Development of Collaborative and Sustainable Supply Chains

The Agroindustry By-Products Case Study

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ABSTRACT

The agro-food sector in Portugal corresponds to 4.1% of GDP and involves more than 11,000 companies throughout the supply chain [16]. Considering the fragmentation and disarticulation of this industry, as well as the need to develop dependence on direct and inverse flows, collaboration between companies should be studied as this can have a positive impact on the environmental, social and economic performance. In this context, the present work aims to understand how supply chains have been dealing with sustainable objectives, and what is the collaboration potential advantage to the improvement of sustainability in supply chains. A methodology is developed, which proposes a possible path for companies that want to develop a sustainable-collaborative work. Such methodology is applied to a company of ETSA Group, Abapor, that works in the collection of by-products in the retail channel. Considering this, the goal is the Abapor's supply chain optimization considering the exploitation of potential collaboration actions through other entities in their supply chain.

From the work developed two valuable outputs were obtained: the creation of a sustainable-collaborative methodology; and the analysis of the Abapor-SONAE interaction and identification of opportunities for improvement in the sustainability chain through collaborative measures.

Keywords: Sustainable-collaborative methodology; Agro-food sector; MobFood project; PPS-7; Abapor.

RESUMO

O setor agroalimentar em Portugal corresponde a 4.1% do PIB e envolve mais de 11,000 empresas através da cadeia de abastecimento [16]. Considerando a fragmentação e desarticulação desta indústria, assim como a necessidade de desenvolver a dependência entre os fluxos inverso e direto, a colaboração entre as empresas deve ser estudada, dado que sugere um positivo impacto a nível da performance ambiental, social e económica. Neste contexto, o presente trabalho pretende perceber como as cadeias de abastecimento têm vindo a lidar com os objetivos sustentáveis, e qual o papel da potencial vantagem colaborativa para a melhoria da sustentabilidade nas cadeias de abastecimento. A metodologia desenvolvida propõe um possível caminho para as empresas que pretendem desenvolver um trabalho sustentável e colaborativo. Esta metodologia é aplicada a uma empresa do Grupo ETSA, Abapor, que trabalha na recolha de subprodutos no canal de retalho. Desta forma, o objetivo é a otimização da cadeia de abastecimento da Abapor considerando a exploração de potenciais ações colaborativas através de outras entidades na sua cadeia de abastecimento.

Do trabalho desenvolvido foram obtidas duas valorizações: a criação de uma metodologia sustentável-colaborativa; e a análise da interação Abapor-SONAE e identificação de oportunidades de melhoria na cadeia, a nível da sustentabilidade, através de medidas colaborativas.

Palavras-chave: Metodologia sustentável-colaborativa; Setor agroalimentar; Projeto MobFood; PPS-7; Abapor.

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BSC – Balanced Scorecard

BSE – Bovine Spongiform Encephalopathy

Ca – Calcium

CE – Circular Economy

CO_2 – Carbon Dioxide

CPC – Centro de Processamento de Carne (Meat-processing center)

DGV – Direção Geral de Veterinária

EBITDA – Earnings Before Interests, Taxes, Depreciation and Amortization

EC – European Community

EU – European Union

FEUP – Faculdade de Engenharia da Universidade do Porto

FIFO – First In First Out

GRI – Global Reporting Initiative

GVA – Gross Value Added

HoReCa – Hotels, Restaurants and Cafes

IISD – International Institute for Sustainable Development

ISCC – International Sustainability and Carbon Certification

IST – Instituto Superior Técnico

ITS – Indústria de Transformação de Subprodutos

KPI – Key Performance Indicator

M1 – Animal by-products of category 1

M2 – Animal by-products of category 2

M3 – Animal by-products of category 3

MGB – Mobile Waste Containers

NGOs – Non-Governmental Organizations

P – Phosphorus

PMMS – Performance Measurement and Management System

PPS – Post-Program Surveillance

R&D – Research and Development

SC – Supply Chain

SCM – Supply Chain Management

SCRS – Strategy, Current state, Requirements, and Solution

SIPOC – Suppliers, Inputs, Processes, Outputs and Customers

SONAE – Sociedade Nacional de Estratificados

SSC – Sustainable Supply Chain

SSCM – Sustainable Supply Chain Management

SWOT – Strengths, Weaknesses, Opportunities and Threats

TCO – Total Cost of Ownership

UN SDG – United Nations Sustainable Development Goals

WWTP – Waste Water Treatment Processes

1. INTRODUCTION

Emmanuel Faber (2016) [1] said that *the beauty of the natural cycles, gives the importance of something that managers often lose to think – that life is more than ideas, mathematical models, and software.*

1.1. PROBLEM BACKGROUND AND MOTIVATION

The urban centers' homogenization, the technological revolution and the geopolitical reorganization of the world, due to the observed high economic growth in the last decades, has led to a significant improve in the population quality of life. This movement, called **globalization**, directed to the progressive unification of the markets and the supply aggregation, have forced companies to rethink demand, production and distribution strategies, culminating in a new supply chain perspective. However, this phenomenon has carried out the permanent degradation of ecosystems, the appearance of ecological disasters, global warming and the depletion of available natural resources. Given the unfeasibility of the situation, consumers and nongovernmental entities have increased the pressure already imposed on the economic groups and the governments. This pressure, considering the adoption of extreme measures in order to reduce the environmental problems, has led to the need, for companies, of implementing increasingly efficient strategies for reducing the environmental impact, increasing at the same time their competitiveness. These impositions have commanded the creation of **sustainable management activities**, concerned not only the environment but also the social and economic issues, the three pillars of sustainability [5]. This type of regulation led to the development of innovative activities in supply chains and one of the options was the creation of closed loop chains. These structures have the objective of combining the direct and reverse logistic flows to maximize the value creation, increasing the product life cycle [6].

In this context, and given the urgent implementation, the deeper the adoption and implementation of these measures, the more they depend on partnerships being able to establish synergies to achieve common goals. However, this **collaborative process** is complex, implying an organizational structure that requires the interdependence of all the stakeholders involved. In view of this, collaboration is seen as a potential competitive advantage, also providing win-win situations.

This was the starting point for the ***PPS-7*** – *Logistics - Sustainable Collaborative Agro-Food Logistics Chain*, integrated in the ***MobFood project*** - *Mobilization of scientific and technological knowledge in response to challenges*. Different entities are involved in this project where the sustainability and collaboration are target objectives. One of these entities is the ETSA Group with the Abapor's company specifically, which is the based case study of this work. This company acts in the animal by-products industry, handling raw materials that are not directly destined for human consumption, transforming them to valuable final products.

The **present work** has been defined, where the goal is to understand how supply chains have been dealing with sustainable objectives and what is the collaboration potential advantage to the improvement of sustainability in supply chains. Also, this work aims to develop a methodology that will define a possible path for companies to be involved in a sustainable and collaborative work. Such methodology

will be applied to Abapor in the PPS-7 context. Considering this, some strategies will be identified considering the exploitation of potential collaborative actions through the entities involved in the project to improve their overall sustainable performance.

1.2. OBJECTIVES DEFINITION

This master's dissertation, as mentioned above, aims to study the supply chains and their sustainable management considering the three pillars of sustainability (economy, society and environment), incorporating as an important aspect the collaboration between the entities involved in the supply chains activities. To achieve the aimed result, it is necessary to:

- Consider the work contextualization, presenting the MobFood project, and specifically the PPS-7, in terms of goals, partners and other important aspects, also validating the collaboration potential;
- Understand how has been evolving Agro-food industry considering the future challenges;
- Study supply chains in terms of definitions, structures and other relevant aspects, bestowing sustainability and collaboration as important integrated aspects;
- Explore examples of real integration of all these aspects to achieve sustainable and collaborative supply chains;
- Develop a general methodology to be implemented when a sustainable collaborative work is considered;
- Implement the methodology developed in a real case study, considering Abapor on the PPS-7 context.

At the end, it leads to the identification of opportunities for the overall supply chain optimization considering not only Abapor but the other PPS-7 partners, aiming the improvement of its sustainable aspects and the construction of collaborative strategies, always with the continuous development perspective.

1.3. DOCUMENT STRUCTURE

The dissertation will be divided into six distinct chapters: Introduction; The MobFood project and current work goals; Literature review; Sustainable and collaborative methodology; Case-study: Methodology application; and Conclusion and Future work.

The ***Introduction*** is the present chapter, **chapter 1**, dedicated to the work contextualization, the importance of the chosen theme, definition of objectives and the presentation of the dissertation's structure. It starts with the characterization of globalization and its consequences, with attention to the measures taken to fight their negative environmental, social and economic impacts. The project that led to the development of this dissertation – MobFood with the PPS-7 – and the main company that will directly integrate the case study – Abapor – were also presented in a basic way. With this, the dissertation's work was defined.

The MobFood project and current work goals, **chapter 2**, aims the MobFood project's presentation considering the entities involved in the PPS-7. It aims both to contextualize the environment of the problem under study and to define, in a clear way, the dissertation's goal.

The ***Literature review***, **chapter 3**, will focus on the Agro-food challenges, supply chains and their structures, sustainable management, collaboration as a competitive advantage and finally a cross-cutting of these four major themes, leading to the development of sustainable and collaborative supply chains. In this context, the theoretical body will be structured in five sections:

- **Section 3.1.** – Agro-food industry;
- **Section 3.2.** – Supply chains management;
- **Section 3.3.** – Sustainability;
- **Section 3.4.** – Collaboration as a competitive advantage;
- **Section 3.5.** – Development of sustainable and collaborative supply chains.

To obtain a logical line of though, at the end of each section, as well as at the end of the chapter, a summary of the main concepts, and the information given in each section, will be presented as conclusions.

The ***Sustainable and collaborative methodology***, **chapter 4**, consists in the presentation and description of the methodology's step proposed into a sustainable collaborative perspective, considering the literature review made in chapter 3.

The ***Case-study: Methodology application***, **chapter 5**, will be based on the MobFood project concentrating specifically in the Abapor company of the ETSA Group. It will involve a process of information gathering to the proposed methodology implementation, aiming the construction of a sustainable collaborative proposal to be implemented in the real context. As conclusion, the implementation will be summarized, and the limitations related, both the methodology, and the implementation, will be presented.

Finally, the ***Conclusion and Future work***, **chapter 6**, will be developed as a summary of the dissertation's work, where possible future developments will be suggested.

2. THE MOBFOOD PROJECT AND CURRENT WORK GOALS

This chapter aims to provide a contextualization and description of the problem under study. The MobFood project will be presented considering the specific PPS where the present work is developed. Regarding this, the companies that are part of the PPS will be identified and described. Through all this basis, the dissertation's problem will be well-defined and, to finish this chapter, conclusions will be provided.

2.1. MOBFOOD PROJECT

The Agro-food sector englobes more than 11,000 companies, being not only an important part of the national economy but also a critical and fragile activity. It is a fragile activity derived from the high fragmentation of the sector, considering the high number of companies involved. Those are often disarticulated, creating serious non-collaborative chains where the value of sustainability, critical in this sector, is not often considered. Within this context, the companies' collaboration towards sustainability was considered an opportunity that is explored by the MobFood project [7].

MobFood is the result of an open debate between several agents from the agribusiness. The overall goal is to find the right path to promote competitiveness into the national food industry, through an organized and integrated way. It aims the construction of a close collaboration between private companies and scientific institutions to the development of R&D departments, innovation and technologies, so as to achieve new sustainable products, services and processes. Considering this, the aim is to turn the sector totally sustainable, resilient, open, safer and with an optimization of resources usage. The project cultivates as principles the food safety and sustainability, the food for health and well-being and the safe food and quality, that are shared by 47 entities from different agribusinesses and R&D entities [7]. The MobFood is financed by Portugal 2020, that is a segmentation of a combined set of strategies to achieve the European Strategy 2020 development. It includes nine Post-Program Surveillance (PPS) integrated considering the emerging technologies, the resources valorization, the sustainable packaging, nutrition, health and well-being, quality and food safety, authenticity and traceability of products, logistics, the consumer and the coordination, implementation, dissemination and exploitation of results [7]. The present work is developed within PPS-7, that aims to explore the potential improvements of collaboration between companies, in order to achieve win-win situations and also to articulate the agro-food sector, considering the positive impact in sustainability.

2.2. PPS-7 – LOGISTICS

The main objective of the PPS-7 is the logistics activities characterization in the sector, at national and international levels, including the European considerations for sustainability. A set of representative companies of the sector will be questioned about their motivations, restrictions, conditionings and requirements at the logistical level, to reduce waste. After that, will occur the development of methodologies to be implemented in the supply chain management, so as to support decisions that include collaboration and integration. In this line, a dashboard will be developed, in order to help the control of the processes taking into account Key Performance Indicators (KPIs) to measure the supply

chain performance. This PPS can be divided into two main steps: the collaboration framework development; and the construction and implementation of a real time monitoring dashboard [7].

With this in mind, and to test, validate and improve the methodology two case studies will be used [7]: (1) **fruits and vegetables** – actually, the generated fruits and vegetables waste is not yet treated, being deposited in landfills or incinerated; and **meat** – the waste generated in the meat supply chain is already transformed, considering the associated legal aspects. However, this project intends the processes exploitation to optimize the overall supply chain and to find other opportunities.

A group of partners compose the PPS-7, which includes ETSA Group, SONAE, Greenyard and Olano. These companies will be briefly described to contextualize the project. It is important to mention that the *Instituto Superior Técnico* (IST) and the *Faculdade de Engenharia da Universidade do Porto* (FEUP) are also part of this project contributing with the scientific knowledge.

2.2.1. ETSA GROUP

> *This company aims to be a multinational reference in the European rendering sector, contributing to the structural development of the sector by the discipline of conduits, ensuring the food chain safety and promoting health and public health advocacy.* – ETSA Group

In 1950, *Indústria de Transformação de Subprodutos [(a)], S.A.* (ITS) was born, consisting on a factory that worked in the transformation of animal fat in cookers fed with direct fire. At that time, there were around thirty small factories in Portugal. However, technological developments, environmental requirements and the Bovine Spongiform Encephalopathy (BSE) disease, led to a restrict legislation and, consequently, the closure of many factories. In 1997 occurred the commercial concentration of ITS and *Sebol – Comércio e Indústria de Sebo [(b)], S.A.*, which before that competed in the market for the collection and transformation of animal by-products. In 2007, *ETSA Investimentos [(c)], SGPS, S.A.* was created, focusing their business on the integrated development of the elimination, recovery and revaluation of animal and other food by-products [146].

(a) By-products Transformation Industry

(b) Trade and industry of tallow

(c) ETSA Investments

At the end of 2008, ETSA was incorporated into the **Semapa Group** (see Figure 1), a publicly-held company, that is composed by three industrial companies: The Navigator Company – European leader in the production of fine paper for uncoated printing and writing, and the production of bleached eucalyptus pulp; Secil Group – production and marketing of cement; and ETSA Group – a set of companies operating in complementary areas, considering the development of solutions in the field of environmental preservation and the use of waste as an energy source. Actually, ETSA is composed by five companies that have different core businesses: Abapor; ITS; Sebol: Biological; and ETSA Log [146]. Abapor works with the retail sector through the by-products collection activity. ITS is a transformation unit through incineration. Sebol is also a transformation unit but has as final products flour and fat that will supply external businesses. Biological is dedicated to the collection and treatment of oils. ETSA Log

is a company created to be responsible for all logistic activities of the group. Abapor, the base company of this dissertation, will be explored in the chapter 5.

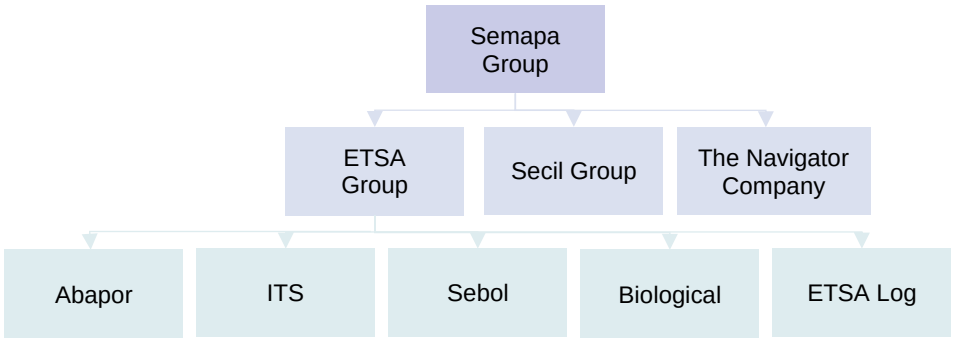


FIGURE 1 - SEMAPA GROUP COMPOSITION CONSIDERING SPECIFICALLY THE STRUCTURE OF ETSA GROUP.

During this time, ETSA has maintained a clear strategic-level policy, valuing the coordination of the team. This is crucial to the positive and sustainable development of the company, being performed at tactical and operational levels. With this in mind, the company considers a set of strategic lines that support the business: the consolidation of the national quote leadership and the diversification of the supply and regulatory risk (internationalization garner competitive advantage through sustained innovation; simplifying internal processes; promoting proactivity; and capturing profitable niches). The values of the company include the compliance of the physical and technical security, the creation of value to all shareholders, the promotion of the commitment and goals achievement of all employees, the support of the R&D projects and innovation, as well as the promotion of a culture considering the rigor and accountability [146]. Since sustainability is the business basis, ETSA is always worried with the development of new measures to turn the group more environmentally sustainable. They invest in the development of internal monitoring plans in order to control environmental aspects, considering the biohazard substances and exhaustive emission analysis, the maximization of the energy and protein utilization of all by-products/wastes and the assess and mitigation of the environmental risk, and internal and external disclosure of the environmental policies.

As a competitive structure, needs to have a good acceptance of its products and services in the market. For this purpose, cultivates as principles: (i) **continuous bet on new technologies** – to grow and develop in a continuous and positive, consistent and sustained manner, adding extensive knowledge in the areas in which it operates; (ii) **professionalism** – count with a good team, competent, led, disciplined, respected and united; and **research and Development (R&D)** – a department of the company that has been continuously developed, having as projects: P2020 Morepe and Sifide; MobFood – the project under study; ash and use of phosphorus; and the hydrolysis of by-products (digest) and flour. Through the hydrolysis of by-products (digest) and flour, ETSA tends to focus on students and universities to bring more knowledge and new business ideas. On the other hand, Semapa is also developing projects, called synergies of the group that can be described as collaborative projects, such as the use of animal oil/fat as biofuel or solvent in the biomass liquefaction process (Secil); valorization of incineration ash (P, Ca, etc.) for application in forest fertilizers; the use of bioactive

compounds or extracts, such as antioxidants and antimicrobials, of eucalyptus, in animal feeds with additive function; and the possibility of synergies with algae to enrich the nutritional value of flours [146].

2.2.2. SONAE

Our mission is to create economic and social value, carrying the progress and innovation benefits to an increasingly number of people – SONAE Group

Sociedade Nacional de Estratificados [(d)] (SONAE), with thirst in Maia, was founded in 18th of August of 1959, with a production core business focused on decorative term laminates. It was in the 80's that the company pretended to diversify the business and opened the retail business with the constitution of the Modelo Continente Hipermercados [(e)] and the first store in Matosinhos, in 1985. Also ventured in the real estate business opening the two first shopping in Portimão and Albufeira, as well as the Sheraton Palácio Hotel [(f)]. In the 90's the company intended to develop strategically all businesses, mainly focusing in the retail, creating new brands as Modalfa, Sport Zone and Worten. The telecommunications business started also in that decade, through the creation of Jornal Público and the brand Optimus. In the 90's the major seal was the construction of the Centro Comercial Colombo, the biggest shopping of the Iberic Peninsula, in 1997. In 2007 the company acquired Carrefour Portugal, which leads to a big geographic expansion, with a big portfolio reorganization. In the present decade has occurred the international expansion being Zippy the most international brand, focus in kids, counting with 49 stores out of Portugal [9].

(d) National Society of Laminates
(e) Modelo Continente Hypermarkets
(f) Sheraton Hotel Palace
(g) Public Journal
(h) Colombo Commercial Center

It is a Portuguese multinational company presents in all continents, englobing 91 countries. With solid roots and permanent ambition for progress, SONAE values union, ethic, trust, people, innovation, social responsibility, frugality and efficiency, and cooperation and independence. In 2016 has created more than 2265 work stations, and in 2017 has a business value around 5,710 M€ [9].
The present work is concentrated into the SONAE MC, company responsible for the food retail. This company has already been distinguished in various areas as sustainability, efficiency and innovation, being a group with good basis, prospering positively to the future.

The most recent award achieved by Sonae was *Edie Sustainability Leaders Awards 2018*. Those awards, created in 2007 are organized by Faversham House, an English editor specialized in sustainability and corporate responsibility. Sonae was distinguished in *Sustainability Reporting* category, competing with companies as Heineken UK, PwC UK, The Crown Estate, Virgin Media and Merchant Carlos and Lloyds Banking Group. The basis of the panel was on the SONAE's sustainability report, supported by the projects implemented in the sustainable development scope. Nowadays, SONAE helps more than 1,000 institutions with the total value of 10 million euros, given more than 1 million hours of employees' training, and implementing ecoefficiency and environmental protection projects [9].

2.2.3. GREENYARD GROUP

We believe fruit and vegetables are key to a healthier future for everyone, and a more sustainable way of feeding the world. – Greenyard Group

Founded in 1987 by Hein Deprez, in Belgium, Greenyard Group is a global market leader of fresh, frozen and prepared fruits and vegetables, flowers, plants and growing media. In general, this company moves 2,000,000 of fresh fruits and vegetables, 800,000 of frozen and prepared products, in a volume of 3,000,000 m^3 of potting soil. It serves 19 out of the top 20 retailers in Europe, employing more than 10,000 employees, in more than 50 production units, in more than 27 countries, having a turnover about 4,18 billion euros. It is in Portugal since 2001, resulting from the fusion of Univeg, Pinguim, Noliko and Petralcom, composing, in 2015, the Greenyard Group. The Portuguese parcel has 34 distribution centers and 23 of the 50 production units. To specify the current state of the business in the four core areas, the Figure 2 is presented.

