Transport Planning in the Glass Industry

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Master's Dissertation

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Mestrado Integrado em Engenharia e Gestão Industrial

2019-06-14

Abstract

The glass packaging industry is a capital intensive industry, where operational efficiency, quality and reliability have a significant role, as the strategic differentiation is limited. In fact, an effective and cost-efficient Logistics Management can be a real point of competitive differentiation.

When the context of a company is a recent market expansion, sales growth and complex flows, along with the difficult context of the transport market, global transport management has a crucial role. The source of transport becomes critical in a company's strategy, in order to assure the regarded efficiency and adequate customer service.

Transport planning can have a significant impact on a company where costs related to transport represent over 10% of the total costs. This planning becomes even more critical when looking at the European transport market, where we can observe a demand-supply imbalance. The lack of capacity leads to a cost increase, already inflated by the cost of fuel, tolls, and road taxes. Furthermore, effective transport systems are essential to European companies' ability to compete in the world economy.

The present dissertation focuses on the operational improvement of transport, which consists in a continuous analysis of relevant information, streamlining a strategy focused on anticipating and preventing critical situations, to therefore enhance customer service level.

Firstly, the identification of opportunities for improving and measuring the potential effects of changes in the transport operations lead to define a strategy to deal with the inefficiencies found. In the end, key performance indicators provide insights for strategic and operational improvement and create an analytical basis for decision making.

Hence, following the transport planning strategy in the long term, not only has a significant impact on customer satisfaction, but also on costs reduction.

Resumo

A indústria de embalagens de vidro é uma indústria intensiva em capital, onde a eficiência operacional, a qualidade e a confiança têm um papel significativo, visto que a diferenciação estratégica é limitada. Efetivamente, uma gestão logística eficaz e eficiente em termos de custos pode ser um fator de diferenciação competitiva.

Quando o contexto de uma empresa é a expansão de mercado recente, o crescimento das vendas e fluxos mais complexos do que nunca, e tendo em conta o difícil contexto do mercado de transportes, a gestão global dos mesmos tem um papel crucial. A origem dos transportes torna-se crítica na estratégia da empresa, para garantir aos clientes um nível de serviço elevado.

O planeamento de transportes pode ter um impacto significativo numa empresa onde os custos relacionados ao transporte representam mais de 10% dos custos totais. Esse planeamento torna-se ainda mais crítico tendo em conta a situação do mercado europeu de transportes, onde se pode observar um desequilíbrio entre a oferta e a procura. A falta de oferta de transportes leva a um aumento de custos, já inflacionado pelo custo de combustível, portagens e impostos rodoviários. Além disso, ter sistemas de transporte eficazes é essencial para as empresas europeias estarem aptas para competirem na economia mundial.

A presente dissertação foca-se na melhoria operacional dos transportes, que consiste numa análise contínua de informações relevantes, agilizando uma estratégia focada em antecipar e prevenir situações críticas e, assim, melhorar o nível de serviço ao cliente.

Inicialmente, foram identificadas as oportunidades de melhoria e foi realizada uma medição dos potenciais efeitos que as mudanças nas operações de transporte poderiam ter, levando a definir uma estratégia para lidar com as ineficiências encontradas. Por fim, os principais indicadores de desempenho são a base para melhorias estratégicas e operacionais e criam uma base analítica para a tomada de decisões.

Assim, seguir uma estratégia de planeamento de transportes no longo prazo, não só tem um impacto significativo na satisfação do cliente, mas também na redução de custos.

Acknowledgements

First and foremost, I would like to express my sincerest gratitude to Professor Jorge Freire de Sousa, for all the support and availability throughout the project, as well as for the encouraging words.

Furthermore, I want to thank Sylwia Mistrzak, Luis Cardoso, and Maria Afonso. I am very grateful for your insights during this project and for being such an inspiration to me. I really admire you. All your constructive criticism and assistance were essential to keep me motivated.

I would also like to say that I am very grateful for all my family and friends that are always supportive.

Last but not least, a special thank you to my parents, grandparents and my sisters, Mafalda and Carlota, who are always present in every stage of my life and whose example, patience and support allowed me to reach where I am today.

Joana

"The optimist sees opportunity in every difficulty."

Winston Churchill

Contents

Abbreviations and Acronyms

AV	Avintes
AT	Athens
CE	Central Europe
CSI	Customer Satisfaction Index
DN	Delivery Note
EU	European Union
EXW	Ex Works
FCA	Free Carrier
FIFO	First In, First Out
FO	Front Office
GA	Gardelegen
IB	Iberia
JE	Jedlice
JIT	Just-in-time
KPI	Key Performance Indicator
LE	Léon
MG	Marinha Grande
PV	Plovdiv
SO	Sofia
VF	Villafranca de Los Barros
VN	Venda Nova
SEE	South East Europe
SCM	Supply Chain Management
SI	Sieraków
TP	Transport Planning

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Chapter 1

Introduction

Although BA's internationalization is established in a lot of opportunities for the group, it exposes the company to economic, political, fiscal, legal, and environmental risks of several countries. Moreover, globalization is associated with technological progress, lower transport costs, and policy liberalization, but it also translates into increased competition in all traded goods and services (EuropeanCommission, 2019).

The glass industry is divided into five sectors that cover different glass products and markets, the glass container sector, where BA is inserted, represents 62% of the total EU glass production, followed by the flat glass, that accounts for 30%. Domestic glass, reinforcement fibres and other glass represent the remaining 8% (GAE, 2019).

The glass container industry is a key driver of growth and economic prosperity in Europe, and contributes to Europe's competitiveness (FEVE, 2019). It has proved to have a significant resilience to the macro-economic cycles and is characterized by the presence of natural barriers to entry as it is a local and highly capital-intensive industry, due to the high implementation and maintenance costs. Additionally, the plant locations play a major role and geographical diversification minimizes the potential impact that an unfavorable evolution of a given market could bring. The glass packaging industry, which markets are considered mature and stable, has been experiencing in some segments a slight growth, even in periods of economic recession. Furthermore, this industry is close to the market needs, whose demands flexibility and versatility. The high technological development is also another characteristic of this industry, and there is a high margin for further technological improvement. Moreover, although the good image and quality of the glass, substitute materials are an obvious threat.

After a significant decrease between 2008 and 2009, the value of products sold by EU packaging glass producers consistently increased since 2009 and went above the pre-crisis level since 2013 (CEPS and Ecorys, 2017). Between 2012 and 2017, the production has increased year after year, representing in the last year more than 21 million tonnes. This positive market trend is influenced by the increasing consumer engagement with environmental causes (FEVE, 2019).

1.1 BA Glass Presentation

'Barbosa e Almeida' was incorporated in 1912, dedicated to the commercialization of bottles. In 1930, its name was changed to 'Fábrica de Vidros Barbosa e Almeida, Lda.' and the industrial activity using semi-automatic technology began, in Campanhã, Porto. In 1969, the Avintes industrial unit started its operations. During 1987, the company was listed in the Lisbon Stock Exchange and, after constructing a new furnace in 1988, the production increased by about 40%, and with it, BA became the leader in manufacturing glass packaging in Portugal. In 1993, BA acquired 94,5% of 'CIVE - Companhia Industrial Vidreira, SA', located in Marinha Grande, and on the following year it was merged to BA. In 1998, Sonae Group acquired 19,9% of the social capital, and detained 49,9% of the voting rights and controls management of BA. During the same year, the Spanish company 'BA - Fabrica de Envases de Vidrio Barbosa & Almeida, SA' was incorporated, with 90,15% of its capital held by BA, and the factory in Villafranca de los Barros was constructed. On the following year, in 1999, BA acquired 54,3% of the company 'Vidriera Leonesa, SA' (VILESA), which had an industrial unit in Léon, Spain. BA's ownership stake was gradually increased until it reached 99% of the social capital of VILESA and it was also in 1999 that BA achieved 37,5 million euros of share capital, which is its current value. In 2004, it occurred a Management Buyout (MBO), when Carlos Moreira da Silva, the Silva Domingues family and the board members and senior employees of the company acquired the total of the share capital. By purchasing the Sotancro group in 2008, BA was able to extend its product range and client portfolio, by including the pharmaceutical and cosmetics sectors. In 2012, this group was merged with BA and it started the geographical expansion of its market to Eastern Europe, by acquiring the Polish group Warta Glass, which allowed to strengthen its position on the spirits segment. In 2016, BA acquired HNG Global, a German glass packaging company, expanding its market in Central Europe. In 2017, took place the acquisition of Yioula Group, composed of 4 plants in Greece (Athens), Bulgaria (Sofia and Plovdiv) and Romania (Bucharest).

Nowadays, BA is present in more than 80 countries, counts with 3900 employees and has a turnover of almost 900 million euros. The twelve plants of the group have a daily production of more than 20 million units of glass containers.

BA Group is composed of three divisions:

• Iberia (IB), formed by the plants of Avintes (AV), Marinha Grande (MG), Venda Nova (VN), Léon (LE) and Villafranca de Los Barros (VF), the first three located in Portugal and the last two in Spain;

• Central Europe (CE), consists of the plants of Sieraków (SI) and Jedlice (JE), located in Poland, and Gardelegen (GA), in Germany;

• Southeast Europe (SEE), composed of the plants of Athens (AT), located in Greece, Sofia (SO) and Plovdiv (PV), in Bulgaria, and Bucharest (BU), in Romania.

Figure 1.1: BA Group plants' location

1.2 Motivation and Aim of the Project

BA has plants distributed in Europe and delivers to over 80 countries, so transport plays an important role within the company's supply chain. Transport is a corporate function in BA, that looks for specialization and synergies between markets, plants, countries and flows.

Road freight transport has a huge importance in economic activity. Although there was an increase in the number of road freight transports during the last years, transport prices have decreased not very significantly, after being raised when there was a capacity shortage some years ago, remaining high, a situation also influenced by the fuel price increase (Eurostat, 2018). In addition, there are several concerns when trying to find transport suppliers, mostly for exports. This task becomes even more demanding when trying to do it during the holiday season or in weeks with bank holidays, especially if they are close to the weekend.

BA delivers to the local market. The last includes the countries where BA plants are located, and that is characterized by its stability, with a client portfolio that is already well known. Besides, BA also delivers to the export market. The complexity of the transports to the countries belonging to the export market is evident, as the client portfolio is not constant and in a lot of situations it can represent a transport distance of more than 1000 km. Additionally, the fact that customers demand a Just-in-Time (JIT) inventory system does not make the transport planning in BA easier. JIT is an inventory management system whereby materials are scheduled to be replenished exactly when the customer needs them for his production process.

Furthermore, there are EU rules that must be followed to fight illegal practices in road transport, to help improving drivers' employment conditions and to guarantee fair competition.

In the last years, BA has been growing exponentially, which was caused by the increase of the production and the acquisitions. The company combines both organic and inorganic growth.

Organic growth is achieved by increasing output and enhancing sales internally, and it is seeking to maximize the growth from within with several investments, namely in new furnaces. Inorganic growth is achieved by successful mergers and acquisitions, which is ideal as this diversifies the revenue base allows BA to gain access to new markets.The higher complexity of the business justifies the need for reviewing the procedures of the organization. Furthermore, introducing a Transport Planning function, able to obtain the right balance between customer needs and the warehouse capacity, as well as to anticipate bottlenecks and others risks, is an essential step in order to the transport team in BA satisfy the needs of the fast-growing company.

Transport Planning is a new function in BA and has as its main goal the improvement of the customer satisfaction regarding the delivery of the orders. The upgrade of the operational efficiency is achieved not only by providing useful information and enhancing communication between departments, but also by defining methodologies for campaigns, peak seasons and unexpected demand. The improvement of the warehouse operation is also needed to achieve the desired results, by performing careful planning of the loads according to the warehouses capacity.

The current project refers to the beginning of Transport Planning at BA, the identification of the opportunities for improvement, the measure of the inefficiencies and the description of the methodology adopted.

1.3 Methodology

The following approach was executed to gain insights about the current transport situation and provide useful information for defining the Transport Planning actions.

The foundation of the Transport Planning started by understanding the transport routes and insert them in SAP, BA's Enterprise Resource Planning (ERP) system. Then, a study of how the Budget, Sales Plans and Production Plans are built and what is the useful information that can be extracted from them was carried. An in-depth analysis was performed in order to detect the critical periods for delivering from each BA plant and division, taking into account the holidays, peak seasons and campaigns. Furthermore, a detailed study was carried out on the external warehouses' chain, used to provide faster deliveries and to improve the customer service, supporting Transport Planning operation. All the information acquired by these analyses allowed to create reports for customers that were considered critical when it comes to the deliveries, and so to define actions together with the departments involved.

The identification of opportunities for improvement on the Transport operations and the measure of the impact of the inefficiencies found was done, which allowed defining solutions for reducing these inefficiencies.

Moreover, the decision of adopting a logistic platform, is considerably changing the transport process, by optimizing the transport assignment process as well as to gain more transparency during the transport execution.

A tool was created to increase the visibility of warehouse loading capacity for the Transport and Warehouse teams. In addition, this tool has as one of the functionalities highlighting the

critical situations for each of the plants, which allows the Transport team to act together with the concerned departments to avoid delays on the deliveries and to perform better service to the customers.

Finally, Key Performance Indicators (KPIs), needed to follow up Transport Planning and assure the control of the processes, were defined, and progress reports were created to have a transparent and continuous evaluation of the situation.

