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Supply Chain in B2C and B2B Online Channels

MEMÒRIA

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Summary

Nowadays, significant challenges with which businesses have to deal is the digital transformation and the omnichannel environment, which can be materialized through E-Commerce. In fact, due to the Coronavirus outbreak in 2020, lots of customers have become used to the convenience of both making the purchase online and receiving it at the required address. Nevertheless, companies often struggle when developing their omnichannel strategy due to the complexity of adapting their current supply chains to the new requirements of the online business.

In connection with this new business trend, the main objective of this project is to start, develop and improve the online activity within a Spanish agri-food company, which has plenty of experience regarding offline operations but none in the online business. Therefore, the aim is to design the most appropriate supply chain to develop this new online business considering omnichannel techniques, the current capabilities of the company and all the requirements to manage food.

To accomplish this objective, research is made regarding E-Commerce and omnichannel strategies from a supply chain point of view. Moreover, the specific agri-food company is also analysed from an operational point of view in order to apply the required E-Commerce techniques when developing its online business. For instance, the geographic area to be covered and the sort of products to be offered need to be determined. Actually, the developments followed by two real online food businesses within Spain are also analysed. Regarding the development of the online activity in the indicated agri-food company and considering the research made, it is determined to evolve from less to greater operational risks as explained below:

- To begin with, the externalized network of Amazon will be used to commercialize cured products online (note that this sort of product does not require chilled facilities). Despite the fact that operational risks are minimized, the management cost is too high to make the business profitable.
- Subsequently, once having acquired some experience and to make the business profitable, operations will be internalized through a centralized supply chain network. The internalization will allow to gain much more first-hand control of the orders' preparation process and to reduce the costs which have to be paid to an external company. The multicriteria method of Brown & Gibson will be used to select the most appropriate centralized warehouse and, afterwards, its suppliers will be determined so that logistics are optimized.

When analysing the sales order history of the inner centralized network from September 2020 to June 2021, it is concluded that, as a future line of research, a convenient supply chain improvement should be made through decentralization, and the optimum decentralized network would be determined when solving the mathematical program that is proposed in this project.

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1. Glossary

- **AMZ:** Amazon.
- **Back – end:** Relating to the part of a system that is not directly accessed by the user, typically responsible for manipulating data.
- **B2B:** Business – to – business (i.e. commercial activity between two business companies).
- **B2C:** Business – to – consumer (i.e. commercial activity between a business company and the final customer).
- **CE:** Circular economy.
- **Commodity product:** It is that product which is the same as other products of the same type from other manufacturers. For instance: sugar is a commodity product since no company can control its supply nor its price level more than its rivals do.
- **DC:** Distribution Centre.
- **EDI:** Electronic Data Interchange.
- **ERP:** Enterprise Resource Planning.
- **EU:** European Union.
- **E2E:** End – to – End.
- **FLW:** Food loss and waste.
- **KPI:** Key performance indicator.
- **LSP:** Logistics Service Provider.
- **OMC:** Organización Mundial del Comercio.
- **OPP:** Order penetration point.
- **PO:** Purchase order.
- **SC:** Supply Chain.
- **SKU:** Stock keeping unit.
- **SOH:** Sales Order History
- **SWOT:** Strengths, weaknesses, opportunities and threats.
- **V:** Name of the analysed agri-food company (that is, *Company V*).
- **3PL:** Third Party Logistics.

2. Preface

The aim of this chapter is to briefly explain the main origin and motivation due to which this project has been realized, as well as to present the previous requirements that have been necessary to develop it.

2.1 Origin of the Project and Motivation

Food is an essential part of our lives, both for human beings and social development and for the whole business economy. Owing to this fact, it becomes notorious to take care of every step of the agri-food chain, from the growth of crops and purchase of raw materials to the production and distribution of the final products.

As explained below, the motivation of this project is to add one further last stage in the supply chain of a huge agri-food company (which will be called V), taking advantage of the current digital transformation and the online business. This will help reduce food loss and waste (FLW), as well as improve its order delivery logistics operations from an environmentally friendly point of view. Furthermore, this project will allow me to gain knowledge in connection with the digital transformation, which is necessary to run any E-Commerce or marketplace business. Moreover, the knowledge that I have acquired through the Master regarding supply chain design will be applied.

2.2 Previous Requirements

Previously to the development of this project, as explained below, it has been necessary to develop and run marketplace and E-Commerce businesses in order to analyse all the operations that are required regarding these business models, and more specifically in relation to the food business requirements and constraints. Moreover, it has been also necessary to understand the structure of Company V. This analysis has been realized during 2020 (even though the very first actions began in the fourth term of 2019).

3. Introduction

Recently, significant challenges with which a large number of businesses have to deal with are the so-called digital transformation and the omnichannel environment. Regarding these concepts, there is the E-Commerce activity: buying, selling and marketing management through the Internet. This new tool has strengthened the relationship between companies and customers (B2C) and has created new requirements regarding the supply chain design.

In fact, owing to the Coronavirus outbreak, E-Commerce activity and home delivery orders have increased significantly, and a large number of customers have become used to the convenience of both making the purchase online and receiving it at the required address.

The fact is that omnichannel shopping is becoming a requirement and companies have to be ready for this. Traditional retailers such as Walmart are now expanding their online services and, in addition to this, vertically integrated companies such as Nike are investing to strengthen their direct – to – consumer business through both online and physical stores.

Nevertheless, a large number of companies struggle to achieve an omnichannel business due to the difficulty of adapting their supply chains in terms of speed, complexity and efficiency. Actually, customers expect to receive their purchase at the required address, with excellent service, and with a significant tight lead time between the order and its delivery.

Companies of all types are seeking to meet customers' needs and the fact is that traditional supply chain networks are usually not designed for almost immediate deliveries with an appropriate service and customer experience. E-Commerce fulfilment needs are far more complex than the ones needed for ordinary wholesalers due to the fact that customers can order at anytime (that is, 24 hours, 7 days per week), which makes demand less predictable. Furthermore, the omnichannel scenario causes a significant increase in terms of operational costs: the cost of delivering an online order can be ten times higher than delivering it to a wholesaler. This is due to the increase in speed and complexity caused by two main factors [9]:

- On the one hand, orders' sizes are much smaller, which makes it difficult to apply economies of scale.
- On the other hand, the offered assortment of references has to be significantly wide.

In relation to the supply chain design, companies usually use a quantitative approach to design the network, which requires a significant amount of time (data collection, modelling and decision making before implementation) and, at the end, it only provides a single strategy. Nonetheless, so as to be competitive in the current volatile environment in which customer needs are constantly changing, it is essential to have a supply chain which is responsive, flexible, resilient and efficient in order to react as quicky as possible to changes.

The fact is that, due to the current volatile environment, it is essential to be resilient, provide speed of implementation and use resources efficiently. Hence, partnerships are very important to take advantage of existing infrastructures such as warehouses. Actually, these synergies enable to reduce both costs and risks, and they also improve customer service and allow faster delivery schedules.

So as to remain competitive, companies must never stop learning so that they can gain knowledge about new capabilities of fulfilment operations, information and transportation flows, and new possible partners.

The aim ought to be providing consumers with an end – to – end omnichannel experience, which requires to design supply chains according to this new trend. Therefore, it is necessary to design a connected fulfilment network which should be deployed along an agile road map, that will be readjusted depending on the changing market conditions. As aforementioned, this supply chain should be agile and resilient so as to be able to adapt quickly to changing trends and customers' expectations, as well as to changes within the logistics service (for instance, fast last mile delivery services).

Regarding this project, digital transformation and omnichannel strategies will be analysed from a supply chain point of view. Furthermore, these new trends will be analysed within Company V, which is leader within the European agri-food sector.

As will be explained below, this company was born in 1956, in Lleida, and since then it has grown significantly, specializing itself within B2B offline operations, with a completely vertical integrated structure. Nonetheless, as aforementioned, the current market scenario requires companies to offer complete end – to – end omnichannel services.

Owing to this fact, Company V ought to readapt its current supply chain network, which is currently optimum for B2B offline operations, to be able to offer online B2B and B2C services as efficiently as possible. The development of Company V's omnichannel strategy will be treated throughout this project.

In order to achieve the objective of this project, to begin with it will be necessary to collect and analyse information regarding the most recent omnichannel supply chain techniques, as well as to understand the current structure and functioning of Company V. For instance, some significant cases of omnichannel strategies within food companies will be analysed.

Subsequently, the online activity within Company V will be developed through two main phases: the strategy will be to evolve from an externalized supply chain network to an internalized one, considering that the internalized supply chain network could be centralized or decentralized. Hence, Company V will be able to start attending online demand as well as to start building an omnichannel network.

3.1 Objectives of the project

The main objective of this project is to start, develop and improve the online activity (both in B2C and B2B online business models) within the agri-food Company V, which has huge experience regarding B2B offline operations but no experience in the online business model. Therefore, the aim is to design the most appropriate supply chain network for the online businesses B2C and B2B, considering the importance of omnichannel strategies, the specific capabilities of Company V and all the specific requirements to appropriately manage food, which is a sort of product that has a limited shelf life (perishable products) and which might require chilled or frozen storage facilities.

To accomplish this objective, one new business called “facility V.O” will have to be created inside Company V and, in addition to this, two phases will have to be followed:

- Phase 1: The externalized supply chain network of Amazon (AMZ) will be used so as to gain knowledge about the online food business and to assess some parameters such as demand and the operational costs.
- Phase 2: Operations will be internalized within Company V so as to have much more first-hand control of all the processes and improve the service level. Regarding this second phase, it will be necessary to evaluate whether it is better to have the supply chain network centralized or decentralized and, due to simplicity, facility V.O will start designing a centralized SC network rather than a decentralized one.

Furthermore, additional aims are the following:

- To provide a tool which might help reducing food loss and waste (FLW) through the use of the unique inventory technique, which will be necessarily applied when developing the online activity within Company V.
- To improve Company V’s order delivery logistics operations from an environmentally friendly point of view.

3.2 Approach

This project will be focused on the design of the appropriate supply chain network that would be required to start, develop and improve the online activity within the Company V. It is clear that, so as to manage an omnichannel strategy and an online business, a specific supply chain network is required. Therefore, it will be necessary to analyse the current structure of Company V in order to justify the convenience of starting the online operations as well as to be able to design the most appropriate supply chain network to attend the online business demand. Furthermore, it is necessary to highlight that the commercialized product is food, which has a limited shelf life and which requires specific storage conditions.

3.3 Scope

This project has been divided into the following two main parts:

- On the one hand, the evolution and current scenario of the online business has been analysed, worldwide and within Spain, as well as the effect caused by the Covid-19 lockdown in relation to customers' consumption behaviour. In addition to this, significant facts have been collected in connection with online businesses' supply chain operations, and two real cases of online food business models have been analysed.
- On the other hand, the collected information has been treated so as to be able to develop the online business activity, both B2B and B2C, within a specific Spanish agri-food business, which has plenty of experience regarding offline B2B operations, but none within the online environment.

  As aforementioned, the sort of product with which this company works is food. This fact will cause several constraints when designing the appropriate supply chain network.

  In order to achieve this objective, firstly, an explanation of the current functioning of this agri-food company is provided and, secondly, a strategy to start the online business is both proposed and applied.

  To finish, an evaluation is realized to assess the convenience of developing the online business activity within Company V.

4. The agri-food Company V

The analysed agri-food organization, identified in this project as Company V, has plenty of experience regarding B2B offline operations but almost none in connection with online and omnichannel activities (neither B2B nor B2C). Hence, to begin with, it is necessary to analyse both the trajectory and current structure of this company due to the following two reasons:

- Firstly, it will allow to decide whether developing the online activity is worth or not.
- Secondly, it is essential in order to design the most appropriate supply chain network that will be required to attend the online business demand, considering the specific details of this company.

Hence, the evolution and main characteristics of Company V are explained below and, in addition to this, a SWOT analysis (*strengths, weaknesses, opportunities and threats*) is developed to evaluate the convenience of developing the online business within this organization.

4.1 Evolution

The analysed agri-food Company V was born in 1956, in Lleida. Coming from a familiar origin, strategic decisions were taken so as to become one of the leaders within the European agri-food business.

Nowadays, it is constituted by 48 companies that are distributed throughout 22 Spanish provinces and 1 facility in Portugal, thus strengthening the activity in rural areas. It has complete vertical integration and guarantees both the control and traceability of all production processes, from the origin of raw materials in the countryside to the consumption of final products at the table. To reach this scenario, the main evolution of the company has been the following:

- **1956 – 1970, Bread Flour:** Company V was born in 1956 through the acquisition of a bread flour factory in Lleida and, subsequently, the by-products of the wheat milling process were used to produce animal feed. The company also began its activity in the poultry sector.
- **1970 – 1980, Livestock integration:** The pork livestock integration model was developed, according to which farms started providing both the facilities and workforce, whereas all the other services were provided by Company V (that is: animals, feed and veterinary control). This model was also developed in the poultry sector. Due to the company's growth, feed production was escalated (from sacks to bulk production), a logistics company was created, and the geographic expansion began through the acquisition of a feed factory in Vic (Barcelona).
- **1980 – 1990, Volume and Logistics:** A new flour factory was built, the acquisition of mother sows was strengthened so as to have auto fulfilment of piggy and traceability, and

the first poultry slaughterhouse was acquired in Tarragona. Moreover, the production of their own pharmaceutical products began through the creation of a laboratory.

- **1990 – 2000, Quality and Traceability:** The capacity of compound feed production (both for pigs and poultry) was increased through the acquisition of new factories, and an incubator was built in Lleida. Livestock integration was also strengthened with much more mother sows and auto-fulfilment of piggy. The company invested in the improvement of quality and traceability procedures and an insemination centre was built, which would ensure a complete genetic control and traceability.
- **2000 – 2010, Verticalization:** During this decade, the business verticalization was achieved through the acquisition of several pig and beef slaughterhouses in Vic, Cuenca and Valdepeñas, as well as poultry cutting rooms and slaughterhouses in Girona, Barcelona, Lleida and Galicia.
- **2010 – 2020, Industrial Specialization:** During this period, Company V worked to be able to produce in large scale volumes, with high quality standards and optimizing production costs. Investments were made in several industrial activities such as compound feed production, slaughterhouses and cutting rooms. Furthermore, the company started to produce elaborated products and significant commercial projects regarding ham.

To sum up, *Figure 1* shows last year results of Company V considering a large variety of activities, from pigs and poultry production to the commercialization of pork, poultry and beef meat.

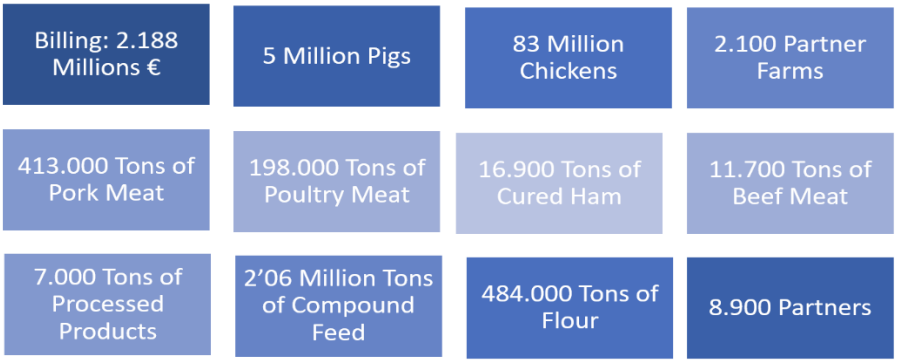

Figure 1: Company V 2020 results.

4.2 Facilities

Nowadays, Company V operates in a large number of agri-food activities, from the manufacturing of raw materials such as compound feed or flour and the livestock farming to the distribution of its food production through B2B offline operations. As seen in *Figure 2*, it covers all the activities of the agri-food value chain, with complete vertical integration and traceability.

So far, as aforementioned, it is covering demand which comes only from the B2B offline channel,

and the aim of this project it to analyse the convenience and to develop the B2B and B2C online activity within Company V.

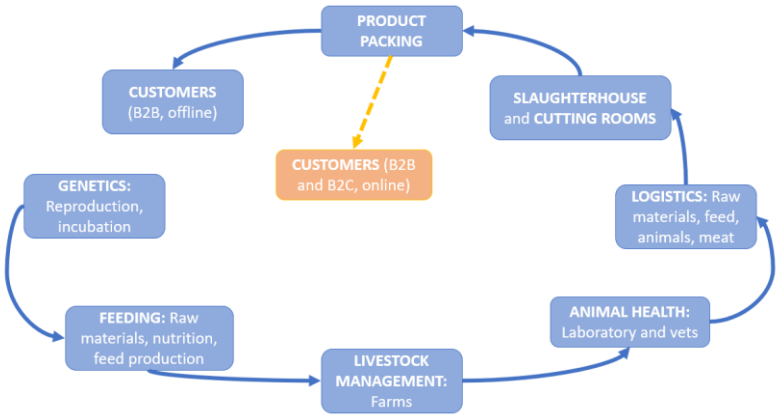

Figure 2: Company V agri-food chain.

So as to manage its complete agri-food vertical integration, Company V has the appropriate facilities for each step of its value chain, decentralized and distributed throughout Spain, with also one facility in Portugal.

4.2.1 Classification

Company V has currently 48 facilities and each one of them is specialized in one specific step of the agri-food chain. In order to be able to achieve the objective of this thesis, these 48 facilities have been classified into 11 groups according to its main function.

Hence, the following *Table 1* provides a summary in relation to the number of available facilities depending on each function:

Type of Product	Quantity of Facilities	Objective
BEEF	1	Beef slaughterhouse, distribution and cutting
COOKED PRODUCTS	1	Manufacturing of baked, roasted and marinated meat products
CURED PRODUCTS	5	Production, drying room, boning room and slicing of cured products
FEED & FLOUR	9	Bread flour and animal feed production
LOGISTICS	2	Logistics, storage and distribution (ambient, chilled, frozen)
OTHER	6	Raw materials purchasing, medicines, poultry hatchering
PORK	6	Slaughterhouse and cutting room of pork meat
POULTRY	9	Slaughterhouse, cutting room and packing of poultry products
RABBIT	1	Rabbit slaughterhouse
VARIED PRODUCTS	7	Distribution of beef, pork, poultry, cured products, mutton
ALTERNATIVE PROTEIN	1	Alternative protein products production

Table 1: Company V facilities summary.

The complete classification of Company V facilities can be found in *Annex A.1*, in which the following information is provided for each facility: detailed location (postal code, province and country), main activity and the sort of product that is produced, and the classification group and company code that has been assigned to develop this project.

4.2.2 Geographic distribution

In connection with the geographic distribution of Company V's facilities, they have been represented in the map shown in *Figure 3*, considering the aforementioned 11 classification groups.

All the facilities are located throughout the Iberian Peninsula, mainly in rural areas, which is a win – win: this sort of location is good for Company V considering that operational costs in rural areas are lower and it is also convenient for the country so as to develop these areas that are located in the countryside. Moreover, some specific patterns which have been observed are the following:

- **Beef:** There is just one facility producing this sort of product and it is located in the north of Portugal.
- **Cooked products:** There is only one facility specialized in this product, which is located in Guadalajara, in the central part of the country.
- **Cured products:** These facilities are distributed through the central strip of Spain (Guadalajara, Salamanca and Teruel) and there is also one facility available in the south (Huelva).
- **Feed and Flour:** This kind of factories are distributed throughout Spain, mostly in the north strip (Barcelona, Guadalajara, Lleida, Palencia, Valencia, Valladolid and Saragossa) but with also one facility in the south (Sevilla).
- **Logistics:** It has to be noted that even though the main management facilities are located in Catalonia (Lleida and Barcelona), logistics activities are spread throughout the country. Moreover, there is one specific warehouse in Barcelona equipped to keep products either in chilled or frozen conditions.
- **Other:** Most of these facilities are located near Lleida and one facility is located near Valladolid.
- **Pork:** The six available pork facilities are distributed mostly within the north strip of Spain, between A Coruña, Barcelona, Cuenca, Mallorca and Saragossa.
- **Poultry:** Most of this sort of facilities are located within Catalonia (Barcelona, Lleida, Girona), and there are also facilities in Pontevedra, Valencia and Valladolid.
- **Rabbit:** Currently there is only one slaughterhouse in Ourense.
- **Varied products:** These facilities are located within the Canary Islands (Gran Canaria,

Lanzarote, Tenerife) and also throughout Ciudad Real, Madrid and Valencia.

- **Alternative proteins:** Currently there is just one factory near Barcelona.

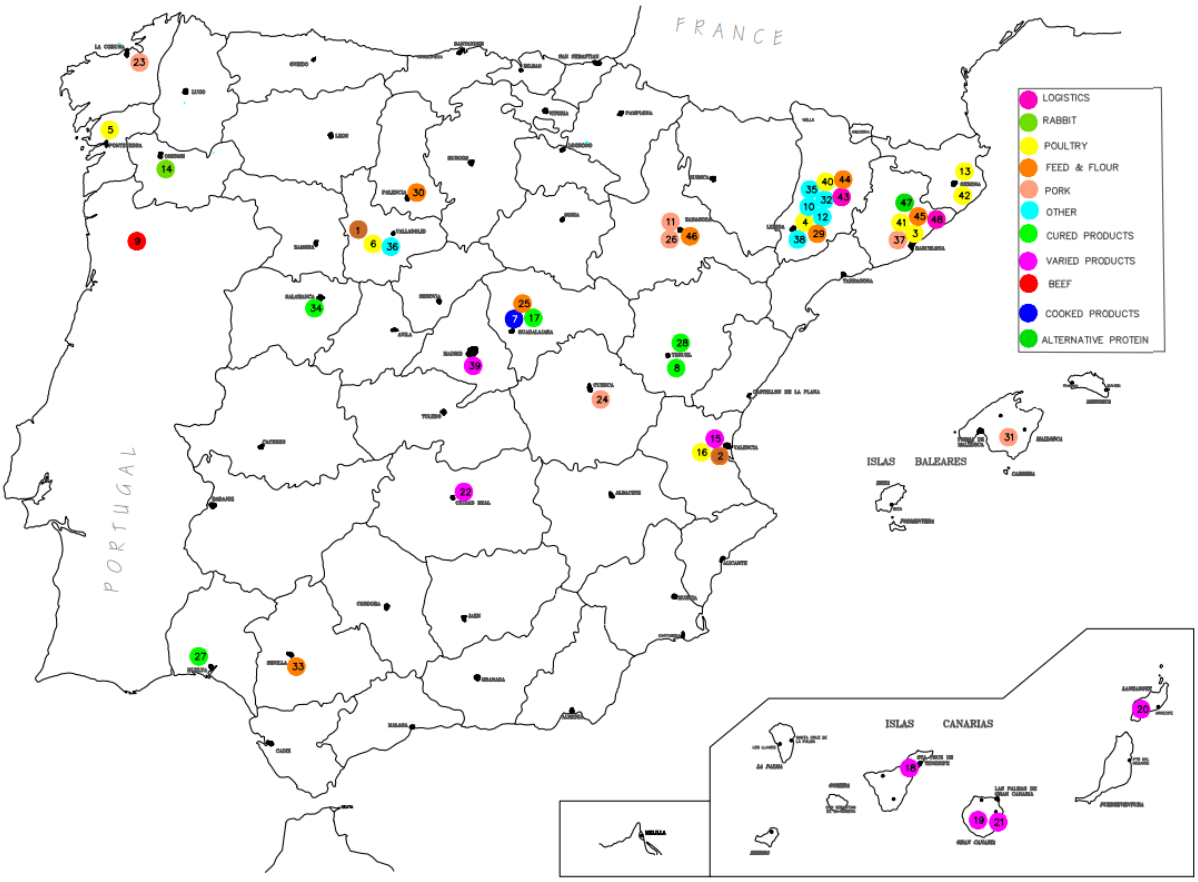

Figure 3: Geographic distribution of Company V's facilities.

Note that a bigger version of this map is provided in *Annex A.2*.

In order to make the most appropriate strategic decisions within Company V regarding its introduction to the online activity, the main characteristics of this new business model are developed in the subsequent chapters of this project.

4.3 Online Food Business SWOT Analysis

Once having described Company V and regarding the objective of developing the online and omnichannel activity to commercialize its final food products (B2B and B2C) through the creation of facility V.O, it is now necessary to develop a SWOT analysis to assess: strengths and weaknesses from an internal point of view, and opportunities and threats from an external point of view.

Hence, through this analysis it will be possible to strategically decide whether investing in the creation of facility V.O to develop Company V's online business model is worth realizing, or not. This analysis is shown in the following *Table 2* and is explained below. Note that there are some concepts which will be explained subsequently in the project.

	Strengths	Weaknesses
Internal Analysis	• High capacity production. • High production efficiency and competitive costs (push production). • Complete vertical integration within the agri-food chain and complete products' traceability (E2E). • Ownership of 47 facilities that are distributed throughout Spain, plus 1 in Portugal. • Production of modular products (ATO, MTS) in Company V.	• Decentralized operating model and no centralized inventory integration. • Specific food handling and storage requirements. • Limited shelf life of products. • No retail experience (only production activity). • No picking experience regarding B2C orders.
	Opportunities	**Threats**
External Analysis	• Development of a new sales channel (online). • Significant forecasted increase of activity within the online channel worldwide. • Data collection regarding customers' food consumption behaviour. • Improvement of customers' experience (omnichannel experience). • Inventory management improvement through the development of the unique inventory technique (centralized inventory management). • Reduction of food loss and waste. • Regarding Spain, food is one of the most important products that is being commercialized online.	• Existence of significant competitors which have plenty of experience as retailers and some regarding the online food activity. • Demand volatility. • Tight lead time and orders' personalization requirements.

