroy**	500 €
Total	3041 €	**Total**	3000 €
		Saving	41 €
		Saving %	1,36 %

Table 14 - Consolidation 7 results

Without consolidation		*With consolidation*		*Sending from Horn*	
Maia – Jeld-Wen	221 €	**Maia – Sines**	0 €	**Horn (Maia) – Jeld-Wen**	800 €
Sines – Horn	2300 €	**Sines – Horn**	2300 €	**Loss**	579 €
Horn – Jeld-Wen	800 €	**Horn – Jel-Wen**	800 €	**Loss %**	260,89 %
Total	3321 €	**Total**	3100 €		
		Saving	221 €		
		Saving %	6,67 %		

Table 15 - Consolidation 8 results

Sending from Horn	
Horn (Maia) – Usine	450 €
Loss	315 €
Loss %	232,32 %

Table 16 - Consolidation 9 results

Without consolidation			*With consolidation*			*Sending from Horn*	
Maia – Arnold		302 €	**Maia – Sines**		0 €	**Horn (Maia) – Arnold**	942 €
Sines – Horn		2300 €	**Sines – Horn**		2300 €	**Loss**	640 €
Horn – Arnold		1099 €	**Horn – Arnold**		1099 €	**Loss %**	211,51 %
Total		3701 €	**Total**		3399 €		
			Saving		302 €		
			Saving %		8,17 %		

Table 17 - Consolidation 11 results

Without consolidation			*With consolidation*			*Sending from Horn*	
Maia – Armitage		378 €	**Maia – Sines**		0 €	**Horn (Maia) – Armitage**	975 €
Sines – Horn		2300 €	**Sines – Horn**		2300 €	**Loss**	597 €
Horn – Armitage		1570 €	**Horn – Armitage**		1570 €	**Loss %**	157,94 %
Total		4240 €	**Total**		3870 €		
			Saving		370 €		
			Saving %		8,92 %		

7 Conclusions

In this chapter the conclusions of the several studies that have been made throughout the dissertation are presented. In addition to the conclusions, there will also be a reference to the main difficulties and limitations felt that somehow hindered the formulation of methodologies or analysis of results.

Packing

After the analysis over the results, it is easy to conclude that the adhesive textile straps with 19 and 16 mm of thickness are not competitive when compared with the current solution, being more expensive between 21-65%.

In turn, the straps of 13 mm of thickness raise some doubts referent to its competitiveness, because the results are not at all conclusive: 2% are more expensive for the reference of the truck to Fibotrespo and 5% more economical in the case of reference of a shipping container. Whatsoever, it must be noted that the context which formed the basis for later comparison with the new proposals is an ideal situation, being reached if the process of strapping was always carried out with automatic equipment, which is not the case in the company, the two equipments, both manual and automatic, are used in equal proportion. Therefore, if the basis of the comparison was the real context, then the textile strap of 13 mm of thickness would be cheaper for any of the references[4]. As already mentioned, the adoption of the ideal solution for the comparison of the new proposals was adopted, because it is a solution that can be reached if the right efforts are done.

One question that might arise is whether it would be better to adopt a mixed solution, since the reference of the truck for Fibotrespo if performed always with automatic equipment would be more economical, so textile straps would be used for ISO containers and for the trucks to Fibotrespo steel straps. However, it is believed that such a solution would not be ideal because of the following factors. First strapping is not a predominant activity, obviously that all activities are important if not they would not be performed, however, is an activity on which there are not too much control. Therefore, it is believed that the most appropriate is simplify the process so that there are no deviations from what was originally established.

By adopting a single type of straps and a single type of equipment to perform the strapping, on the one hand the process is simplified and, in the other hand, it is ensured that no deviations from the intended process will be made, because there are no alternatives.

As a conclusion it can be noted that the adhesive textile strap of 13 mm is an interesting solution, since it is more economical than the effectively current solution, in addition to the several advantageous characteristics described in the State of art that this type of strap presents.

As limitation to the construction of the methodology that inevitably led to an approach which is not totally accurate is the fact that there are not any past record information of this activity. It is not known for sure how much is spent on this activity, how much is spent by truck, the quantity of scrap, and other details. Therefore, two references have been selected which were

[4] The use in equal proportions of the two equipment available would lead the adhesive textile stsaps to be 6% cheaper for the ISO container reference and 5 % more economical regarding the truck for Fibotrespo

referred by the company to be adopted, but in case of fractional loading in addition to the various combinations of different dimensions, it was not possible to verify which strap is more effective.

As future consideration it can be referred that the steel straps begins to fall into disuse, mainly due to environmental issues. We live in a world increasingly concerned with sustainability, so the change in a relatively near future to a more sustainable type of strap is a strong possibility.

Loading

The first proposed solution, compact rails, is the most economical, thus if it is proved that it is a solution 100% effective, then it is certainly a very interesting solution for SIR and could be adopted by other group companies that have the same difficulty. This solution has a limitation in relation to the third, since this last ensures that the sliding bases are always available at the company so there is no risk of failure relatively to lack of equipment to proceed to the containerisation. This first solution of the slats compacts requires the compact to be cut often at GHP. The transportation cost is the same, as is visible in the results, because the compact travels with the return of the pallets to Euroresinas and later to SIR. Therefore, there is a certain risk, relatively low, inherent in this proposal.

The second solution is not considered competitive due to the need of high investment in sliding bases and because there is a need to guarantee the return of the same. Beyond that, the time to amortize the investment, 37 months, goes against the guidelines of the company in which non-strategic investments must be amortized no later than two years. Additionally, there is a risk associated with this solution and is not reduced due to the return travel of the sliding bases by ocean that, for being fractional loadings, is common to have delays which may lead to a break in the activity cycle.

The third solution is considered the intermediate and therefore an interesting solution. The investment is moderate being amortized over five months, does not depend on third parties and therefore the risk of lack of equipment to perform the containerisation is practically null.

In terms of future considerations, an examination of the feasibility of Loadplate positioned in a strategic place for it to be used by some companies of Sonae Indústria, both NBB and BB, would be something that could prove interesting since, taking into account companies of NBB and BB, the number of containerisations is relatively high.

Carriers Analysis

This is a subject on which no conclusion can be drawn, since the aim of the approach was to find a way to assess and validate the logistic operators and create a methodology for building contracts that effectively exposes the conditions prevailing for the company.

Based on these objectives, it is believed that they have been achieved, whatsoever, it can only be confirmed in the future after the implementation.

As forward-looking statements, it is important to note that some of the group companies, including SIR, Impaper and GHP, must seek to create a core group of carriers, since, as mentioned several times, it is a best practice that is relatively easy to implement and with quick results.

A criticism that should be done regarding the approach developed for this theme is that it has not been studied in the contract which weight should be given to performance indicators of logistics operators and the costs, ie, it is not possible to measure though this approach which factors are most prevalent and in order to understand when a solution has better prices but the worst performance indicators. Therefore, there is an opportunity regarding this deficiency and as future consideration it may also be noted that this study should be done in order to allow the comprehension of the most relevant factors.

Cargos consolidation

From the studies conducted in this dissertation about this topic can be concluded that most of the consolidations identified are profitable for the company. This practice is excellent for the creation and development of synergy between the various group companies. It is also considered a best practice, as it is proven that the logistics management should be made across all divisions and plants because the local optimization does not lead often to the global optimum and it is the latter that matters most.

Therefore, this analysis was very relevant and very positive for the group Sonae Indústria and justifies a detailed study about the next steps that have to be done so it can be possible to integrate consolidations into the supply chain activity.

The limitation noted was the fact that some companies did not provide the necessary information to ascertain the profitability of certain consolidations, which raises a curious and interesting aspect, since this lack of interest proves the absence of synergy. If asking a simple and brief information, there was no kind of interest and some barriers were even raised, then it will be extremely difficult to create and to promote the synergy necessary so that consolidations of cargos from various group companies can be made.

As future statement, it is pertinent to study and analyse all the implications and necessary conditions so the consolidations can be made effectively. It is something that has to be carefully thought and well standardized. considering the patterns of communication between companies, the definition of the situations in which loads are removed from internal costumers to allow certain consolidations, to develop a approach that benefits all companies involved, among others. For example, Euroresinas is a key company to the success of consolidations. To send load to GHP with the consolidation does not bring any additional cost, however Euroresinas also gets additional responsibility and work for their employees. Therefore, it is essential to create a policy to eliminate these situations by requiring payment of the technical proportional share of the cost of transport from the companies that benefit from consolidation. Otherwise, there may be no interest from some companies and unconsciously, or not, they may sabotage this practice. It is also fundamental to be aware that in future it is very likely to be necessary to apply a heuristic to optimize the consolidation or even use an Information System.

It is believed that after the full implementation of the approaches proposed, the general objectives of this dissertation can be achieved. Those objectives are: to create and develop the synergy among the NBB companies, to improve the Logistics efficiency by reducing costs and to increase the service level to the costumer.

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ANNEX A: Activity profiling per market