All these steps allowed to define actions to increase operational efficiency, and consequently, to have a better customer service regarding the delivery of the products.

1.4 Dissertation Structure

The present dissertation is structured in six chapters. The first includes the presentation of the company where the project was developed and its context, as well as an introduction of the methodology followed during the project. The second chapter includes a review of the literature, putting in evidence the present situation of supply chain, logistics, and transport, by referencing the digitalization in logistics and the adoption of transport systems. In the third chapter Transport operations are described, mentioning the Transport situation within the company, the Warehouse operation, and the current difficulties for Transport. In the fourth chapter, the opportunities for improvement are identified. Then, the impact of Transport Planning solutions is measured at three levels, Transport operation, Warehouse operation and Customer Service. In the fifth chapter Transport Planning solutions for achieving the identified goals are described. In the end, the sixth chapter presents conclusions and future work.

Chapter 2

Literature Review

The presence of organizations on both domestic and global markets leads them to experience a growing international competition. Therefore, it is recognized the need for supply chain efficiency, as customer demands for both high-quality products at a low price, accurate deliveries and an enhanced customer service (Akkerman et al., 2010).

In order to be competitive in the global economy and to increase the efficiency in supply chain management, it is important to have an effective system of transport logistics. Globalization leads to an increased complexity of supply chains and more demanding logistics functions. Efficient policies and strategies of the logistics development are the basis of success, as improving the logistics efficiency allows a cost reduction that can support investments opportunities (Srisawat et al., 2017).

The impact of transport on the competitive advantage of a company is considerable. Not only transport represents a big part of the total logistics costs of a company, but also responsiveness to market demand has an enormous role in improving Customer Service. Developing logistics excellence is a strategy that leads to an increase of customer satisfaction (Razzaque and Sheng, 1998). In fact, quicker response, faster delivery, and more informed decision making can help a manufacturer to enhance the service level (Qi et al., 2019).

Within at least the next 30 years in the European Union, freight transport primary indicator of functionality and growth will be dynamic supply chains (Macioszek et al., 2017). Hence, a supply chain able to adapt not only to the customer needs but also to transport market context seems fundamental in order to be competitive.

2.1 Supply chain

2.1.1 Supply chain management

Supply chain management (SCM) is the preparation, planning, control, and realization of the materials flow, aiming for cost-effectiveness, range from designing and purchasing through production and distribution to the customer (Boiko, 2019). It is primarily concerned with production, supplies, location, warehouse inventory, transportation and information areas. SCM refers to four

flows, according to the literature (Qi et al., 2019): material flow, business flow, capital flow, and information flow. SCM is assumed as operational strategic situation in service and product industries, as it impacts the organization success in a more competitive business environment (Shakerian et al., 2016).

Supply chain management is referred to in the literature as having representative differences of the more classic view of logistics, although some of these elements have also been recognized as essential to the successful planning of logistics operations (Rushton, 2014). These differences are the following:

1. The supply chain is viewed as a single entity, also considering the suppliers and the customers, rather than a series of fragmented elements such as procurement, manufacturing, distribution, etc. The real change is that both the suppliers and the end users are included in the planning process, thus going outside the boundaries of a single organization in an attempt to plan for the supply chain as a whole.
2. Supply chain management can be considered as a strategic planning process, with strategic decision making assuming more relevance than the operational systems.
3. Supply chain management provides for a very different approach to dealing with inventory, as it aims that inventory is used as a last resort to balance the integrated flow of product through the pipeline. Traditionally, inventory has been used as a safety valve be tween the separate components within the pipeline, which led to high costs related to stocks.
4. Supply chain management supports the use of integrated information systems that are a part of the whole supply chain rather than acting in isolation for each of its intervenients. These enhance visibility of product demand and stock levels through the full length of the pipeline.

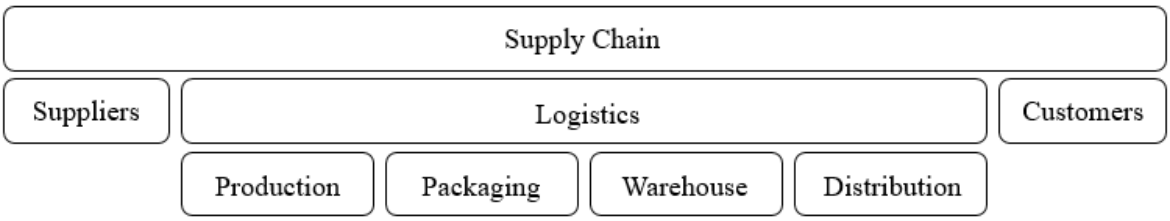

Figure 2.1: Conceptual integrative Supply Chain suggested by Rushton (2014)

Supply chains increased complexity and importance lead to the need of a managerial discipline that focuses on the management of processes and relations across the supply chain. Organizations operate as networks with the purpose of creating value to the customer in the form of products and services. Their interaction is both upstream and downstream, as it includes not only suppliers, but also logistic service providers (LSP), carriers, shippers, etc. for the physical cargo movements, in addition to the informational and financial flows associated to them, and in the end, customers (Konovalenko and Ludwig, 2018).

There are three key challenges that are addressed by SCM: Coordinating with other decision layers, achieving global optimization and managing uncertainty (Amorim, 2018).

Information sharing among stakeholders is a key aspect of coordination amongst parties in a supply chain (R. Sendhil Kumar, 2012). Regarding the information flow direction, the one relative to inventory and production plan is a two-way communication between downstream and upstream partners. The information regarding sales and demand forecasting are flows from downstream to upstream in the supply chain. The adequate sharing of information can lead to cost reduction, related to the whole supply chain, and to the improvement of customer service. Besides products and financial flow, an effective share of information is a key factor for supply chain management (Hiep Cong Pham, 2019).

An optimized functioning of supply chain leads to an enhanced planning system, a better warehouse inventory management, more on-time deliveries, demand conformity, costs reduction and, in the end, increase the company's market value. According to Boiko (2019), SCM solutions implementation allows companies to gain competitive advantages by:

- the reduction of the cost and order processing time by 20-40%;
- the reduction of purchasing costs by 5-15%;
- the reduction of time to market by 15-30%;
- the reduction of the warehouse inventory by 20-40%;
- the reduction of the production costs by 5-15%;
- the increase in profits by 5-15%.

2.1.2 Supply chain planning

Supply chain planning is described as a cross-functional effort, composed by the activities that create and capture value by balancing supply and demand (Watson, 2009). Beyond coordination, it requires cross-functional collaboration to evaluate the supply chain and the needs of the organization and then to identify a solution for creating and sustaining value based on the collaborative assessment. As Akkerman et al. (2010) mentions, problems related to lack of planning in the supply chain are due to poor communication and coordination. Through the combination of cost minimization and profit maximization, it is possible to tackle the general trade-off in planning: service, costs, capital expenditure and working capital.

Flexibility is an important characteristic of a supply chain to deal with changing internal and external conditions to guarantee reliable performance (Cirp et al., 2019). Hence, demand uncertainties such as fluctuations in the volume of ordered goods, introduction of new products, the related increase of product customization as well as the need to meet subsequent changes in demand affect medium-term decisions on a planning level.

Managerial decision making is divided into different levels of decision, depending on its time horizon, long-term, mid-term, and short-term planning, or alternatively: strategic, tactical, and operational planning. Rudberg (2009) distinguishes three planning levels in distribution management:

• Distribution network design, concerning long-term decisions on the physical distribution structure, such as determining the need and characteristics of warehouses and cross-docking points, the related transportation links, etc.;

• Distribution network planning, concerning mid-term distribution planning decisions related to fulfilling demand or forecasts;

• Transportation planning, concerning short term planning of the distribution of actual customer orders. This can include the loading and routing of vehicles, for example.

2.2 Logistics

Logistics consists of the activities that have the goal of placing the right product, at the right time, to the right place, in the right quantity, quality and order in a cost-efficient manner. It involves all the operations needed for moving the products, from the location of the production units and the warehouses, to provisioning, management of physical flows in the manufacturing process, packaging, storage, handling of inventories, product management in cargo units, preparation of lots for clients, transport and design of the physical distribution of products (Larrodé et al., 2018). Logistical networks require the coordination of simultaneous processes and are complex, dynamic and highly interconnected (Cirp et al., 2019).

Regarding the location of logistics infrastructures, in developed countries they are based on the experience due to the limited data sources and their planning and development are done in an unorganized way (Srisawat et al., 2017). The lack of logistics planning can lead to inefficiencies not only at the operational level but also in terms of costs.

2.2.1 International Logistics

International logistics refers to all the tasks that include the planning and cross-border logistics processes. The international flow of goods is under specific conditions depending on the destination country and particular procedures may result of the long transportation distances or high order lead times. In addition, each country of destination can be inserted in markets with different macro and micro-economic aspects (Cirp et al., 2019).

On an international basis is important for both buyers and sellers to know the terms of trade that have been agreed. These terms, named incoterms, mean different responsibilities relative to the transport element of the order (Rushton, 2014). The term ‘delivery’ is used when risk passes from the seller to the buyer. There are four categories for grouping incoterms, according to the obligation of both parts involved. EXW considers to the minimum obligation, and DDP the maximum obligation for the seller (Malfliet, 2010). The main incoterms are defined as follows:

E-terms: Departure term

EXW (Ex Works)

The merchandise is placed at the disposal on the establishment of the seller, or at another named place, without being ready for export or even loaded onto any transport vehicle.

F-terms: Shipment terms - Main carriage unpaid

FCA (Free Carrier)

The seller completes its obligations until the delivery of the merchandise in a certain place, ready for export, to the care of the international carrier (usually indicated by the buyer).

FAS (Free Alongside Ship)

The seller completes its obligations until the delivery of the merchandise next to the ship conveyor at the designated port of loading, ready for export.

FOB (Free On Board)

The seller completes its obligations at the moment when the transshipment of the vessel at the designated port of shipment. Then, the buyer assumes all liability for losses and damage.

C-terms: Shipment terms - Main carriage paid

CPT (Carriage Paid To)

The seller has the responsibility of contracting and paying the freight to leave the merchandise at the place of destination, as well as for the dispatch for export. Then, the buyer assumes its responsibility for risk of loss and damage.

CIP (Carriage and Insurance Paid to)

The seller has the responsibility of contracting and paying the freight to leave the merchandise at the place of destination, as well as for the dispatch for export, plus the hiring and payment of the insurance until the destination. Then, the buyer assumes its responsibility for risk of loss and damage.

CFR (Cost and Freight)

The seller is responsible for payment of costs necessary to place the merchandise on board of the ship, for the payment of the freight until the port of destination and for the export order.

CIF (Cost, Insurance and Freight)

The seller is responsible for payment of costs necessary to place the merchandise on board of the ship, for the payment of the freight until the port of destination and for the export order. In addition to these responsibilities, the same as the ones of the incoterm CFR, the seller must still pay the transport insurance premium main.

D-terms: Arrival terms

DAT (Delivered At Terminal)

The seller completes its obligations when the merchandise is placed at the purchaser's disposal at the designated terminal of destination, not dealing with the formalities. Moreover, it assumes the costs and risks inherent in the transport to the port of destination and unloading of the goods.

DAP (Delivered At Place)

The responsibility of the seller is to place the goods at the disposal of the buyer, at the designated terminal of destination, or at another agreed place. The merchandise must be ready to be unloaded. The seller does not have to deal with the formalities for importation, assuming the costs and risks inherent in the transportation to the place of destination.

DDP (Delivered Duty Paid)

The seller assumes all the risks and transport and delivery of the goods at the designated place of destination. It delivers the goods to the buyer at the designated destination, dealing with the import formalities.

2.2.2 Digitalization in Logistics

Industry 4.0. is the name given to the fourth industrial revolution, which is attributed to the digital transformation that a lot of companies are undergoing. It aims to use the emerging technologies to implement Internet of Things (IoT) and services to achieve a complete integration of the processes, that result in higher flexibility, efficiency, and quality with lower costs and less impact on the environment, creating intrinsic value for the industry and broader society. Digitalization main goal is to generate a digital representation of an analog signal, to be electronically stored or processed, allowing communication at every place, at every time for every user with any kind of device. Although digitalization is mainly attributed to the production process, it is important to measure this concept impact in logistics and along the supply chain, as it can enable real-time full-transparency from suppliers to customers, connect and decentralize processes and lead to autonomous management (Kayikci, 2018). Logistics can gain an ample vision of mass adoption of digital technologies, such as cloud, data analytics, machine learning, blockchain, IoT, etc., on how to have a sustainable development by the use of appropriate technologies, allowing to vertically and horizontally integrate the supply chain intervenients.

Qi et al. (2019) proposes a data-driven supply chain management (DSCM) model, represented in figure 2.2. It is composed by two interconnected supply chains, a physical chain referring to the tangible flow of physical materials, and a virtual chain referring to the intangible flow of information, representing the physical chain in the virtual environment. In addition, there is an implicit service chain representing a collection of value-adding services relevant to supply chain management.