Fresh products

- #1 in Europe, and #3 globally
- Sourcing & sales of Fresh F&V
- >5,500 employees
- 32 distribution centers
- Active in 20 countries

Frozen products

- #2 in Europe
- Production & sales of Frozen F&V
- >2,000 employees
- 11 facilities
- Active in 7 countries

Prepared products

- #4 in Europe and #1 in mushrooms globally
- Production & sales of Prepared F&V
- >1,000 employees
- 4 facilities
- Active in 7 countries

Horticulture

- #3 in Europe
- Production & sales of growing media
- >450 employees
- 10 facilities
- Active in 5 countries

FIGURE 2 - CURRENT STATE OF THE CORE BUSINESSES OF GREENYARD GROUP. ADAPTED FROM [11].

As said above, the customers are many of the world's largest food retailers, supplying, in a steady and high-quality way, fruits and vegetables to their stores. Greenyard Group values the relationships between the company and their customers, having two major goals: (1) **to expand the fruit and vegetables category** – through the offer of products, retailers have opportunities to differentiate from competitors. Greenyard helps them to expand and diversify their offer, introducing new concepts and a rapid response to the ever-changing customers trends. Through collaboration processes retailers enter with its wide range of products and its in-depth expertise; (2) and **to construct a direct connection to the field** – the worldwide network of growers and the flexible logistics of Greenyard leads to the match between supply and demand and to the accomplish of customers expectation. The expected is to buy fruit and vegetables at time, place and price that suit customers' lifestyle, schedule and budget.

As values, Greenyard Group is passionate, being proud of its achievements and their stable and strong relationships; are entrepreneurial, being hands on, pragmatic, flexible and proactive; are reliable, since they do what they say, respecting people and the planet, working with quality and transparency; are creative, encouraging to think in a different way, challenging themselves and the people around,

innovating to enhance their products and processes; and are sharing, being team players and is through the know-how and experience sharing that they built long-lasting relationships.

Through reliability, one of the aspects talked is the respect for the planet. Greenyard practices sustainability, having five themes that can titled the performance sustainability goals: (i) **environment** – to reduce the environmental impact of all sites and factories, carefully measuring and monitoring the use of energy, water and other resources, being the avoidance of food waste a relevant objective in the supply chain of perishable products; (ii) **sustainable trade** – to improve social standards, aiming to source fruit and vegetables in a sustainable way, respecting nature and providing growers with a fair return; (iii) **sustainable growing** – to promote sustainable solutions to the agricultural supply chains, developing strategies to help growers to improve soil quality, water usage, waste management, biodiversity and carbon balance; (iv) **healthy products** – to develop products and stimulate the consumption of fruits and vegetables; (v) and **people** – to provide a safe, healthy and inspiring working environment.

2.2.4. OLANO

Strong of our family identity, we have combined over the years, growth and independence. Olano offers a resolutely structured and modern image, being a sustainable company that approaches the future with serenity. – Olano Group

Olano is a multinational specialist in cold logistics. Operating in the cold chain, Olano considers the fresh products preserved from +2ºC to +25ºC and the frozen products preserved at -18ºC. Inside these parameters can be transported sea, fresh, health and meat products. The considered operations must accomplish a sustainable development policy and strategy, sensitizing and encouraging the collaborators to practice also. Therefore, Olano improves the quality of the professional life, privileging the team work, acting in a sustainable way to guarantee the future of the group.

Composed by a modern and structured familiar group, it is a corporative and unified brand. The principal foundation of the company is the project sharing with its stakeholders, achieving the potential benefits that are intended to be achieved with the present project PPS. Counting with 46 affiliates of the company, 2,000 collaborators and 1,000 own vehicles plus 1,000 weekly traction, have flexibility to operate at an international level: Portugal, Spain, Italy and France [12].

Through all this data and considering the dissertation context, in the next section will be presented the problem description which will support all developing work.

2.3. PROBLEM DESCRIPTION

Composed by the presented four companies, the PPS-7 has an inherent channel. SONAE provides the retail partnership, Greenyard Group considers the logistics chain of fruits and vegetables, Olano is the logistics company responsible for the transport and logistic of the frozen products and ETSA Group, more precisely, Abapor, provides the component to realize the circular economy taken the by-products of SONAE and transforming them in revalorized products.

So, this project will be developed considering the MobFood project context and ETSA Group is the applicant company. The proposal is to study the direct interaction between the retail and the process of by-products collection as can be seen in Figure 3. In this line it considers an overview of Abapor's supply chain to characterize the initial situation and, therefore, an analysis of the potential collaborations that can be done between Abapor and the other companies to expand the portfolio of by-products transformation and to optimize the overall supply chain, considering the improvement of sustainability.

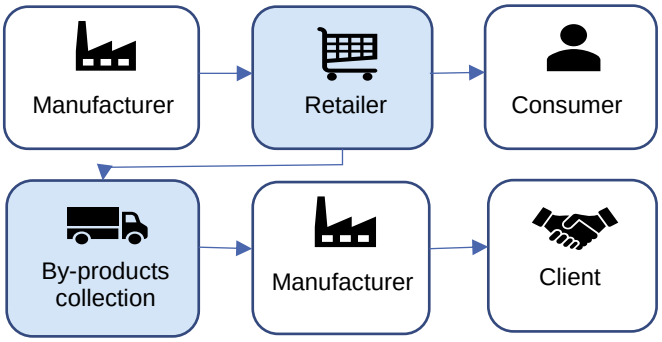


FIGURE 3 - PROBLEM DESCRIPTION SCHEME.

2.4. CHAPTER CONCLUSIONS

This chapter provided the context on the problem under study, with the presentation of MobFood project and the PPS-7 under which the present work will be developed. The PPS-7 aims to characterize the different logistics activities of the Agro-food sector, integrating sustainable aspects and possible collaborations in the chain. It is based on the identification of motivations, constraints, and requirements in terms of logistics and sustainability, in order to build sustainable chains that will allow the reduction of waste and environmental impacts. At the same time, it is considered the development of process management methodologies to support decisions in an integrated and collaborative way.

Considering the companies that composed the PPS-7, we have:

- **ETSA** is a specialized company in the by-products' transformation, extremely focused and supported by the sustainability in the context of waste revaluation. It is a company with history, structured and integrated in a group that has an important paper in the national economy. Instead of the core business, it is a company focused in innovation and development considering collaborative processes not only internally but also externally, taking into account the stablished synergies into Semapa. In this line, is a potential good collaborator considering the experience in operations related to the revaluation of by-products and the availability and knowledge about the establishment of collaborations or synergies.
- **SONAE** is a Portuguese multinational company very recognized, being a well-structured, diversified and consolidated organization, due to its success, antiquity and interventional areas. Considering the national and international presence, it is a company with experience and knowledge. In terms of sustainability has already developed some projects and, as mentioned above, gain some awards. With this, Sonae is a potential good partner considering the experience in several businesses, the

food retail flow in a quantitative and qualitative way and its interest considering the increase of sustainability.

- → **Greenyard** is a multinational company specialized in the distribution of fresh, prepared and frozen products and other horticultures, having a group of jointed companies with strong relationships, valuing communication. This company has stablished a set of strategic objectives in the sustainability context, considering the environment, the sustainable development, the products and the employees. With this, Greenyard turns a potential good partner due to the quantitative and qualitative flows of its products and the strategic goals taking into account sustainability, suggesting an organized and directional perspective.
- → **Olano** works specifically in the cold chain, being composed by a familiar and structured group that turns possible the international intervention. This company has also, as mentioned above, experience in the establishment of partnerships or synergies. It constitutes Olano as a potential good collaborator, not only for collaboration processes but also due to the core business be specific, which leads to a focused perspective.

Each company will help in the project with a distinct approach, potentializing the success through new ideas and perspectives. In this line, the present work aims to do a process mapping of Abapor's supply chain in order to understand in a clear and simple way how the business unit is operating. Therefore, through a structured map of the processes, suggestions are given for the operations optimization considering the others PPS companies' supply chain analysis so as to achieve collaborative and sustainable goal.

3. LITERATURE REVIEW

The present chapter consists on the review of existing literature. It aims to provide bases of knowledge and approach to the problem presented in the previous chapter.

The aim is to analyze the Agro-food industry and identify the challenges posed to supply chains. Subsequently, focusing on the dissertation's theme, the concepts of sustainability and collaboration will be addressed. This approach intends to bear the advantage of including sustainability measures and establishing collaborations in the supply chain. In this way, the chapter is organized into six sections. In section 3.1. the Agro-food industry is presented, considering its importance, areas of intervention, challenges and concerns. In section 3.2. the concept of supply chain is defined, giving relevance to how it is managed. Section 3.3. defines sustainability, justifying the origin of the concept and the challenges that are inherent to it. In section 3.4. the collaboration is explored and analyzed its potential. Section 3.5. was developed to support the construction of the methodology presented in chapter 4 and considers two approaches in the literature to the development of supply chains, one aimed at the sustainable perspective and the other the collaborative viewpoint. Section 3.6. resumes the main chapter conclusions.

The data was obtained through literature review including books, articles and webpages, that were found by search engines like Google Scholar and specific scientific databases, namely ScienceDirect and ResearchGate. The keywords applied were, among others, agro-food industry; supply chain; sustainable supply chain; circular economy; collaborative supply chains; and supply chain integration.

3.1. AGRO-FOOD INDUSTRY

Agro-food industry goes from the supply of agricultural inputs to the consumption. It is characterized as a set of activities related to the transformation of raw materials into food products, guaranteeing also their availability to the final consumer. This industry is the central entity between the primary sector (agricultural production, livestock and fisheries) and the distribution (retail, wholesale market and HoReCa [(i)] channel), generating around 3,000 million euros and employing about 110 thousand workers [141].

[(i)] HoReCa – Hotels, Restaurants and Cafes

The Agro-food sector operates until 1990 and is, probably, the one that provides the major support to the national economy [13]. At a **European level**, it comprises 287 thousand companies and exports on a total of more than 76.2 million euros, representing 16.5% of the world market share and contributing about 21% to the European GVA [(j)] [16]. Considering data provided by the FoodDrink Europe [15], during 2010, the Agro-food represented the largest European employer industry, accounting for about 15% of the industry's employment, corresponding to a total of 4.2 million people.

[(j)] GVA – Gross Value Added: is the measure of the value of goods and services produced in an area, industry or sector of an economy.

Due to the relevance of this sector to the national economy it is important to address a continuous development perspective. In view of this, safety and quality were the identified utmost challenges in this industry. It occurs because this sector leads directly with the human health, producing products for

human consumption. Considering this, it was considered the **most regulated European activity sector**, requiring the control of the entire supply chain, given relevance to ensuring quality control and improving tracking and tracing practices [20; 23; 25].

Agro-industry is also considered as a **chameleon industry**. This statement emerged when companies started to face difficulties to put their products in the market. It occurred due to the change of marketing techniques, consumption trends and modern technology [17; 18]. With this, and with the continuous development perspective mentioned above, the industries had to cultivate the adaptability. In this line, through the study of the customers' needs, as well as the constant concern to the search of healthier processes and innovation, it was observed the appreciable evolution of this industry by the need of the products adaptability [14]. Given this approach, it is important to know the guidelines for the development of this industry, always based on the variability of the market, the needs imposed worldwide and the mandatory regulations. In this line, considering the market perspective, were identified ten **general trends** [22]: the pure food; the "green" chains and products; the local strategies; the highlights for premium products; the special attention to seniors; the statement "the old is the most valued"; the science bases; the regulation; the opportunity to achieve niche markets; and the constant search for protein. With this in mind, it is verified the growing concern to the type of food consumed and to the value attributed to healthy and sustainable options. This leads to the opportunity to develop new chains considering the creation of new businesses.

Into the world development perspective and because, by 2050, is planned that the world food supply will increase 70% due to the 9 billion people, some **challenges** were identified: the need of the primary sector development; the market development to face competitiveness; the increase of strategical and operational dependence on the upstream sectors due to the growing distribution concentration; the changing of the economic and fiscal environment, which cause barriers to the competitiveness development; the increasing competition for the use of limited and finite natural resources; the climate changes; the need of a sustainable and safer food supply; and the market orientation considering the customers' trends [21]. Facing these challenges, a program of the Community Framework for Research and Innovation named **Horizon 2020** was created. This program hopes that in the period 2014-2020, projects will be carried out, not only considering research but also innovation and experimentation projects, and societal challenges development, with the necessary co-financing [21]. It plans the development of actions to guarantee the supply and the improvement of the primary production systems. It will make them sufficiently efficient in terms of resources, promoting the ecosystem services. These commitments, coupled with the development of a competitive supply chain structures, can potentially accelerate the transition to a total sustainable European bio-economy [14].

In **Portugal**, the highlighted challenges consider the promotion of the authenticity and the quality of the traditional Portuguese products, through a healthy, original and convenient approach. It considers the inclusion of more national origin raw materials, considering the innovation of the products' portfolio, creating differentiation, and thus competitive dimension and value-added. This will consider the development of innovative and sustainable production systems, taking into account the processes and product sustainability. It was already verified in this industry that, these challenges, considering the

importance of the sector, its current evolution and its dimension, can be achieved with taking advantage of collaboration and cooperation between the different stakeholders, creating synergies and consequently creating more sustainable business models and supply chains [19].

3.1.1. Section Conclusion

The Agro-food industry was identified as the most important sector to the national economy [13], the most regulated European activity sector [20; 23; 25], and as a chameleon industry due to the adaptation need [17; 18]. These characteristics will support and help the sector continuous development. In this line were identified some development perspectives considering the market trends and the world needs, resulting essentially in the development of sustainable products and chains to face the future world supply [14]. In view of this, the development of sustainable supply chains, as well as the collaborative potential advantage [19], were identified as the major guideline of this industry, supporting in this way the dissertation's goal.

3.2. Supply Chains and its Management

For a long time, companies have considered the efficiency and effectiveness of business functions in a separated way and inside a single company. With this occurs the lack of connectivity, possibly duplicating organizational efforts and resources, leading to the establishment of not global organizational goals. However, is clear today that is not enough to operate as single entities with isolated areas, turning integration a tendency in the organizations. In this line, the development of the concept *supply chains* appeared, promoting the overview of the chain in an integrated perspective, including upstream and downstream levels. Considering this, in this section will be presented: a set of definitions related to the supply chain concept; the integrated perspective of the chain through supply chain management, mentioning definitions, the integration evolution and the overall goals; and logistics as an important area inside supply chains.

3.2.1. Supply Chain Definition

Thirty years ago, Oliver and Weber [34] published a paper that addressed the term **Supply Chain (SC)** for the first time. The SC definition was already proposed by many authors over time and has turned more and more complex. In its classical form, SC is a forward approach involving a set of combined processes, aiming to fulfill the requests of the customers. This system includes all possible network entities, such as, suppliers, manufacturers, transporters, warehouses, retailers and customers [35]. Bailou (2004) [99] characterized SC as the structure that has all activities associated to the transformation and flow of goods and services, including their attendant information flows, from the sources of raw materials to end users. Chopra & Meinde (2007) [100] alleged that must exist an involvement of all parties in supply chain, directly or indirectly, with the overall goal of fulfill a customer request. They also said that a SC is dynamic and involves the constant flow of information, product and funds between different stages. Min (2015) [101] defined SC as an integrated system that synchronizes a set of interrelated business processes to: create demand to products; acquire raw materials and parts; transform these raw materials and parts into finished products; add value to these products; distribute

and promote these products to both retailers or customers; and to facilitate the information exchange among several business entities. Furthermore, said that a SC is characterized by a forward flow of products and a backward flow of information. In a final perspective, Martin Christopher (2017) [73] described SC as an organizations' network involved, through upstream and downstream linkages, in different processes and activities producing value in form of products and services for the ultimate consumer. Supply chain is then a network, where companies work in an integrated way, through upstream and downstream linkages, synchronizing several business processes as demand planning and procurement, processing, distribution or commercialization. In a direct or indirect way, all parties are involved such as manufacturers, suppliers, transporters, warehouses, retailers or customers. Additionally, supply chains include all activities from sources to end users and a dynamic approach characterized by a forward flow of products and a backward flow of information exist.

But this integrated approach needs much more attention, and the lack of open visions, considering the external environment of the chain, results in disorganized and inefficient SC. It is important to look for the evolution of SC, as presented in Figure 4, going from a perspective of individual areas to an integrated overview. This leads to the appearance of a cross-functional and a cross-organizational integration and coordination, transforming decisions more strategic into the related factors that directly or indirectly influence supply chain operations and activities.

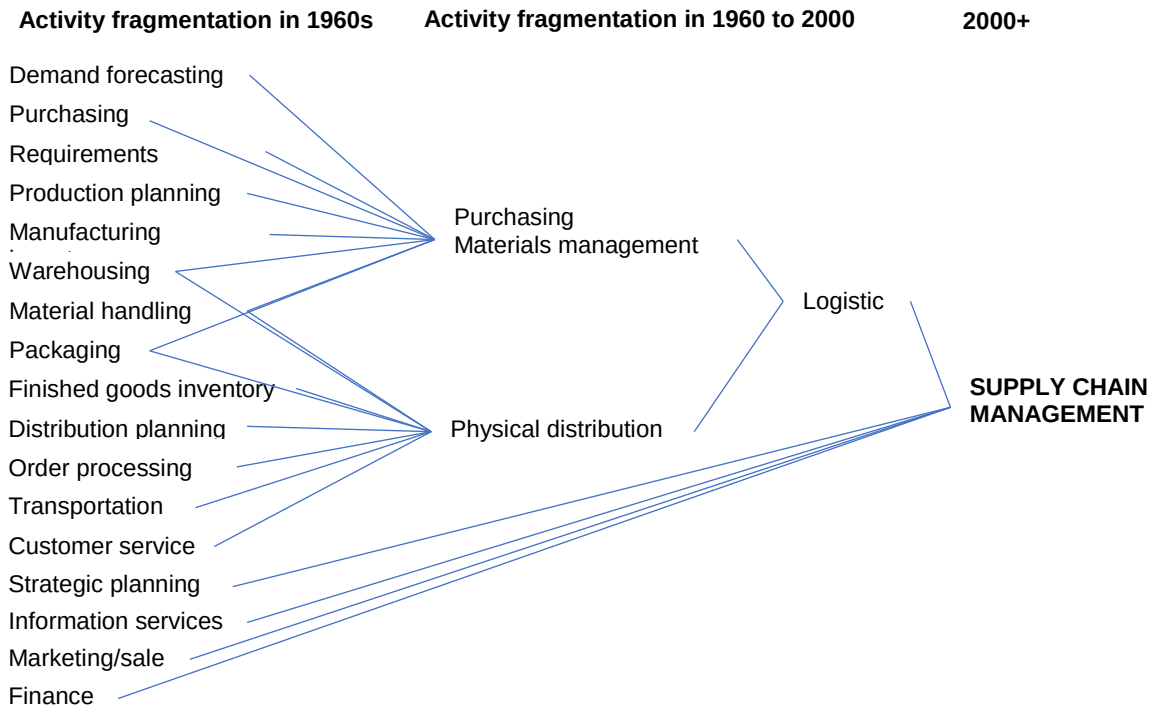


FIGURE 4 - EVOLUTION OF SUPPLY CHAIN MANAGEMENT. ADAPTED FROM RODRIGUES (2016) [102].

3.2.2. SUPPLY CHAIN MANAGEMENT

Considering this, an important area in an organization is the **Supply Chain Management (SCM)**, that has grown considerably at both research and industrial levels [36]. SCM encompasses a set of approaches to efficiently integrate suppliers, manufacturers, warehouses and all the entities of the chain. It includes the plan, the implementation and the control of all SC operations, resources, information and

funds, and direct and reverse flows [37]. It englobes also the coordination of production, inventory, location and transportation activities, among stakeholders, to achieve the best mix of responsiveness and efficiency [73]. This area covers similarly the development and performance of the information systems that are needed to support coordinated activities.

An important activity in management is to **control**. Within the SCM, the measurement and evaluation of the chain performance is crucial. This control can be applied to many areas, as the control of: processes, human and physical resources, economic performance, environmental parameters, collaborations' effectiveness or relationships (e.g. supplier-retailer). To do so, a set of metrics can be used, which will quantify the efficiency and/or effectiveness of actions of a part or the entire process of the system, in comparison to a pattern or target [142]. Regarding this, Liebetruth (2017) [142] presented different approaches to support the control activity of SCM, in order to achieve better performance, as: Key Performance Indicators (KPI), Total Cost of Ownership (TCO); Balanced Scorecards (BSC), Maturity Assessments.

KPI are strategically important metrics that often represent a balanced set of aspects such as productivity, utilization, or performance in general. The following Table 1, shows the common KPI used on SC, based on three authors: Keebler (1999); Liebetruth (2005); and Weber et al. (2012) [142]. The work of Keebler (1999) has a strong focus on external and internal metrics, as well as, on metrics of cost and control of operative logistics. On the other hand, the work by Liebetruth (2005), was conducted through the focus on SC classical logistics performance elements, such as, inventory, delivery reliability, and accuracy of planning systems. Weber et al. (2012) [142] suggests that progressive companies achieve better results through the establishment of a consistent system, where KPI are integrate into the operations and strategic levels, as well relating its own performance to their most important external partners.

TCO is a method to analyze how other qualitative and quantitative factors, not only the purchasing price of a product, can affect the cost of a product over its acquisition process, or even, its lifetime [142].

On the other side, **BSC** is a top down instrument for defining organization's goals and objectives, with the key notion that firms must go beyond financial measures. It is constructed through a strategy map, where cause-and-effect-relations between the different objectives are explored to illustrate how the ultimate financial goals can be met. That include four key performance measurement areas, namely, financial, customer, internal operations and innovation (a learning perspective). From this strategy map, a BSC and an implementation plan can be developed [142].

The **Maturity Assessment** is a comprehensive methodology for measuring and managing the performance in a specific field, offering a framework to assess the effectiveness and efficiency of those organizational units with a special focus on the alignment with the overall strategy [142].

TABLE 1 – RESULTS OF EMPIRICAL SURVEYS ON SUPPLY CHAIN'S KPI. ADAPTED FROM LIEBETRUTH (2017) [142].

