

Improving Service Level: A Case Study in a Ceramic Industry Sub-sector

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To my family, friends, and Marta

Abstract

The association representing Portuguese companies operating in one of the ceramics sub-sectors noted that in recent years there has been a loss of competitiveness in Central European markets due to logistical challenges in distribution. INEGI's industrial engineering and management consultancy services were therefore hired to develop a project with the main goals of surveying the global market and the current distribution operation of Portuguese manufacturers. Additionally, it was intended to identify best practices and different alternatives for the future distribution system.

The work began with the analysis of the global context of exporters and importers of the subsector, being possible to position Portugal as the eighth largest exporter worldwide. In addition, the largest competitors were identified, and their context was presented. It was found that the Italian and German competitors have a higher average selling price and present products with higher quality in the market, while the Spanish competitors have lower average sales prices. The positioning of Portuguese producers is less clear since there is no possibility of increasing the sales price due to low recognition of Portuguese brands. Additionally, it is not possible to lead by cost due to the higher price of production factors, namely electricity and natural gas.

A survey of the logistical characteristics inherent to the sub-sector and the functioning of the current distribution system was also carried out. Taking into account the input of the companies involved in the study, the level of service presented to customers was also characterized. Thus, a survey of customer perception was conducted in order to compare the level of service of Portuguese manufacturers with that of competitors and, although customers were mostly unwilling to provide detailed data, it was concluded that the perception of the quality of Portuguese products is low as well as availability. Moreover, improvement opportunities were identified regarding the delivery time presented as well as the transportation cost.

Given the gathered information, a phased strategy was proposed with short, mid, and long-term solutions with the objective of improving the level of service. In the short term, it was recommended that the production companies control transportation and increase the use of synergies in order to share costs. In addition, changes in the supply and product offering systems were suggested in order to increase availability and reduce delivery time.

In the mid term, the introduction of centralized transport management was recommended to increase the frequency of shipments where there is a need to consolidate loads or, in other words, gathering orders from several suppliers and shipping them together. In the long term, the use of one or more advanced warehouses was recommended in order to reduce the distance to customers, allowing a higher level of service. In this last scenario, in the long term, it would be necessary for there to exist a paradigm shift and for manufacturers to start selling not only a product, but also the service provided to the client.

More and more, the level of service is a source of differentiation. Thus, associated companies need to recognize its importance as well as that of logistics. The expectation is that the proposed solution will serve the customer better, thus increasing the competitiveness of Portuguese products in international markets.

Melhoria do Nível de Serviço: Um Caso de Estudo num Subsetor da Indústria Cerâmica

Resumo

A associação que representa as empresas portuguesas que operam num dos subsectores da cerâmica verificou que nos últimos anos existiu uma perda de competitividade nos mercados da Europa central devido aos desafios logísticos existentes na distribuição. Neste sentido, contratou os serviços de consultoria em gestão e engenharia industrial do INEGI para se desenvolver um projeto que tinha como principais objetivos a realização de um levantamento do mercado global e da operação de distribuição atual dos fabricantes portugueses. Adicionalmente, pretendia-se identificar as melhores práticas e diferentes alternativas para o futuro sistema de distribuição.

O trabalho iniciou-se com a análise ao contexto global de exportadores e importadores do subsector sendo possível posicionar Portugal como o oitavo maior exportador a nível mundial. Além disso, foram identificados os maiores concorrentes e apresentado o seu contexto. Verificou-se então que os concorrentes italianos e alemães praticam preços médios de venda mais elevados apresentando no mercado produtos com uma qualidade superior enquanto os concorrentes espanhóis praticam preços médios de venda inferiores. O posicionamento dos produtores portugueses é menos claro uma vez que não existe a possibilidade de aumentar o preço de venda devido ao baixo reconhecimento das marcas nacionais. Adicionalmente, não é possível obter a liderança pelo custo devido ao preço elevado dos fatores produtivos, nomeadamente da eletricidade e do gás natural.

Foi ainda realizado um levantamento das características logísticas inerentes ao subsector e do funcionamento do sistema de distribuição atual. Tendo em conta o *input* das empresas envolvidas no estudo foi também caracterizado o nível de serviço apresentado aos clientes. Assim, foi realizado um levantamento da perceção dos clientes com o intuito de comparar o nível de serviço dos fabricantes portugueses com o dos concorrentes e, apesar de os clientes, na sua maioria, não apresentarem disponibilidade para fornecer dados detalhados concluiu-se que a perceção da qualidade dos produtos portugueses é baixa assim como a disponibilidade. Além disso, foram identificadas oportunidades de melhoria relativamente ao tempo de entrega apresentado bem como ao custo de transporte.

Perante a informação recolhida foi proposta uma estratégia faseada com soluções a curto, médio e longo prazo tendo como objetivo a melhoria do nível de serviço. No curto prazo recomendou-se que as empresas produtoras controlassem o transporte e que aumentassem o aproveitamento de sinergias no sentido de partilhar custos. Além disso, sugeriram-se alterações nos sistemas de abastecimento e oferta dos produtos com o objetivo de aumentar a disponibilidade e reduzir o tempo de entrega.

A médio prazo recomendou-se a introdução de uma gestão centralizada dos transportes para aumentar a frequência dos envios em que existe a necessidade de fazer uma consolidação das cargas. A longo prazo recomendou-se a utilização de 1 ou mais armazéns avançados para diminuir a distância aos clientes permitindo apresentar um nível de serviço superior. Neste último cenário a longo prazo seria necessário que existisse uma mudança de paradigma e que os fabricantes comesçassem a vender não só um produto, mas também o serviço prestado.

Cada vez mais, o nível de serviço é uma fonte de diferenciação pelo que, as empresas associadas precisam de reconhecer a sua importância assim como a da logística. A expectativa é que a solução proposta permita servir melhor o cliente aumentando então a competitividade dos produtos portugueses nos mercados internacionais.

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Acronyms

3PL: Third-party Logistics

CSCMP: Council of Supply Chain Management Professionals

DC: Distribution Center

DDP: Delivered Duty Paid

EXW: Ex-Works

FCL: Full Container Load

FOB: Freight on Board

FTL: Full-truckload

Incoterms: International Commercial Terms

INE: Instituto Nacional de Estadística

IT: Information Technology

ITC: International Trade Center

kton: Kiloton, the equivalent to a million kilos.

LTL: Less-than-truckload

SLA: Service-level Agreements

STL: Shared-truckload

TPL: Third-party Logistics

M€: Millions of euros

UAE: United Arab Emirates

UK: United Kingdom

USA: United States of America

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1 Introduction

1.1 Project's framework and motivation

INEGI is a Technological Interface Center dedicated to research and innovation activities on a technological basis, technology transfer, consultancy, and technological services. It was created in 1986 within the Mechanical Engineering Department of the Faculty of Engineering of the University of Porto (FEUP) and it is oriented towards the development of industry and the economy in general based on knowledge, technological density of products and processes in technology-based innovation. The company values are the following: customer orientation, responsibility, cooperation, passion for innovation and ambition (INEGI, 2021).

The following project was inserted in the part dedicated to services, more specifically industrial engineering and management consultancy services. This unit provides consulting services with the main objective of supporting its clients in the identification of areas with improvement potential in the scope of industrial management, going through the assessment of the current situation followed by the solution design and ending with the implementation support. They seek to boost efficiency levels in their clients' operations and processes through a structured and consistent approach. The developed projects belong to several areas being: logistics and supply chain management, operations management, quality and process engineering, benchmarking and performance management, quantitative marketing and customer management, sector studies, and public transportation and urban logistics. Its work is oriented towards several areas: strategy, organization, processes, technology and information systems, infrastructure, and finally business analytics and big data (INEGI, 2023).

The ceramics sector in Portugal is geared towards export and, although the Portuguese products have quality, the image of the Portuguese brands is not yet at the same level as its competitors. In addition, there are logistical difficulties in exporting, and it is necessary to improve the level of service (Mussini, 2017). In this context, the association that represents the Portuguese companies operating in the ceramics sector has identified as critical to increasing the competitiveness of Portuguese products the improvement of the service level, and, consequently, the reduction of the delivery time. In this sense the association hired INEGI's industrial engineering and management consultancy services to develop a project.

The project has as scope only one of the ceramic sub-sectors, which for confidentiality reasons will be referred to as sub-sector A. The purpose is to identify solutions for the distribution of sub-sector A products for Central Europe. The markets that fall within the scope of the project are France, Germany, Benelux and Austria. The solutions studied should allow companies to increase the level of service so as to increase the competitiveness of Portuguese products in international markets.

The present work is part of the strategic planning of the sub-sector and is intended to carry out a market analysis and a survey of the current distribution operation.

In addition, several scenarios for the distribution of the products to the target markets should be raised in order to allow the improvement of the service level.

1.2 The association and the brand

The association was born as a combination of three national associations that for more than 20 years shared the national sectoral representation of Portuguese ceramics among themselves. In this context, it is the only sectoral associative structure of national scope and encompasses the following sub-sectors: finishing ceramics (flooring and coverings), special ceramics (refractory, electrotechnical and other products), structural ceramics (tiles, bricks, vaults, stoneware tubes and rustic bricks), ceramic sanitary ware, utilitarian and decorative ceramics, and glassware (table and decorative glass).

The association's mission is to represent its members in the ceramics and decorative glassware industries, and to defend their business interests, in order to promote increased competitiveness in the sector, ensuring sustainable development and strengthening inter-business cooperation and cross-sectoral, intending to be the reference institution in the leadership and dynamization of the ceramic and glassware sector.

In the past year, the association launched brand A with the purpose of supporting the internationalization efforts of the Portuguese ceramic sector. The objective of the new collective brand is to change the perception that international markets have of Portuguese ceramics.

The brand activation plan is focused on the European markets where digital channels, campaigns and communication in the international press will be privileged. Beyond that, the brand will be present in several events such as: fairs, conferences, and exhibitions.

In addition to the brand's communication and marketing strategy, the association intends to carry out a study to improve the level of service in the target markets of Central Europe for sub-sector A, having consulted INEGI's industrial engineering and management consulting team to support it in this project. Within this sub-sector there are 28 companies, 19 of which are represented by the association and belong to the A brand. In the present project, 6 companies of brand A were included, representing about 49% of the sub-sector's turnover in 2021.

Since 2010, the Portuguese ceramics industry has maintained a turnover of over 850 million euros. In 2014, this same industry had a turnover close to one billion euros and the sub-sector with the highest proportion sub-sector A (PWC, 2016). In 2021, the combined turnover of the 28 companies operating in sub-sector A was 366 million euros, 68% of which was exported (Figure 1) (INE, 2022).

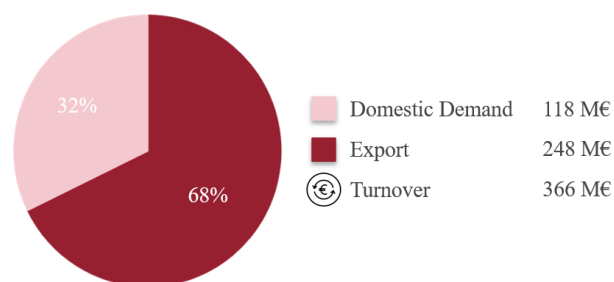


Figure 1 - Portuguese ceramic sub-sector A turnover in 2021.

In this same year, the exports from sub-sector A accounted for about 30% of Portugal's total exports of ceramic products. The exports of this sub-sector decreased in 2019 and 2020, but in 2021 there was already a growth, and the quantity exported in was larger than the quantity exported in 2017 so there are signs of recovery. However, the 2018 quantity was not reached.

The slowdown in 2019 and 2020 was also experienced in the remaining ceramics sub-sectors (Figure 2) (ITC, 2023).

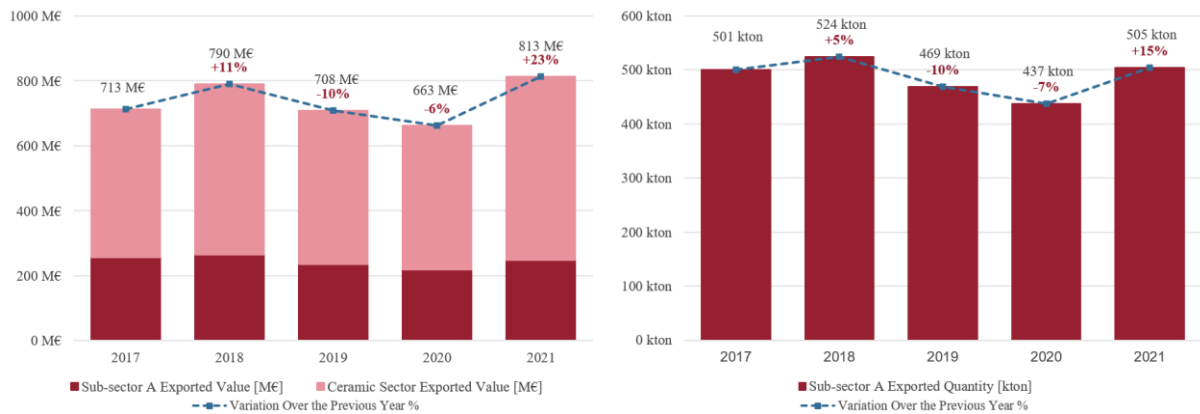


Figure 2 - Evolution of the value and quantity exported to the world by the Portuguese ceramic sector and by sub-sector A.

Analyzing the exports of sub-sector A to the markets that belong to the scope of the project (Figure 3), the one that presents the greatest importance is the French one. In 2021, France, Germany, Benelux, and Austria absorbed 36,4%, 5,3%, 6,3% and 0,9% of the total quantity exported by Portugal, respectively. Together, these markets represented almost 50% of the quantity exported by Portugal in 2021. In this way, Portugal exported to the target markets 247 thousand tons of products equivalent to 119 million euros. The average sales price per ton exported to these markets was 482 euros, which varies according to the market analyzed. Germany and Austria absorbed the products with the highest average price. In turn, France was the market that absorbed the products with the lowest average price (ITC, 2023).

	 Quantity [kton]	 Value [M€]	 Average Price [€/ ton]
France	184 kton	85,5 M€	465 €/ ton
Germany	27 kton	15,5 M€	580 €/ ton
Benelux	32 kton	15,6 M€	494 €/ ton
Austria	4 kton	2,4 M€	537 €/ ton
Total	247 kton	119 M€	482 €/ ton

Figure 3 - Sub-sector A Portuguese exports to target markets in 2021.

1.3 Goals of the project

It is possible to state that the present project has more than one objective. The aim is then first to identify the major competitors of the Portuguese producers and then to perform a characterization and a benchmarking. In addition, it is also necessary to characterize the current distribution operation and to identify the logistical difficulties and problems that exist in exporting to target markets as well as the level of service provided to customers. Finally best practices and different alternatives for the future distribution system should be identified.

The ultimate goal is to present the various possible solutions that would allow manufacturers to provide the level of service expected by customers. It is believed that the improvement of the service level is a tool for the increase of exports as it contributes to the increase of competitiveness and also to the improvement of the Portuguese brands recognition.

1.4 Project approach

The project was developed in 2 main stages. First of all, it was necessary to carry out a collection of data and necessary information. Thus, sectorial studies were analyzed in order to increase the knowledge about the sub-sector. Subsequently, the data obtained from international databases regarding exported values and quantities were analyzed.

The data concerning the export operation of the Portuguese players to the target markets were obtained through a survey in the form of a questionnaire (Appendix A) containing open-ended questions. Additionally, semi-structured interviews were conducted with relevant players in sub-sector A. In this first stage more semi-structured interviews were also done, but the respondents were the Portuguese players' customers. It was intended to compare the level of service provided by Portuguese producers with the one provided by the international competitors. In addition, some area managers were also interviewed in order to obtain more information.

Then, in the second stage, after elaborating the different solutions for the distribution system a qualitative comparative analysis was performed identifying strengths and weaknesses associated with each option.

1.5 Structure of this dissertation

This chapter (chapter 1) is of an introductory nature. The context and motivation of the project as well as the entities involved were presented. In addition, the objectives of the project and the methodology were discussed. In chapter 2, the theoretical framework of the work is made, and the definition of the supply chain is discussed, as well as how its efficient management allows gaining a competitive advantage. The different distribution channels, the outsourcing trend, the importance of the service level and the structural configuration of the supply chain are also addressed. Chapter 3 is dedicated to the definition of the problem, or survey of the current situation. It was decided to divide this survey into three parts. Firstly, the largest exporters of ceramics subsector A are analyzed, then the importers and the importance of the target markets. Finally, the entire distribution situation of the brand A players is analyzed. Chapter 4 presents the proposed strategy for the evolution of the distribution system. Thus, proposals for the short, mid, and long-term are presented. The last chapter (chapter 5) presents the main conclusions of the project and perspectives for future work.

2 State of the Art

2.1 Logistics and supply chain management

According to the Council of Supply Chain Management Professionals (CSCMP): “Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies.”(CSCMP, 2023).

Logistics management is an integral part of supply chain management and, simply put, deals with the movement and storage of products. It also involves facility and inventory management while taking care of order fulfilment, communications, and information in order to create value for the customer. Previously it was considered that these activities added little value, so the aim was to minimize cost. However, logistics has become a way to gain a competitive advantage since it creates value for the customer through the quality of the logistics service. Nowadays, logistics activities are managed in order to provide an effective and low-cost customer service while gaining a competitive advantage and improving the organization's performance (Mentzer et al, 2008). CSCMP defines logistics management as: “part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements.” (CSCMP, 2023).

It is possible then to define key elements that belong to the domain of logistics management being them: customer service, procurement, order management and fulfilment, warehousing management, materials handling, inventory management and transportation network design and management (Mentzer et al, 2008).

The importance of supply chain management has increased due to the globalization of the economy and changes in the market. In addition, with the increasing number of different items and reduction in order volumes, management becomes more complex. On the other hand, there is pressure to increase the level of service, which is a differentiating element that adds value to products and services (Guedes, 2022). The growth of e-commerce has also contributed to the increased importance of logistics since the final consumer is looking for fast delivery but mainly at a low cost (Joeress et al, 2016).

An example of a supply chain is shown in Figure 4. In this case, the manufacturer sends its products to a distributor who in turn takes the products to the retailers.

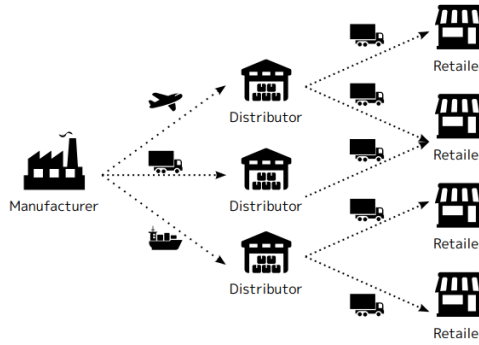


Figure 4 – Example of a supply chain, (Toyota and Sasase, 2015).