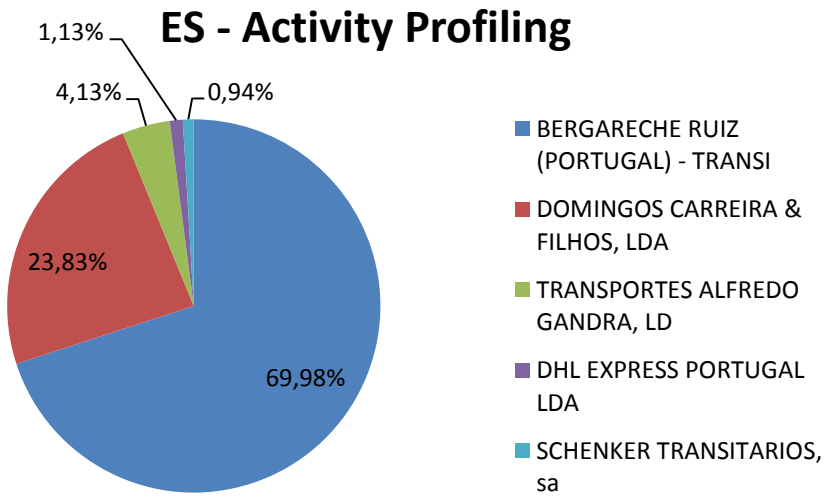

Figure 22 – ES – Activity profiling

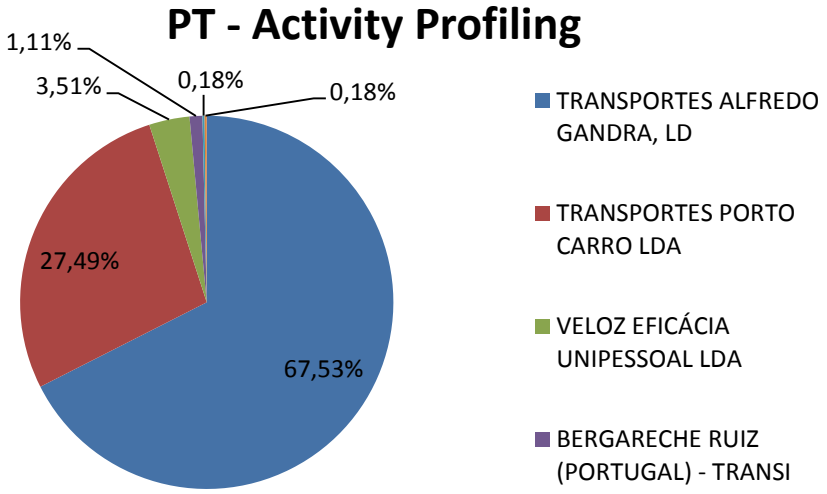

Figure 23 - PT – Activity profiling

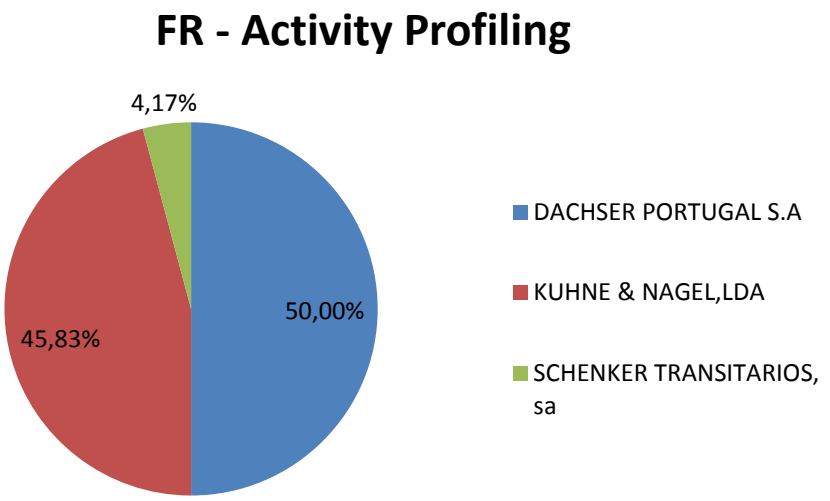

Figure 24 - FR – Activity profiling

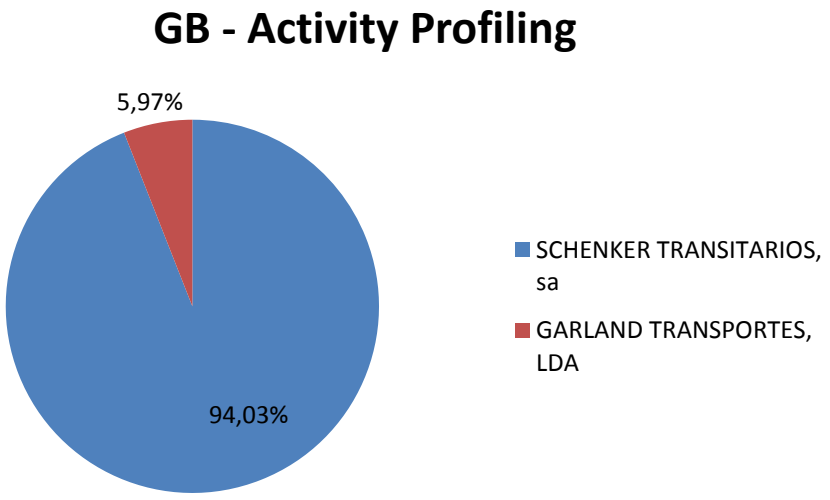

Figure 25 - GB – Activity profiling

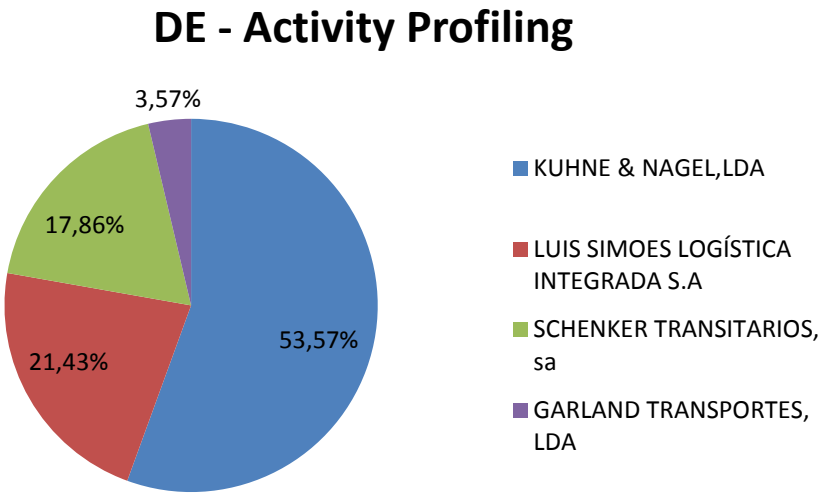

Figure 26 - DE – Activity profiling

ANNEX B: Costumers ranking per market

Table 18 - Ranking of ES core costumers

Costumers	Weight (Kg)	Rw	Gw	TTC (€)	Rt	Gt	Nr. of trips	Rn	Gn	Grade	Final
TAFISA	213717	1	10	5900	2	9	24	4	7	26	2
PRIFORM, S.A.(BARC	88917	2	9	5869	3	8	40	2	9	26	3
COMPOSITES GUREA, S.A.	87198	3	8	3246	5	6	8	9	2	16	5
GPO.ALVIC FR MOBILIARIO S.L.	75123	4	7	9923	1	10	43	1	10	27	1
POMA S.A.	29172	5	6	4830	4	7	35	3	8	21	4
SANTOS COCINA Y BA\O, S.L. TEF	28937	6	5	2170	8	3	12	7	4	12	8
POSTFORMADOS SALAS S.A.L.	21582	7	4	2713	7	4	18	6	5	13	7
MADERAS LAMELAS, S.L. TEL	14805	8	3	2965	6	5	20	5	6	14	6
MAMPAR S.A.	12485	9	2	938	10	1	8	10	1	4	10
INDÚSTRIAS LOSAN, S.A.	12146	10	1	2060	9	2	10	8	3	6	9

Table 19 - Ranking of PT core costumers

Costumers	Weight (Kg)	Rw	Gw	TTC (€)	Rt	Gt	Nr. of trips	Rn	Gn	Grade	Rank
IBEROPERFIL-PERFIS POSTFORMADOS SA	65339	1	10	2829	1	10	43	2	9	29	1
AGUEDAPLACA-COMERCIO DE DERIVADOS D	25858	2	9	1267	2	9	32	3	8	26	2
MOBAPEC-MOBILIARIO ESCOLAR,LDA	24368	3	8	1001	3	8	23	5	6	22	4
J. P.Leitão,Sa/Maia	24271	4	7	812	4	7	47	1	10	24	3
SoaresdaCosta Angola(P/cIberoperf)	16631	5	6	282	9	2	3	10	1	9	9
TECNIWOOD-SOLUÇÕES - MADEIRAS E	14206	6	5	602	7	4	31	4	7	16	5
WOODONE MOBILIÁRIO;SA	13677	7	4	376	8	3	16	8	3	10	8
ARAUJO & LINO, LDA	12693	8	3	709	6	5	22	6	5	13	6
CAETANOBUS-FABRICAÇÃO DE	7754	9	2	225	10	1	11	9	2	5	10
SOMAPIL-SOCIEDADE DE MADEIRASDE PI	7656	10	1	799	5	6	18	7	4	11	7

Table 20- Ranking of FR core costumers

Costumers	Weight (Kg)	Rw	Gw	TTC (€)	Rt	Gt	Nr. of trips	Rn	Gn	Grade	Rank
Isoroy SAS-Auxerre	127882	1	8	11961	1	8	38	1	8	24	1
COMEY	67385	2	7	6897	2	7	27	2	7	21	2
JELD-WEN FRANCE	11739	3	6	2875	3	6	14	3	6	18	3
USINE BANGUI	5368	4	5	713	5	4	5	5	4	13	5
MIMEA FRANCE	3887	5	4	1248	4	5	7	4	5	14	4
HUBLER	2526	6	3	482	6	3	2	6	3	9	6
TECHWOOD	1592	7	2	467	7	2	2	7	2	6	7
DALTEC	403	8	1	161	8	1	1	8	1	3	8

Table 21 - Ranking of GB core costumers

Costumers	Weight (Kg)	Rw	Gw	TTC (€)	Rt	Gt	Nr. of trips	Rn	Gn	Grade	Rank
ARMITAGE VENESTA WASHROOM SYSTEMS	129769	1	7	16653	1	7	39	1	7	21	1
ARNOLD LAVER TIMBER WORLD	20659	2	7	3947	3	5	13	2	6	18	2
CARELLA LAMINATE SYSTEMS LTD T/A	17116	3	5	6198	2	6	6	3	5	16	3
TEACHER BOARDS (1985) LTD	4988	4	4	1351	4	4	4	5	3	11	4
COOKSTOWN PANEL CENTRE LTD	1661	5	3	655	5	3	1	6	2	8	5
KINGSPAN ACCESS FLOOR , LTD	633	6	2	272	6	2	3	4	4	8	6
FALCON PANEL PRODUCTS LTD	267	7	1	76	7	1	1	7	1	3	7

Table 22 - Ranking of DE core costumers

Costumers	Weight (Kg)	Rw	Gw	TTC (€)	Rt	Gt	Nr. of trips	Rn	Gn	Grade	Rank
Glunz AG, Werk Nettgau	49583	1	6	6832	1	6	21	1	6	18	1
Weiss - Doppelbodensysteme GmbH	1558	2	5	427	2	5	3	2	5	15	2
Fries Holzsysteme GmbH	1397	3	4	380	3	4	1	3	4	12	3
Nieburg Kuechen GmbH	791	4	3	182	4	3	1	4	3	9	4
Lindner AG	750	5	2	160	5	2	1	5	2	6	5
GHP GmbH Werk Horn	529	6	1	38	6	1	1	6	1	3	6