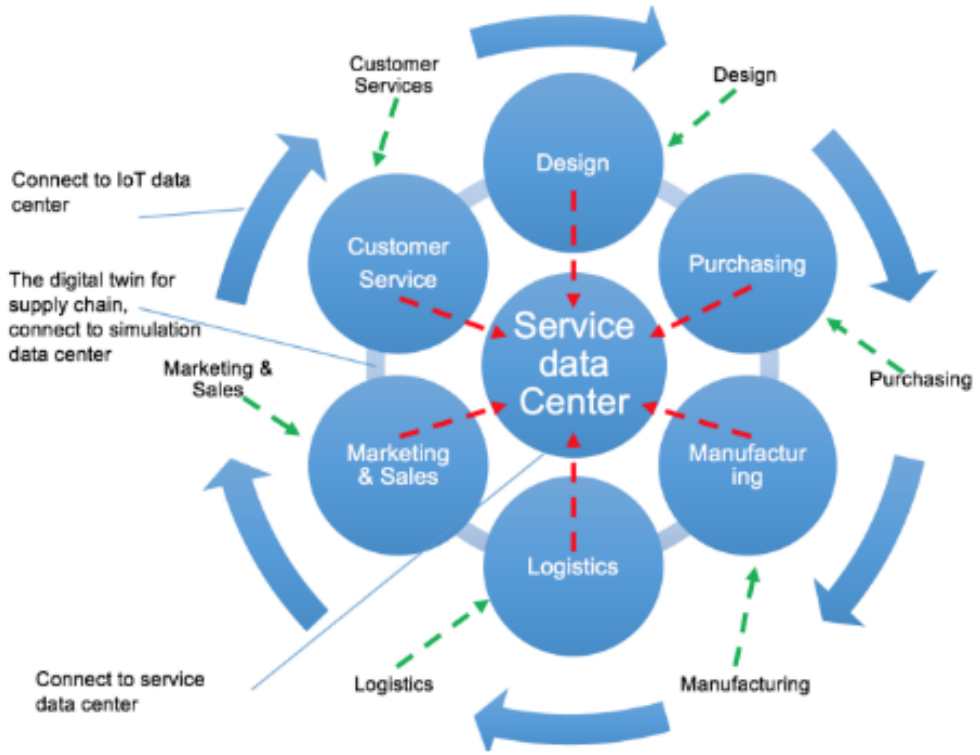

Figure 2.2: Data-driven Supply Chain Management model

The simulation data center, directly linked to the virtual supply chain, allows to simulate, analyze, and predict the operation of the virtual supply chain. The IoT data center, directly linked to the physical supply chain, enables to collect, clean, integrate, and analyze the real-world data obtained from different stages of the supply chain. The service data center, linked to the service chain, functions to prescribe a variety of value-adding services, such as consulting, knowledge service, diagnosis, maintenance, and update to various stakeholders (e.g., customer, supplier, distributor, etc.) involved in different activities of supply chain management. In addition, the service chain is integrated with the physical chain through various industrial product-service systems. It also drives decision making about supply chain management to be driven entirely based on the data about the physical chain, entirely based on the data about the virtual chain, or even on the combination of both physical and virtual chains.

The digitalization provides significant benefits to plan, manage and synchronize freight and logistics operations, as it is based on “cooperation, connectivity, adaptiveness, integration, autonomous control and cognitive improvement”. Moreover, it allows real-time and full transparency along the whole supply chain, increasing visibility, and efficiency for transport and logistics centers. A higher level of optimization is reached by using big data analytics, and gathering information in cloud computing. Management decisions may be better-informed, by having decentralized and autonomous decision-making, open intelligent user interfaces design allowing horizontal and vertical collaboration. Increased automation is achieved with human-machine interaction, and errors reduced in complex processes. Finally, a better understanding of consumer experience is

possible due, for example, to augmented reality solutions. Furthermore, digitalized companies are better prepared to timely react and adapt to disruptions along the supply chain, as they have their workflows optimized and lead times reduced.

Digitalization impacts logistics at the economic, environmental, and social dimensions of sustainability. Regarding the economic effects, digital logistics ecosystem should provide an affordable and efficient operating system that not only includes collaborative solutions and a mix of transport mode choices but also supports the local economy. From an environmental perspective, it is important to empower the use of renewable energy sources and technologies that reuses and recycles its components, minimizing gas emissions, pollution, and waste. At a social level, community needs must be satisfied, promoting safety, equity, and quality in individuals life (Kayikci, 2018).

2.3 Transport in Logistics

Road transport fleets and operations are the logistics activities that are most commonly outsourced. In fact, road freight transport outsourcing is a widely accepted trend, but very often is not established an adequate comparable research with the own-account transport, and its dominant role is highlighted in almost all related studies, many of them containing empirical surveys. This fact led to a global perception of transport outsourcing as a "one size fits all solution", this being one of the "logistics outsourcing research paradoxes". Some studies reveal projections about its increasing significance, in Europe, in the near future. Its expansion is related to the increase of the revenue of industry and to the number of companies that use transport suppliers and can also be related to a rise in the volume carried by logistics providers (Stojanović, 2017).

There are many drivers that enable outsourcing, namely globalization, that leads to the lack of expertise of some transport suppliers for different countries. Moreover, the increased demand for just-in-time (JIT) deliveries by the customers, associated to higher operational complexity and higher costs, make logistics control to have a crucial role in distribution operations (Razzaque and Sheng, 1998).

2.3.1 Transport Systems

Interfaces between logistics and freight transports, allow the interaction between actors along the supply chain, transport planning, and transport processes, are poorly identified and coordinated in most European countries. These interfaces have the most influence in areas such as data and information exchange, trade, transport and transshipment of goods, sticking to standards and offer and use of transport modes (Stein et al., 2016).

There are three categories of functionality and operability of interfaces: "vehicle-sided" interfaces, that are a consequence of a transport process using various vehicles; "infrastructure-sided" interfaces, that are the result of a transport process along the transport route infrastructure; and "information-sided" interfaces, which represent all the organization of transports, from preparation to follow-up, and aim to reduce the business risk, to meet the customers' needs and to fulfil

regulatory conditions. The last interfaces are characterized by the specific customers' requests, such as just-in-time deliveries, communication technologies available on the market, environmental and transport policies or the implementation of economic, for example, rules concerning the import and export, and company goals, that can be focused, for example, on increasing efficiency or maximizing profits.

2.3.2 Transport in Europe

Although the transport sector represents an essential element of the economy of the European Union, particularly regarding its member states, its development is threatened by many challenges that the sector is facing. European citizen's look for fast, efficient, and on-time delivery of goods. Therefore, there is a need to act. So, a "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" was prepared. It includes measures for having sustainable transport in the future, aiming to improve an efficient energy performance of vehicles of all modes. This is crucial to optimize the performance of multimodal logistic chains, including by using more resource-efficient modes, where other technological innovations may be insufficient, such as in long-distance freight. Also, it is necessary to gain efficiency by using improved traffic management and information systems, advanced logistics and market measures (Niculescu and Minea, 2016). Enabling cooperative logistics is a "win-win" business, that is empowered by coherent cooperation of the relevant stakeholders and by the use of efficient interfaces between short and long-distance networks (Nathanail et al., 2016).

In the literature it is proposed a National Single Window Integrated Platform (NSW) concept, a national system that will act as a single point of contact of freight-related information between public and private stakeholders from different transport modes. NSW to several European countries, able to support multimodal transports and logistical operations. However, its development in every European country seems a very complex goal, as it needs planning, funding as well as a political commitment. This platform design should include at least modules for Scheduling, Booking, Shipment Tracking, Documents Processing, and Reports Creation. The first module should provide a dynamic point to point schedules, cut-off/availability, and routings. The module for booking should allow secure booking requests, sent via the Internet, and confirmed electronically. The module for Shipment Tracking enables the traceability and the view of single or multiple shipments. The Documents Processing Module allows not only the creation but also to view and print documents. The last module shows the information displayed by categories, such as Shipment Details, Commodity, Transport/Service, Estimated Dates, Actual Dates, and Container Details (Niculescu and Minea, 2016).

Chapter 3

Transport Operation

Taking into consideration the increasing complexity of BA business, there was the need of introducing a planning function to obtain the correct balance between the customer needs and the logistics resources capacity, in order to anticipate bottlenecks and others risks.

Transport Planning is based on the analysis of the calendar of the year, identifying peaks, highlighting campaigns, and considering critical periods. This planning allows to manage the number of loads according to each warehouse capacity and so to better manage the customer expectation.

In terms of BA's organization, Transport Planning is a new division inside the Transport department, focused mainly on the IB and CE divisions operation. It aims to increase collaboration and improve interdependence between several departments responsible for the entire supply chain, from production planning to logistics execution.

Firstly, supporting the Production Planning department is an essential function of Transport Planning, by assuring it has the necessary information to plan the production efficiently, optimizing it to reduce the transport costs and moving articles according to the available capacity. It is critical for Transport Planning to inform Production Planning about the feasibility to deliver when moving the production to a different plant, in order to avoid failures and also to optimize the transport costs. Moreover, the insights given by the Transport Planning to the Front Office, which is composed by the sales team, allow them to have the information needed to manage the customer expectation and to reduce the disappointment that can result of the delays by adjusting the delivery deadlines. Furthermore, useful information is provided to the Transport team, for it to cover all the volume of transport requested and to have the possibility of procurement of alternative transport solutions. In the end, the Warehouse operation is also going to benefit from Transport Planning, as it allows the Warehouse to be prepared for the capacity needed, and to have the reduction of the delays and waiting times as a result, and again, improved customer service.

In figure 3.1 are represented the BA's departments that are influenced by Transport Planning actions.

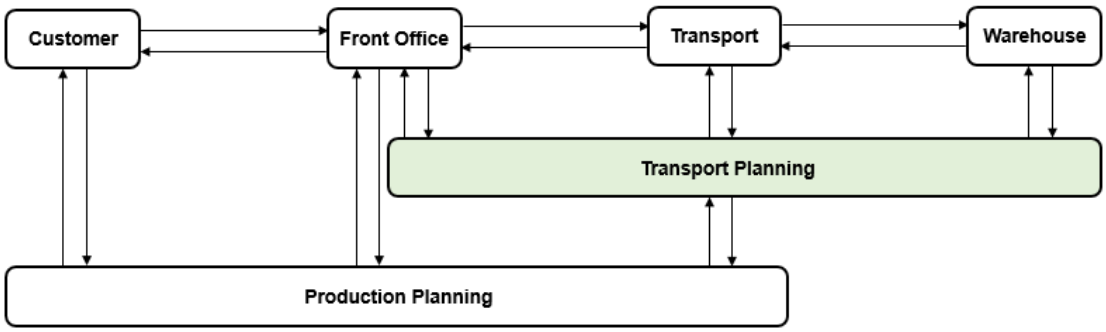

Figure 3.1: BA departments influenced by Transport Planning

The reason behind Transport Planning being mostly focused on the IB and CE divisions operations, during this project, is because, although SEE division was acquired in 2017, until the end of 2018 the transports related to this division were not centralized in the corporate function. Then, SEE Transport was centralized and, at the moment, the best practices are still being shared, and the systems integration being done. Besides, as mentioned before, Transport Planning is new, so it is preferable to design how it is going to work with the already well-known operations of IB and CE divisions and, in the future, implement Transport Planning in SEE division operation.

3.1 Transport in BA

Transport is an important part of BA's business, not only for the impact on costs but also the relevant role in customer service. Transporting finished goods from BA to the customers represented a cost of 69 million euros in 2018; around 59% of this value was from IB, 27% from CE and 14% from SEE.

In terms of organization, Transport in BA is a corporate function, looking for specialization and synergies between markets, plants, countries, and flows. It is divided in IB Operation, CE Operation, SEE Operation, Reverse Logistics and, since 2019, Transport Planning (IB+CE). Until the end of 2018, there was also a department of Transport Development with a temporary mission of procurement, the aim of searching an IT Tool needed to improve the Transport operations, developing reports with relevant information to support the Transport and to eliminate errors. As a result of this department, a lot of information was acquired, and this allows Transport Planning to act.

As mentioned above, transports from Iberia represent more than half of the total volume of transports at BA Group, and the costs associated to them follow a similar proportion, as can be seen in table 3.1. The number of transport suppliers working with BA is also considerably higher in the IB division.

Table 3.1: Comparison of Transport volume from each of BA divisions

	Number of Suppliers	Weight (k ton)	Trips (k)	Cost (M€)
Iberia	104	1 110	69	41
Central Europe	68	450	28	18
Southeast Europe	69	400	22	10

The main destination countries from each of the BA plants is represented on the maps in 3.2. From IB, most of the transports are to Spain, France, and Portugal. From CE, the most common destination countries are France, Germany, Poland, and Italy. The main receivers of the transports from SEE are in Italy, Romania, Greece, and Bulgaria.

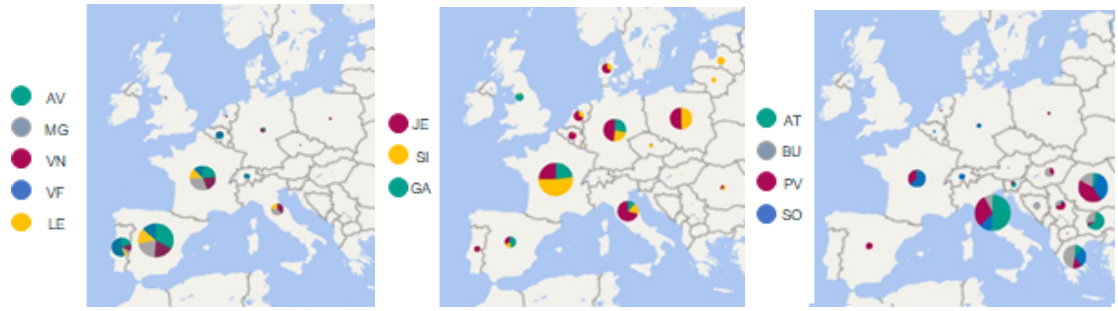

Figure 3.2: Maps of the main countries of destination of the transports from the plants located in IB, CE and SEE, respectively

Transport of finished products is done by road or by sea, the last one not being very significant: about 13% of all transports from the IB division and only about 1% from the CE division. The map in 3.3 represents the main destiny countries of the exports of BA by sea.