Table 2: SWOT analysis regarding Company V and the convenience of developing its online food activity.

Hence, from an **internal point of view** and considering the aim of commercializing its products online, the following main points have been identified:

- Regarding its **strengths**, since productivity is one of its main competitive advantages, production efficiency and very competitive production costs are guaranteed. Moreover, due to its complete vertical integration, it can provide consumers with complete traceability (*E2E: End-to-End*). The ownership of a large number of facilities that are distributed throughout the Iberian Peninsula is a significant advantage so as to design the appropriate internalized SC network that facility V.O will require. Finally, since the produced products have modularity, ATO and MTS techniques can be applied, which provide efficiency when producing and agility regarding the orders' preparation process.
- Considering its **weaknesses**, the inventory is not centralised due to its main decentralized operating method, thus there is no unique inventory technique applied and each facility has its own SC network. Despite its food production competitive advantage, it has no experience in retail business nor in dealing with the preparation process of B2C orders, which are usually significantly smaller than B2B orders and might require personalization. In addition to this, specific food handling and storage requirements will have to be considered when designing the required SC network in facility V.O, as well as the fact that products have a limited shelf life.

From an **external point of view** and when analysing the current market scenario, the following main points have been identified:

- In connection with the **opportunities**, Company V would be opening a new business channel with a growing sales forecast. Customer's experience would be improved through omnichannel techniques and it will allow the company to collect a lot of data regarding food consumption behaviours, specially through B2C orders. In addition to this, it would be necessary to develop the unique inventory technique, which would improve its inventory management and would allow the company to reduce food loss and waste. Finally, regarding Spain, food is one of the most important products that is being commercialized online [6].
- Regarding the main **threats**, on the one hand it has to be considered the existence of significant competitors such as Mercadona and AMZ Fresh, which have plenty of experience as retailers and already significant know-how about the online food business channel. On the other hand, focusing on B2C orders, additional threats would be the higher volatility of demand and the fact that customers are looking for tight lead times and the chance of making personalized orders.

Eventually, after having realized this SWOT analysis, it is concluded that investing in the development of Company V's online business through the creation of facility V.O is worth realizing. This is due to the fact that, through the appropriate organization of the aforementioned strengths, it is fair to think that facility V.O will be able to design an appropriate SC network for this new business model. Actually, this SC network design has been developed, step by step, in a subsequent section within this project.

5. Online Business: Definition and Evolution

In 1998, the expansion of the electronic commerce all around the world was recognized by the OMC and the Statement on Global Electronic Commerce was approved [10]. According to this statement, the electronic commerce was defined as the "production, distribution, commercialization, sale and delivery of goods and services through electronic means" [11].
The aim of this section is to understand the evolution of the online business worldwide and within Spain, which is necessary to know so as to afterwards define the most appropriate strategy to develop the online business within Company V.

5.1 Worldwide Online Business

The electronic commerce was born in the USA at the end of the XIX century, when some sales were made through catalogues and sent through postal codes. This evolved with the use of the telephone, which allowed people to make some purchases.
Subsequently, in 1914, the Western Union created the first credit card, which became popular in the 50s. Afterwards, B2B electronic commerce improved with the appearance of computers for businesses in the 70s and the use of electronic data interchange (EDI). In addition to this, telemarketing appeared in the 80s: as had happened with the telephone, the TV was also used to show several products that had to be sold, and the purchase would be managed through the telephone. In this step, EDI and credit cards were essential so as to process all the payments. For instance, the first B2B sale was made in 1981 by the travel agency Thompson Holidays, which provided its employees with online catalogues that were real time updated so that they could negotiate with the clients [3].
Since the end of the 80s, significant technological events have happened, which have defined the evolution of the electronic commerce. As shown in the following *Figure 4,* the most important events have been the following ones:

- In 1989, the World Wide Web (WWW) was created, and the Internet began to be used by individuals.
- In 1991, the National Science Foundation (NSF) allowed to use the Internet for commercial purposes.
- In 1992, the first online library was created (*Book.com*).
- During 1994, the Secure Socket Layer (SSL) technology was developed, which enabled to secure the data transfer and to make online purchases securely.
- Between 1995 and 1998, several important E-Commerce services were launched, such as Amazon, Ebay and Zappos. This meant the revolution of digital purchases. Moreover,

Coca-Cola made it possible to buy its products via SMS.

- Between 2001 and 2003, Amazon launched its mobile service, eBay bought PayPal and Apple launched its own online store called iTunes.
- In 2004, payments with credit cards were standardized through the development of NFC technology (Near Field Communication) and a council which would stablish the safety rules when using credit cards was created.
- To finish, Prestashop was created in 2007 and became the most important company regarding software to create E-Commerce. Subsequently, in 2008, its competitor Magento was launched.

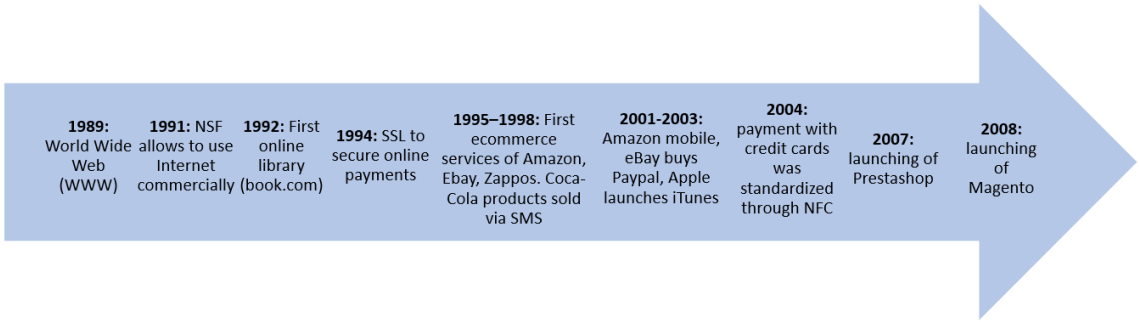

Figure 4: Technological events regarding electronic commerce evolution [3].

This evolution has been possible due to the worldwide availability of Internet. Actually, the number of Internet users all over the world has been increasing year by year (see *Figure 5*): in 1995 there were 16 million users, whereas in 2019 there were 4131 million users in Internet, from which 75% of them usually used E-Commerce services to make some purchases.

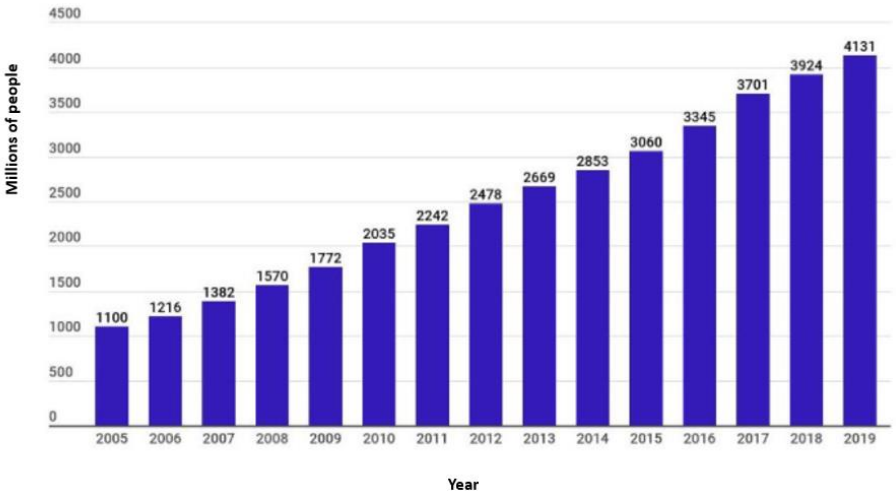

Figure 5: Internet users' evolution worldwide (*Statista* [3]).

Regarding the evolution of E-Commerce usage all around the world, it has also been increasing year by year. This can be seen in *Figure 6*, which shows the increase in terms of volume of sales, and in *Figure 7*, which shows the increase in terms of market share in comparison with the ordinary offline commerce:

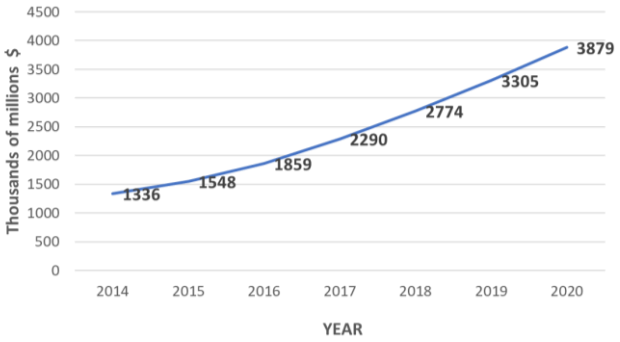

Figure 6: Worldwide E-Commerce evolution. Volume of sales (*Statista* [4]).

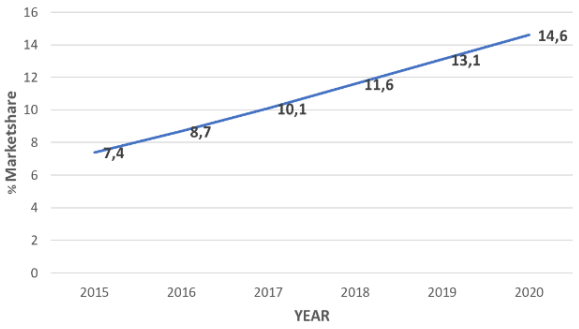

Figure 7: Worldwide E-Commerce evolution. Market share (*Statista* [4]).

It is also important to analyse the worldwide market share of total purchases, depending on the channel through which they have been realized: in store or through the Internet. This can be seen in the following *Figure 8*, which indicates that groceries and food is the sort of product in which the market share difference is bigger: in 2017, just 23% of worldwide groceries and food was bought through the Internet.

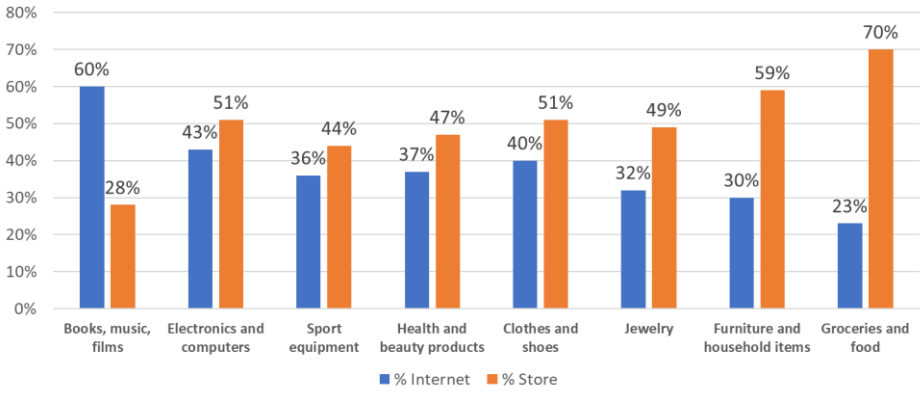

Figure 8: Market share by category of product and purchase channel (*Statista* [4]).

To finish analysing this worldwide scenario, it has been forecasted that E-Commerce retail sales worldwide will progressively increase year by year at an approximate rate of 13%. This is shown in the following *Figure 9*, in which the volume of sales through physical retail and E-Commerce has been forecasted:

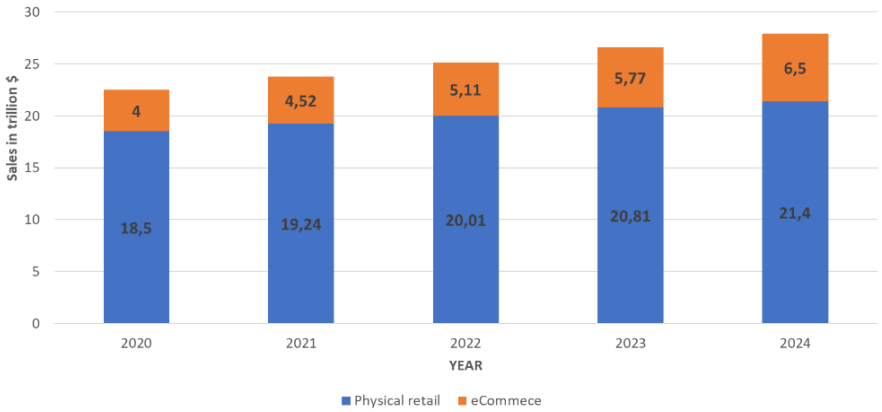

Figure 9: Retail sales worldwide (physical and E-Commerce) from 2020 to 2024 (*Statista* [5]).

5.2 Spanish Online Business

Regarding the current situation of electronic commerce within Spain, the results of an online survey realized to 2900 people, from 30th June 2020 to 14th July 2020 provides some significant facts [6]. These are explained below:

- In 2019, for the first time in history, purchases that had been made through the Internet exceeded the value of 50000 million euros. In 2019, electronic commerce grew 21.4% compared to the previous year and, globally, it has grown 210% during the last 5 years (*Figure 49* of *Annex A.3*).
- During 2019, each customer spent an average of 2076€ per year regarding online purchases, which represents an increase of 100% compared to 2015 results (*Figure 50* of *Annex A.3*).
- In 2019, 24.3 million people usually bought through Internet, which meant an increase of 12.2% compared to 2018. Regarding this fact, approximately 76.4% of all Internet users usually made their purchases through the electronic commerce (*Figure 51* of *Annex A.3*).
- In connection with the reasons because of which users buy through the E-Commerce service, the most important are: the comfortability and convenience, the prices, and the efficiency and time saving achieved when making online purchases (*Figure 52* of *Annex A.3*).
- In relation to the sort of products which are bought through the Internet in Spain, the most important are: clothes and shoes, trips, tickets for shows, transport tickets and home delivery of food.
- Regarding the delivery lead time, most of the customers (50.5%) consider that the online purchase should be delivered within a lead time of 3 days (*Figure 53* of *Annex A.3).*

5.3 Online Business during Lockdown

The complete lockdown that was applied in Spain from March 2020 to May 2020 caused significant changes regarding the consumption behaviour.

This lockdown boosted the E-Commerce sales within Spain. Actually, during the aforementioned months, E-Commerce purchasing was used by 75.2% of the Spanish Internet users [6]. In addition to this:

- 83.9% of the whole Spanish internet users who had already made online purchases in 2019, continued purchasing online during the aforementioned period of 2020.
- 47.2% of Spanish internet users who had not bought online in 2019, made its first online purchase during the aforementioned months of 2020.
- Regarding the average expense in online purchasing during this period, 44.9% of E-Commerce users in Spain spent between 101€ and 500€ per purchase (see additional information in *Figure 54* of *Annex A.3*).
- The most important reason due to which consumers bought using E-Commerce services was to assure safety against contagion (46.1%).

During this lockdown, the categories of products which had a bigger volume of sales through E-Commerce were: clothes and shoes (38.5%), food and beverages (30.5%) and health products (27.2%). In fact, the only category of products which had an increase of E-Commerce sales during this period was the category of food and beverages, which had an increase of 6.8% with respect to 2019 (see additional information in *Figure 55* of *Annex A.3*).

To finish, regarding the main effect on the consumption behaviour caused by the lockdown, 41% of the consumers who had made an online purchase during the main lockdown believe that their consumption behaviour will change. As shown in *Figure 10*, the main change is that the volume of online purchases through E-Commerce is likely to increase.

Figure 10: Consumption behaviour changes due to Spanish lockdown March – May 2020. (Source: [6]).

6. E-Commerce Operations

There is no doubt that the Internet has become an important channel of commercialization and that E-Commerce purchasing demand is likely to increase. Furthermore, regarding the Spanish online business, food is one of the most important products that is being commercialized online.

Owing to these facts, a large number of companies are keen on using the huge potential offered by Internet and they develop advanced systems to analyse customers' consumption behaviour but, wrongly, they forget about SC operations and logistics. Hence, so as to develop the online SC strategy within Company V appropriately, it is necessary to know the main E-Commerce operations techniques.

Online commerce is only feasible if customers feel that it is safe, reliable, and convenient for them. Hence, commercializing through the Internet requires that companies cover new supply needs and, consequently, operations and logistics become essential. It is required to have an operations system capable of managing a large volume of orders, whose demand might be difficult to be forecasted. In addition to this, the fact is that when running an online business, exceptions and incidents are frequent:

- On the one hand, customers usually ask for personalized products. This fact affects the location of the order penetration point and the configuration of the whole SC.
- On the other hand, there are often several returns, which require to develop an inverse logistics system.

Poor back – end developments and weak delivery systems are the main reasons which might cause the failure of any online business. For instance, the following two businesses had to close due to the lack of an appropriate SC strategy:

- ***Pets.com*:** Its aim was to offer the online purchase of pets' products and deliver purchases to each customer's house. However, it failed due to the following reasons: disregard of shipping costs, disregard of warehousing costs, no benchmarking analysis development, and pricings with too low profit margins (2% - 4%) to cover all the expenses [12].
- ***Kozmo.com*:** Its aim was to offer the online purchase of essential items around several locations within the USA, and orders would be delivered at the required address within 1 hour lead time, regardless the customer's location. Nonetheless, it failed due to the following reasons: no charge for the delivery service, no minimum purchase requirement in the online store, and messengers were not allowed to take any tips [13]. Hence, the main cause of its failure was an inappropriate cost analysis due to the simple fact that, on the one hand, the company had to pay for the last mile delivery but, on the other hand, it did not charge this cost to customers, thus eventually this business model was not profitable.

Commercializing through the Internet offers a large number of business opportunities and, at the same time, it makes it necessary to deal with several challenges that have to be covered through the design of an appropriate SC.

In order to successfully run any E-Commerce, it is necessary to develop a logistic back – end capable of covering customers' demand and all the specific requirements. Hence, both operations and logistics have to be integrated in the E-Commerce business model according to the following main elements [7]:

- **The business model:** It will be determined by the value proposition that is offered, and its focus and scale.
- **The service policy:** It will depend on the selected inventory policy, suppliers' management policy and the distribution network.

All these factors will have to be analysed when developing the online food business within Company V.

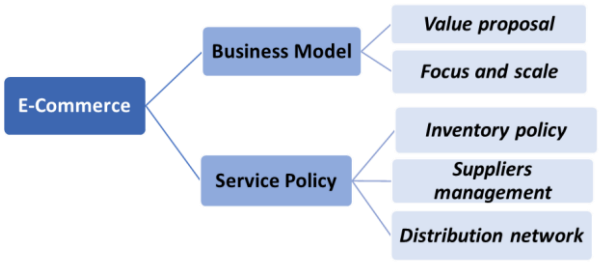

Figure 11: Integration of operations and logistics within E-Commerce [7].

6.1 Supply Chain design for E-Commerce

As explained in [7], it is necessary to cover the following steps in order to design an appropriate supply chain for an online business:

1. Definition of the business' focus and scope.
2. Definition of the business model and value proposition.
3. Design of the logistics system (i.e. design of the SC network).

These three steps are explained below considering that the vision of Company V's online project is to create an online food business through which food purchases are made online (at any time, from anywhere) and delivered at the required address, all this managed through an appropriate SC strategy, taking advantage of the ownership of a large number of facilities that are distributed throughout the Iberian Peninsula (see *Annex A.2*).

6.1.1 Definition of the business' focus and scope

Before activating any E-Commerce business, it is necessary to determine the category of products that will be offered, since not all types of products are suited for Internet commercialization: it depends on the products' value, its logistics requirements, and the capacity of distinction among others. For instance, whereas books and electronics are categories which have a good penetration rate through E-Commerce, commodity products usually fail.

Furthermore, once the category of products has been chosen, it is also necessary to narrow the variety of products which will be offered so as to focus on very specific markets and customers. For instance, DELL, which was one of the first companies to commercialize computers online, began its activity focusing only on B2B operations and, progressively, it began to operate also in the B2C market, both with standard and personalized products. Hence, this change in its business scope (from B2B to B2C operations) required several modifications in its SC: for instance, due to the possibility of ordering personalized products, the order penetration point would have to be modified in its SC [7].

In connection with Company V's online business, the market share to be covered will be both B2B and B2C customers, who are basically located within Spain (despite the fact that some tests will be performed to reach specific European countries). The sort of products that will be offered online will be all the assortment that is produced within Company V, which is the following: beef, cooked products, cured products, pork, poultry, rabbit, mutton and alternative protein.

6.1.2 Definition of the business model and value proposition

Once the category of products that will be commercialized has been selected, the business model and value proposition have to be defined. These factors will eventually determine both the service policy and quality of the whole E-Commerce.

As aforementioned, running an E-Commerce requires overcoming the uncertainty that people associate to the online activity due to its intangibility. People who use the Internet to acquire whatever they need usually have much higher service expectations than people who buy in the offline market. Hence, one tool to achieve customers' loyalty in E-Commerce is to design and appropriate logistic back – end and a SC which is able to respond rapidly to the unforeseen and to a wide variety of exceptions, and which can manage returns efficiently. Furthermore, successful online businesses sustain its value proposition by improving some factors of the offline market, such as offering more competitive prices, a wider range of products and a competitive service guarantee.

Hence, service quality is a strategic variable that distinguishes one online company among the others, and which is essential to increase the volume of sales. Moreover, operational costs cannot be forgotten.

To sum up, the value proposition and service quality of any E-Commerce depend on the following factors [7]:

- Communication and customers' expectations management.
- Orders' personalization: It will determine the order penetration point in the SC.
- Availability of products: It depends on the inventory policy and the suppliers' management.
- Lead time and reliability of orders' delivery: It depends on the designed distribution network.

The service quality offered by any E-Commerce depends on the selected business model, of which there are three main possibilities [7]:

- **Drop shipping business model:** Regarding this option, the main company only processes the orders and invoices, and manages the database. However, the main responsibility of preparing and handling the orders to customers completely depends on a third party. On the one hand, the main advantages of this model are its low risk and the small amount of investment required. On the other hand, this business model also has significant disadvantages:
    - It does not ensure which service level is really being offered to the customer since the handling is under the control of the third party.
    - It does not allow the main company to get close to its customers.
    - The drop shipping creates a significant dependency on suppliers, which eventually causes very tight profit margins.
- **Ownership of the SC:** There are companies which invest in building their own SC. Regarding this scenario, the main company takes risks and has to deal with a significant investment. However, the main company will receive all the value generated through the online sales (Amazon would be an example of this business model).
- **Hybrid system:** Finally, there are companies which decide to run mixed systems, using specialized logistics operators or shared distribution systems (for instance, Zara uses some warehouses and the logistics service of the third party XPO Logistics [14]).

Hence, service quality depends significantly on the selected business model and the fact is that the company will select the main business model depending on its economic capacity, and on the collaboration agreements reached with its suppliers and third parties.

In relation to Company V's online project, the value proposition and business model are defined as explained below:

- On the one hand, the value proposition will be to improve several factors of the offline business, such as:
    - Offer products at more competitive prices, for the same quality, by avoiding several intermediaries and optimizing logistics.
    - Online availability of all Company V's assortment of products, which are characterized by its high quality and traceability standards. It will be possible to make purchases at any time, from anywhere, and have them delivered at the required address.
- On the other hand, regarding the business model to be used, the aim would be that Company V eventually managed its own SC network, thus maximizing the service quality offered. However, since this company has no experience regarding the online business, it will be necessary to start using an externalized network, which will be also used to gain knowledge regarding online operations, thus subsequently it would be possible to internalize some of the activity. Regarding personalization, it will be limited and will depend on each specific product.

6.1.3 Design of the logistics system

Any E-Commerce needs a SC strategy to determine the most appropriate inventory policy management and the main distribution system. These two factors are directly related to the assortment of products that will be offered and to the delivery lead time promised to customers [7]. Hence, these two variables (the inventory and the distribution system) are really important to be analysed so as to define the most appropriate SC strategy to start the online business within Company V.

The Inventory:

As aforementioned, the online business requires providing customers with high service quality level, and products have to be always reachable by customers. Therefore, it is compulsory to analyse how to create, maintain and localize the inventory, which implicates the assumption of high maintenance costs as well as costs due to inventory obsolescence (regarding perishable products such as food). Some of the variables that will define the inventory policy management are the size of the products' catalogue, the geographic market to be attended and the required delivery lead time of orders.

Furthermore, there is another variable to consider: the behaviour of products' demand, which varies depending on the customers' needs. Obviously, the more predictable products' demand is, the easier it is to optimize the inventory, and vice versa. Hence, regarding the behaviour of

products' demand, the following two facts have to be considered [7]:

- On the one hand, when demand is easy to be forecasted, the company should develop appropriate planification systems regarding inventory.
- On the other hand, when demand cannot be easily forecasted, the company should either work close with its suppliers so as to be able to react quickly, or it should use promotional campaigns to control demand variability and sell those products which have lower sales' turnover.

Considering the online business of Company V, the inventory policy management will be complex due to the wide range of products that are produced and the need to manage deliveries within a tight lead time. In addition to this, it will be necessary to analyse the behaviour of products' demand, owing to the fact that food consumption depends on the season of the year and also on the specific geographic area which is covered.

Therefore, to manage an online business appropriately, it is worth having complete visibility of the inventory and of its localization, which can be achieved through the unique inventory technique. This will be required so as to manage Company V's online business appropriately.

The Distribution System:

There are two main points to be considered when designing the distribution system of an E-Commerce's SC: the location of the facilities and the property of the distribution system [7].