It is then noticeable that there may be several companies in the chain, so it is necessary to coordinate and integrate all those involved. Each player must recognize that they are part of a complex network, and it is of high importance to define the level of customer service in order to meet customer requirements. Those who are involved are interdependent, so the performance of one affects the performance of the others and the existence of several players increases complexity and introduces dynamics and uncertainty into the chain.

One of the best-known dynamics is the bullwhip effect in which a small variability in the client's order has a big impact on the manufacturer's order to its supplier, since this effect is amplified along the chain, and this is noticeable in the graphics of Figure 5. This effect has consequences at the stock level because the players increase this same level in order to maintain the established service level. In this way, costs increase while resources are used inefficiently. To minimize this effect the integration and synchronization between the various players in the supply chain is fundamental (Paik and Bagchi, 2007).



Figure 5 – The bullwhip effect, (Paik and Bagchi, 2007).

2.2 Gaining a competitive advantage through supply chain management

The source of a competitive advantage lies in a company's ability to differentiate itself in the eyes of the customer from its competitors and maximize profit by operating at a lower cost. Business success derives either from a cost advantage or a value advantage, or in the ideal situation, both. In this way, companies tend to position themselves in the market in order to have a cost or value advantage (Christopher and Safari, 2010).

Cost advantage

The player who offers a product at the lowest price has a competitive advantage, but it is only possible to be profitable if the whole operation is highly efficient. Reducing the production cost can be achieved through economies of scale and through the increased efficiency and productivity that can be provided by efficient supply chain management (Christopher and Safari, 2010).

Value advantage

Currently there is a perception that consumers do not buy products but instead buy benefits. Thus, it can be seen that the product does not sell for its own sake but for what it can offer. If the product or service does not stand out from the competition, there is the possibility that the marketplace will see it as commodity. If this happens, the sale will most likely go to the supplier with the lowest price.

One way to differentiate is through market segmentation and creating value for a specific segment. Another alternative is differentiation through service.

More and more markets are service sensitive. The service provided is entirely connected with logistics and supply chain management. It is increasingly difficult to compete through brand image and through technologies, so the attention of companies is focused on service. Service refers to the provision of an increased offer and presents different forms being them: after-sales service, delivery service, financial packages, technical support, among others (Christopher and Safari, 2010).

Positioning

Seeing this, companies tend to position themselves in order to have a cost or value advantage. If they fail, customers do not see their products as different and do not have a cost advantage, so they fall into a commodity market (bottom left corner on the Figure 6 matrix). In this case, they must seek to gain a cost advantage (bottom right corner on the Figure 6 matrix) either by economies of scale or by increasing efficiency. On the other hand, they can differentiate themselves through service (top left corner on the Figure 6 matrix). In all industries, customers are looking for a fast and reliable response from suppliers. In addition, short lead times, just-in-time delivery, and value-added services are also valued. On the other hand, differentiation through technology is difficult to achieve since technology is also available to competitors. In effect, the challenge for management is to put companies in a position of cost advantage and differentiation at the same time (top right corner on the Figure 6 matrix) by defining strategies at the supply chain level (Christopher and Safari, 2010).

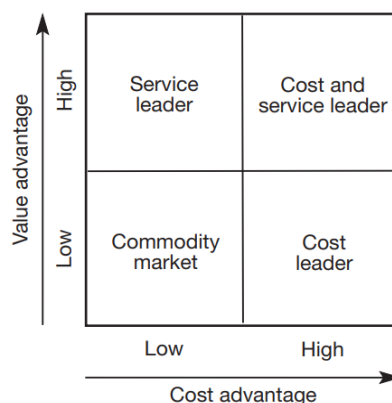


Figure 6 - Market positioning, (Christopher and Safari, 2010).

Regarding the level of service, logistics allows to offer a reliable, responsive and personalized service. Regarding cost, it allows to gain an advantage through the best use of capacity and assets, and through the synchronization of supply. Effectively, the aim is to gain an advantage by reducing costs and improving the level of service (Christopher and Safari, 2010).

2.3 Distribution channels

Distribution channels refer to the way goods or services reach the end customer. So, there are different types of approaches to distribution. When the consumer buys directly from the producer there is a mention of a direct channel. On the other hand, when intermediaries such as wholesalers, retailers or distributors are used, there is a mention of an indirect channel. In fact, there is also the possibility of using a hybrid approach using direct and indirect channels (Fernando, 2022).

Regarding direct orders, in recent years there has been an increase in online purchases. Usually in this channel companies choose to establish partnerships and outsource delivery services to specialists who use specialized vehicles and operate from distribution centers or retail stores (Rushton et al, 2014).

Concerning indirect orders, Figure 7 shows the main channels that allow a product to be transferred from the factory to the retailer.

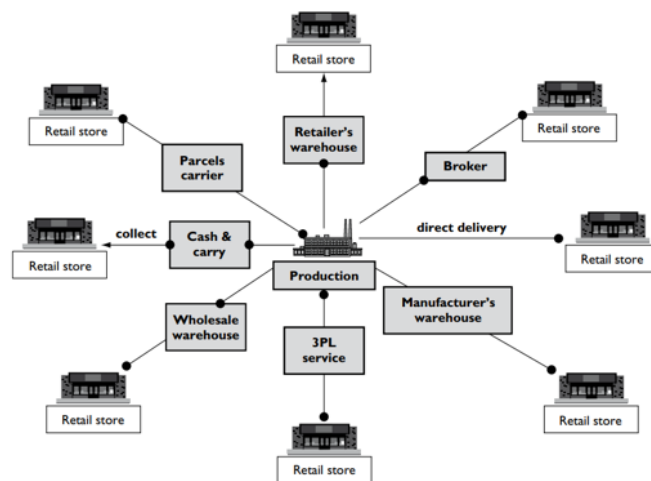


Figure 7 – Different distribution channels to retail, (Rushton et al, 2014).

The business-to-business channel continues to be of great importance as it includes industrial products transactions. In this case some companies choose to outsource delivery services or develop these competencies internally (Rushton et al, 2014).

It can be concluded that there are different alternatives for performing the distribution. Its structure varies from company to company and is dependent on several factors including the type of product or service, the business model, and the market segment. Taking into consideration the different variants, companies need to understand which intermediaries to use, the number of levels of intermediaries or, in other words, how many companies handle the product before the final customer is reached, and also the intensity of distribution at each level since not all types of intermediaries are used at all levels (Rushton et al, 2014).

The distribution of goods that have been sold through different sales channels is known as multichannel fulfilment. Each channel requires a different configuration of the logistics system, so it is necessary to find the most suitable configuration to serve the existing channels. The particular case of Internet sales has caused some problems for companies.

The mix of different channels represents a challenge not only at the distribution level but also at the marketing and sales level. The interaction of the different channels to provide a better customer experience is known as omnichannel (Rushton et al, 2014). In this context, companies must define the right channel mix and also to decide if they should or not go omnichannel. Besides that, different channels require different partnerships or collaborations and that also must be considered (Guedes, 2022).

2.4 Logistics outsourcing

In a logistics context, when referring to outsourcing there is a frequent reference to third-party logistics service providers (3PL). These companies perform value-adding activities including transportation and warehousing. Typically, they offer activities such as picking and shipping or cross-docking and, in some cases, other operational services are offered such as inventory management, tracking and tracing, assembly, installation, and eventually supply chain management. When we talk about 3PL we talk about a relationship between a shipper and a third party. This relationship must be longer than one year and is distinct from a basic supply of services. It is intended that all stakeholders benefit, and joint efforts are made to improve cooperation and customization of the logistics solution. The option to resort to a 3PL not only represents planning at the tactical level, but also at the strategic level (Marasco, 2008).

The establishment of logistical alliances has several benefits. These can include improvements in economies of scale, efficiency of operations, and bargaining power. It also makes it possible to increase the range of services and increases the speed of learning and adaptation to new systems (Hertz and Alfredsson, 2003).

Regarding the type of service provided, there are two dimensions that allow to divide the 3PL companies into groups. The first dimension is the general ability to solve problems and has more importance when there is a need to coordinate several clients. The second dimension is the ability to adapt to a client. Figure 8 shows a matrix that was constructed by assigning two levels at each dimension. This way, it was possible to divide the 3PL companies into 4 groups: standard 3PL provider, service developer, customer adapter and customer developer (Hertz and Alfredsson, 2003).

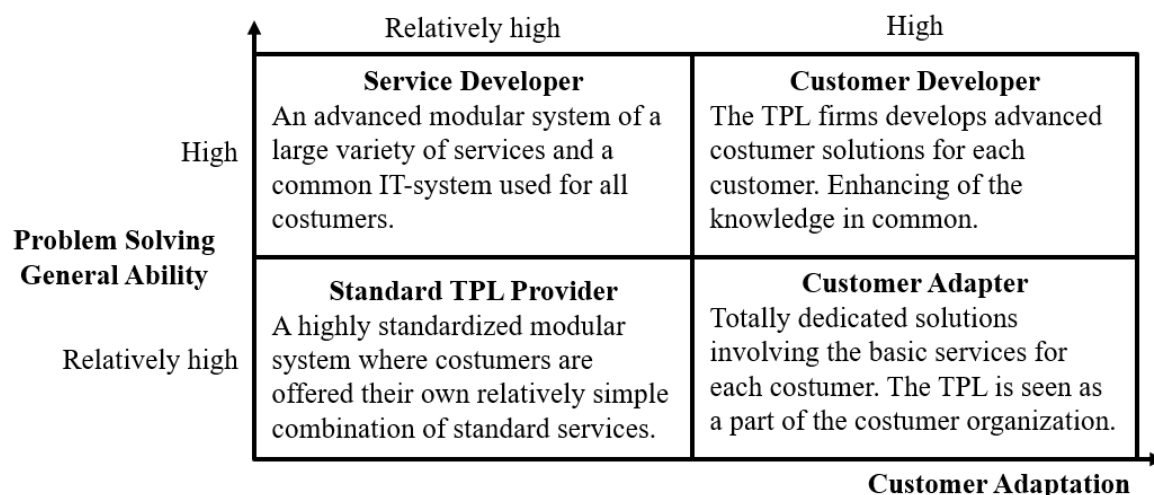


Figure 8 - 3PL classification, adapted from (Hertz and Alfredsson, 2003).

A standard 3PL provides the usual transportation, warehousing, and distribution services. A service developer provides advanced value-added services and usually collaborates with different customers. Their standard activities are modularized and can be combined to meet the requirements of each customer. In this case the focus is on creating economies of scale and the use of advanced IT system is essential to speed up development.

A customer adapter has a small number of customers, so it has a close relationship with each one. It does not develop services, but instead controls its customers' logistical activities and improves their efficiency. In the case of the customer developer, the level of integration with the customers is very high and sometimes involves taking control of the entire logistics operation. In this way, the number of customers is reduced and the amount of work for each one is extensive (Hertz and Alfredsson, 2003).

Outsourcing has emerged as a trend in recent years as 64% of shippers report that they have been using this type of service more. On a regional level, 58% of American shippers and 57% of European shippers report that they are using 3PL more often. Within the European market there is pressure to reduce costs and there is pressure on 3PLs to become larger in order to benefit from economies of scale. Increasingly, customers are asking for an integrated service within the countries belonging to the European Union (FAQ-Logistique, 2013).

It is recognized that the decision to distribute using own means or to use third-party logistics (3PL) services is of high importance. Each option has its advantages and disadvantages.

If the option is to outsource, it is possible to increase the focus on core business activities and reduce the investment, since fixed costs become variable costs. It is also a good opportunity to reduce costs and avoid labor problems. If the operations are carried out by specialists, it is assumed that they will be more efficient and will also provide a better service. In just-in-time and quick response environments, using 3PL is the only way to consolidate loads in a cost-effective way. Furthermore, its use simplifies the relationships between the different players in the supply chain. This option is also the one that allows to have more flexibility to changes in the market. Logically it is possible to have a wider geographical coverage and enter new locations more quickly and cheaply. In situations of high seasonal demand, it is also a good option since installing capacity sized for peak demand can be too expensive. So, it is possible to install capacity for average demand and outsource in periods of higher demand or outsource all distribution (Guedes, 2022).

On the other hand, there is also a loss of control over operations and customer service level. By outsourcing these activities there is a loss of skills and knowledge. Information is also lost about the market and the specific requirements of the customers. If the quality of service provided is lower than promised there is a deterioration of the relationship with the customer and a potential loss of sales. Finally, it is known that the integration of logistics functions is highly challenging and if not well achieved leads to an increase in inventory and consequently costs (Guedes, 2022).

In the case of outsourced transportation, two delivery modes exist. The first mode is known as full-truckload (FTL) and the second mode as less-than-truckload (LTL). The selection of the delivery mode is dependent on different variables and typically companies want to minimize the cost of transportation, but the need to respect a certain delivery frequency may lead to this not happening (Furlog, 2023).

In the case of full-truckload, a full truck is rented, and producers tend to opt for this mode when the delivery to be made uses the entire capacity of the truck. On the contrary, when the delivery to be made is of insufficient size, producers tend to opt for less-than-truckload, and in these cases the logistics operators consolidate the loads. Load consolidation or groupage consists in grouping small dispatches whose destinations are close to each other. This way, it is possible to increase the speed and frequency of delivery since if this grouping did not exist, producers would only send orders when the quantity was sufficient to use the entire capacity of a truck. At the same time, the transportation costs are reduced since they are shared among several companies (Furlog, 2023). However, the use of LTL also has some disadvantages compared to FTL, as the travel time is longer due to stops and it adds handling steps, which increases the probability of damage to the transported goods (Segal et al, 2022).

2.5 International commercial terms (Incoterms)

In the sequence of globalization there was a need to standardize international trade rules. Incoterms are a set of rules that refer to shipping with respect to international transactions and they provide definitions that allow each party to be associated with its obligations (Vidović et al, 2015).

In Figure 9 the rules to every transportation mode are shown and it is possible to conclude that there are several different modalities, and, in some cases, they are only applied to one mode of transport.

The Ex-Works (EXW) modality presents a greater relevance in the present work. In this modality, the producer sells his product without including transportation costs, so the client assumes these costs as well as the associated risks. The manufacturer only makes the goods available at its facilities. (JOMATIR, 2020).

It is also necessary to highlight the Delivered Duty Paid (DDP) Incoterm. According to this term, the seller is responsible for delivering the goods to the customer's premises or to a place designated by the same. Likewise, the risks and costs of transport are covered by the seller (JOMATIR, 2020).



INCOTERMS 2020	FREIGHT COLLET TERMS					FREIGHT PREPAID TERMS						
	EXW Ex-Works	FCA Free Carrier (Warehouse)	FCA Free Carrier (Port/Airport)	FAS Free Alongside Ship	FOB Freight on Board	CFR Cost & Freight	CIF Cost Insurance & Freight	CPT Carriage Paid To	CIP Carriage & Insurance Paid	DPU Delivered at Place Unloaded	DAP Delivered at Place	DDP Delivered Duty Paid
Mode of Transport	Any Mode	Any Mode	Any Mode	Ocean Only	Ocean Only	Ocean Only	Ocean Only	Any Mode	Any Mode	Any Mode	Any Mode	Any Mode
Obligations and Charges												
Export Packaging	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Export Formalities	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Loading at Point of Origin	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Origin Inland Freight	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Origin Port charges	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Forwarder Fees	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Ocean / Air Freight	Buyer	Buyer	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Destination Port Charges	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller	Seller	Seller
Customs Clearance	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller
Import Duties & Taxes	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller
Delivery Charges to Final Destination	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller	Seller

Figure 9 - Incoterms, (JOMATIR, 2020).

2.6 Customer service

Although the vast majority of companies consider customer service an important aspect of their business, they have difficulty in describing exactly what it means. Historically, assumptions were made about what the customer wanted rather than taking into account actual requirements (Rushton et al, 2014). Recently, customers have become more demanding and have higher and higher expectations. In the past, consumers were satisfied with differentiating features or low prices, so there was little focus on customer service. Nowadays this is not enough, customers expect good products at low prices, and it is very difficult to differentiate by price or quality. Thus, customer service is essential to differentiate from the competition and to gain a competitive advantage (NICE, 2023).

It is critical for companies to have a clear definition of customer service and thus to specify and recognize customer service metrics.

The level of customer service is directly influenced by logistics since its metrics have an impact on the quality of service provided. It is possible to take the example of delivery speed, availability of stock, and also delivery reliability. Logically, a higher level of service implies higher logistics costs, so it is essential to find the right balance. Goals and metrics must then be defined in a way that they can be controlled in order to keep the customer satisfied (Rushton et al, 2014).

Providing customers with the required level and quality of service at the lowest cost is the purpose of supply chain management (Christopher and Safari, 2010).

Customer service allows to gain a competitive advantage through differentiation. Whatever the attractiveness of the product, it is essential to keep the customer satisfied, so the role of logistics is essential. It is not necessary to provide the best service but the right service. So, there are the seven right ones in customer service, and they are: the right quantity, cost, product, customer, time, place and condition (Rushton et al, 2014).

It is possible to separate the service level in three categories depending on the time instant they occur. There are the pre-transaction elements that occur before the transaction, the transaction elements that are directly related to the physical transaction and are usually the most related to distribution and logistics, and finally the post-transaction elements that occur after the delivery has taken place. The most common transactional elements are order cycle time, inventory availability, delivery time, delivery reliability, condition of goods and order status information. Regarding the post transactional, the more ordinary elements are: invoicing procedures and accuracy, returns policy and customer complaints and procedures (Rushton et al, 2014).

Previously the balance between service costs and service level was addressed. Although this balance is not easy to define, it can be explained as the point where the additional revenue for each increment of service is equal to the extra cost of providing that increment. Usually, companies follow one of the following approaches: either they define a certain service level and, for that value, minimize its cost, or they try to maximize the service level for a given budget (Rushton et al, 2014). Typically, the relationship between service level and service cost is defined as a rising curve (Figure 10). However, it is possible to shift this same curve to the right, and for the same cost, offer a better service. This displacement can happen if alternative strategies are found to serve customers. Increasing the response capacity, it is possible to achieve lower lead times and reduce stock dependency. To do so, it is necessary to increase the flow of information and understand in detail what the specific requirements of each customer are (Christopher and Safari, 2010).