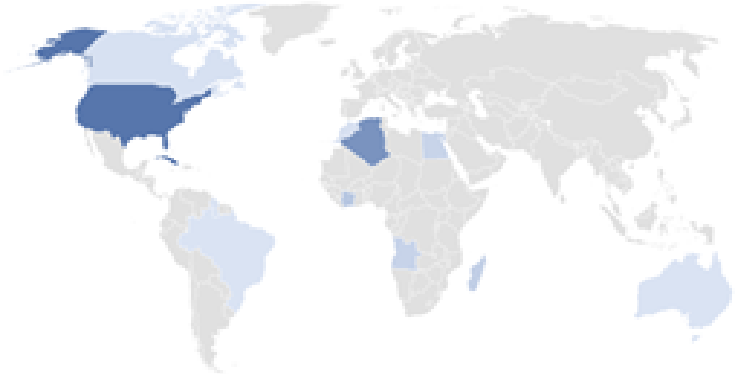

Figure 3.3: Map of the main countries of destination of the transports by sea from BA

On one hand, to be able to get better transport prices when negotiating with transport suppliers, a high volume of material must be delivered. On the other hand, customers do not want to receive a large quantity at the same time, they demand just-in-time (JIT). JIT works better for companies using repetitive manufacturing functions, characteristic of BA main customers, and its primary

goal is to decrease costs by keeping only the inventory on hand to meet immediate production needs. Having external warehouses, where finished products can be stored near the customers until they are delivered, is a way of getting better transport costs while supplying what customers demand.

BA uses local external warehouses, situated in the countries where there are BA plants, which are mostly needed due to the lack of space on the production plants and for safety stock. In addition, they can be used for extra stock which are maintained in these warehouses to mitigate the risk of stockouts caused by uncertainties, not only in demand, but also in supply.

Besides, BA also uses external warehouses, located in the export market. The main reasons for having these are also the need of having a safety stock, that can be imposed by large customers to have it near the receiver, or because the Transport team detects a necessity due to the distance or difficulty on finding suppliers for specific routes. Moreover, external warehouses can be used for the pipeline. The pipeline is the term used by the company when intermodal transports are used, and warehouses are needed to move finished products from containers to trucks, which are used to deliver to the customer. This happens when the customer does not have the possibility of unloading containers, but the transport cost associated to the delivery of a high volume of products in containers is lower than when it is done just by the road.

The agreements with the external warehouses are done with the ones that provide the best price with the best lead time.

The location of the external warehouses used by the IB and CE divisions can be seen on the map in figure 3.4.

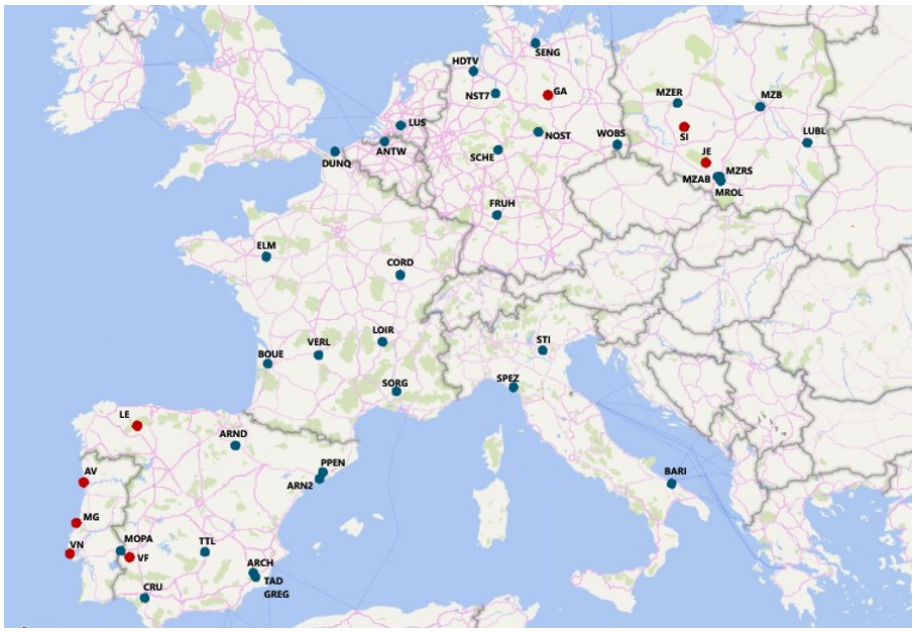

Figure 3.4: Map of the external warehouses' chain

Hence, one significant advantage of having an external warehouses' chain is having the ability to provide better customer service, by reacting in a more agile way in case of delays or other incidents, and therefore improve the customer satisfaction.

Indeed, external warehouses' chain plays a critical role in the markets where BA has no plants, as it provides the ability to react faster according to the customer's needs.

3.1.1 Transport Process AS IS

BA final products transport is organized using different carriers for single trade lanes and areas. Generally, transports are arranged as Full Truckload (FTL). The product is packed on pallets and shipped from dedicated plants to BA customers all over the world.

The process starts when the customer places the order that is received by the Back Office in a Portal, by Electronic Data Interchange (EDI), which is the transfer of data from one computer system to another without the need for human intervention, by standardized message formatting, or by Optical Character Recognition (OCR). Then, the Sales Orders are created by the Back Office manually, via Portal, EDI or OCR. Afterwards, Sales Orders are checked, and Delivery Notes (DNs) are created by the Front Office (FO) for each truck. Through SAP, the Transport team visualizes all the unassigned orders and manually searches the suitable carrier in SAP (containing information about price, route, market share, etc.), and then contact the carriers. The transport assignment needs to be organized by phone or email. If the carrier accepts the transport, it is assigned to the DN, and a shipment document is automatically created. After that, an e-mail is sent to the carrier with information, such as the loading point, unloading point, and delivery's date and time. Confirmation and response messages are stored in the user's mailbox or paper form.

Both FO and Transport team follow up on the delivery. For receiving status information during the transport process, the carrier needs to be contacted via phone or e-mail to get the necessary transparency. In the case there is the need to change the DN, the FO informs the Transport team, and the team contacts the transport supplier, which confirms the changes and updates the transport status. The transport process above described is represented in figure 3.5.

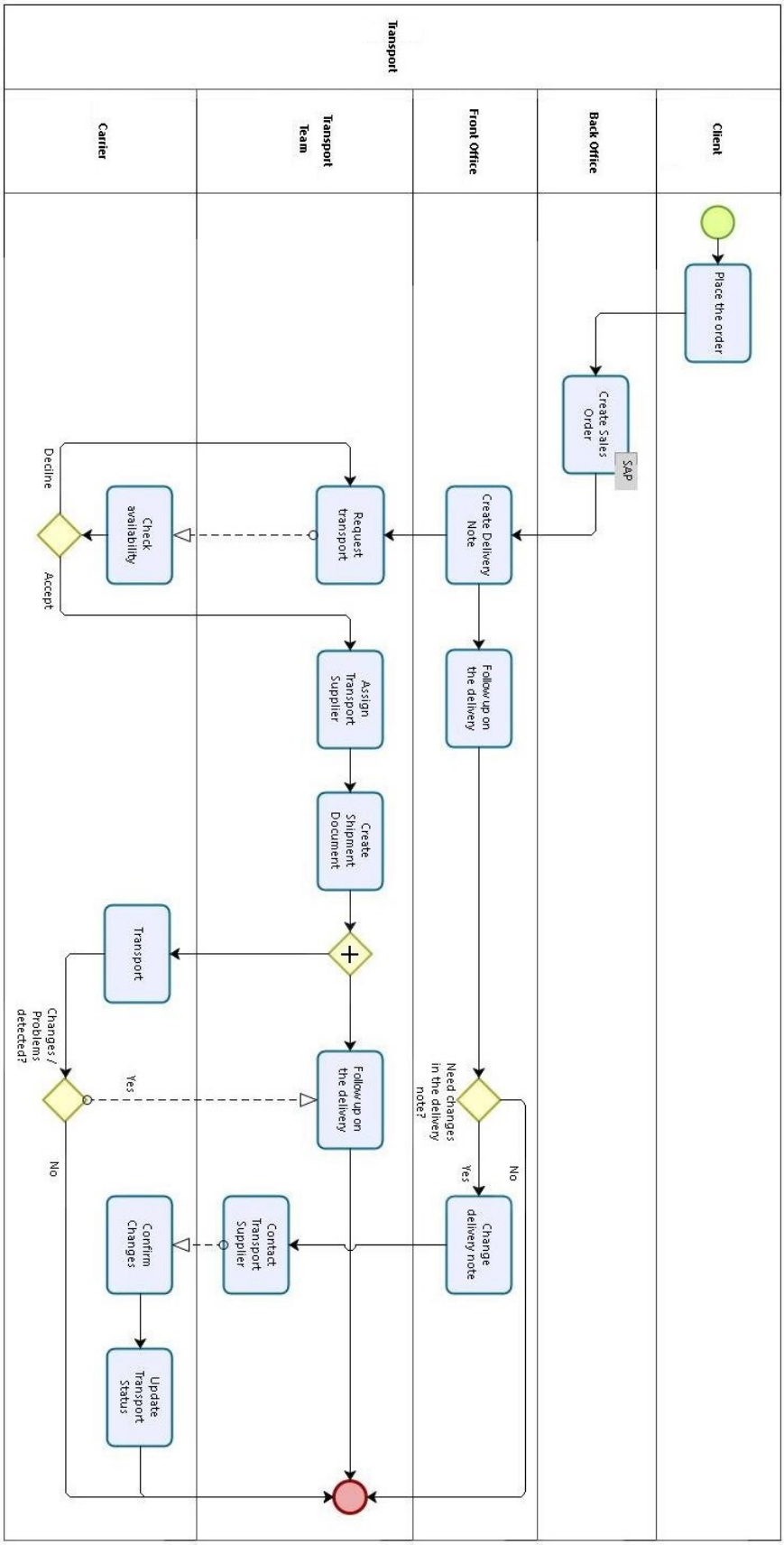

Figure 3.5: Transport process map

The responsibilities of BA intervenients on the transport process are represented in table 3.2.

Table 3.2: Departments' responsibilities related to transports

Department	Responsibilities
Back Office	• Receive by portal/ EDI/ OCR new orders from customers and create orders based on e-mails in the system; • Contact with other departments involved in the process to unblock orders issues (e.g., lack of information, missing stock, etc.).
Front Office	• Daily contact with customers; • Management of the customers' expectations; • Creation of the Delivery Notes and definition of the sales orders exceptions for Transport; • Follow up of complete orders and sales orders exceptions; • Unblock orders with customers.
Transport	• Organize transports based on Delivery Notes and sales orders exceptions; • Provide all the information needed for the Front Office operation.

3.1.2 Loading Process

There is no time slot booking for BA loading process. This process is based on the dispatching rule FCFS (first come, first served), as the loads are sequenced by their arrival times. However, when there are trucks that are considered as urgent to leave, they can be loaded first.

The process since the arrival of the carrier to the warehouse for loading, until the delivery to the customer, described in figure 3.6, starts when the truck arrives to do the check-in and informs the expedition about its Delivery Note number, which emits the Loading Request document. Then, the carrier is informed by the expedition of which is the warehouse that the truck should be positioned for loading, as in most of the plants there are more than a warehouse with this purpose. When it is its turn for loading, the carrier goes to the loading position so that the cargo can start. After it is finished, the Delivery Note is issued, and the truck can deliver to the customer.

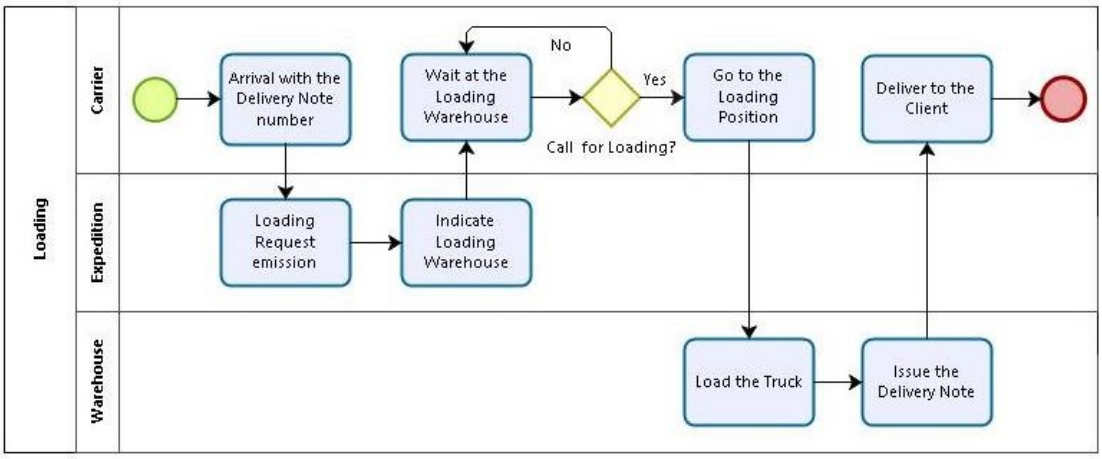

Figure 3.6: Loading process map

3.2 Difficulties in the Transport Operation

Transport performance in BA is conditioned not only by internal factors but also by external ones.