- Location: Facilities can be distributed either as a centralized or a decentralized distribution system, depending on the characteristics of the market, the required delivery lead time of orders and the orders' size. On the one hand, a decentralized distribution system is recommended for regional markets, small orders' size and when the delivery lead time is tight. On the other hand, centralized systems are convenient for global markets, big orders' size and when the delivery lead time is not too tight.
- Property of the distribution system: Regarding this point, the decision of externalizing or owning the facilities of the main distribution system has to be assessed depending on the financial capacity of the company, and the required storage systems and business competences. On the one hand, owning the distribution system is recommended when the company has plenty of financial capacity, and when it requires specific storage systems and significant operative competences. On the other hand, externalizing the distribution system is convenient for companies which have limited financial capacity, and which do not need specialized storage systems and which work with non-operative competences.

In connection with Company V's online business, it will be possible to take advantage of the existing facilities owned by the company, which are decentralized and distributed throughout the Iberian

Peninsula. Hence, the location of the available facilities is already fixed. However, it will be necessary to decide whether it is better to use a centralized or a decentralized distribution system. Despite the fact that Company V has enough financial capacity to manage its own distribution system within the online business, it is determined that it would be more convenient to start externalizing most of the services due to the lack of knowledge regarding online operations. Hence, this strategy will allow Company V to gain knowledge about back-office software for online businesses (i.e. Magento) and the need to have all the inventory integrated through the unique inventory technique. Eventually, due to the specific requirements that have to be followed when managing food and the need to use specialized storage systems, the most convenient will be to internalize as much as activity as possible.

Moreover, it is very important to note that the distribution system, together with the business model, might evolve over time depending on the company's financial capacity, the development of new capacities, or changes regarding customers' needs and the evolution of the logistics sector. For instance, at the beginning, Amazon had to build its own centralized distribution system in the USA due to a lack of specialized operators. Subsequently, due to the expansion towards Europe, it had to decentralize its distribution system and it had to externalize some activity, such as some logistic activity in Spain, which is currently managed by Logista and Norbert Dentressangle.

6.1.4 Order penetration point

Nowadays, due to the increase of global markets, competition and shorter product life cycles, the positioning of the order penetration point (from now on, it will be named OPP) has become a strategic key factor when designing a SC.

Actually, the OPP is the point within the manufacturing value chain where a specific product is linked to a specific customer order and, depending on the position of the OPP, there are four main manufacturing environments [1]: engineer to order (ETO), make to order (MTO), assemble to order (ATO) and make to stock (MTS). Therefore, as indicated in *Table 3*, the main manufacturing chain can be divided into the following two main stages. Notice that the dotted line stands for forecast-driven activities, and the continuous line stands for customer-order-driven activities.

- On the one hand, there is one stage that is forecast-driven (upstream the OPP, that is the dotted line in *Table 3*). Regarding this stage, push and lean manufacturing strategies are recommended.
- On the other hand, there is another stage that is customer-order-driven (the main OPP and downstream, that is the continuous line in *Table 3*). Regarding this stage, pull and agile manufacturing strategies are recommended.

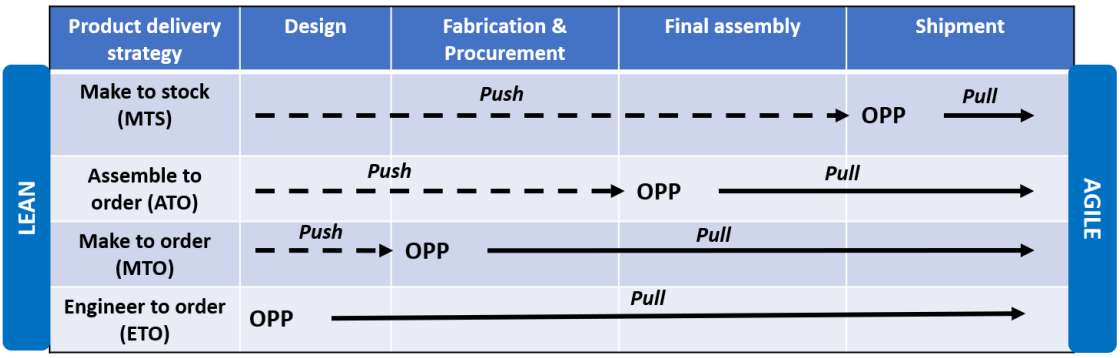

Table 3: Product delivery strategies according to the position of the OPP [1].

The positioning of the OPP is a key factor when designing the SC network regarding Company V's online business and, in fact, there are three main factors that affect its positioning: the market, the product and the production characteristics [1]. These factors are explained below.

The Market:

- The ***delivery lead time required*** by the market indicates how far backwards the OPP can be located; the further backwards the OPP is located, the more lead time is needed to attend orders.
- The ***volatility of product demand*** indicates to what extent it is possible to manufacture products "to order" (high volatility) or "to stock" (low volatility). Whereas products can be forecast-driven if volatility is low, forecasting is very difficult when there is high volatility.
- In relation to the ***product range and product customisation requirements***, on the one hand, a broad product range and a wide set of customisations are not feasible to be provided through a MTS strategy since the investment in final good inventory would be too high. On the other hand, a narrow range of products and predetermined customer choices would make it possible to use ATO or MTS strategies.
- Regarding the ***customer order size and frequency***, on the one hand, large customer order sizes are associated with high demand volumes, which usually have lower demand volatility and, on the other hand, frequency leads to a repetitive demand so that forecasting can be accurate. For instance, a customer could make a long term delivery contract of a large order size, which could be delivered through frequent and small batches, so that almost a MTS strategy would be feasible.
- Eventually, there are products which have ***seasonal demand.*** So as to cover all demand when it occurs, it might be necessary to shift between MTS, MTO or ATO, depending on the season. For instance, it might be necessary to manufacture some products through MTS or ATO in periods with low demand to cover the peak of high demand.

The Product:

- Regarding the ***modular product design***, it is usually used for ATO strategies. It allows to provide customers with a wide variety of choices and, at the same time, lead time is significantly small and manufacturing efficiency is assured for upstream operations.
- The ***product's customisation possibilities*** significantly influence the location of the OPP. If the customisation choice has to be made at early production stages, the MTO policy would be the most appropriate, whereas if the customization choice can be made at a very late production stage, the ATO strategy could be applied, thus making upstream operations much more efficient.

The Production Characteristics:

- The ***production lead time***, which is a major factor to be considered regarding the delivery lead time required by the market.
- In relation to the capacity of the production process, it is important to locate the ***bottleneck,*** which is actually a candidate for the OPP due to the following two reasons:
    - On the one hand, considering demand volatility and product customization, it is advantageous to have the bottleneck upstream the OPP, so that the bottleneck does not have to deal with these issues.
    - On the other hand, the bottleneck should be located downstream the OPP so that it only needs to deal with products for which the company already has real customer orders.

There is a significant difference between pre-OPP and post-OPP operations and, in fact, two types of supply chain strategies are distinguished: lean or agile. In addition to this, the main competitive priority that is directly related to the location of the OPP is delivery speed: if delivery speed is an order winner (a characteristic which makes the product win orders), the OPP should be positioned as close to the final goods inventory as possible. Hence, the differences between these two stages are explained below [1]:

- On the one hand, regarding **pre-OPP operations**, lean strategies are recommended upstream the OPP. Usually, pre-OPP activities are forecast-driven and need to focus on optimizing the resource capacity, assuring price competition through cost efficiency and optimizing inventory.
- On the other hand, in relation to **post-OPP operations**, agile strategies are required downstream the OPP to provide competitiveness regarding delivery speed. In this stage, the process is difficult to be optimized because resources are customer-order-driven, thus some excess capacity might be required to respond to the variability of customer demand.

In relation to Company V's online business, the positioning of the OPP will depend on the level of internalization of the distribution system:

- Regarding the first phase in which, as aforementioned, the externalized SC network of Amazon (AMZ) will be used, the MTS technique will be required, due to the fact that products have to be ready to be dispatched inside AMZ's warehouses as orders are received, thus ensuring a tight delivery lead time.
- In relation to the second phase in which the main distribution system will be internalized within Company V, it will be necessary to use the ATO or the MTS techniques depending on each specific product and storage case, thus it will be possible to deal with a tight delivery lead time, which is one of the key requirements of the online business. Actually, the use of the ATO and the MTS techniques will be appropriate providing that customisation possibilities are very limited. These techniques will help when dealing with products that have seasonal demand. Eventually, the MTO technique could be also used to manage specific larger orders.

As will be explained subsequently, Company V has lot of experience managing its facilities through push production systems so as to attend B2B offline orders, and there is plenty of capacity regarding its processes of slaughtering (that is for beef, pork, poultry, rabbit and mutton), curing (that is for cured products) and manufacturing (that is for alternative protein products). Furthermore, as an advantage, the result obtained through these processes make it possible to use modularity so as to prepare exactly what customers order through the ATO technique (for instance, as will be explained subsequently, a slaughtered pork is a modular product, from which different references can be obtained depending on the order to be attended).

Eventually, the bottleneck within Company V's online business will not be within production processes, but in the picking and orders preparation process. Hence, it will be convenient to use the ATO technique, so that the bottleneck and the OPP will coincide. This positioning will also allow to use lean strategies regarding production processes (i.e. production costs will be optimized) and agile strategies will be applied within the picking and orders preparation process, thus delivering orders as efficiently as possible.

Nevertheless, in order to apply ATO and MTS techniques appropriately, the offered range of products within the online business will have to be narrowed and products' customization limited.

Obviously, at some point, it could be necessary to strategically change the position of the OPP either forwards or backwards the SC.

6.2 Omnichannel Strategy

Nowadays, consumers are demanding an excellent service level and much more comfort when purchasing. Consequently, businesses have the need of transforming consumption into a unique experience and to make it as comfortable and convenient as possible. In fact, due to the current high competitiveness of the market, offering the possibility to shop online with an appropriate customer service level has become a requirement to remain competitive.

To understand the word omnichannel, it has to be split in the word "*omni*", which comes from the Latin and means "*everything*", that attached with "*channel*" finally means "*all the channels*". Hence, an omnichannel strategy is based on the simultaneous and interconnected use of different communication channels with the main objective of bringing the online and the offline businesses together. Furthermore, all the available purchase channels are connected between them and every channel contributes to improve the whole shopping experience offered by the other channels, and to strengthen the relation between the offline and the online markets. Moreover, the omnichannel strategy also allows to collect a significant amount of information from customers' activity who use either the offline or the online channels, which is very useful to make the whole SC more efficient [15].

For instance, an example of omnichannel strategy would be the following: when a customer is in a physical store, it might use an online application to check whether a specific reference is available in that store and, afterwards, staff might help the customer to make the order online, which will be delivered afterwards in the indicated customer's address.

The omnichannel strategy cannot be confused with the multichannel strategy. The word "*multichannel*" means "*several channels*"; hence, customers have several channels through which they can make an order (the online website and the physical stores, for instance), but these channels are not connected between them, thus sellers who work in the physical store do not know about the online sales, and vice versa. Therefore, regarding the multichannel strategy, there is competitiveness between the different purchasing channels and there is no exchange of information between them.

Therefore, investing in the development of an omnichannel strategy leads to the improvement of customer service levels since customers will make the purchase with much more comfort. Actually, all the interaction points with customers are improved: offered services, sales, loyalty in the business, and the whole brand image. Moreover, as aforementioned, a large amount of data can be collected and analysed in order to improve the whole SC process.

So as to develop an omnichannel strategy, the following two main steps have to be followed from a general point of view [15]:

- To begin with, it is necessary to know the "buyer person" of the business. This concept was created in 1983 by Alan Cooper and its aim is to know several details of a brand's customers so that the business can develop specific strategies to cover customers' demand as appropriately as possible [16].
- Secondly, it is necessary to integrate the business' channels, and this requires the alignment of the offline and the online businesses. Due to this fact, it will be necessary to develop the unique inventory technique in order to be able to manage all the inventory from a centralized point of view.

In connection with Company V, once the online business will be functioning, multichannel strategies will have to be avoided and, instead, a robust omnichannel strategy ought to be developed; hence, the offline and online businesses will have to be interconnected so as to have the customer service level optimized. Therefore, it is necessary to know which are the main characteristics of an omnichannel SC, as well as the most appropriate fulfilment methods to be used. These facts are explained below.

6.2.1 Omnichannel SC Characteristics

The aim of this section is to determine the characteristics that are required in order to achieve an omnichannel SC, which will be necessary so as to align the online and the offline businesses within Company V.

The fact is that, currently, many companies still struggle to manage an omnichannel strategy due to the new requirements that their supply chains have to deal with, such as additional speed, complexity and efficiency. As aforementioned, customers now expect to be able to make their purchases either through the offline or the online channels, and they expect to receive them at the required address within a very short lead time between the order and the delivery, with appropriate service and convenience.

In order to deal with this new challenge, as stated by McKinsey & Company [9], omnichannel supply chains should match the following seven key elements:

- **1. Customer-centric supply chain strategy:** It is the starting point to design an omnichannel SC, which has to meet customers' needs throughout all channels. The following significant points have to be analysed:
    - Strategy and segmentation: It will be necessary to divide the SC into different segments and to provide each one of them with a specific objective. The SC will have to be appropriately adjusted to offer either responsiveness (agile strategy) or efficiency (lean strategy). As aforementioned, the positioning of the OPP within Company V's online business will be significant so as to use lean techniques within

the main production processes and agile techniques regarding the picking and orders preparation processes.

- Customer-backed service aspirations: So as to differentiate from competitors, it is necessary to offer customers something special across the different segments. Moreover, it is required to decide which factor customers value more: speed, flexibility, or service.
- Assortment and complexity management: The company has to determine how its general portfolio will be managed, that is, it has to assign to each sort of product the channel through which it will be commercialized. Hence, regarding the online business, Company V's global assortment will have to be reduced to specific references.
- Risk management: It is necessary to determine the main risks of the SC in order to be able to prepare the business to deal with possible SC disruptions by having the required contingency plans. Considering the main elements that will interact within Company V's online SC, the main risks that have been identified are the provisioning of products and the logistics provider. Their description and contingency plan are shown in *Table 4*.

SC Risk	Description	Contingency Plan
Provisioning of products	Commercialization of products which are produced just in one facility (beef, cooked products, rabbit, alternative protein).	In case one of these unique facilities was not able to produce for any reason, feasible substitute providers should have previously been identified.
Logistics provider	There is only one company which can provide B2C chilled logistics service throughout Spain.	In case the current provider had not enough quality service when delivering, a substitute would be required (B2B chilled logistics, internalization, small B2C chilled businesses).

Table 4: Risk management within Company V's online SC.

- Sustainability: The SC should support the circular economy and promote sustainability. Hence, regarding the development of the omnichannel strategy within Company V:
  - Food loss and waste will be reduced.
  - Logistics will be improved from a sustainable point of view through the unique inventory technique.
  - Sustainable packaging will be used: for instance, it will be required that packaging has the certificate FSC (Forest Stewardship Council).

- **2. End-to-End (E2E) planning and information flow:** It is essential to have key information flow capabilities so that the SC can function according to customers' expectations. Hence, so as to make deliveries within a tight lead time, it is necessary to have access to the right products in the right place and at the right time (real time). In relation to this fact, the following key points have to be assessed:
    - Demand planning and inventory management: Key demand signals have to be determined within the omnichannel environment, thus demand can be treated with advanced analytics. Hence, it will be possible to determine the optimal inventory level at each stage of the SC (DCs, stores, partners' facilities). Inventory should be constantly monitored to manage its availability as efficiently as possible.

      When developing the online SC within Company V and considering that it will have to be managed together with the ordinary B2B offline activity, both the inventory and demand will have to be analysed. On the one hand, the unique inventory technique will allow to know which stock is available for the online activity (B2B and B2C) and its location (in case a decentralized network was required). On the other hand, due to the fact that food consumption behaviour varies a lot depending on each specific area, demand should be analysed to position the inventory appropriately.
    - Supply and replenishment planning: The optimal amount of capacity has to be deployed along the different segments of the SC. Regarding Company V's online business, products' fulfilment in DCs and in partners' facilities will have to be accurately synchronized with customers' demand.
    - Sales and operations control tower: Its role is to align the different organizational entities when dealing with trade-offs and when facing constraints, due to the fact that specific customers, channels or orders might have to be prioritized.
    - Distributed order management: Its function is to ensure real-time visibility and accessibility of inventory across all channels of the SC and locations. Hence, in case a decentralized network was required to manage Company V's online business, it would allow to use the right fulfilment node to attend customers' demand efficiently.

- **3. Omnichannel fulfilment. Node operations:** Due to the current complex environment, it is necessary to have the key physical flow facilities to ensure competitive cost structures and an appropriate service level. Therefore, the following key points have to be analysed:
    - Warehouse management: To face such a complex environment, it might be

necessary to invest in automation to increase speed, quality and efficiency. Moreover, it is necessary to decide whether DCs should be internalized or externalized.

Regarding Company V's online business, the warehouse management will have to be externalized in the first phase of the development so as to gain knowledge and, subsequently, its internalization will be evaluated.

- Optimization of return flows: The SC structure has to consider the reverse logistics, which is necessary to manage returns efficiently. Both in Phase 1 and in Phase 2 of the online business, there will be the following two main return flows to be managed: from DC to the production facility, and from the customer (B2C and B2B) to the DC.

- **4. Omnichannel fulfilment. Transportation and logistics service provider (LSP) management:** It is necessary to have E2E transparency of product flows. Moreover, transportation costs have to be kept under control. Hence, it is necessary to choose the right logistics partners for each segment of the SC.

  In connection with Company V's online business, two main different LSP will be required so as to minimize transportation costs: one chilled B2B LSP to move goods from the production facility to either the DC or to B2B customers, and one chilled B2C LSP to transport goods from the production facility or DC towards B2C customers.

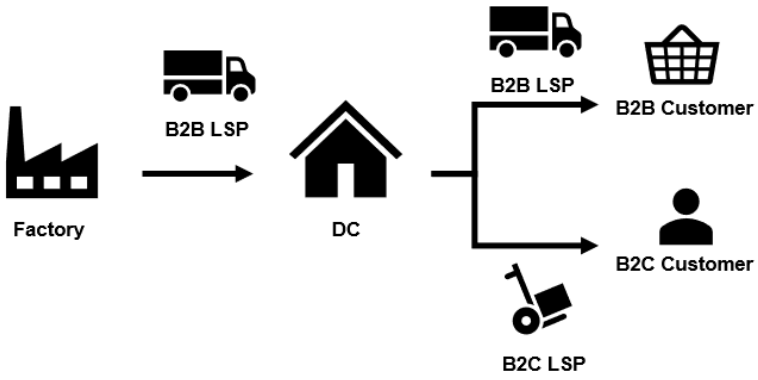

Figure 12: LSPs within Company V's online business.

- **5. Digitization and process automation:** To run an E2E omnichannel SC efficiently, the following three key points have to be analysed:
  - Software and data strategy: To have E2E visibility, it is necessary to choose the most appropriate software for each business. Furthermore, this software will also enable the capture of significant data along the value chain. The aim is to build an

omnichannel data lake to link the data from different systems, so that it will be possible to make decisions based on real-time information.

- Process automation: Advanced digital tools such as robotic process automations and Internet of Things (IoT) can help to improve the omnichannel SC efficiency.

Regarding Company V's online business and so as to manage it together with the existing B2B offline business, the following two main software systems will be used:

- On the one hand, one ERP (Enterprise Resource Planning) so as to control purchases, production and deliveries.
- On the other hand, one E-Commerce system called Magento, which is necessary to build the main online store and also to control the available inventory of each reference.

- **6. Operating model and change management:** The traditional management mode of the company will have to be adapted to the current new omnichannel requirements through the following three main elements:
  - Processes and structures: Firstly, the SC processes have to be designed prioritizing omnichannel optimization. Secondly, the company's structure should be adjusted to capture cross-channel benefits and information, thus avoiding silos between channels.
  - Capabilities and mind-set: Due to the fact that the omnichannel strategy might represent a cultural change within a company, it is necessary to determine the new skills that the whole company should learn.
  - Performance management: The performance of the E2E SC can be measured either considering the joint performance or considering each individual channel. The most appropriate method has to be chosen.

  Regarding the development of the omnichannel strategy in Company V, it is important to design the most appropriate SC so as to capture cross-channel benefits from the current existing B2B offline operations. This will require a significant cultural change due to the fact that, so far, the different facilities which integrate this organization have been working independently. However, so as to have an efficient omnichannel operations system, information such as inventory management will have to be shared across the different facilities. Eventually, regarding performance evaluation and owing to the current decentralized management, the most appropriate will be to measure the online business performance separately from the offline business performance.

- **7. Network and ecosystem of the future:** To finish, the following key elements have to be assessed so as to manage an appropriate omnichannel strategy:
    - The supply network: Suppliers' management has to be planned and they have to be integrated to enable an agile upstream SC, which has to be able to respond quickly to changes depending on omnichannel customers' requirements. Furthermore, the physical flow of goods through the network has to be planned, considering supply speed and footprint.
    - The distribution network: Firstly, it has to be decided whether a specific distribution network has to be designed for each channel, or if a general omnichannel network is good enough to cover all the different channels. Secondly, the right composition of this network has to be determined: number of DCs, node types or partners' facilities.
    - Inventory-sharing concepts: Depending on the business, inventory could be shared across all the channels, or each channel should manage its own specific inventory.
    - Customer collaboration: Along the SC, it is necessary to determine the key areas where customers' collaboration might be useful to improve information exchange and product flow, thus helping optimize the whole SC.

  Regarding Company V's online project, it will be managed as a complete new business, known as "facility V.O", whose aim will be to develop the online activity within Company V and build an omnichannel strategy, thus it will work close with Company V's offline business.

  Suppliers of the online "facility V.O" will be the main production facilities of Company V, which could also perform as warehouses and DCs. Hence, since everything will be owned by Company V, integration will be feasible and an agile upstream SC will be assured. Moreover, facility V.O will have to plan the physical flow of goods as efficiently as possible so as to attend the online demand.

  In connection with the distribution network, "facility V.O" will have to design the most appropriate one considering the possible use of external partners' facilities and the availability of all the facilities which currently constitute Company V. Hence, there will be two main distribution networks depending on the business channel that is attended (offline or online) but, since eventually the same facilities of Company V will be used, they will have to be integrated so as to provide an appropriate omnichannel experience.

  In relation to the inventory, even though everything is owned by Company V and due to the fact that the 48 current facilities are managed independently, facility V.O will have to buy the required products to other facilities within Company V. Initially, to simplify the project

and reduce uncertainty, the online assortment of products will be smaller than the offline one and, in fact, there will be some products that will be commercialized both offline and online at the same time. Actually, the fact that facility V.O will have to buy products to other facilities within Company V will improve the omnichannel strategy due to the fact that: facility V.O will have to optimize its inventory levels to attend the online demand and, at the same time, the other facilities in Company V will have to adjust their production schedules to attend both the offline demand and the requirements produced by the new facility V.O.

In connection with customer collaboration and taking into account that food consumption behaviour depends significantly on each specific location, online communication techniques such as questionnaires should be used so as to distribute the inventory efficiently throughout the SC.

Hence, the omnichannel strategy within Company V will be promoted through the online activity developed from the facility V.O, from where an appropriate SC network will have to be implemented so that customers can access Company V's products either through the offline or the online channels and considering that both business channels have to coexist. As shown in *Figure 13*, the SC network to be developed by facility V.O will have to consider the following elements: products' suppliers from Company V, key partners for storage and logistics, and the main online demand to be attended.

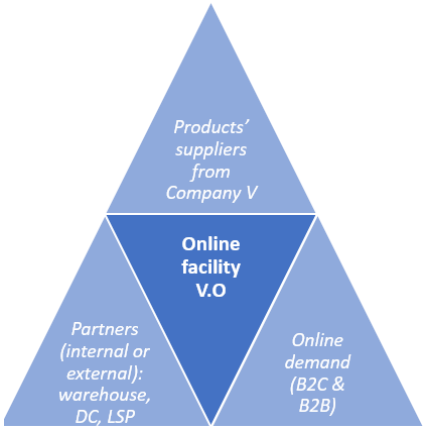

Figure 13: Facility V.O's key elements.

6.2.2 Fulfilment Methods

The purpose of this section is to analyse which are the most appropriate fulfilment methods for an omnichannel SC, which will be required in Company V.

When managing an omnichannel business, there are actually two main flows to be defined: the physical and transport flow of products, and the information flow.

Therefore, it necessary to analyse, from an operational point of view, the fulfilment options which

are available to run the whole SC in order to choose the most appropriate method for, in this specific case, Company V and the food market. This will help when designing the physical flow network, considering that the commercialized products are food.

The fact is that customers' orders can be supplied in several ways and, in addition to this, the most traditional and cost-efficient method has been, so far, shipping orders from a warehouse or DC. This is due to the fact that warehouses usually have a higher level of automation, they have been designed for handling significant volumes and, regarding its location, they are usually placed where operations costs are low, such as rural or industrial areas within the outskirts of large cities. Nonetheless, due to omnichannel strategies, increasing customer expectations require faster and more convenient deliveries [9]. Hence, the most appropriate fulfilment options will have to be assessed when developing the online activity in Company V through facility V.O.