ANNEX C: Cargo analysis

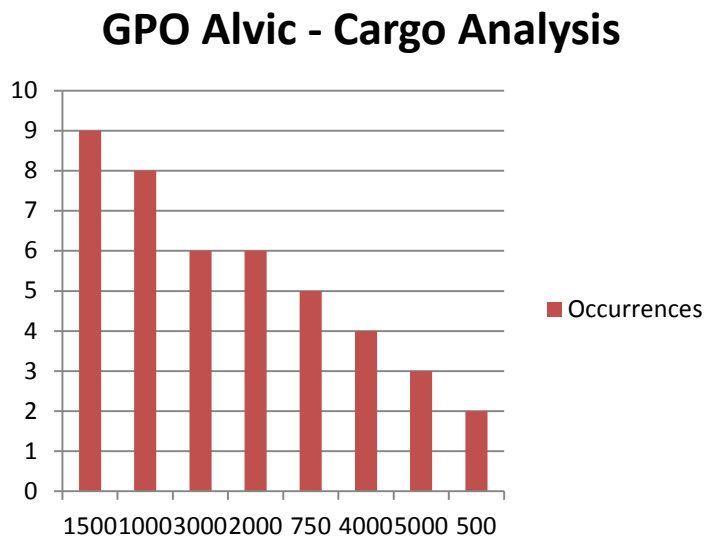

Figure 27 - Alvic cargo analysis

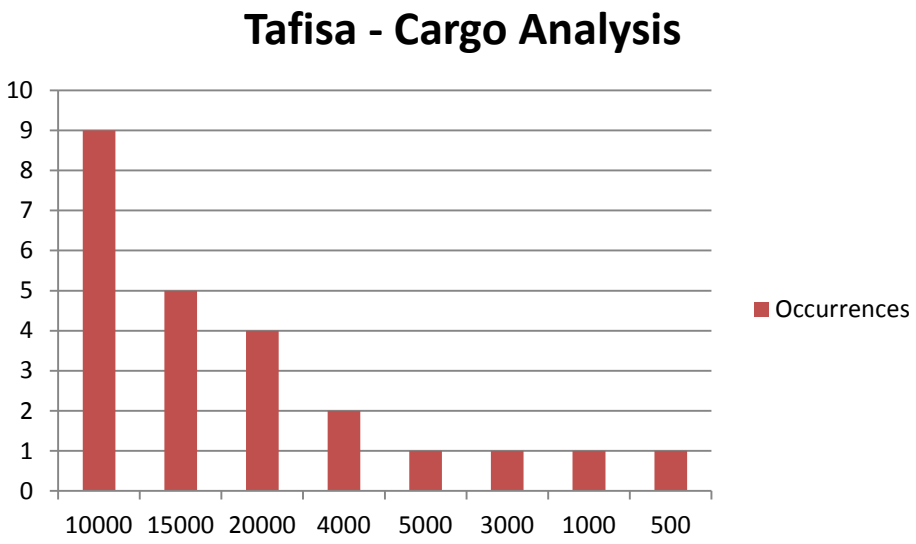

Figure 28 - Tafisa cargo analysis

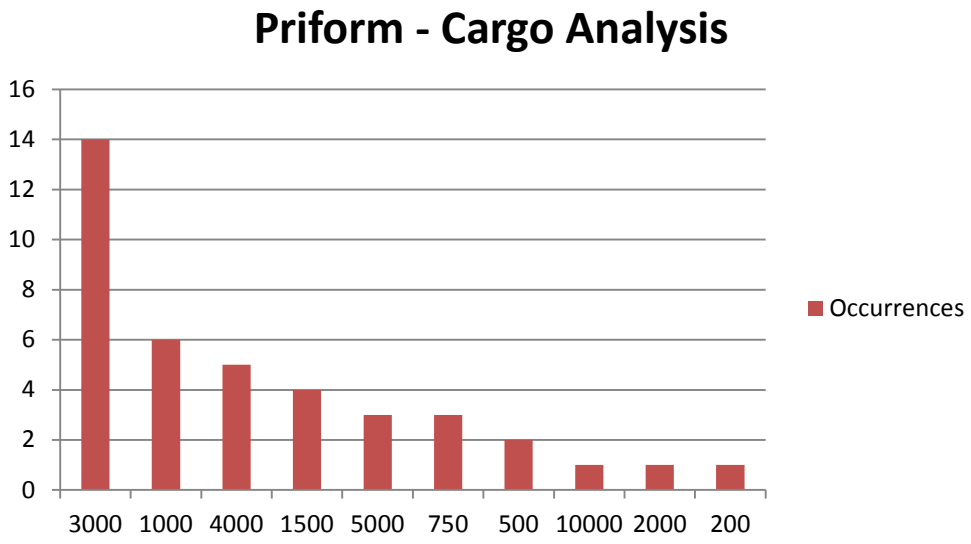

Figure 29 - Priform cargo analysis

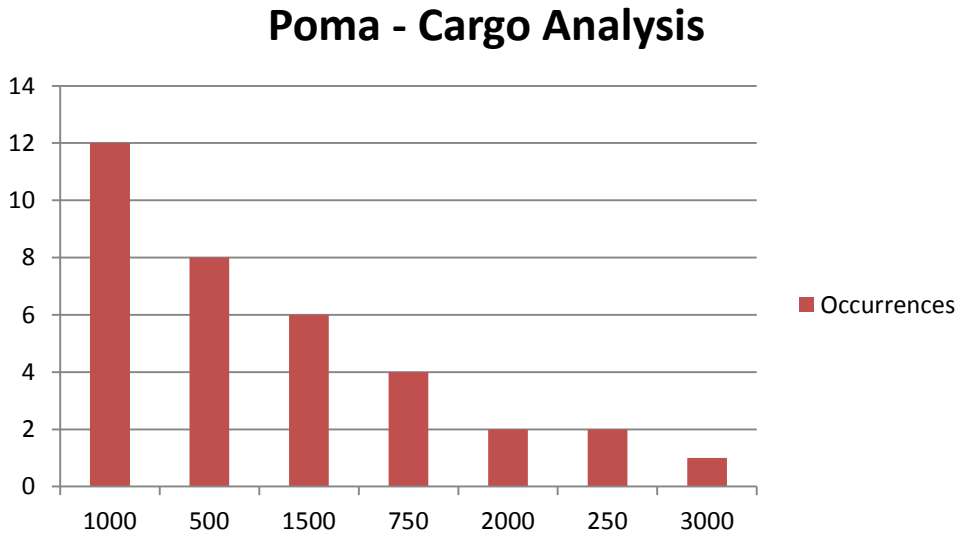

Figure 30 - Poma cargo analysis

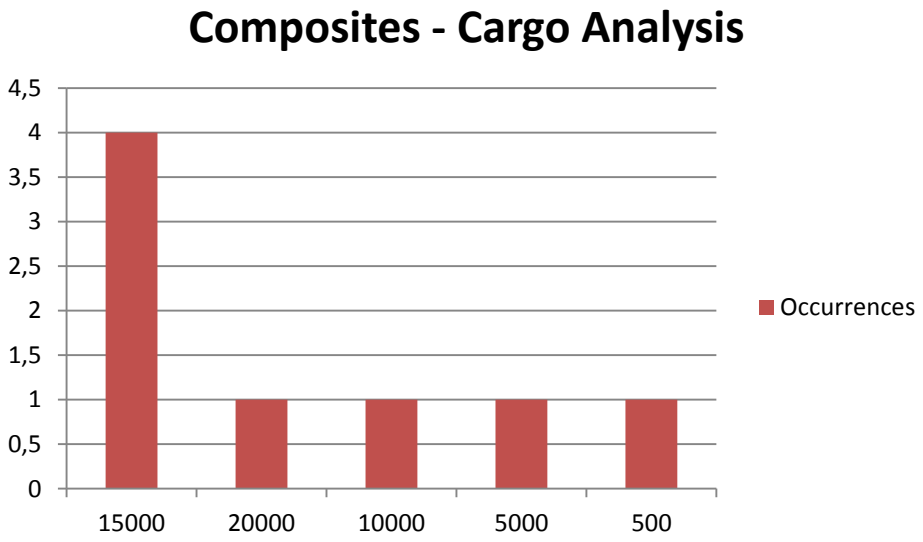

Figure 31 - Composites cargo analysis

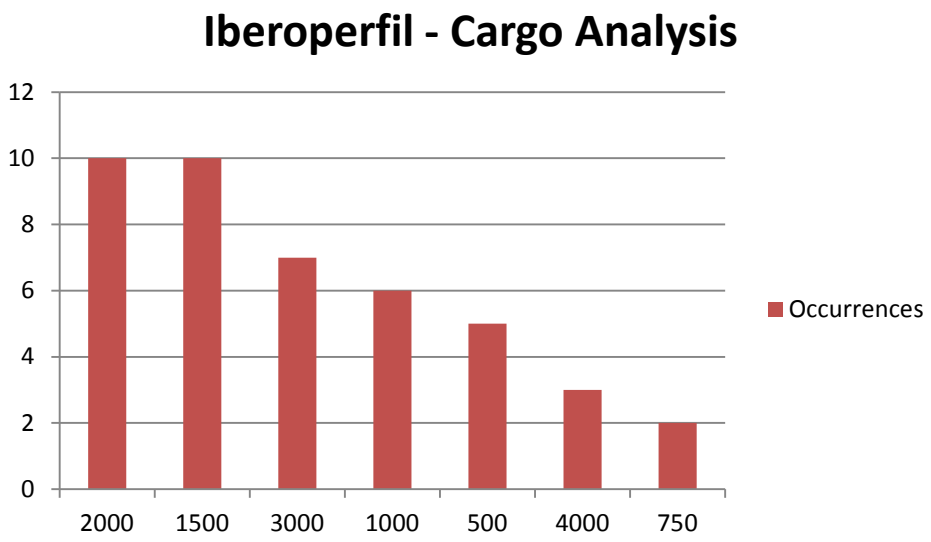

Figure 32 - Iberoperfil cargo analysis

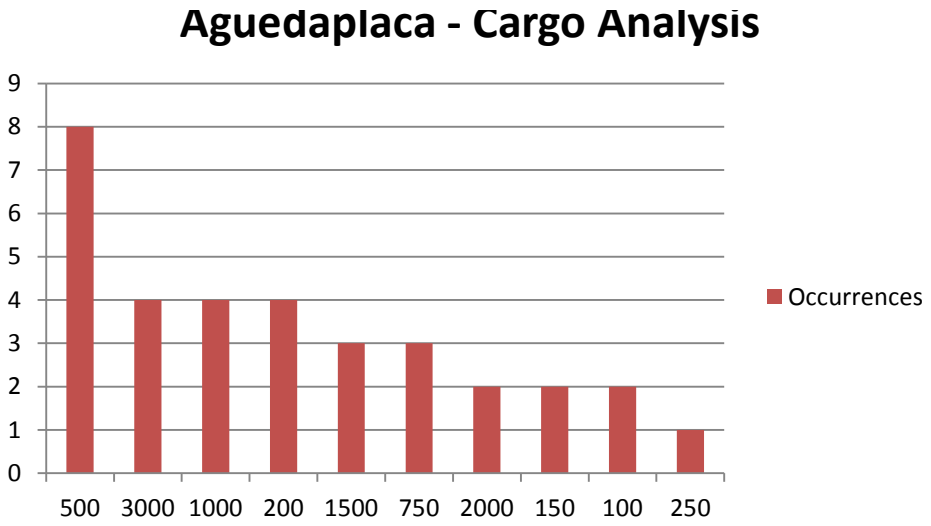

Figure 33 - Aguedaplaca cargo analysis

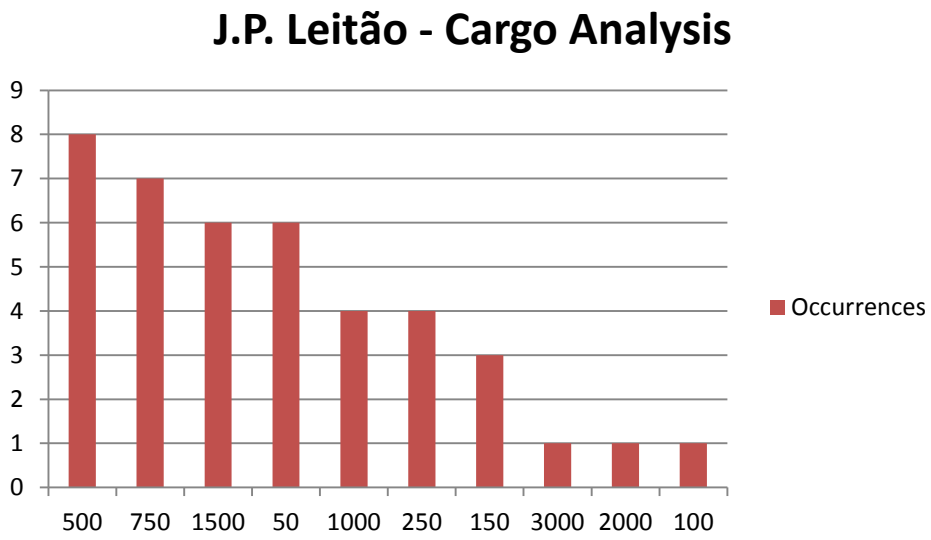

Figure 34 - J.P. Leitão cargo analysis

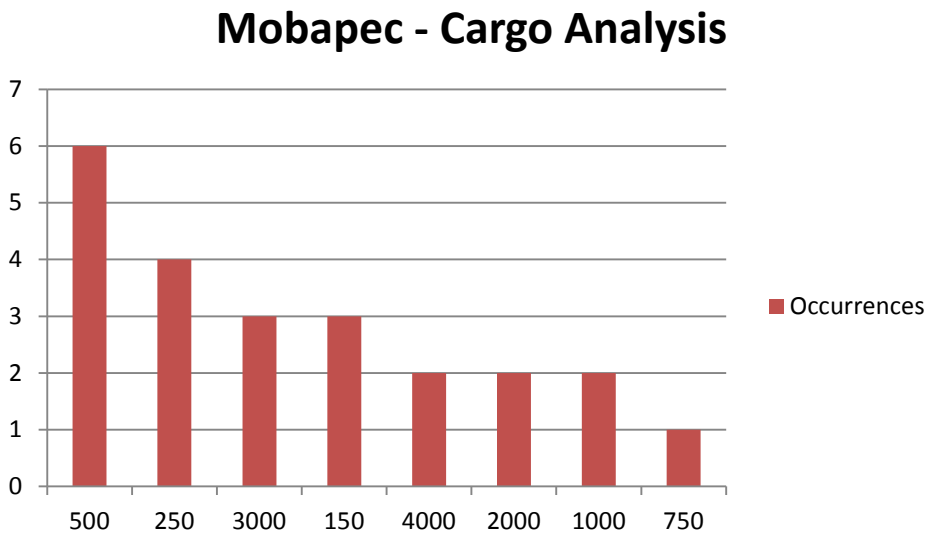

Figure 35 - Mobapec cargo analysis

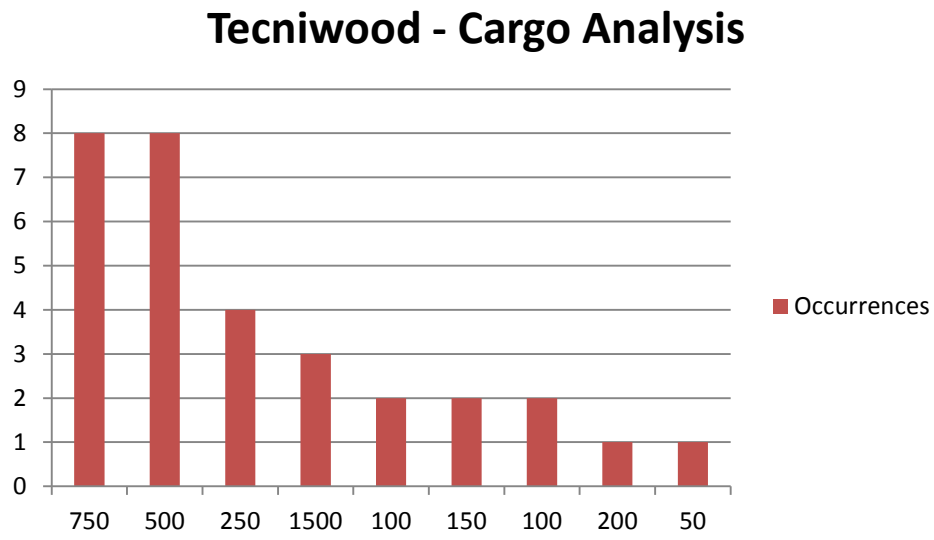

Figure 36 - Tecniwood cargo analysis

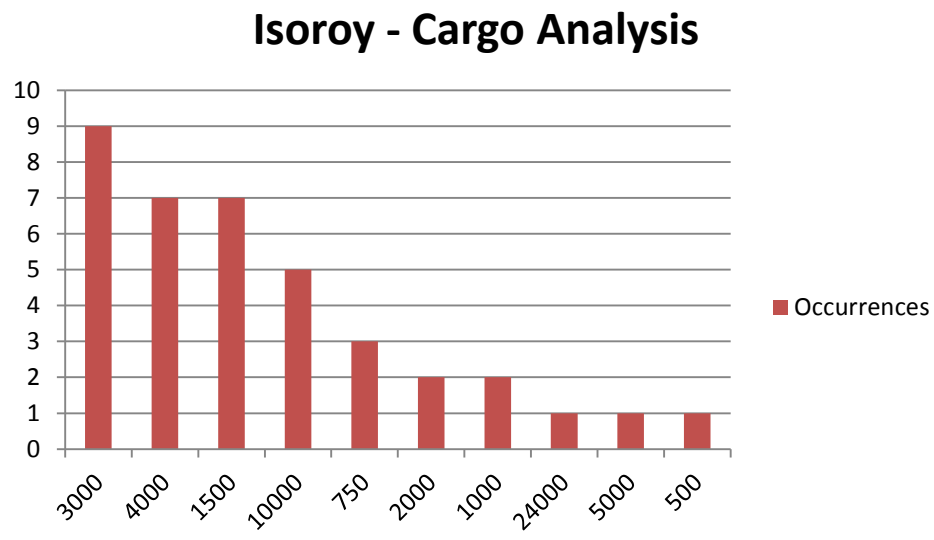

Figure 37 - Isoroy cargo analysis

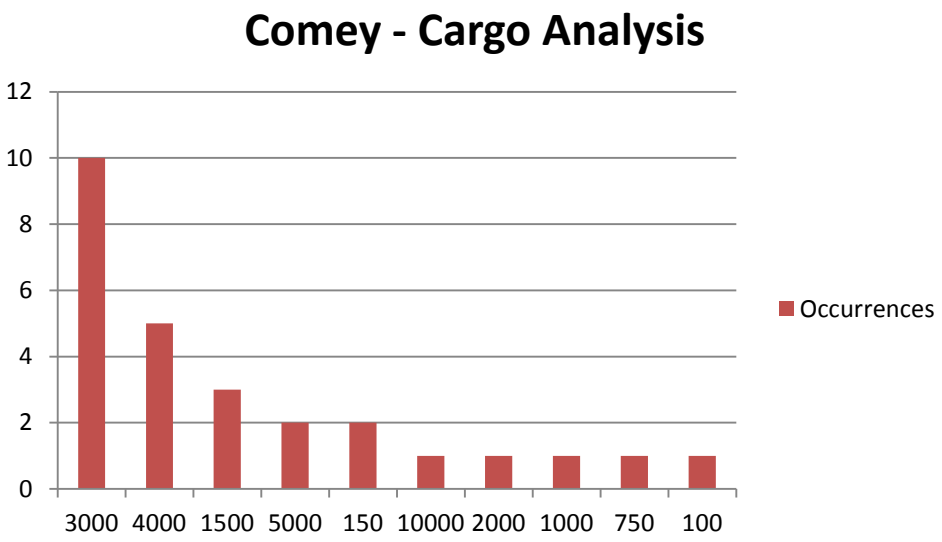

Figure 38 - Comey cargo analysis

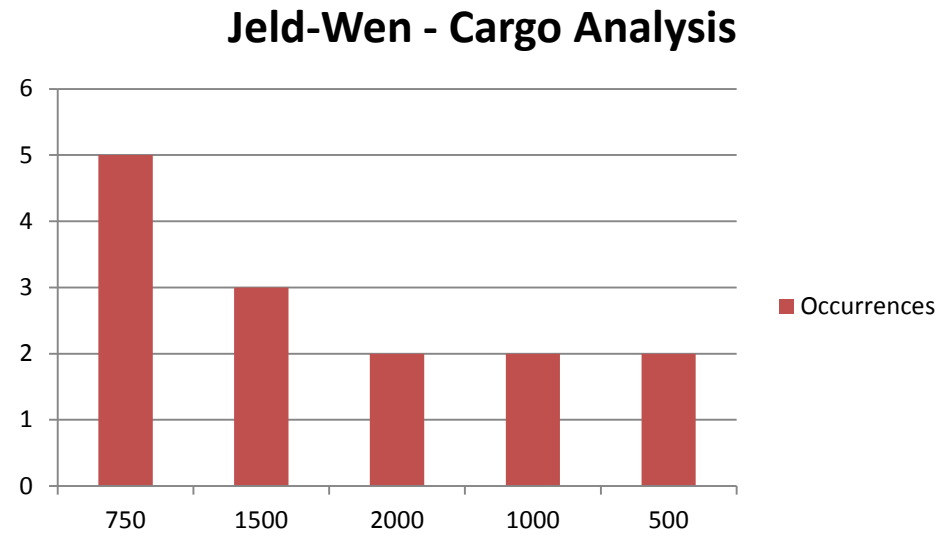

Figure 39 - Jeld-Wen cargo analysis

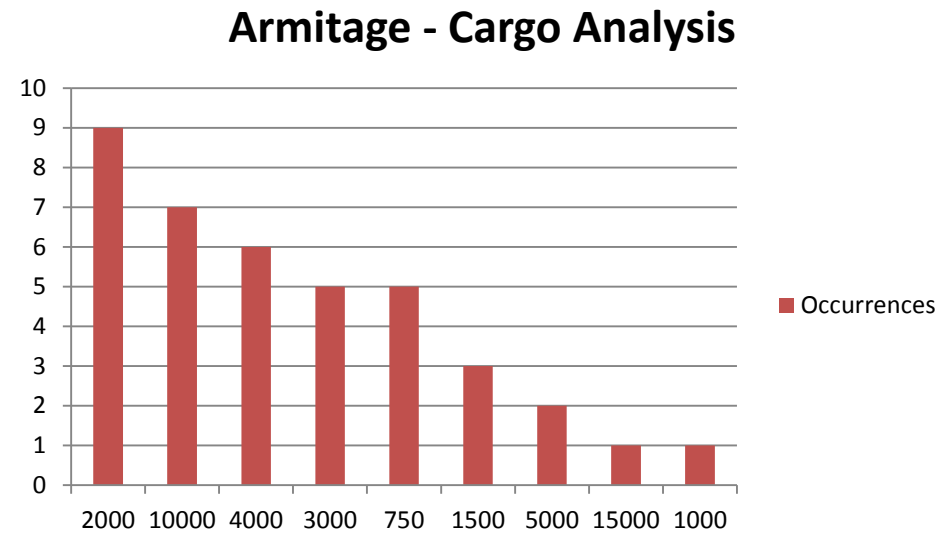

Figure 40 - Armitage cargo analysis

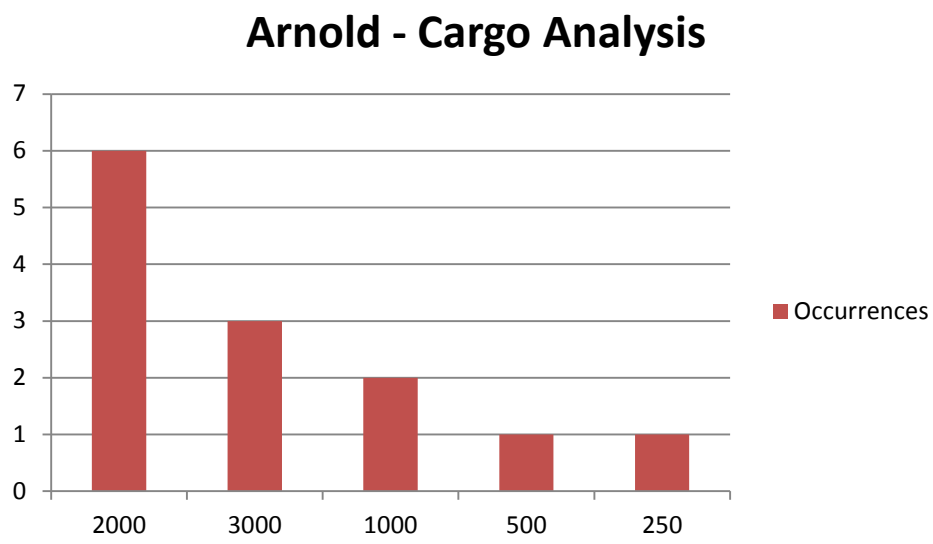

Figure 41 - Arnold cargo analysis

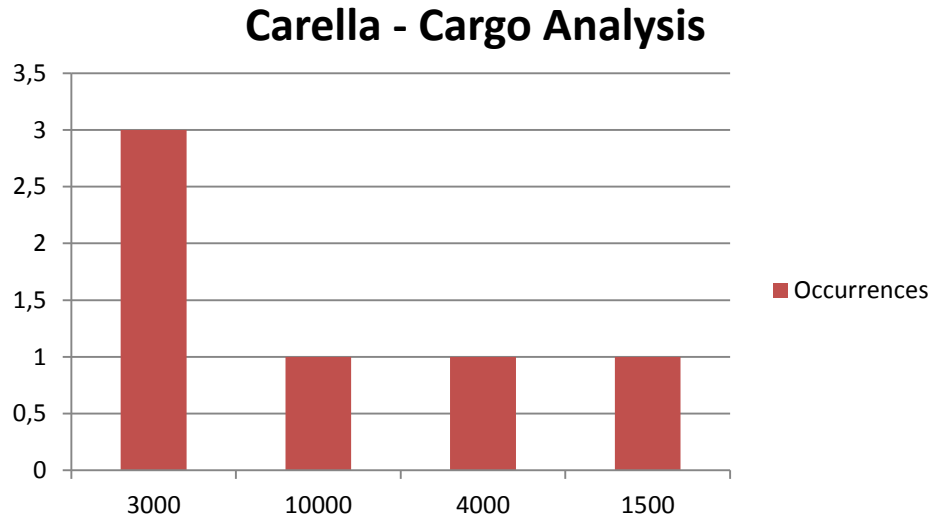

Figure 42 - Carella cargo analysis

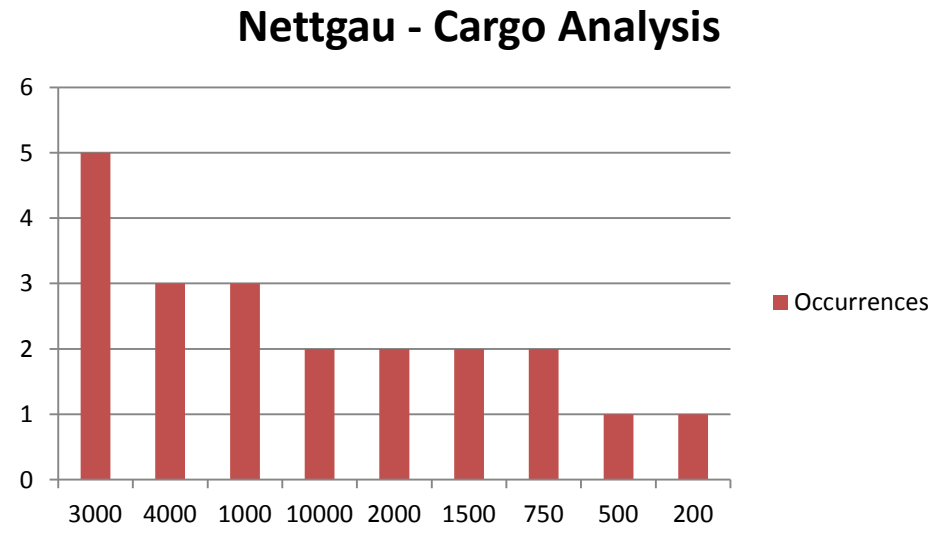