Study	Metrics area/Information aspect (avg. capture)	Capture over average	Capture under average
Keebler 1999	Involved Trading Partner (59%)	Customer complaints, On-time delivery, Over/Short/Damaged, Returns and allowances, Order-cycle-time, Overall Customer Satisfaction	Days sales outstanding, Forecast accuracy, Invoice accuracy, Perfect order fulfilment, Inquiry response time
	Internal Focus (61%)	Inventory account accuracy, Order fill, Out of stocks, Line item fill, Back orders, Inventory Obsolescence, Incoming material quality	Processing accuracy, Case fill, Cash-to-cash cycle time
	Cost (61%)	Outbound freight cost, Inbound freight cost, Inventory carrying cost	Third party storage cost, Logistics cost per unit vs budget, cost to serve
	Productivity (44%)	Finished goods inventory turns, Orders processed/labor unit, Product units processed per warehouse unit	Units processed per time unit, Products units processed per transportation unit
	Utilization (42%)	Space utilization vs. capacity, Equipment downtime	Equipment utilization vs. capacity, Labor utilization vs. capacity
Liebetruth 2005	Financial metrics (70%)	Actual cost vs. budget	Cash-to-cash cycle, company value
	Strategic level (40%)	Accuracy of planning systems, degree of uncertainty, cooperation need, power distribution	Compatibility of data-standards, Data-transparency, Compatibility of IT-systems, Trust, Quality of interfaces, Supply Chain Complexity (involved companies)
	Operative level (63%)	Inventory, Delivery reliability (on time, in full), Capacity utilization vs. capacity, Order lead time, Customer satisfaction, Network complexity	Geographical distribution, Efficiency potential, Lead time potential, Time-to-market, Reaction time to inquiries
Weber et al. 2012	Financial metrics (60%)	Freight cost, Total logistics cost, Inventory carrying cost, Cost of administration in logistics	Cost of mistakes, Customer profitability, Turnover per working hour
	Customer metrics (50%)	Customer complaints, Customer satisfaction	Returns, Reaction time to inquiries, accuracy of billings
	Process metrics (58%)	Delivery reliability (on time, in full), Turn rate, Inventory account accuracy, Labor utilization vs. capacity, Space utilization vs. capacity	Order lead time, downtimes, orders processed per time unit, units processed per time unit, Equipment utilization vs. capacity, Units processed per employee
	Financial metrics (70%)	Actual cost vs. budget	Cash-to-cash cycle, company value

To create, implement or review a **SC Performance Measurement and Management System (PMMS)** it is necessary to have a set of criteria to evaluate if the PMMS, that will be created or putted in place, is/will be suitable and effective. Liebetruth (2017) [142] proposes a list of variables that can be considered to create a suitable and effective PMMS. Those are presented in Table 2, where three main aspects and associated characteristics are given: the performance of elements; the measurement systems; and the management processes.

TABLE 2 – GUIDELINES FOR PERFORMANCE MEASUREMENT AND MANAGEMENT SYSTEMS (PMMS). ADAPTED FROM LIEBETRUTH (2017) [142].

Criteria for particular Performance Elements	Criteria for the Performance Measurement System or Instrument	Criteria for the Performance Management Process
Validation	Multidimensional	Consistency with goals, business strategy and incentive system
Robustness	Understandable and evidence-based cause-effect-relationships	Reliability of measurement process and acceptance by users
Availability of information	Free of redundancies and inconsistences	Action orientation, usefulness and economy
Controllability		
Control-span adherence		

Considering some of these criteria and regarding SC objectives, it is provided an evaluation of the above presented approaches (Table 3) to choose the most appropriated tool. Using one of these approaches, it is intended that SC could be conveniently analyzed and measured to control and optimize all the chain.

TABLE 3 – EVALUATION OF PMMS APPROACHES REGARDING THE FULFILLMENT OF GUIDELINES. ADAPTED FROM LIEBETRUTH (2017) [142].

Aspects	KPIs	TCO	Balanced Scorecard	Maturity Assessments
Multidimensionality	Yes, KPIs can be very diverse	No, only focus on cost and cost-evaluated effects	Yes, idea of instrument	Yes, instrument is flexible enough to cover many dimensions
Understandable and evidence-based cause-effect-relationships	Not necessarily	Only with focus on cost and cost-evaluated effects	Yes, possibly based on empirical evidence	Yes, possibly based on empirical evidence
Free of redundancies and inconsistences	High risk	Limited risk as only costs are calculated	Preparation of strategy map limits the risk	Possible, but it must be addressed in the process of designing
Consistency with goals, business strategy and incentive system through the capture of SCM and sustainability aspects	Special KPIs on SCM and sustainability can be defined. Consistency must be assured for each KPI, outside the system	Instrument can be used to support SCM and sustainability but is not comprehensive; TCO can be one aspect to align actions with goals, strategy and incentives.	Alignment with incentive system can be established and aspects of SCM and sustainability actively integrated	Instrument is very flexible but time-consuming, it can be linked to the incentive system
Reliability of measurement process and acceptance by users	Originally no reference on the measurement process. Must be established for each KPI separately	Originally no reference on the measurement process and thus on the acceptance	The process of designing the Balanced Scorecard ensures a high acceptance of stakeholders and users	The process of designing the structure, content and process ensures high acceptance of users; measurement process should be well defined
Action orientation, usefulness and economy	Depends on the fulfillment of the above stated guidelines	Should be able to support decisions on sourcing and logistics	Due to consistency a good chance to induce actions; risk of dilution	Good chance of a high usefulness as processual aspects integrated; risk of over engineering.

These set of control approaches as well as the presented criteria to choose which will be the appropriated tool, help companies to support it continuous development. In view of this, the awareness about the ongoing and rapid worldwide industrialization, as mentioned above in the section 3.1., indicates the importance of implementing sustainable manufacturing and processes, as a continuous development policy. So, SC tends to expand their activities considering, not only economy aspects but also environmental and social ones [36].

3.2.3. SECTION CONCLUSION

SC is a set of combined processes that produces value, including all the entities in the organizations' network, aiming to fulfill the requirements of the customers. The management of those processes is named SCM and includes the planning, implementation and control of all supply chain in terms of e.g. operations, resources or information. The SC control is a critical activity into SCM and must be performed to guarantee the continuous development of the chain. In view of this, a set of approaches were explored considering the implementation of KPI, the development of a TCO, the construction of a BSC or the development of a maturity assessment. However, the continuous development is a comprehensive area, which can be applied considering several subjects. In terms of the Agro-industry, as mentioned above in the section 3.1., the awareness about the ongoing and rapid worldwide industrialization indicates the importance of implement sustainable manufacturing and processing. In this line, sustainability had already been studied and some aspects will be presented in the next chapter.

3.3. SUSTAINABILITY

Environmental and social problems have been the cause for initiatives related to the development of sustainability. The major environmental and social problems are, respectively: pollution (atmospheric, sound, visual, etc.), traffic congestion, use of toxic or non-recyclable products, natural resources scarcity, energetic problems, lack in the supply of potable water, effluents, and space scarcity; poverty, violence, corruption or terrorism acts, unemployment, child or forced labor, lack of hygiene and work security, discrimination, remuneration, excessive work hours, education (lack of studies, habilitations, etc.), lack of family support, and deposition. Considering these problems, has been important to study how can them be reduced or eliminated, and companies have here an important role to play. Some companies, named multinational companies have developed initiatives worried about the resources' availability, announcing the development of new technologies and the implementation of programs to control natural resources consumption, as well as the development of alternative power sources.

In this section will be presented: a set of definitions related to the sustainable development concept; the sustainable supply chain management as a need to achieve the sustainable goals; KPI to provide a current state of the company; economic, social and environmental responsibility; and legislation applied to sustainability.

3.3.1. SUSTAINABLE DEVELOPMENT AND MANAGEMENT

The term “sustainable development” was first introduced in the United States Conference on the Human Environment in 1972 [58]. It has received more attention with the Brundtland report (1987). This report originates the emergence of eco-innovation (eco-design, life-cycle assessments or cleaner production) and sustainability-oriented innovations, promoting the integration of ecological and social aspects into products, processes and organizational structures [59] (see Figure 5). From this moment, companies obliged itself to create, redesign and adapt its supply chains following a sustainable perspective [57].

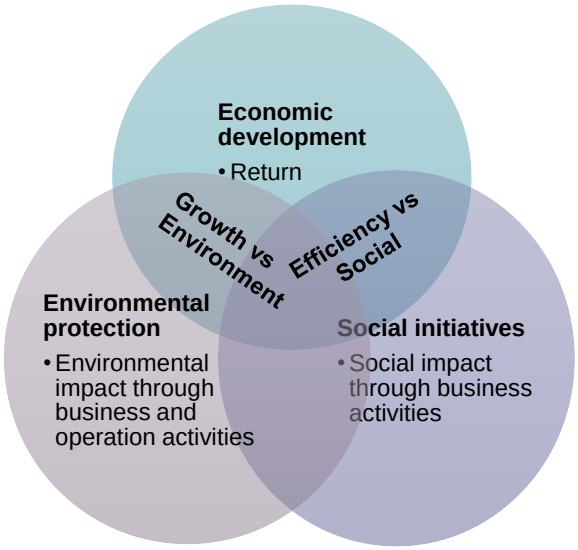


FIGURE 5 - SUSTAINABLE BUSINESS STRATEGY. ADAPTED FROM FERNANDES (2008) [104].

Sustainable development is defined as “the development that meets the needs of the present without compromising the ability of the future generations to meet their own needs” [59]. In this line, considering the actual world perspective, and similarly to the notions above in the section 3.1., the **sustainable global strategy**, targeting 2020, considers: (i) better products and services, reducing the environmental impact from the use of energy, resources or hazardous substances; (ii) cleaner and more efficient production processes, strengthening competitiveness; (iii) and shifts in consumption towards goods and services with lower impacts.

In view of this, the FoodDrink Europe [38] represents an active entity which role is to help the industry, the policy-makers and the civil society to work together in order to ensure that Europe continues to have the highest quality and safest food in the world, driving prosperity and ensuring quality jobs. The main drivers of this entity are: food safety and science, investing in research, bringing new products to the market and working in partnership; nutrition and health; environmental sustainability, tackling climate changes, increasing energy efficiency, addressing food waste, protecting biodiversity and working in partnership; competitiveness, improving trade opportunities, ensuring the security of supply and facilitating dialogue into the supply chain; and responsible business conduct. FoodDrink Europe and its members are working on the implementation of the **UN Sustainable Development Goals (SDGs)**. These goals are a set of 17 with 169 targets which are a core part of the UN 2030 Agenda for Sustainable Development, a universal agreement, which regards the implementation of these measures. It is relying on action by all countries (developed and developing) mobilizing governments, institutions and

stakeholders (citizens, civil society, private sector, academia, etc.), at all levels [38]. All the mentioned sustainable development goals are exhibited in Figure 6.

To apply strategies to achieve these goals, organizations had been started developing a definite level of commitment towards sustainable practices. Being SC a very important system within organizations the implementation of **Sustainable Supply Chain (SSC)** provides an opportunity to organizations to distinguish themselves from its competitors, gaining in market position while contributing positively to society. Sustainability theory intends the organizations' adaptation or the inclusion of some practices, as the closed products cycles, diffusing environmentally friendly strategies at the different supply chain levels. It is important to not forget that sustainability has also a social perspective, having the objective of providing better working conditions, fair compensation, equal human rights and cultural diversity.

FIGURE 6 - UN SUSTAINABLE DEVELOPMENT GOALS [38].

To turn SC sustainable, innovation is important because leads to the improvement of a product, process, marketing methods or organizational methods in the business, the organization or in the external relations. It has a significant degree of novelty for a firm and can also constitute a big opportunity for the market and the world [61]. There exist three general types of sustainability-oriented innovations:

- **Process innovations** – production of goods and services aiming the increase of eco-efficiency and metabolic consistency. The small and medium enterprises by changing the way to use the resources, manage non-product outputs through a closed-loop production, improving the overall eco-efficiency of the business [62] (e.g. cleaner production, waste handling – recycling, water, sewage, air pollution – eco-efficiency and logistics – efficient transportation).
- **Organizational innovations** – reorganization of structures and routines through new ways of management using mainly "deal primarily with people and the organization of work" [61] (e.g. overarching concepts and systems, innovation process, supply chain management, stakeholder

management, organizational structures, sustainability vision, employee development and training, code of conduct, employee engagement in sustainability and health and safety).

- **Product innovations** – improvements or development of innovative products or services, in this context improving for example the eco-design of the products with ecological materials, such as organic or recycled, with high durability or low energy consumption [63] (e.g. eco-design/design for the environment, life-cycle analysis, ecolabel, life-cycle costing, materials, packaging and fair-trade and organic products).

However, to implement new processes or to develop new products in a new perspective, the company must be aligned and committed. It requires changes at both thinking and organizational perspective. With this and considering a continuous development approach, it is crucial to implement management strategies. SCM was described above, however this management is much more specific, named **Sustainable Supply Chain Management (SSCM)**. It was created integrated into SCM, with the aim of increase the sustainable performance.

There are many definitions and all over the time, those came more complex and directional to the reality. Seuring and Muller (2008) [107] define SSCM as the "management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements". At the same time Carter and Rogers (2008) [143] defined it as the "strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chain". In 2013, Ahi and Searcy [107] create as definition "the creation of coordinated supply chains through the voluntary integration of economic, environmental, and social considerations with the key inter-organizational business systems designed to efficiently and effectively manage the material, information, and capital flows associated with the procurement, production, and distribution of products and services in order to meet stakeholder requirements and improve the profitability, competitiveness, and resilience of the organization over the short and long term". With this, is important the creation of a work base that will enhance the knowledge of the initial sustainable performance of the company. In the literature, this base is mainly built by defining and measuring **KPI**. To complement the information provided in section 3.2.2. were presented some important issues that must be considered. It is relevant to say that the KPI mentioned above are general and this will be a specific perspective. In view of this, from a sustainability perspective the introduction of KPI aims to summarize data related to environmental impact, to the workers in their work environment and to the economic perspective. When well defined and presented, KPI can create evolutionary expectations and lead to actions. There exist many sustainable KPIs, but the Global Reporting Initiative (GRI) has provided the KPI basis to the development of many sustainability reports. Considering this, these reporting guidelines provide a structured and guided framework to companies develop measure and communicate it in a standard way. These specific KPIs can be consulted in Annex 1.

But has said before, the companies must commit themselves to the sustainable development, creating an intern responsibility into economic, social and environmental areas.

3.3.2. Economic, Social and Environmental Responsibility

There exists the companies' need to be compromised with some principles, oriented by security value and ethics of citizenship, to developing and favoring politics to promote technologic innovations, clients' satisfaction and the well-being of the community. In this line, and since companies have a crucial influence on the environment, they must assume the responsibility to consider all management decisions and individual and collective actions that can affect the internal and external environment.

To **social and economic responsibility** there exist some measures considered to benefit collaborators and the community in general, improving the business image. These measures can be: school and social support, development of anti-corruption measures, respect for human rights, abolition of child labor, elimination of forced and compulsory labor, non-ethical and sexual discrimination and freedom of association and collective bargaining. Some companies can also contribute to the unemployment reduction, fight social and economic exclusion, develop sustainable technologies or integrate people with disabilities [104]. The **environmental responsibility** leads to the organizations impact in the live and non-live natural systems, including ecosystems, earth, air and water, considering the directions of GRI. As mentioned above, these reporting guidelines define a set of KPI, which are related to natural resources and production, including also the performance related to biodiversity, environmental compliance, wastes or products and services impacts [104].

However, these responsibility policies have several barriers in companies, as culture through cultural differences and economic instability, justice through the lack of legislation and oversight, lack of available information or dissemination and lack of academic studies in the area. Legislation is crucial in the implementation of sustainable measures and companies must align the sustainable goals and strategies considering that [111].

3.3.3. Legal Aspects

Nowadays exist measures stipulated by the International Standards Organization (ISO), especially considering **ISO 14001**. It lists a set of standardized measures so that a structure or system for environmental management meets all the requirements of legislation, which may affect the operational aspects of the organization. The social and ethical responsibilities, defined before, are also consider by the legislation. Considering the Portuguese **standard 4460-1/2007**, social responsibility is a continuous and voluntary compromise celebrated by the organization contributing on a proactive way for the sustainable development. It standard pretends to guide companies in order to do the steps to the implementation of sustainable measures efficiently.

Despite this external legislation, companies must also build an **internal legislation**. Each company or organization must make a commitment to the rules it intends to take, mentioning also the implementation of continuous improvement, prevention of pollution, compliance with environmental regulations,

implementation and maintenance of environmental management systems and, in particular, establishing a commitment between the all entities of the chain.

3.3.4. SECTION CONCLUSION

The perspective inherent to the development that meets the needs of the present without compromising the needs of the future is viewed as the sustainable development. The Brundtland report in 1987 leads to the emergence of eco-innovation and sustainability-oriented innovations, as the integration of ecological and social aspects into products, processes and organizational structures. In this line, FoodDrink Europe is an organization that helps the industry and is working on the implementation of the UN SDGs, that are 17 with 169 targets, which guide companies towards more and more sustainable measures. To achieve it, all companies must be aligned and invest in innovation due to the need of products, processes or services improvements. The innovation development can be done in terms of processes, organization and product levels. It requires management efforts that balance the environmental, social and economic goals, that lead to the SSCM. This type of management is viewed as a strategic and transparent integration of sustainability, associated to the procurement, production and distribution activities, to achieve the stakeholders' requirements and improve the profitability, competitiveness, and resilience of the SC. Considering this, the development of SSC creates an opportunity to competitive advantage that is being very important nowadays. This SSC development requires the knowledge of the SC current state. It was identified that the selection and measure of KPI can be a potential good approach to achieve it. However, all these developments and innovations require economic, social and environmental responsibility from companies. And, due to the legal obligation, it is also important to take knowledge and construct the sustainability plan aligned to the sustainable goals and strategies and the imposed legislation.

In that point of view, Hockerts and Wustenhagen (2010) [68] said that the transformation of industries requires the interplay between new entrants and with all stakeholders involved, turning collaboration as a way for sustainable success.

3.4. COLLABORATION AS A COMPETITIVE ADVANTAGE

The appearance of new business strategies and innovation capabilities, associated to the goals related to the imposed regulations, e.g. as said before about sustainability, have become a challenge to SC. Considering this, collaborations had been viewed as a strategic solution for companies to achieve those challenges. In this section will be presented: a SC collaboration definition; and the SC in-in and in-out collaboration, as two different implementation perspectives, considering the advantages and possible interactions.

3.4.1. DEFINITIONS AND GENERAL CONSTRUCTION

SC collaboration is a partnership process in which at least 2 entities work together to fulfill the common goals and mutual benefits, accomplishing an efficient planning and execution of operations, adding value to the chain [74; 75]. In view of this, companies can take advantage sharing information and making strategic alliances to improve performance or reduce costs and inventories [71]. On this process

may be included governments and institutes that can define development policies or goals as well as can help in the R&D activities [70]. Considering the existent literature, can be identified two levels of collaboration, being the first level, a collaboration process considering only the activities of a company or inside a SC and the second level counts with collaboration with external entities (out of the company or SC).

3.4.1.1. First Level – Supply Chain In-In Collaboration

The collaboration between the departments of the chain is more than team work. It is needed to business development and sustainability, providing advantages as the improvement of service level performance and inventory management, and the increase of customers and employers satisfaction, leading to the overall supply chain improvement. In this line, into the chain level exist three types of possible interactions [104]:

- **Communication activities integration and interaction** – considering the departments interaction through meetings and information flows, team work, resources and common goals sharing. It is important to measure the share of information and to optimize the time allocated to these activities in order to ensure that is not negative to the company in terms of productivity.
- **Integration as a set of collaborative activities between departments** – the departments work in a collaborative way based in common goals, occurring the share of values and compromises. It is viewed as marketing relationship, emphasizing an informal structure of relationships management, based not only in information sharing but also in the creation of a corporative spirit.
- **Integration as a set of communication activities integration and interaction, as well as the establishment of collaborative activities between departments** – the combination of the two first points, creating a multidimensional process.

However, different SC need different interaction and collaboration levels in order to achieve the pretended performance objectives. Considering this, can be identified and classified four stages based on interaction and collaboration levels, as presented in Figure 7. Regarding collaboration and interaction, this matrix presents four stages:

(1) **High interaction and Low collaboration** – document sharing but there is no collaboration between the departments, being departments physically separated and united through information systems.
(2) **High interaction and High collaboration** – complex management situations where must happen more interaction, relationship and more open mind. It is more applied in terms of customized products.
(3) **Low interaction and Low collaboration** – 3PL are an example, being independent of the logistic department.
(4) **Low interaction and High collaboration** – applied to companies that must renovate the products portfolio frequently, obliging a team work between marketing, distribution and production departments.

However, these types of interaction and collaboration are considered only inside the SC or the company, referring to the collaboration and coordination of the logistic function with other functional areas, as marketing or production. In other way, the second level of collaboration occurs between the SC and external entities.

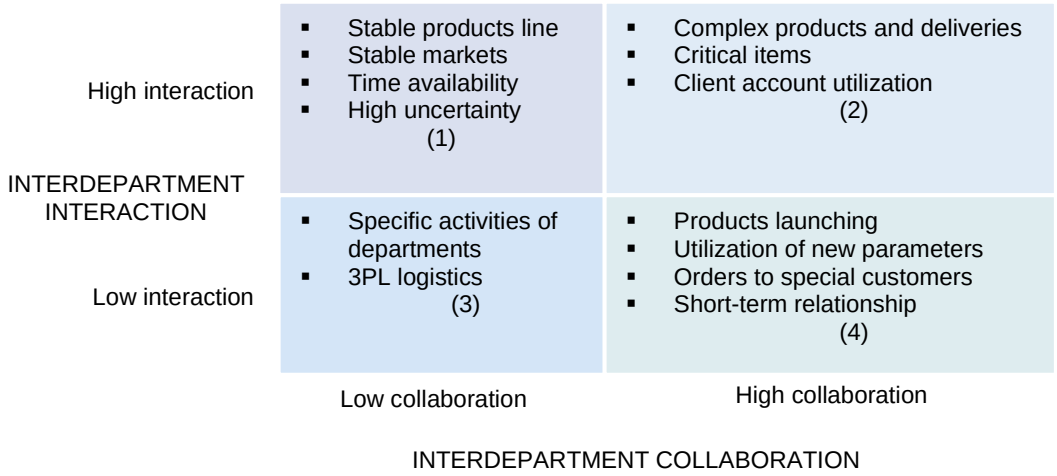


FIGURE 7 - INTERACTION AND COLLABORATION LEVELS MATRIX. ADAPTED FROM [104].