There are several fulfilment methods that facility V.O could implement to develop Company V's online business depending on the following factors: lead time, degree of productivity, volume-handling capacity, inventory-holding capacity, and the operational costs (that is, employees' wages and rent) [9]. These methods are briefly described subsequently:

- **Ship from factory:** Orders are shipped directly from the production facility, which might be located offshore or nearshore, usually within low-cost countries. Despite the low operational cost and the high capacity of production and inventory-holding of this method, the required lead time might be too high for an omnichannel SC that has to be agile and responsive.
  Nevertheless, regarding Company V's geographic distribution, its facilities are all distributed throughout the Iberian Peninsula, mainly in rural areas. Hence, considering that production facilities are significantly close to the target market, facility V.O could ship some products from factory so as to attend specific areas with enough agility and responsiveness.
- **Ship inventory in transit:** Products are directly shipped to determined destinations depending on specific customer orders or according to demand sensing. The required lead time is still too high for an omnichannel strategy.
  Owing to the geographic distribution of Company V's facilities, they are not far from the market and shipping routes are not long. Hence, this fulfilment method will not be used and, in fact, goods that are moved have to reach a specific customer or a specific warehouse.
- **Ship from warehouse or distribution centre (DC):** Regarding this method, products are manufactured in the factory and they are subsequently stored in a DC, from where they can be shipped to the customer. The SC can function through a centralized or decentralized DC network and, in addition to this, warehouse operations can be internalized or outsourced to a 3PL (*Third Party Logistics*). These facilities are usually located close to the final destination market (according to demand sensing analysis) and are significantly

automated, thus lead time is reduced. However, operational costs are slightly higher than the previous fulfilment methods.

In connection with Company V's online business and so as to offer the agility and responsiveness that an omnichannel strategy requires, facility V.O's SC will have to consider the use of a DC network so that products are located close to target customers. In fact, DCs candidates might be internalized or externalized and centralized or decentralized. Regarding the possible use of internalized DCs, the main candidates would be the main production facilities of Company V, although just some of them will be appropriate since facilities have to match specific quality standards when dealing with food: specific storage conditions will be required (that is, dry, chilled or frozen conditions) and cross contamination has to be prevented. In addition to this, facility V.O will have to use demand sensing so as to locate products in the most convenient locations depending on food consumption behaviour.

- **Ship from dark stores:** Regarding the concept of dark store, it is a noncustomer-facing warehouse, significantly small and non-automated, that is usually located in or close a densely populated area. In spite of causing a reduction of production and storage capacity and that it increases operational costs (processes are not automated and there is no economy of scale), dark stores allow to reduce lead time significantly. In fact, when the dark store fulfilment method is chosen, the following main capabilities have to be developed:
    - Regarding the physical flow, it is necessary to supply the dark store through small quantities at a high frequency.
    - In relation to the information flow and so as to have the right inventory in the facility, it is necessary to develop demand sensing and capacity planning at each location. Moreover, dark stores require real-time and accurate inventory visibility.

  The use of dark stores within the SC network of facility V.O would allow to reduce orders' lead time significantly, especially regarding densely populated markets. For instance, in this case, the use of food parcel delivery 3PLs would allow to deliver orders in less than 24 hours.
- **Ship from retail store:** Regarding this method, in-store inventory is mainly used to supply orders which customers have made online but are keen on collecting them in-store.

  Unfortunately, due to the fact that Company V does not own any retail store, this fulfilment method is not feasible now.
- **Ship from pop-up node:** This innovative method is based on using specific elements such as trucks, vans or bikes as temporary DCs, which have been previously supplied with a

low amount of products to attend demand from customers who will buy via an app when attending a special event. Despite the fact that the lead time is almost null, this method's operational costs are very high. For instance, a pop-up node would be a container placed in a sports event or a truck which drives around a city holding some inventory just to attend demand from customers who order via an app. In fact, 3-D printing techniques could also be used regarding this fulfilment method.

Despite the chance of offering such a tight lead time to customers, this fulfilment method is too innovative to be applied when developing facility V.O's network.

- **Consumer:** As aforementioned, facility V.O will have to develop an appropriate inverse logistics strategy so as to manage returns efficiently.

To sum up, it is clear that, when running an omnichannel strategy, it is important to reduce lead time as much as possible so as to be agile and responsive. Therefore, it is necessary to use a fulfilment method which enables proximity to the customer, even though it makes operations to be less efficient and more costly, as well as the need to develop new capabilities within the organization.

In connection with the development of Company V's online business, the two main fulfilment methods that will be used by facility V.O are: the shipment from factory and the shipment from warehouse or DC. In addition to this, an improvement could be implemented in the near future by shipping from dark stores.

These fulfilment options require specific information flow capabilities: demand and inventory planning, stock visibility throughout the decentral node network, and distributed order management.

As will be explained below, Company V's facilities currently operate from a decentralized point of view (i.e. inventory status is not shared across the organization). Nonetheless, in order to appropriately manage the omnichannel strategy within Company V, the alignment of the offline and online business units will be necessary and, due to this fact, it will be necessary to start developing the so-called unique inventory technique: it is an inventory management strategy based on the complete integration of the company's inventory, which will be managed from a centralized point of view through a complete visibility of both quantity and its localization. Hence, inventory management will be optimized so as to attend both the offline and the online business units in Company V.

As aforementioned, the fact is that when developing Company V's online business, it will be necessary to attend demand coming both from the online and offline business channels, like FNAC or Inditex currently do.

Regarding this challenge and as stated by FNAC's SC director "*inventory does not have to increase, but it is necessary to use it better through the concept of total single stock*" [17].
As will be explained in the next section, the design of an omnichannel SC requires testing, learning, and adjusting the SC network according to customers' needs [9]. Through this testing and using the unique inventory technique, it will be possible to efficiently manage Company V's inventory, which is a significant KPI due to food limited shelf life.

6.3 Online Food Businesses

Considering what has been explained so far, it can be stated that, since consumers can now easy use Internet's services, the online business has experienced a significant increase in terms of volume of sales, and it is now being used by significant companies within the retail sector.

In connection with this project, its aim is to analyse online operations within the food industry so as to design the appropriate SC network that will be required to efficiently manage Company V's online business, which will be based on food. The fact is that online food businesses must consider additional constraints in comparison with non-food businesses, such as specific storage requirements (that is, dry, chilled or frozen conditions) and the fact that the sort of product which is handled has a limited shelf life.
Hence, before starting to develop Company V's online business through the new facility V.O, the following two success cases of online food businesses have been analysed: the Mercadona E-Commerce and the AMZ Fresh marketplace.

6.3.1 Mercadona E-Commerce

Mercadona, as many other retailers worldwide, already provided customers with the possibility of delivering their purchases, which can be made either through the webpage or in the store, at the required address. Nevertheless, as stated in [18], it is now developing an E-Commerce strategy based on the "hive model", through which there has been a significant improvement in terms of productivity and efficiency, owing to the fact that online orders are not prepared in the main stores but in specific warehouses known as "hive", where the picking and preparation of online purchases are realized.

Hence, as explained in [2], Mercadona launched its online purchase project in 2018 with a strategy known as "laboratory", which consists in starting the E-Commerce business covering only specific postal codes so as to be able to learn consumption patterns and improve E-Commerce operations before expanding the business. Therefore, to begin with, in 2018 it built its first warehouse called "the hive" in Valencia, which would be only used for online purchases. Subsequently, once E-Commerce operations in Valencia would have been consolidated, this model would be also applied

in Barcelona (2019) and in Madrid (2020). In relation to the hive and the laboratory strategies followed by this company so as to launch its online business, the service will be activated only in specific key cities and, in addition to this, covering just specific postal codes at the very beginning. Moreover, it would have a specific warehouse called “the hive” in each of the selected places.
The main aim of the laboratory strategy is to initially test the online service within a specific area and to gain knowledge so as to be able to improve the whole E-Commerce service and operations in each major city. This is actually what this organization has been realizing in Barcelona and Madrid.

In connection with the launch of Mercadona’s E-Commerce service in Barcelona [2]:

- On the one hand, considering the **hive model**, a warehouse was opened in June 2019 in the industrial park of Zona Franca (see location in *Figure 14*). Hence, both the preparation and expedition of online purchases would not be made from the ordinary stores but from this new facility so as to improve productivity and efficiency. This hive warehouse required an investment of 7 million euros and it would have a surface of 10500 squared metres, from which 2500 squared metres would be only used for fresh products.
- On the other hand, regarding the **laboratory method**, initially the service would be only available within the neighbourhoods of Les Corts and Sarrià Sant Gervasi (see location in *Figure 14*), from where it had been forecasted that there would be a demand of 30000 deliveries per month and a staff requirement of 92 employees. Afterwards, as E-Commerce operations would improve and consolidate, this service would be extended towards other neighbourhoods within the city as well as to other villages located around Barcelona.

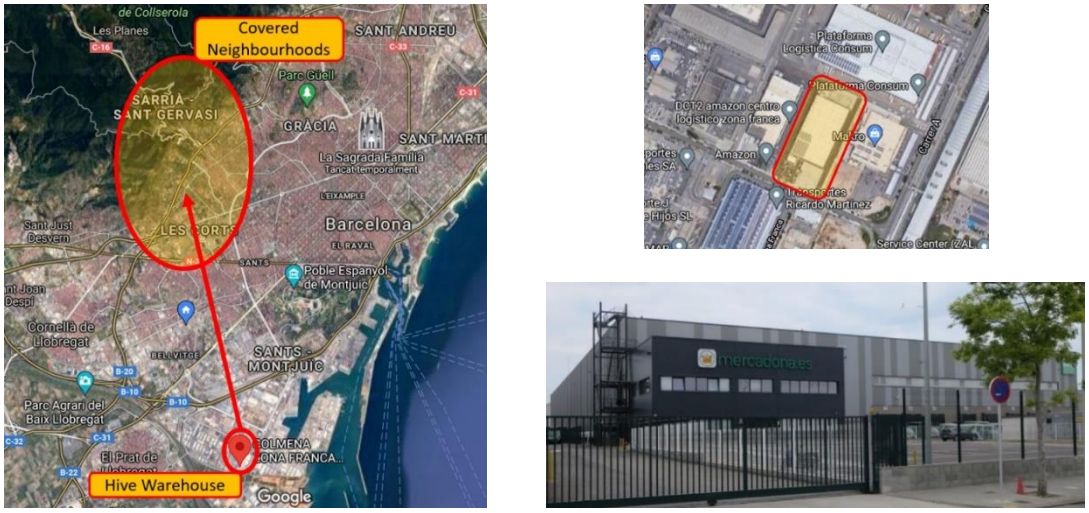

Figure 14: Mercadona’s hive warehouse in Barcelona (Zona Franca) and initial covered area (Source: *Google Maps*)

In relation to the launch of Mercadona's E-Commerce service in Madrid, as explained in [18], it was launched the 20th April 2020, thus becoming the third Spanish hive:

- On the one hand, the **hive model** was applied with the opening of a warehouse in Getafe, from where only those purchases which had been made through the online store would be prepared and expedited, instead of doing this process from its ordinary stores. This warehouse required an investment of 12 million euros as well as the hiring of 350 employees.
- On the other hand, regarding the **laboratory strategy**, the E-Commerce service in Madrid was just available within the neighbourhoods of Retiro, Salamanca and the area of Mendez Alvaro. Subsequently, as operations were being consolidated, the service was expanded to additional postal codes in the city, thus it became possible to cover the neighbourhoods of Rios Rosas, Chamartín, Tetuán and Ventas (that is, the following postal codes: 28002, 28003, 28016, 28020, 28036, 28046 and 28028).

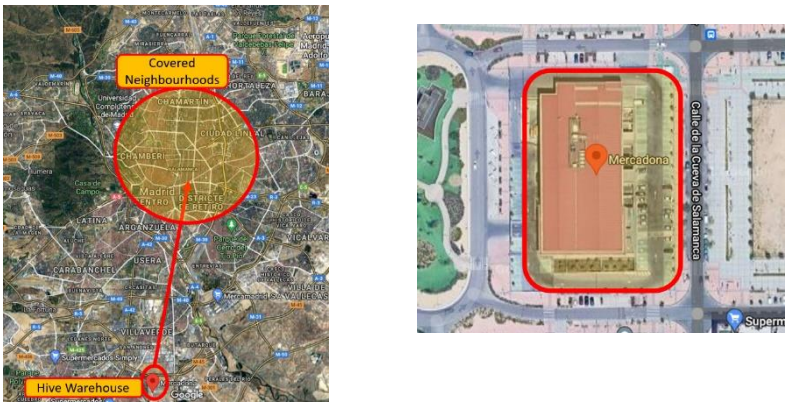

Figure 15: Mercadona's hive warehouse in Madrid (Getafe) and the initial covered area (Source: *Google Maps*).

Therefore, Mercadona's strategy to develop the online business is based on the following two main points:

- **The hive model:** Instead of using the ordinary stores so as to realize all the picking process to attend online orders, it has decided to build warehouses which are specialized in the picking process which is required to attend online orders. These warehouses which are only used to attend online purchases are called "hives". Due to this strategy, productivity and efficiency have increased by 4 times in comparison to the orders' preparation process which used to be made in the ordinary stores [2]. For instance, due to this model, orders which have fresh products can now be prepared the same day when they have to be delivered, thus quality, freshness and the whole cold chain are improved.

- **The laboratory model:** The aim of this strategy is to learn the online consumption patterns of each determined area. Food consumption behaviour varies a lot depending on the specific Spanish area which is analysed. Hence, Mercadona's aim is to start its online activity step by step, gaining knowledge about food consumption behaviour so as to improve its SC and manage warehouses' inventory as efficiently as possible.

In relation to the delivery of online purchases, Mercadona has the required logistics service internalized. As explained in [2], specific vehicles for its E-Commerce service have been designed by its partner Subiela: these vehicles have been equipped with three different departments, and each one of them is set at a specific temperature so that all sort of products can be transported (non-refrigerated, chilled and frozen). Actually, it has two main types of vehicles: one model which can carry up to 15 orders, and the other one which can carry up to 9 orders and which is specifically used to access hard – to – reach locations. These vehicles are mechanized to minimize cargo handling and to reduce the download and delivery amount of time as much as possible.

To finish this analysis, the main characteristics of Mercadona's E-Commerce service have been summarized in the following *Table 5* [2]:

Delivery Locations	Mercadona's webpage allows to make the E-Commerce purchase only in those postal codes of Valencia, Barcelona and Madrid where home delivery is available.
Delivery Cost	The preparation and delivery cost of any E-Commerce order has been set at 7.21€ (taxes included).
Minimum Order	50.00 €
Delivery Lead Time	The delivery is scheduled in the day after of the purchase, from 7:00h to 22:00h, from Monday to Saturday. The delivery time frame can be chosen with 1 hour slot.
Products	The assortment of products is equivalent to the one available in the offline stores and products are classified into different categories.
Fresh & Frozen Products	The maintenance of the cold chain is assured by using internalized vehicles which are equipped with three different departments for non-refrigerated products, chilled products (5ºC) and frozen products (- 22ºC).

Table 5: Mercadona's E-Commerce characteristics [2].

6.3.2 AMZ Fresh Marketplace

In connection with Amazon (AMZ), after having organized an efficient SC for non-perishable products that can be stored in dry conditions, it decided to create AMZ Fresh, which has the aim of becoming another efficient SC capable of supplying and dealing with perishable products that require either chilled or frozen storage conditions. Hence, in addition to the comfort of purchasing food online (the purchase can be realized at anytime and anywhere), the order would be delivered at the required place and within a tight lead time. As stated by AMZ Fresh' vice-president Ajay Kavan in [19], "*the key to success is a combination of low prices, wide range of products and*

efficient delivery".

The AMZ Fresh service was launched in 2006 in Seattle (USA) [20], and purchases and distribution processes of different food products where analysed during several years. Afterwards, AMZ Fresh service landed in Europe in 2016 through the UK market, in London, and it finally reached Spain 15 years after its birth, in 2021 [19]. Currently, the AMZ Fresh service is available in specific key cities within the following countries: the United States, Japan, the UK, Germany, Italy and Spain.

In connection with the beginning of AMZ Fresh in Europe, AMZ's customers who lived in London had access to a wide range of food references that would be delivered at their homes. The main characteristics of this AMZ service which started in London were the following [19]:

- **Purchase:** AMZ Fresh services were only available for AMZ' Prime customers who lived within 69 specific postal codes in London.
- **Delivery schedule:** The delivery was available within 1-hour slots, from 7:00h to 23:00h, from Monday to Sunday. Moreover, same day deliveries were available for orders that had been made before 13:00h.
- **Delivery costs:** Those orders which had a value higher than 40 £ had free delivery service, whereas orders which had a value lower than 40 £ had a delivery cost of 3.99 £.

Regarding Spain, AMZ Fresh began its activity the first week of February 2021 in Madrid, offering a wide range of fresh and frozen products which would be delivered at the required address. The main characteristics of this AMZ service that started in Madrid are the following [20]:

- **Purchase:** AMZ Fresh service in Spain is so far only available for AMZ Prime customers who live in the city of Madrid and within its surroundings.
- **Delivery schedule:** Purchases are delivered within slots of 2 hours, between 8:00h and 24:00h. The most convenient schedule can be chosen when making the online purchase.
- **Delivery costs:** Those orders that have a value higher than 50€ have the delivery for free, whereas purchases whose value is less than 50€ have a delivery cost of 3.90€. Moreover, a minimum purchase value of 15€ is required.

Subsequently, AMZ Fresh service was also launched in Barcelona the 2nd March 2021, with the same conditions as the ones available in Madrid [21].

Therefore, AMZ Fresh service will be offering more than 10000 references of fresh and frozen products, such as meat, fish, fruits, vegetables, or milk. It will be competing against significant retailers which have also started offering food E-Commerce services, such as El Corte Inglés, the aforementioned Mercadona E-Commerce or Carrefour. Actually, it has to be noted that AMZ Fresh is likely to represent 5.8% of the whole Spanish food industry within the short term [21].

AMZ Fresh's vice-president Ajay Kavan stated that "*it is necessary to design the system step by*

step so as to improve the service according to the learning achieved by practice and customers' opinions" [19]. Owing to this fact, the AMZ Fresh service is initially only available within determined postal codes of each city, and it will be expanded step by step according to the laboratory strategy.

As a conclusion of these two success cases regarding online food businesses, there are significant tools which should be applied when developing Company V's online business:

- In relation to the **hive model**, facility V.O will have to determine the most appropriate DC network to make the picking and dispatching process of online orders (B2C and B2B). These DCs might be externalized or internalized and they might work according to a centralized or decentralized system.
- Regarding the **laboratory model**, facility V.O should progress step by step to develop Company V's online business appropriately. Hence, as aforementioned, this online business will be developed through the following two main phases:
    - **Phase 1:** Facility V.O will use the externalized SC network of AMZ in order to gain knowledge about the online food business, due to the fact that Company V has huge experience regarding B2B offline operations, but none regarding the online food business.
    - **Phase 2:** After achieving some know-how in phase 1 and so as to improve the offered service level, operations should be internalized within Company V, taking advantage of the possibility of using its facilities, which are distributed throughout the Iberian Peninsula, as DCs. Regarding this phase, it will be necessary to decide whether it is better to operate with a centralized or a decentralized SC network. In fact, the following strategy will be followed: to begin with, a centralized SC network will be implemented, through which a significant amount of data will be collected about the consumption behaviour throughout the country. Subsequently, facility V.O will be able to design the most appropriate decentralized SC network taking into account the analysis of the collected data.
- Finally, depending on each phase within the development of Company V's online business, specific delivery schedules and costs will be set, and the covered geographic area will have to be determined.

7 Functioning of Company V

As explained before, Company V is an agri-food company constituted by 48 different facilities, which are distributed throughout the Iberian Peninsula and with the property that each facility is specialized in one specific step of the whole chain.

Regarding the development of Company V's online business, it will require the creation of facility V.O, whose aim will be to build the required SC network so as to manage the new online business together with the current offline operations as efficiently as possible.

Therefore, so as to design the most appropriate SC network for the online business and the development of an omnichannel strategy within Company V, it is necessary to cover several specific details regarding its current functioning:

- Company V has complete **vertical integration**, that is, backwards and forwards.
    - Through its **backward vertical integration**, it has control over its essential suppliers. Hence, it strengthens the efficiency of the production processes by assuring the provisioning of appropriate raw materials, according to the lead time and quantity batches agreed. Moreover, it also allows to control raw materials' costs, thus making it possible to offer a significant competitive price within the market. For instance, farms buy the compound feed that is required to the main Company V, which will assure excellent quality, competitive costs and agreed lead time.
    - Regarding its **forward vertical integration**, it allows the company to improve its logistics and have additional new commercial channels. On the one hand, it allows to offer a much better after-sales service through a complete knowledge of the required production process and, on the other hand, it provides the company with a large amount of information regarding customers' opinions. For instance, the manufactured compound feed is used to supply the farms.
- In connection with its complete vertical integration, Company V can assure the **complete traceability** of any produced product, from the origin of the main raw materials to the final consumer who eventually eats the product, at any stage level, E2E.
- In general, Company V uses a **hybrid operating model** [22]: a large number of issues are managed from a decentralized point of view, whereas specific strategic tasks and decisions are centrally controlled.
    - In connection with its **decentralized operating model**, so as to promote competitiveness, each of the aforementioned 48 facilities is considered as a single business which has to optimize its own profit and loss account. In addition to this, since Company V has a large variety of different manufacturing facilities, the best

method to manage them is through a decentralized operating model. Therefore, each facility manages its distinct SC network according to its specific requirements. Considering a decentralized operating model, standardization and efficiency are assured in each facility, and the key advantages are that it is faster, more agile and more responsive to change according to consumer preferences.

  - In relation to its **centralized operating model**, it is basically used to plan the procurement of raw materials that are required for almost all its facilities (that is: wheat, soy, packaging, etc), thus economies of scale can be applied and purchase costs improved. Moreover, strategic decisions that affect a specific facility are also analysed from a centralized point of view.

- One of the main competitive advantages of Company V is its high production capacity of different agri-food products such as flour, feed, animals' medicines, livestock, meat and packed products. In fact, its facilities use push production systems so as to achieve economies of scale, efficiency and very competitive production costs through lean production techniques.

  Nonetheless, the challenge is that, due to the decentralization of its facilities, the manufactured inventory is managed independently in each facility. Therefore, there is no centralized inventory integration nor general inventory visibility across Company V and, due to this fact, inventory management cannot be optimized nor food loss and waste minimized. This issue will be assessed in the next section.

- To finish, in connection with Company V's push production technique, the sort of product which is obtained has modularity: as shown in *Figure 16*, the products which are obtained at the end of Company V's production chain and which are processed in the slaughterhouses are modular, since they all have the same parts. For instance, a slaughtered pork is a modular product from which different references can be obtained depending on the order to be attended. Therefore, regarding the second phase of Company V's online business, facility V.O will be able to apply the ATO (assemble to order) or the MTS (make to stock) techniques to attend the online demand. Regarding these methods, lean techniques can be applied when producing, and agility is guaranteed in the orders' preparation process.

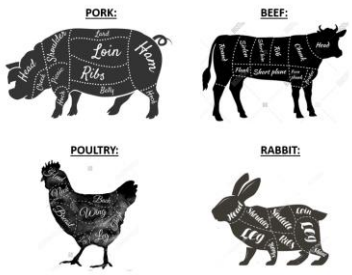

Figure 16: Modularity in Company V's products.

7.1 Food surplus and waste

As aforementioned, due to the decentralization of facilities, there is no centralized inventory integration within Company V and inventory management cannot be optimized, thus there is usually some amount of food which has to be thrown away. Therefore, there is food waste throughout the different facilities that is caused, among other reasons, because of an ineffective management of food surplus.

The expression "food loss and waste" (FLW) indicates the amount of food production that was originally produced for human consumption, but was not finally consumed; FLW is the amount of food that has been produced, retailed or served but that has not been consumed nor redistributed to feed people, animals nor used to produce new products. For instance, in 2010, FLW represented between 30% to 40% of all food production and, in 2013, it was determined that the amount of FLW produced was, as average, 1.3 billion tons per year world-wide [23].

One major factor that eventually causes FLW is food surplus, which can be managed in several different stages of the food supply chain so that it does not become FLW, either recovering it for human consumption or preventing it at the main source by limiting the use of the unnecessary natural resources.

As explained in [23], the Circular Economy (CE) indicates that technological innovations should be used so as to reduce FLW, through the valorisation of it at different stages of the agri-food supply chain, while discovering new business opportunities. Nonetheless, the adoption of innovative technological solutions to prevent food waste is actually a significant challenge for companies that work within the food supply chain. For instance, some technological solutions stated by CE to reduce FLW are explained below:

- The development of appropriate demand planning patterns would help the upstream stages of the food supply chain to adjust production, storage and distribution so as to minimize food surplus. Information sharing along the supply chain is very important, as well as the development of information systems to analyse data and make forecasting to avoid overproduction.

- In addition to this, the development of web platforms and apps might enable the sharing and redistribution of food surplus that otherwise would become waste.
- Finally, due to the perishability of food products, new technologies might allow to extend shelf life through packaging improvements of new storage systems.

It is clear that the agri-food supply chain is very complex and that there are lots of areas where CE principles could be applied so as to reduce FLW. In fact, one of these areas is the inventory management, which is crucial when dealing with products that have a limited shelf life.

As aforementioned, Company V, in spite of the fact that it has complete vertical integration, it has not the inventory integrated (there is no "unique inventory"). In the opposite way, it has been characterized by operating with a "push" production model and a MTS product delivery strategy, which enables the company to work with high volumes of production to achieve economies of scale, thus optimizing its operating costs.