Figure 43 - Nettgau cargo analysis

ANNEX D: Contract for the carriers

Carrier:	

	General	PT	ES	FR	GB	DE
Claim-free shipment percentage	0,00%	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %
Damage-free shipment percentage	0,00%	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %
On-time arrival percentage	0,00%	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %
Distance between accidents (Km)	0	0	0	0	0	0

PT	Zona	Time to deliver	Frequency per week	Weight (Kg)					
Braga	47/48			250	500	750	1500		
				500	750	1000	1500		
Porto	40/44			150	250	500	1000	1500	3000
Aveiro	38			500	1000	1500	2000	3000	
Viseu	35/36								

ES	Zona	Time to deliver	Frequency per week	Weight (Kg)						
Pontevedra	986/36			500	1000	1500	4000	10000	15000	20000
				15000						
Navarra	948/31			1000	1500	3000	4000			
				750	1000	1500	2000	3000		
Barcelona	93/08									
Jaén	953/23									

FR	Zona	Time to deliver	Frequency per week	Weight (Kg)				
Yonne	89			1500	3000	4000	5000	10000
				750	1500	2000		
Gers	32							

GB	Zona	Time to deliver	Frequency per week					
				750	2000	3000	4000	10000
Stoke-on-Trent	ST							
				1000	2000	3000		
Oldbury	B							
				3000				
Derry	BT							

DE	Zona	Time to deliver	Frequency per week	Weight (Kg)				
				1000	2000	3000	4000	10000
Braunschweig	38							