3.4.1.2. SECOND LEVEL – SUPPLY CHAIN IN-OUT COLLABORATION

This joint creation of value, based on the capacity of entities to cooperate and to acquire, capture, exchange and assimilate knowledge, in order to respond competitively to the market, requires the establishment of a trust base, being the key element for success and the way for establishing advantageous long-term relationships [74; 76]. It should be noted that one of the prerequisites for partnering is that instead of partners are hopeful that they will achieve positive returns, successful partnerships are those that distribute both gains and losses equally, demonstrating the willingness to commit to everything that is involved in the collaboration [77; 78].

According to the literature review, there are three types of collaboration strategies, namely [79; 80]:

- **Horizontal collaboration** – when two or more distinct or competing organizations cooperate to share their private information and resources (e.g. distribution centers).
- **Vertical collaboration** – when two or more entities such as the manufacturer, the distributor, the carrier and the retailer, share their responsibilities, resources, and performance information to serve relatively similar end customers. Several software examples to perform this type of collaboration are: vendor managed inventory (VMI), efficient customer response (ECR) and collaborative, planning, forecasting and replenishment (CPFR).
- **Lateral collaboration** – has the objective to develop more flexibility by the combination and share of capabilities in both vertical or horizontal conducts.

Given the trust as the basis of the collaborative process, it is necessary to present variables that aim to promote this construction [81; 82; 83; 84; 85; 86; 87]: (i) **consistent expectations and objectives** – the objectives of each of the collaborators must be aligned, always supported by their organizational values, and then proceed to define the joint objectives and monitor them according to the organizational

values of each entity; (ii) **long-term orientation and alignment of incentives** – there should be a clear sharing of resources and incentives for both entities when a collaborative process is established, regardless of whether or not the objectives are actually achieved. Only then, the degree of effort employed by each of the parties, can potentially achieve the return on the initial investment; (iii) **interdependence –** considering the responsibility that a company cannot act autonomously but must motivates the will of each of the entities to participate actively in the decision making and the joint planning, promoting a strong brainstorming that can bring about positive results leaving no entity out of the process; (iv) **temporal history** – as a relationship lasts, the expectation of benefit increases and the level of trust as well, which translates into greater willingness and a consequent increase in the level of cooperation; (v) **information sharing** – this variable is seen as the basis of collaboration in supply chains and obvious that it will only occur if there is another essential factor, called trust.

The benefits of establishing effective collaboration [82; 92; 93] relate to the reduction of costs, sharing of risks, complementarity of resources, fast response capability, knowledge transfer, and improved service delivery. For example, collaboration approach was the basis for the success story of Hewlett-Packard, Electrolux, Sony and Braun companies, through the reduction of recycling and disposal cost by 35%. This was due to the development of a common European Recycling Platform [94].

However, it should be mentioned that, as in everything else, companies do not always develop a positive collaborative relationship, either because of the lack of understanding and the lack of long-term results, or because of the existence of cultural and structural barriers to individual entities, often promoting opportunistic behavior, which cannot exist in this type of approach [75; 79; 95]. Also, the no understanding of the current processes is an often source of no alignment between goals and practices.

3.4.2. SECTION CONCLUSION

The required transformation of industries needs the interplay with all stakeholders, so collaboration is viewed as a strategic solution for companies to accomplish the new world trends. In SC it is a partnership process between two or more entities with the overall goal of adding value to the chain. This value creation requires the stablish of a trust base to achieve the complete capacity of entities to collaborate, cooperate and acquire, capture, exchange and assimilate knowledge. It was identified two types of collaboration perspectives: in-in collaboration and in-out collaboration. The first one is related to the establishment of collaborative processes inside of a supply chain or company, between departments or operational areas. The second perspective consists in the definition of collaborative processes between the company or supply chain with external entities. The collaboration process requires information sharing, joint and non-individual conflict planning and resolution, collaborative performance measurement and sharing of resources and capabilities. The benefits of stablishing collaboration are related to the cost reductions, sharing of risks, resources complementing, faster response processes, knowledge transfer, and the improvement of service delivery. However, the scenario can be also negative due to lacks that can be crucial into the overall collaboration process.

In conclusion, to achieve a successful collaborative supply chain is important to align goals at a strategic level but also understand the processes, at an operational level. The research project has the goal of

developing sustainable and collaborative supply chains and it is important to mix the information presented before and explore strategies to apply on supply chains to create collaborative strategies to improve the sustainable performance.

3.5. Development of Sustainable and Collaborative Supply Chains

For Michael Porter (2008) [104] the path is through sustainability, as was been identified above by organizations and authors. The strategy is composed by the increase of efficiency, the pollution reduction and the profitability improvement. It was also supported in the previous sections that an existent solution to answer this challenge is collaboration. With it, companies can work in sustainable measures taking advantage through knowledge and resources sharing. This will increase both the business flexibility and the possibility of being more and more sustainable. Considering this, in this section will be presented: a methodology developed to implement sustainability in SC, presenting the advantages and limitation through sustainability integration; and a methodology developed with the aim of integrating collaboration in SC, considering also the advantages and limitations through the integration of collaboration.

3.5.1. Implementation of Sustainability in Supply Chains

To the sustainability implementation, the International Institute for Sustainable Development (IISD) developed an approach. It has as basis that the sustainable development policies are already integrated into the business strategic plan. So, the implementation plan considers seven steps, starting from stakeholders' analysis to the control phase (see Figure 8) [104], which will be described further.

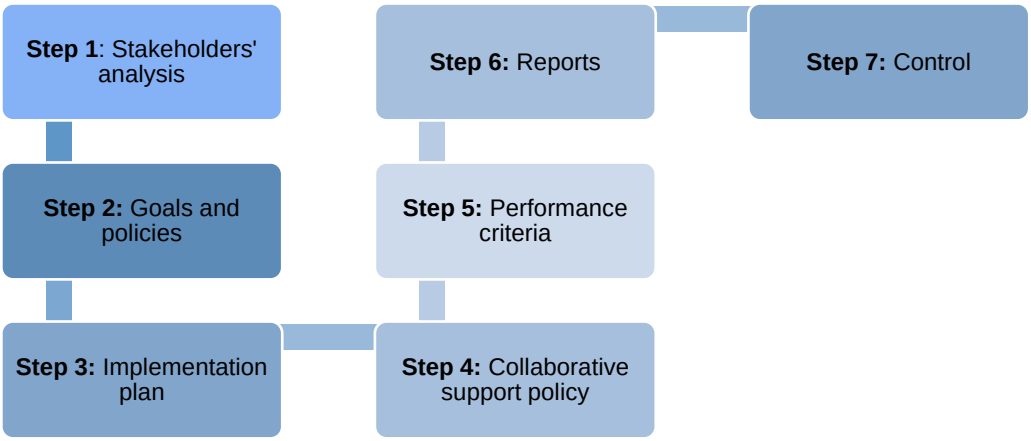


FIGURE 8 - METHODOLOGY TO THE IMPLEMENTATION OF SUSTAINABILITY IN SUPPLY CHAINS. ADAPTED FROM FERNANDES (2008) [104].

Stakeholders' analysis: identification and analysis of direct and indirect entities/parts that influence the companies' activities. In certain cases, the complexity and heterogeneity between stakeholders turn difficult this analysis.

Goals and policies: it aims the information sharing considering the intended sustainable development, to define goals and policies that will support the overall approach.

Implementation plan: considering the developed goals and policies is created an implementation plan that dictate which are the changes that will occur in the company's performance, as operational behaviors or attitudes. It has taking also into account how it will be managed and counting all implemented practices.

Collaborative support policy: pretends the collaboration between the human resources considering the communication and participation to improve the implemented practices.

Performance criteria: definition of performance indicators that can be measured and compared with standards defined by the company or with old measures of those. It demonstrates if the development is or not efficient and invite to adaptations.

Reports: all the implemented measures and data collected will be resumed and publicized into a sustainable report, that will be sent to the stakeholders and divulgated publicly.

Control: to verify the sustainable measures implementation, companies must increase the monitorization of the internal processes verifying their compliance. It is also important meeting with stakeholders in order to optimize all processes and, if needed, change some practices.

Considering this, is important to study where, in the chain, can be applied the sustainable measures. In this line, the literature review [104] provides information about an important area that has been explored to implement sustainability in the product chains: reverse logistics.

3.5.1.1. REVERSE LOGISTICS

The **reverse flows** can start in all processes of the chain, and when it occurs, the goal is always to reinsert the product in the chain [106]. Considering Figure 9, a figure constructed by the dissertation's author, the **linear approach** considers that raw materials and components are sourced, prepared for manufacturing and send to the retailer that can sell them or not. If the retailer sold the product, it will go to the consumer. All these steps generate waste, in different categories, as logistical, packaging or usage waste. These wastes, in a linear economy, are not considered to further use or re-manufacturing. That leads to an opposed approach to sustainability development. Instead, the second approach, the circular one, focus on the optimization of value chain, by a restorative and regenerative line – **the closed loop chain**. Reverse logistics is responsible for the flow or collection of materials or products from consumers. These products can be obsolete, with defect, damaged or non-functional, being part of two logistical channels [122]: (1) **pos-sale channel** – considering the flow of materials with less or none use that returns to the manufacturing cycle due to non-conformities problems or commercial questions; (2) **pos-consumption channel** – the other materials, at end of life, that return to the manufacturing cycle, originating recycled or reused materials.

As the product itself, packages are also part of this specific waste collection process, being in reality the most influencer to the creation of reverse flows. The definition of Pourmohammadi (2005) [119] is the most suitable considering the dissertation's theme, characterizing reverse logistics as the planning, implementation and control process, through an efficient and effective way, of the waste and by-products flow, related information, with the innovation goal, considering new marketing channels, value recuperation and definition of appropriate depositions' strategies.

As referred before, the reverse logistics has a legal origin, but also an economic perspective and a social and environmental responsibility, that were talked in section 3.3.3., however, in terms of the economic perspective, the origin of reverse logistics leads to the reduction of costs, reduction of materials utilization and the value recuperation, through products that if not collected, turning in waste. But the collection and remanufacturing processes can be made by external entities and not by the origin manufacturer. If we consider the first hypothesis, the external entity does not consider the reduction of costs or materials utilization, considering only the value recuperation. In other way, if the collection was made by the origin manufacturer, this leads to production and energy costs reduction, as well as transportation (through routes optimization – a mix between distribution and collection) and solves the problem of where the deposition can be made. In an indirect way occurs the reduction of costs inherent to environmental problems and the improvement of organization's image. Considering the legislative perspective, taking into account the agro-food industry, for example, the retailers are obliged to forward the wastes to competent entities, and not deposit them in landfills. The circular approach is done by using cyclical material flows, renewable energy sources and cascading (energy cycles or recycling of energy), contributing to all three dimensions of sustainability. This has also an important paper, limiting the throughput flows to a level that nature tolerates and utilizes ecosystem cycles in economic cycles respecting the natural reproduction rates. It operates at different levels, from micro-levels, through products, companies and consumers, meso-levels through eco-industrial parks, to macro-levels if applied to cities, regions, nations and beyond. In this line, and in a more complex perspective than Figure 9, the Annex 2 provides an overview of different flows that can be approached through circular economy. However, it is not always possible due to incompatibilities or profitability, and in this case the option is other alternative routes as the inclusion in another SC.

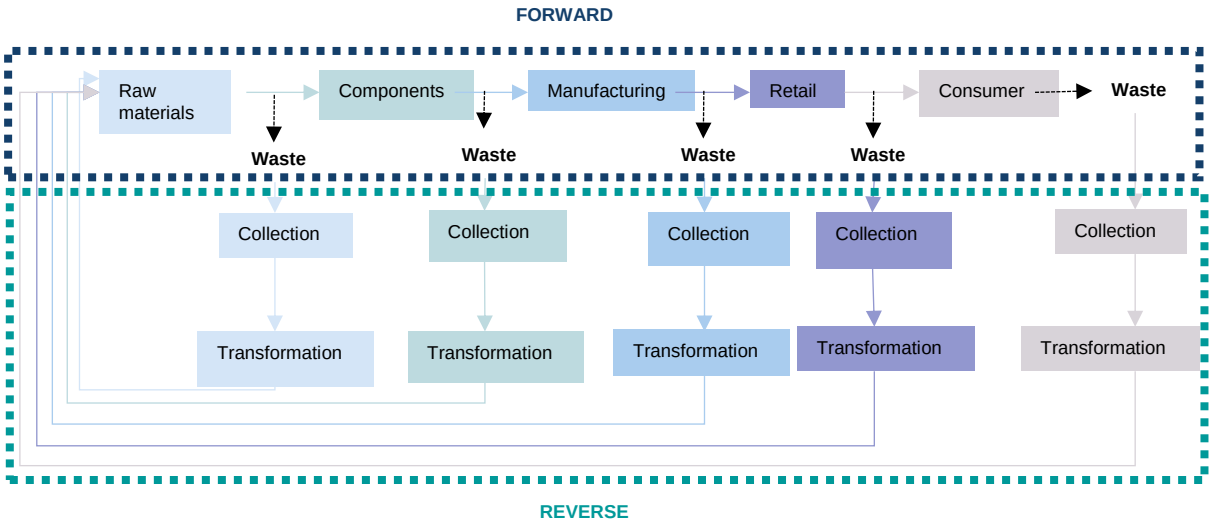


FIGURE 9 - FORWARD AND REVERSE FLOWS IN A SINGLE SUPPLY CHAIN.

3.5.1.2. ADVANTAGES THROUGH THE SUSTAINABILITY INTEGRATION

The overall **advantages through the sustainability integration** (see Table 5) into a company are the improvement of efficiency and the increase of competitive advantage. However, when considering the implementation in a SC, the advantages are much more. Considering the specification of the triple-bottom line of sustainability, some advantages were organized through environmental, economic and

social. In the **environmental aspects**, the objective is the reduction of production-consumption system of virgin materials, the inputs of energy and the outputs of waste and emissions by the application of material cycles and energy recovery. The **economic objective** is cost reduction considering virgin raw materials and energy, waste management and emissions control, as well as the risk reduction related to legislation and public image, additionally exploring new product designs and market opportunities. Finally, **social objectives** include employment growth, economy share and the implementation of community and cooperative approaches. So, as benefits, CE leads to environmental, economic and social wins [97].

TABLE 4 - ENVIRONMENTAL, ECONOMIC AND SOCIAL ADVANTAGES TO THE SUPPLY CHAIN THROUGH SUSTAINABILITY INTEGRATION. ADAPTED FROM KORHONEN ET AL. (2018) [97].

<table>
<tr><th>Environmental wins</th><th>Economic wins</th><th>Social wins</th></tr>
<tr><td>Reduction of material and energy inputs</td><td>Cost reduction in terms of raw materials and energy, as well as environmental legislation, taxes and insurance</td><td>Through product valorization, more work positions and, consequently, new employment opportunities</td></tr>
<tr><td>Virgin inputs are utilized essentially to the extent possible renewable, from production systems</td><td>Resource are valorized not only once, but many times</td><td>The sense of community, collaboration, and participation through the sharing of information, increased</td></tr>
<tr><td>Reduction of wastes and emissions</td><td>Minimization of costly scarce resources</td><td>Leads to group share instead of individuals owning and consumption of physical products</td></tr>
<tr><td>Resources are used not only once, but many times</td><td>Increasing of market potential through the green image and responsibilities, which attracts the investment</td><td rowspan="2">Reduction of the environment and public health risks</td></tr>
<tr><td>CO_2 neutral fuels and their wastes are renewable nutrients that can provide benefits to nature</td><td>Value leaks and losses are reduced</td></tr>
<tr><td rowspan="3">Environmental legislation compliance</td><td>Cost reduction in terms of waste management and emissions control</td><td rowspan="2">Operational efficiency improvement providing more safety and clean infrastructures</td></tr>
<tr><td>New markets founded by product valorization</td></tr>
<tr><td>Better position in the market through the knowledge of market trends in a view of customers that value “environmental care”</td><td>Increase of employees’ motivation</td></tr>
</table>

3.5.1.3. LIMITATIONS TO SUSTAINABILITY INTEGRATION

The major **constraints to implement sustainability in supply chains** are several, considering that it is a world worry and are many entities involved. In this line the limitations are: **cost** due to the perception that “green” products are more expensive, being the innovation and development costs incorporated into overall costs of the product. However, the difference between the costs of traditional and environmental-friendly products is not significant; **lack of business compromise** in all areas of the chain including senior managers and suppliers; **lack of knowledge** or available information; **availability** since local distributors in general do not made available this type of products, just in the “big” cities. If demand become higher, this problem can be exceeded; **less acceptable alternatives** since that, in the

market, do not exist sufficient environmental-friendly alternatives; **lack of specifications**; **purchase habits** considering that traditional families, in a general way do not consider the change from traditional to new products; **thermodynamic limits**, since considering the second law of thermodynamics, recycling always requires energy and the process is incomplete, generating wastes and side-products of its own. So, each process is a process and must be evaluated; **spatial and temporal system boundary limitations**; **limits** imposed by physical economic growth; **path dependencies** and lock-in; **intra-organizational vs inter-organizational strategies and management**; and **definition of physical flows**.

3.5.2. IMPLEMENTATION OF COLLABORATION

As it turned out, companies tend to follow an increasingly sustainable approach [36], however this cannot be achieved if a collaborative plan is not established within each SC or even between different chains. It occurs because sustainability does not produce significant positive results when carried out individually, but rather when many entities do so in an integrated way. Thus, it becomes necessary to optimize SC by making them shared, something that will only be possible by establishing close collaboration between stakeholders. Considering this, Ivo de Carvalho (2017) [98] has developed a methodology to integrate collaboration in SC. It aims to map all physical, administrative and temporal flows, including materials and products from the supplier to the final client. It intends to stablish a strict relationship between the supplier and the retailer, promoting opportunities' identification and minimizing entropies. It can be seen in Figure 10 where is presented the proposed methodology framework.

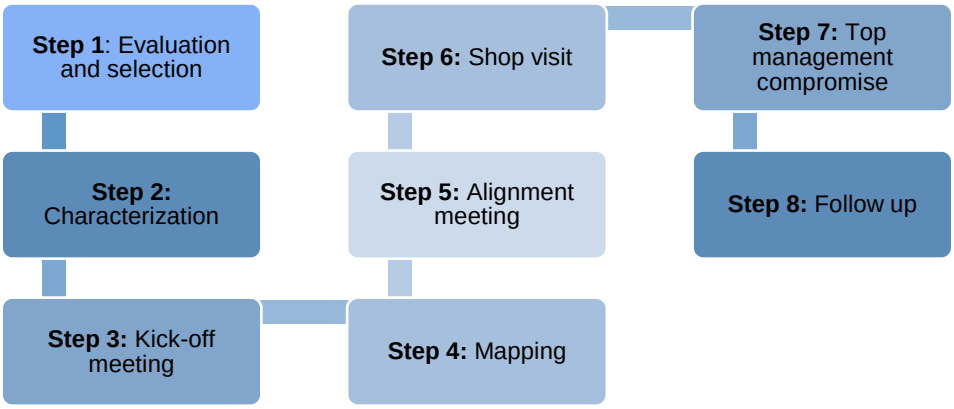


FIGURE 10 - METHODOLOGY TO IMPLEMENT COLLABORATION IN SUPPLY CHAINS. ADAPTED FROM IVO DE CARVALHO (2017) [98].

The objective of this methodology is to increment the flexibility and agility through the introduction of collaboration activities that eliminate waste and increase value in the chain. All the considered phases will be further explained, not only in terms of goals but also considering the organizational way to develop the specific activity and respective frameworks to be applied.

1st step - Evaluation and selection: Considering the literature review it is important to know the strategic goals of the company to turn the methodology based on real needs, taking into account the strengths and fragilities of the company. In this way, the efforts will not be unfitted to the reality. This phase includes information collection in terms of projects related to this theme and constraints that can

influence the collaborative structure. Further, a meeting with all departments is important to present the project, scope and methodology, being able to identify initial opportunities of improvement. Parallelly, it is relevant to do a stakeholders' characterization, and, since Ivo de Carvalho (2017) [98] just studied the collaboration between the company (retailer) and suppliers, did a methodology considering just these entities. In this line, suppliers were categorized in: **suspended supplier** – contingent relationship, mainly if the sell or purchase of products are pendent; **relationship with fluctuations** – tension between suppliers and company; and **suppliers' collaboration** – aligned relationship with all areas, not existing constraints to a collaborative work. This categorization framework allows company to select the suppliers that are more available to stablish partners' relationships. After that selection, the strategic goals of suppliers must be aligned with the strategic goals of the company (retailer), mainly in terms of economic aspects, capacity of competition differentiation and the strategic value and performance of the supplier to the company. This last variable is critical due to the focus in the value generation traducing supplier importance in the strategic goals of the company, for example in the development of emerging sectors (e.g. health care and well-being sectors) or because the product supplied is important and rare, where is difficult to find another supplier.

2nd step - Characterization: The benchmarking analysis is the tool implemented in this phase, using questionnaires to support this analysis. Benchmarking is a management framework used to search for the best practices, innovative ideas and effective operational procedures, to obtain higher levels of performance. The overall goal in this case is the collaborative benchmarking to achieve interorganizational learning. Ivo de Carvalho (2017) [98] has defined three important sections in the mentioned questionnaire: **general supplier characterization** – to profile the supplier, considering the potential opportunities of improvement. It pretends also to do a supplier map that will be positive to the 4th step of this methodology, the mapping; **collaboration between partners of the supply chain** – to evaluate the interest and knowledge of suppliers and to realize a relationship diagnosis; and **collaboration in SC** – to evaluate future collaborations, proposing to the supplier that choose the areas where exists the possibility to collaborate. The evaluation of the importance of the company (retailer) in terms of collaborative approaches is also proposed, sharing also the collaborative practices that has been implemented by the supplier in the last years. To suppliers' characterization was verified that is important to construct a dashboard that gives the supplier data through indicators that are present in Table 5 and the values attributed to them, in a continuous way.