Nevertheless, this "push" and MTS strategy also leads to a surplus of food inventory and, due to this fact, there is eventually some food waste. In addition to this, this scenario is also negatively affected by the fact of not having the inventory of the different facilities integrated, thus it is very difficult to control and optimize inventories throughout the company. The current FLW scenario in Company V is shown in the following *Figure 17*:

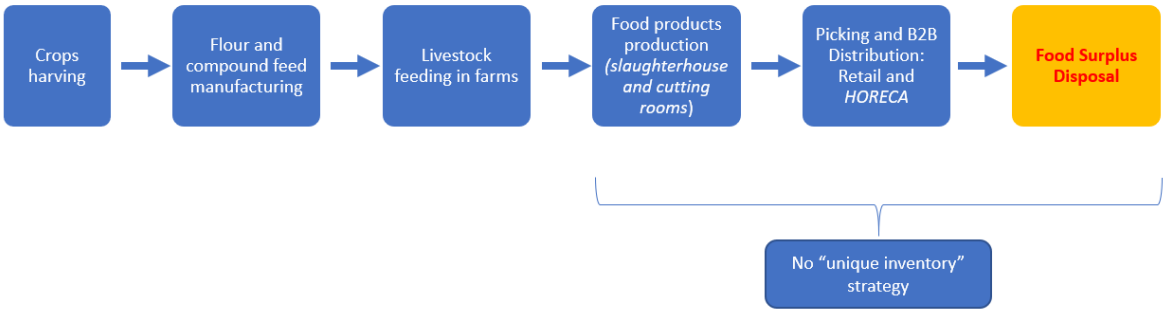

Figure 17: Current FLW status in Company V.

Therefore, one action that could be implemented in one of the last stages of the current supply chain of Company V would be the following: to create the aforementioned facility V.O in order to manage an online business channel through which already manufactured products which had a significant short shelf life could be commercialized with a significant reduction of price applied. This action would minimize current food waste and would be providing additional value to the whole agri-food supply chain, thus boosting the circular economy principles. The possible implementation of this new online business channel through the facility V.O within Company V is shown in the following *Figure 18*:

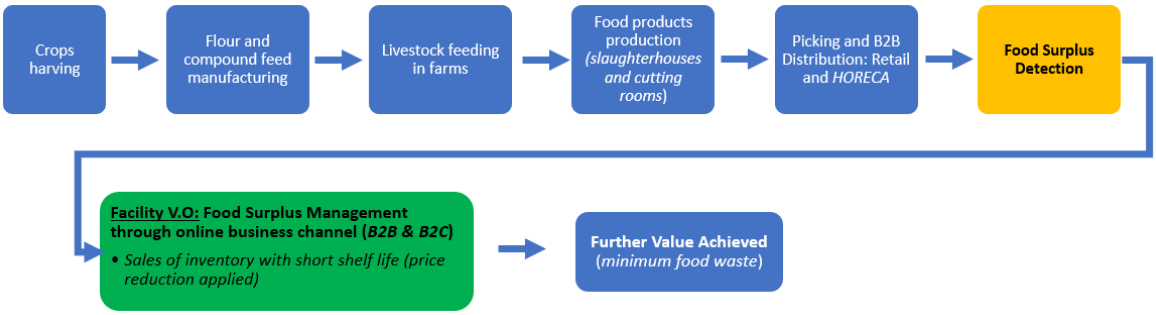

Figure 18: Technological action to reduce FLW in Company V.

In fact, owing to the development of this online business channel within Company V and more specifically due to its front office management, the food inventory could be optimized throughout the different facilities of the company. Hence, there would be savings for both the producers and the consumers: producers would be selling a surplus that would have been thrown away otherwise, and consumers would be buying products at cheaper prices (price reduction applied due to short shelf life).

Furthermore, the development of Company V's online business will require that facility V.O should start implementing the unique inventory technique within the Company V in order to have complete visibility of it across the different facilities, thus controlling parameters such as quantity, location and shelf life of the different references.

8. Development of Company V's online business

In connection with the development of Company V's online business and owing to the fact that it has no experience within the online channel, its introduction into this new business model has been planned through two consecutive phases, evolving from a very simple scenario towards a much more complex business model.

Furthermore, in order to measure the profitability of this new business channel and to design the most appropriate SC network, the aforementioned "facility V.O" will be created, which will follow the two phases explained below:

- **Phase 1:** To begin with, the externalized SC network of Amazon (AMZ) will be used so as to gain knowledge about the online food business, assessing factors such as demand or the operational costs. Moreover, this externalized partner will provide facility V.O with the possibility of commercializing the products throughout Europe.
- **Phase 2:** Subsequently, operations will be internalized within Company V so as to have much more first-hand control of all the processes and to improve the service level. Regarding this second phase, it will be necessary to assess whether it is better to have the SC network centralized or decentralized and, due to greater simplicity, facility V.O will be making the first test with a centralized SC network.

The main characteristics of these two phases haven been summarized in the following *Table 6.* Note that, as aforementioned, this analysis began the fourth term of 2019 and has been realized during 2020.

	Outsourcing level	Commercial channel	Sort of product	Geographic scope	Pull or Push	SC Management
Phase 1	Externalized (AMZ *Marketplace)*	B2C	Ham	Spain, France, Germany, UK	Push	Centralized
Phase 2	Internalized	B2C & B2B	Ham, Meat	Spain	Hybrid	Centralized Decentralized

Table 6: Phases of the online food business model implementation within Company V through facility V.O.

8.1 Phase 1

It was in the fourth term of 2019 that it was decided to start the online activity of the agri-food Company V. To begin with, as indicated in *Table 6*, facility V.O would make an externalized partnership with the AMZ marketplace.

From all the assortment of products that are produced within Company V, facility V.O decided to begin the online activity focusing only on the Iberian ham legs and shoulders commercialization (a variety of cured product), due to the following reason: this sort of product can be both kept and

transported in cool and dry conditions, with no requirement of chilled facilities nor cold chain conservation.

Once the sort of product that would be commercialized had been chosen, facility V.O had to select which Company V's facility would be the most appropriate for the orders' preparation process. To make this decision appropriately, the most important fact to know was the AMZ's warehouse where the product would have to be sent, since the distance between these two locations (the chosen facility and the AMZ's warehouse) would determine the transportation cost.

According to AMZ's policy, the warehouse that would be assigned for ham legs and shoulders would be the one located in Toledo.

In relation to the company's facilities where ham legs and shoulders (cured products) are produced (see light green points in *Figure 19*), the transportation cost from each one of them towards the aforementioned AMZ's warehouse had to be computed so as to choose the facility that would minimize this logistic cost.

To compute this logistic cost, the following facts of Phase 1 had to be considered:

- The possible facilities to be used were the ones located in points: 8 and 28 in Teruel, 17 in Guadalajara, 27 in Huelva and 34 in Salamanca (*Annex A.2*).
- Due to Company V's recommendations, this transport should be made in chilled conditions, thus an agreement had to be made with a chilled logistic operator.
- Owing to the fact that this company policy costs depends on the distance from the origin to the destination, the minimum logistic cost would be achieved by using the closest facility to the aforementioned AMZ's warehouse. As indicated in *Table 7* and *Figure 19*, the closest facility to the aforementioned AMZ's warehouse was point 17 in Guadalajara.

DESTINATION	ORIGIN	DISTANCE (KM)
AMZ's Warehouse in Toledo	(8) or (28) Teruel	326
	(17) Guadalajara	99
	(27) Huelva	570
	(34) Salamanca	250

Table 7: Distance to the available cured products facilities in Company V (source: *Google Maps*).

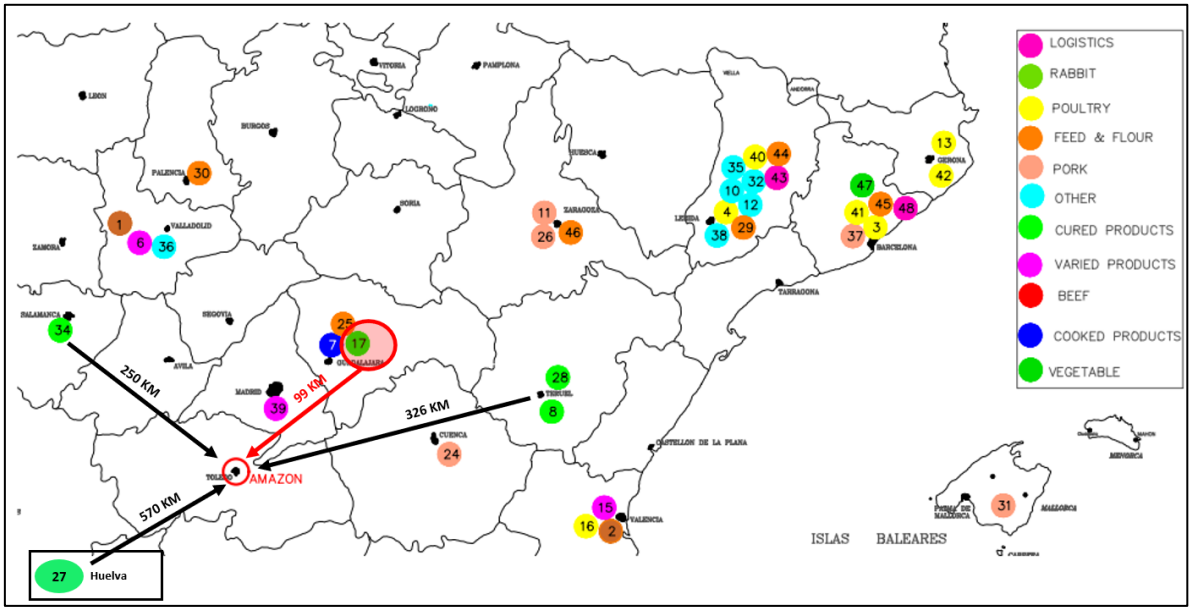

Figure 19: Phase 1 SC network.

Therefore, the required facility to be used so that facility V.O would minimize transportation costs is the one located in "point 17", in Guadalajara (highlighted in red in *Figure 19*).

It has to be noted that, despite the fact that AMZ Marketplace provides companies with the possibility of expediting orders from their own facilities (instead of expediting orders from AMZ's warehouses), due to Company V's operating model, only push operations were allowed so far, that is, no pull manipulations as orders would be received were allowed. Consequently, facility V.O had to send the products towards the aforementioned AMZ's warehouse, from where B2C orders would be prepared as they would be received.

8.1.1 Benchmarking analysis

As aforementioned, AMZ Marketplace would provide facility V.O with the possibility of commercializing Iberian cured products (ham legs and shoulders) throughout Europe. Hence, it was necessary to select the countries where it would be better to run each business and, in addition to this, there would be one specific back office for each country owing to the fact that, as will be explained afterwards, AMZ's operating costs depend on each country.

Cured Spanish ham is exported to more than 134 countries all over the world but, due to sanitary legislation and proximity, the EU is the main destination. Actually, the following graphic shows the continuous increase of general Spanish ham exportation volume from 2007 to 2017 [8]:

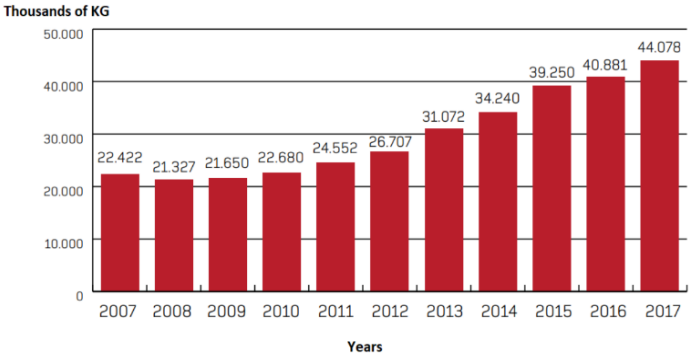

Figure 20: General Spanish ham export evolution [8].

Moreover, the following graphic shows the general Spanish ham exportation that took place in 2017, by country. As seen, the five most important countries regarding export volume of general Spanish ham in 2017 were: Germany, France, Portugal, Italy and the UK [8].

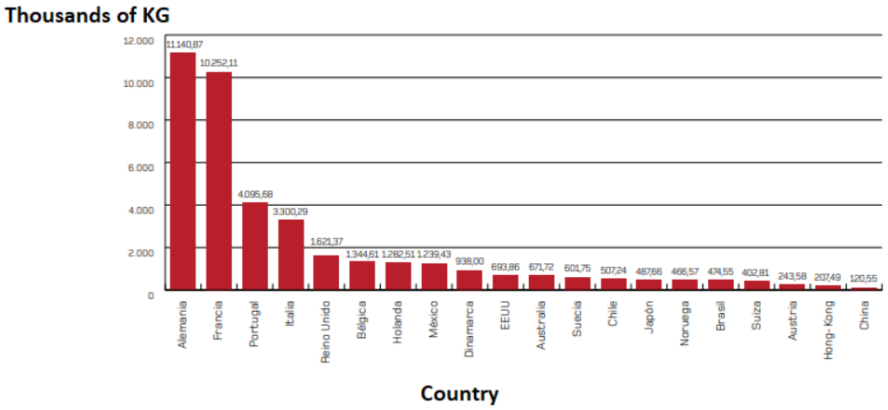

Figure 21: General Spanish ham export by country in 2017 [8].

Regarding specifically the Iberian breed ham and as stated in [24], "*65% of European people often eat Iberian ham and two out of ten people will increase consumption in the future*". Furthermore, as shown in *Figure 22*, the countries where the consumption of Iberian breed cured products is bigger are the followings: Germany (66% of population), the UK (58% of population), France (49% of population) and Spain (84% of population).

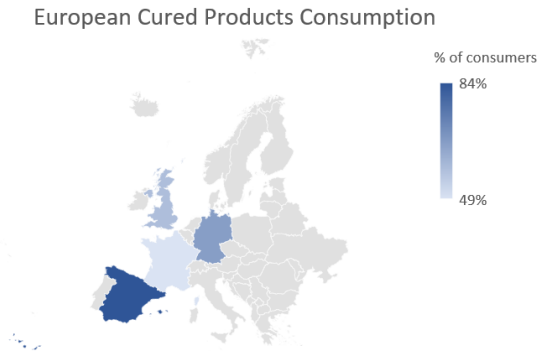

Figure 22: European countries that have a bigger consumption of Iberian breed cured products.

To sum up, regarding this Phase 1 and according to this analysis, facility V.O decided to activate the AMZ Seller back office in those countries where the Iberian breed ham consumption had been higher in addition to Spain, that is: Germany, France and the UK. Note that, as will be explained below, different references were activated in each country owing to marketing criteria.

8.1.2 Supply Chain

Regarding the supply chain required in Phase 1, there are three main players (see *Figure 23*):

- The selected facility of Company V, to which facility V.O will have to pay for the purchase of the main Iberian products and the orders' preparation process required.
- The main AMZ marketplace, to which facility V.O will have to pay for several services such as storage, B2C delivery or advertisement.
- The customers, who will eventually assess the offered service. If the order was not delivered appropriately, reverse logistics would be required.

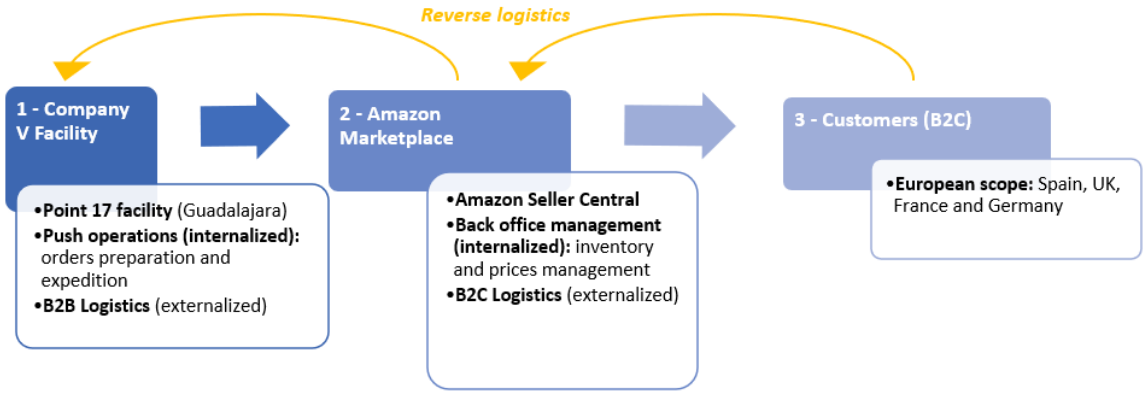

Figure 23: Phase 1 SC.

Capacity analysis in "point 17" facility:

The OPP strategy that facility V.O would have to use in Phase 1 is MTS (make to stock), owing to the fact that, when working with AMZ's SC network, it is compulsory to always have some stock of products stored in the assigned AMZ's warehouse, already manipulated and ready to be dispatched, so that orders' expeditions can be managed as they are received.

Hence, so as to make this SC as efficient as possible and to ensure that "point 17" facility would be able to absorb the additional demand that facility V.O would generate, this facility was visited, and the productivity rates shown below were obtained (see *Table 8*). Note that all the available pieces require the same workload.

In connection with the product's preparation process, the following steps had to be followed in the selected facility (see *Figure 24*):

- Phase (1): Ham legs and shoulders selection and vacuum packing.
- Phase (2): Cover, band and box handling.
- Phase (3): Palletizing (18 pieces per pallet).
- Phase (4): Labelling and expedition.

Figure 24: Product's preparation process in Phase 1.

Hence, regarding these steps, the following productivity rates were obtained:

STEP	ACTION	PRODUCTIVITY	
		Observation	Value (pieces / hour X employee)
Phase 1	Ham legs selection and vacuum packing	900 pieces, 8 hours, 3 employees	37
Phase 2	Cover, band and box handling	60 - 70 pieces, 1 hour, 3 employees	20
Phase 3	Storage	--	--
Phase 4	Labelling and expedition	25 pieces, 1 hour, 1 employee	25

Table 8: Productivity values in point 17 facility (*measurement realized in one ordinary working day*).

Considering these productivity rates, three different push scenarios were assessed depending on the resources invested (see analysis in *Annex A.5.1*). Eventually, it was determined that a capacity to dispatch 400 pieces per week would be enough, thus facility V.O would have to hire 1 employee, 4 hours per day, 5 days per week.

Once having analysed the selected facility, it was decided to start commercializing 6 types of Iberian ham legs. Hence, it was necessary to determine the optimum purchase batch size that facility V.O would have to buy to Company V in order to minimize the inventory management costs. Hence, it was decided to apply Harris Wilson model, whose hypothesis are the following:

- Considering the available data, constant and homogeneous demand was determined (D).
- The entrance of the batch inside AMZ's inventory is instantaneous.
- Ham legs were acquired by facility V.O at a fixed cost, the acquisition cost (C_A), making purchases to Company V.
- Keeping the product inside AMZ's inventory had a fixed cost, stock ownership cost (C_h).
- Stock out was not allowed in AMZ's warehouse.

To begin with, so as to determine the average demand that would be applied in Harris Wilson hypothesis, it was necessary to perform a test in the fourth term of 2019, thus 300 units of each reference were sent to AMZ so as to compute its average weekly consumption rate (see *Annex A.5.2*).

Subsequently, according to the results obtained through this test, the average weekly consumption rate was distributed among twelve weeks (that is, three months), beginning in week 12 of 2020 (16/03/2020), as can be seen in *Annex A.5.3.* To do this, considering Covid-19 crisis, it was assumed that the average demand would remain the same as the one determined in the fourth term of 2019 (when, as a pattern of cured products, almost 70% of the annual sales take place), since there was the assumption that eCommerce businesses would increase sales due to the mobility restrictions.

Therefore, once having performed this test, all the necessary information to apply Harris Wilson hypothesis was available (see *Table 9*): the average consumption per week, the acquisition cost (C_A) and the stock ownership cost (C_h) in AMZ for each reference.

PRODUCT	Average consumption (units/week)	C_A (€/order)	C_h (€/unit·month)	C_h (€/unit·week)
Jamón Gran Reserva Duroc 50%	11	83.87	33.89	8.47
Jamón Gran Reserva Duroc 100%	3	125.52	33.89	8.47
Paleta de Cebo	1	82.82	21.69	5.42
Paleta de Bellota 100%	8	148.63	21.69	5.42
Paleta Duroc 100%	21	65.83	21.69	5.42
Jamón Ibérico de Cebo	5	165.21	33.89	8.47

Table 9: Phase 1 products' information.

Considering this information, Harris Wilson hypothesis was applied in each of these six references so as to know the optimum batch size (Q*) to be prepared and delivered to AMZ as well as the cycle time (T*) of them. A summary of the results is shown in the following *Table 10* and complete computations are shown in *Annex A.5.3*:

PRODUCT	Q* (units)	v*	T*	T* (weeks)
Jamón Gran Reserva Duroc 50%	51	3	0.39	5
Jamón Gran Reserva Duroc 100%	33	1	0.91	11
Paleta de Cebo	21	1	1.48	18
Paleta de Bellota 100%	74	1	0.74	9
Paleta Duroc 100%	79	3	0.31	4
Jamón Ibérico de Cebo	49	1	0.80	10

Table 10: Harris Wilson results regarding Phase 1.

8.1.3 Costs

So as to obtain the total cost that facility V.O would have to assume when managing Phase 1 SC, costs have been divided into three main types: internal process costs, picking and distribution costs, and the AMZ costs (which are divided into fixed and variable costs). The complete analysis of costs can be seen in *Annex A.5.4*.

- **Internal process cost:** This cost includes the purchase of the main hams, all the required packaging production and the vacuum-packed process. Because of confidentiality, just total costs are shown.
- **Picking and distribution:**
    - **Picking cost:** This cost includes the final packaging manipulation required to have 18 units in one pallet ready to be expedited in Company V's warehouse. Considering that push production can be applied, the cost applied by the factory in point 17 is 1'10 € / unit (if pull production was required, the picking cost would be 1'50 € / unit).
    - **B2B Distribution cost:** This is the unit cost required to deliver the product at the assigned AMZ warehouse, which is located in Toledo. Hence, it has been computed considering the palletizing format of 18 units per pallet, the weight of each SKU and the logistic cost (in € / kg) shown in *Annex A.4*.
- **AMZ Fixed Costs:** These costs are available in *Annex A.5.5*.
    - **Storage:** The sort of product that is commercialized in this Phase 1 is considered to be as big size and it is stored in Spain. Hence, the storage cost in AMZ is 18.00 € / (cubic feet x month) from January to September and 25.00€ / (cubic feet per month) from October to December. So as to obtain a standardized cost, these values have been weighted respectively by 75% and 25% (considering the number of months of each period) to obtain the storage cost of 19.75 € / (cubic feet per month). In relation to the volume, each unit of packed ham occupies a volume of 1.576 cubic feet (used conversion rate: 35.31 cubic feet / m^3).

Measures (cm)	Volume (m^3)	Volume (cubic feet)
89 x 33 x 15.2	0.045	1.576

Table 11: Packed product's measures.

Moreover, regarding the forecasted consumption rate, it is considered that each unit of product, as average, would be kept 22 days in AMZ's warehouse, thus just 71% of this cost has been applied to each unit of product.

  - **AMZ's B2C Delivery:** It is the cost that AMZ charges for the delivery of the product to the final consumer. It depends on the country of destination and also varies depending on the weight and measures of each product. In this case, the rate to apply is the one regarding products of "*big size – measures ≤ 120 x 60 x 60 cm*". For instance, the B2C delivery of SKU *Jamón Gran Reserva Duroc 50%* to a customer in UK would cost 16'00€.

- **AMZ Variable Costs:** When computing the total unit cost, variable costs have been weighted by just 60% due to the fact that, considering the test performed in the last term of 2019, they only occur in specific scenarios.
  - **Long storage:** It is a cost which is applied only for the inventory which is kept in AMZ's warehouse for more than 365 days. In this case, this cost is not considered due to the fact that inventory is planned to last less than 1 year.
  - **Advertising:** So as to boost sales in each country, it is necessary that the marketing department advertises the available products. In this case, it has been agreed that 250.00 € per month would be invested in each country and that there would always be an inventory amount of at least 30 units, thus obtaining a variable cost of 8.33 € / unit at most.
  - **Inventory return and withdrawal:** This variable cost is related to the reverse logistics and it is applied when the customer is determined to return the product (for instance, because of quality issues) and also when the seller need to withdraw inventory from the AMZ's warehouse (for instance, due to products' shelf life issues). This cost depends on the weight and measures of each product, and it also varies depending on the country from where the return is required. For example, the return of one unit of SKU *Jamón Gran Reserva Duroc 50%* from Germany would cost 11.25€.

Hence, the total inventory management cost per unit for each reference in Phase 1 can be computed depending on the country of destination applying the following expression:

$$Total\ Cost\ \left(\frac{€}{unit}\right) = Internal\ Process\ Cost + Picking + B2B\ Distribution + 0.71 \cdot Storage + AMZ's\ B2C\ Delivery + 0.60 \cdot [AMZ\ Variable\ Costs]$$

Formula 1: Expression to compute total SC management cost in Phase 1.

Finally, regarding the sales process, AMZ applies a commission cost for each purchase, thus affecting the profit margin (AMZ's commission cost is 15% of each product's sale price).

To sum up, the following *Table 12* provides a summary of the total cost of managing the inventory

in this Phase 1 SC and also the required sale price that each reference should have so that facility V.O could achieve, for instance, an approximate profit margin of 50€ per unit (see the complete development in *Annex A.5.4*).