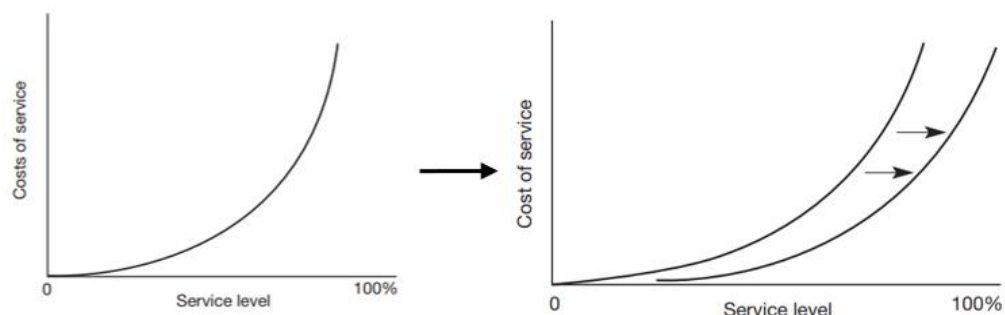


Figure 10 – Service level costs, (Christopher and Safari, 2010).

To measure the service level different metrics must then be used. The definition of these metrics depends on the particular customer and its core requirements.

It is critical to accurately measure each of these metrics and to establish what is the objective for each of them. In this way it is possible to track the evolution over time and take steps towards achieving the desired results (Rushton et al, 2014). To control the performance of the service it is mandatory to set standards for each metric. If the customers themselves define these standards, it is possible to guarantee their effectiveness. Thus, it is necessary to carry out research activities and also make benchmarks to identify targets within each market segment (Christopher and Safari, 2010).

It is then possible to conclude that keeping the customer satisfied is essential to the success of a business. In addition, it is the main source of differentiation in a market where products are increasingly similar and brand loyalty is decreasing (Rushton et al, 2014).

2.7 Supply chain structural configuration

Centralization and decentralization of production and distribution

The definition of the logistics network is intended to answer a wide variety of questions. Involves defining the number, size and location of all facilities that belong to the distribution system. Before designing the entire network, it is mandatory to understand the fundamental requirements for the company and collect enough data in order to perform a quantitative analysis (Rushton et al, 2014).

Usually, the logistics network is not designed from scratch and the company already has plants, distribution centers and corresponding delivery areas. The most common situation is that there is an unplanned system that has grown along with the company. Therefore, it is necessary to find a compromise between the best solution and the current design. Since distribution centers and vehicle fleets have high costs, changes to existing systems are also expensive and impact customer service (Rushton et al, 2014).

It can be stated that the main reason for designing the logistics network is to serve the customer effectively while minimizing the cost of that service. It is not only necessary to meet demand but also to provide an adequate level of service. In order to provide the best customer service, the distribution centers would be very close to the customers and stock the entire product portfolio. This way the delivery would be very fast but obviously the cost of this solution would be very high. The best solution to minimize the cost would be to have only one central warehouse and make deliveries only when there are enough orders to fill a truck. Despite the low cost, this solution would be too slow and could lead to loss of customers. It is then essential to find a compromise between these solutions. A consensual solution is to define a number of distribution centers per area where they are supplied by large vehicles and then smaller vehicles deliver to the customers (Rushton et al, 2014).

In this context, it is important to distinguish between primary and secondary transportation. Primary transportation refers to the supply of the distribution centers from the point of production. Secondary transportation refers to final delivery, that is, from the distribution centers to the final customer (Rushton et al, 2014).

The decision to centralize or not to centralize manufacturing is very dependent on the value of the product and the frequency of delivery. If the cost of transportation is expensive or the delivery frequency is high, the potential for centralization is lower. High delivery speed requires plants to be close to the end customer. Similarly, when the cost of delivery is high, a more regional solution is desired in order to minimize distances. The greatest potential for centralization is in high-value products where the cost of transportation is not significant relative to the cost of the product and where the frequency of delivery is low (Guedes, 2022).

Regarding stock location, the matrix in Figure 11 can be used as a tool to assist in the process of deciding the location of stocks. For each dimension a division into two levels was made.

The first dimension refers to the value of the product and the second dimension refers to the volume throughput. According to this matrix, products with low value and high throughput should be held close to the costumers while products with high value and high throughput should be held in a global distribution center to minimize safety stocks.

Volume Throughput	High	Decentralize Multiple distribution centres Local delivery	Regional stockholdings
	Low	Regional stockholdings	Centralize Global distribution centre Airfreight
		Low	High
		Product Value Density	

Figure 11 - Product segmentation by value and throughput, adapted from (Rushton et al, 2014).

Centralization is a strategy often used when the companies pretend to reduce safety stocks and so, reducing costs while maintaining the same service level. However, an increase in transportation costs and lead time is inevitable (Ming and Donghong, 2013).

The decision to use a more or less centralized solution has advantages and disadvantages. In Europe the trend is to centralize stocks due to the many advantages (Figure 12):

Centralization Advantages
▪ Cost reduction with inventory, primary transport and employees; ▪ Increase of the reaction speed to changes in the market; ▪ Greater product availability; ▪ Decrease of the investment and economies of scale; ▪ Reduction of the learning costs; ▪ It allows to balance the demand peaks; ▪ Reduced costs with information technology and increased reliability; ▪ Achieving a consistent level of service across Europe; ▪ Enables the use of large 3PL service providers; ▪ It allows consolidation of loads; ▪ Permits the centralization and integration of logistics management for all of Europe.

Figure 12 - Centralization advantages, adapted from (Guedes, 2022) and (Adenso-Díaz et al, 2016).

In addition, the good quality of the logistics infrastructure in Central Europe have been factors that have driven this trend (Guedes, 2022).

On the other hand, there are several arguments that support decentralization of stocks. The biggest advantage of this type of solution is the increased delivery speed and higher service level. It is well known that during COVID e-commerce had a great growth with not only the number of orders increased but also the average value of each order. In the year of 2020, 293 million European consumers made purchases on the Internet (Voyado, 2023).

Even before the confinements, online shopping was already showing great growth. With the increase in this type of sales, the number of shipments direct to the customer is bigger.

In addition, consumers are increasingly asking for deliveries to be made very fast, and there are companies that promise to reach them in less than 24 hours. With this level of demand on delivery time, some companies had decided to decentralize the stock.

But, in this type of delivery, the customer must be prepared to pay a little more for the service. Many companies offer different shipping options, and in the case of longer delivery times the cost will be lower. It is, however, important to have the possibility of fast delivery since it is valued by some customers who are willing to pay more (Space, 2022).

Then, some arguments supporting decentralization of stocks are presented (Figure 13).

Arguments That Support Decentralization
▪ Need for customization in each country or use of local labelling or packaging; ▪ Make-to-order approach; ▪ Demand for very fast delivery from the customer; ▪ The ability to increase the service level; ▪ Reduction of the delivery costs; ▪ Need to gain visibility and presence in local markets or to support commercial activities; ▪ Decreased value of lost sales; ▪ Existence of information technology that allows central coordination and physical decentralization.

Figure 13 - Arguments that support decentralization, adapted from (Guedes, 2022) and (Adenso-Díaz et al, 2016).

When planning a logistics structure, a comparative analysis must be made between the main alternatives. It is then necessary to understand the interactions between the different distribution costs and what impact the number type and location of facilities have on the total logistics cost (Rushton et al, 2014).

Thus, to find the best solution complex trade-offs must be considered. To decide on the number of warehouses, the relationships between the following types of costs have to be analyzed: primary transport cost, inventory holding cost, storage cost, systems cost and local delivery cost (Guedes, 2022).

In Figure 14 a typical cost structure is shown:

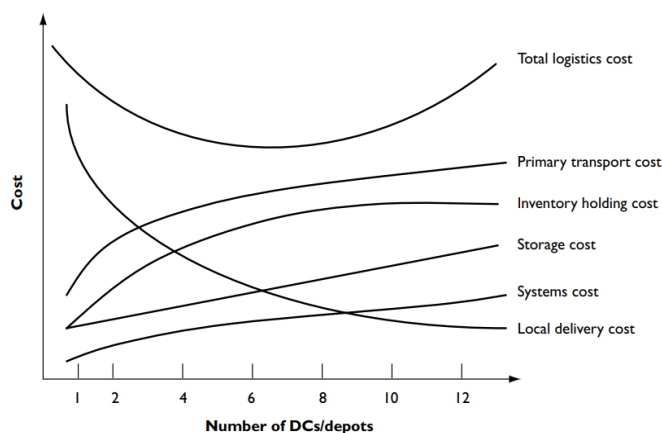


Figure 14 – Typical cost structure in function of the number of depots, (Rushton et al, 2014).

Each of the costs will then be explained in more detail. Regarding storage costs, it was mentioned earlier that by using a more central solution, or in other words, a smaller number of distribution centers, it is possible to reduce costs through economies of scale, and better use of space and equipment. In addition, the amount of safety stock required is lower.

Besides the cost of warehousing, it is necessary to consider the cost of holding the inventory, which can be divided into three parts: cost of capital, cost of service, or in other words the cost of managing the stock and insurance for it and the cost of the risk of deterioration, damage, or obsolescence. Typically, the inventory holding cost function grows as the number of distribution centers increases. However, after a certain number of distribution centers the tendency is to create an inflection point where costs start to decrease.

The opposite is true for the cost of delivery to the client, since the greater the number of warehouses, the closer they are to the client and the shorter the distance travelled. The greater the number of warehouses, the lower the delivery cost. Primary transportation refers to shipments from warehouses or from production points to distribution centers. Thus, the greater the number of distribution centers, the greater the distance travelled and the higher the cost. Information systems costs are more difficult to analyze as there is a wide variety of options. In the general case, the greater the number of installations the higher the system cost (Rushton et al, 2014).

The total logistics cost is obtained by adding up the different cost components. The graph in Figure 14 is only representative and it is necessary to model the costs for all situations. In order to select the best option, trade-offs have to be analyzed because by reducing the cost of one of the components the cost of another may be increased, so it is essential to analyze the total cost of the system (Rushton et al, 2014).

For the definition of scenarios external and internal factors must be considered. The external factors should assess the available modes of transport, changes in infrastructure and regulations, environmental impacts, industry trends and information systems. Internal factors are intrinsically linked to the industry in question and are categorized into qualitative and quantitative. These factors should be developed in detail as they will be inputs to the formulation of hypotheses. The desired level of service is one of the most important inputs and the design is developed with the desired service level in mind. What is intended is to minimize the cost for a given level of service (Rushton et al, 2014).

Over the last three decades globalization has been a strong trend, and from a supply perspective, finding global sources was a strategic element. Companies have chosen to find suppliers in foreign countries to remain competitive in an increasingly interconnected world. Attention was turned to countries with cheap labor since it was possible to obtain products and raw materials at a lower cost. However, with COVID came supply chain disruption, so companies that had single, remote suppliers were severely impacted. So, there is a consensus that supply chains need to become more flexible and adaptable. Regionalization and installing more capacity in the country of origin are identified as solutions to reduce the risk of global sourcing (Koerber and Schiele, 2022).

The location of the sources has a big impact on the design of the logistics network. For companies with manufacturing plants outside Europe the situation of defining the European supply chain is clearer and the most common option is to centralize stocks in the Netherlands, Belgium, Northern France or Germany. In the case of factories within Europe the definition of the optimal solution is not so clear (Guedes, 2022).

Definition of the decoupling point

There are two classical philosophies for the functioning of supply chains being the push and the pull models.

With regard to the push or make-to-stock model, the aim is to carry out supply taking into account the anticipation of demand. For the system to be efficient, it is necessary to correctly forecast demand, plan activities and efficiently handle stocks. The operation of the chain is then based on the planning of needs along the chain (Carvalho et al, 2020).

Concerning the pull or make-to-order model, supply only takes place, when necessary, that is, based on the response to demand. For the system to be efficient, there must be great visibility along the chain, and it is essential that information is passed quickly. In addition, production and distribution time should be reduced as much as possible. (Carvalho et al, 2020).

Although there are these two classical operating philosophies when looking at the totality of a supply chain there are always parts of the chain operating on one of the two models. Chains are neither fully push nor fully pull so it is essential to define the point of transition from push to pull. This stock point is known as the decoupling point (Figure 15). This point makes it possible to separate the response to the customer from the limitations of time and supply capacity (Carvalho et al, 2020).

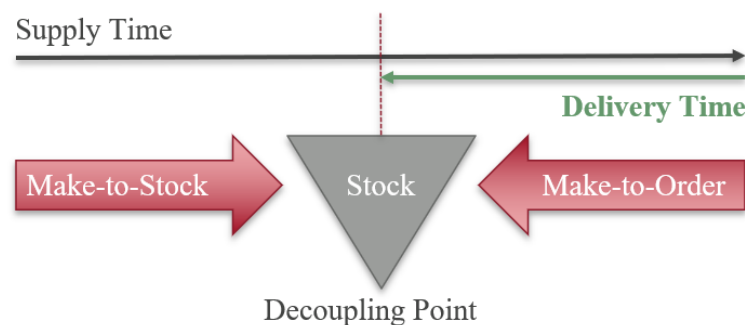


Figure 15 - Decoupling point, adapted from (Carvalho et al, 2020).

The adequate location of the decoupling point is of great importance when designing a logistics network. Naturally, the further downstream the decoupling point is located the shorter the delivery time but the higher the risk since the longest part of the chain works based on forecasts.

Postponement

Postponement consists of delaying the processes that give products a specific identity. In this way, it is necessary to redefine the products and readjust production and distribution so that customization activities occur only after the customer requirements are known. This customization results in a significant increase in the number of references and, if carried out at the right point, reduces the total cost of the supply chains (Carvalho et al, 2020).

Time postponement

This type of postponement consists in placing the decoupling point as far upstream as possible. This way, fewer processes take place based on demand forecasts, resulting in a more pleasant and easier to forecast demand, making it possible to reduce intermediate stocks. To implement this strategy, it is necessary that the processes that induce little differentiation are performed before the decoupling point and that the processes that occur afterwards are flexible and fast (Carvalho et al, 2020).

Logistics postponement

This type of postponement consists in placing the product customization processes closer to the point of consumption. Again, the decoupling point is placed as far upstream as possible, with customization activities being carried out in a unit closer to the customer and not in the factory (Carvalho et al, 2020).

3 Definition of the Problem

The present chapter aims to characterize the current situation of the distribution operation of the products of sub-sector A for the target markets of Central Europe. To this end, the following methodology was applied: First, the global export context of sub-sector A was addressed. Then, the Portuguese export situation at a global level and for the target markets was framed. From the point of view of exports, it was also analyzed the market in a global way, and it was proceeded to an identification and characterization of competitors followed by a benchmarking. It was also relevant to analyze the importing markets in a global way and the evolution of imports in the target markets. Finally, the brand A players involved in the study were characterized as well as their distribution operation to Central Europe.

3.1 World-wide exports of the products of sub-sector A

3.1.1 Global context and the importance of clusters

The production process of the sub-sector A products is significantly automated, and the sub-sector is characterized as being capital intensive. Besides the high investment in equipment, the cost of energy is also relevant. Companies located in countries where natural gas is cheaper are naturally more competitive since they obtain the final product at a lower price (Pereira, 2005).

Then, the competitiveness of each country depends on various factors, the most important of which are product quality, brand recognition, geographic location, level of service and the price of the production factors. The price of production factors, particularly labor and energy costs, is extremely relevant as it conditions the price of the final product which is, in itself, a considerable competitive factor. Thus, the creation of economies of scale allows, in part, to circumvent this situation. The companies tend to compete on price or quality with only a small proportion trying to differentiate themselves through service level (Rius et al, 2006).

The manufacturers' main customers are the retailers who in their turn sell the products to the end customer. These retailers tend to place more fractional and more frequent orders, minimizing the need to tie up capital in inventory.

Typically, manufacturers in sub-sector A are organized in clusters. A cluster is a geographic concentration of interconnected companies, including specialized suppliers, service providers, associations and other companies related to a certain industry. These companies are competitors but also cooperate and help each other. The decision to operate within a cluster has advantages in that it allows access to inputs, specialized employees, information, and institutions. Furthermore, it allows benefiting from complementarities and to measure performance more efficiently. Besides that, the companies in the area increase their productivity and innovation is stimulated as well as the formation of new businesses within the cluster (Porter, 1998).

The economy's process of globalization is forcing industries like ceramics to operate in highly competitive environments where they must consider a variety of factors in addition to the increased standards for quality and level of service, such as flexibility, availability, speed, and geographic coverage of their supply and distribution chains. In this respect, logistics should become a differentiating and value-adding competitive component. To provide customers with customized and high-quality services, industrial organizations must thus be in complete control of the logistical chain (Rius et al, 2006).

3.1.2 Portugal as a global exporter

Global exports of the sub-sector A

As previously noted, in Portugal there are 28 companies that fall within the ceramic's sub-sector A. There is an effort towards internationalization on the part of these players who in 2021 exported around 68% of their turnover. Exports are made to more than 120 markets and in 2021 the quantity exported was 505 thousand tons.

Portuguese companies operating in sub-sector A are predominantly located in the Aveiro region to benefit from the synergies approached before. However, there is a strong competition between the different players which has resulted in an increase in productivity and quality. In a sub-sector where the life cycle of products is less than 3 years, there is little innovation by Portuguese producers who generally follow the trends set by Italian designers. Portuguese players try at the same time to build economies of scale to lower production costs and to know consumer needs and preferences. Thus, they intend to present on the international markets quality products and with a design that meets international trends (Pereira, 2005).

Portugal presents ideal conditions to produce ceramics, namely, raw materials of great quality and variety. However, the increase in energy costs, more specifically natural gas, does not allow Portuguese producers to compete on price in international markets (PWC, 2016). Although this increase in the price of natural gas has happened in other countries, government entities supported the companies in a significant way, something that did not happen in Portugal, since the support measures were insufficient (Larguesa, 2022).

Even though in the Aveiro region there is a strong export-oriented business concentration and support entities, there is also a strong competition among companies and a lack of an overall strategic vision that would allow to create synergies in distribution to international markets (Pereira, 2005).

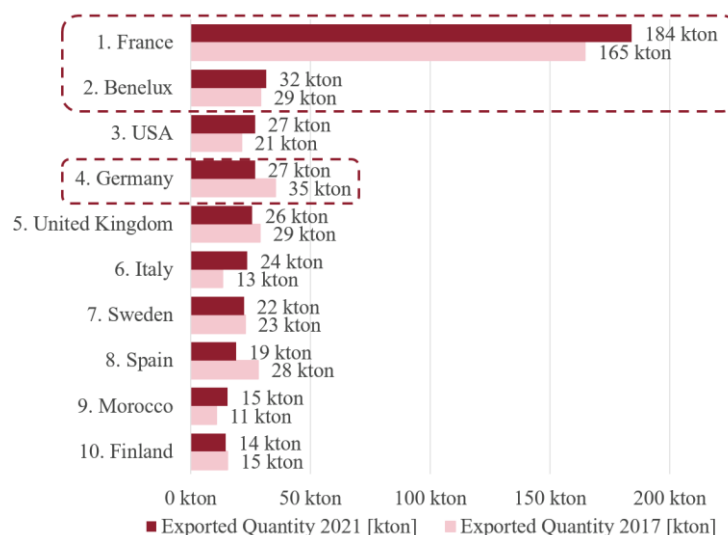


Figure 16 - Comparison of the quantity exported by Portugal per destination market.