ANNEX E: Cargo consolidation

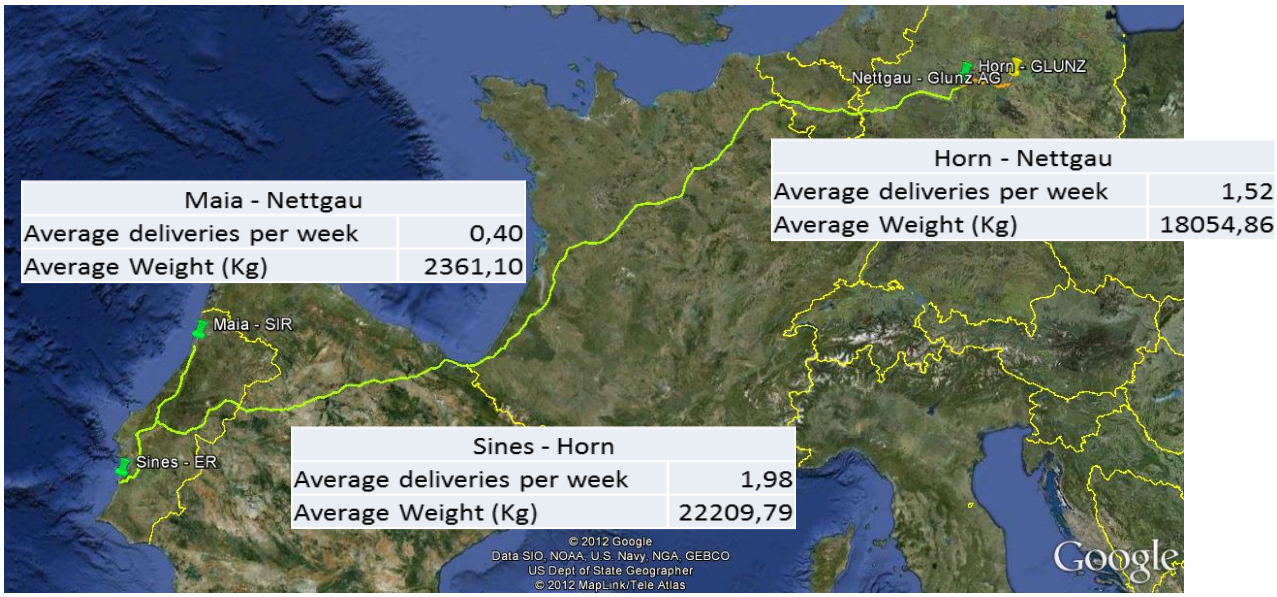

Figure 44 – Consolidation 1

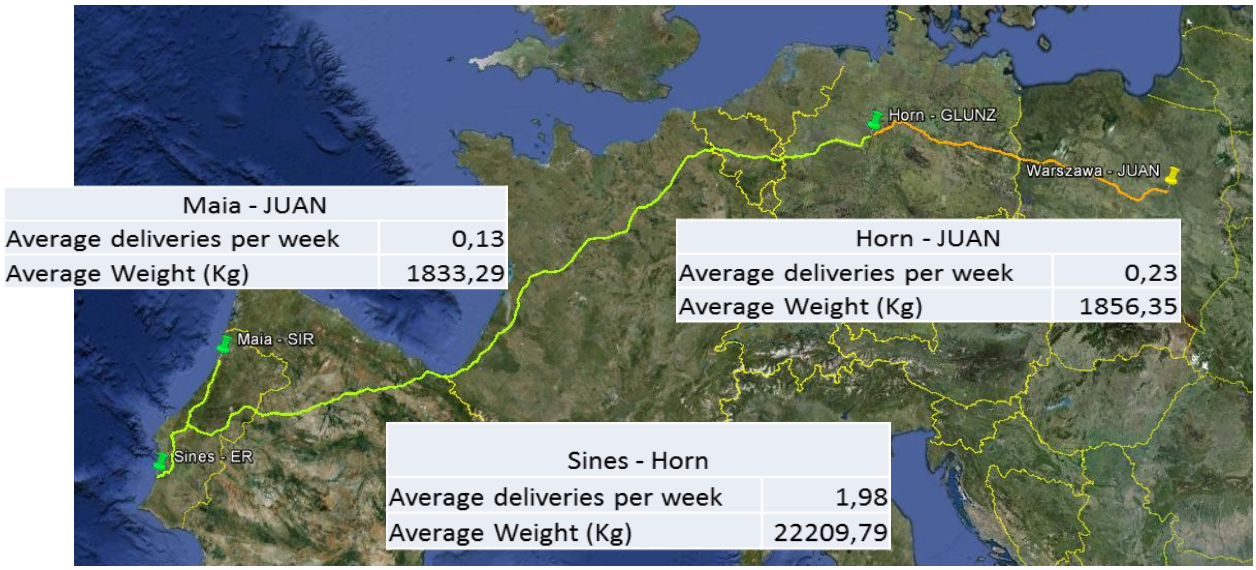

Figure 45 – Consolidation 2

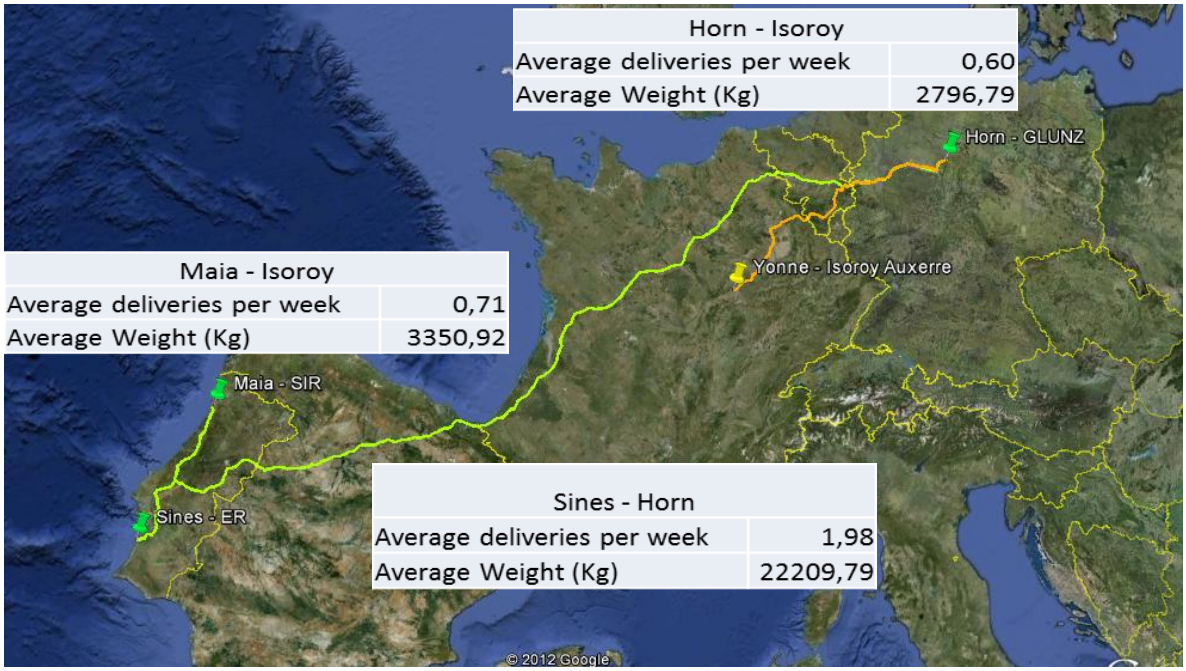

Figure 46 – Consolidation 3

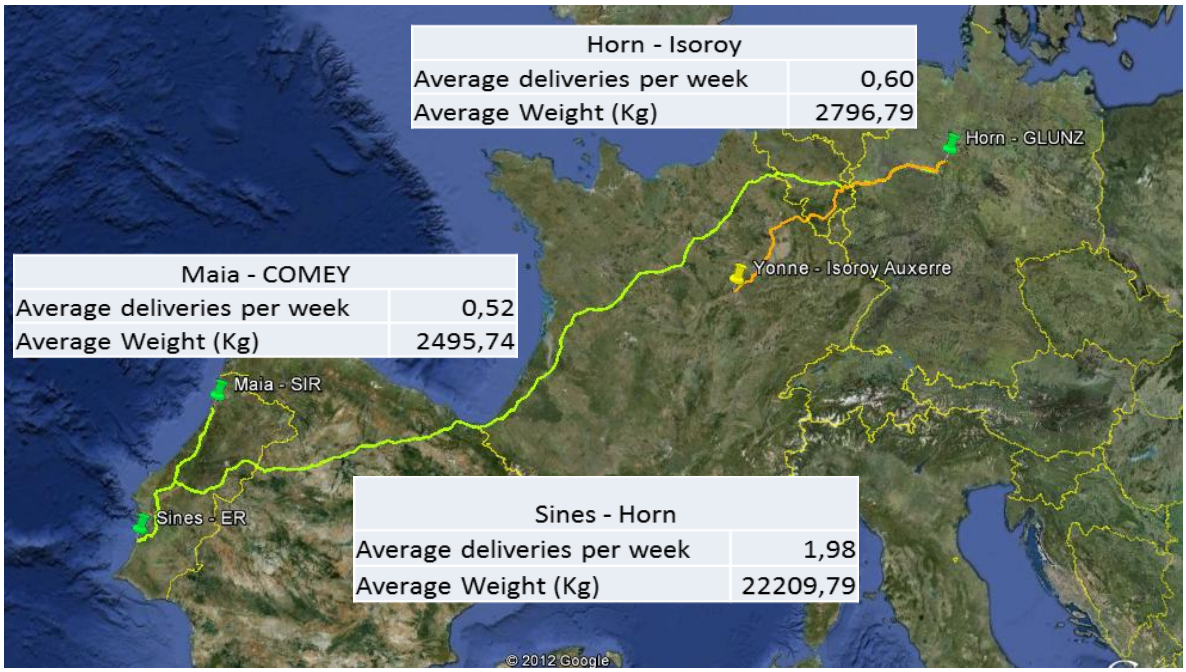

Figure 47 - Consolidation 4