Country	SKU	KG		TOTAL COST (€/unit)	Sales Process (€/unit)		
		Range	Average		Sale price	AMZ Comission	Profit margin
Spain	Jamón Gran Reserva Duroc 50%	7,5 - 8,0	7,75	**125,81 €**	207,00 €	31,05 €	50,14 €
	Jamón Gran Reserva Duroc 100%	7,5 - 8,0	7,75	**167,46 €**	256,00 €	38,40 €	50,14 €
	Paleta de Cebo	4,5 - 5,5	5,00	**121,60 €**	202,00 €	30,30 €	50,10 €
	Paleta de Bellota 100%	5,0 - 6,0	5,50	**189,59 €**	282,00 €	42,30 €	50,11 €
	Paleta Duroc 100%	4,5 - 5,5	5,00	**104,61 €**	182,00 €	27,30 €	50,09 €
	Jamón Ibérico de Cebo	8,0 - 8,5	8,25	**207,95 €**	303,00 €	45,45 €	49,60 €
UK	Jamón Gran Reserva Duroc 50%	7,5 - 8,0	7,75	**136,91 €**	220,00 €	33,00 €	50,09 €
	Paleta de Bellota 100%	5,0 - 6,0	5,50	**200,18 €**	294,00 €	44,10 €	49,72 €
	Jamón Ibérico de Cebo	8,0 - 8,5	8,25	**218,69 €**	316,00 €	47,40 €	49,91 €
France	Jamón Gran Reserva Duroc 50%	7,5 - 8,0	7,75	**131,10 €**	213,00 €	31,95 €	49,95 €
	Paleta de Bellota 100%	5,0 - 6,0	5,50	**194,33 €**	288,00 €	43,20 €	50,47 €
	Jamón Ibérico de Cebo	8,0 - 8,5	8,25	**212,88 €**	309,00 €	46,35 €	49,77 €
	Paleta de Cebo	4,5 - 5,5	5,00	**127,47 €**	209,00 €	31,35 €	50,18 €
Germany	Jamón Gran Reserva Duroc 50%	7,5 - 8,0	7,75	**128,32 €**	210,00 €	31,50 €	50,18 €
	Jamón Ibérico de Cebo	8,0 - 8,5	8,25	**210,10 €**	306,00 €	45,90 €	50,00 €

Table 12: Phase 1 costs summary.

8.1.4 Results

The aim of this section is to analyse the results obtained by facility V.O in Phase 1: the theoretical scenario obtained through Harris Wilson hypothesis will be compared with the real scenario that took place from week 12 to week 23 of 2020.

It has to be noted that, regarding the period from week 12 to week 23, Harris Wilson results could only be partially applied due to schedule constraints in “point 17”, thus inventory management costs could not be optimized.

So as to compare Harris Wilson scenario with the realistic one, both results have been summarized in *Annex A.5.6.* Regarding these results, the following details outstand:

- It has to be considered that, in spite of the fact that both costs and prices had been previously analysed, benefit is eventually negative due to the fact that not all the products which had been sent to AMZ could be sold. Consequently, in addition to not producing any income, its withdrawal cost from AMZ’s warehouse had to be assumed.
- Regarding the size of the first batches expedited to AMZ’ warehouse, due to facility’s

constraints in week 12, only batches of 50 or 100 units could be prepared of each reference. Consequently, 50 units of each reference were initially dispatched.

- In relation to SKU *Jamón Gran Reserva Duroc 50%*, the forecasted batch size of 51 units could not be prepared in week 16 due to factory delays caused by Easter holidays. Consequently, there was no stock of this product in AMZ's warehouse in week 17. Nevertheless, customers did not notice it since the back office was adjusted with stock and subsequently 100 units were expedited in week 18. Doubling the previously computed batch size was a mistake in terms of inventory costs, since afterwards demand decreased significantly.
- Regarding the references *Jamón Gran Reserva Duroc 100%* and *Paleta de Cebo*, as aforementioned, a batch size bigger than the optimum one had to be expedited in week 12, thus increasing inventory costs.
- Eventually, regarding the three other references, the main mistake was to send bigger batch sizes and earlier than the schedule obtained through H. Wilson theory. This was due to bullwhip effect: due to mobility restrictions caused by Covid-19, E-Commerce sales were supposed to increase significantly between week 16 and week 23, and the non-stock scenario experienced in week 17 could not take place again.

In fact, facility V.O maintained Phase 1 activity during all 2020, and it would be progressively stopped as Phase 2 activity would be activated. The volume of B2C sales managed through this Phase 1 via AMZ marketplace has been summarized in the following *Table 13*:

	Phase 1: B2C Sales in 2020										Total
SKU	March	April	May	June	July	August	September	October	November	December	
Paleta de Bellota 100%	27	25	9	7	9	12	10	14	16	21	150
Paleta Duroc 100%	29	73	30	10	0	2	8	7	4	0	163
Jamón Ibérico de Cebo	10	21	25	18	12	0	0	0	0	0	86
Jamón Gran Reserva Duroc 100%	4	0	0	0	3	0	1	1	1	1	11
Paleta de Cebo	14	8	1	3	1	2	0	1	0	0	30
Jamón Gran Reserva Duroc 50%	31	26	29	9	6	3	6	6	4	0	120

Table 13: Phase 1 B2C orders summary in 2020.

Furthermore, it is interesting to note that, despite the European market share indicated in [24], the market share that finally took place in Phase 1 is the one shown in *Figure 25*: Spain (61%), the UK (22%), France (14%) and Germany (3%).

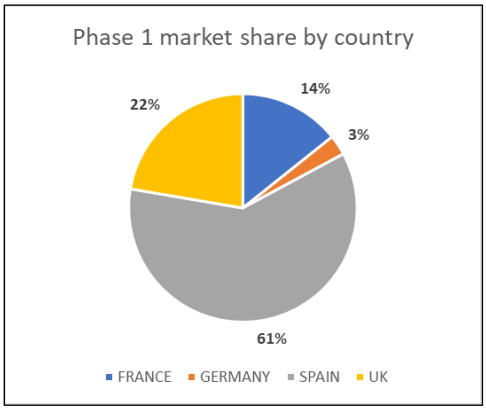

Figure 25: European market share consumption in Phase 1.

To conclude regarding this Phase 1, it is necessary to note that the cost of managing this externalized SC is high, specially due to the explained AMZ costs (both fixed and variable). In connection with this fact, a significant amount of money is paid to another business due to the externalization of operational activities that could be realized within Company V. This alternative will be analysed in the following section.

8.2 Phase 2

After having acquired some experience within the online business through Phase 1, Company V was determined to internalize operations so as to have much more first-hand control of the whole process, improve the service level and reduce the SC management cost which, as seen in Phase 1, was significantly expensive due to the external AMZ costs. Therefore, “facility V.O” would have to design the most appropriate SC so as to manage the online food business internally within Company V, thus the following main factors will have to be analysed: the facilities to be used and the inventory management policy, transport, information management, purchasing and costs.

Regarding the internalization process and considering the strategy that had been followed by the aforementioned online food businesses Mercadona and AMZ Fresh, facility V.O determined that the most appropriate strategy would be to start with a centralized SC and, if convenient, a decentralized SC could be subsequently designed. This is due to the following main reasons:

- When working with a centralized SC, it is enough to manage just one warehouse, thus fixed costs and risks are lower than in a decentralized SC, in which several warehouses are required.
- Furthermore, it is one significant test so as to learn about the behaviour of online food consumption, since a large amount of data will be collected in terms of SOH (Sales Order History),that is, a laboratory strategy.

8.2.1 Products, Market and Facilities

When internalizing the online food business within Company V's own structure, facility V.O would have to determine the assortment of products that would be offered, the market that would be covered and which Company V's facilities would be required so as to run the business.

Products:

In connection with the assortment of products, facility V.O determined that not only cured products would be offered, but all the assortment of food products that are produced in Company V except rabbit, that is: alternative protein, beef, cooked products, cured products, mutton, pork and poultry. More precisely, the following *Table 14* shows the amount of SKUs of each product family that would be offered:

Product Family	Quantity of SKUs (units)
Alternative protein	4
Beef	50
Cooked products	3
Cured products	30
Mutton	8
Pork	34
Poultry	14

Table 14: Amount of SKUs per product family in Phase 2.

Hence, facility V.O would make purchases of these 143 SKUs to Company V, and it would be necessary to select the most appropriate facilities as suppliers so that operational costs could be minimized depending on the selected SC configuration (centralized or decentralized). In addition to the purchase, it would be necessary to select the most appropriate facility where the orders' preparation process would be realized considering that operational costs have to be as small as possible. Regarding this fact, an expression to compute the total operational cost depending on the SC configuration will be presented.

In connection with this assortment of products, as aforementioned, one of its main strengths is its modular behaviour, owing to which the OPP can be positioned significantly downstream the process, thus the MTS technique can be applied. Hence:

- Facility V.O would be supplied with ready for sale products that have been manufactured through lean techniques, thus the transfer price from Company V to facility V.O should be very competitive.
- Facility V.O would have to apply agile techniques regarding the final picking process in the warehouse, through which each order would be prepared inside one case and dispatched to the required address.

Market:

The market that will be covered when developing this Phase 2 is the Spanish Iberian Peninsula and the Balearic Islands, attending both B2B and B2C customers. This is due to the following reasons:

- The strategy is to develop the online business within Company V progressively, gaining knowledge through a laboratory strategy. Hence, the international market would not be considered yet. This is also due to the fact that there are no B2C chilled logistics operators covering the EU when dispatching from Spain and, in addition to this, reaching the EU from Spain requires bigger transit times which would eventually increase the orders' delivery lead time.
- Regarding the aim of developing an omnichannel strategy within the Company V, not only B2C customers would have to be attended as in Phase 1, but also online B2B demand would have to be covered.

Facilities:

As aforementioned, facility V.O will have to select, to begin with, the facilities that could be used as warehouse(s) and, subsequently, the facilities to which purchases will be made so as to supply the selected warehouse(s). This will allow to determine the orders' penetration process. Actually, this analysis will depend on the SC configuration that is used, and the following factors will have to be considered:

- The location of the selected facilities should help minimize the SC operational cost. Hence, the warehouse(s) where orders will be prepared should be located close to customers and, at the same time, facility V.O's suppliers should be as close to the warehouse(s) as possible so as to minimize transportation costs.
- The selected facilities will have to meet the following constraint: only facilities where food products can be managed are feasible. Hence, any food production facility could be used as a warehouse to develop the orders' preparation processes.

Therefore, the feasible facilities that could be used both as supplier and warehouse for facility V.O have been listed below, classified by product family. Note that both these product families and facility codes are listed in *Annex A.1*.

Product Family	Facility Code
Alternative protein	47
Beef	9
Cooked products	7
Cured products	8, 17, 27, 28, 34
Pork	11, 23, 24, 26, 31, 37
Poultry	3, 4, 5, 6, 13, 16, 40, 41, 42
Rabbit	14
Varied Products (Mutton)	15, 18, 19, 20, 21, 22, 39

Table 15: Feasible facilities in Phase 2.

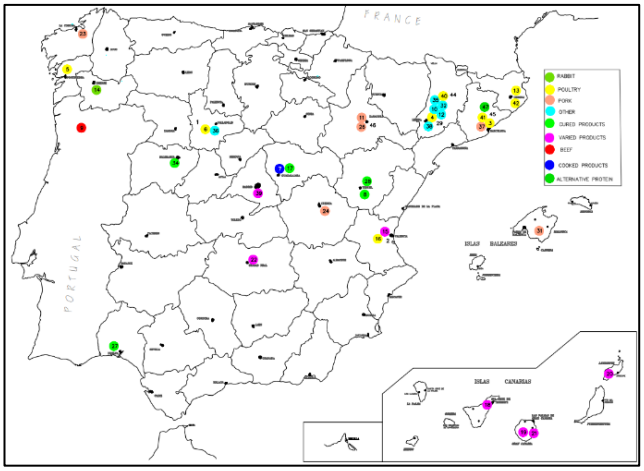

Figure 26: Map of feasible facilities in Phase 2.

8.2.2 Logistics:

Considering the assortment of products with which facility V.O will be working, chilled logistics will be required in order to appropriately maintain the cold chain throughout the SC.

Since none of Company V's facilities is specialized in chilled logistics, facility V.O will need to have 3PLs partners so as to make all the required movements of goods between the factory and the warehouse, and from the warehouse to the required customer. Therefore, as aforementioned, facility V.O will require the following two main types of 3PLs:

- One B2B chilled logistics operator to transport the goods from the factories to the warehouse(s), and from the warehouse(s) to any B2B customer. Due to confidentiality, the selected 3PL cannot be stated.
- One B2C chilled logistics operator to transport the purchases from the warehouse(s) to any B2C customer. Currently, there is only one B2C chilled logistics operator that is able to cover the entire Spanish Iberian Peninsula and also to reach the Balearic Islands.

Both 3PLs offer the same transit time between the collection of the goods and its delivery, which is the following: 24 hours throughout the Spanish Iberian Peninsula, 48 hours to connect the Spanish Iberian Peninsula with the Balearic Islands, and 24 hours if the shipment is within the Balearic Islands.

In relation to the cost of these chilled logistic services, both depend on the following main variables: the weight of the cargo, the distance to be covered and, therefore, the origin – destination of each shipment.

8.2.3 Information management:

The development of the online business within Company V has the following two main objectives: acquire an omnichannel strategy and try to reduce the amount of FLW. To accomplish these aims, the information management is a key factor.

As aforementioned, in spite of the fact that each facility manages its own inventory and this information is not shared among the different facilities due to a decentralized operating model, the online business developed through facility V.O will provide Company V with a tool to work with the unique inventory technique. Hence, it will be feasible to offer the detected food surplus via online with a significant discount.

In order to manage all the information, the following three main elements will be required:

- **ERP:** Each facility within Company V has its own ERP (facility V.O included), through which the inventory is monitored in terms on quantity, batches and shelf life.
- **Magento:** Facility V.O will have to develop its Magento software, which is an open source E-Commerce platform through which several parameters are managed, such as: the inventory available online, from which geographic location each sort of product can be bought and delivered to, pricing, advertisements, etc.
- **Web:** It is the main shop window through which all the terms and conditions that have been established in Magento are both shown and communicated to customers from a marketing point of view.

In connection with these elements and so as to develop the unique inventory technique regarding the online business, facility V.O will manage the following two main information flows (see *Figure 27* below):

- **Flow 1:** Information management from Company V's facilities to the Web.
    - Step 1: The ERP of each facility sends determined inventory information (SKU, quantity, batch and shelf life) to facility V.O's ERP, from where the information is transmitted to Magento platform.
    - Step 2: Facility V.O's Magento platform centralizes all the data from the different Company V's facilities. Moreover, products' pricing, the available inventory online and the covered geographic locations are determined.
    - Step 3: Finally, Magento transmits all the defined terms and conditions to the Web, through which it is communicated to customers, who will eventually make a purchase.
- **Flow 2:** Information management from the Web to Company V's facilities once an online purchase has been made.

- Step 1: Once a customer has made an online purchase in the Web, Magento confirms the payment and it immediately transmits the purchase order (PO) towards facility V.O's ERP.
- Step 2: Facility V.O's ERP will transmit the PO to the most appropriate facility depending on the SC configuration that has been adopted, and the available online inventory will be updated.
- Step 3: Company V's facility receives all the information of each PO in its ERP (SKU, quantity and delivery address) in order to dispatch it.

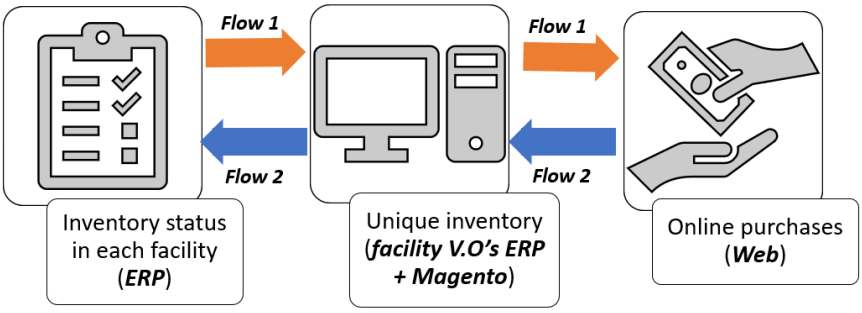

Figure 27: Information management in Phase 2.

8.2.4 Centralized SC

Considering the laboratory technique that has been used by significant businesses such as Mercadona or AMZ Fresh when initiating their own online businesses, as aforementioned, facility V.O decided to initially centralize its online operations and, afterwards, the convenience of decentralizing the network would be assessed. Hence, this would allow to gain knowledge regarding the online food consumption behaviour within Spain and, in addition to this, investment and risks due to internalization would be less than in a decentralized scenario.

The main details to define the most efficient centralized SC network considering several factors will be subsequently developed and SOH will be analysed.

Furthermore, since efficiency and time saving are some of the most valued factors when buying online, facility V.O will have to deal with the following constraint: orders will have to be delivered within a tight lead time between the purchase and the delivery of 24 to 72 hours.

Regarding this development, it is important to note that no relation between capacity and demand will be made since plenty of capacity is guaranteed in Company V. This is due to the aforementioned characteristics of Company V's facilities:

- Push production techniques are applied within factories that are specialized in each product family. Moreover, the modularity of the products make it feasible to apply ATO and MTS techniques. Hence, continuous inventory of all product families is assured.

- Considering that the transit time offered by the B2B 3PL is 24 – 48 hours, products can be rapidly supplied to the selected facility V.O's warehouse, thus POs can be attended within the agreed lead time.

Centralized warehouse selection – Brown & Gibson Method:

As seen in *Table 16*, there are 48 facilities in Company V which are candidates to perform as a centralized warehouse. Regarding these facilities and in order to be able to select the most convenient centralized warehouse within Company V, facility V.O's aim is not only to minimize the SC management cost, but to also consider other factors. Hence, facility V.O would apply the Brown & Gibson method due to the fact that, as will be explained, it is a multi-criteria method which considers quantifiable and subjective factors at the same time (that is: critical, objective and subjective factors).

Classification Group	Facility Code
Feed & Four	1, 2, 25, 29, 30, 33, 44, 45, 46
Poultry	3, 4, 5, 6, 13, 16, 40, 41, 42
Cooked products	7
Cured products	8, 17, 27, 28, 34
Beef	9
Other	10, 12, 32, 35, 36, 38
Pork	11, 23, 24, 26, 31, 37
Rabbit	14
Varied products	15, 18, 19, 20, 21, 22, 39
Logistics	43, 48
Alternative protein	47

Table 16: Company V's candidates to perform as the centralized warehouse.

Therefore, the critical, objective and subjective factors that have to be considered will be explained below.

Critical Factors:

So as to select its centralized warehouse among the candidates, facility V.O has determined the following two critical factors:

1. Since the sort of products that will be manipulated is food, the selected facility must have the approval for food handling. Consequently, the classification groups "feed & flour", "other" and "logistics" cannot be considered as no food can be manipulated in this sort of facilities.
2. So as to minimize the SC management cost, the logistics cost should be minimized and, consequently, the distance between the centralized warehouse and the different areas to be covered has to be minimized. Therefore, considering that the area to be covered is the Spanish Iberian Peninsula and the Balearic Islands, the centralized warehouse from where

all the shipments are expedited has to be located somewhere in the centre of the country. As a result, facility V.O determined that the centralized warehouse had to be located within the following provinces: Avila, Segovia, Soria, Guadalajara, Cuenca, Toledo or Madrid.

Classification Group	Facility Code
Poultry	3, 4, 5, 6, 13, 16, 40, 41, 42
Cooked products	7
Cured products	8, 17, 27, 28, 34
Beef	9
Pork	11, 23, 24, 26, 31, 37
Rabbit	14
Varied products	15, 18, 19, 20, 21, 22, 39
Alternative protein	47

Table 17: Candidates after critical factor 1.

Classification Group	Facility Code	Province
Cooked products	7	Guadalajara
Cured products	17	Guadalajara
Pork	24	Cuenca
Varied products	39	Madrid

Table 18: Candidates after critical factor 2.

Objective Factors:

The objective factors that facility V.O would consider when selecting the most appropriate centralized warehouse are the following costs:

- **Facility opening:** This regards to the cost of setting up all the products that will be commercialized within the facility's ERP, and it is part of the fixed cost, which needs to be minimized.
- **Facility functioning:** This considers the appropriate maintenance cost of the facility, and it is also part of the fixed cost that needs to be minimized.
- **Wages:** This regards to the cost of all the staff required to keep the facility functioning [25].
- **Indirect costs:** This considers possible extra costs that facility V.O might have due to the activity in the facility.

These objective factors would be analysed within a period of 5 years (from 2020 to 2025) applying an update rate (i) of 3% [26].

	Facility (7)	Facility (17)	Facility (24)	Facility (39)
Facility opening	400,00 €	440,00 €	390,00 €	370,00 €
Facility functioning	1.800,00 €	1.920,00 €	1.560,00 €	1.440,00 €
Wages	22.026,00 €	22.026,00 €	22.176,00 €	27.316,00 €
Indirect costs	2.880,00 €	2.880,00 €	2.880,00 €	2.880,00 €
i	3%	3%	3%	3%

Table 19: Brown & Gibson objective factors (annual costs).

So as to obtain the objective factor (FO_i) of each facility, the following formula has to be applied:

$$FO_i = \frac{1/Ct_i}{\sum_{i=1}^{n} 1/Ct_i}$$, where Ct_i is the net present value of the cost (NPV).

$$NPV = \sum_{t=1}^{n} \frac{R_t}{(1+i)^t}$$, where: R_t is the cost in year (t) and (i) is the update rate.

Formula 2: Objective factor (FO_i) expression in Brown & Gibson method.

All the details to obtain the objective factor (FO_i) for each facility are shown in *Annex A.6.1* and a summary is provided as follows:

Facility (i)	Total cost = C_i	$1/C_i$	FO_i
7	122.705,66 €	0,0000081	0,260
17	123.295,23 €	0,0000081	0,259
24	122.283,49 €	0,0000082	0,261
39	145.253,62 €	0,0000069	0,220
		0,0000313	**1,000**

Table 20: Brown & Gibson objective factor FO_i results.

Subjective Factors:

The main qualitative factors according to facility V.O to select the most appropriate centralized warehouse are the following, listed from more to less importance:

1. **Storage quality:** The quality with which products are delivered to customers depends significantly on the storage quality of the facility. Even though all the considered facilities must provide appropriate storage facilities to manage food, it is considered that facility 39 (varied products) might provide much better service since it is already used to manage several types of products.
2. **Link with 3PLs hubs:** The link between the warehouse and the 3LP hub should be as efficient as possible so as to minimize products' deterioration during transport. Hence, considering that most of the logistic operators have a hub near Madrid, the closer to Madrid, the better would be the warehouse. Due to this fact, the best candidate regarding this factor would be facility 39.
3. **Link with the Balearic Islands:** According to the aforementioned point, since most of 3PLs have its hub near Madrid and from there products are shipped to the Balearic Islands, the closer to Madrid, the better would be the warehouse. The aim is to minimize products' deterioration due to transport. Hence, facility 39 would be the best candidate according to this factor.
4. **Social impact:** In order to minimize social impact, facility V.O considers that it might be more appropriate to locate the activity as close to Madrid as possible due to the fact that it

is already an industrialized area and, moreover, the transport between the warehouse and 3PLs hubs would be minimized. Therefore, the closer to Madrid, the better would be the analysed candidate.

5. **Weather:** In order to store and transport the managed food as appropriately as possible, it is necessary to avoid heat peaks. To assess this factor, the frequency of temperature peaks above 30ºC has been evaluated (from more to less frequency: Madrid, Guadalajara and Cuenca [27]). The less frequency of extreme heat, the better candidate.
6. **Advertising:** In order to be as close to customers as possible to boost sales, advertising possibilities are important. Hence, the bigger amount of people living in the area, the better (from bigger to smaller population: Madrid, Guadalajara and Cuenca [28]).

The assessment of these subjective factors in each of the candidate facilities is shown in the following table:

	Facility (7)	Facility (17)	Facility (24)	Facility (39)
Link with Balearic Islands	Agile	Agile	Not agile	Very agile
Weather - Frequency of extreme heat	High	High	Medium	Very high
Social impact	Medium	Medium	High	Low
Link with 3PLs hubs	Agile	Agile	Not agile	Very agile
Advertising	Close to customers	Close to customers	Not close to customers	Very close to customers
Storage quality	Appropriate	Appropriate	Appropriate	Very appropriate

Table 21: Assessment of subjective factors in each candidate facility.

In order to compute the value of each subjective factor depending on the candidate facility, it is necessary to develop the following main steps:

1. Compute the weight of each factor w_j comparing them two by two through a binary criteria w'_{jk}: 1 if (j) is more or as important as (k), and 0 if (j) is less important than (k). To compute w_j the following formula is applied:

$$w_j = \frac{\sum_{k=1} w'_{jk}}{\sum_{j=1} \sum_{k=1} w'_{jk}}$$

Formula 3: Factor's weight in Brown & Gibson method.

2. Compute the value R_{ij} for each candidate facility (i) and factor (j), comparing facilities two by two and using the same binary criteria as before.
3. Eventually, the subjective factor FS_i can be computed for each candidate facility applying the following formula:

$$FS_i = \sum_{j=1} w_j \cdot R_{ij}$$

Formula 4: Subjective factor (FS_i) expression in Brown & Gibson method.

The results which have been obtained are shown in the following table and all the intermediate computations are shown in *Annex A.6.1*:

Subjective Factor	R_{ij}				W_j
	R_{7j}	R_{17j}	R_{24j}	R_{39j}	
Storage quality	0,2222	0,2222	0,2222	0,3333	0,3333
Link with 3PLs hubs	0,2857	0,2857	0,0000	0,4286	0,2667
Link with Balearic Islands	0,2857	0,2857	0,0000	0,4286	0,2000
Social impact	0,2857	0,2857	0,0000	0,4286	0,1333
Weather - Frequency of extreme heat	0,2857	0,2857	0,4286	0,0000	0,0667
Advertising	0,2857	0,2857	0,0000	0,4286	0,0000
FS_i	0,2646	0,2646	0,1026	0,3683	

Table 22: Brown & Gibson subjective factor FS_i results.