Internal factors that difficult Transport operations include the lack of consideration by the FO of the lead time needed for delivering when accepting the customers' orders. Additionally, the lack of immediate visibility of these orders by the Transport team, as when the order is received by the FO, only after being analyzed, it is sent to the Transport department, and so increases the probability of delivering to the customers with delay. The fact that there is no time slot booking for the loads at the warehouses is also a factor that can lead to not accomplishing the delivery deadline, as the trucks can arrive all at the same time and, therefore, some of them need to wait a considerable time to be loaded. This lack of Warehouse loading capacity control leads to delays that can have extra costs associated. These costs can be charged by the customers, or even by the transport suppliers. In Central Europe, these costs are usually directly charged according to the number of waiting hours. In Iberia, although this situation does not happen frequently, it must be taken into consideration that the supplier can reflect this cost in the future transport cost charged to BA, as there is a price table, agreed between BA and each supplier, that is reviewed annually.

Furthermore, there are external factors that constrain Transport operations, such as the lack of transport suppliers and a highly regulated transport market. The fact that transport prices are high, it has an important impact on the Transport costs. They have been raised when there was a capacity shortage some years ago and, although they have decreased, it was not in a very significant way (Eurostat, 2018).

Actually, as it was previously mentioned, there are several concerns when trying to find available transport suppliers, mostly for exports, as it can represent a considerable transport distance. Considering the exports, the difficulty on finding a transport supplier, especially when a large number of trucks is needed, is a critical aspect, as it can be the cause of many delays in deliveries, affecting the customer satisfaction. Transport booking becomes even more difficult when trying to do it during the holiday season or in the weeks with bank holidays, especially when they are close

to weekends.

In addition, there are EU rules to avoid illegal habits in road transport and to enhance drivers' employment conditions, based on the principle of "equal pay for equal work", meaning that the same remuneration rules apply to a truck driver delivering goods in another member state after a cross-border delivery as to drivers in the host country. Moreover, to ensure better rest conditions for drivers, companies must organize the timetables for their drivers in a way that allows them to return home once every three weeks.

To guarantee fair competition, new time limits were defined for 'cabotage', which means delivering within another EU country after a cross-border delivery, instead of the past limit based on the number of deliveries. Border crossings are registered to help detect fraud. To tackle the problem of companies registered in another member state to avoid additional costs, while the main business activity is conducted in another, companies are obliged to have substantial business activities in the member state where they are registered (EUR-Lex, 2019). To ensure the protection of their drivers against big competition from Eastern Europe countries that pay much lower wages, countries like France, Italy, and Germany have implemented strict regulations about the driver's restrictions when transporting goods on Sundays and Public holidays. Additionally, Germany imposed restrictions on night driving and during the summer (Eurostat, 2016), which led to being very difficult to deliver to some clients in specific periods, such as to export from Poland to Germany when the deliveries are after the weekend, unless it is near the border.

All these characteristics of the transport market, together with the inefficiencies of the Transport operation at BA, contribute to the high costs associated to transports at this company, as well as to the difficulty of having the capacity of carriers needed.

Chapter 4

Opportunities for improvement

Transport Planning in BA aims to improve the operational efficiency, which as major consequences has an increased customer satisfaction and a significant reduction of the costs related to transporting.

Some problems were detected, regarding the lack of Transport Planning and the flow of information between the Front Office, Production Planning, Transport and Warehouse departments that needed to be reviewed:

- The Front Office accepts all requests;
- There are no previous alerts of peaks and campaigns, which has consequences not only on the transport costs, but also on the process of finding available carriers, as in most of the times it is difficult to find the number of trucks needed;
- Loads on the warehouse are not prioritized;
- It is not taken into consideration the maximum warehouse loading capacity per day;
- No time slot management;
- Manual business processes;
- Insufficient and not automatic carrier allocation;
- Lack of transparency and real-time visibility;
- No online cost control.

Transport Planning allows to tackle these sources of problems, by the following steps, in two different points of view:

In the short term,

- Managing customer expectation;

- Managing the number of loads according to the warehouse loading capacity;
- Increasing the efficiency of the logistics processes, by making the transport logistics processes along the supply chain transparent and cost-effective.

In the long term,

- Avoiding the peaks, detecting the campaigns, smoothing the operation and having in consideration the critical periods.

The necessary input starts based on the yearly budget and proceeds, along the year, looking at the sales plan, production plan, and the moving articles. Also, the information obtained from the warehouses, as the capacities of loading and the routes are an input to do the planning.

The output of the Transport Planning provides useful information for diverse areas of BA. Sales Team can be better informed in order to manage the customer expectation by adjusting the deliveries' deadlines. Transport team can be prepared to cover all the volume of transport requested, as well as to have the possibility of procurement of alternative transport solutions. This improves the Warehouse operation by minimizing delays and reducing queues and waiting times. Furthermore, it allows the external warehouses' chain to be prepared according to the distribution and customers needs.

4.1 Measurement of inefficiencies

To better understand the effects of Transport Planning performance within the company, an in-depth analysis of the impact of the lack of inefficiencies detected, described above, was performed, based on the company's information. This enabled the opportunity of identifying at which levels should Transport Planning act. A measure of the parameters analyzed, described below, was done to assess the potential effect of Transport Planning.

Transport Planning actions mostly impact the Transport operation, the Warehouse operation, and, in the end, the Customer Service level.

4.1.1 Transport Operation

• Complaints due to delivery delays and associated costs

In BA, claims due to delays on deliveries to customers have a relevant impact in terms of costs and customer satisfaction. In fact, for several times, customers had their production lines and employees stopped because of BA delays on the deliveries, that can be of more than one day. Although there are delays caused by unpredictable reasons, such as accidents, most of them can be avoided if the trucks are booked in advance. Hence, booking in advance is a solution to tackle the difficulty of finding available transport suppliers when there are peaks in the number of deliveries.

Since 2017, more than 100 complaints regarding delays on deliveries from BA plants located in Iberia and Central Europe were filed by customers, and these represented an important cost for the company.

Moreover, there was an increase in the total number of complaints regarding delivery delays between 2017 and 2018, as can be seen on the graph on the left in figure 4.1. This situation was influenced by the high number of complaints regarding deliveries from the polish plants in CE. Also, costs associated with these complaints increased almost five times between these two years. Furthermore, this trend continues, as the number of complaints in 2019 was higher when comparing the same periods of the previous years, as represented on the graph on the right in figure 4.1.

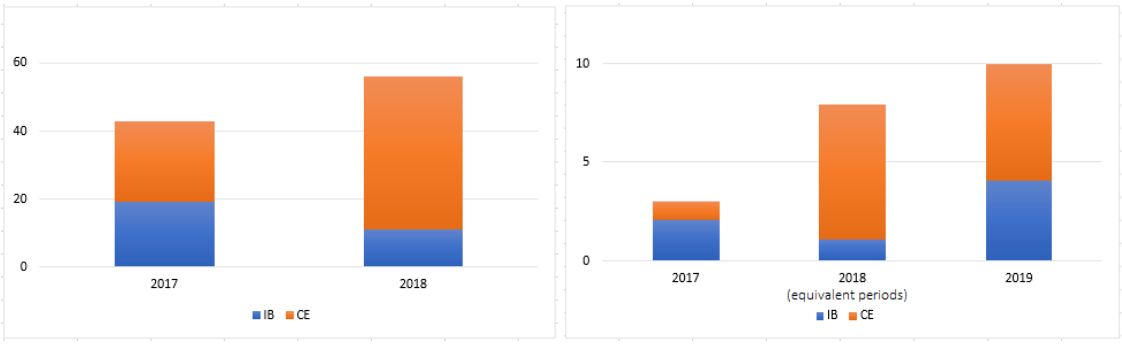

Figure 4.1: Number of complaints by division

Therefore, looking at the increased operational efficiency that can be achieved with Transport Planning actions, which aim to reduce all controllable sources of delays, costs related to complaints due to delays in deliveries can be saved. These savings are obtained because the number of complaints expected after the improvements described in the following chapter, is not relevant. Thus, annual savings for IB and CE divisions are expected to be of at least 50 thousand euros, which were the costs related to late deliveries complaints in 2018 for these divisions. Also, as the Transport Planning actions are starting to be implemented in SEE, savings are also expected for the four plants located in this division by 2020.

- **Extra Transport costs**

Extra Transport costs are the costs related to transporting final products that are charged to BA, typically because of the delays on the deliveries to the customers, because of missing trucks, or because of the waiting time for loading of transport suppliers. These costs are more relevant when deliveries are from the plants in Central Europe, especially from the German plant. In Iberia, the waiting time of the carriers is usually not charged, although it can lead to an increase in the annual price agreed with the transport supplier.

Since 2017, extra Transport costs represented almost 200 thousand euros for BA and the increase between 2017 and 2018 of the total extra Transport costs is very significant, as can be seen on the graph in figure 4.2, especially in CE.

CE extra Transport costs are much more relevant than the IB ones, not only for the above-mentioned reasons but also because of having a more difficult transport market context. The two plants in Poland only represent 20% of the CE extra Transport costs, the rest of the percentage

representing only the German plant. Moreover, the increase in these costs between 2017 and 2018 was of three times for the Polish plants and five times for the German plant.

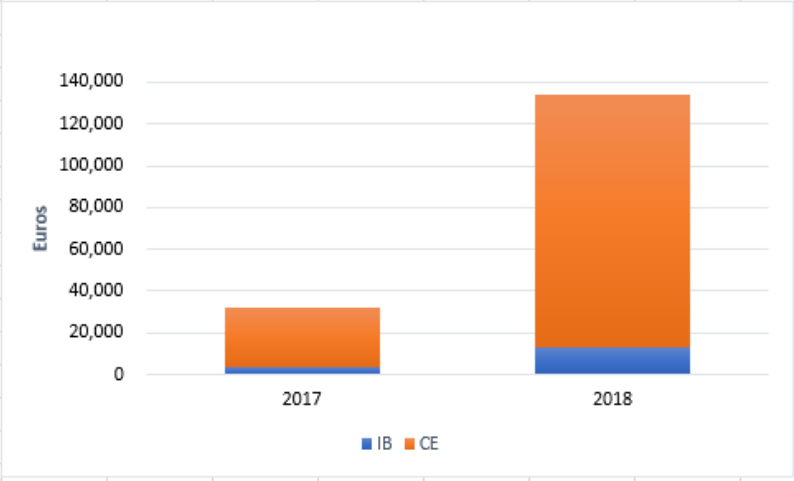

Figure 4.2: Extra Transport costs by division

With Transport Planning, a reduction of extra Transport costs can be expected for the present and following years, as its actions aim to reduce these additional costs primary sources, which include delivery delays and missing trucks caused by lack of transport availability and waiting time of transport suppliers. Moreover, when all Transport Planning actions are also implemented in SEE, it can be expected to reduce the extra Transport costs for the four plants located in this division by 2020.

- **Orders' acceptance with not enough lead time**

BA is a customer-oriented company, as it is focused on meeting customers' needs and providing a high customer service level. Deliveries' orders are received by the Front Office, which accepts all the requests. This practice leads to the acceptance of orders with deliveries' dates that don't cover the lead time needed since the placement of the order until the delivery to the customer. These orders are called deliveries with short time. Moreover, FO does not take into consideration the maximum warehouse daily loading capacity.

Effectively, about 5% of the total number of deliveries from the IB division, and about 4% of the total number of deliveries from the CE division is accepted with not enough lead time for delivering on time.

The distribution of the number of days below the lead time needed to deliver on time of the orders accepted with short time can be seen in figure 4.3. On average, the IB division has a short time of 1,7 days and the CE division of 1,83 days.

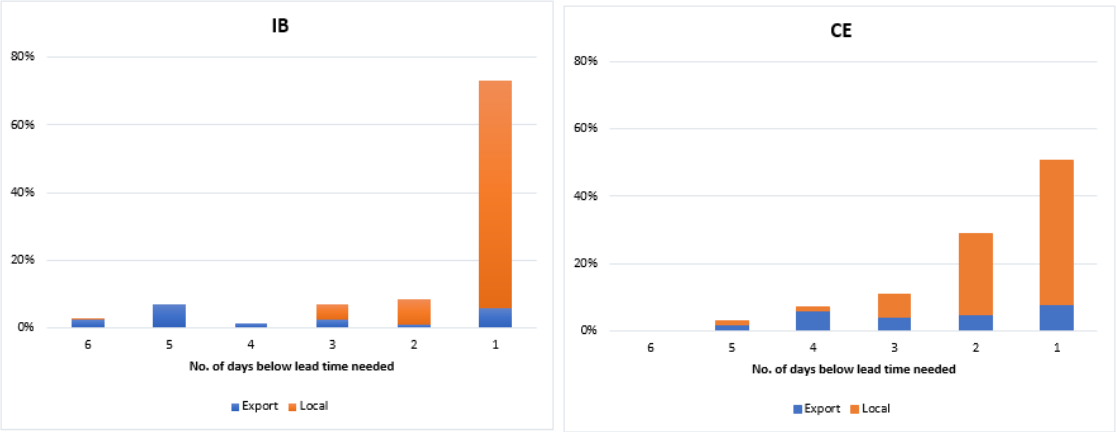

Figure 4.3: Deliveries with short time by division

Significant improvement of the flow of information between the Front Office, Production Planning, Transport, and Warehouse departments can be achieved by Transport Planning, as it performs a continuous interaction with these departments. Follow-up of the sales with the Front Office, of the production and moving articles with the Production Planning, of the daily planned loads of the warehouse and the alerts given to the Transport team, when based on the analysis of the information obtained, allows to take actions in order to improve the Transport operational efficiency.