TABLE 5 - PERFORMANCE INDICATORS TO SUPPLIERS' CHARACTERIZATION. ADAPTED FROM IVO DE CARVALHO (2017) [98].

Type of information	Indicators
Logistics	Lead time
	Delivery frequency
	Scheduling
Business performance	Sales
	Purchases
	Total of purchases/Deliveries to the specific retailer
Stock quality	Monthly evolution of wastes/category
	Monthly evolution of stocks
	Monthly evolution of OTIA
	NSF evolution

3rd step - Kick-off meeting: The kick-off meeting must be carried out with a helper tool, as PowerPoint, with a specific structure:

1. **Introduction:** Mentioning why, what and how will be realized this project, explaining the collaborative development challenge. The company's initial map is presented to a brainstorming, exploring additional potential opportunities.
2. **Project goals:** It is important to explain that is crucial to know the value chain from the supplier to the client.
3. **Advantages:** Mentioning that will be advantages through the identification and implementation of continuous improvement opportunities in operational and non-operational processes; elimination or reduction of wastes; risk reduction associated to the chain function; acquisition of more knowledge; higher availability and efficiency. In this step must be stipulated that risks and benefits are shared equally.
4. **Outputs:** Proposition of an improved plan of costs and manufacturing and logistical processes, through the map of the processes and products flow and through critical points identification. However, a plan needs to be controlled and to do this must exist a tool of benefit quantification through specified KPIs.
5. **Scope of the project:** Considering the specific project of Ivo de Carvalho (2017) [98], packaging was the main goal, responsible for the inefficiencies of the chain.
6. **Methodological principles:** Consider the hypothesis of development of a fitted methodology for each supplier, specifying the different business areas, those characteristics and specifications.
7. **Methodological steps:** Presentation of future work, scheduling the date of the next meeting.

If during the meeting occurs the presentation of new ideas, those must be considered to further analysis.

4th step - Mapping: The overall goal is to identify and design the actual processes, operations and materials and information flows, eliminating wastes and improving the delivered value to consumer. In this methodology is intended to occur a day dedicated to supply chain mapping, organized in some steps:

- Visualize a presentation by both entities (retailer and supplier), focusing essentially in logistics and supply chain direction.
- Following the integration treatment and planning of the process under study.
- Characterize the stakeholders' weight to the company.
- Presentation of a map that represents the path of a product life-cycle.

It must indicate the resources that need to be applied in the chain to develop the processes. In this phase must be developed a flow mapping and stepping of the primary opportunities and also plan a visit to the stakeholder (supplier) infrastructures. This visit can be guided by a checklist in order to structure the relevant observations. After that, the collaborators must discuss the observed opportunities identification.

5th step - Alignment meeting: After the treatment of data, a tool must be developed that share the data collected and promotes the presentation and establishment of developed and future work. Different for

the first meeting, the goal is to construct an interventional plan to achieve the identified opportunities. This interventional plan includes a set of metrics that must be monitored to evaluate the collaborative performance. At the end of the meeting it is important to schedule the shop visit, that is the next step.

6th step - Shop visit: This step consists in a shop visit, where supplier and company (retailer) concentrate efforts to understand the processes' reality and construct an effective plan. Similar to that occurs in step 4, a checklist was developed to guide the visit. Through this visit a set of new opportunities can be enumerated and added to the previous list, being included in the execution plan already defined.

7th step - Top management compromise: It is essential to ensure that is stablished a compromise between people in both companies with power and responsibilities to ensure that the collaborative goals are not compromised. With mapping complete and with a constructed plan is necessary to schedule a meeting with the top managers to stablish the compromise, allocating resources, time and presenting the identified opportunities. It is intended that, due to the knowledge and business experience, be stablished an opportunities prioritization. The contract signature will finish the meeting.

8th step - Follow up: After the accomplishment of the previous steps, the monitoring of collaborative relationship has to be performed in a periodic way. The existence of a dashboard is an effective solution to present these monitoring indicators in a continuous and real time update. However, follow up is not only for monitoring but also to promote discussion and possible improvements.

3.5.2.1. Advantages through the Collaboration Integration

The integration of collaboration in supply chain not always has a positive impact. However, if the relationship be positive there exist many advantages that can be considered, and it promotes a collaborative advantage: (i) **higher efficiency** – the processes' efficiency is a success metric and a determinant factor to rentability, achieved through the information sharing, improvement of the logistic processes, products or service changes, in terms of characteristics, volume or requirements; (ii) **business synergies** – considering the combination of perspectives, resources and capabilities, it is expected that the benefits be higher than single entities benefit. A holistic vision of the chain promotes an overview and whole analysis of the chain; (iii) **quality** – the overall product, process or service provided by a collaborative development must be better than the provided by a single entity. It promotes the construction of trust between the product or service and the consumer, increasing in this way the market share; and (iv) **innovation** – through a collaborative work, it originates new ideas and new business paths, also having resources sharing that helps the development and implementation of those ideas.

3.5.2.2. Limitations to Collaboration Integration

There exist many advantages through collaboration, however exists a relevant variable, that is the cause of many negative collaboration activities, called **trust**. The lack of a real knowledge or a default in the defined compromise origin consequences that cannot be expected, being a potential negative variable to establish a collaboration process. Also, the importance of the alignment between the chain is due to the share of all variables that can affect the overall collaboration performance, as cultural and structural barriers, that must be considered when developed an interventional plan. Another factor that is relevant

is that companies have always perform activities in a single and isolated way and a global perspective can be a difficult task.

3.5.3. SECTION CONCLUSION

The development of **sustainable** SC must be aligned with the business strategic plan. Considering the proposed methodology, to integrate sustainability must be: developed a stakeholders' analysis; stablished a set of goals and policies; constructed an implementation plan; chosen the performance criteria to evaluate the overall performance, wrote reports and control all the processes. An area that has been developed through the sustainability implementation is the reverse logistics, an important structure incorporated in supply chains to achieve closed-loop chains. It leads to several advantages as the reduction of inputs of energy and outputs of emissions, implementation of energy recovery and materials cycle, development of market opportunities, reduction of costs and resources utilization, employment growth or the achievement of community improvements. However, the purchase costs and habits of the consumers or the lack of business compromise can be limitative. To implement **collaboration**, the chosen methodology was proposed and developed by Ivo de Carvalho (2017) [98] and pretends to map all physical, administrative and temporal flows, stablishing a strict relationship between supplier and retailer, promoting the identification of opportunities and the optimization of the operational processes. It can provide higher efficiency, the development of business synergies, higher quality or the more predisposition to implement innovation in the chains. However, it is important to consider that the collaborative process not only be positive and has limitations, which can compromise the overall process, as trust, lack of real knowledge, cultural barriers or unfitted interventional plans.

3.6. CHAPTER CONCLUSION

To contextualize the problem under study with a theoretical perspective a literature review regarding SCM and the integration of sustainability and collaboration into the SC was developed. Given the above information, a set of resume points can be presented:

- → SC is viewed as a set of combined processes considering all entities involved, forming a network of organizations that work to achieve the customers' satisfaction. With the new market trends, SC must improve their operational performance and the integration of all areas as well as their effective and efficient management.
- → Through the awareness on the ongoing and rapid worldwide industrialization, it is important to implement sustainable measures to monitor SC activities so as to not compromise the environment and society, considering also the economic inherent aspects. The investment in terms of costs and resources is high and, through collaboration, this impact can be reduced considering costs and resources sharing.
- → The implementation of sustainability and collaboration in SC must have a guided methodology, as the presented in sections 3.4.1. and 3.4.2., respectively. However, all implementations can be positive or negative and carried out some advantages and limitations. The goal is that the developed methodology will lead to economic, social and environmental wins, through cost reduction, reduction of emissions and pollution or new employment opportunities, as well as higher efficiency, higher

possibility of innovation development or the improvement of quality. In terms of limitations, the integration can be difficult due to cultural barriers, the lack of strategic alignment or lack of trust, and associated implementation costs.

In the next chapter the overall goal is to construct a general methodology that can be implemented in SC to integrate not only sustainability but also collaboration. It follows an integrated perspective, based on the present chapter, that is to be applied in real companies. Further will be developed a case-study in the MobFood project context with Abapor, from ETSA Group, as the central entity. The purpose is to implement the methodology developed in the next chapter and draw conclusions on how to improve such SC towards a sustainable SC.

4. SUSTAINABLE AND COLLABORATIVE METHODOLOGY

Based on this dissertation's goal a **sustainable and collaborative methodology** is developed along this chapter. Through the alignment of processes, perspectives and goals, considering the increase of the sustainability performance, the methodology targets a joint-collaboration between all entities involved. It aims to identify sustainable opportunities and to develop trust all over the chain, to optimize the operational performance of the involved companies. In sum, the methodology will be a helper tool to construct a measurement and monitoring approach that can be used towards the construction or improvement of sustainable and collaborative supply chains.

The developed methodology (see Figure 11) comprises in total **six main steps**. The first two establish the basis for collaboration sets: an in-in (step 1) and an in-out (step 2) collaboration. The first one – internal company's alignment - comprises the implementation of collaboration processes or practices inside the company or supply chain, which can be illustrated by the collaborative work between different departments [104]. The second one – stakeholders' analysis and selection - deals with the collaboration between a company and external entities – stakeholders -, such as the joint work between a retailer and a supplier [77; 78]. These two steps are essential to follows this order as before a company decides to work in a collaborative form, with their partners, must before do an internal assessment and better understand its activities. Each one of these main steps involve a set of components that will be detailed later on. After these two main steps the methodology includes four other steps: Kick-off meeting; Integrated mapping; Implementation plan; and finally Control. These six steps will be detailed below.

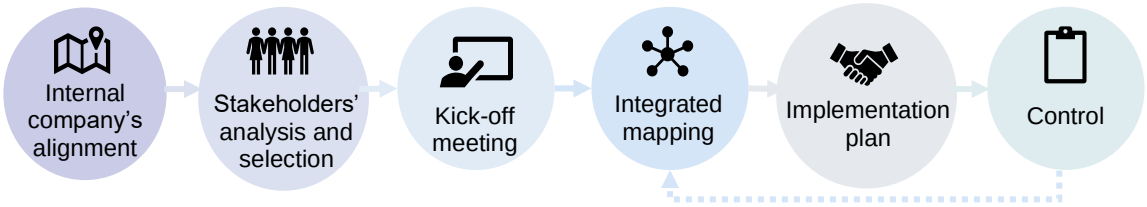


FIGURE 11 - PROPOSED SUSTAINABLE AND COLLABORATIVE METHODOLOGY.

The sharing of information and resources sharing is a crucial variable. In general terms, the methodology can be considered as an oriented and general path to implement a working process. With this in mind, each company should adopt the methodology to their specifications, in terms of processes, operations, resources, external environment and strategic goals. The methodology should be implemented considering also the company needs, strengths and weaknesses, and should not be developed based on an inexpedient reality. The implementation of a methodology fitted to the reality aligned with the normal functioning of the parties involved, promotes the achievement of an efficient solution with higher benefits to all the members of the supply chain.

4.1. 1ST STEP: INTERNAL COMPANY'S ALIGNMENT

The first step of the proposed methodology aims to develop an internal company's alignment and comprises four main phases: company's strategic and sustainable goals; resources allocation; company's mapping; and sustainability performance analysis.

4.1.1. COMPANY'S STRATEGIC AND SUSTAINABLE GOALS

Before initiating the implementation of the methodology becomes necessary to know the **strategic and sustainable goals** of the company. The definition of these goals must be done through a meeting with a team composed by elements of several departments of the company, as the logistics, operations, financial and human resources, in order to construct a set of goals transversally fitly inserted in the chain. The strategic goals must be achievable taking into account what the company wants to reach considering their plans and vision. The sustainable goals must include environmental, economic and social aspects, the three pillars of sustainability [5]. Considering the literature review, these goals can be constructed bearing in mind the drivers and the targets of the UN SDGs [38]. With this definition, if these objectives are related to a sustainability improvement perspective considering a collaborative work, is possible to **validate internally the application of the methodology**.

4.1.2. RESOURCES ALLOCATION

When implementing the methodology, the company should **allocate the necessary resources** to develop the project. Those must englobe physical and human resources as well as an effective allocation of work hours. This physical and human resources allocation should be done considering the creation of a multidisciplinary and multifunctional team, integrating human resources with a transversal knowledge of the chain and providing to them the necessary physical and financial resources (e.g. payment of extra travel). The establishment of a time horizon is crucial to safeguard the resources allocated. In this perspective, the work hours must be allocated considering this time horizon, in a continuous periodicity taking also into account the team dimension (the higher the team, potentially, the less time it will be necessary to allocate each element).

4.1.3. COMPANY'S MAPPING

After both the identified goals and the allocation of the team, is time to understand how the work has been developed, considering both the company's operations and physical and information flows. Taking into account the methodologies described in the literature review (see section 3.4.), only the retailer-supplier collaboration methodology highlights the relevance of the processes mapping. However, if the company wants to identify opportunities it must have a complete knowledge of the chain processes and functioning. Decisions should not be taken based on the individual goals of each stakeholder but with the aim of improving the SC performance as a whole. In view of this, the methodology proposed to the implementation of a collaborative SCM (see section 3.4.2.) plans the processes mapping with the overall goal to identify and design the actual processes, operations, materials and information flows [98]. One of the tasks of the multidisciplinary team is the **construction of a macro-mapping of SC's** entities and processes, considering as the central point the transformation processes performed by the company. In view of this, the team must, jointly, identify the suppliers, the customers and the inputs and outputs of each performed process. A SIPOC analysis could be used as this as an adequate tool, which is used to identify all the relevant elements of a process. It is organized through the five elements that compose the acronym: S – Suppliers; I – Inputs; P – Process; O – Outputs; and C – Customers [130].

After performing the macro-mapping, the **micro-mapping** should be developed, where each one of the Main SIPOC elements are now detailed. To do so the team must be divided in small groups and each one must develop each part of the mapping considering the physical, administrative and temporal elements. The members of the working group are expected to visit the field and talk to the workers, considering the various infrastructures and departments. This mapping must be done in a standard tool. In this line, the team must construct an Excel standard format to be applied in this phase and in the next ones. The physical mapping contemplates the processes identification as a sequence of activities necessary to transform an entry in a service or a useful product to a customer. The temporal mapping considers both the temporal duration of each process activity or of the overall process, and the activities schedule. The administrative mapping reflects the information flows into the chain, in terms of the relevant information sharing and documental processes.

4.1.4. COMPANY'S SUSTAINABILITY PERFORMANCE ANALYSIS

After the mapping, through the goal of developing a sustainable collaborative work, the sustainable aspects are important to be known. With this, the available information related to the three pillars of sustainability – economic, environmental and social aspects – must be addressed and, if possible, included into the developed mapping. To do this, as identified in the literature, the selection and measurement of relevant KPI are an efficient and usual approach to address the SC performance. A **set of general KPI** was then selected. These are presented in Annex 3. Such KPIs includes operational, environmental, economic and social indicators. The **operational indicators** are related to the processes and operations, considering the products flow, the operations' time and the resources utilization. It aims to identify optimization opportunities in terms of processes and operations. The **environmental indicators** consider the resources, wastes, emissions and the consumption of water and energy. This analysis pretends to provide to the team work a tool to the identification of opportunities, aiming the reduction of the company's environmental impact. The **economic indicators** are indicators of control. This means that they will serve as a basis for sustaining collaboration and development activities. By implementing these measures, they help to ensure that there are no significant financial impacts that put the company at risk. On the other hand, good economic indicators show a company consolidated financially, and can thus develop sustainably. The **social aspects** are, mainly, related to the human resources, considering their health and safe, as well as the discrimination factors. It pretends to increase the employees' value and to reduce the discrimination potential. The team must take these KPI suggestions and **evaluate if these indicators are suitable to their SC** analysis. In view of this, the team work should evaluate if: *Is the KPI goal specific to the pretended goal?; Can this KPI measure the progress? It is relevant to the problem context? Has potential for identifying opportunities?.*

4.1.5. STEP CONCLUSION

The result of this step is the achievement of an extensive and complete analysis that integrates both the business knowledge, with the physical, administrative and temporal mapping, and the relevant sustainability measures. This integrated overview of the company promotes and supports an efficient and effective decision-making process. The final product of this step is the identification of the opportunities (e.g. exploitation of a new production line) and bottlenecks (e.g. optimization of the

transportation process) of the chain, given special important to the sustainable improvement opportunities. These must be identified in the micro-mapping and well-described further, taking into account the opportunity definition and the point of the chain where it happens.

4.2. 2ND STEP: STAKEHOLDERS' ANALYSIS AND SELECTION

This step aims to analyze the stakeholders and select them according to a set of selection criteria. With this in mind, it is composed by three main phases: first selection criteria – selection through the identified opportunities; second selection criteria – selection through the stakeholder's behavior and the relationship with the allocated opportunity; and third selection criteria – selection through the power and interest in the applicant company.

4.2.1. FIRST SELECTION CRITERIA

In a general way, a stakeholders' analysis must be performed considering the firm's customers; investors and risk assessors; regulators and watchdogs; employees; business partners and competitors [126]. However, the treatment and analysis of such a wide sample will not be efficient. In this way, the first step is a team meeting to identify all stakeholders that are directly involved in the identified opportunities in the first methodology's phase, reducing considerably the number of entities in the sample. In this step, the number of stakeholders must be small, considering a maximum of ten entities chosen. Of these ten entities, through the rejection's criterion presented further, a maximum of five must be final chosen to integrate this sustainable collaborative work. Those can be involved in the same opportunity or not.

4.2.2. SECOND SELECTION CRITERIA

Morris et al. [139] develop a list of criteria that can be applied to the stakeholders' analysis, being a basis for the selection process. The objective of this study is the selection of potential good collaborators, assessing their behavior in the business and understanding their relevance, the work perspective and their relationship with the allocated opportunity. In this paper the authors highlight some relevant criteria that should be taken into account during the selection phase, such as: (1) contribution – in order to understand if the stakeholder have information or sufficient expertise that could be helpful to collaborate; (2) legitimacy – realizing to what extent the stakeholder is involved and will be responsible for the commitment; (3) willingness to engage – considering the stakeholder availability to engage; (4) influence – taking into account the influence that the entity may have on other agents (e.g. other companies, NGOs, consumers, investors, etc.); and, lastly, (5) the involvement need – if the stakeholder really wants to achieve the goals and need to achieve them. With these criteria, the author proposes the assigning of values – low, medium and high – into a matrix including all criteria and all stakeholders, as can be seen in Table 6. The evaluation criteria provided by the author are merely indicative. These can be eliminated or changed in a way that fits better the reality of the company.

Table 6 - Table to the stakeholders' analysis considering 5 criteria (example). Adapted from Morris et al. [139].

Stakeholder	Contribution	Legitimacy	Willingness to engage	Influence	Involvement need
SH1	High: Knowledge of X issue is of value to the company	High: Directly affected by company's activity	High: Proactive group that is already engaging	Low: Relatively unknown group	Low: Not an outspoken stakeholder
SH2	Medium	Medium	High	Medium	Medium
SH3	Low	Low	Medium	Low	Medium
SH4	Low	Medium	Low	Medium	Medium

4.2.3. THIRD SELECTION CRITERIA

Additionally, is important to study the behavior of the stakeholders considering the historical performance. The power/influence matrix helps to focus on the key stakeholders, identifying who can make or break the business, helping also to do a stakeholders' prioritization. The power component reflects the level of authority that the stakeholder has in the business. If the stakeholder develops a job that, if not done, compromises the company, it has a high value of power. If the work done is only to add value or is not relevant enough and if there are other companies doing this work, the stakeholder will not have great power under the company. The influence parameter indicates the level of involvement that the stakeholder has. This component can be defined through a set of questions considering the stakeholders' responsibilities, the expectations with a sustainable collaborative work, the advantages through this type of work, the consequences of not establish a collaborative work, their dominance, and the influence that they have in others (e.g. governments, NGOs or other companies) [138].

Given these criteria, a solution is to allocate the stakeholders in a prioritized rate, mapping them according to the power and interest in the applicant company (see Figure 12). It is a simple analysis, to provide a basic characterization, using a chart, and allocate the entities on the grid.

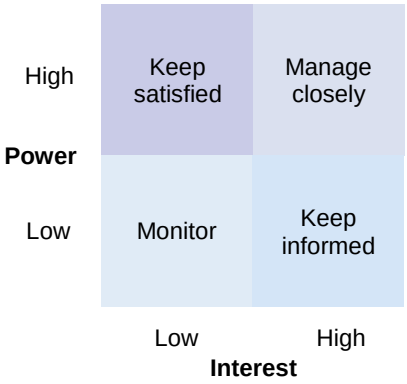


FIGURE 12 - FRAMEWORK TO ALLOCATE ALL STAKEHOLDERS TO THEIR INFLUENCE IN THE BUSINESS. ADAPTED FROM [138].

The classification is a result of a trade-off between the criteria mentioned, that is: (i) **high power, highly interested people** (to manage closely): "the ones that can make the difference" - the company must be fully engaging these people and make them satisfied. They are the ones that are in the top of the stakeholders' prioritization; (ii) **high power, less interested people** (to keep satisfied): "the victims" -

should be studied in the light of the work they must do in order not to disengage from the business. With this, the company must ensure that the stakeholder does the work he should but cannot bore him; (iii) **low power, highly interested people** (to keep informed): “the irresponsible” - adequately these people must be informed, and the company must talk to them to ensure that no major issues are arising. People in this category can often be very helpful with the detail of the project; (iv) **low power, less interested people** (to monitor): “the bystanders” - these people must be monitored, but do not be bored with excessive communication.

4.2.4. STEP CONCLUSION

This analysis aims to ensure that the implement of a collaboration in-out created value for the companies involved. The literature review identifies it as an important factor to establish a solid trust base, potentializing the entities’ capacity to cooperate, acquire, capture, exchange and assimilate knowledge [74; 76]. In this line, the final product will be a list of stakeholders well-characterized (see Annex 4) considering: (1) the activities where can be involved; (2) the performance criteria values and, finally, (3) the influence category in which they are inserted. Through this product the team company has capacity and knowledge to choose and prioritize a maximum of five entities to collaborate. In case of a tie, the trade-off between the cost and benefit of the collaboration should be analyzed.