Of the 120 markets to which Portugal exports, the most important is France (Figure 16). Together, the Central Europe target markets represented 48,9% of the exported quantity in 2021 (ITC, 2023).

Exports of sub-sector A to the target markets

Analyzing the modes of transport used for exporting to the target markets there is a clear predominance of road transport since it carries 86,6% of the total quantity. The use of maritime transport for France is residual, but for the markets of Germany, Benelux, and Austria it represents 42,4%, 36,4% and 60,7% respectively (Comtrade, 2023).

Knowing that the products of sub-sector A have a low value and are heavy, it can be verified that in exports the cost of transport represents a significant percentage of the sales value. Thus, in some cases, for longer distances, the flexibility and speed of road transport is sacrificed in favor of maritime transport, which is less expensive.

In Table 1, air and rail transport modes are represented together over the nomenclature of other modes of transport. This grouping was chosen because the use of these modes is marginal. The mode of transport used for export is of high importance as it not only impacts the service level but also the transport cost.

Table 1 - Modes of transport used for exportation to target markets in 2021.

Markets 	Road 	Maritime 	Other modes of transport
France	178 kton (96,8%)	1 kton (0,6%)	5 kton (2,6%)
Germany	15 kton (55,1%)	11 kton (42,4%)	0,7 kton (2,4%)
Benelux	19 kton (60,8%)	12 kton (36,4%)	0,9 kton (2,8%)
Austria	2 kton (38,4%)	3 kton (60,7%)	0,04 kton (0,9%)
Total	214 kton (86,6%)	27 kton (10,8%)	6 kton (2,5%)

In order to describe the logistical flow of the sub-sector to the target markets, the assumption was made that only road transport would be used, given its predominance. In the next topic the distribution operation for Central Europe will be explained in more detail, but for the calculation of the logistical flow it was only necessary to know that the capacity of the trucks used is 24 tons. Thus, if it is assumed that all deliveries are made by full truck it is possible to calculate the number of annual deliveries.

This number of deliveries is a minimum number since it is known that in a significant part of the shipments there is a consolidation of loads. In any case, performing this calculation was important to make a high-level description of the flows. It then turns out that for the target markets, a minimum of 10.283 deliveries were made in 2021 (Figure 17).

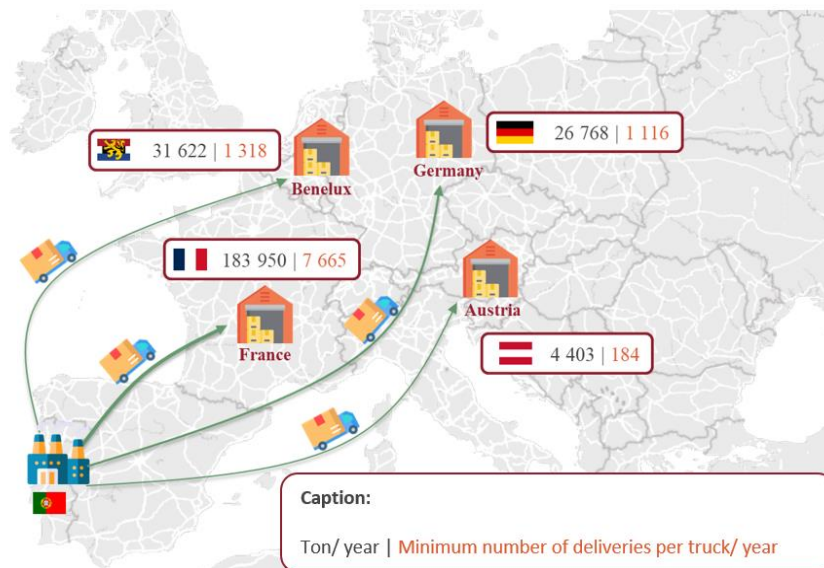


Figure 17 - Portuguese sub-sector A logistic flow to the target markets in 2021.

3.1.3 Identification of competitors and its context

When analyzing the values exported by each country in 2021 (Figure 18), Italy and Spain stand out from all the others being considered as the biggest players in sub-sector A. Portugal comes in eighth place with an export value of 248 million euros. Countries like China, India and Turkey are still very important exporters, the last two showing great growth in recent years (ITC, 2023).

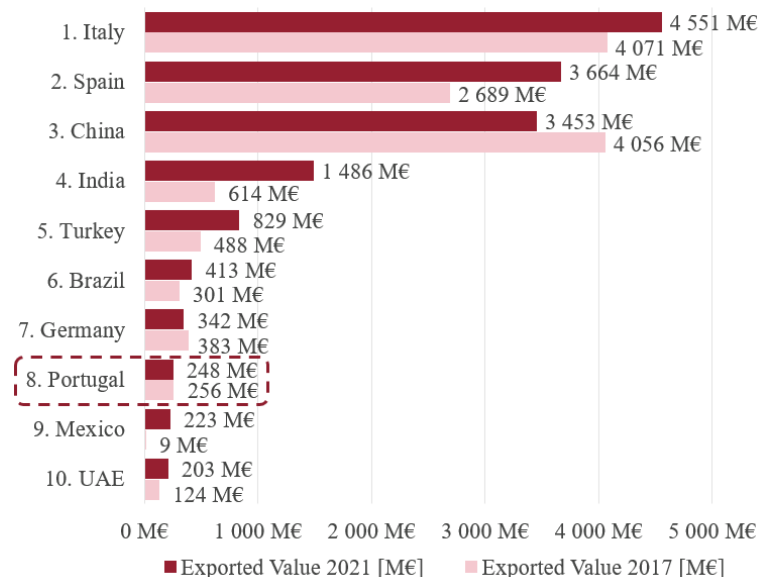


Figure 18 - Top exporters of sub-sector A by value.

Identification of players for benchmarking

In order to make a comparison between players it was first necessary to identify the main competitors of the Portuguese producers. Thus, Table 2 was elaborated using data referring to the year 2021 (ITC, 2023). Thus, the main criteria for identifying a country as a competitor were defined, such as geographical proximity to the Central European markets, turnover, and sharing similar economic and social policies, or in other words, belonging to the European Union.

Countries that are more geographically distant from the target markets naturally have a longer distribution time. Therefore, their distribution strategy generally presents other characteristics, and, in most cases, the price factor is preferred to the detriment of delivery time. Additionally, countries with energy and labor costs significantly lower than those in Portugal were not considered competitors since they do not compete under similar production conditions. In these cases, the average sales price per ton is generally lower than the Portuguese players, which makes it inviable to compete with these countries.

On the other hand, were considered competitors those countries that present, as main target markets, at least one of the Central European countries in the scope of this work. In this way, countries that export exclusively to other markets were not considered competitors. It should also be added that in 2021, Portugal had an average sales price per exported ton of 491 euros.

Table 2 - Main players' customers and average price per ton in 2021.

#	Country	€/ ton	Main Customers	Benchmark ?
1	Italy	691 €/ ton	1 st France (749 M€) 2 nd USA (583 M€) 3 rd Germany (582 M€)	✓
2	Spain	416 €/ ton	1 st USA (447 M€) 2 nd France (399 M€) 3 rd UK(212 M€)	✓
3	China	328 €/ ton	1 st Vietnam (505 M€) 2 nd Philippines (358 M€) 3 rd Hong Kong (315 M€)	✗
4	India	443 €/ ton	1 st Saudi Arabia (132 M€) 2 nd USA (91 M€) 3 rd UAE (75 M€)	✗
5	Turkey	280 €/ ton	1 st USA (138 M€) 2 nd Germany (101 M€) 3 rd UK (85 M€)	✗
6	Brazil	211 €/ ton	1 st USA (101 M€) 2 nd Paraguay (54 M€) 3 rd Argentina (39 M€)	✗
7	Germany	682 €/ ton	1 st Benelux (70 M€) 2 nd Switzerland (42 M€) 3 rd Austria (33 M€)	✓

According to the criteria defined, 3 countries have been identified as competitors.

Firstly, Italy and Spain were selected for benchmarking since they have a similar distance to target markets as Portugal and an average price per ton that allows Portuguese players to compete. In addition, their main clients include the Central European markets.

Subsequently, China, India and Brazil were excluded since, when compared to Portugal, they have much lower cost of production factors, which translates into a lower average price per ton. Furthermore, their main clients are not in the Central European markets, so there is no direct competition in these markets.

Although Turkey has a strong presence in Central European markets, it was excluded from the countries chosen for benchmarking since, when compared to Portugal, the cost of production factors is significantly lower, making it difficult for Portuguese players to compete against Turkish prices.

Finally, Germany was selected since it has an average price per ton that allows Portuguese players to compete and also has a strong presence in Central European markets. Moreover, its geographical location allows a competitive advantage over the Portuguese in the Central European markets.

The competitor's context

As noted previously, the positioning of the players depends on the country where they produce their products so that within the same country companies tend to compete in the same market segments. Thus, it becomes relevant to describe the contexts in which each of the identified competitors operate.

The Italian companies are concentrated in Sassuolo (north of Italy) and use a clear differentiation strategy, characterized by the sale of high-end products. In their turn, the Spanish players are concentrated in Castellon (east of Spain) and have opted for a cost leadership strategy (García, 2016). The value chain articulation of the Italian cluster differs from that of the Spanish cluster. In general, Italian companies are more proactive downstream and there is a strong focus on marketing and improving distribution. On the other hand, Spanish companies focus more on production and cost reduction. Thus, Italian companies differentiate their products more by leading in the most sophisticated markets and Spanish companies have lower prices (Hervás-Oliver and Albors-Garrigós, 2007). Italian manufacturers have invested not only in development and research essential for technological evolution but also in distribution structures and new production plants in countries with cheaper labor. In addition, they followed a verticalization strategy and took control of the market from production to distribution (PWC, 2016).

German companies, on the other hand, use a differentiation strategy which is nevertheless different from that followed by the Italians. While the latter stand out for design, the Germans stand out for durability (Russo et al, 2012).

During 2022 there was a significant increase in the price of natural gas in Europe. Thus, companies in the sub-sector saw their production costs increase and their margins crushed. In order to respond to this challenge, they either increased the selling price or decreased production. On the one hand, price increases drove customers to look for cheaper alternatives. On the other hand, with the production cuts there was a shortage of products and a longer delivery time (Rogers, 2022).

Thus, it can be understood that European manufacturers have lost competitiveness compared to countries that have a cheaper energy source. The comparison between the selected players is still valid as the rise in costs has affected all of them. However, government support for rising energy costs differed between countries.

3.1.4 Benchmarking

For benchmarking purposes, two graphs were constructed with the values referring to exports at world level (Figure 19) (ITC, 2023). The countries under analysis are those previously indicated.

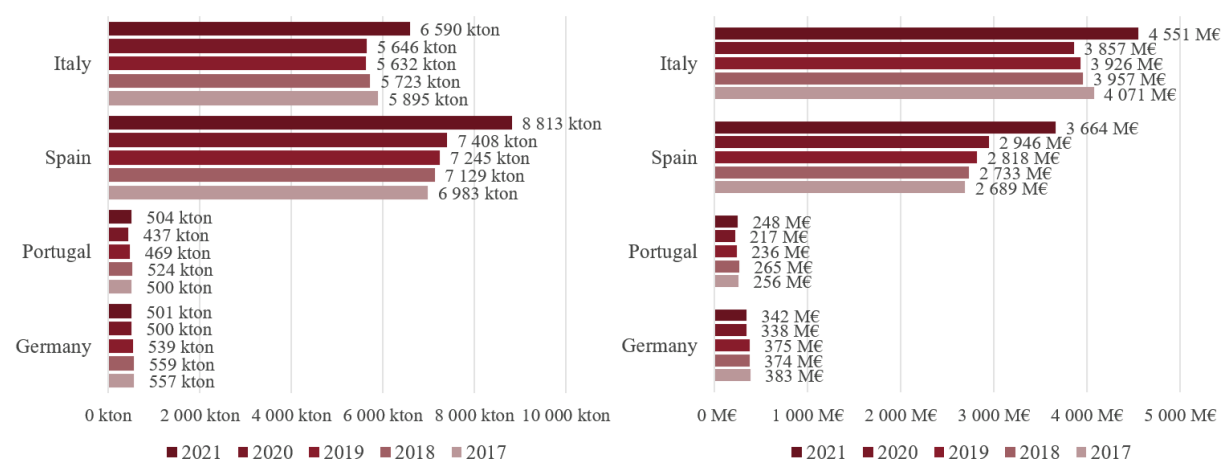


Figure 19 - Quantity and value exported to the world by Portugal and its competitors.

The quantity exported by Italy and Spain is clearly higher than that exported by Germany and Portugal. Although the quantity exported by Spain is higher, the value exported by Italy is clearly larger. In terms of quantities, Germany and Portugal are very close, but the German values are significantly higher.

While Italy slowed down in the years 2018 and 2019, Spain was able to increase consecutively both in quantity and value with the increase in the latter being more significant.

Another graph was then prepared in order to compare the average price per ton exported to the world (Figure 20) (ITC, 2023). It was observed that Italy and Germany have the highest average pricing when comparing the prices per ton of the various players that were chosen, which is consistent with the differentiation strategy adopted. In turn, Portugal presents an average price higher than Spain, which has the lowest average value and uses a cost leadership strategy.

As regards the evolution of the average price, that of Italian and German producers has remained roughly constant despite oscillations. On the other hand, the average price for Spanish producers has increased consecutively.

The Portuguese average price shows a downward trend, moving further and further away from the average price of Italians and Germans and, at the same time, getting closer to the average price of Spain.

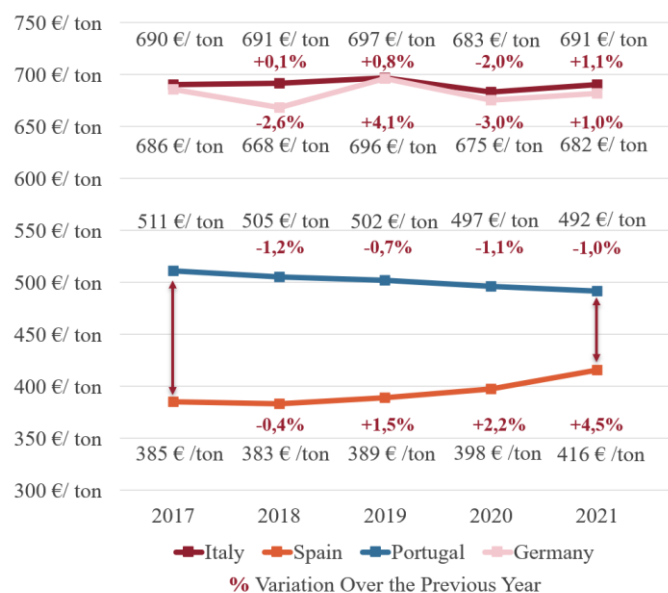


Figure 20 - Sub-sector A Portugal and its competitor's average price per ton exported to the world.

In order to complement the comparative analysis, it was relevant to understand which means of transport are used by competitors to export to the target markets. In the case of Spanish producers, road transport carried about 91% of the products, while for German producers this percentage was approximately 100%. Portugal's percentage use of road transport is slightly below that of its competitors, at approximately 87% (Comtrade, 2023).

As noted throughout the comparative analysis, each one of the competitors opts for a market positioning, finding different ways to gain a competitive advantage. The brands of Italian and German producers are recognized, allowing these manufacturers to charge higher sales prices. Furthermore, the Italians are the world reference in terms of design and are able to establish trends. In its turn, German producers focus more on the durability and functionality of their products. In the case of Spanish producers, although they have a low price and lead by cost, their brands also have a high recognition. These three competitors have advanced manufacturing technologies and are able to keep up with market trends, particularly the increasing demand for larger format products.

In the case of Portuguese producers, market positioning is less clear. There are difficulties in increasing the average price of products as brand recognition is not yet at the level of competitors.

Thus, buyers perceive that Portuguese products do not have the same quality as those of competitors. On the other hand, the lack of financial support for the increase in the cost of natural gas does not allow for the possibility of leading by cost. Additionally, production technologies are not as advanced due to lack of investment. It is therefore difficult to follow the trend of large formats. In this sense, Portuguese producers can try to differentiate themselves through the level of service. If they are able to deliver their products faster, cheaper and in better condition, there is, then the possibility of increasing competitiveness and consequently market share.

3.2 World-wide imports of the products of sub-sector A

3.2.1 Analysis of the global market

In order to place the Central European markets in a global context of imports of products of sub-sector A, the largest importers worldwide in terms of value were analyzed. The markets of France, Germany and Benelux belong to the five largest importers worldwide in 2021, representing about 15% of the imported value. On the other hand, Austria is in 23rd place, absorbing 1% of the world's value (ITC, 2023).

Worldwide, from 2017 to 2021, exports of sub-sector A products increased by 30% from 13.338 million euros to 17.352 million euros. On the turn, France Germany, Benelux and Austria increased their imports by approximately 14%, 15%, 48% and 9%, respectively (ITC, 2023).

3.2.2 Analysis of the target markets

As previously mentioned, within the target markets, the French market is the most important for Portuguese producers and in 2021 represented about 74% of the quantity exported to these markets (Figure 21) (ITC, 2023).



Figure 21 - Evolution of the quantity exported to the target markets by the Portuguese sub-sector A.

Since 2017, France increased the quantity imported by 18% and in 2021 it imported 1953 thousand tons. Portugal was the third largest supplier with a market share that has remained at 8%. However, in 2021 the exported quantity increased 10% when compared to 2017. The main suppliers were still Italy and Spain with market shares of 47% and 29% respectively. Turkey increased the quantity exported by 26% compared to 2017. This market is the most important for Portuguese producers absorbing 36% of the exports in 2021 and its imports continue to increase due to the lack of installed capacity (ITC, 2023).

Germany increased the quantity imported by 20% since 2017, and in 2021 it imported 1594 thousand tons. Portugal was the ninth largest supplier with a market share that decreased from 2% to 1% and the quantity exported decreased by 31% when compared to 2017. The main supplier was still Italy with a market share of 44%. The German market has lost importance from the perspective of Portuguese producers but in 2021 it represented 5% of the exported quantity (ITC, 2023).