Moreover, the analysis of several documents for creating reports for the customers considered as critical when anticipating peaks on the number of orders together with the continuous follow-up of the departments that have an impact in Transport Planning allows to avoid delays on the deliveries and to better negotiate in advance the prices with the suppliers. An increased efficiency on the exchange of information between departments improves the ability to meet sales projections and deliveries requests. This enables the detection in advance of potentially critical situations for logistics operations, and so to act accordingly. In the end, these actions lead to enhance customer service by reducing the delays on the deliveries.

4.1.2 Warehouse Operation

- **Waiting time for loading in the warehouses**

The average time between the check-in and the check-out at BA warehouses of IB and CE divisions is 2:26h above the standard time. The figure 4.4 has represented this average time per plant. The excessive time is mostly due to the time spent by the trucks waiting until they start to be loaded. This situation is mainly caused by the presence of other trucks also waiting to be loaded, as there is a lack of control of trucks arrival time.

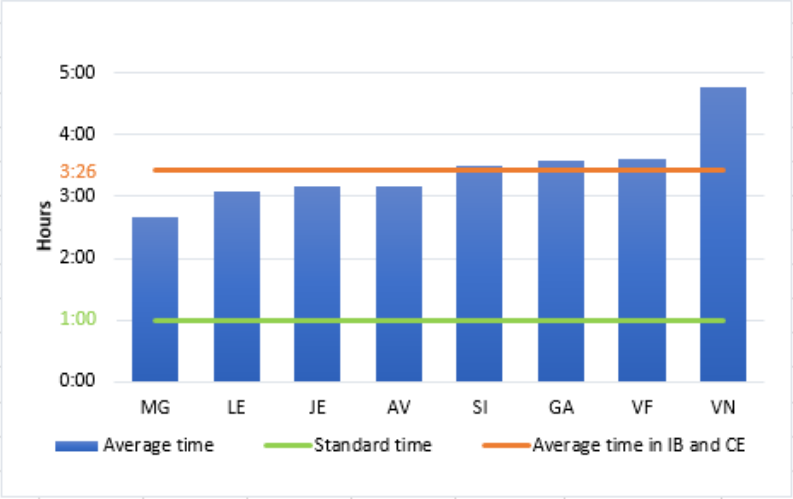

Figure 4.4: Time from check-in to check-out by plant

In effect, more than half of the trucks loaded have spent two or more hours between the check-in and the check-out, as can be seen in figure 4.5.

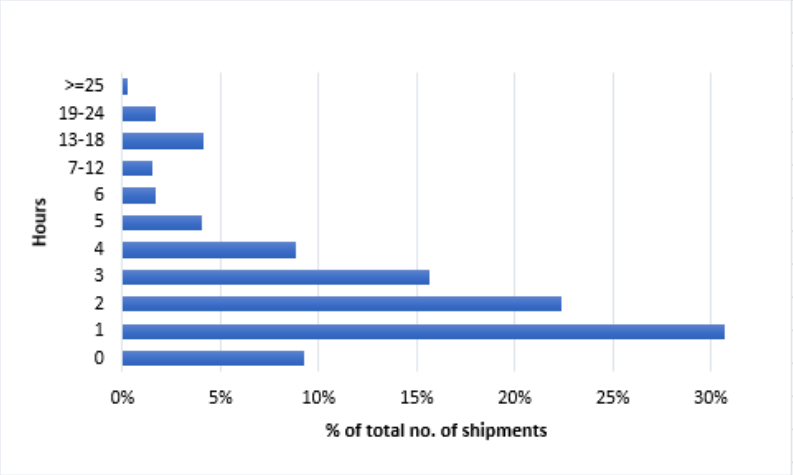

Figure 4.5: Percentage of shipments with a given time between the check-in and the check-out

Following Transport Planning operational improvements, with the use of a tool that allows to tackle the increase of the number of loads and to detect the unexpected need for trucks, the standard time intended between the check-in and the check-out at BA warehouses is of one hour. This is the time needed for all the process between the check-in and the check-out of the trucks at the warehouses.

Furthermore, the significant increase of the operational efficiency that can be achieved by the actions above mentioned allows not only a lot of waiting time saved for all the parts involved on the deliveries to the client but also increased customer satisfaction, by delivering on time.

4.1.3 Customer Service

• **Customer Satisfaction Index**

Customer Satisfaction Index (CSI) is an indicator of the customers' perception of the performance of the company relative to their expectations, that allows to evaluate the company's performance and to assess the ability to answer to the customers' needs.

With the increased competition associated to the globalization and having very few ways to differentiate itself, the commodity-like nature of the industry where BA is inserted requires exceptional operational efficiency to achieve increased customer satisfaction.

BA evaluates the customer satisfaction annually with several factors. One of the six evaluated factors in the CSI is "Logistics and Promptness with the Deliveries". The impact of the frequent delays in delivering along with the problems in the transport market that were previously mentioned is visible, as it resulted in a relevant decrease of this index since 2015

Customer satisfaction related to deliveries to customers is expected to become higher by the improvement of the flow of information between all the departments that have an impact in Transport operations. Also, by the continuous follow-up for detecting critical situations within the most relevant customers, together with the increase of the efficiency of the logistics processes, make the transport logistics processes along the supply chain transparent and cost-effective. Furthermore, improving the transparency of the Warehouse loading capacity and increasing the visibility of the Front Office, Transport Managers and Warehouse team on the number of the expected loads per day, allows to take action to tackle the potential critical days, and so to improve the customer service level.

Hence, it is expected to achieve with the "Logistics and Promptness with the Deliveries" a satisfaction level of about 8, on a scale of 1 to 10, for the current and following years, close to the ones before 2017, the year when SEE integration occurred, as a result of Transport Planning. Additionally, the same level of customer satisfaction is expected for the SEE division by 2020, when Transport Planning is also completely acting in the SEE division.

Chapter 5

Transport Planning

In the present chapter it is outlined the methodology adopted to tackle the inefficiencies detected to achieve a smoother logistics operation and ultimately better customer service.

Firstly, future changes in the transport process are mentioned, which include the decision of implementing a new logistics platform that increases the efficiency of the logistics processes, by making the transport logistics processes along the supply chain transparent and cost-effective.

Then, the creation of a tool that manages the number of loads according to the warehouse loading capacity and that provides the required visibility for warehouse loading operation is described.

After, the steps followed to smooth the operation are characterized, in order to avoid peaks and detect campaigns and critical periods.

In the end, the Key Performance Indicators (KPIs) needed to follow-up the Transport Planning are defined, as well as progress reports that allow tracking the Transport operational performance by displaying the set KPIs.

5.1 Transport Process TO BE

The decision of implementing a logistics platform was performed in order to optimize the transport assignment process. Moreover, it allows to reduce the delivery delays, not only by increasing visibility and proving time slot booking but also getting more transparency during transport execution while receiving automatic event message with real-time status updates by the carrier. This automatism also offers the possibility to rate single carriers by KPIs, such as on-time delivery.

TRANSPOREON is a web-based logistics platform that connects industrial and trading companies with their logistics partners. Its implementation aims an increase of efficiency within the logistics processes, and it provides a cost-effective and transparent way of dealing with the transport logistics processes along the supply chain.

The following improvements needed at Transport Operation, Warehouse Operation and Customer Service are expected to be achieved with TRANSPOREON implementation.

Transport Operation

• Improvement of global transport organization;
• Better and faster communication;
• More efficient usage of "BA fleet";
• More transport capacity;
• Higher attractiveness for suppliers.

Warehouse Operation

• Planning of warehouses capacity and resources;
• Reduction of waiting times avoiding extra charges;
• Avoidance of late cancellations.

Customer Service

• Tracking trucks and control delivery status;
• Reacting faster in case of any incident;
• Provide information in advance to customers;
• KPI and OTIF reports.

Furthermore, a better internal communication and an increased team motivation and development are complementary achievements of TRANSPOREON implementation.

To accomplish these, BA has decided to adopt the following modules of TRANSPOREON:

1. Transport supplier allocation

The creation of a Sales Order in SAP triggers the creation of a delivery that can be automatically assigned to a certain supplier and therefore appears in its system with the status "pending approval". This assignment is based on:

• Price ranking;
• Supplier quota in certain routes;
• Direct selection of a supplier to a route.

2. Online platform for slot booking

Online platform for time slot management based on each loading point's capacity, restrictions and booking rules accessible through an external link for both transport suppliers and clients: EXW (Ex Works) or FCA (Free Carrier) orders.

3. Visibility package

Overview of all deliveries status through:

• GPS location;
• Status modification (delayed/ arrived/ unloading);
• Notifications to transport and customer service teams.

4. Reporting

Tool that generates reports about transport activity, warehouse performance and transport costs.

The use of each of the modules above described enable the following enhancements:

1. Transport supplier allocation $\longrightarrow$ Automatizing manual processes

- Reduction of e-mails and phone calls;
- Immediate notification when an order is created or is being modified;
- Generation of invoices with online acceptance of prices and extra costs.

2. Online platform for slot booking $\longrightarrow$ Improvement of Warehouse operation

- Reduction of queues and waiting times;
- Decrease in delays;
- Smoothing Warehouse operation by distributing trucks along the day.

3. Visibility package $\longrightarrow$ Live monitorization of deliveries

- Reduction of e-mails and phone calls;
- Increase visibility to all stakeholders;
- Reduction of number of delays;
- Improve Customer Service.

4. Reporting $\longrightarrow$ Enhancement of overall operation

- Analysis of costs and transport supplier performance;
- Cost reduction.

5.2 Warehouses' management tool

The absence of visibility of the warehouse loading capacity impedes to take actions in case of overcapacity. As a solution to this, it was decided to create a tool that alerts all people involved in the transport and loading processes in case of a critical situation. These situations have a big impact not only at the customer level, but also on the relationships with transport suppliers and, in the end, have an impact on the transport costs negotiations.

Hence, the development of a warehouses' management tool aims to assure the transparency of the Warehouse loading operation and to increase the visibility of the Transport Managers and the Warehouse team on the number of the expected loads per day in each plant, while having in

consideration the maximum warehouse loading capacity per day. This allows to anticipate the detection of the critical days, and to act in order to avoid them. In fact, the information obtained with this warehouses' management tool provides the insight needed to prevent an excessive number of loads in the different warehouses. Its previous detection enables the sales team to adjust the delivery deadlines with the customers, and also the Transport team to be alerted of the critical days. By considering the number of transports needed to book for a particular day, they have the possibility of finding in advance transport solutions. Moreover, it also alerts the warehouse team to be prepared for a critical day, considering the number of loads.

The layout of the tool chosen to achieve the main goal of providing visibility of the warehouse loading capacity was a calendar. It gives the possibility for identifying potential critical days and when needed, distributing the number of loads in a way that allows avoiding waiting time for transport suppliers and, in the end, for customers. Transparency is a critical trait that needs to be fostered in all people involved in the process. An overview of this tool is represented in figure 5.2.

Furthermore, the warehouses' management tool provides a real-time visualization of the number of loads that are planned for each day within the next 30 days at each of the IB and CE plants. The option for this period range was based on the fact that DNs can only be received by Transport team in a maximum of one month in advance.

The number of planned loads is obtained by counting the number of deliveries planned for loading, for each day and for each division, after extracting directly and in real time from SAP the document with all the orders information for the following 30 days. The counting of the days starts at the moment when data information is updated, by selecting the button "Update Data". This button is located on the index of this tool, which is represented in figure 5.1.

Figure 5.1: Warehouses' management tool index

Afterwards, by selecting the month for which is pretended to visualize the information, an overview of the month situation is displayed, which already contains the updated number of loads planned for each warehouse, as represented in figure 5.2.