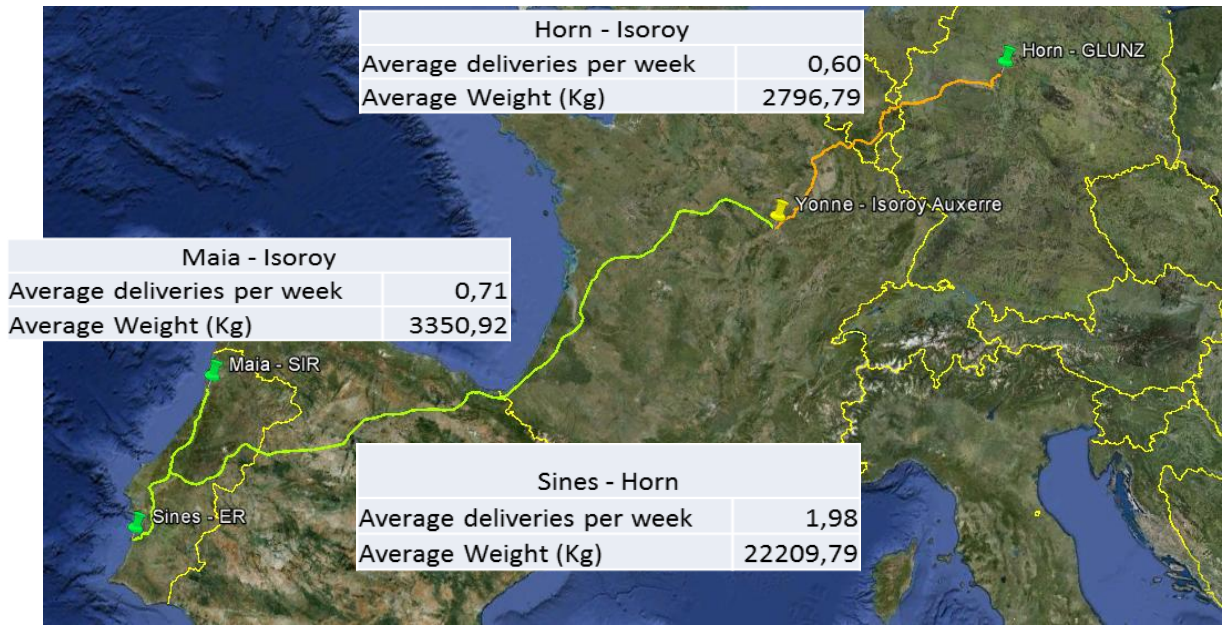

Figure 48 - Consolidation 5

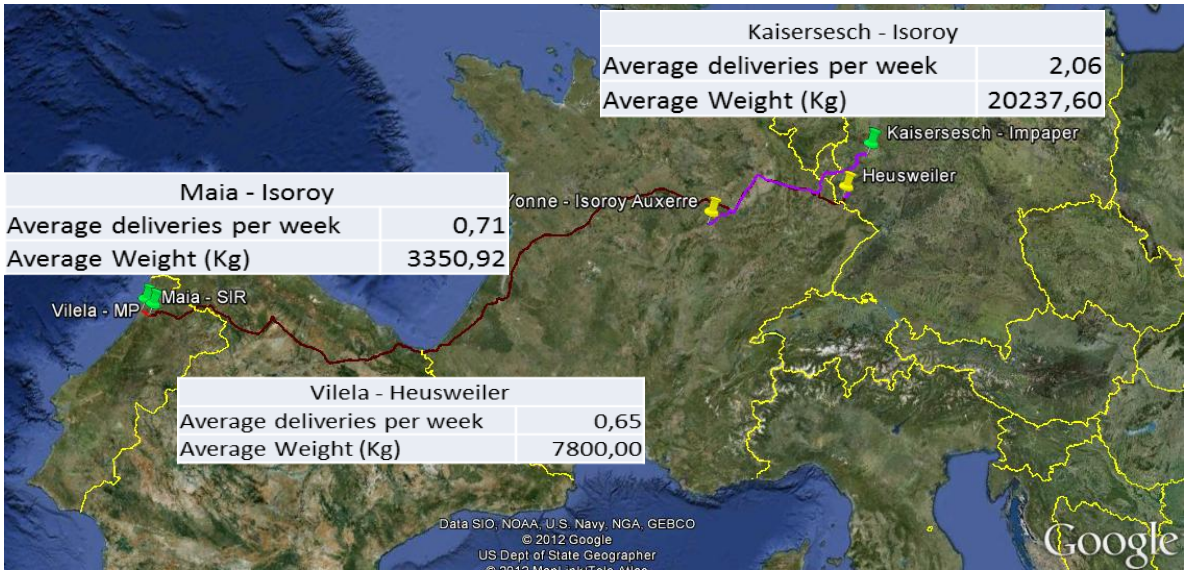

Figure 49 - Consolidation 6

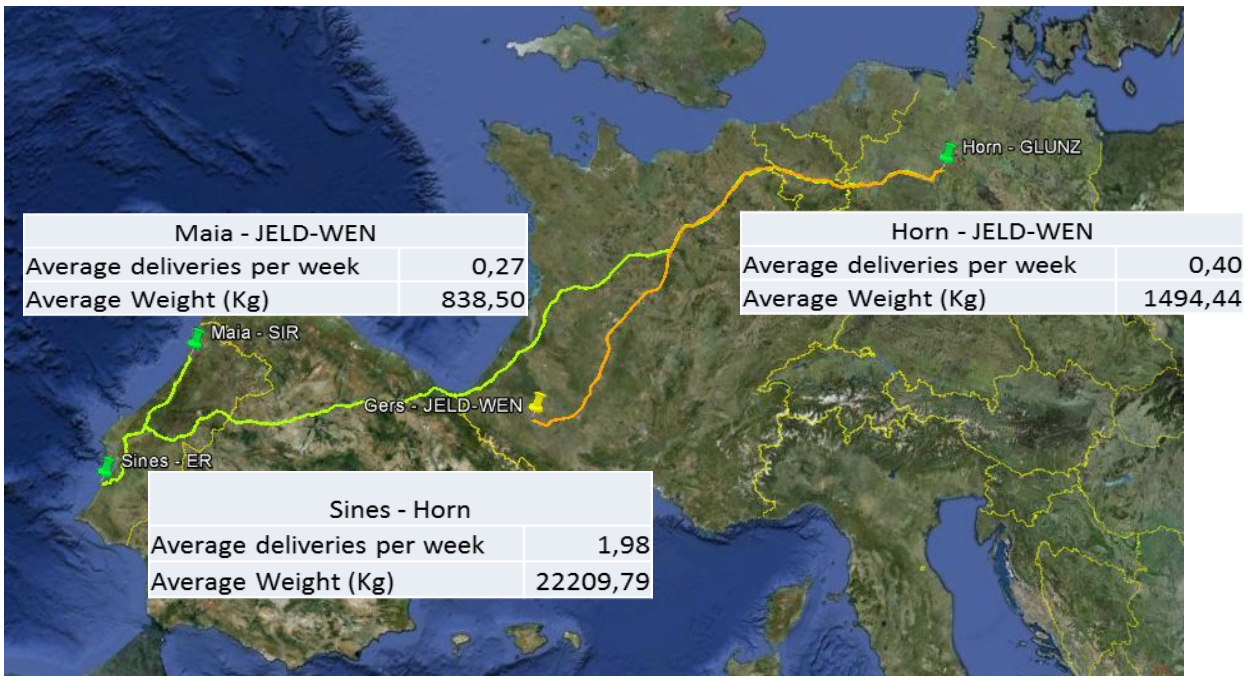

Figure 50 - Consolidation 7

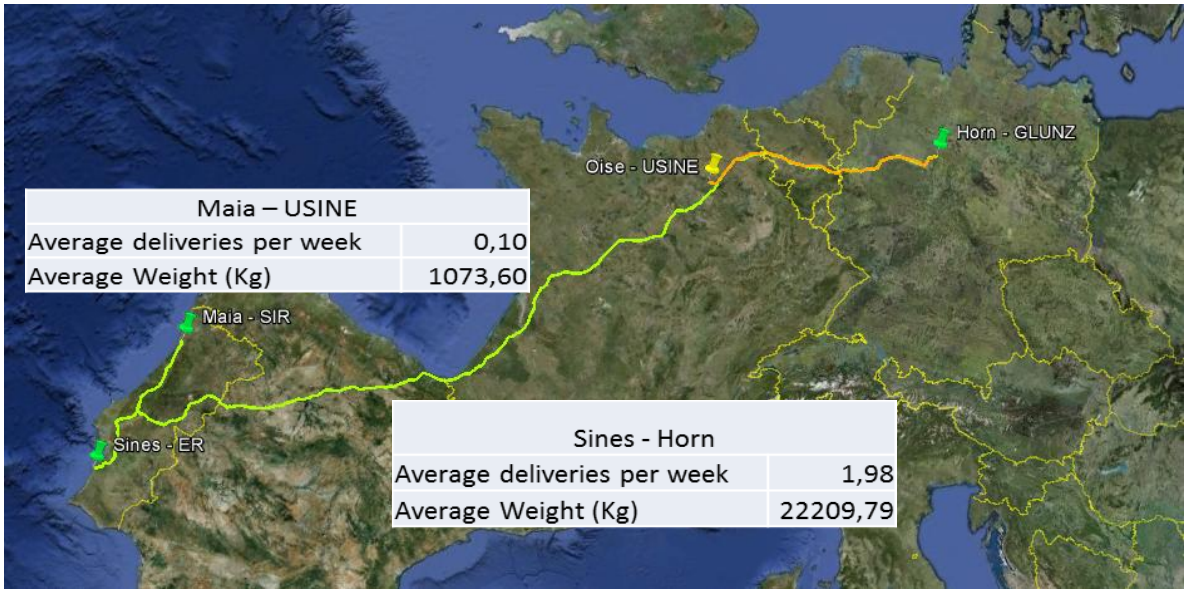

Figure 51 - Consolidation 8

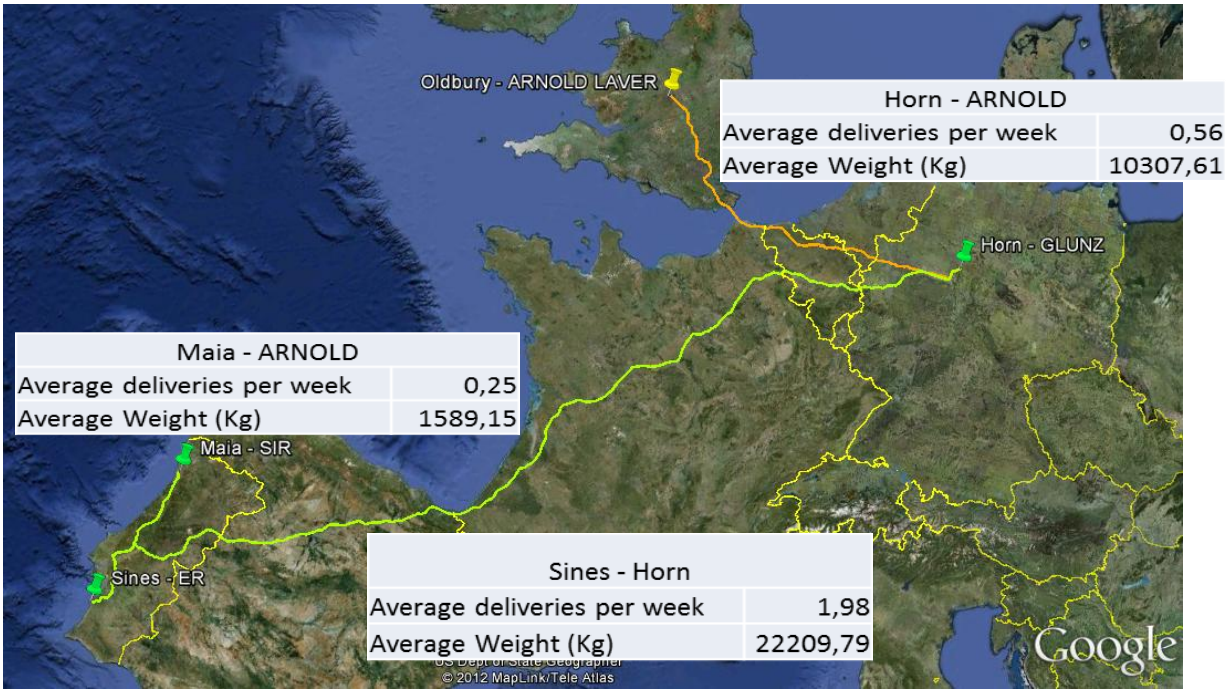