Benelux increased the value imported by 48% since 2017, and in 2021 it imported 649 million euros. Portugal was the ninth largest supplier with a 2% market share. The main supplier was still Italy with a market share of 33%. Given the recent increase in global imports from Benelux, there is potential for an increase in Portuguese exports to this market, as Portugal was only in ninth place in the ranking of the largest suppliers. Since 2020, the quantity exported to this market has shown consecutive growth recovering the decrease that occurred in 2019 (ITC, 2023).

Austria increased the quantity imported by 9% since 2017 and in 2021 it imported 348 thousand tons. Portugal was the seventh largest supplier with a market share of approximately 1%. In 2018 the quantity exported to this market increased 29% but since then has been kept roughly constant. The main supplier is Italy with a market share of 57% (ITC, 2023).

3.3 Brand A players' current situation assessment

As noted previously, of the 28 Portuguese players of sub-sector A, the association represents 19 and 14 were inquired in this study. However, only 6 answers were obtained, but they were nevertheless representative, since the 6 companies together represented approximately 49% of the subsector's turnover in 2021. The graph in Figure 22 shows that there are companies of various sizes, with 6 of the 14 companies accounting for about 80% of the turnover in 2021 (Iberinform, 2023). Players A and C belong to Italian Groups, but the remaining companies are Portuguese and do not have any production units in other countries. Even the two companies belonging to Italian groups present the products on the market under the same brand name as before they were acquired. The factories are then mostly located in the Aveiro area, but it is observed that two companies are located north of Santarem (Figure 22).

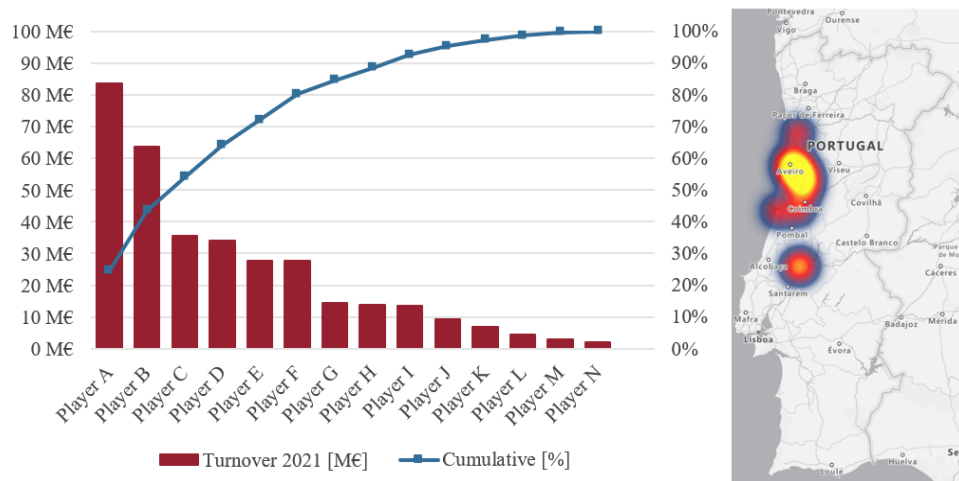


Figure 22 - Brand A player's turnover in 2021.

Through the answers to the questionnaires, semi-structured interviews with members of the players' logistics and commercial areas, and sectorial studies, it was possible to identify the logistical characteristics of the sub-sector and also to characterize the current distribution operation of the brand A players for the Central European markets.

3.3.1 Logistical characteristics of the operations

Increasing complexity

In recent years, the complexity of supply chain management of sub-sector A has increased considerably. In the past there was a small number of references, but today the scenario is very different. The manufacturers have increased their offer by making more colors, finishes and formats available. Thus, the number of articles has increased considerably and, consequently, the volumes have become more fragmented.

Format of the products

Of the components discussed earlier, the one that has caused the most difficulties for players in recent years is the product format or size. A division can be made between small and large formats, and customers are increasingly looking for large formats. From a logistics point of view, the format of the products has an impact not only on the unit load used but also on the average response lead time. The average response lead time is equivalent to the time that elapses between the order placement and the order being ready to be shipped.

It has been noted that of the 14 players included in the project only the 5 largest have the capacity to produce large formats. This limitation is related to production aspects, as these products require more advanced and expensive pressing machines, with this equipment being responsible for giving the product its shape. Even within the players that have the necessary equipment, not all their production capacity can be allocated to large formats, since they still have equipment allocated to the small formats. Thus, in general, brand A players have a longer response time for large formats.

Loading units

When it comes to the loading units for storage and dispatch of finished product the pallet is the choice. For both small and large formats the European pallet (120 cm x 80 cm) and the American pallet (120 cm x 100 cm) are used.

For the large formats, more specific pallets can be used, and both have a width of 80 centimeters, but the length can vary from 125 to 180 centimeters. The weight of a full pallet depends on the product in question and the size of the pallet but on average is 900 kilograms. The products are packed in boxes, and the number of boxes placed on each pallet can vary between 30 and 70 depending on the weight and shape of the goods.

It is noted that there is currently a significant percentage of pallets that are not dispatched as full pallets. Incomplete pallets can be single-product or multi-product. In this case, their average weight is naturally lower. These incomplete pallets may also be called picking pallets. The orders that include this type of pallet are more complex as they add operations to the preparation of the orders and often cannot be stacked, which increases the costs associated with transportation. Naturally, the logistics costs associated with picking pallets are higher.

Supply chain operating philosophy

Among the players surveyed there are differences in the functioning of supply chains. In general, players tend to apply both models, push and pull. Thus, the production planning is done taking into account two inputs which are the customers' orders and the stock levels.

In this sub-sector, start-up costs are high as are setup times. This high changeover time is mainly seen in the pressing operation. Thus, what is verified is that production batches are typically large since producers want to increase their efficiency and achieve economies of scale. In this way, players are able to optimize the use of resources, namely electricity, natural gas, and raw materials.

Similarly, producing larger batches allows producers to maintain quality for a greater number of pieces. What occurs is that between batches, it is not possible to guarantee consistency and uniformity in terms of color and texture. Thus, by producing a larger quantity, the manufacturers minimize the differences between the units, meeting the agreed specifications.

3.3.2 Distribution operation to Central Europe

Customer segments and their location

Currently, in Central Europe the main customers of the Portuguese players are retailers and in 2021 this segment represented approximately 87% of sales. The remaining customers are distributors and construction companies.

In order to reduce the inventory holding costs, the retailers place smaller but more frequent orders and with this market segment the players have defined a minimum order quantity of only one box. This allows the retailers to reduce the risks associated with product obsolescence, something that is critical in an industry where the life cycle has been decreasing and is now less than 3 years. In turn, the final customer is increasingly demanding in terms of delivery time and there is little brand loyalty, so in case of unavailability or long delivery times, the decision is to select another manufacturer. Thus, it can be concluded that delivery time is critical to maintain market share and therefore logistics strategy is decisive. To clarify, delivery time includes not only the response time, but also the distribution time, which corresponds to the time that elapses between the products being ready to be shipped and their delivery to the customer.

Regarding information about sales, the players were not very willing to share information about their clients' locations and respective purchase amounts, and it was only possible to obtain the location of 55 customers (Figure 23). However, it is known that the gravitational center of demand is in France, with this market absorbing about 74% of the quantity exported in 2021. Furthermore, it can be seen that in this market, customers are more concentrated in the northern region. Regarding the German market, customers are mainly located in the west and south. As far as Benelux is concerned, the most important customers are located in the Netherlands. The Austrian market is the least important, but customers in this market are predominantly located in areas close to Germany.

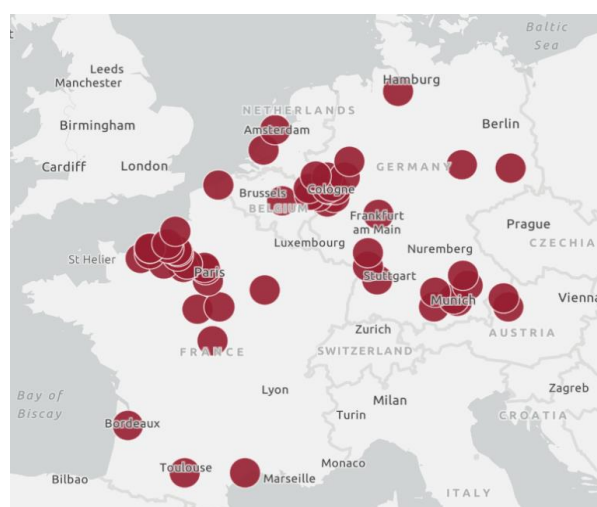


Figure 23 - Customer locations.

Configuration of the distribution chain

The distribution of products to the Central European markets varies depending on the destination country, the order quantity, the client and the producer. The typical configuration is shown in the Figure 24.

It is important to mention that the Portuguese players do not have production units or warehouses in other countries and the only existing infrastructures in the target markets are commercial offices.

Although two players belong to Italian groups, the distribution of the products for the Central European markets is carried out through Portugal and its operation is similar to that of the other players.

The most common distribution operation, using road transport, will be described.

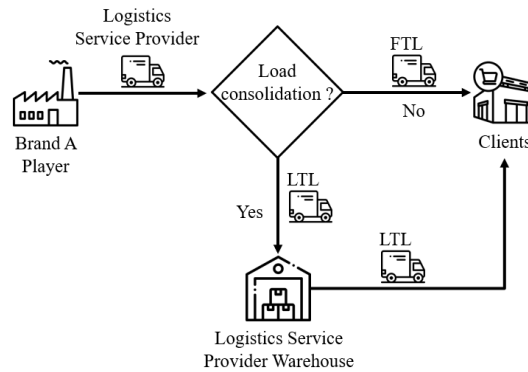


Figure 24 - Brand A Portuguese player's typical distribution chain configuration.

The distribution operation takes place as follows: manufacturers store the finished products in warehouses within their facilities. Subsequently, a transporter collects the same products and, depending on the delivery mode, either goes directly to the retailers or transports the products to its distribution center where it consolidates the loads according to their destination. Finally, after the consolidation the same operator delivers to the clients.

Whether transport is managed by producers or customers, the transport service is outsourced using standard transport firms. Outsourcing turns out to be the only option since neither the production companies nor the customers have fleets of trucks. From the producers' point of view, this solution is very flexible. On the other hand, they lose control of the level of service that is critical to maintain market share in international markets.

Modes of transport and Incoterms

Sub-sector A goods are not only fragile but also heavy which leads to a low optimization of the transport in terms of volume. In this sub-sector, the cost of transport to European markets is relevant as the distance to target markets is significant and the value density (€/ton) of the goods is low.

Transportation of the goods to the Central Europe target markets is done predominantly by road. Although transport by sea has a lower cost and greater capacity, the speed and flexibility of road transport makes it the predominant means of transport. Road transport is the only one that allows to go door-to-door and has a wide geographical coverage. The Incoterm used depends on the customer's requirements but the most common is Ex-Works (EXW). In this case, the customer selects the logistics operator in charge of the transport and the manufacturer's only responsibility is to make the goods available on the defined date.

There are also clients who do not wish to manage transport, and, in these cases, it is the producers who contract it. Since customers still carry the transport costs, there is an effort to obtain the lowest price in order to offer them a more competitive transportation cost. It can therefore be seen that in these cases, producers assign transports individually to their usual carrier so that within a region there are several logistics service providers operating. In this way, each operator only optimizes its subsystem and, despite consolidating loads and optimizing their allocation to vehicles, it is rare that they reach high load factors, thus increasing the cost of shipments.

If the maritime transport were used, it would be necessary to make transshipments and then resort to road transport, which would add additional operations, increasing the cost, the distribution time, and the risk of damage.

Thus, companies only resort to sea when customers do not require short delivery times and want to minimize the total cost. In this case the Incoterm used is Free on Board (FOB) and the seller takes over all costs and risks until the goods have been delivered on board of the ship.

Depending on the size of the orders, shipping is done by FTL or LTL. In cases where the order is large enough, the operators send a full truck directly to the customer. In the case of smaller orders, operators consolidate loads according to destinations and the same truck carries a variety of products. It is then verified that the products of sub-sector A are consolidated with other types of products. With the decrease in the size of the orders more and more the shipments are made in consolidated cargo with about 31,6% of deliveries being made in full-truckload in 2021.

The fact that the main customers are retailers contributes to the significant percentage of incomplete pallets shipped since their orders are more fragmented. In 2021 approximately 56,8% of pallets were shipped as full pallets.

The weight of the pallets is of high relevance for transport. There are two restrictions on the capacity of trucks, weight, and volume. The trucks that are used by the logistics operators can carry a cargo of 24 tons and a volume equivalent to 33 European pallets. In the case of the products of sub-sector A, if full pallets are transported the restriction is always on weight. However, for incomplete pallets the restriction varies, but in most cases, it is weight. Regarding the consolidation of loads with other types of goods, lightweight products are preferred in an effort to optimize the loads in terms of volume.

In order to systematize the information about shipping by truck and full pallet, Table 3 was elaborated with data referring to 2021. It is noteworthy the low percentage of complete trucks sent to France. Although in the other markets the percentage is higher, the large quantity exported to France decreases the total weighted average. Regarding full pallet shipments, there is less discrepancy between countries, with only Benelux standing out with a percentage of 64,1%.

Table 3 - Characteristics of exporting to the target markets.

Markets	FTL %	Full Pallet %
France	25,2%	55,3%
Germany	42,4%	55,3%
Benelux	38,0%	64,1%
Austria	50,6%	49,8%
Total	31,6%	56,8%

Current service level and logistics pain points

As far as the level of service is concerned, it was found that there are differences between the brand A players.

Regarding the average response time of producers (from the time the order is placed until it is ready to be shipped), varies depending on the player in question, the products ordered and the stock levels. If the required stock is available, it can be shipped immediately.

If not, the average response time is 15 days. However, in general, it was found that availability is low, and most of the time customers are presented with an average response time of 15 days.

The distribution time varies depending on the mode of transport used and its terms.

Indeed, when Ex-Works is used, the customer is only informed when the products are ready to be collected and, in this way, there is no visibility of the time it takes for the products to arrive at their destination.

When the players contract the transport, there are 4 scenarios that influence the total lead time or delivery time.

In the scenario where the products are available and the delivery is made by full truck, the distribution time is conditioned by the distance to the customer and the availability of the truck. Usually, the truck is either available on the same day that the products are finished or the following day.

When products are available and delivery is made by LTL, the distribution time is conditioned by the time products wait to be collected at the players' warehouses and also for consolidation at the operators' warehouse. Typically, for France this average extra time is 1 day and for the other target markets it is 3 days. The shipping frequency explains this difference and will be addressed later.

When the products ordered are not available, the average response time of 15 days is added to the previous scenarios.

Table 4 presents the total lead time from when the order is placed until it reaches the respective customer in each of the target markets. The delivery time then varies between 3 and 24 days.

Table 4 – Brand A players current delivery time by target market.

Scenarios	Target Markets			
	France	Germany	Benelux	Austria
Stock Available Full Truck	3 - 4 days	4 - 5 days	4 - 5 days	5 - 6 days
Stock Available Groupage	4 - 5 days	7 - 8 days	7 - 8 days	8 - 9 days
Stock Not Available Full Truck	18 - 19 days	19 - 20 days	19 - 20 days	20 - 21 days
Stock Not Available Groupage	19 - 20 days	22 - 23 days	22 - 23 days	23 - 24 days

There are also some countries which impose restrictions on the movement of lorries, particularly on Sundays and public holidays. Thus, depending on the route, there may even be an increase in distribution time. Appendix B shows the general driving restrictions in each country.

It was also observed that when transport management is the responsibility of the players there is a difficulty in offering customers a competitive price for shipments of less than 3 tons or the equivalent of approximately 3 full pallets. In a context where retailers place smaller and smaller orders and where only 56,8% of the exported quantity is made on full pallets, this difficulty leads to a loss of competitiveness. When the transportation price presented to the customer is high, the customer tends to choose another supplier, and most of the time ordering a larger quantity is not an option. So, it can be concluded that there is currently a cost with lost sales and that often producers are unable to reach more distant customers given the cost of transport.

In shipments in which operators consolidate loads, the delivery frequency is not as high as desirable, which leads to an increase in the distribution lead time.

This happens because there is no distribution of the expeditions over the days of the week, and most of the expeditions take place on Fridays. Thus, what is verified is that, although the orders are ready to be shipped, they wait for transportation in the warehouses of the players. In the shipments to France, it is usual to have shipments in the middle of the week as, due to the strong commercial relations with this market, it is easier to consolidate ceramics with other products. However, for the remaining markets most of the shipments happen on Fridays. This explains why in these markets the products wait an average of 3 days for consolidation.

Finally, customers report that sometimes products are not delivered in the best condition. There are products that arrive broken or boxes that arrive torn. Knowing that the main market segment is retail it is essential to ensure that the products arrive in good condition to the customers and ready to be displayed. This issue of damage is further aggravated when maritime transport is used, not only because of the intrinsic characteristics of the mode but also because of the additional handling steps.

Customers perception

Semi-structured interviews were then conducted with the main clients and area managers of the Portuguese companies. Expectations were then based on the information collected from 10 significant customers.

Regarding the perception of the quality of the products, the customers refer that the Portuguese producers is below that of international competitors, as expected.

Regarding the level of service, customers say that when compared to the international competitors, the brand A producers have lower availability and at the same time a longer delivery time. About damage to products, it was referred that damage is less frequent when working with competitors. In both situations, the cost of transport is always on the customers' side. However, the customers refer that importing from Portugal is more expensive. This extra cost is not only due to the higher distance to the clients but also to the lower utilization of operational synergies in distribution.

Concerning the terms of international trade, it was found that most of the international competitors practice the same conditions, with transport sometimes managed by customers and sometimes by manufacturers. Like the Portuguese, the international competitors have a minimum order quantity of one box.

The most important topic of the survey was the comparison of delivery times. Although customers were not willing to detail the delivery time of competitors, they mentioned that it was significantly lower than that presented by the brand A players. Furthermore, they indicated a desirable delivery time between 3 and 4 days.

Concluding remarks

The current situation assessment met the perspectives of both association A and the brand players. So, the initial strategy of focusing the measures on improving the service level was confirmed.

Faced with the impossibility of competing on price, players have been forced to compete on quality, but it is necessary to work on the image of national brands. In this sense, the improvement in the level of service is intended to increase the Portuguese brands recognition, allowing them to increase the selling prices, and, consequently, the profit margins.

Considering all the context mentioned earlier, it is essential that the best practices and alternatives to be developed are aligned with the players' strategies.

4 Future Distribution System Best Practices and Alternatives

This chapter presents a phased strategy that should allow the brand A players to improve the service level in the Central European target markets. Thus, the assumptions and requirements are presented first. Then the strategy is presented, which contains global recommendations and two scenarios to be implemented in the mid and long-term.