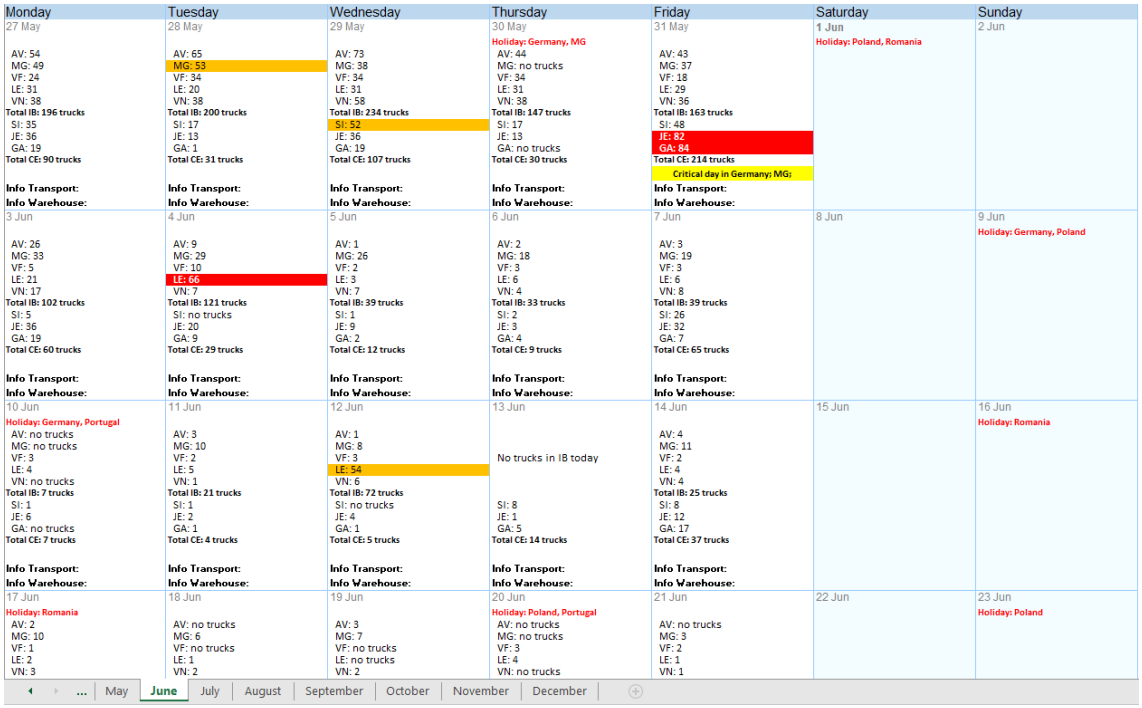

Figure 5.2: Warehouses' management tool layout

Besides representing the planned number of loads for each of the warehouses in IB and CE divisions, the tool sums up the total number of loads per division, so Transport managers of each division can have a global overview. In addition, the tool highlights the plants according to the number of loads that are planned for each of the days. The red color is used if the number of loads is already above the maximum capacity. The orange means that it is near the maximum loading capacity of that plant per day. This function assumes a major role as it is the one which allows taking action before the warehouse loading situation becomes a real problem.

In table 5.1 is represented the maximum daily capacity considered for each plant.

Table 5.1: Maximum daily loading capacity of each plant

Division	Plant	Maximum no. of loads
IB	AV	100
	MG	60
	VF	120
	LE	60
	VN	50
CE	SI	60
	JE	58
	GA	40

Additionally, the warehouses' management tool automatically represents the holidays of BA's plants locations, including the local ones. In this way, the users have a perception of a specific week's difficulty. As the consequence of having a holiday, there is usually the need of distributing the loads of that week by a fewer number of days.

Furthermore, it automatically identifies if a day is critical for a given plant or for the plants located in a particular country when it comes to finding available transport suppliers. Moreover, it has space for the Transport and Warehouse teams to insert additional information for a specific day, needed to support or to react to the expected operational activity of that day.

The criteria used for a day to be automatically considered as a "critical day" for a given plant or for the plants located in a particular country, is based on being a problematic day for finding transport in a specific location. This situation is caused when a day is between a weekend and a bank holiday, or because it is a day between two bank holidays. In these cases, the day is highlighted with the yellow color. This functionality is also very important, as it allows us to take preventive actions to tackle potential problems on these days. For example, in figure 5.3 is represented a day of this calendar, the 22nd of April, which is considered as a "critical day" in Léon, as it is a Monday and on the following day is a local holiday, so it is a difficult day to find transport suppliers during this day.

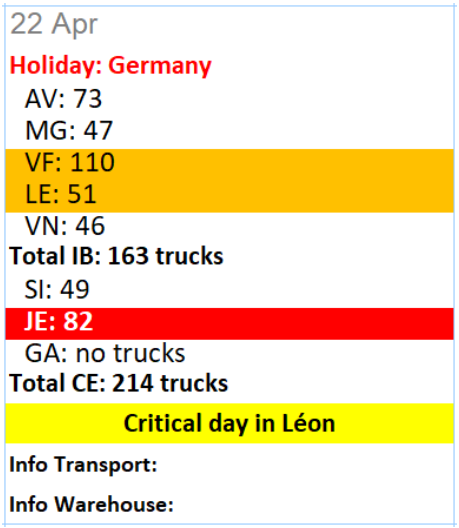

Figure 5.3: Warehouses' management tool day

As it can be seen in figure 5.3, a day in the calendar of the warehouses' management tool has automatically represented:

- Holidays of the BA's plants locations (local or national);
- Planned number of loads per plant;
- Planned number of loads per division;
- Plants or countries where it is a critical day for finding transport suppliers;
- Information added by the Transport team (optional);
- Information added by the Warehouse team (optional).

In conclusion, by the use of the warehouses' management tool containing all the information mentioned above, Transport Managers, Warehouse Managers and all the people involved can take preventive and corrective actions in the case of the number of planned loads being close or above the maximum capacity. Furthermore, they are also able to better prepare the critical days by negotiating in advance with the suppliers, which allows not only a cost reduction but also increased customer satisfaction, with the decrease of the delays of the deliveries.

5.3 Smoothing the operation

To enable actions to be taken in the long term, by detecting peaks, campaigns, and critical periods, it was assumed the decision of performing a monthly analysis for the customers considered as critical. The criteria used for deciding which customers to analyze was defined according to the average volume of trucks to deliver from each of BA's divisions to the national or the export market. About 80 customers were considered as critical.

As the operations of the IB and CE divisions are well known and SEE division was acquired recently, and because the best practices are still being assimilated and systems integration being done, the monthly analysis described in this section, performed for detecting the critical customers, is already including all the twelve plants of the three divisions, IB, CE, and SEE.

In order to obtain the volume of trucks needed for the analysis, the Sales Plan is regularly extracted from SAP. This document is monthly updated and contains information about the quantity of each material sold to a particular customer, the plant where that material is produced, the country of destination for which that quantity is going to be delivered and the period in which the sale occurs. For the past months, it has represented the real sales, and for the actual and future months, it represents the monthly updated sales forecast.

To calculate the trucks needed for delivering a certain quantity of material, the information about the characteristics of the final product is analyzed, such as the height, the pallet type used and the number of jars that fit in that pallet. In a truck can be loaded 26 pallets, or 33 pallets in the case of Euro pallets, if their height is higher than 1.3 m, or the double, 52 pallets, or 66 pallets in the case of Euro pallets, if the pallet height is below 1.3 m.

As it was previously mentioned, the difficulty of finding carriers increases when the deliveries are for the export market, so different criteria were used for selecting the customers to include in the monthly report. The customers of IB division considered on the analysis were the ones with a variation between two consecutive months of 100 trucks, when delivering to the local market, and of 30 trucks, when delivering to the export market. For the customers of CE and SEE divisions, considering the lower volume of the number of deliveries from these divisions, the criteria used was of 50 trucks for the local market and of 25 trucks for the export market.

The report of each critical customer includes useful information for the analysis, such as the production dates, the responsible Sales Manager, the type of transport and the receivers, as the same customer can have different places to deliver in the destination country. Additionally, also included in the report, are the risks and concerns regarding the peaks on the number of deliveries.

These peaks are defined together with the Transport Managers, as well as the actions that should be implemented to tackle concerns like confirming the forecast with the Sales Managers and sharing it with the transport suppliers, sending stock to external warehouses near the customers, negotiating in advance with the transport suppliers, etc.

Furthermore, a comparison of the previous sales forecast and the real sales for the same period is performed. In addition, there is also a comparison between the real sales and the sales forecast for the current year with the real sales of the previous year. By performing these comparisons, it is possible to gather information about how the forecast varies and, along with the Planning Team, understand possible reasons for the variation and discuss the actions to reduce it along the year.

In figure 5.4 is represented, as an example, the layout of the report used for presenting the information of one of the approximately 80 critical customers monthly detected.

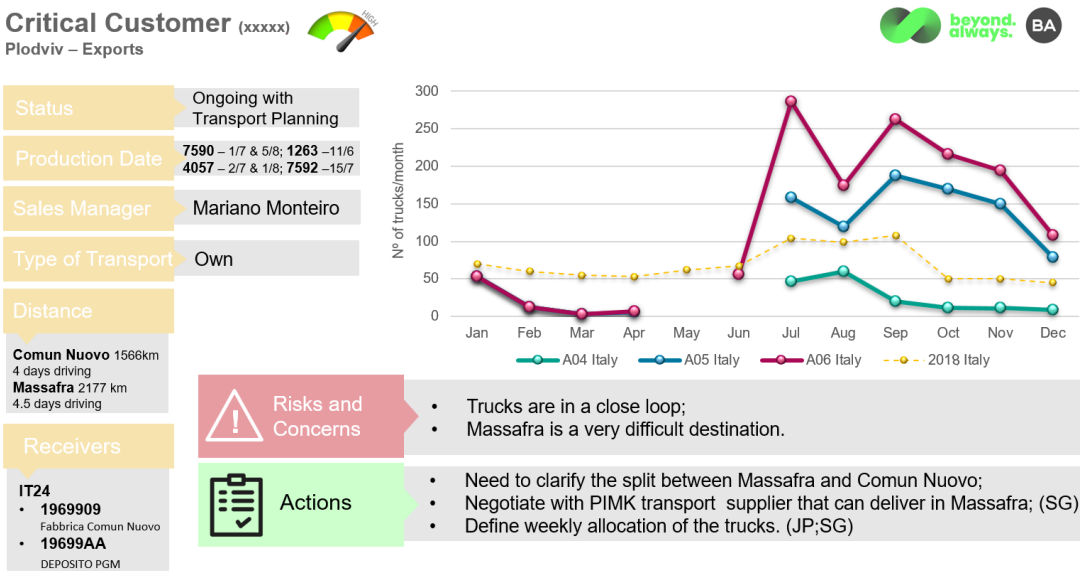

Figure 5.4: Critical customer report

Additionally, to ensure relationships that are beneficial in the long term with the customer, there is a Customer Segmentation. This allows having criteria to use in a situation where there is a need to prioritize the customers, for example, to define the ones to provide a more flexible service or the ones that should be delivered with no delays and have a better Customer Service.

In fact, as Kolarovszki et al. (2016) mentions, different customers require a different management, as the costs and profit associated with them are different. Furthermore, in this way, sales strategies for individual customer segments can be identified. The criteria used by BA for Customer Segmentation is based on the customers' sales revenue and growth potential.

In conclusion, this analysis carried by the Transport Planning aimed to anticipate peaks and campaigns and, by the follow-up of the production planning and the sales, detect the customers that are critical in terms of deliveries, and act together with them in order to avoid delays on the deliveries and better negotiate in advance the prices with the suppliers. The information obtained with the Transport Planning follow-up, not only provides the insight needed for the Sales teams to adjust with the customers the orders' distribution along the year, but also for the Transport team to have the possibility of defining actions to tackle tough periods for the deliveries to certain customers. In the end, improved customer service is achieved, as well as the reduction of extra costs due to customer complaints about not delivering on time. The higher costs of not booking in advance are also avoided.

5.4 Performance evaluation

5.4.1 Key Performance Indicators

Different KPIs are used to assess the Transport performance and Transport Planning effectiveness on achieving its goals. They provide insights for strategic and operational improvement and create an analytical basis for decision making. Also, they allow focusing on the most critical aspects.

In addition to KPIs that are already used to assess the Transport performance (table 5.2), some KPIs were defined to evaluate Transport Planning and to measure the Warehouse operational performance and transport suppliers performance that have a potential impact on delivery delays (table 5.3).

5.4.2 Progress reports

In order to enhance Transport performance visibility, progress reports were created to enable a complete overview of Transport operation performance and a comparison towards targets. This improves the decision-making process and allows the possibility of making quick and informed decisions based on transparent information.

The KPIs described in tables 5.2 and 5.3 are a basis of these reports. Evaluating the Transport operational performance with both division and plant overview provides good insights: the first, for evaluating the performance at each plant level, and the second, for the comparison between different plants within the same division. Figure 5.5 represents the information associated with the Transport operational performance of a plant in a certain period of time.

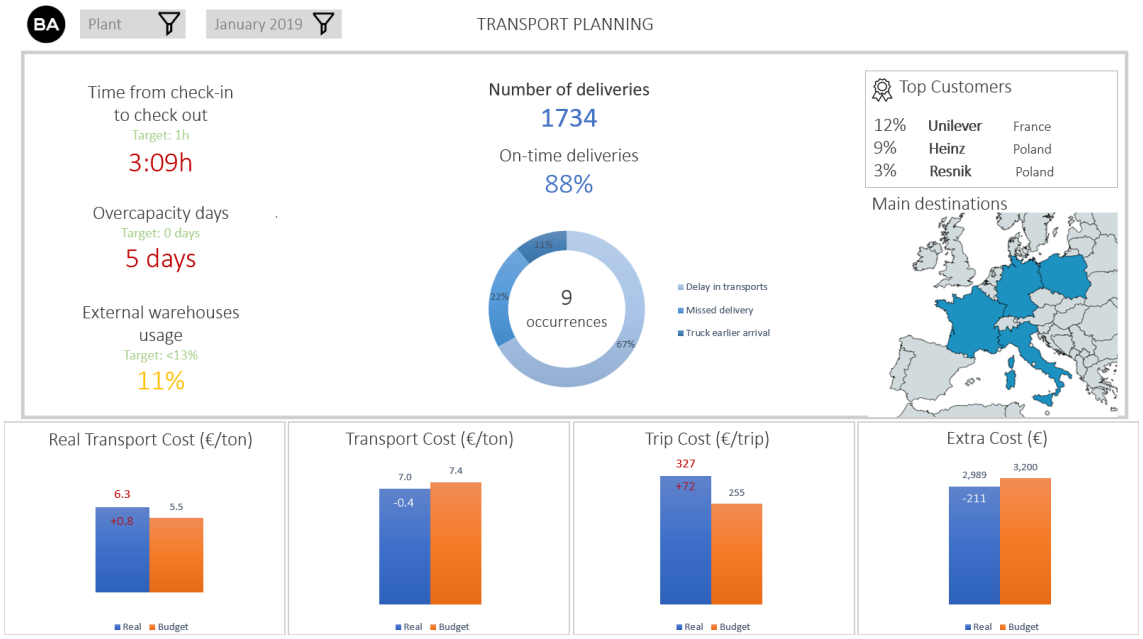

Figure 5.5: Transport Planning progress report - plant overview

The information regarding the performance of an overall division in a certain period is represented in figure 5.6.