Hence, both the objetctive (FO_i) and subjective factors (FS_i) have been measured considering all candidate facilities:

	FO_i	FS_i
Facility (7)	0,2602	0,2646
Facility (17)	0,2589	0,2646
Facility (24)	0,2611	0,1026
Facility (39)	0,2198	0,3683

Table 23: Values of FO_i and FS_i for each candidate facility.

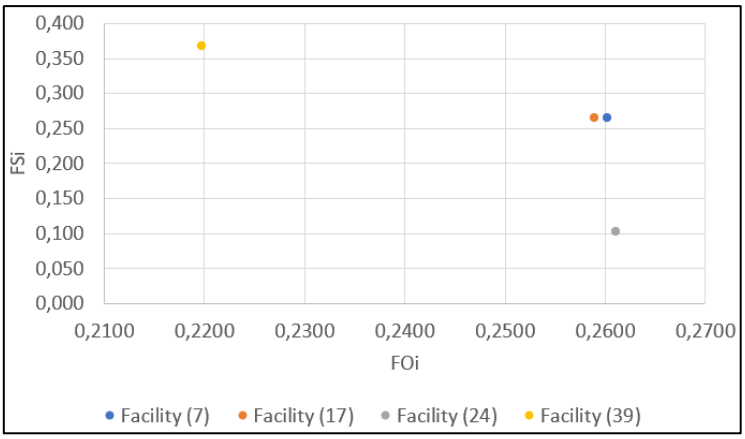

Figure 28: Brown & Gibson: objective and subjective factors value representation.

In order to determine which is the best candidate to become the centralized warehouse according to facility V.O's factors, the preference index (IL_i) has to be computed by weighing the objective and the subjective factor through the parameter (α).

$$IL_i = \alpha \cdot FO_i + (1 - \alpha) \cdot FS_i \text{ , where: } 0 \leq \alpha \leq 1$$

Formula 5: Preference index (IL_i) expression in Brown & Gibson method.

As seen in the following table and graphic, a sensitivity analysis has been performed to obtain de value of the preference index (IL_i) depending on the value assigned to (α). Hence, the following most appropriate candidates are obtained (see them highlighted in green in the subsequent table).

- If $0 \leq \alpha \leq 0,7$: the most appropriate candidate is facility (F39).
- If $0,8 \leq \alpha \leq 0,9$: the most appropriate candidate is facility (F7).
- If $0,9 < \alpha \leq 1$: the most appropriate candidate is facility (F24).

α	IL_i for each facility			
	F7	F17	F24	F39
0	0,265	0,265	0,103	0,368
0,1	0,264	0,264	0,118	0,353
0,2	0,264	0,263	0,134	0,339
0,3	0,263	0,263	0,150	0,324
0,4	0,263	0,262	0,166	0,309
0,5	0,262	0,262	0,182	0,294
0,6	0,262	0,261	0,198	0,279
0,7	0,261	0,261	0,214	0,264
0,8	0,261	0,260	0,229	0,249
0,9	0,261	0,260	0,245	0,235
1	0,260	0,259	0,261	0,220

Table 24: IL_i index depending on (α).

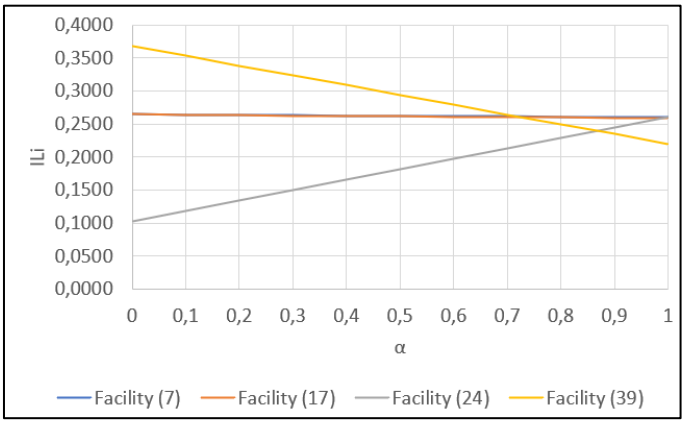

Figure 29: Sensitivity analysis of index IL_i.

Therefore, considering the results obtained through the sensitivity analysis regarding the preference index (IL_i), facility (F39) is chosen as the most appropriate location to perform as the centralized warehouse within the internalized online business of Company V. This is due to the fact that:

- When both objective and subjective factors are weighted the same (that is $\alpha = 0,5$), facility (F39) achieves the highest preference index value.
- Facility (F39) gets the highest preference index value for a wider range of (α). In fact, when subjective factors are weighted more than the objective factors (that is: $0 \leq \alpha \leq 0,4$), facility (F39) has the highest preference index and, in addition to this, when objective factors are weighted the same and slightly more than the subjective ones (that is: $0,5 \leq \alpha \leq 0,7$), the facility with the highest preference index is also the (F39).

Hence, considering that the centralized warehouse (i) has been located in facility (F39), it is now possible to determine the following costs:

- **Variable cost due to product storage and picking process:** In connection with the functioning costs and wages that are applied in facility (F39), these costs are the following:
  - B2B orders → 0'50 €/kg.

- B2C orders → 0'80 €/kg.

Note that, since the B2C orders' picking process is less efficient, it causes this cost to be more expensive than in B2B orders.

- **Variable cost due to transport of POs to customers:** In relation to the two different chilled 3PLs that are required depending on the order to be delivered, the costs when dispatching from facility (F39) are the following:
  - B2B orders → 0.0015 €/(kg·km)

    To determine this value, the tariff shown in *Annex A.4.1* is used: the average cost of a minimum shipment of 1 pallet (150kg) is 81.01€. Moreover, an average distance of 350km is considered when covering the Spanish Iberian Peninsula from Madrid.
  - B2C orders → 0.0054 €/(kg·km).

    To determine this value, the tariff shown in *Annex A.4.2* is used considering the following hypothesis about parcel logistics: average weight of 5 kg and medium range shipments (350 km).

SC Network:

Once facility (F39) has been selected as the most appropriate centralized warehouse, the next step is to determine the most appropriate supply facilities that will constitute the centralized SC network. To do this and so as to minimize the SC management cost, it is necessary to minimize logistics costs, thus the distance between each supply facility and the selected centralized warehouse needs to be optimized.

Hence, the closest supply facility to the warehouse (F39) has to be selected for each product family so as to design the centralized SC network that will minimize costs (see these distances in *Annex A.6.2*). Actually, facility V.O would determine two different networks due to the fact that, so as to offer high quality service within the online business, a contingency plan is highly recommended in case any supplier failed.

Therefore, the two SC networks that will be used by facility V.O to internally centralize the online business in Company V are shown in the following *Table 25* and in *Figure 30,* where facilities considered as contingency plan have been circled in red. However, regarding the contingency plan to be applied when necessary, there are three product families (P1, P2 and P3) with no possible contingency plan due to the fact that there is only one supplier within Company V.

Centralized warehouse facility (i)	Product family (k)	Supply facility (l)	Supply facility (l) contingency plan
F39	Alternative protein - P1	F47	F47
	Beef - P2	F9	F9
	Cooked products - P3	F7	F7
	Cured products - P4	F17	F34
	Mutton - P8	F39	F22
	Pork - P5	F24	F11 or F26
	Poultry - P6	F6	F16

Table 25: Selection of supply facilities.

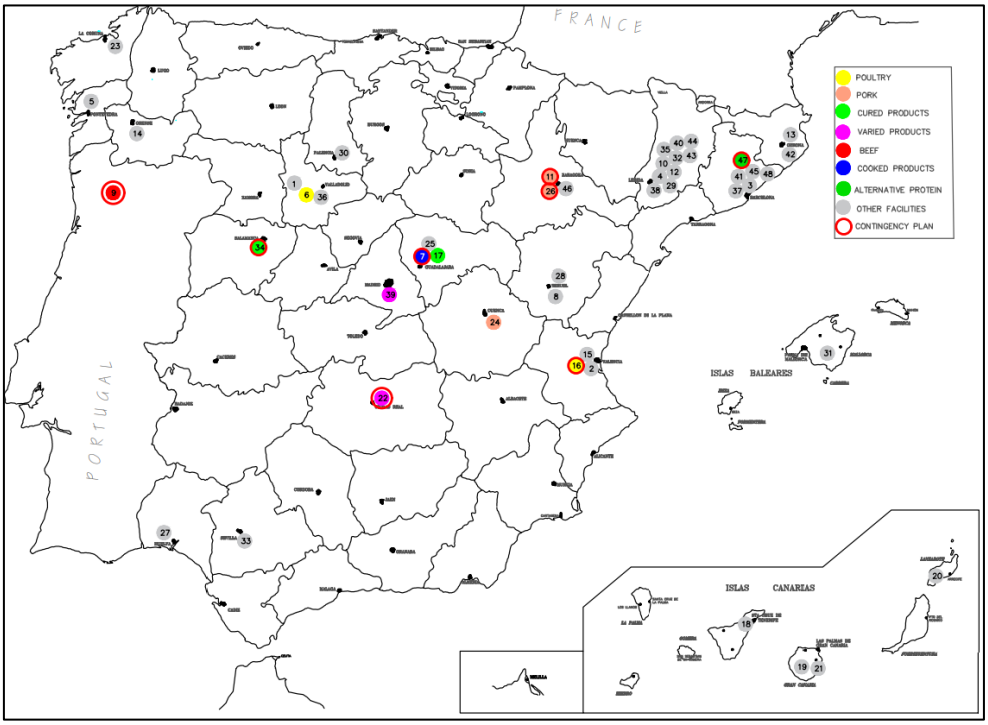

Figure 30: Centralized SC network and contingency plan in Phase 2.

SOH Analysis:

Regarding this centralized SC network, facility V.O activated the internalized online business within Company V in September 2020, once significant knowledge had been acquired through the externalized services of AMZ marketplace and after the centralized warehouse (F39) and its supply facilities had been determined.

In this section, the sales order history (SOH) of this centralized business will be analysed in order to assess the convenience of this centralized SC network.

Regarding the period from the 1st September 2020 to 25th June 2021, a data frame has been obtained which consists in 7288 observations that are analysed through 13 variables. This data

frame has been initially treated through R Studio (see the developed R script in *Annex A.6.3*). As shown in the following image, the collected variables are the following: PO date, PO date month, business unit, business type, PO Id, destination city, destination region (that is, the demand area "j"), product family (k), product, SKU, PO quantity in units, product weight (kg / unit) and the PO quantity in KGs.

```
> summary(df)
    PO Date                PO Date Month  Business Unit      Business Type    PO Id           Destination City
 Min.   :2020-09-01   October 2020  :1619   Length:7288        B2B:1801      Length:7288        Length:7288
 1st Qu.:2020-11-22   April 2021    :1282   Class :character   B2C:5487      Class :character   Class :character
 Median :2020-12-17   February 2021 : 748   Mode  :character                 Mode  :character   Mode  :character
 Mean   :2021-01-11   May 2021      : 739
 3rd Qu.:2021-03-12   September 2020: 610
 Max.   :2021-06-25   March 2021    : 500
 NA's   :1801         (Other)       :1790
         Destination Region            Product Family   Product             SKU             PO Qty (units)
 Balearics          :1944     Beef               : 288   Length:7288        Length:7288        Min.   : 1.000
 Galicia            :1206     Pork               :1388   Class :character   Class :character   1st Qu.: 1.000
 Castilla La Mancha:1072      Poultry            : 347   Mode  :character   Mode  :character   Median : 1.000
 Asturias           : 510     Mutton             :3736                                         Mean   : 1.378
 Navarra            : 466     Cured product      : 367                                         3rd Qu.: 1.000
 Cantabria          : 446     Alternative protein: 722                                         Max.   :16.000
 (Other)            :1644     Cooked product     : 440
 Product weight (KG/unit)  PO Qty (KG)
 Min.   :    0.06          Min.   :    0.06
 1st Qu.:    0.98          1st Qu.:    1.32
 Median :    5.00          Median :    5.00
 Mean   :  328.83          Mean   :  329.56
 3rd Qu.:    8.00          3rd Qu.:   10.00
 Max.   :72867.88          Max.   :72867.88
```

Figure 31: Variables of the data frame in centralized SC (R Studio).

When analysing both B2B and B2C SOH, significant seasonality is observed, with significant peaks of demand in October 2020 and in April 2021:

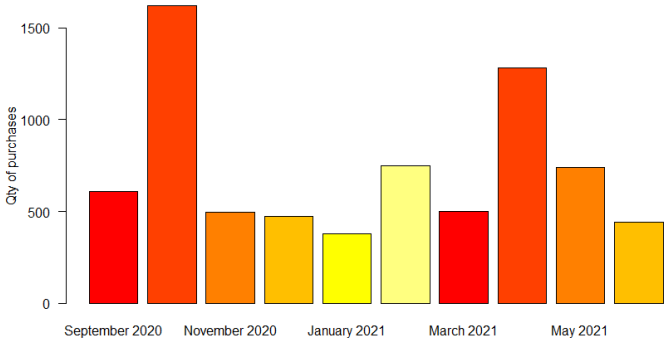

Figure 32: B2B & B2C SOH per month (R Studio).

In connection with the destination region (j) of these purchases, the fifth main places have been, from more to less frequent: Catalonia, Andalusia, Aragon, Castilla la Mancha and Castilla y Leon:

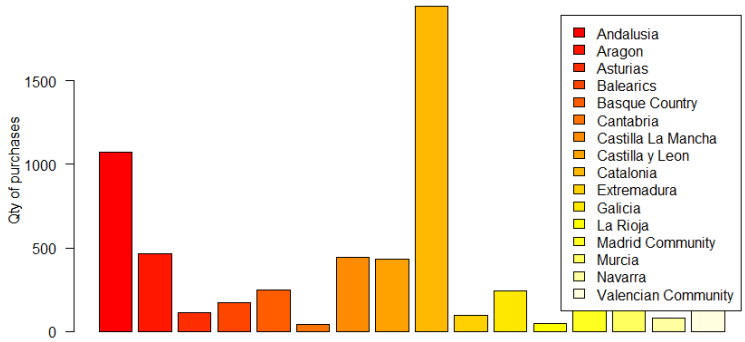

Figure 33: B2B & B2C SOH destination (R Studio).

In relation to the consumption distribution among the available product families (k), significant differences are observed. Actually, the product families with more demand have been mutton, pork and alternative protein.

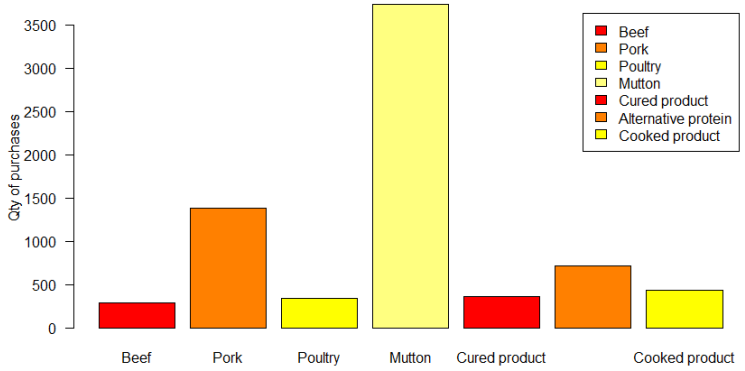

Figure 34: B2B & B2C SOH consumption per product family (R Studio).

Nonetheless, regarding the type of business, a significant difference has been observed between the amount of B2C and B2B purchases: as seen in the following image, B2C demand has represented almost 75% of the whole online activity.

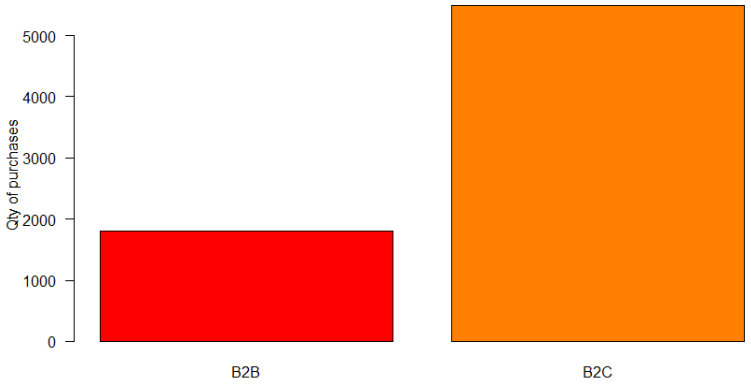

Figure 35: Type of business distribution in B2B and B2C (R Studio).

Owing to this fact, a specific analysis considering only B2C SOH has been realized. Regarding this, the same demand seasonality as before is observed, with demand peaks in October 2020 and in April 2021.

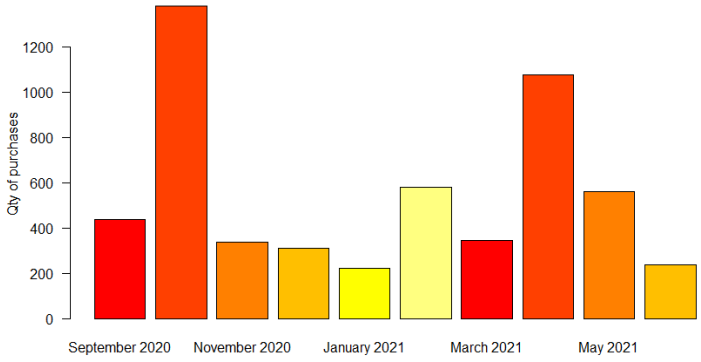

Figure 36: B2C SOH per month (R Studio).

Moreover, the average weight of B2C purchases has been approximately 8 kg, with an approximate maximum weight of 18 kg. This is shown in the following box plot:

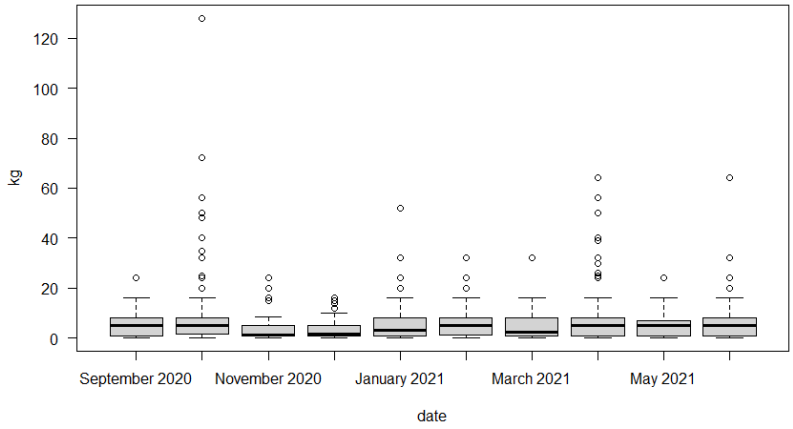

Figure 37: B2C SOH box plot (R Studio).

In relation to the main destinations (j) of B2C orders, the fifth most frequent have been, from more to less: Catalonia, Andalusia, Aragon, Castilla la Mancha and Castilla y Leon:

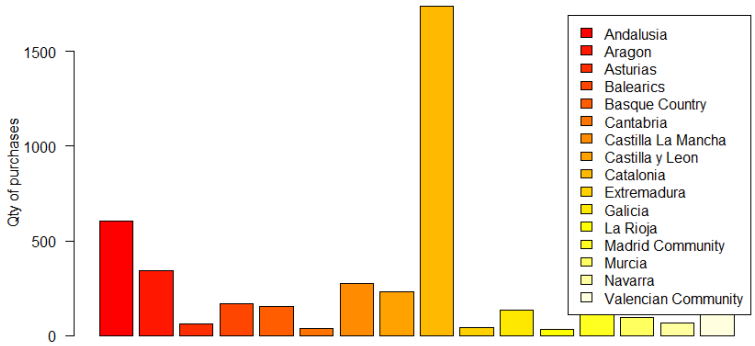

Figure 38: B2C SOH destination (R Studio).

To finish, regarding the consumption distribution among the different product families, the most consumed ones have been, as before: mutton, pork and alternative protein.

Figure 39: B2C SOH consumption per product family (R Studio).

Centralized SC Assessment:

Regarding the centralized SC network that has been determined by facility V.O considering the need to minimize the SC management cost and Brown & Gibson conclusions, the main observations of the analysed SOH are the following:

- The type of business distribution share has been: 25% B2B and 75% B2C.
- Significant demand seasonality: peaks of demand in October 2020 and in April 2021.
- The main destination regions (j) of the purchases have been: Catalonia, Andalusia, Aragon, Castilla la Mancha and Castilla y Leon.
- The most consumed product families (k) have been: mutton, pork and alternative protein.
- Finally, regarding B2C orders, their average weight has been approximately 8 kg, with an approximate maximum weight of 18 kg.

Nevertheless, in order to assess the convenience and efficiency of the determined centralized SC network (that is, the location of the warehouse in facility F39, in Madrid, and its selected suppliers), it is necessary to analyse demand behaviour depending on the demand area to attend (j) and the product family (k) to be delivered. Moreover, this will allow facility V.O to discover significant details in its SC network that could be improved.

Alternative protein:

Regarding the demand of alternative protein products:

- On the one hand, warehouse F39 (in Madrid) is supplied from facility F47 (in Barcelona).
- On the other hand, demand comes mainly from Castilla la Mancha, the Madrid Community and Catalonia.
- Regarding these facts, the dispatching of orders with their delivery address in Catalonia

directly from factory F47 located in Barcelona might reduce SC costs, since there are some products which currently are transported from Barcelona to Madrid and that, eventually, they have to be delivered to a customer in Catalonia.

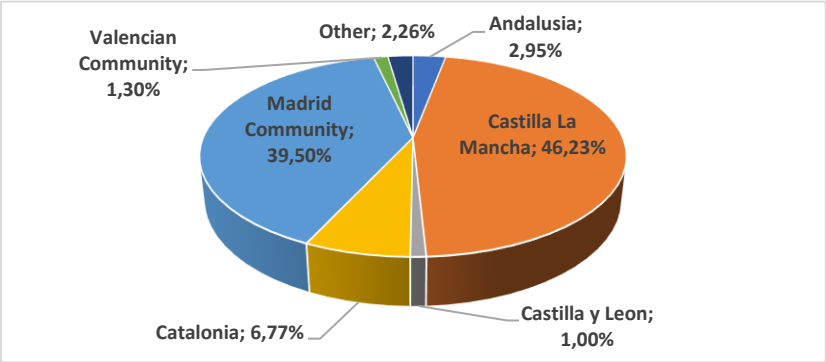

Figure 40: B2B & B2C SOH of alternative protein per destination (j).

Beef:

Regarding the demand of beef products:

- On the one hand, warehouse F39 (in Madrid) is supplied from facility F9 (in the north of Portugal).
- On the other hand, demand comes mainly from the Valencian Community, the Madrid Community, Andalusia and Catalonia.
- As a result, considering this product family, the SC network is already significantly optimized, since Madrid is located in the middle of the journey regarding the main delivery addresses.

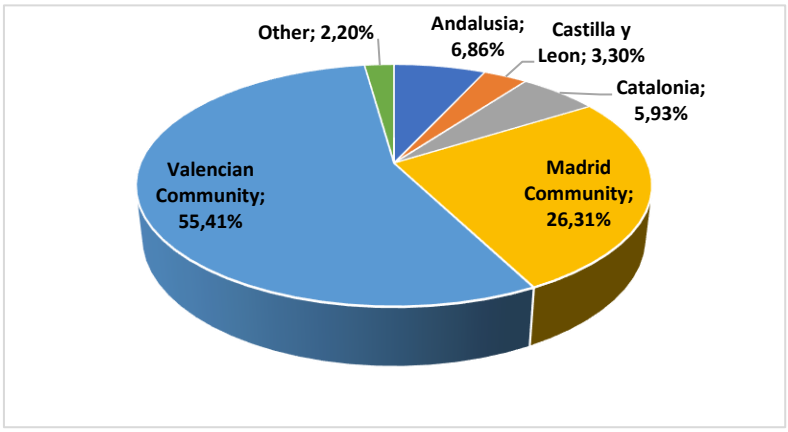

Figure 41: B2B & B2C SOH of beef per destination (j).

Cooked products:

Regarding the demand of cooked products:

- On the one hand, warehouse F39 (in Madrid) is supplied from facility F7 (in Guadalajara).
- On the other hand, demand comes mainly from the Madrid Community, Andalusia, the Valencian Community and Catalonia.
- In relation to these facts and so as to improve the current SC network, it might be convenient to own some inventory of this product family somewhere near Lleida so as to cover demand throughout Catalonia and the Valencian Community. This way, significant extra transportation costs of moving products from Guadalajara to Madrid, and then going backwards would be avoided.

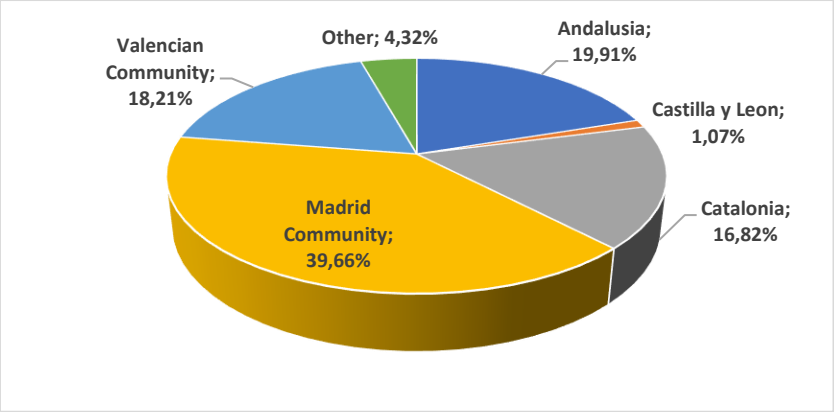

Figure 42: B2B & B2C SOH of cooked products per destination (j).