4.3. 3RD STEP: KICK-OFF MEETING

After understanding the company internally and having made a stakeholders’ selection, the next step comprises the assessment of the stakeholder availability to collaborate. It aims to evaluate if the partner is available to allocate the same effort and resources into the collaborative relationship and if they are aligned in the strategic points. The execution of this third step comprises two phases, namely, a selected stakeholders’ invitation and a meeting to present the project to the interested ones.

4.3.1. MEETING INVITATION

The invitation is performed by the team and addressed to the selected stakeholders. It should be performed through an email invite or a letter in a simple way, including the goals, the timeline and all subjects of the meeting. The goals will be composed by the sustainability relevance, as well as the importance of the chain knowledge, to the chain optimization and performance improvement. Since it will be a two hours meeting, the timeline can be composed just for the beginning and finishing hours. The stakeholders must know previously the subjects to be discussed on the meeting, as the propose of the sustainable collaborative work, the brainstorming that will be developed to achieve the processes understanding and the alignment of goals and policies.

4.3.2. MEETING DEVELOPMENT

The second phase is the meeting realization, performed with the stakeholders that showed the willingness to collaborate. The idea is to book an individual meeting with each one of the interested stakeholders. This meeting is based on the methodology presented by Ivo de Carvalho [98], in the section 3.5.2., considering the third phase of the proposed methodology. In addition, the multidisciplinary

team with a helper tool, as PowerPoint, must carry out the kick-off meeting. A possible structure for the meeting is described below.

- **Introduction:** clarification of why, what and how will be executed this project, elucidating the proposal of collaborative engagement to improve, in a jointed way, the sustainability performance.
- **Project goals:** the project goals are the exposed in the invitation, having additionally a complementary explanation.
- **Advantages:** in this step of the meeting is supposed to present the collaborative advantages considering sustainability, discriminating the economic, environmental and social benefits that can be achieved. However, it is also important to clarify that instead of the positive goals could be originated through the collaborative process, the issues can occur, and the engagement could turn negative.
- **Information sharing:** in this phase is proposed a presentation of the company's mapping developed in the first step of this methodology, the goals and policies, and the improvements that were considered to stablish collaboration with the chosen stakeholders. After that, a brainstorming should be promoted considering the goal of understanding the general processes of the stakeholder's company. The final product will be a stakeholders' company SIPOC analysis, as the one developed in the first phase for the requesting company.
- **Opportunities identification:** through the knowledge about both companies, a second brainstorming is performed to discuss the opportunities identified above by the company as well other solutions to improve the overall sustainability performance.
- **Alignment of goals and policies:** considering the exposition of the individual goals and policies, all entities must discuss the possible paths and constraints to align all goals and policies, potentializing the creation of an implementation development basis, with a clear vision and more probability of success.

4.3.3. STEP CONCLUSION

At the end of the meeting the invited company must have a positive or negative answer for the sustainable collaborative work development. Considering a positive answer, the entity must allocate the necessary human and physical resources as well as the time to the project development.

4.4. 4TH STEP: INTEGRATED MAPPING

After the kick-off meeting all entities have a clear knowledge about the individual performance. In addition, as well as performed in the first stage of this methodology, the entities must integrate all the data related to both processes and sustainable aspects.

To the construction of this integrated mapping each entity must construct its own supply chain mapping in a common tool (developed in the first methodology's step), having in mind that it is a sustainable collaborative work. This map must be developed by each allocated team following the requirements of the first step considering the sections 4.1.3. and 4.1.4., basing on a realistic perspective, including knowledge of all departments and facilities, as well as views of operators and employees.

The final product of this phase will be the holistic mapping of the integrated supply chains and a list of all the opportunities identified. These opportunities will be the bottlenecks of the chain (e.g. optimization or performance improvement needs), given special important to the sustainable improvement opportunities (e.g. performance improvement opportunities considering environmental, social and economic aspects). However, it is important to consider that these opportunities must be identified taking into account a collaborative advantage perspective.

4.5. 5TH STEP: IMPLEMENTATION PLAN

With the alignment of the goals and policies, the integrated mapping and through the identification of joint opportunities, it is time to bring together the information and draw up an action plan. In view of this, both teams should book an alignment meeting.

4.5.1. IMPLEMENTATION PLAN DEVELOPMENT

The first stage is the development of a plan to define which approach to apply at each identified opportunity. Through a map analysis and a brainstorming to discuss the sustainable and collaborative goals previously defined is possible to construct a final list of opportunities. To well-define this list is important to consider some aspects. SCRS [140] is an analytical tool that, with some changes, can be applied in this context. It is the acronym from S – Strategy; C – Current state; R – Requirements; and S – Solution, being aspects that can provide a well-characterization of each goal. One example of the application of this tool is showed in Table 7, considering also the inclusion of the KPI column, allocating to each goal a set of KPI that will be helpful to the control phase. The GRI sustainability reporting guidelines [137] proposes a set of key performance indicators to measure sustainability performance, considering the economic, environmental and social aspects, as the economic performance, the market presence, the provisioning of materials, the energy and water wastes, the gas emissions, the employment or labor relations. These measures will sustain the measurement and monitoring of the performance of the future sustainable collaborative supply chains.

Table 7 - Analytical tool to the characterization of the goals and methodology to achieve them.

SC Goal	Current state	Methodology	Requirements	Solution	KPI
SC Goal 1	The current state must be well-described, in a way that can be possible a comparison between the initial and the following states.	This parameter provides a basis to the work that must be developed to achieve the specific goal, as a plan with the main steps that must be carried out.	All that is needed to achieve the goal, as physical and human resources, investment or other relevant requirements.	What must be specifically done to achieve the goal.	A set of metrics to control each opportunity including the current state measure indication.

4.5.2. SCHEDULED PLAN DEVELOPMENT

The second stage will be the scheduling of the plan. In this line, the characterized goals will be analyzed in terms of complexity and the companies will schedule the plan in a schedule tool. The schedule

contemplates the time in which the activities should be carried out. It is a graphical representation of the time to be invested in a certain task according to the tasks to be performed simultaneously or in prioritized order (in case the tasks depend on each other to be executed).

4.5.3. SUSTAINABLE COLLABORATION COMPROMISE

After the development of the implementation plan composed by the sustainable and collaborative goals definition, methodology and requirements, and the schedule of it, is essential that all parts stablish a compromise. Through the Ivo de Carvalho's methodology [98] is necessary the top management engagement to ensure the compromise between the power entities to ensure a long-term partnership. All entities must sign a compromise contract, and the work must be developed through the implementation of the planning tool, considering also the further control phase.

All entities must be aligned and synchronized to achieve positive goals. In view of this and considering the literature review, it is crucial to promote the information sharing to create a healthy work development [74; 76]. Considering this, the compromise should be measured to achieve the performance vision of both involved stakeholders, through KPIs as the accomplish of the reporting activities, the level of processes' information sharing; or the level of collaboration. The KPI's measure can be done through a quantitative scale from 1 to 10 by each stakeholder individually.

4.5.4. STEP CONCLUSION

In the context of the development of a methodology for implementing a collaborative and sustainable work, once the implementation plan and its temporal scheduling are projected, as a final product a collaborative activity management tool will be obtained. To do this a compromise between the partners should be established. This compromise measurement could be performed through collaborative KPI, measuring the collaborative profile. In this line, a set of KPI were suggested aiming a health and successful collaboration approach.

4.6. 6TH STEP: CONTROL

After the implementation of the joint defined plan, is necessary to ensure the monitorization of the KPIs previously defined (step 5) to assess the success of the collaborative relationship. The evaluation report should follow the structure displayed in Table 7, considering the updating of the KPIs measures providing also a comparison to understand the work progress. The measure of these indicators must be performed considering a time horizon of three months and the communication of these results must be carried out by a specific responsible of all entities. All information is essential to be shared through all chain and it is important to schedule control meetings, not only to control the implementation process but also to promote the brainstorming and to identify other possible improvement opportunities. If negative results occurring or if were identified other sustainable and collaborative opportunities, the implementation plan must be reviewed. To do this the partners must back off to the fourth phase of the methodology where the opportunities are identified into the integrated mapping and, if it will be the case, the implementation plan must be adapted.

4.7. CHAPTER CONCLUSION

The proposed methodology is a general and operational path for companies to establish collaborative actions, achieving a more sustainable performance. It is a continuous plan and must be carried out through a continuous development perspective, triggering improvement measures, as the resources allocation optimization or an implementation plan review, to address possible failures in the implementation plan. To resume this methodology, all the steps will be described in a briefly way:

- → **1st step – Company's alignment**: This step provides a full internal knowledge of the company interested in beginning a collaborative work to promote a sustainable supply chain with their partners. This holistic knowledge includes (1) the validation of the intention to develop the project; (2) the construction of a physical, administrative and temporal mapping, important to understand the current state operations and flows; (3) the identification of relevant sustainable parameters and issues; and, lastly, (4) the identification of opportunities.
- → **2nd step – Stakeholders' analysis and selection**: Since the goal of the present methodology is the promotion of collaborative processes, the selection of the stakeholders is a crucial step. This step considers: (1) the identification of stakeholders that have influence in the identified opportunities; (2) a stakeholders' analysis to understand their behavior and influence on the company; and, finally, (3) the stakeholders' selection and prioritization.
- → **3rd step – Kick-off meeting**: The identified stakeholders are invited to a meeting with each of them, where the project is presented to understand the stakeholder availability to collaborate in a sustainable collaborative work.
- → **4th step – Integrated mapping**: This step consists on a construction of an integrated mapping to identify the common lacks and to study the interactions between the entities. Through the developed Excel standard sheet, the entities must design its own supply chain mapping. Considering this, the final product will be a holistic mapping where a set of opportunities must be identified and well-characterized.
- → **5th step – Implementation plan**: A final list of sustainable and collaborative goals is made considering the characterization of each opportunity through 5 parameters well-described in the Table 2: (1) current state; (2) methodology; (3) requirements; (4) solution and (5) KPI. This step ends with a top management meeting alignment where the relevant decision-making entities of each company sign a compromise document.
- → **6th step – Control**: This step occurs to ensure the monitorization of the KPI previously defined in the step 5. It is important to mention that is essential the information sharing through all the entities involved and the book of control meetings, as explained above.

In short, the development of this methodology fills a gap in the literature in terms of methodologies that integrate the collaboration between different entities and the optimization of the sustainable performance of the chains. This dissertation thus creates a simple and operational work tool that can be applied to any company that aims to increase sustainability and intends to work in partnership.

Considering the MobFood project, in the next chapter this methodology will be implemented with Abapor as the applicant company.

5. CASE STUDY: METHODOLOGY APPLICATION

Abapor is the company where this dissertation's work is developed. Considering this, the proposed methodology will be applied taking into account the data and requirements of the above presented PPS-7 (section 2.2.). The work is developed considering four entities: Abapor (ETSA Group), SONAE, Greenyard and Olano, with the overall goal of studying the Abapor's SC and optimize it considering, not only but also, possible collaborations between the PPS partners.

This chapter will be divided considering the steps that are included in the above proposed methodology (chapter 4): company's alignment; stakeholders' analysis; kick-off meeting; integrated mapping; implementation plan; and control. However, to contextualize, first will be provided a general overview of Abapor.

5.1. ABAPOR: A GENERAL OVERVIEW

This dissertation's central entity, as mentioned above, is ETSA Group, that is divided in 6 companies. Into this group, Abapor, company directly related to the retail business, was the chosen as study object. It is due to be the company that is more related and more integrated into the PPS environment.

Abapor is a business dedicated to the provision of services in the conditioning in refrigerated equipments, collection, transport, sorting and unpacking of by-products. Considering the packaging interest, taking into account the by-products odor and preservation, Abapor performs another business activity that is the supply, installation and maintenance of refrigeration equipments, as refrigerating chests, plastic barrels or boxes. To the by-products transport, Abapor supplies also follow-up guides that are obliged in terms of legislation considering the Mod. 376/DGV. It was necessary a set of measures to neutralize or reduce this risk associated to the animal by-products, which can constitute a danger's driver to the human and animal's health in some circumstances. Considering this, was defined, in the Regulation (EC) 1774/2002, the animal by-products classification taking into account three risk categories:

- **Category 1 (M1)** – high risk, being able to result in a human or animal fatal disease, without possibility of treatment. This category includes all the animal parts, including leather, skin, blood and hooves of animals suspected to being infected or having a transmissible disease; animals killed due to the eradication of transmissible diseases; body or body parts of pet, zoo and circus animals as well as animals used for experimental, scientific or wildlife purposes suspected of infectious agents; animal origin material that contains non-authorized substances residues, environmental contaminants or material collected in the process of waste water treatment; catering waste from boats and airplanes; and mixes of M2 and M3 by-products with M1 by-products (passes everything to M1). In general, this category includes cattle and small ruminants.
- **Category 2 (M2)** – agents' transmission capability, resulting in a danger disease, possible to be treated. This category includes slurry and digestive contents of slaughtered animals approved for consumption; animal material collected from effluents and slaughterhouses dealing with M2

products; animals that have veterinary drugs residues or imported animals not properly verified; animals or parts of animals which have not been slaughtered for consumption; and mixtures of category 2 with 3 (passes all to M2). In general, this category includes pigs, horses, rabbits and birds that have died accidentally or due to illness.

- **Category 3 (M3)** – negligible risk of diseases transmission (low risk). In this category, in general, are included parts of slaughtered animals that, for commercial reasons, are not for consumption; non-ruminants blood with the respective normal veterinary analysis (*ante* and *post mortem*); raw milk obtained from healthy animals (cow, sheep or goat); fish and other fishery products; shells, hatchery by-products and broken eggs; and blood, hides and skins, hooves, feathers, wool, horns and bristles of farmed animals.

Abapor collects, mainly, M3 by-products including meat, fish and other food kinds, in bulk or packaged. The collection of M1 or M2 by-products is rare and when happens the service is forwarded to another company of the group (ITS). To clarify, for ETSA only exist two types of by-products since the M1 and M2 are treated jointly, becoming all M1. Abapor collects the M3 by-products through the modern distribution, municipal markets or, in a small scale, industries, being the traceability of the product always recorded. Considering the collection points decentralization, it was necessary to create four operation points in Portugal (Figure 13), situated in Vila Nova de Gaia, Coruche, Loures e Tunes. These

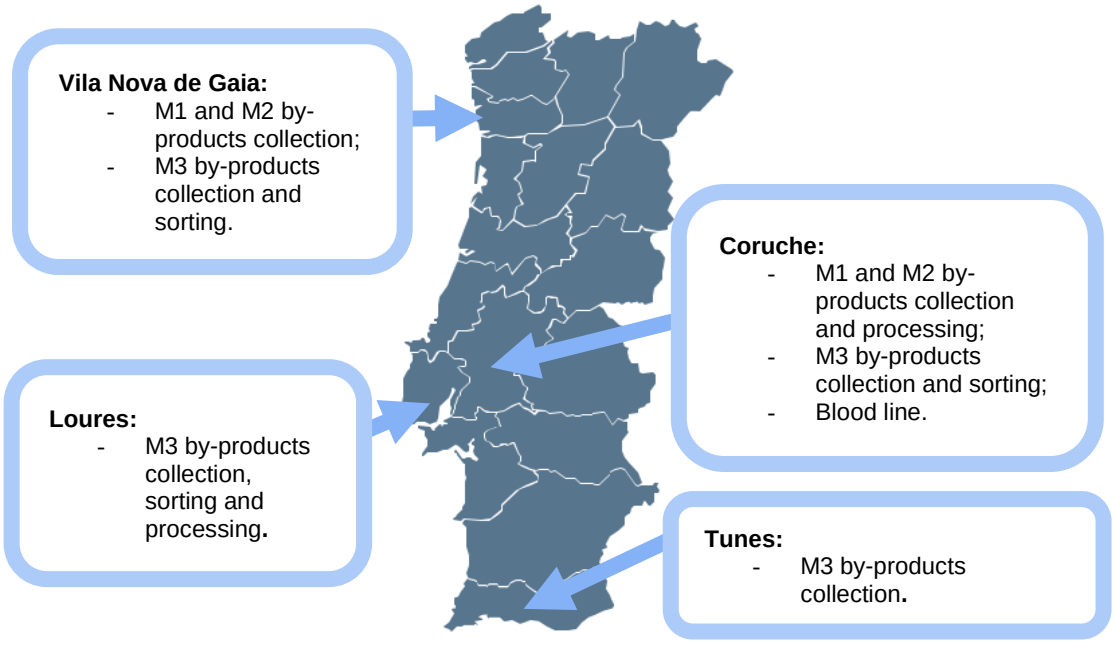


FIGURE 13 – ABAPOR OPERATIONAL POINTS IN PORTUGAL.

infrastructures give support to all operations and each center develops different operations, existing a complementarity of activities and flows between the operations points. Additionally, Azores and Madeira have their own infrastructures that will not be considered in this dissertation due to its small impact.

Considering the identification of the strategic goals of the company, it is necessary to analyze the current state, in terms of strengths, weaknesses and the aspects that can influence the strategic development. To do so a SWOT analysis was applied where the exploitation of new business initiatives, focusing in 4 elements comprising the acronym: S – Strengths; W – Weaknesses; O – Opportunities; and T – Threats.

Through the knowledge of these positive and negative elements, companies can communicate to achieve more effectiveness, identifying some primary collaborative opportunities. The **Abapor's SWOT** matrix is presented in Figure 14 with the essential points identified, which will be explained below.

	Strengths	Weaknesses
	. Possibility of investment in innovation and development (R&D department). . National distribution of own infrastructures. . Operational points with large dimensions. . Recent fleet and fleet monitoring system development. . Cheaper or offered raw materials. . Collaborative programs.	. Business not funded or supported by the state. . Deteriorated infrastructures. . Lack of ventilation. . Very physically demanding activity for workers. . Volunteers absence.
	. Open market in the products revalorization and a big products portfolio to explore. . Activity more valued. . Collaborative activities with external entities.	. The by-products collection activity is not valued. . High relevance of the final product price. . High restriction in terms of the applied legislation. . Conditioned relationship with the suppliers and clients.
	Opportunities	Threats

FIGURE 14 - ABAPOR SWOT ANALYSIS.

In terms of **strengths**, (1) Abapor has the possibility of investment in innovation and development due to the fact that it is a company strategic goal, also considering the external financed projects, as MobFood; (2) Abapor has the collection centralization into four operational points distributed into the national territory, turning possible the resources optimization, especially in terms of the transport activity; (3) has infrastructures with big areas, which leads to the easier implementation of new operations; (4) has a recent fleet and has been developing a fleet monitoring system that will help in the transport and collection operations optimization; (5) has cheaper or offered raw materials, supporting the economic sustainability of the business; (6) and has the integration of the company in collaborative programs with universities and other external entities that will help in the operations optimization. Considering the **weaknesses**, (1) Abapor has a business that is not supported by any fund or by the state, not having any external financial support; has deteriorated infrastructures because the products that are managed are harmful, becoming corrosive and it requires constant maintenance; (2) has low ventilation which can become danger to the employees' health, specially to the sorting operators; (3) performs an activity very physically demanding considering the deteriorative state of the products and the weight, being difficult hiring and maintaining employees; (4) and has absence of volunteers due to the work requirements. In terms of **opportunities**, (1) being a business that operates in the by-products revalorization, the market is always open to new solutions and exists a big portfolio of products to explore; (2) being the environmental impacts more and more negative, this business has gaining more attention and is more valued to fight the destruction trend; (3) and the establishment of internal or external collaborations potentializes the more close relationship between stakeholders and the emergence of new business opportunities. Considering the fourth and final point of the SWOT analysis, the **threats** pass by that, (1) although much innovation and development happens, the by-product is not sufficiently valued so that

the collection operation is costlier than what the retail business pays for the by-product collection; (2) the final product price is too relevant for the economic sustainability of the business since until the expedition the profit is negative; (3) the current legislative system is strict, turning difficult the operations optimization; (4) and the relationship between Abapor, the suppliers and the clients is conditioned due to the lack of activity valorization.

Through the SWOT analysis it can be concluded that the MobFood project, that considers the exploitation of new businesses as well as the improvement of the meat chain, is completely integrated in the Abapor vision. This happens because, with these projects, Abapor can finance the research works, the market is opened to the exploitation of new by-products transformation, and, through the negative environmental world perspective, the company can take advantage to the by-products' transformation valorization. In addition, it is also important to mention that, since the relationships with the suppliers and the clients are conditioned, the establishment of collaborative approaches, promoted by MobFood, will be an important step to develop more closed relationships. With this, the company obtains a basis to develop a new path, taking knowledge about all strengths and weaknesses and about they can't control.

Considering the above conclusions and taking into account the methodology proposal in the chapter 4, this thesis will provide an application of the sustainable collaborative work considering Abapor as the focus company.

5.2. METHODOLOGY IMPLEMENTATION

The need to study the interactions between Abapor and their main clients/suppliers (retailers), in order to find points of possible collaboration to optimize the chain towards sustainability, implies the construction of a methodology to be followed. According to the description of the problem, presented in section 2.2., the general approach should consider Abapor's SC activities mapping and the study of its interactions with partners to find opportunities for intervention. It is important to mention that this methodology will be applied to Abapor considering only the MobFood project, thus restricting the universe of exploitation, to the partners within the PP7 of this project.

5.2.1. INTERNAL COMPANY'S ALIGNMENT

This step is composed by four main subjects: (1) validation of the methodology considering the company's current state and strategic and sustainable goals; (2) the multidisciplinary team conception to allocate human and physical resources as well as time to the work development; (3) the Abapor's physical, temporal and administrative mapping to study all operations of the company; and, finally, (4) the opportunities identification.

5.2.1.1. ABAPOR'S STRATEGIC AND SUSTAINABLE GOALS

The first step in this application development is to understand if this sustainable collaborative work methodology is validate considering the company's current state and its strategic and sustainable goals.

In terms of current state, through the presented SWOT analysis conclusion, Abapor must explore all potential collaborations, not only to increase it by-products transformation portfolio and to optimize processes, but also to establish better relationships with the stakeholders.