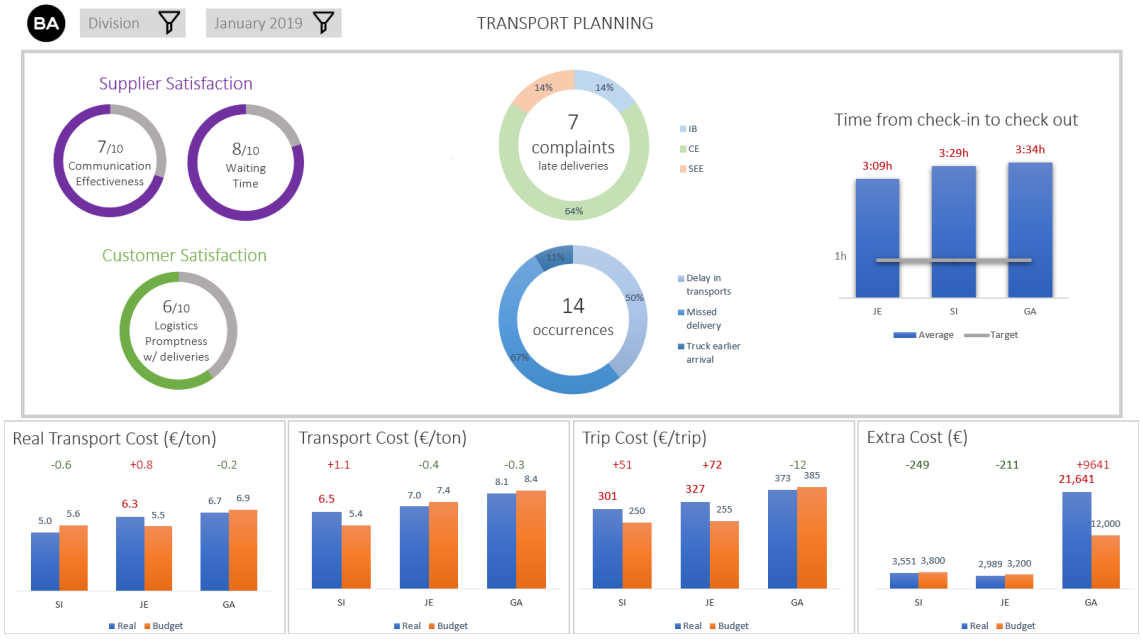

Figure 5.6: Transport Planning progress report - division overview

In this way, an effective representation of the performance indicators is carried out, allowing to take substantiated actions when needed.

5.5 Expected results

By adopting the Transport Planning solutions presented in previous sections, the inefficiencies measured in chapter 4 are expected to be reduced in a significant way.

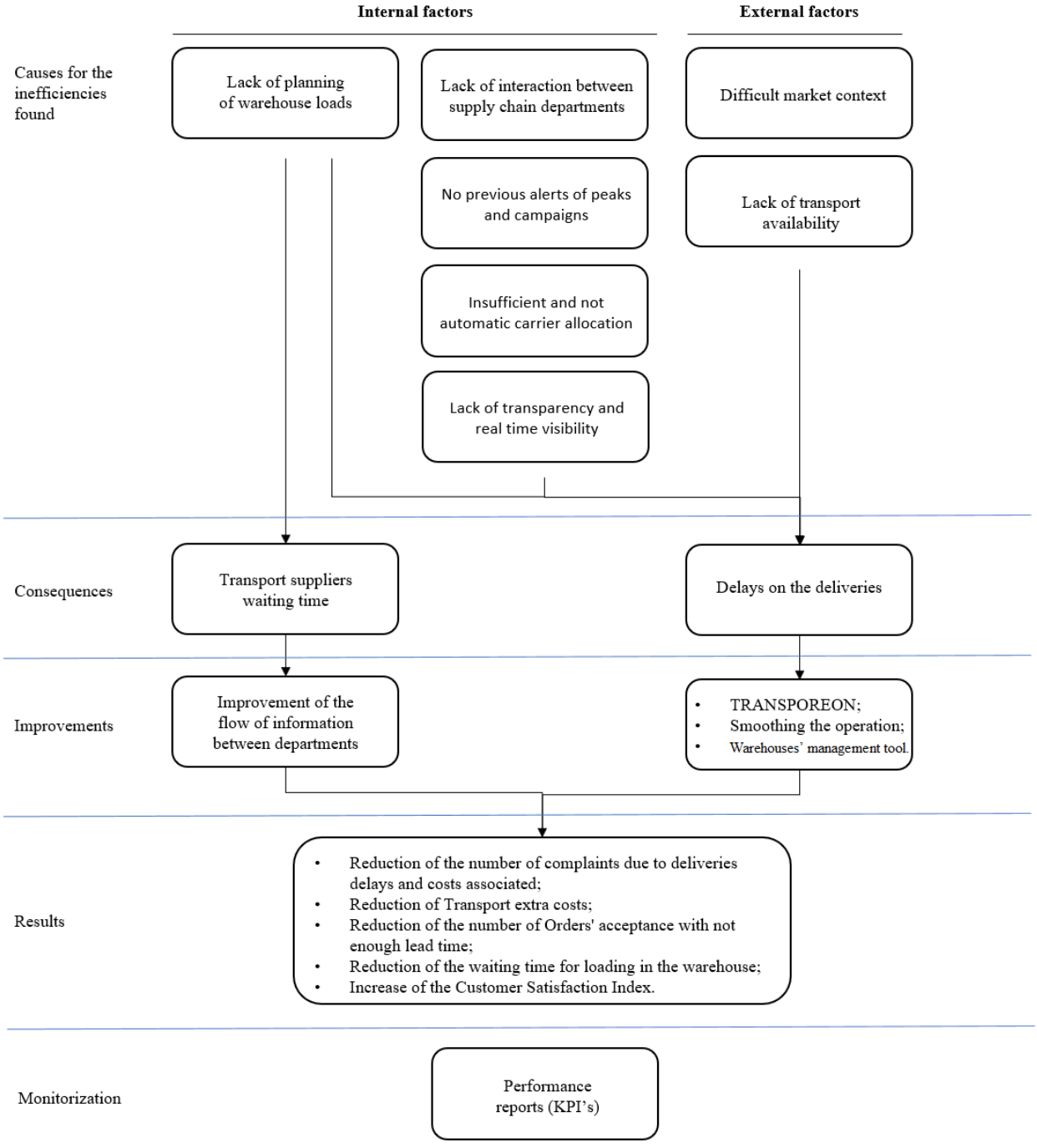

Figure 5.7: Expected results

Hence, the elimination of the number of orders' acceptance with not enough lead time and a substantial decrease of the average waiting time for loading in the warehouse led to a lower

number of delays on the deliveries. This decrease of the number of delays causes a reduction of the number of complaints associated to them, and together with the diminishing of extra Transport costs, yearly cost savings have an order of magnitude of several hundred thousand euros.

Furthermore, all the results achieved with the operational improvement led to increased customer satisfaction, translated in a higher Customer Satisfaction Index.

Table 5.2: Existing KPIs for the assessment of Transport performance

KPI	Scope	Description	Units	Drill down
Real Transport Cost	Transport	Metric that evaluates the transport cost per each ton of material transported.	EUR/ton	Plant/ Division Period
Transport Cost	Transport	Metric that evaluates the transport cost per each ton of material sold.	EUR/ton	Plant/ Division Period
Trip Cost	Transport	Metric that evaluates the transport cost per trip.	EUR/ton	Plant/ Division Period
Extra Transport Costs	Transport	Metric that measures the extra transport costs charged by customers to BA, for several reasons, usually delays on deliveries or missing trucks.	EUR	Plant/ Country/ Division/ Period
On-Time-In-Full (OTIF)	Transport Planning	Metric that evaluates if the customer is getting what is ordered when it was asked to. It is a measure of delivery, and it helps to indicate if the relationship between departments is working effectively.		Reason/ Plant of origin/ Period
Customer Satisfaction Index	Transport/ Customer Service	Metric that evaluates the customer satisfaction on parameters defined by BA, the one used for evaluating transports being “Logistics and Promptness with the Deliveries”. It allows a comparison with the indicators of the previous year and with the competition.		Plant/ Division/ Target Country/ Parameters/ Period
Complaints	Transport	Number of complaints due to late deliveries. It can alert TP to find potential sources of delays.	No. of complaints /ton	Reason (Product or Service)/ Type/ Plant of origin/ Destination country/ Supplier/ Transport date

Table 5.3: Suggested KPIs for the assessment of Transport performance

KPI	Scope	Description	Units	Drill down
Supplier Satisfaction Index	Transport/ Warehouse	Metric that evaluates the supplier's satisfaction on the parameters defined: waiting time and communication effectiveness.		Division/ Period
Waiting time	Transport Planning/ Warehouse	Average time between check-in and check-out.	min	Plant/ Division Period
Overcapacity days	Transport Planning	Metric that measures the number of days with a number of planned loads above the maximum daily warehouse loading capacity.	days	Plant of Origin/ Period
External warehouses usage	Transport Planning	Metric that represents the ratio between the number of planned loads above the average stock of an external warehouse delivered from a plant, and the total sales of that plant. This allows assessing the operational effectiveness, considered better when the use of the external warehouses is less needed.		Plant of Origin/ Period
Punctuality of the carriers	Transport Suppliers	By monitoring the on-time pickup, shippers may see the timeliness of their carriers, and how it impacts delivery schedules. It helps to detect the carrier's inappropriate behavior, and avoid it from impacting product delivery. It alerts supply chain leaders to take action and avoid customer dissatisfaction.		Plant/ Period

Chapter 6

Conclusions and future work

Transport Planning actions improved several aspects of Transport operations in BA, and its main challenges initially proposed were tackled during this project. It is worth mentioning that, as this is the beginning of Transport Planning at BA, some of the suggested solutions will have an impact on Transport operational performance in the long term. In addition, continuous analysis of the information available is needed in order to detect potential sources of critical situations and take actions to avoid them. Hence, the main driver for effective Transport Planning actions is the sales forecast continuous analysis, aiming to improve its accuracy and stability and install a culture of continuous improvement.

Regarding the flow of information between the Front Office, Production Planning, Transport, and Warehouse departments, significant improvements were attained, as Transport Planning performs a continuous interaction with these departments. Follow-up of the sales with the Front Office, of the production and moving articles with the Production Planning, of the planned loads at the warehouses and the alerts given to the transport team, based on the analysis of the information obtained, allowed to take actions in order to improve the Transport operational efficiency.

Moreover, the analysis of several documents for creating the reports for the customers considered as critical when anticipating peaks on the number of orders together with the continuous follow-up of the departments that have impact in the Transport Planning, allowed to avoid delays on the deliveries and to better negotiate in advance the prices with the suppliers. In fact, increased efficiency in the exchange of information between departments improved the ability to meet sales projections and deliveries requests. This allowed to detect in advance potential critical situations for logistics operations, and so to act accordingly. In the end, these lead to enhance customer service by reducing the delays on the deliveries.

Furthermore, the use of the warehouses' management tool (created with the aim of getting transparency of the Warehouse operation and increase the visibility of Warehouse loading capacity by the Front Office, Transport Managers and Warehouse team, by the visualization of the number of the expected loads per day) allowed to take actions in order to tackle potential critical days.

All these solutions have an impact on Transport operation, on the Warehouse operation and, in the end, on Customer Satisfaction. Hence, a reduction of the number of complaints due to delivery delays and costs associated, a decrease of extra Transport costs, a fall of the number of orders' acceptance with not enough lead time and a reduction of the waiting time for loading in the warehouses are accomplished. In the end, Customer Satisfaction increases.

Due to time constraints, considering the short time of this dissertation, and because some of the proposed measures have an impact in the long term, the exact cost savings associated with Transport Planning solutions could not be precisely measured. However, it is known that they represent an order of magnitude of hundreds of thousands of euros.

Future work of Transport Planning includes not only the continuous follow-up above described but also monitoring TRANSPOREON implementation in all BA plants. The last is essential to guarantee its success in achieving an improved and more efficient transport process. Furthermore, the continuous improvement of the relationship with customers and transport suppliers. Following a strategy of continuous improvement, focusing on the relationship with suppliers will allow not only to improve the transport service level but also to reduce cost. This relationship takes time to build as mutual trust is needed along with a mentality change of both parts. Moreover, apply all Transport Planning solutions to the plants located in the SEE division is a goal to achieve still during the current year.

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