4.1 Assumptions

In order to design and compare the different alternatives of supply systems for brand A products in Central European markets it was necessary to consider some assumptions.

Although increasing the flexibility of the production process would reduce the response lead time, it was considered that this would be constant since it was outside the scope of the project.

By indication of the brand A players, the possibility of acquiring a fleet of trucks was excluded and, in this way, the outsourcing of transport proved to be the only available option. In addition, manufacturers do not intend to build or acquire new plants so for the design of the alternatives the addition of new plants was excluded.

It is known that within the market segments, retailers are the most demanding from a distribution point of view. They require a short delivery time while placing frequent and fragmented orders. Furthermore, it was verified that this segment absorbs a large part of the players' exports and that the logistical pain points identified are mainly related to their demands. Therefore, the alternatives for the future distribution system focused on this segment.

4.2 Requirements

In order to design the different scenarios, it was first necessary to define which requirements they should correspond to. In addition, there was a focus on trying to solve or minimize the pain points associated with the service level.

Regarding delivery time, a target between 3 and 4 days from the time the order is placed until it is delivered to the customer has been established in the direction of meeting customer expectations. In this sense, there is a need to ensure short delivery times and a high frequency. Thus, road will be the preferred mode of transport in all recommendations and scenarios because nowadays and in a mid-term time horizon, this mode of transport proves to be the only one capable of meeting the requirements.

The different scenarios to be presented are also intended to reduce the number of products that are delivered damaged.

Finally, it was intended to keep the minimum order quantity of one box since international competitors take the same approach.

4.3 Proposed strategy

Taking into consideration the current state, not only of the current distribution system but also of the entire offering system, it was considered that to achieve the defined requirements the best approach would be to provide the sub-sector players with a set of solutions to be adopted in a phased manner. Given the low maturity of the sub-sector in terms of physical distribution of the products to the target markets the proposed strategy does not present a high degree of disruption.

Thus, for the design of the high-level scenarios, a phased approach was adopted integrating short (less than 2 years), mid (between 2 and 5 years), and long-term (between 5 and 10 years) solutions, prioritizing initiatives focused on global recommendations and on a centralized transport management, which would allow sustaining later projects of adding elements to the logistics network (Figure 25).

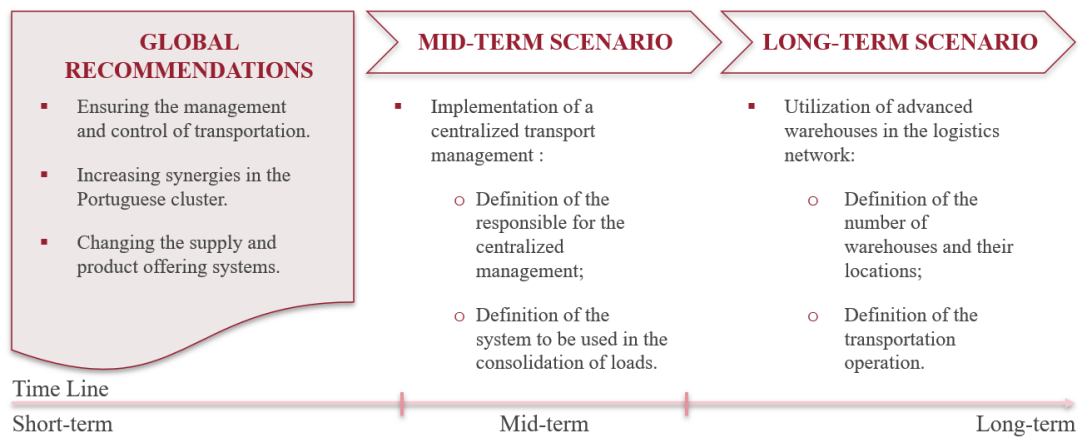


Figure 25 - Proposed strategy.

The following sections will discuss the global recommendations and also the scenarios developed for the mid and long-term as well as the options that exist in each of them.

4.4 Global recommendations

The global recommendations correspond to the actions that the players should implement in the short-term in order to improve the service level. The takeover of the transport operation by the brand A players and the increased synergies between them were then addressed. Finally, the supply and product offering systems were also approached.

The heterogeneity of practices at the level of supply models led to the development of these global recommendations with the goal of placing the players on a level that would allow the implementation of more complex scenarios.

4.4.1 Ensuring the management and control of transportation

In chapter 3, it was noted that the most used commercial term (Incoterm) when exporting to target markets is Ex-Works.

Although this Incoterm exempts the producer's responsibilities, its use does not benefit them. It can be verified that when it is used, there is a loss of control over the transport operation and consequently of the end-to-end service level. Although in this situation customers outsource transportation, they report that for groupage shipments, the costs are high due to low optimization, and, in addition, there is dissatisfaction about the condition of the products and also about the failure to meet the established delivery deadlines.

In order to ensure a shorter distribution time and a minimization of the number of products that are delivered damaged, it is recommended that players ensure the control of transportation by using the Delivered Duty Paid (DDP) Incoterm. This would also allow them to measure the service level and the performance of the entire distribution operation.

In this sense the players should establish service level metrics such as delivery speed, availability of stock and percentage of damaged products. For each of the defined metrics it would be necessary to set goals. Additionally, companies must monitor the evolution of these indicators and take actions in order to achieve the established goals.

Since international competitors present their products on the market with a price that does not include transport, it would be convenient to follow the same approach. Thus, the products would be presented with a price that excluded the cost of transport and a price would then be presented to the customer depending on distance and quantity. So, the Incoterm to be used would be a customized DDP and as stated earlier, with some of the customers it is already in use.

Once the players have secured control of the transport, they should reduce the number of logistic operators used to establish partnerships in order to build a relationship of trust. Secondly, service-level agreements (SLAs) must be established. These SLAs would oblige operators to comply with a previously agreed service level allowing expectations to be aligned. Within the agreed service level, criteria such as distribution time and delivery quality can be defined.

In this sense, it would be possible to penalize those who perform below what was agreed and reward those who perform above what was agreed. Similarly, by tracking the performance of the various partners it would be possible to allocate the loads to those who perform better.

Regarding the condition of the products delivered, there are also other measures that can be applied by the players. Firstly, it is important that players establish a quality control over the packaging of the shipped pallets. The correct pallet wrapping plays a fundamental role in the condition of the products, especially in incomplete pallets. In these cases, it is important to guarantee not only the correct wrapping but also the layout of the products on the pallet. The way products are arranged on pallets directly influences the occurrence of damage, so players have to ensure that the arrangement does not put the products at risk while maximizing pallet utilization.

Finally, it would be important to understand with the logistics operators whether the current packaging is adequate or whether any changes need to be made to provide greater protection for the products.

4.4.2 Increased synergies in the Portuguese cluster

Although the Portuguese sub-sector A is organized in the form of a cluster, the players do not make use of synergies in distribution to international markets. Meanwhile, international competitors, namely, Spanish, and Italian, take advantage of their organization in the form of cluster and use synergies, namely related to storage and transportation.

In order to optimize the distribution of products to the target markets, it is recommended that players collaborate horizontally. As things stand, for groupage shipments, companies assign transports individually to their usual operator and, within the same region, there are several logistics service providers operating. Thus, each operator performs a specific optimization of its subsystem, so operators have difficulties in obtaining high load factors.

Such inefficiencies result in increased waiting time and multiple handling of products, which in the case of fragile products like ceramics increases the likelihood of damage. In addition, the transportation costs charged by the operators are high (Leitner et al, 2011).

Increasing the synergies between the various brand A players would allow costs to be shared. In this sense, producers should be available to share resources, namely a transport and storage logistics operator.

Additionally, considering the volume exported, the consolidation of loads between players would allow the creation of new distribution routes reducing the price associated with transportation and increasing the delivery frequency which would contribute to the decrease of the distribution time. The fragmentation of orders and the distance to target markets justifies the need to follow this approach.

In an ideal scenario, Portuguese producers should go further and not just take advantage of operational synergies. Like their Spanish and Italian competitors, they should work on a collaborative basis recognizing that their competitors are outside their group (Figure 26). For the brand A players to gain a competitive advantage, work must be done to improve the image of the cluster and, consequently, enhance the value of the brands operating in it. A cluster with a good reputation and visibility attracts new customers thus benefiting all players. Finally, if Portuguese producers were able to share knowledge, best practices would spread faster as well as the adoption of new technologies.



Figure 26 - Sub-sector A European clusters.

4.4.3 Supply and product offering systems

Recalling the information in Table 4, it is clear that in the current situation it is not possible to meet the delivery speed expectations of customers. Thus, given the need to decrease the response time and increase the frequency it is mandatory to change the current strategy.

When purchasing products, customers choose from a catalogue and, in this way, it can be seen that customization only exists in rare situations. In the same way, the average product life cycle of 3 years allows for some stability in the offer. In the current situation, in the catalogs presented there is no reference to the delivery time or availability associated with each of the articles.

Due to the existence of trends, in the range of products offered by the producers, there are some that are more popular, which means their sales volume is higher, as well as their order frequency (fast movers). It is essential, then, that each of the producers first define what their most popular products are. Typically, the ABC XYZ matrix is used for this decision, since it allows one to consider not only the sales volume but also the uncertainty of demand (Thieuleux, 2023). Players should conduct this analysis taking into account orders from customers located in the target markets. This segmentation is important as trends vary from region to region.

These more popular products are often referred to as high rotation and are recommended to follow the make-to-stock strategy in order to be able to ensure more demanding service levels, namely short delivery times.

In order to provide the best level of service, this strategy would be applied to all products. However, this solution would substantially increase the costs related to warehousing and holding inventory. Thus, this strategy was not considered, and the recommendation is to adopt different strategies for the supply system depending on product rotation (Figure 27).

The communication regarding the availability of each reference is then intended to be more transparent to the customer, namely, include in the catalogs themselves what is the delivery time offered for each of the products.

The market must be aware that the players will offer products with fast delivery and products with longer delivery. So, for the most popular items (fast movers) the strategy to use would be make-to-stock in order to guarantee a very short delivery time. As the products would be ready to be shipped, naturally the delivery speed would be higher.

Knowing the risks and costs associated with the make-to-stock approach, this was the recommendation, since customer expectations associated with delivery time do not allow for another approach in a production process with such reduced flexibility.

Properly executed, this strategy would allow for increased product availability and better use of economies of scale. Associated with this paradigm shift are some risks such as inventory obsolescence. Similarly, there will be an increase in the warehousing and inventory holding costs.

Additionally, if players had good demand forecasting models at their disposal, it would be possible to better optimize production planning. It would also be necessary to ensure that proper inventory management policies are adopted.

For products with a lower rotation (slow movers), demand forecasting becomes more complex, and the risk of obsolescence is higher. So, for those products that are less on-trend, it was recommended to use the make-to-order approach.

In addition, it was recommended that producers establish supply contracts with their customers. The supply contract would be an agreement between the producers and the clients in which there is a commitment to purchase a certain quantity of each item at a certain price within a set time interval (Khan et al, 2016).

In this sense, predefined stock levels would be guaranteed, and replenishment would be done based on the actual demand. Thus, even for less popular products it would be possible for the players to present a quick delivery. In this way, producers could hold stock of the items contained in the agreements and at the same time significantly reduce the risks associated with holding it.

With the clients unavailable to make the agreements, in orders for less popular products, they would have to accept a longer delivery time.

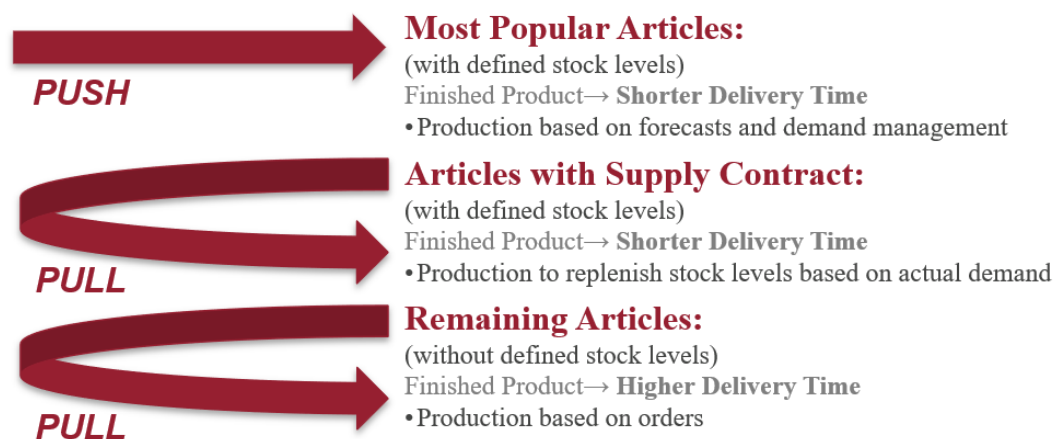


Figure 27 – Proposed supply system.

4.4.4 Concluding remarks

The recommendations that the players should follow in the short-term were then presented (Figure 28).

Thus, if they are able to guarantee control of transport and take advantage of synergies it will be possible not only to measure and control the level of service but also to share costs by offering customers more competitive prices for transport. In addition, some actions were also recommended that would mitigate the number of products damaged during transportation.

The revision of the supply and offering system and its subsequent transparent communication to customers through catalogs primarily ensures a shorter response time and greater availability for popular or contract items. Additionally, visibility is also increased over the level of service offered.

SUMMARY OF THE GLOBAL RECOMMENDATIONS	
	▪ Ensuring the management and control of transportation using the DDP Incoterm and keeping the cost the customer's responsibility; ▪ Establishing and monitoring service level metrics. For each indicator set goals and actions to achieve them; ▪ Reducing the number of logistics operators in use and establishing partnerships; ▪ Establishing service-level agreements (SLAs) with the logistics operators; ▪ Monitor the performance of the logistics operators and allocate loads to those showing the best performance; ▪ Establishment of quality control over pallet packaging and article arrangement; ▪ Maximization of pallet utilization; ▪ Study the possibility of changing the packaging in order to provide greater protection for the items; ▪ Increase the use of synergies between players in distribution to target markets; ▪ Define actions to improve the cluster's image; ▪ Increase collaboration between players to accelerate the diffusion of best practices and new technologies; ▪ Increase transparency regarding product availability by including the delivery time associated with each item in the catalogs; ▪ Using the make-to-stock philosophy for the most popular items (fast movers); ▪ Use the make-to-order philosophy for non-popular items (slow movers); ▪ Establishment of supply contracts with customers; ▪ Use of demand forecasting models and optimize the stock management.

Figure 28 - Summary of the global recommendations.

4.5 Mid-term scenario

In the mid-term scenario it was proposed to implement a centralized transport management, which should be carried out after the global recommendations presented earlier. Although the recommendations would allow for an improvement in the level of service, this mid-term scenario would make possible to present an even better service.

It was therefore recommended that a central transportation management should be created that would act as a control tower centralizing the transportation requests of the various players.

Thus, this control tower would be in charge of organizing orders and optimizing the allocation of loads, allowing to increase the load factor of the trucks and the delivery frequency, reducing the distribution time and the price of transportation. Although the improvements associated with this scenario are more related to shipments where there is a consolidation of loads, full truck deliveries would also be benefited since with the exported volumes it would be possible to obtain more competitive prices due to quantity discounts.

It would also be possible to practice a transport modality called shared-truckload (STL) in which the players would rent a full truck together and share the space inside, each paying for the capacity they use. When compared to LTL, STL is cheaper and faster.

It is cheaper as logistics operators charge less for the full truck rental and faster as the time the ceramic products wait for consolidation with other types of products would be eliminated, once the quantity exported to the markets is sufficient to ensure daily shipments and there is no need to consolidate ceramics with other types of products. It would also reduce the number of steps involved in handling the products, thus minimizing the occurrence of damage.

Next, the options designed for the management of the transport central and also for cargo consolidation will be presented.

4.5.1 Definition of the responsible for the management

Regarding the management of the transport control tower, two options were considered (Figure 29):

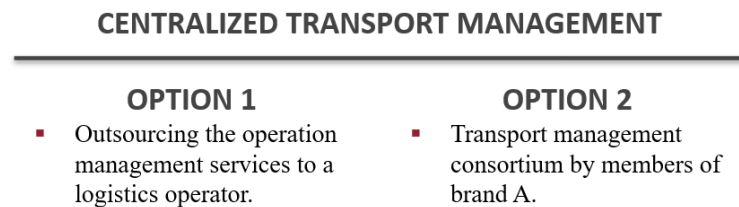


Figure 29 - Centralized transport management options.

Option 1 would be to select just one logistics operator to manage all the transport needs. By establishing a strong partnership, it would be possible for the same operator to specialize in the transportation of the ceramic products, which would also reduce the occurrence of damage during transportation.

In opposition, selecting the second option, the management would be in charge of a team selected by the brand A players which would allow to have more control over the entire operation.

In this case, the recommendation is to outsource this management by selecting a logistics operator as partner. Thus, in addition to ensuring greater exemption, it is possible to assume that being a specialist, the partner would be able to manage more efficiently and provide a higher level of service.

4.5.2 Definition of the system to be used in the consolidation of loads

In chapter 3 it was reinforced that given the fragmentation of orders, most of the loads sent to customers are consolidated. In this mid-term scenario, it was considered that there would be a consolidation of loads only among the players of brand A and, for the realization of this operation, two options were considered (Figure 30):



Figure 30 - Load consolidation system options.

Thus, the consolidation would be done through the milk run system (option 1) or using a logistics platform in Portugal (option 2).

In the milk run system, players would pass on their transportation needs to the control tower and, after cargo allocation, the truck would follow a fixed distribution route, and collect the products from a defined number of players (Figure 31).

Thus, each one of the players would receive from the central management the products' collection schedule, and at the defined time the articles would have to be ready to be loaded, without any delays. Although economical and efficient, given the need for high synchronization, this solution presents a high implementation difficulty and would be demanding for players.

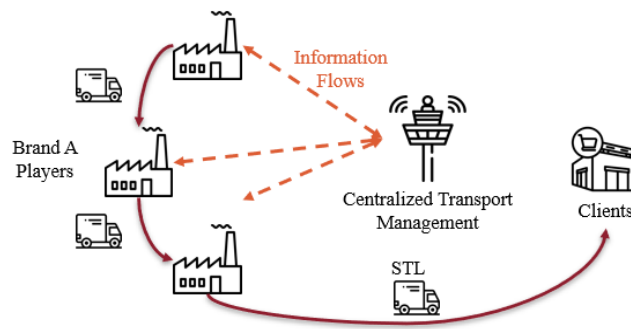


Figure 31 - Milk run system.