Considering the strategic and sustainable goals, Abapor hasn't exclusive goals, being those integrated in the ETSA's perspective. Through a meeting with the Logistics Director, Dr. Rui Abranches, Abapor strategic goals were identified, namely: to grow, with value creation in a sustainable development perspective and with a high social awareness; to promote the community's development in which it is related; the human resources development providing them with a permanent valuation and career opportunities according to the demonstrated ambition and capabilities; and to be attentive to business opportunities. Concentrating all its activities in a circular economy model oriented to sustainability, the company assumes by itself a sustainable responsibility towards its business, community and people. For the establishment of sustainable policies and guidelines, Abapor, as all ETSA Group, considers the ISCC – International Sustainability and Carbon Certification [147]. With this approach, the sustainable goals are:

- **Social perspective:** (i) human resources investment considering the collaborators education and development; (ii) development of work health and safe measures; (iii) implementation of preventive measures for major accidents; and (iv) promotion of involvement, proximity and community respect policies.
- **Environmental perspective:** (i) to guarantee environmentally conscious biomass production processes; and (ii) reduction of greenhouse gases and the sustainable resources use.
- **Economic perspective:** (i) financial performance solidification increasing the financial capacity to new realities adaptation.

With these goals, it is possible to understand the importance given to the creation of value; the concern in the development of human resources; the attention given to new business opportunities; the promotion of environmental awareness, and, lastly, the solidification of the financial performance in order to sustain the exploitation of new realities. To achieve these goals, a possible solution is the establishment of a sustainable collaborative work, taking into account that Abapor has an integrated mission towards sustainability and, as mentioned in the section 3.4. of the literature review, collaboration is seen as a strategic solution to achieve the sustainability challenges.

Considering the taken conclusions it is possible to validate the methodology development towards a sustainable collaborative work.

5.2.1.2. RESOURCES ALLOCATION

Since the methodology development basis for this application is the MobFood project with the PPS-7, all entities must construct an isolated team to work jointly. Abapor chose to start the project with one human resource working full time a day, the dissertation's author. This resource had the direct support of the Logistics Director and, when applied, the assistance of other entities of different departments, such as the financial, the operational, the human resources or the logistics departments.

Being the project end time schedule three years, it is important to mention that the referred resource only was allocated for 6 months, which turns impossible the conclusion of the work referring to the PPS-7. It will be explained and justified further.

5.2.1.3. COMPANY'S MAPPING

With the team constructed and the resources constraints identified, the dissertation's author follows the methodology. The approach is composed by a macro and a micro perspective. It will be start by a SIPOC analysis (Figure 15) where are specified the essential elements to understand the operations flow, considering suppliers, inputs, processes, outputs and customers [128]. The developed analysis is based exclusively in Abapor operations and, since it is a macro perspective, not include temporal and information flows. To develop this mapping occurred a meeting with the Logistics Director and the dissertation's author.

5.2.1.3.1. MACRO PERSPECTIVE: SIPOC ANALYSIS

In terms of suppliers, as said above, Abapor includes the modern distribution (in the SIPOC divided into distribution and big distribution), as well as municipal markets and industries. The products that are collected in these points are fish and meat by-products (in bulk), packaged products (packaged meat and fish), dairy and dry products. The processes performed by Abapor are both collection and sorting. The collection considers the transfer of by-products from retail to Abapor. Sorting operation is mainly referred to the products division considering the typology and, applied mostly to the packaged products, to separate plastic from the by-product. The outputs are not transformed products. Considering this, is obtained meat by-products, fish by-products, dairy and dry products.

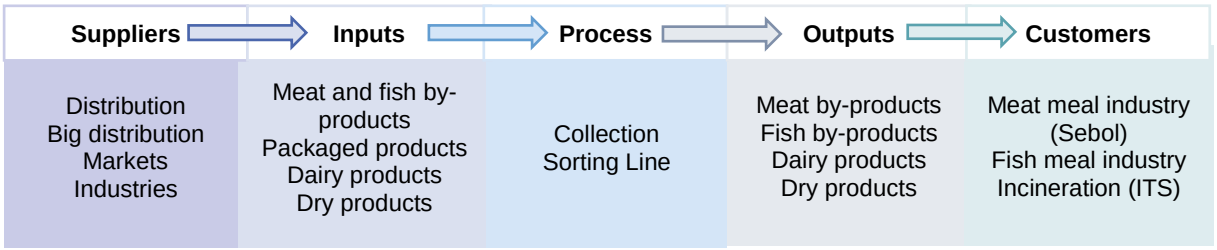


FIGURE 15 – ABAPOR'S SIPOC ANALYSIS.

The destination of these products is covered by legislation and these outputs need to be forwarded to industries that not produce for human consumption. In line with this, and considering the ETSA Group companies, the meat by-products that are categorized as M3 are forwarded to Sebol to be transformed in flour and fat and the M1 and M2 by-products, as well as the dairy and dry products are forwarded actually to ITS for incineration. The fish by-products will go to a fishmeal industry, which is external to the ETSA Group.

5.2.1.3.2. MICRO PERSPECTIVE: PHYSICAL, INFORMATION AND TEMPORAL MAPPING

Considering the micro perspective, to develop this mapping the dissertation's author visited the field, jointly with the Logistics Director and some operational coordinators and talked to the workers, considering the various infrastructures and departments. The main result of this step, the operations map presented in Annex 5, considers not only the operations performed by the Abapor's team but also the destination of the products in view of ITS, Sebol and Narciso lines. Through the map analysis, this

can be divided in three phases: suppliers, collection operation, and operation unit processes, including the by-products' destination. Those will be explained in a separated way.

PHASE 1 – SUPPLIERS: This phase considers the Abapor's supply, taking into account the necessary retail operations in a general perspective. It is divided into four main steps: target suppliers; suppliers' operations; storage operation; and information sharing.

Target Suppliers: Seven Abapor's big groups of clients/suppliers were identified seven: (i) distribution (e.g. Continente Bom dia, Pingo Doce, My Auchan); (ii) big distribution (e.g. Continente, Pingo Doce, Jumbo); (iii) industries (e.g. Nobre); (iv) local markets (e.g. Mercado de Alvalade, Mercado do Chile); (v) waste operators; (vi) other operators, and (vii) other entities. Within the scope of the present dissertation, just the distribution, big distribution, industries and markets are chosen to be the target suppliers' groups.

Suppliers' contractual operation: These entities are called clients if the entity pays to Abapor for the collection process and are considered suppliers if Abapor pays to the supplier to perform the collection or simply collect for free. Considering the identified entities groups, mainly in the case of distribution, big distribution and markets, exists a contract that specifies the payment of a contractual value turning these entities in clients. The industries, in a general way, don't celebrate contracts and just ask Abapor to the by-products collection when is needed. In this case, in a general way, don't exist any payment, turning them suppliers.

Storage Operation: The scheme presented in Figure 16 considers the sales process, as well as the by-products cold conditioning. In terms of operation Abapor is only responsible for the by-products cold conditioning and collection. However, it is important to understand what happens in the overall process with the suppliers/clients. It will be explained considering the retail business:

- The store receives the products, as meat; fish; dairy; dry and packaged products. These products go on sale and, if they were purchased, will occur an expedition for the final client. If they were not purchased could have three destinations: **donation**, when the product is in the end-of-life but is already good for consumption, **waste (trash)** or be **forwarding to recycling entities**, considering the meat and fish by-products and the end-of-life products. If the products were donated or go for organic wasted, the process is finished. The duration of this overall operation is variable, taking into account the different types of products to be considered. However, we can say that the total operation, from the product reception to the shipment (if not sold), takes less time in the case of meat and fish, since they have a shorter shelf life.
- It is in this phase that the contact with Abapor and the retail starts. When the product is sent to a recycling entity, in this case Abapor, the first step is a packaging process requiring plastic bags. Further, those plastic bags are deposited in refrigerating chests, provided by Abapor, with the respective identification. In a general way the chests are identified with the name of the product (meat, fish, dairy or dry), with the associated category (M1, M2 or M3) and the collection entity (in the case of M3, Abapor). Abapor is responsible for the provisioning of the chests, as well as their maintenance. The retail entity is responsible for cleaning, disinfecting and preserving these

equipments. After these conditioning operations, exclusively Abapor performs the process starting the collection and transportation process. The cold storage time of the by-product depends on the frequency of collection, which is usually carried out twice a week. This indicator is important because the fuller the coffers, the worse the packaging and the more deteriorated the by-product is, which is also not advantageous for the characteristics of the final product of the transformation process. This may therefore reduce the selling price of the by-product to the processors.

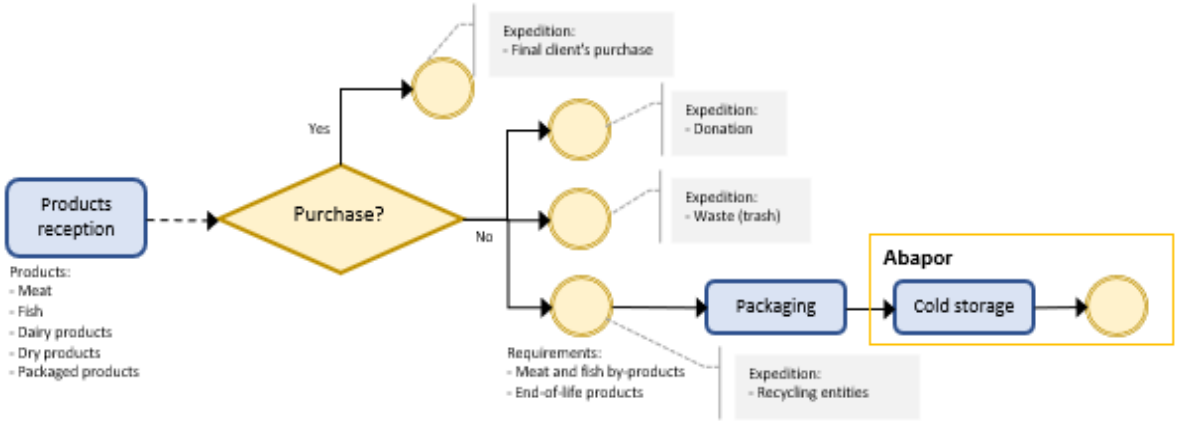


FIGURE 16 - REVERSE CHAIN'S RETAIL PROCESS.

Information Sharing: In this process, the information sharing is realized between the retailer and the logistics department. The subjects are related to the refrigerating chests, when they are damaged or defective. In this case, Abapor acts by sending a technician or other chest for replacement.

PHASE 2 – COLLECTION OPERATION: The collection operation is the main activity of Abapor where occur the by-products transfer between retail and Abapor. To this phase are considered three activities: routes planning; collection operation; and information sharing and documentation.

Routes Planning: In the Abapor's information system the routes are planned considering two collection times per week in each collection point, as said above. These routes are optimized taking into account the distance and the available time. However, the average products flow in each collection point is important since the maximum weight of the vehicle can't be exceeded and, as much weight have the vehicle more is the fuel consumption, which is also an important issue. The collection in the industries is not included in the routes and is done when required, being added to the standardized routes when the collection must be performed. When the routes are defined, the company considers the working hours of the driver (8 hours/day and 5 days/week). It is also important to mention that those routes are done considering the collection of M3 by-products and, if it is required to collect M1 or M2 by-products, those are collected by the ITS's specific vehicles. The appearance of M1 or M2 by-products is rare because the retail process can't purchase products that compromise the human health, and when appearing must be immediately forwarding to incineration, not being part of the routes planning.

Collection Operation: With the route paper and the necessary logistics resources, the vehicle exits Abapor's facilities (see Figure 17). When the driver arrives at the collection point must wait for the collection authorization. Then, the driver and, in some cases the helper, enter in the collection point with

a tecnibox with wheels (MGBs) or a cart to facilitate the by-products bags transportation. When they arrived at the shop division, the by-products bags are transferred from the refrigerator to the MGBs or the cart and carried out to the vehicle, where are organized, preferentially by typology, in containers. The stores that already have cold rooms can condition the product out of the refrigerator and the collection process is the same. However, another option is the exchange of containers, where the store deposits the by-product in the container and during the collection process, it is taken directly to the vehicle and an empty container is left. Through the attendance in a collection process that was accompanied by the dissertation's author, it was possible to measure an average time of 30 minutes at each collection point, including the movements for each collection point as well as the effective collection process. This process is simple but, in some cases, more time-consuming that should be due to the inaccessibility. The time that takes the weighing the unloading, the cleaning and the filling of the vehicle depends on several factors, such as the driver and the possible presence of a helper, the traffic of the installations and the quantitative flow of the product. The only requirement is that these tasks must be carried out in a mandatory way and, in the case of cleaning, it must be deep due to the nature of the by-products. In conclusion, the time of each activity is variable because it depends on several factors but, in a general way, the whole operation must be realized within the working hours of the driver, that is, 8 hours. After completing the route, the vehicle returns to the unit and the first stop is on the weighing scale. The driver leaves the vehicle and goes to the reception station, to indicate how many tecniboxes/containers has. The given weight will be the total weight of the vehicle, without the driver's weight and the weight of the tecniboxes/containers (34/35 kg each one). After that, the driver unloads the logistical resources containing the by-product collected with the help of a pallet truck. After the unloading operation, the vehicle returns to the weighting scale to obtain the by-product total weight, removing the empty vehicle weight from the first weighting value. It is from here that the bead is obtained. The final step is the vehicle washing and disinfection with specific processes that must be fulfilled, and further goes on to fuel the vehicle.

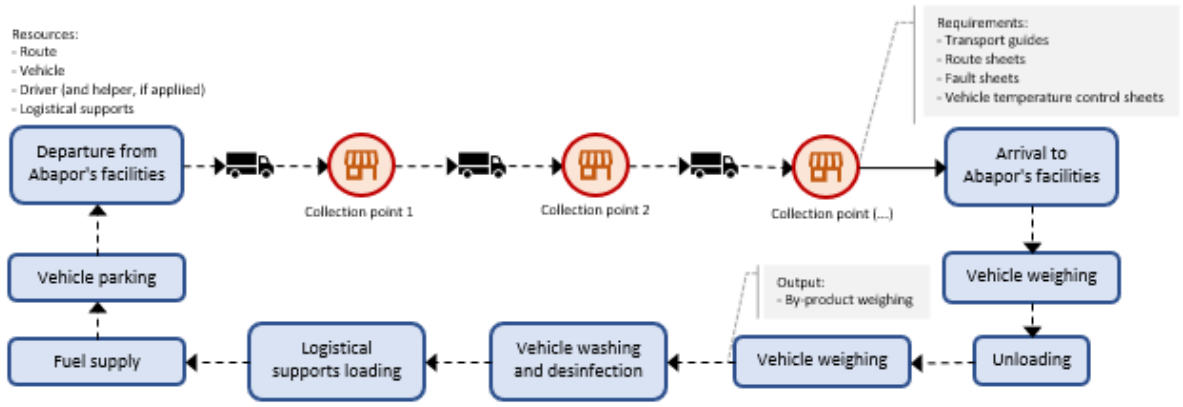


FIGURE 17 - COLLECTION OPERATION CONSIDERING THE VEHICLE'S DAILY CYCLE.

Information Sharing and Documentation: The information sharing is done between the driver and the logistics department to communicate some changes (e.g. routes) or, as a recurrent case, for the driver to inform of the absence of by-product in store or the closure of a collection point. In addition, the information flows through documentation. This includes route sheets, transport guides, temperature

control sheets and fault sheets. The transportation guides include the by-products weight per collection point, however it is not significant because the written weight is a visual observation, not taken the real weight. Both the route sheets and the transport guides must be filled when the collection process is complete and must be delivered to the indicated place. The vehicle temperature control sheets are not mandatory but must be completed by measuring the temperature of the vehicle. This is a relevant indicator for compliance with hygiene and safety measures, and this measurement is applied because the collection vehicles must be refrigerated. The fault sheets are a means of presenting vehicle failures to the logistics department. These failures can be cleaning, breakdown or destruction of the vehicle.

PHASE 3 – OPERATIONS UNIT PROCESSES: This phase comprises the processes occurring in the Abapor's operations units, being defined through two activities: sorting operation; and information sharing.

Sorting Operation: Only M3's by-products arrive at the sorting process (see Figure 18). Regarding the unloading process of the by-products, a hygienic sanitary control, as well as a documentary report and weighing (activities mentioned above) are carried out. If the sanitary control detects a considerable deterioration or any other relevant factor that makes impossible to continue the M3's operation, this by-product becomes M1 or M2 and is sent to the ITS for incineration. After this control takes place the first sorting that consists in the separation of the product by typology, in pallets: meat and packaged meat; fish and packaged fish; and dairy and dry products. The by-products that need to be refrigerated are stored in a cold room. Sorting by product typology is a process with a very variable duration. However, it is usually not very time consuming since the pallets inside the vehicles have already been sorted by typology. In reality, in general, what will take more time will be the grouping of the pallets by typology. After this first sorting, the fish and fish packaged are sent to a fish by-product processing unit, Narciso Dias & Filhos, Lda., in Peniche. The dairy and dry products are currently incinerated due to the lack of efficient and economically sustainable processes for revaluation of this by-product. Only the meat and its packed products are subject to a manual sorting process. The pallets with this by-product are routed to the screening mats, where they are individually dumped mechanically onto the carpet. In this, all the conditioned product or with foreign bodies (e.g. knives or metals) is operated. Foreign bodies are removed and sent to a waste container. Packaging is hand cut and separated. After this process the different operating units have different approaches:

- **Loures** - after carpet screening, the by-product is routed directly to the meat hopper where the transformation process begins.
- **Vila Nova de Gaia** - An auxiliary carpet is attached to the sorting carpet that sends the by-product into a truck. When this truck is filled it supplies the vehicle-transfer of 26 tons, which forward the by-product from Vila Nova de Gaia to Loures.
- **Coruche** - When the sorting process is finished, the pallets are dumped to the vehicle-transfer that transfer the by-products from Coruche to Loures.

As previously mentioned, **Tunes** is not a sorting unit, having to send the M3 by-product directly to Loures (without sorting). The only operation that is carried out in Tunes is the by-product cooling when necessary. In the case of secondary sorting, by observation when visiting the different operating units,

the process will take an average of 15 minutes per pallet. However, this time is variable by different factors, such as: the flow of stored product to be sorted; operator sensitivity to odor; the deterioration of the by-product; or even the room temperature. The sorting process is performed daily (Monday to Friday) with an 8 hours schedule. The packaging resulting from the process shall be collected on a fortnightly basis by a responsible undertaking. The routing of the sorted meat byproduct is done daily. The fish by-products are sent to Peniche as soon as there is enough quantity to fill the transfer vehicle, as well as the dry and dairy products that go to the ITS.

Information Sharing: In the sorting operation it is good operational practice to internally subdivide the pallets. A lot is characterized by the product type (meat, fish, dairy and dry), its category (M1, M2 or M3) and the date of receipt of the by-product. It promotes more efficient control at the operational level by promoting the FIFO approach during the screening process (in the case of meat). On the other hand, routing operations require transportation guides, mandatory by law, both in the case of routing of the product internally (for Sebol or ITS) and for external routing.

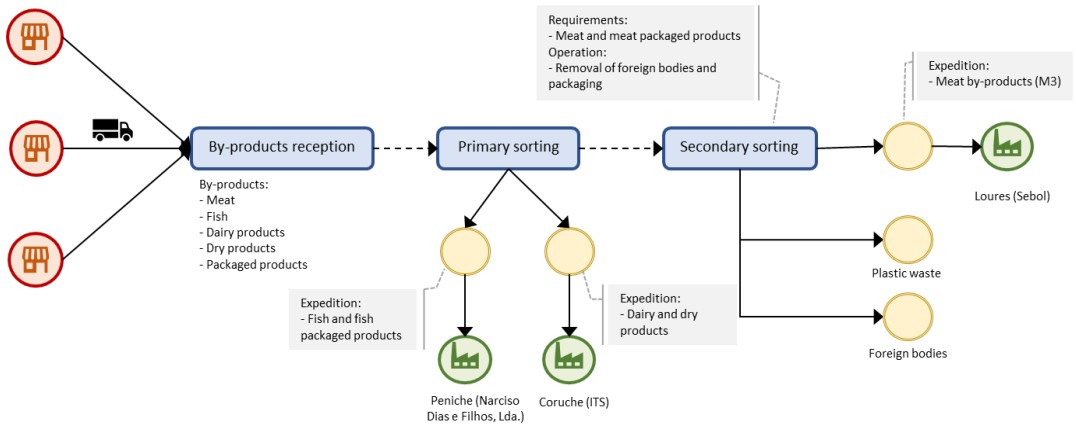


FIGURE 18 - ABAPOR'S SORTING OPERATION.

5.2.1.4. SUSTAINABILITY PERFORMANCE ANALYSIS

After understanding the processes' activities - namely scheduling operations' time, required documentation and information's flows, the next step comprises the deep understanding of Abapor's sustainability performance. Abapor is in itself an oriented company to the circular economy, since through its activities searches for providing a service that allows the cumulative valorization of animal origin by-products, avoiding the going of them to landfill. In terms of sustainability strategy, as said before, Abapor, part of the ETSA Group, intends to consolidate the internal operation, reinforcing its leadership in the market and, at the same time, its competitive position. This is achieved by increasing efficiency levels, improving industrial practices and logistics, focusing on sophisticated equipment and retaining excellent employees. In addition, the company aims to focus on foreign markets, innovation and the exploration of new opportunities for geographic and sector diversification.

The methodology proposes a set of KPIs (see Annex 3) to measure this performance. However, it was also mentioned that the chosen KPIs should be fitted to the company's reality. Considering this, and the available data, some KPIs will be not relevant and others will be characterized focusing specific tasks

and in a qualitative way. In view of this the further explanation considers: operational indicators; environmental indicators; economic indicators; and, lastly, social indicators.

Inputs/Outputs: This indicator, as explained above, seeks to obtain the value of the degree of conversion of inputs into outputs. In Abapor this parameter is applied considering the secondary sorting operation (separation of meat by-product from packages and foreign bodies). It is important to include this indicator to quantify the waste generated in this process. Since this waste is mostly plastic, and since this component is an environmental concern worldwide, Abapor must reduce the amount of plastic generated or treat this waste in a more sustainable way. The higher the degree of conversion, the less waste. Thus, this indicator promotes the improvement of environmental sustainability.