Figure 52 - Consolidation 9

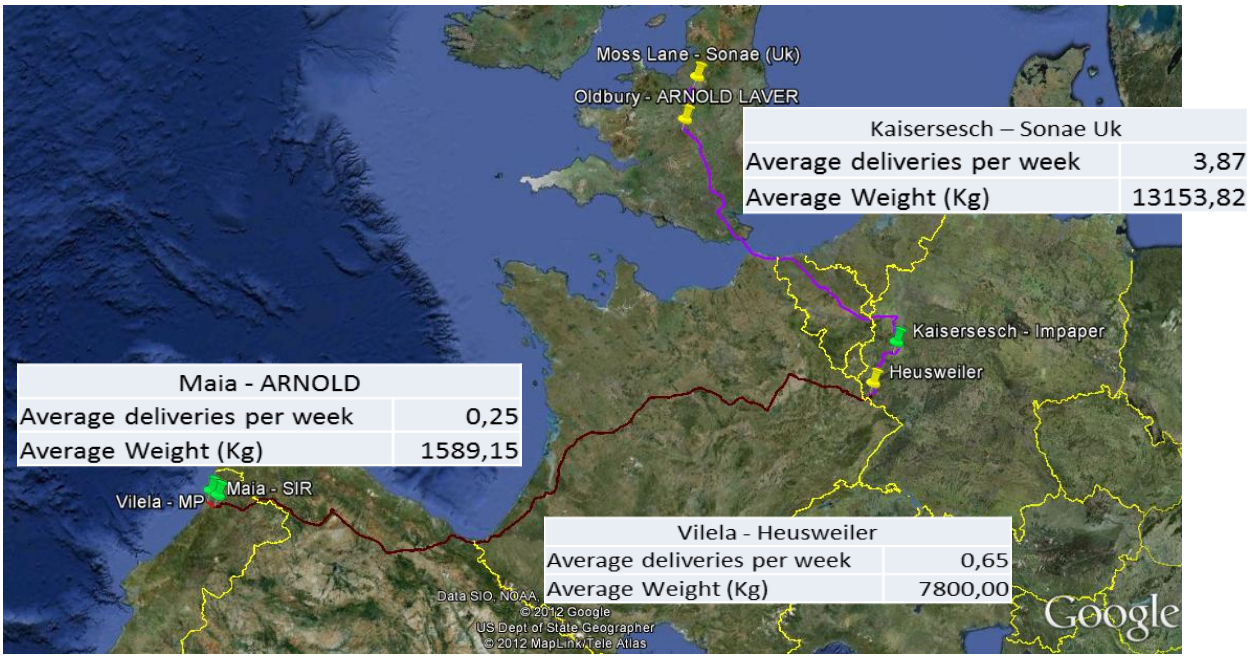

Figure 53 - Consolidation 10

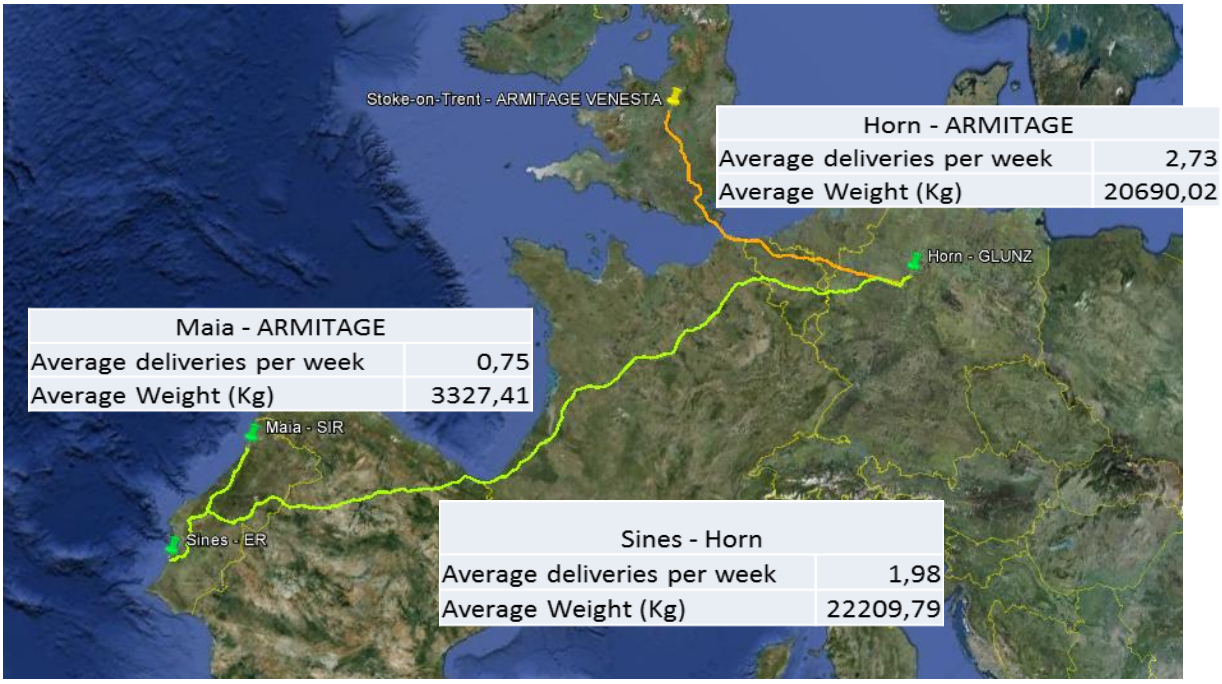

Figure 54 - Consolidation 11

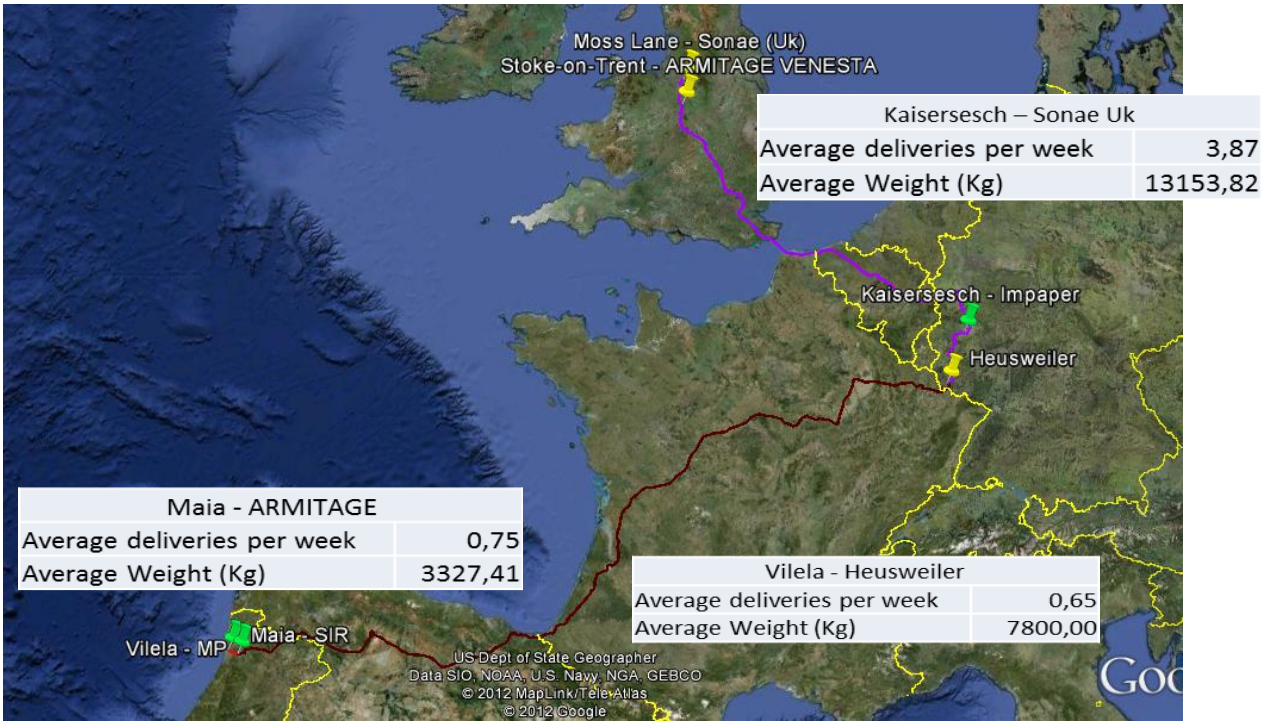

Figure 55 - Consolidation 12

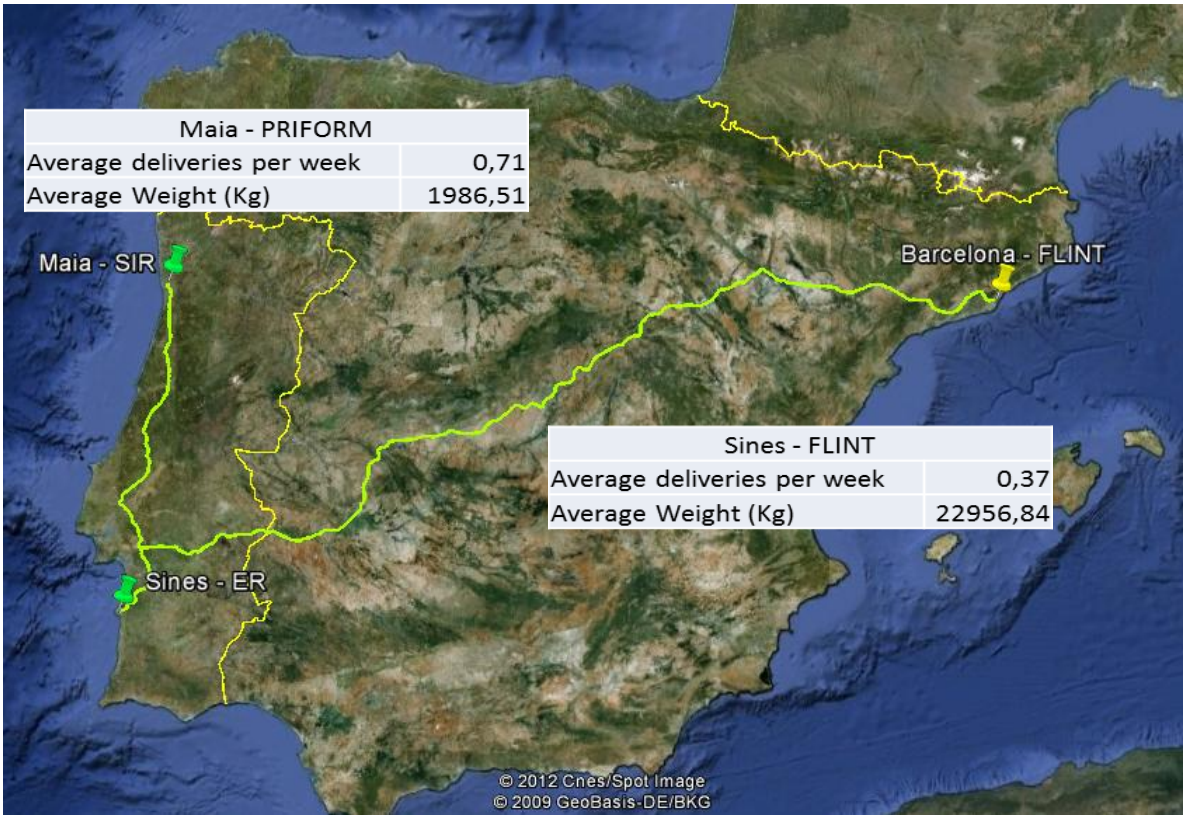