The second option would be to use a logistics platform for groupage (Figure 32). Again, this platform could be outsourced to the same logistics operator responsible for central transport management. Alternatively, it would be possible to rent or build the platform and manage it through a consortium of the brand A players. Given the demands of the operation, it was considered that this platform would be outsourced to the logistics operator responsible for the centralized management of the transport.

In this case, the players would pass on the transportation needs first. Then the tower would organize a full truck transport in order to transfer the products from the manufacturers' facilities to the logistics platform where the products would finally be consolidated and shipped to the customers.

As for the location of the logistics platform, it would be necessary to analyze several options and choose the most economical one. This would be a complex decision, and it would be necessary to analyze the inbound and outbound transportation routes, the availability of space and respective accesses, and also the distance to producers. This decision would be made in conjunction with the logistics operator selected to manage the operation. However, considering the distribution of the manufacturers and their business volumes (Figure 22), the Aveiro region should be a candidate for the location of the warehouse.

As for storage capacity, it is not intended to be large in order to minimize the warehousing costs. However, it is also not intended to be just a pure cross docking operation where there is little or no storage space between unloading and loading (Van Belle et al, 2012).

Thus, there must be some storage area in order to decrease the difficulty of execution. Logically, the closer to the pure cross docking operation the higher the exigency for the players.

Since the operator would charge a price per moving unit it would be possible to keep the operating costs on the customer's side and included in the transport cost presented. In this alternative, the operational costs of the platform may compromise the gains related to the use of the STL. Thus, facing the short-term scenario, there is the possibility that customers will have to pay more for distribution of the products. However, the level of service would always be higher when compared to the short-term scenario.

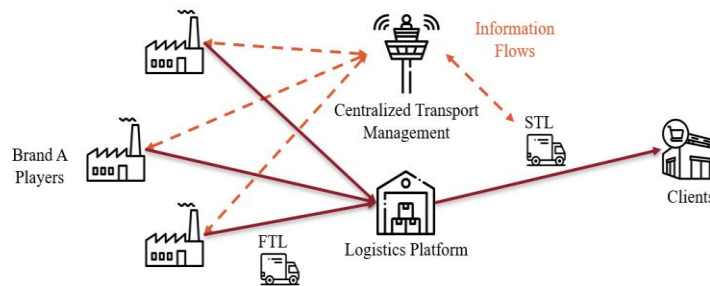


Figure 32 - Utilization of a logistics platform for groupage.

Comparing the two options, the first is more difficult to execute, but at the same time is more efficient and requires less handling, which minimizes damage to the products. In the second option, operational costs would be added, namely the costs associated with the entire platform operation.

The advantages and disadvantages associated with each of the options have been summarized in Table 5.

Table 5 - Load consolidation systems advantages and disadvantages.

OPTION 1 Milk Run System	OPTION 2 Logistics Platform
ADVANTAGES	
- Higher efficiency; - Lower operational costs; - Lower handling of products.	- Easier implementation and execution; - No need for high synchronization.
DISADVANTAGES	
- Higher difficulty of execution; - High synchronization requirement.	- Higher operational costs; - Adds handling steps, increasing the likelihood of product damage.

Compared to the first option, the second one adds costs and, at the same time, does not allow to provide a better service to customers.

Although the distribution costs are charged to the customers, naturally, if the price offered by the players is lower, the products become more competitive.

In this mid-term scenario, the logistics platform option was introduced only to provide players with a less demanding solution, and in the other qualitative criteria, the milk run system is always preferable.

So, if the players are ready to execute the milk run collection system, this should be the preferred option. If this maturity doesn't exist, the alternatives are to invest to increase the competencies or to go for option 2, which is easier to implement and execute.

4.5.3 Concluding remarks

It can then be seen that this scenario is intended to assist the exploitation of synergies in transportation to the target markets. Thus, and although there would be gains in full-truckload shipments, the greatest gains associated with the implementation of this scenario would be associated with cases in which loads are consolidated.

Regarding the cost of transportation, although it has not been quantified, it is expected that if players choose the milk run system, it will be possible to offer customers a more competitive price since for the STL mode once the price charged by operators is significantly cheaper when compared to LTL.

However, the most significant gain associated with this scenario would be in the increased frequency of shipping to the target markets. Taking into account the volumes exported to each of the markets, and assuming correct optimization of cargo allocation it would be reasonable to assume daily shipments to France, Germany and Benelux while for the regions of Austria furthest from Germany we could assume shipments every 2 days.

So, for the markets of France, Germany and Benelux, for popular articles and articles with supply contracts and assuming they would always be ready to be shipped, the delivery time would be equivalent to the travel time which is between 3 and 4 days for France and between 4 and 5 days for Germany and Benelux. For these same products, for the Austrian market, the trip would take between 5 and 6 days, and in case of cargo consolidation an additional day should be added, since it was assumed that there would be shipments every 2 days. For the remaining items, in addition to the travel time it was also necessary to consider the response lead time obtained in chapter 3 and equivalent to 15 days.

Table 6 shows the estimated delivery times associated with each market, transportation mode, and item.

Table 6 - Estimated delivery time after mid-term scenario implementation.

	Target Markets			
	France	Germany	Benelux	Austria
FTL Popular Articles and Articles with Supply Contract	3 - 4 days	4 - 5 days	4 - 5 days	5 - 6 days
STL Popular Articles and Articles with Supply Contract	3 - 4 days	4 - 5 days	4 - 5 days	6 - 7 days
FTL Remaining Articles	18 - 19 days	19 - 20 days	19 - 20 days	20 - 21 days
STL Remaining Articles	18 - 19 days	19 - 20 days	19 - 20 days	21 - 22 days

So, within this scenario, by choosing option 1 or 2 it will always be possible to present a lower delivery time to customers. Additionally, given the possibility of specialization of the selected operator there is the possibility of minimizing the occurrence of damage to products during distribution.

4.6 Long-term scenario

In the long-term scenario, the utilization of advanced warehouses was proposed, and this should be realized after the implementation of centralized transport management. This scenario was designed to provide customers with a superior service level, namely a very short delivery time. For very high requirements regarding delivery time, the only option to counter the distance to the customers is to move stock to one or more locations close to the customers.

These advanced warehouses could be outsourced to a logistics operator. Alternatively, it would be possible to rent or build the platforms and manage it through a consortium of the brand A players.

Given the complexity of the operation, it was considered that this platform would be outsourced. Thus, in addition to guaranteeing exemption and data protection, it would be possible to reduce the difficulty of executing the scenario and, assuming that the partner would be a specialist, a better level of service would be guaranteed.

The choice of the logistics partner is of high importance and cannot only be based on cost criteria.

Reliability, experience, know-how and quality of service should weigh at the moment of decision. It is intended that this operator performs all warehousing operations, including picking. There must then be a guarantee of qualification by the company responsible for the entire management.

If the operator responsible for centralized transport management is able to provide this type of service with the desired quality, this should be the first option, thus avoiding synchronization problems. If it doesn't have this capacity, the operators would have to collaborate.

The costs associated with warehousing and inbound transportation to the advanced warehouses would have to be carried by the costumers. If they want to benefit from the level of service that the scenario allows, they must be prepared to pay for this differentiating service and not just for the product itself. Thus, it can be seen that the implementation of the scenario would allow the players to start selling to their customers not only the products but also the service provided. By providing a very short delivery time it would be possible to gain a competitive advantage through the differentiation strategy.

As for stock management, each player, would be responsible for advancing the desired references in the desired quantities. Naturally, the tendency is to place in advanced warehouses the most popular products that are made to stock. Additionally, for customers with supply agreements it would also be possible to present them with the option of advancing the stock providing a shorter delivery time. However, when compared to the option of keeping the products in Portugal, the decision of having the stock advanced would be more expensive for the customer.

Depending on the use of the warehouses by each of the players, the logistics operator responsible would charge an individual price. One of the requirements for this implementation is that there must be visibility along the chain, in other words, the operator responsible for the storage operation must transmit to the players the stock levels associated with each reference and production lot.

Thus, it is also necessary that there is a frequent exchange of information between the advanced warehouse and the central transportation management, since the warehouse needs information about product collection times and the respective allocation of loads, and that in these warehouses there would also exist the hypothesis to consolidate loads between different manufacturers to ensure a high delivery frequency.

In each of the options for estimating delivery time for products with advanced stock it was considered that it would be possible to deliver on a daily basis to all target markets.

4.6.1 Definition of the number of warehouses and their locations

Regarding the number of warehouses and their locations, 3 options were considered (Figure 33). The first option would be to centralize the advanced stock, the second option would be more decentralized placing items in each of the target markets and the third option would be more opportunistic placing stock within the clusters of the largest competitors.

Since the objective of this project was not to design the logistics network and consider the cost structure associated with each of the alternatives, it was decided to present qualitative advantages and disadvantages for each of the options raised.



Figure 33 - Number of warehouses and their locations options.

Option 1 – Central warehouse

In this option only one advanced warehouse would be added to the logistics network with the objective of centralizing the stock. Compared to a more decentralized option, this option allows greater advantage to be taken of economies of scale and, at the same time, higher potential for cargo consolidation. Concentrating inventory in just one advanced point would allow for a higher inventory turnover rate as well as providing a consistent level of service in the Central European target markets.

To define the best location for this warehouse, a careful quantitative analysis would be required, however, the northeastern region of France should be a candidate as the French market absorbed 74% of the quantity exported to the target markets in 2021. In addition, placing the warehouse in the northeastern region would also allow it to be closer to the remaining target markets.

If this location was selected, it was estimated that for items with advanced stock, it would be possible to deliver to the French market in a time interval of less than 24 hours, and to the further away customers in the target markets in a time interval of less than 48 hours.

Option 2 – One warehouse in each of the target markets

In this option, 4 warehouses would be added to the logistics network, 1 in each target market. To define the location of each of these warehouses it would once again be necessary to perform a careful quantitative analysis.

Compared to the previous more centralized option, this one would offer customers a shorter delivery time, expected to be less than 24 hours. However, there would be less potential to take advantage of economies of scale and to optimize load consolidation. In addition, the difficulty of execution is higher since it would be more challenging for players to manage advanced inventory at multiple points.

It is also important to mention that this more decentralized option was raised not because there is a need for customization in each market or to use local labeling or packaging but because it provides a very short delivery time.

Option 3 – Warehouses in the competitors clusters

This option is more opportunistic and could add to the logistics network 1 or 2 warehouses within the competitors' clusters, namely in Sassuolo in Italy's Emilia-Romagna region and in Castellon in Spain's Valencia region.

This placement would make it possible to use the transportation routes of the competitors that are concentrated in these regions.

Given the greater affluence of goods from these clusters, it was assumed that it would be possible to obtain a more competitive price for transportation to the target markets increasing the competitiveness of Portuguese products.

When compared to the other options, the total distance traveled by the products would be greater what can increase the global distribution costs. So, in this option it will be very important to explore what are the gains in terms of transportation cost for using competitors' routes and also to understand what the additional cost of placing the products in the advanced warehouses is.

In this option the estimate for delivery time of products with advanced stock is less than 96 hours from Spain and less than 72 hours from Italy. So, for these items it would be possible to meet customer expectations in delivery time, but it remains to be seen at what cost.

4.6.2 Definition of the transportation operation

It was also important to analyze the organization of all transportation from the time the products leave the factories until they reach the customers.

As far as items that do not go to the advanced warehouses are concerned, the recommendation is that they go directly to the customer whether they are shipped by full-truckload or whether it is necessary to consolidate the loads. And, in the latter case, this consolidation could be done by the two options presented earlier, either by the milk run system or by using a logistic platform.

For shipments to the warehouses, it is possible to use both road and sea transportation, but in order to perform this optimization it is necessary to analyze the costs carefully, since although the ship is cheaper, given the longer distribution time, the amount of stock to be stored has to be higher, and therefore this cost trade off must be analyzed.

Consolidation of loads is still possible for both shipments to warehouses and shipments to customers. Thus, the control tower proves to play a decisive role for both full-truckload and consolidated load shipments whether they are made from the players' facilities or from the advanced warehouses.

Figure 34 shows how the transport operation would work.

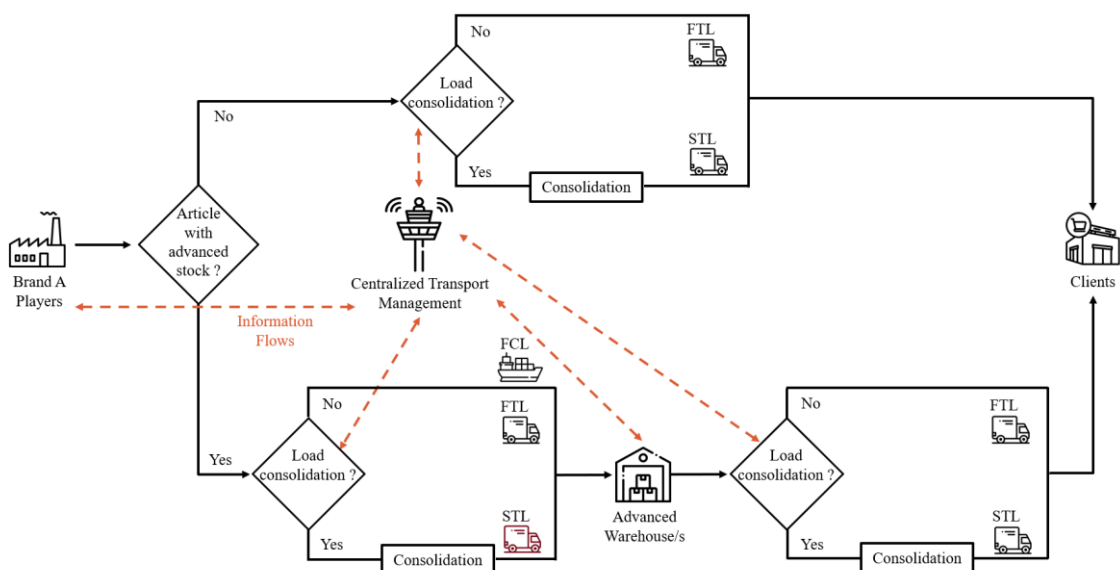


Figure 34 - Transportation operation.

4.6.3 Concluding remarks

It can then be verified that this long-term scenario is intended for players to offer customers an even shorter delivery time. Thus, it is intended that in the long-term manufacturers start selling not only the products but also the service provided.

Faced with this situation, three options and their respective advantages and disadvantages were raised. Next, a comparative analysis of the 3 options raised will be performed, taking only qualitative criteria into consideration (Table 7).

Table 7 - Advantages and disadvantages associated with each option.

OPTION 1 Central warehouse	OPTION 2 One warehouse in each of the target markets	OPTION 3 Warehouses in the competitors clusters
ADVANTAGES		
Compared to a more decentralized option: - Economies of scale; - Lower investment in infrastructure; - Higher potential for load consolidation optimization; - Less complexity of stock management; - Savings regarding safety stock; - Higher stock rotation.	Compared to a more centralized option: - Higher proximity to customers; - Very fast delivery time.	Use of the intense logistics flows that already exist in competing countries that can translate into a more competitive delivery price and better service level.
DISADVANTAGES		
Compared to a more decentralized option: Longer delivery time.	Compared to a more centralized option: - Higher investment in infrastructure; - Lower potential for load consolidation; - Managing stocks in several locations adds complexity to the operation; - Lower stock rotation.	- Longer delivery time; - Greater distance travelled by the products what can jeopardize the gains from using competitors' routes; - Strategic difficulty of execution due to political and competitive issues.
ESTIMATED DELIVERY TIME		
Less than 48 hours for products with advanced stock.	Less than 24 hours for products with advanced stock.	Less than 96 hours from Spain and less than 72 hours from Italy for products with advanced stock.

Although there are references to economies of scale and gains from using competitors' routes, it is not possible to say which option would be more economical for the customer. This requires a thorough analysis and optimization of each scenario. Certainly, this analysis will have to be done in a future project in order to help the decision to be taken by the players.

In terms of handling steps, the 3 options are similar, so it is not expected that there will be any differences in the condition of the delivered products.

In the previous table, a special emphasis was placed on the delivery time. It was clear that the option with more warehouses (option 2) would be the fastest and option 3 would be the slowest.

According to the assumptions considered, the 3 options are expected to meet the customers' expectations regarding delivery time. However, options 1 and 2 would allow brand A players to differentiate themselves even further. Thus, the decision of the option will not only take into account the quantitative analysis to be performed, but also the strategic plan for the future of Portuguese companies.

5 Conclusions and Perspectives for Future Work

The association representing the ceramics sub-sector A companies in Portugal has identified a loss of competitiveness in Central European markets for these companies in comparison with the international competitors. This loss of competitiveness was linked to logistical difficulties in distributing the products in the target markets. In this way, the association hired INEGI's industrial engineering and management consultancy services to develop a project. The objective of this work was not only to identify the best practices and different alternatives for the future distribution system in order to improve the service level, but also to carry out a survey of the current distribution operation and to identify the main competitors.

In this regard, the overall export context of the products of the ceramics sub-sector was analyzed first. Thus, Portugal was identified as being the eighth largest exporter worldwide of this type of products, and it was concluded that, effectively, the markets that belonged to the scope of the project were of very high importance, and that the player's main customers were included in them.

Next, and directly meeting one of the project's objectives, a selection of the competitors of the Portuguese players was made, and then Italian, Spanish and German producers were identified. Thus, it was possible to describe the competitors' context and to benchmark it with the Portuguese one. It was concluded that the Italian and German competitors have a higher average selling price and present products with higher quality in the market, while the Spanish competitors have lower average sales prices. The positioning of Portuguese producers is less clear since there is no possibility of increasing the sales price due to low brand recognition and also it is not possible to lead by cost due to the high price of production factors, namely electricity and natural gas.

Still in the problem definition stage, the specific current situation of the players of brand A was surveyed. It was perceived that, just like their competitors, Portuguese players are organized into a cluster, but do not take advantage of synergies in the distribution of products.

Logistical characteristics of the operations were identified and the increase in complexity, the change in product formats, the load units used, and the operating philosophy of the supply chain were then addressed. So, according to the assessment conducted, the players production planning is done taking into account two inputs which are the customers' orders and the stock levels. Thus, supply chains operate according to both push and pull strategies. However, in general, it was found that product availability is low, and most of the time customers are presented with an average response time of 15 days.

Regarding the distribution operation, it was identified that the customers were mainly retailers. It was also essential to identify the typical configuration of the distribution chain, and it was identified that, most of the time the customer manages the transport and producers lose control of the operation and the level of service. As for the cost of the same, it is always on the client's side.

Subsequently, the current level of service that is presented to the players was measured and, what was taken away is that delivery time is dependent on several variables but almost always unable to meet customer expectations.