Cured products:

Regarding the demand of cured products:

- On the one hand, warehouse F39 (in Madrid) is supplied from facility F17 (in Guadalajara).
- On the other hand, demand is spread across the country, with the main origins in Catalonia, the Madrid Community, Andalusia, Aragon, Castilla la Mancha and Castilla y Leon, and also in the north of the country (Asturias, Basque Country, Galicia).
- Therefore, the management of some inventory in a feasible facility located near Catalonia and another located somewhere in the north of the country would help reduce transportation costs, since some cured products are now being transported to Madrid and then backwards.

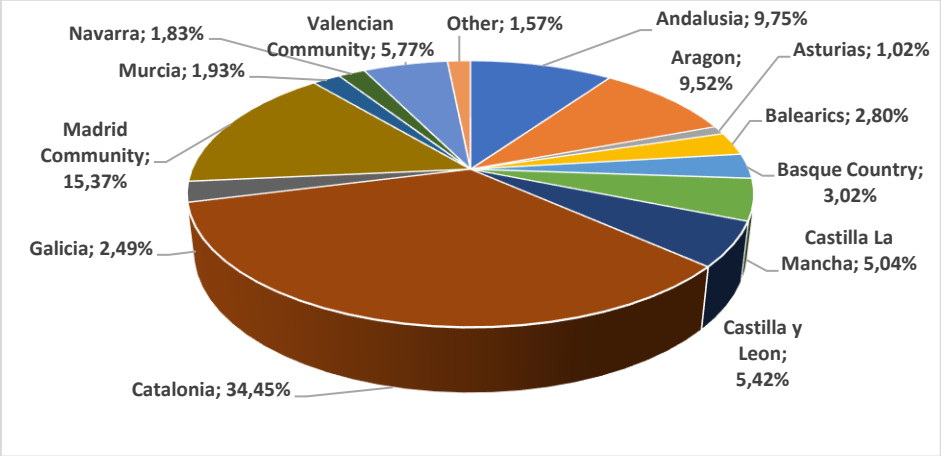

Figure 43: B2B & B2C SOH of cured products per destination (j).

Mutton:

In the case of mutton products, owing to the fact that the centralized warehouse F39 is also the supply facility for this product family, the SC costs are already significantly minimized. In fact, mutton demand comes mainly from the Valencian Community, Andalusia, the Madrid Community and Catalonia.

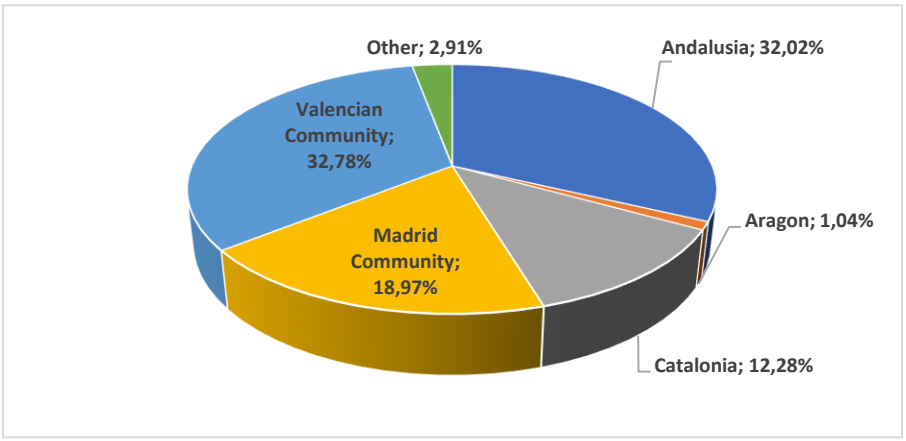

Figure 44: B2B & B2C SOH of mutton per destination (j).

Pork:

Regarding the demand of pork:

- On the one hand, warehouse F39 (in Madrid) is supplied from facility F24 (in Cuenca).
- On the other hand, demand comes mainly from the Valencian Community, the Madrid Community, Andalusia and Catalonia.

- In connection with these facts, it might be appropriate to dispatch pork products directly from factory F24 (in Cuenca) so as to reduce logistics costs. This way, facility V.O would avoid transporting products from Cuenca to Madrid to finally deliver them backwards in the Valencian Community or in Catalonia.

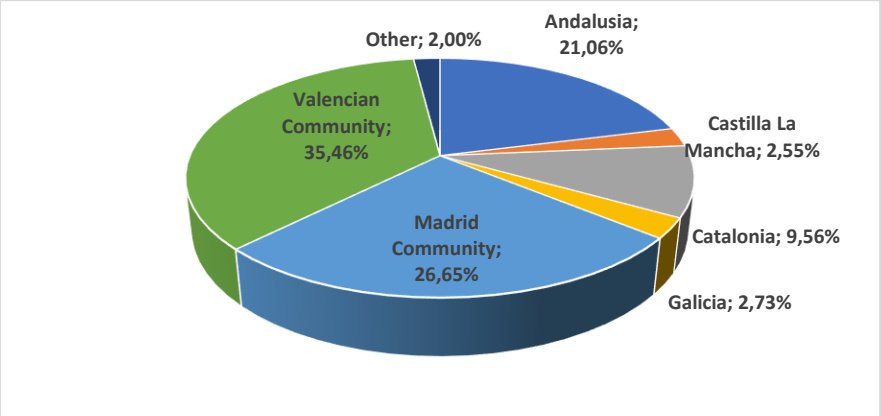

Figure 45: B2B & B2C SOH of pork per destination (j).

Poultry:

Regarding the demand of poultry:

- On the one hand, warehouse F39 (in Madrid) is supplied from facility F6 (in Valladolid).
- On the other hand, demand comes mainly from Catalonia, Andalusia, the Madrid Community and the Valencian Community.
- Owing to these facts, for instance, the current SC costs could be reduced if facility V.O decided to also dispatch this sort of product directly from any of the available factories located in Catalonia (F4, F40, F41, F3, F42, F13) or in the Valencian Community (F16), so that the demand of these regions would be attended more cost efficiently by reducing the distance to be covered.

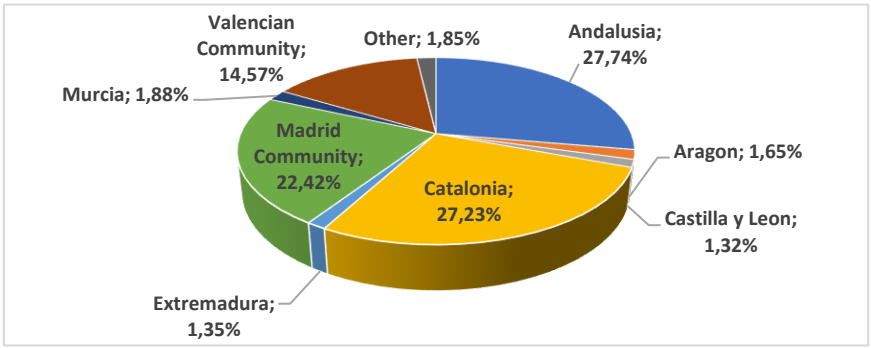

Figure 46: B2B & B2C SOH of poultry per destination (j).

As a conclusion, regarding these possible measures to be applied in order to improve the current centralized SC network, a decentralization would be required.

8.2.5 Future line of research: SC Improvement

Therefore, the design of the most appropriate decentralized SC network would be the main next step to improve the online business in Company V. To accomplish this, facility V.O would have to proceed applying Mercadona's hive model, that is: analysing consumption behaviour step by step so as to determine the most appropriate locations in which a warehouse should be opened and the sort of products to be stored in each of these locations. Regarding this fact, a deep analysis of the aforementioned SOH through R Studio would provide significant consumption patterns through which facility V.O would be able to decide which additional warehouses should be opened as well as the most appropriate inventory policy to be applied depending on each product family and location.

In fact, in connection with the aforementioned analysis by product family, some locations in which a warehouse might be required would be within the regions (j) where consumption has been higher in addition to the Madrid Community, that is: Catalonia, the Valencian Community, Andalusia and somewhere in the north of Spain.

Regarding the design of the most appropriate decentralized SC network, a mathematical program is subsequently provided in order to select additional warehouses and their suppliers as efficiently as possible. The total decentralized SC management cost is expressed through the objective function (Z), in Euros, which should be minimized.

In order to determine this mathematical program, the following parameters and variables have been determined:

- **i:** Facility to be used as centralized warehouse.
- **l:** Manufacturing facility that supplies product to facility V.O's warehouse(s).
- **j:** Demand area to attend (that is, the destination region within the Spanish Iberian Peninsula and the Balearic Islands).
- **k:** Commercialized product family.
- **CF_i :** Annual fixed cost to maintain warehouse "i" opened and functioning to attend facility V.O's requirements, in (€). According to Company V, this cost depends on each facility and considers the facility opening cost (ERP management) and its functioning cost.
- **d_{li} :** Distance between facility "l" and warehouse "i", in (km).
- **d_{ij} :** Distance between warehouse "i" and the demand area to attend "j", in (km).
- **CT_{ikl} :** Cost of purchasing and transport product family "k" from facility "l" to warehouse "i", in (€ / kg·km). The purchase cost of each product family "k" in any feasible facility "l" that

facility V.O has to pay is the same. However, CT_{ikl} depends on the distance between the facility "l" and the warehouse "i" where the cargo will have to be sent. Consequently, the smaller distance between "l" and "i", the lower cost. B2B chilled 3PL will be used in these shipments. Company V's established transfer prices are shown in the following *Table 26* (due to confidentiality, these values are not real, they are just representative).

- **Q_{ikl} :** Quantity of product family "k" to be supplied from facility "l" to warehouse "i", in (kg).
- **$CV1_i$:** Variable cost in "i" due to product storage and picking process regarding B2B POs, in (€/kg).
- **$CV2_i$:** Variable cost in "i" due to product storage and picking process regarding B2C POs, in (€/kg).
- **$B1_j$:** 1 if in "j" B2B customers are majority; 0 if otherwise.
- **$B2_j$:** 1 if in "j" B2C customers are majority; 0 if otherwise.
- **Q_{ijk} :** Quantity of product family "k" to be supplied from warehouse "i" to demand area "j", in (kg).
- **$CT1_{ij}$:** B2B transportation cost from warehouse "i" to demand area "j", in (€ / kg·km).
- **$CT2_{ij}$:** B2C transportation cost from warehouse "i" to demand area "j", in (€ / kg·km).
- **X_{ikl} :** 1 if product family "k" is supplied to warehouse "i" from facility "l"; 0 if otherwise.
- **D_{jk} :** Demand of product family "k" from area "j", in (kg).

Note that the binary parameters "$B1_j$" and "$B2_j$" are defined depending on the main type of customer to be attended in each area "j" as a simple way to differentiate the distinct costs applied to facility V.O in terms of storage, picking and transport for B2B and B2C orders.

Therefore, considering these variables and parameters, the following objective function (Z) is determined, according to which the costs with which facility V.O would have to deal are the following, from left to right: the fixed cost of the used warehouse(s), the cost regarding the purchase and transport of products from each Company V's facility to the warehouse(s), the cost of products' storage and picking process in the warehouse(s) depending on the type of order (B2B or B2C), the transportation cost from the warehouse(s) to the customer depending on the type of order (B2B or B2C) and, eventually, an indirect cost due to inverse logistics to deal with returns, which are supposed to mean 4% of the total amount dispatched per product family (note that $CT2_{ij}$ is applied since returns are supposed to be of small quantity).

$$Z = \sum_i CF_i + \sum_i \sum_k \sum_l CT_{ikl} \cdot d_{li} \cdot Q_{ikl} \cdot X_{ikl} + \sum_i \sum_j \sum_k CV1_i \cdot Q_{ijk} \cdot B1_j + \sum_i \sum_j \sum_k CV2_i \cdot Q_{ijk} \cdot B2_j + \sum_i \sum_j \sum_k CT1_{ij} \cdot d_{ij} \cdot Q_{ijk} \cdot B1_j + \sum_i \sum_j \sum_k CT2_{ij} \cdot d_{ij} \cdot Q_{ijk} \cdot B2_j + \sum_i \sum_j \sum_k 0{,}04 \cdot Q_{ijk} \cdot d_{ij} \cdot CT2_{ij}$$

Formula 6: Expression to compute the SC management cost in a decentralized network.

This is subject to:

- $\sum_l X_{ikl} = 1$, that is, warehouse "i" requires only one supplier "l" for each product family "k".
- $\sum_i Q_{ijk} = D_{jk}$, that is, the quantity of product family "k" to be supplied to area "j" has to equal the demand of product family "k" from area "j", in (kg).

Regarding the aforementioned cost (CT_{ikl}), its value depending on each product family is the following:

Product family		CT_{ikl} (€/kg·km)
Name	Code (k)	
Alternative protein	P1	0,18
Beef	P2	0,16
Cooked products	P3	0,05
Cured products	P4	0,15
Pork	P5	0,05
Poultry	P6	0,04
Varied products (Mutton)	P8	0,14

Table 26: CT_{ikl} value per product family "k".

According to the analysis of this expression and considering the aforementioned details, the variables that would have to be minimized in order to optimize facility V.O's SC management cost when working with the decentralized scenario are the ones highlighted in the expression below: the fixed cost of the warehouse (CF_i), the distance between the supply facility and the warehouse (d_{li}), and the distance between the warehouse and the demand areas (d_{ij}).

$$Z = \sum_i \boldsymbol{CF_i} + \sum_i \sum_k \sum_l CT_{ikl} \cdot \boldsymbol{d_{li}} \cdot Q_{ikl} \cdot X_{ikl} + \sum_i \sum_j \sum_k CV1_i \cdot Q_{ijk} \cdot B1_j + \sum_i \sum_j \sum_k CV2_i \cdot Q_{ijk} \cdot B2_j + \sum_i \sum_j \sum_k CT1_{ij} \cdot \boldsymbol{d_{ij}} \cdot Q_{ijk} \cdot B1_j + \sum_i \sum_j \sum_k CT2_{ij} \cdot \boldsymbol{d_{ij}} \cdot Q_{ijk} \cdot B2_j + \sum_i \sum_j \sum_k 0{,}04 \cdot Q_{ijk} \cdot \boldsymbol{d_{ij}} \cdot CT2_{ij}$$

Formula 7: Variables to be minimized regarding the expression to compute the SC management cost in a decentralized network.

The resolution of this mathematical program (using the aforementioned SOH and, for instance, the Solver software) and the analysis of the obtained solution would allow facility V.O to design the most appropriate decentralized SC network.

9. Planning and Budget of the Project

In relation to the process that has been followed so as to develop this project, the aim of this section is to show the organization of the different required tasks that have been realized and, in addition to this, to compute the project's budget.

9.1 Project's planning

In order to achieve the aim of this project, the main tasks realized have been the following: the analysis of Company V, information research regarding the online business and the SC operations that are required in this sort of activity and, eventually, the implementation of the online business within the organization through two steps (Phase 1 and Phase 2). These tasks, which have been all developed throughout the project's memory, are listed in the following *Table 27*.

In fact, the schedule of the different tasks is shown through the Gantt Chart in *Figure 47*.

Note that, as aforementioned, there are tasks which have required significant amount of time to be completed due to the fact that the business was implemented in real life.

Title	Start date	Due date	Duration
TFM			
Analysis of Company V	30/09/2019	23/10/2019	18d
Evolution of Company V	30/09/2019	04/10/2019	5d
Structure analysis	07/10/2019	18/10/2019	10d
SWOT Analysis	21/10/2019	23/10/2019	3d
AMZ Test	30/09/2019	27/12/2019	65d
Phase 1 - AMZ Marketplace	08/01/2020	12/06/2020	113d
Analysis of AMZ Test	08/01/2020	13/01/2020	4d
Benchmark	14/01/2020	17/01/2020	4d
Point 17 facility analysis	20/01/2020	30/01/2020	9d
Pricing policy	31/01/2020	07/02/2020	6d
AMZ Sales	16/03/2020	05/06/2020	60d
Results analysis	08/06/2020	12/06/2020	5d
Online business analysis	15/06/2020	10/07/2020	20d
E-Commerce operations	13/07/2020	22/07/2020	8d
SC design for E-Commerce	13/07/2020	16/07/2020	4d
Analysis of real cases	17/07/2020	22/07/2020	4d
Phase 2 - Centralized SC	23/07/2020	30/06/2021	245d
Logistics & Information flow	23/07/2020	23/07/2020	1d
Product, Market, Facilities	23/07/2020	27/07/2020	3d
Centralized Warehouse	28/07/2020	03/08/2020	5d
SC Network	04/08/2020	10/08/2020	5d
Phase 2 Sales	01/09/2020	25/06/2021	214d
SOH Analysis	28/06/2021	05/07/2021	6d
SC Improvement proposal	06/07/2021	08/07/2021	3d
Conclusion	06/09/2021	07/09/2021	2d

Table 27: Project's tasks list.

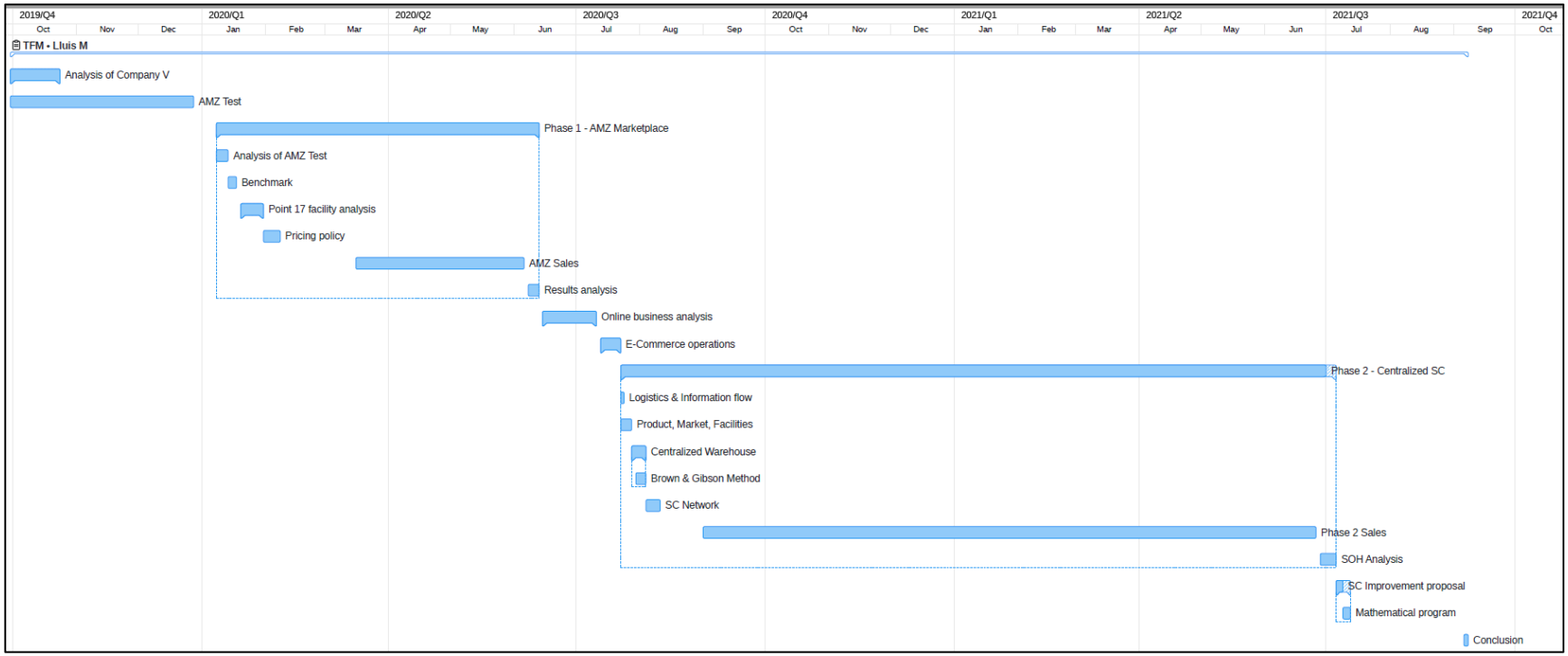

Figure 47: Project's Gantt Chart.

ETSEIB

9.2 Budget

In order to compute the budget of this project, the costs of the following factors are considered:

- **Time:** According to the Gantt Chart, this project has been realized throughout 474 days, and an average workload of one hour and a half per day has been required. Moreover, considering the average monthly Spanish wages in 2020, an average cost of 13€ per hour can be considered [25]. Therefore, the cost of time is 9243€.
- **Auxiliar material:**
    - On the one hand, the laptop that has been used to develop this project cost 600€ and, considering that is has a useful life of 5 years, 26% of its useful life has been consumed, which represents a cost of 155.84€.
    - On the other hand, there has been a cost of 8€ regarding other auxiliar material such as pens, pencils and a notebook.

Therefore, as shown in the following table, the total budget of this project has been 11382.28€ (21% of service taxes included).

Factor		Quantity	Cost per unit	Cost
Time		474 days = 711 hours	13 € / hour	9243 €
Auxiliar Material	**Laptop**	1 unit	600 € / unit. Useful life of 5 years.	155.84 €
	Other	----	8 €	8 €
Total Budget				9406.84 €
Total Budget (21% VAT included)				11382.28 €

Table 28: Description of the project's budget.

10. Environmental impact

The development of this project has had a very low environmental impact and, in addition to this, Company V's environmental impact has been reduced when applying the different phases of the project. This is due to the following reasons:

- The development of this project has required minimum material waste: the main tool that has been used is the laptop, whose manufacturer already considers environmental impact minimization.
- The new sort of activity which is treated in this project is the online business, which does not require physical stores.
- Regarding the development of the online business, one of the main requirements that has been analysed is the optimization of the required SC network, thus its environmental impact is minimized (for instance, transportation routes have been considered). Furthermore, this new business channel would allow Company V to minimize food loss and waste.

Therefore, the environmental impact of this project is almost neutral, as the minimum impact that its development has required is almost compensated through its positive environmental impact (that is, optimization of the SC network and reduction of FLW in Company V).

Nonetheless, it is necessary to state that, in spite of the fact that no physical retail stores are required when running an online business, the fact that customers do not have to collect their orders in the main stores but, instead, they can have them delivered at the required address, causes a significant increase of the logistics activity due to the last mile delivery, thus there is negative environmental impact. Consequently, it would be necessary that the last mile 3PL invested in offering its service through environmentally friendly vehicles.

11. Conclusions

The availability of the Internet worldwide has made E-Commerce usage to increase year by year; actually, buying online provides consumers with significant comfortability, convenience and time saving. Regarding Spain, this trend has been recently reinforced by the lockdown that was applied from March 2020 to May 2020, a period during which E-Commerce was used by 75.2% of Spanish Internet users, with food and beverages being the second most consumed sort of product.

Currently, consumers are demanding an excellent service level, and as much comfort when purchasing as possible. Owing to these facts, omnichannel scenarios have become a requirement for any business to remain competitive. Hence, it was determined that Company V, as an agri-food business with plenty of experience in offline B2B operations, should also provide consumers (both B2B and B2C) with the possibility to make online purchases.

So as to develop E-Commerce and omnichannel strategies, organizations have to invest in designing appropriate SC networks that can handle large volume of orders, which may require personalized details and which might be difficult to be forecasted, as well as some returns. In relation to these facts, the business scope needs to be analysed so as to determine the most appropriate inventory policy, the distribution network (suppliers, warehouses, DCs) and the required order penetration point.

Through the analysis of Company V and regarding the assessment of the SWOT analysis, it has been concluded that it would be worth investing in the development of its online and omnichannel business due to the following main reasons: high production efficiency of modular products, ownership of several facilities spread around the country and the chance to participate in a new fast growing business channel. Nevertheless, in addition to the ordinary online operational challenges, limited products' shelf-life and the requirement of chilled transport and storage conditions have to be assessed.

The analysis of two real online food businesses (Mercadona E-Commerce and AMZ Fresh Marketplace) has allowed to determine two main techniques when developing an online food business: the hive model, according to which the picking and dispatching of online orders should be done in specific facilities, and the laboratory model, regarding which the SC network should be designed step by step while learning about food consumption patterns depending on each location.

So as to implement these techniques in Company V through the facility V.O, it has been determined that the following two phases have to be followed:

- In relation to Phase 1, the use of the externalized SC network of AMZ has allowed facility V.O to gain knowledge regarding the online food business, considering that cured products have been commercialized online in Spain, Germany, France and in the UK. Nonetheless, the analysis of the collected SOH has demonstrated that the SC

management cost of this scenario is high and that, in fact, most of the required operations could be realized internally within Company V.

- In connection with Phase 2 and once having acquired some experience, operations have been internalized in Company V from a centralized point of view, thus risks and fixed costs are minimized. Nevertheless, the analysis of the SOH obtained in this step has demonstrated that the designed centralized SC network could be improved if it was decentralized.

To conclude, the future line of research of this project would be to analyse the performance of Company V's online business considering a decentralized SC network, the structure of which would be determined by solving the mathematical program that has been proposed.

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