Figure 56 - Consolidation 13

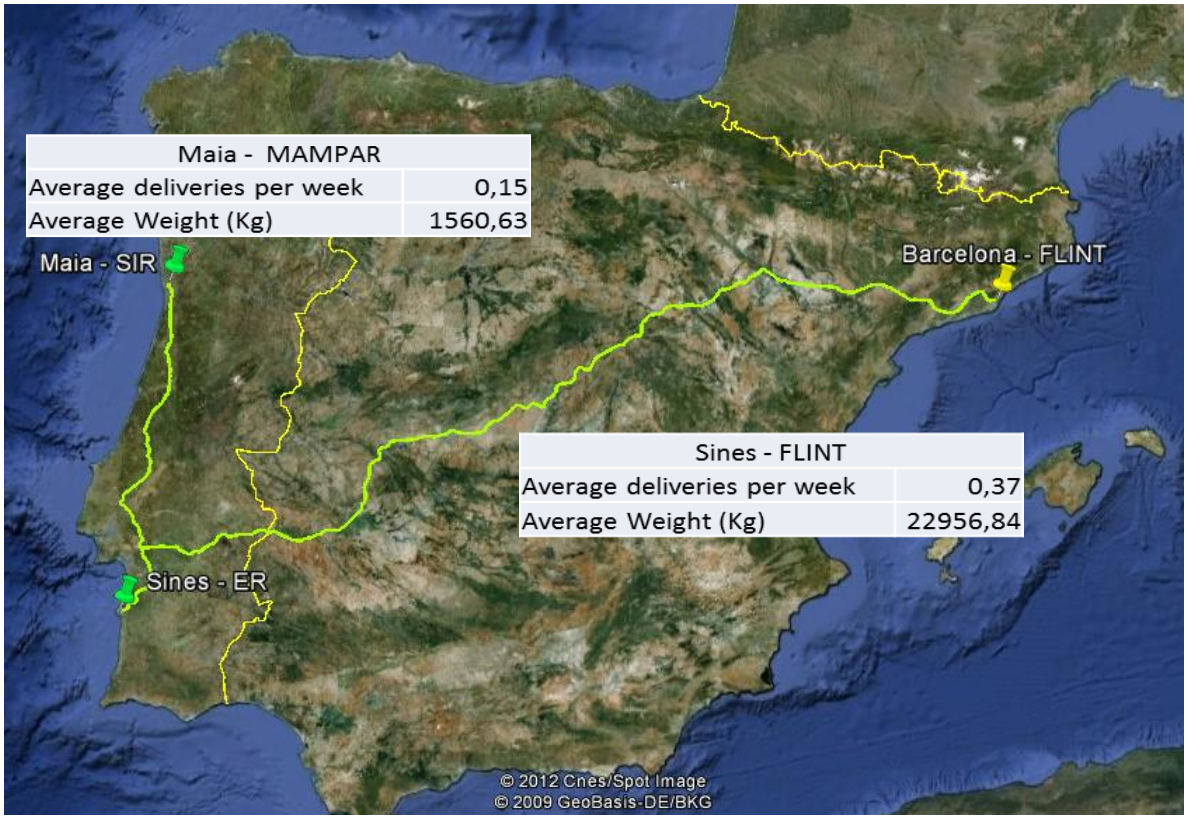

Figure 57 - Consolidation 14

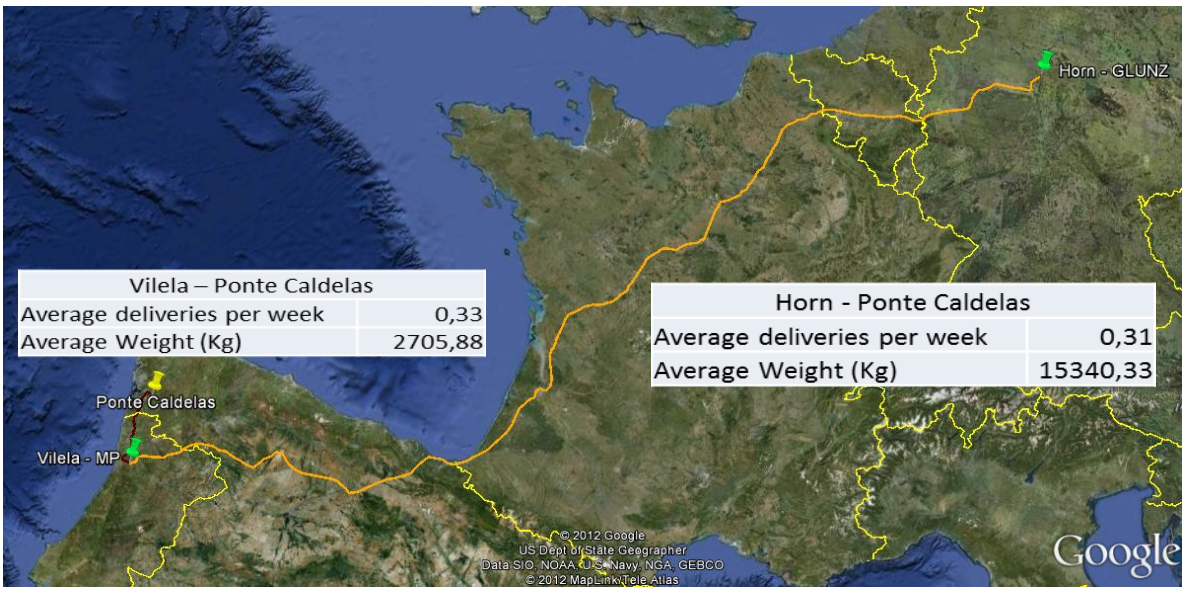

Figure 58 - Consolidation 15

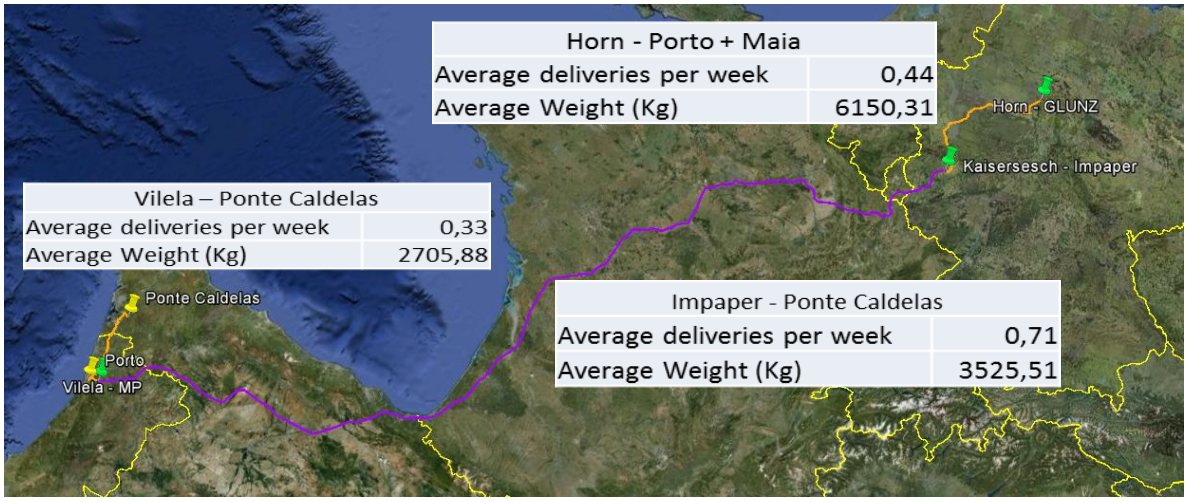

Figure 59 - Consolidation 16

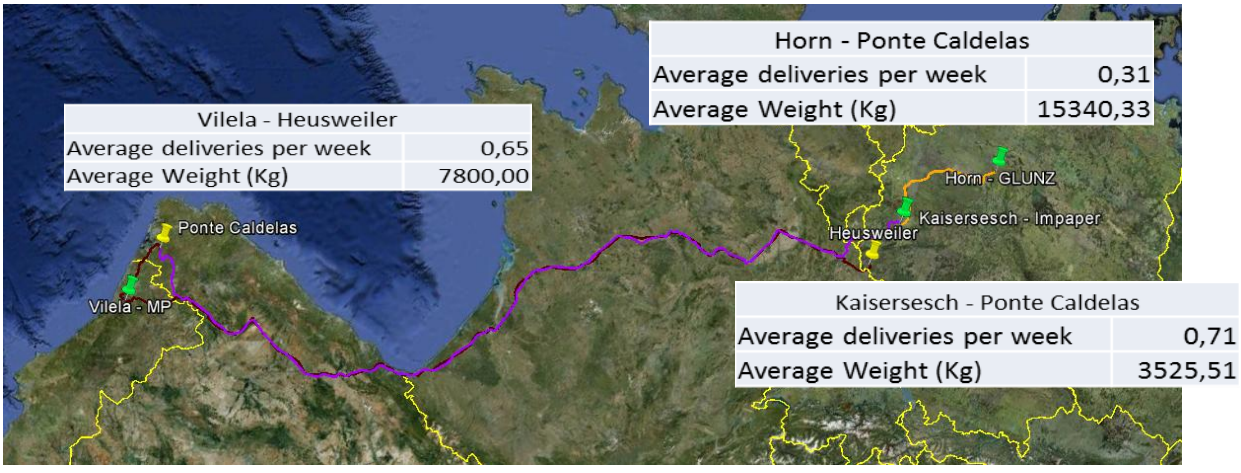

Figure 60 - Consolidation 17