This is because the delivery frequency is low given the lack of collaboration between players. Similarly, customers report that there are often products that are delivered damaged.

When questioned, customers mentioned that the quality of Portuguese products is lower than that of international competitors and that availability is lower and delivery time is longer. Regarding transport, even when working with competitors, customers always carry the cost, but there is a reference that importing from Portugal is more expensive. However, this extra cost is not only due to the higher distance but also to the lower utilization of operational synergies. From the assessment carried out with the customers, a desirable total delivery time of between 3 and 4 days was also obtained.

After validation with the association and players of the current situation, different alternatives were designed for the distribution of products having as main input the improvement of the service level.

Given the current state of the distribution and offering systems, it was considered that the best approach would be to propose a set of solutions to be adopted in a phased manner. Thus, solutions to be implemented in the short, mid, and long-term were presented.

In the short-term it was decided to make global recommendations. In order for players to be able to measure and improve the service level it was recommended that they take control of the transport but at the same time keep the cost the customer's responsibility.

In addition, it is intended that the players take advantage of their organization in the form of a cluster and take advantage of synergies in distribution. Ideally, there would be many benefits if companies worked on a collaborative basis, improving the image of the cluster and enhancing the value of the brands in it.

The last recommendation was that there should be increased transparency about the delivery time associated with each of the products. In addition, it was recommended that for the most popular items the approach should be make-to-stock and for the less popular items the make-to-order approach should be followed. Additionally, supply contracts with the clients could be established.

The mid-term scenario aims to add a central transportation management with the goal of decreasing distribution time and associated cost.

Thus, to carry out the management of this control tower, two options were raised being the first subcontracting and the second a consortium between the brand A players. In this case, the recommendation was for outsourcing in order to obtain greater efficiency and exemption.

For the system to be used in the consolidation of loads, two options were considered, the first being the use of a milk run system and the second the use of a logistics platform. It was concluded that although the first option would be more economical and efficient, it would be more demanding on the manufacturers. The second option would be easier to execute but more costly, while adding handling steps. If players are prepared for the milk run collection system, this should be their choice, but if they want a less demanding option, they should go for the second one. In both situations, the total delivery time would be similar, and for popular or contract supply products it would be between 3 and 7 days depending on the distance to the customer. Thus, it would not be possible to fully meet customer expectations and therefore a long-term scenario was presented.

In order to provide an even shorter delivery time, the long-term scenario adds advanced warehouses closer to the customers to reduce the distance to the customers.

The recommendation made was to outsource these operations and keep the stock management on the producers' side. However, it was pointed out that the items to be moved forward should be the most popular and those whose customers with a supply contract wanted.

The implementation of this scenario implies a paradigm shift since the players, instead of just selling their products, would also sell the service. Indeed, if customers want a very high level of service, they must be prepared to cover additional costs.

Regarding the number of warehouses and their locations, 3 options were raised and for each one of them the advantages and disadvantages were analyzed. The first option raised was to use a central warehouse, the second was to use a warehouse in each of the target markets, and the third option was to use warehouses within the competitors' clusters.

Although the qualitative analysis greatly aids the players' decision, it is not enough. Thus, for the final decision, it is necessary to conduct a thorough analysis of the costs and benefits of each of the options, and especially to understand what the long-term strategic plan of the brand A players is, and what service they want to provide.

Of the issues addressed, the most challenging will indeed be to get the players to collaborate and to share the transportation and warehousing. Although there is a consensus about the need to serve customers better, only the implementation of the proposed strategy will be able to confirm the commitment of each of the players.

Customers have shown willingness to compromise on transport control but demand that production companies commit to a certain level of service.

This project was only the first step towards improving the service level in the Central European target markets. As future work it will be necessary to explore the options raised for the long-term scenarios being directly related to the design of the logistics network.

Thus, in order to compare the various options, it is necessary to consider complex trade-offs. The different cost components interact with each other, so it is necessary to understand how they interact and what impact the number and location of warehouses has. The costs that must be considered when designing this logistics network are the primary transportation cost, the secondary transportation cost, the storage cost, and the inventory holding cost.

Since the recommendations were to outsource the distribution operation, it will be necessary to conduct a thorough survey of logistics operators and the services they offer. In order to choose an operator, it is not only the costs that must be taken into consideration, but for a given level of service it is pretended to obtain the lowest price for the customer, and in order to obtain the prices for the services provided, it will be necessary to provide various information to the operators.

So, it will be necessary to do a complete analysis of customers. In this regard, it is necessary to collect the locations of all customers and, in addition, to collect the quantities ordered and their frequency. Later, it will be necessary to build some typical distribution routes. Regarding the costs of warehousing and keeping inventory, it is necessary to raise with the players which references they want to advance and in what quantities. The quality of the data to be collected is essential to ensure that the best solution is selected.

In an even more distant scenario and after using advanced warehouses, manufacturers should study the technical feasibility of implementing time postponement for the less popular items with no supply contract. In this way, it would be possible to present faster delivery of these products. By having a point with intermediate stock, the response reaction would naturally be faster with the assumption that the subsequent processes would be fast and flexible. In this sense, it would also be necessary for producers to make investments not only to make the production process more flexible, but also to adapt to customers, especially in the increasing demand for large formats.

Throughout the work it was found that, in general, producers are insufficiently prepared for the demands of retailers, both in terms of quantities and delivery times. They have not been able to make the transition from working with wholesalers and constructors to the fragmented and frequent orders from retailers.

It is then necessary for players to recognize the importance of supply chain management. In addition, improving the service level would reduce the cost of lost sales. There needs to be a paradigm shift and companies need to start selling not only the product but also the service provided to the customers.

Thus, the continuation of this project and implementation of the proposed strategy is essential to increase the competitiveness of brand A products in international markets. The level of service that can be expected after the implementation of the scenarios should allow national companies to become more competitive and allow for the creation of more value.

Once again, companies must not forget the importance of logistics in the success of their business, given that in current trends, the service level is one of the main sources of differentiation.

References

- Adenso-Díaz, B., S. Lozano and P. Moreno (2016). "How the environmental impact affects the design of logistics networks based on cost minimization." Transportation Research Part D: Transport and Environment **48**: 214-224.
- Carvalho, J. C., Alcibíades Paulo Guedes, Ana Lúcia Martins, Ana Paula Barbosa Póvoa, C. A. Luís, Eurico Brilhante Dias, João Carlos Quaresma Dias, João C. Rosmanninho de Menezes, Luís Miguel Domingos Fernandes Ferreira, Maria do Sameiro Carvalho, Rui Carvalho Oliveira, Susana Garrido Azevedo and T. Ramos (2020). Logística e Gestão da Cadeia de Abastecimento.
- Christopher, M. and a. O. R. M. C. Safari (2010). Logistics and Supply Chain Management, 4th Edition, Pearson Business.
- Comtrade, U. (2023). Trade Data.
- CSCMP. (2023). "CSCMP Supply Chain Management Definitions and Glossary." Retrieved 17/02/23, 2023, from CSCMP Supply Chain Management Definitions and Glossary.
- FAQ-Logistique. (2013). "Current State of the 3PL Market Shippers Reflect Continued Confidence with Use of 3PL Services." Retrieved 17/02/23, 2023, from <https://www.faq-logistique.com/CAP-GEMINI-3PL-02-Current-State.htm>.
- Fernando, J. (2022). "What Is a Distribution Channel in Business and How Does It Work?" Retrieved 17/02/23, 2023, from <https://www.investopedia.com/terms/d/distribution-channel.asp>.
- Furlog. (2023). "What is groupage and for which shipping is convenient." Retrieved 17/02/23, 2023, from <https://furlog.com/en/what-is-groupage-and-for-which-shipping-is-convenient/>.
- García, I. V. (2016). COMPARATIVE ANALYSIS BETWEEN ITALIAN AND SPANISH CERAMIC TILE, Universitat Jaume.
- Guedes, A. P. (2022). Introduction to Logistics & Supply Chain Management. FEUP.
- Guedes, A. P. (2022). Logistics Strategy & Network Design. FEUP.
- Hertz, S. and M. Alfredsson (2003). "Strategic development of third party logistics providers." Industrial Marketing Management **32**: 139-149.
- Hervás-Oliver, J. L. and J. Albors-Garrigós (2007). "Do clusters capabilities matter? An empirical application of the resource-based view in clusters." Entrepreneurship & Regional Development **19**(2): 113-136.
- Iberinform (2023). Relatórios Comerciais e Dados de Empresas.
- INE (2022). Comércio Internacional.

- INEGI. (2021). "Mais de 35 anos a converter conhecimento em valor." Retrieved 15/02/2023, 2023, from <http://www.inegi.pt/pt/sobre-o-inegi/o-inegi/>.
- INEGI. (2023). "Gestão e Engenharia Industrial." Retrieved 15/02/2023, 2023, from <http://www.inegi.pt/pt/servicos/consultoria/gestao-e-engenharia-industrial/>.
- ITC. (2023). "List of importing markets for a product exported by Portugal - Product: 6907." Retrieved 17/02/23, 2023, from https://www.trademapp.org/Country_SelProductCountry_TS.aspx?nvpm=1%7c620%7c%7c%7c%7c6907%7c%7c%7c4%7c1%7c1%7c2%7c2%7c1%7c2%7c1%7c1%7c1.
- Joerss, M., F. Neuhaus and J. Schröder (2016). "How customer demands are reshaping last-mile delivery." McKinsey&Company: Travel, Transport & Logistics.
- JOMATIR. (2020). "Regras de Comércio Internacional." from <https://jomatir.pt/incoterms/>.
- Khan, M., M. Y. Jaber, S. Zanoni and L. Zavanella (2016). "Vendor managed inventory with consignment stock agreement for a supply chain with defective items." Applied Mathematical Modelling **40**(15): 7102-7114.
- Koerber, T. and H. Schiele (2022). "Is COVID-19 a turning point in stopping global sourcing? Differentiating between declining continental and increasing transcontinental sourcing." Journal of Global Operations and Strategic Sourcing **15**(2): 219-234.
- Larguesa, A. (2022). "Cerâmica em “crise existencial” lança marca para dar gás às exportações." ECO.
- Leitner, R., F. Meizer, M. Prochazka and W. Sihn (2011). "Structural Concepts for Horizontal Co-operation to Increase Efficiency in Logistics." Cirp Journal of Manufacturing Science and Technology **4**.
- Marasco, A. (2008). "Third-party logistics: A literature review." International Journal of Production Economics **113**: 127-147.
- Mentzer, J. T., T. P. Stank and T. L. Esper (2008). "SUPPLY CHAIN MANAGEMENT AND ITS RELATIONSHIP TO LOGISTICS, MARKETING, PRODUCTION, AND OPERATIONS MANAGEMENT." Journal of Business Logistics **29**(1): 31-46.
- Ming, F. and L. Donghong (2013). "Effect of Warehouse Centralization on Lead Times " 6th International Conference on Information Management, Innovation Management and Industrial Engineering.
- Mussini, M. (2017). Grespanaria cresce 16,5% e exporta mais. D. d. Aveiro. Diário de Aveiro.
- NICE. (2023). "Why is customer service important in today's society?" Retrieved 17/02/2023, 2023, from <https://www.nice.com/info/why-is-customer-service-important-in-todays-society>.
- Paik, S. K. and P. K. Bagchi (2007). "Understanding the causes of the bullwhip effect in a supply chain." International Journal of Retail & Distribution Management **35**(4): 308-324.
- Pereira, M. E. T. (2005). Factores de Competitividade e Desempenho Empresarial: um estudo aplicado ao sector da cerâmica em Portugal PHD, Universidade de Aveiro.
- Porter, M. E. (1998). Clusters and Competition: New Agendas for Companies, Governments and Institutions.
- PWC (2016). Capacitação da indústria da Cerâmica Portuguesa - Um cluster, uma estratégia, mercados prioritários.

- Rius, V., M. T. Miguel Angel and J. S. García (2006). Logistics and delivery times in the ceramic sector: the need for a logistics platform., Universitat Jaume I of Castellón.
- Rogers, D. (2022). "Material concerns: Soaring energy costs hit Europe's brick and ceramics makers." Global Construction Review.
- Rushton, A., P. Croucher, P. Baker and a. O. R. M. C. Safari (2014). The Handbook of Logistics and Distribution Management, 5th Edition, Kogan Page.
- Russo, M., P. Borkey, E. Cubel, F. Lévêque and F. Mas (2012). Local Sustainability and Competitiveness: The Case of the Ceramic Tile Industry. EUROPEAN FOUNDATION for the Improvement of Living and Working Conditions.
- Segal, T., D. Kindness and K. Beer. (2022). "Less-Than-Truckload Definition and Shipping Service Basics." 2023, from <https://www.investopedia.com/terms/l/lessthantruckload.asp>.
- Space, M. (2022). "Statistics That Prove How Your Delivery Speed Impacts Your Business." from <https://www.meteorspace.com/2022/08/25/statistics-that-prove-how-your-delivery-speed-impacts-your-business/>.
- Thieuleux, E. (2023). "ABC XYZ Analysis in Inventory Management." Retrieved June 3, 2023, from https://abcsupplychain.com/abc-xyz-analysis/#ABC_XYZ_analysis_in_Inventory_Management.
- Toyoda, K. and I. Sasase (2015). Secret Sharing Based Unidirectional Key Distribution with Dummy Tags in Gen2v2 RFID-enabled Supply Chains.
- Van Belle, J., P. Valckenaers and D. Cattrysse (2012). "Cross-docking: State of the art." Omega **40**(6): 827-846.
- Vidović, M., M. Kilibarda, S. Zečević, M. Miljuš and G. Radivojević (2015). Proceedings of the 2nd LOGISTICS INTERNATIONAL CONFERENCE. 2nd LOGISTICS INTERNATIONAL CONFERENCE. Belgrade, Serbia, University of Belgrade, Faculty of Transport and Traffic Engineering, Vojvode Stepe 305, Belgrade, Serbia: 327.
- Voyado. (2023). "10 Ways Covid-19 Affects e-commerce Growth in Europe." Retrieved 18/02/23, 2023, from <https://www.apptus.com/whitepapers/how-covid-19-affected-ecommerce-in-europe/>.

APPENDIX A: Brand A Players Survey



Survey to Brand A Players

Dear producer,

This survey was created as part of the Study for the Improvement of Service in Central European Markets for the Sub-sector A producers associated with the Brand A promoted by the association A.

The main objective of this survey is to gather the logistical information necessary for the development of the study and to understand the level of service provided by the Portuguese sub-sector A players in the value-added markets of Central Europe, particularly in France, Germany, Benelux and Austria.

We emphasize the importance of your participation for the conduct of this study.

We thank you for your time.

Contact

Representant name	
E-mail	

General Company Data as of the end of 2021

Company name	
Number of employees	
Turnover (€)	

Questions

1. Please indicate the total turnover in euros for sub-sector A in 2021:

Sales 2021	
Total (€)	

2. Please indicate the average weight and value exports of sub-sector A to the following countries in 2021:

	2021	
Country	Value (€)	Weight (ton)
France		
Germany		
Benelux		
Austria		

3. Please indicate the infrastructures/partners you have in the following countries, if applicable:

Country	Warehouse	Plant	Commercial Office	Logistics Operator	Not Applicable
France					
Germany					
Benelux					
Austria					
Other					

4. Please indicate the average percentage of sales for each market segment/sales channel, in the Central European market (France, Germany, Benelux and Austria) for sub-sector A:

Market segment/ Sales channel	Average sale %
Distributor	
Retailer	
Construction company	
E-commerce	
Final customer	
Other:	

5. Name your top 3 customers by 2021 in the Central European market (France, Germany, Benelux and Austria), for the sub-sector A:

TOP 3 Customers

6. If applicable, identify the new market segments/sales channels, customers or regions you intend to reach in the coming years in the Central European market (France, Germany, Benelux and Austria) for the sub-sector A:

New market segments/sales channels, customers, or regions

7. Please indicate the sizes of pallets used and their approximate average weight (per pallet) in exports to the Central European market (France, Germany, Benelux and Austria), in sub-sector A:

Pallet	Measures (mm)	Average weight (kg)
Europallet	1200 x 800	
American	1200 x 1000	
Other:		



8. The company has defined with its customers in the Central European market (France, Germany, Benelux and Austria) a minimum order quantity for the sub-sector A? If yes, how many pallets/boxes?

Country	Minimum order quantity pallets	Minimum order quantity boxes	Not applicable
France			
Germany			
Benelux			
Austria			

9. Please indicate the average response lead time, in days, from the time a purchase order is received from a customer until it is ready to be shipped, in the sub-sector A:

Average response time

10. Please indicate the average distribution lead time, in days, from when the cargo is ready to be shipped until it reaches its destination for the following countries, in the sub-sector A:

Country	Average distribution lead time (days)
France	
Germany	
Benelux	
Austria	

11. Please indicate the terms (INCOTERMS) utilized in exports to the following countries in the sub-sector A:

Country	EXW (Ex-Works)	DDP (Delivered Duty Paid)	Other:
France			
Germany			
Benelux			
Austria			

12. If applicable, please indicate the logistics operators with which the company operates most frequently for the Central European market (France, Germany, Benelux and Austria), in the sub-sector A:

Country	Logistics Operators
France	
Germany	
Benelux	
Austria	



13. Please indicate the percentage of shipments made in full-truckload and less-than-truckload to the Central European market (France, Germany, Benelux and Austria), in the sub-sector A:

Country	Full-Truckload %	Less-Than-Truckload %
France		
Germany		
Benelux		
Austria		

14. What is the percentage of full pallets and not full pallets shipped annually to the Central European market (France, Germany, Benelux and Austria), in the sub-sector A:

Country	Full Pallets %	Not Full Pallets %
France		
Germany		
Benelux		
Austria		

15. If you have any additional considerations within the scope of the study for Service Improvement in the European market (France, Germany, Benelux and Austria) for sub-sector A associated to the Brand A, please share them in the following response field:

We thank you for taking the time to complete this questionnaire and we naturally remain available for any question you may have.

APPENDIX B: General Traffic Restrictions for Trucks

Countries	General Traffic Restrictions for Trucks
Portugal	No general restrictions
Spain	No general restrictions
France	From 22:00 on Saturdays and the day before public holidays to 22:00 on Sundays and public holidays
Germany	Sundays and public holidays from 00:00 to 22:00
Belgium	No general restrictions
Netherlands	No general restrictions
Luxembourg	From 21:30 or 23:30 on Saturdays and the day before a public holidays
Austria	On Saturdays from 15:00 to 00:00, Sundays and public holidays from 00:00 to 22:00
Switzerland	On Sundays and public holidays from 00:00 to 24:00, at night from 22:00 to 05:00