Lead time: This measurement allows to understand the allocation of time to each task/process. In Abapor there are two processes in which this indicator is relevant: collection and secondary sorting. The collection and secondary sorting operation mean time values were mentioned previously, 30 minutes/collection point and 15 minutes/pallet, respectively. These measurements are variable, indicating instability, which directs that the process is not completely controlled. In this case, it is necessary that Abapor see the variables that can influence the time in these processes. Regarding collection, it depends on human resources, access to collection points, and access to the chests at collection points or conditions of transport. Considering the sorting process, the variables were presented previously when explaining the process, in the operating time. With the knowledge of this indicator and its optimization (stability), Abapor can create improvements in the three pillars of sustainability: economic (e.g. cost reduction), environmental (e.g. rapid waste treatment), and social (e.g. improvements in working conditions) sustainability.

Idleness: These KPI measures the forced stops in the processes. Considering Abapor this parameter is relevant in the collection activity given the fact that operators must postpone the collection process in some stores due to lack of access to them. This leads to non-compliance with the routes, which promotes the inefficiency of the collection process. By controlling this parameter, Abapor can fulfill the routes and thus optimize the process, increasing the economic sustainability performance.

Failures: In terms of failures, Abapor may fail due to: vehicles; the lack of human resources; route sheets (by duplication of collection points or empty collection points in the course of leaf compliance); or machines (e.g. breakdowns in carpets or forklifts). The most notorious failures are related to the lack of human resources due to work-related injuries as a result of work-related accidents; and route sheets, which, although not optimized, lead to redundancies in the collection process. The search for solutions to improve this indicator leads to an increase in the process's efficiency, improving economic and social sustainability by reducing costs and through the creation of better work conditions for operators (e.g. reducing the weight of by-product bags in the process of collection).

Downtime: This is not a relevant indicator for Abapor given that the operations it performs occur only from Monday to Friday at an 8-hour workday. Thus, the remaining time of the week can be allocated to any other activity or possibly a need in atypical times of greater by-product flow to be collected or sorted.

Fuel consumption: Despite its sorting operations, Abapor summarizes its activities in the collection of by-products, which directly involves transportation. Thus, one of the most relevant factors is fuel consumption. This is probably the factor that causes the most impact on the transportation cost and is important that Abapor observe what influences it, such as: the vehicle's weight and load; the nature of driving conditions and the stop's frequency; driving techniques; and the specification of the vehicle including airflow management equipment. With this in mind, Abapor must manage these parameters individually (possibly make them into KPI) and thereby reduce transport costs by increasing its economically sustainable performance.

The core business of Abapor, as mentioned before, highlights the environmental aspect. ETSA has the ISCC certification [147], having published and developing environmental policies integrated with quality and sustainability. This certification is the world's first certification system for sustainability and reduction of greenhouse gas emissions. The European Commission (EC) and the 27 EU countries recognize this certification. This is used for all types of biomass and bioenergy, ensuring that all biomass has been produced consciously and respecting the environment through a commitment to reduce greenhouse gases, sustainable land use and protection of the natural environment. This policy covers Abapor taking into account CO_2 emissions from the by-product collection processes. In view of the data collected (see Table 8) and taking into account that all data except the related to raw materials are associated to the ETSA as a whole, it should be noted that: all the raw materials used in Abapor are of renewable origin, coming from the collection process; the energy consumption is geared towards energy efficiency and renewable sources. At ETSA, 53% of the energy consumed comes from self-production. This occurs in the Coruche's factory complex where residues M1 and M2 are subjected to an internal co-incineration process which results in closed-cycle thermal energy, supplying the plants of ITS and blood; reducing and controlling emissions is a concern of ETSA, leading to the installation of a unique gas and odor incinerator worldwide, in addition to the chemical scrubbers and WWTPs transiting its facilities. In addition, taking into account energy self-production, although these data are not shown in the Table 8, it is known that there was a significant decrease in the use of fossil fuels, thus avoiding the use of about 4,000 tons of fuel oil that equivalent to 12,000 tons of CO_2, and thermal destruction of vapors and odors; and one of the important environmental factors is the waste generated by Abapor. This is essentially related to plastic, which is a matter of environmental concern for its time-consuming decomposition. Thus, Abapor must control this indicator and try to find ways to reduce it effectively.

TABLE 8 - ENVIRONMENTAL KPI ACHIEVED VALUES.

Environmental KPI		
Raw material	By-products of fish and packaged fish	7927.12 tons/year
	By-products of dry and dairy products	1358.06 tons/year
	By-products of meat and packaged meat	10,869.65 tons/year
	Total quantity	20,154,83 tons/year
Waste generated	2017	2179.93 tons/year
Energy expenditure	2016	2017
	37,000,000 GJ	38,000,000 GJ (+2.7%)
CO_2 emissions	2017	0.6 million tons
Water expenditure	2016	2017
	41.25 Mm3	45 m3 (+9.1%)

The KPI results presented in Table 9 are related to the ETSA Group and not to Abapor specifically, because it was not possible to know the specific results of these parameters. However, since the ETSA acts on the set of all companies, the results can be analyzed in this way. Thus, in 2017, ETSA revealed a solid financial performance, not maintaining the results but improving them. Accordingly, this performance the business value can be achieved through the turnover ratio. In addition, in 2017 an increasing of 8.6% can be seen justified by the group with the increase of the external sales and exportation. This is not a very significant indicator for Abapor because of the activities it carries out, but for the ETSA Group it is important to realize the overall economic performance. It should be noted that the group companies act together and not as isolated entities. If we were to consider them isolated, Abapor could not be economically sustainable given the high transport costs and the collection price whose trade-off is negative to Abapor; though their operational activities, in 2017, occurred an increasing of 11.6% in EBITDA, which is important to know because leads to the knowledge about the maintenance of the operational performance with better economic results; considering the deduction of earnings and all expenses and losses, ETSA has also achieved an improvement of the liquid result in 2017. With this surplus, Abapor can invest in improvements at processes and operations, as well as considering the purpose of this dissertation, the improvement sustainable performance; and the debt indicator is crucial for a company given that the debts can lead to bankruptcy, however given the value obtained in 2017, ETSA is comfortable in this aspect, not only not registering debt as having to receive 0.9 million euros from other entities.

Another indicator that was suggested in the inclusion of this analysis (Annex 3) but the value could not be obtained was the investment in innovation. This factor is important in order to realize if the company has a real interest in investing in innovation and if it has done so. Given Abapor's knowledge of infrastructures and processes, investment in innovation is perceptible and therefore should be a parameter measured by the company. It should happen not only by the discrimination of this value but also for external knowledge, especially if innovation is related to sustainability.

TABLE 9 - ECONOMIC KPI ACHIEVED VALUES.

Economic KPI		
Turnover ratio	2016	2017
	26.7 million euros	29.0 million euros (+8.6%)
EBITDA	2016	2017
	6.9 million euros	7.7 million euros (+11.6%)
Liquid result	2016	2017
	3.0 million euros	3.2 million euros (+6.7%)
Financial debt	2017	
	-0.9 million euros	

Social issues in general and those relating to workers are given special attention by Abapor. In this way it develops: a strong investment in human resources, translated into training; the implementation of continuous improvement in health and safety at work; major-accident prevention policies; and policies of involvement, aiming for closeness and respect with surrounding communities. In the case of Abapor, some of these policies are dealt with under the ISCC certification and implemented with the impetus to involve employees in the management and development of a quality, environment and sustainability

system. With the values indicated in the Table 10 it is possible to draw some conclusions, however the data collected for some of the indicators are relative only to the year 2017 and a comparative analysis cannot be presented. With this in mind, some conclusions can be drawn: of the 85 existing employees, around 58 employees have a permanent contract, which indicates a significant stability of human resources. It is also possible to conclude that more than 50% of employees are over 41 years old, which indicates, on the one hand, more work experience, and on the other, a weak bet on young workers. However, it should be noted that Abapor is committed to improving the capabilities of employees by the increase in training offered; and there are more male than female employees. This difference results from the type of work required essentially in the collection process, since this process involves lifting large weights. Thus, it does not become significant because it is not about gender discrimination. However, this requirement in terms of excessive weights or even in the process of sorting by contact with sharp objects, leads to many cases of work accidents. With this in view, it is possible to identify a 50% decrease in work accidents in 2017, which is very significant and causes the improvement of the efficiency of operations by maintaining the human resources available.

TABLE 10 - SOCIAL KPI ACHIEVED VALUES.

Social KPI				
Total of collaborators	85 collaborators			
Collaborators with permanent contracts	69.27%			
Accidents of work	Typology	2016	2017	Differential
	Cut	4	2	-2
	Fall	6	0	-6
	Trauma	6	7	+1
	Gas inhalation	1	0	-1
	Moving to work	0	1	+1
	Fracture	1	0	-1
	Dislocation	1	0	-1
	Total	19	10	-9 (- 47.37%)
Distribution by gender/age	Male		Women	
	69.12%		30.88%	
	Age distribution			
	Up to 25		8 (9.4%)	
	26-30		9 (10.5%)	
	31-35		7 (8.2%)	
	36-40		13 (15.3%)	
	41-45		19 (22.4%)	
	46-50		11 (12.9%)	
	51-55		9 (10.5%)	
	56-60		8 (9.4%)	
	More than 61		1 (1.2%)	
Academic education (professional education hours)	2016		2017	
	454		515 (+13.4%)	

5.2.1.5. OPPORTUNITIES IDENTIFICATION

Considering all data collected and through the proposed methodology is time to identify opportunities of improvement in the chain (see Table 11), given special importance to the sustainability improvement. These opportunities were identified through levels: operational – short-term opportunities (immediate to 1 year), considering improvements in specific processes and operations; tactical – medium-term opportunities (from 1 to 2 years), considering the creation of targets and, essentially, conditions for

processes and operations in general to be improved; and strategical – long-term opportunities (from 2 to 5 years), being integrated into the entity's vision of the future.

TABLE 11 - IDENTIFIED OPERATIONAL, TACTICAL AND STRATEGICAL OPPORTUNITIES TO THE ABAPOR'S SC OPTIMIZATION.

Operational opportunities	Chain phase
Plastic reduction: Find alternatives to plastic for the packaging of products and deposition of by-products. This will improve the environmental sustainability performance, reducing the amount of plastic in the process.	**Suppliers (1)** Intervenients: Retail Abapor
Improving accessibility: Improvement of the collection operation by facilitating access to Abapor's freezers or the chambers where the by-product is located. This will reduce the lead time related to the collection process, improving Abapor's performance.	**Suppliers (1)** Intervenients: Retail
Better retail waste control: Quantification of waste to ensure that no waste is sent to the organic waste that can go to Abapor.	**Suppliers (1)** **Collection operation (2)** Intervenients: Retail Abapor
Look at alternatives to products conditioning: Given that there are some problems detected with the coffers and given that the coffers are expensive to maintenance or replacement, it is important to consider other options for storing the by-product in store.	**Suppliers (1)** Intervenients: Retail Abapor
Reduction of by-products' bags weight: Given the identified problems arising from the excessive weight of bags of by-products during the collection process, it is important to find alternatives to make this process more comfortable for the human resources. This will increase the operational performance, also avoiding work accidents.	**Suppliers (1)** Intervenients: Retail Abapor
Tactical opportunities	**Chain phase**
By-product weight information: Obtain by-product weighing by collection point. This will improve the route optimization collection process. Although a guide is delivered to the pick-up point, the real weight of the by-product is not discriminated against and is derived from a weigh-in made by the operator of the collection.	**Suppliers (1)** Intervenients: Retail
Scheduling of by-product collection: To avoid collision of the delivery time of goods in store and collection of by-products, there should be a schedule of by-product collection for each collection point. This improve the collection process performed by Abapor, avoiding also the crossing of the by-product with products reception.	**Suppliers (1)** **Collection operation (2)** Intervenients: Retail Abapor
Collection price optimization: Taking into account the increasing costs of resources, an analysis of these costs is necessary for financial sustainability in order to understand whether Abapor is practicing the appropriate price for the by-product collection process.	**Collection operation (2)** Intervenients: Abapor
Routes optimization: Taking into account the history of by-product flow collected at each collection point, it is possible to optimize routes. However, the sharing of retail information with Abapor, taking into account the lack of a by-product in the collection process or the exceedance of by-products that require the urgent collection of the same, are also important factors for this optimization.	**Collection operation (2)** Intervenients: Abapor
Strategical opportunities	**Chain phase**
Increase in the portfolio of products collected: Looking at the retail there are many by-products that are not yet collected and therefore sent to landfill. Regarding this, Abapor should explore these opportunities in order to increase the range of end-of-life products.	**Collection operation (2)** Intervenients: Retail Abapor
Find options to the revaluation of dry and dairy products: Although the processing is not within the competence of Abapor, the meeting of options for the valorization of dry and dairy products other than incineration can bring economic benefits during the referral process.	**Operations unit processes (3)** Intervenients: ETSA Group
Find options to the plastic wastage: If it is not possible to drastically eliminate plastic, it is necessary to find solutions for the revaluation or disposal of wasted plastic. This is an important factor in increasing Abapor's sustainable performance.	**Operations unit processes (3)** Intervenients: Abapor

5.2.2. STAKEHOLDERS' ANALYSIS AND SELECTION

Basing on this dissertation's scope, considering the PPS-7 and the involved partners, the goal of this step will not be the stakeholders' selection because they are already chosen, but the partners' prioritization. The final product will be the choice of a partner with whom the rest of the dissertation will be developed. Therefore, the selection criteria defined in the proposed methodology (section 4.2.) will be applied to framework and analyze the partners: SONAE, Olano and Greenyard Group. It is important to mention that Olano and Greenyard Group are not stakeholders of Abapor but external entities, however, being MobFood partners, must be considered in this study.

5.2.2.1. FIRST SELECTION CRITERIA

Since SONAE is the only entity involved directly in the operational performance, it made part of the major identified opportunities. Olano and Greenyard are included in the exploitation of new markets and processes, considering in this way their inclusion in Abapor's SC. The allocated potential collaborators to the identified opportunities are in Table 12. When is not applied the allocation of partners it means that only Abapor has influence to develop this opportunity, and it cannot be identified as a collaborative prospect.

TABLE 12 - ALLOCATION OF PARTNERS TO THE IDENTIFIED OPPORTUNITIES IN ORDER TO ESTABLISH COLLABORATIONS.

Identified opportunity	Allocated partners to potentially collaborate
Plastic reduction	**Sonae**; other retailers
By-product weight information	**Sonae**; other retailers
Improving accessibility	**Sonae**; other retailers
Scheduling of by-product collection	**Sonae**; other retailers
Increase in the portfolio of products collected	**Sonae**; **OLANO**; **Greenyard Group**
Collection price optimization	Not applied
Better retail waste control	**Sonae**; other retailers
Look at alternatives to products conditioning	**Sonae**; other retailers
Reduction of by-products' bags weight	**Sonae**; other retailers
Routes optimization	Not applied
Find options to the revaluation of dry and dairy products	Not applied
Find options to the plastic wastage	Not applied

5.2.2.2. SECOND SELECTION CRITERIA

The proposed methodology indicated the use of a list of criteria developed by Morris et al. [139], to be applied to stakeholders. The criteria to be followed are: contribution; legitimacy; willingness to engage; influence; and involvement need. However, in this analysis only three of these will be applied (see Table 13): contribution; influence; and involvement need. The remaining criteria have been eliminated because, as part of a project, all entities must, on the one hand, be involved equally having equal responsibility, and on the other hand must be permanently available to collaborate. Thus, the conclusions of this analysis were:

- **SONAE** – Considering the opportunities verified, the contribution to SONAE in the development of a sustainable collaborative work with Abapor is to improve its performance in terms of: (i) **environmental sustainability** by reducing the plastic it uses, having to opt for more sustainable

solutions, by quantitative control of the waste generated, and for wanting to revalue more types of products at the end of life, betting heavily on the circular economy; (ii) **economic sustainability** by the quantitative knowledge of the by-product generated getting opportunity to negotiate the collection payment more objectively; and, lastly, (iii) **social sustainability** by reducing the weight of by-product bags or by improving the by-product deposition processes from an operator perspective. At the level of **influence**, SONAE is a large company that bets on several business areas and, given its size, has influence in the national economy as well as in the national consumers. In this way, a significant improvement of sustainability will have relevance both for the retail chains and will have an essentially environmental impact at the national level. Considering the **need to be involved** in this type of work, SONAE aims essentially to improve its image in the market by improving performance in sustainability, not being crucial for the maintenance of the business, but being a competitive advantage.

- **Olano** – A collaborative partnership with Abapor on the sustainability level will open doors to Olano for the implementation of the circular economy, which is the fundamental **contribution** of the partnership and also the existent **need for involvement**. Given the **influence**, this is essentially a logistical company, which does not have a great impact on the national economy or contact with other entities but is essential for the supply of retail chains.
- **Greenyard Group** – This company is a multinational producer and distributor that will **benefit** from the collaboration, as well as the company above, with the implementation of processes related to the circular economy by revaluation of the wastes of the chain. However, this company has high **influence** both nationally and internationally. It is responsible, among other activities, for the supply of bananas from Costa Rica, a product that has much demand in Portugal and, as perishable, generates high waste. With this, the implementation of circular economy in partnership with Abapor would have a great impact for both entities, thus justifying the **need for involvement**.

TABLE 13 - MOBFOOD PARTNERS' ANALYSIS CONSIDERING THE PROPOSED BY MORRIS ET AL. [139]

Stakeholder	Contribution	Influence	Involvement need
Sonae	High	High	Medium
OLANO	High	Low	Medium
Greenyard Group	High	High	Medium

5.2.2.3. THIRD SELECTION CRITERIA

The last criterion of analysis is the study of the behavior of the partners against Abapor. With this, the power/influence matrix will be presented (see Figure 19) considering the partners' allocation. Although Abapor has several suppliers, SONAE is one of the largest suppliers of by-products. Considering that Abapor only develops its activities if it has by-products to be collected, SONAE has a great influence in the business of Abapor. Considering the previous step, in terms of contribution and interest in the development of sustainable collaborative work, the classification assigned was "High" and "Medium" respectively. In conclusion, we can say that if SONAE stops being a supplier of Abapor, the activity of the latter is compromised and, on the other hand, that the contribution and interest in the development

of collaborative work is high, which makes SONAE "High power and High interest ", being the one that can make the difference. In this way, Abapor must be fully engage and take advantage of the project to take benefit of the company's experience and the professionals to improve the joint operations, being SONAE a priority partner. Both Olano and Greenyard, as previously mentioned, are not involved in the Abapor's chain. Therefore, there is no historical performance or relationship for to perform this analysis. However, taking into account the conclusions obtained in the second selection criterion, we can conclude that both companies, in the current state, have no power in the company, but are very interested in establishing the partnership. Thus, we can identify them as "Low power and High interest". In this line, Abapor should take advantage of the opportunity analysis to expand the business to other areas, but these are not priority collaborative partners.

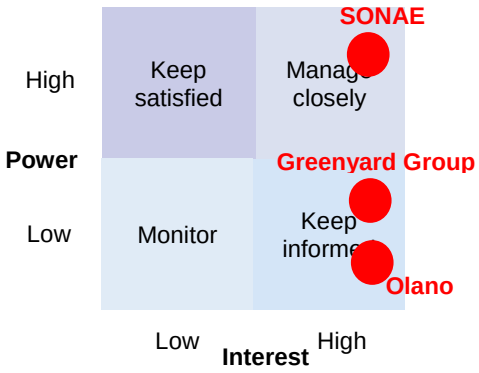


FIGURE 19 - POWER/INTEREST MATRIX WITH THE ATTRIBUTION OF PARTNERS.

5.2.2.4. MOBFOOD PARTNERS' PRIORITIZED RATE

Considering the conclusions illustrated in Table 14 the chosen partner to establish a collaboration process in the dissertation's temporal perspective is SONAE, being an entity that is involved operationally with Abapor and has interest and capacity to cooperate.

TABLE 14 - MOBFOOD'S PARTNERS SUMMARY ANALYSIS.

Stakeholder	Identified opportunities	Contribution	Influence	Involvement need	P/I Matrix	Rate
Sonae	Plastic reduction	High	High	Medium	High Power/High Interest	1
	By-product weight information					
	Improving accessibility					
	Scheduling of by-product collection					
	Increase in the portfolio of products collected					
	Better retail waste control					
	Look at alternatives to products conditioning					
	Reduction of by-products' bags weight					
Greenyard Group	Increase in the portfolio of products collected	High	High	Medium	Low Power/High Interest	2
OLANO	Increase in the portfolio of products collected	High	Low	Medium	Low Power/High Interest	3

5.2.3. KICK-OFF MEETING

From the analysis and prioritization of the MobFood partners, SONAE was the selected to advance first. It should be mentioned again that this dissertation will only include the work developed with Abapor until the moment of delivery of the study. With this can be anticipated that the work will not go beyond the collaborative study with SONAE.

Following the methodology, it requires the verification of SONAE's availability to collaborate. However, considering the project in which this dissertation is inserted, all the partners involved must be willing to develop the sustainable collaborative work.

In order to summon SONAE to the kick-off meeting of this work, an email was sent mentioning both the purpose of the meeting and proposals for scheduling it. The above-mentioned objective is related to the discussion of the objectives of the PPS-7, defining future work taking into account the Gantt Diagram presented during the PPS application (Table 16). This diagram includes the work to be carried out until the end of the project and the timing of the project by activities. The date and time of the meeting was combined considering the availability of both parties.

This meeting was held at IST since there are resources allocated to the PPS from IST and FEUP to share knowledge. With this, the project was framed in the **introduction** of the meeting mentioning the aspects presented in Table 16 related to the MobFood/PPS 7 identification. It is within this project that the work of this dissertation will be inserted. Additionally, the specific work to be developed is also identified in Table 15 as *SONAE/Abapor sustainable collaborative work*.

TABLE 15 - MOBFOOD/PPS 7 - PROJECT IDENTIFICATION; AND THE CURRENT SUSTAINABLE COLLABORATIVE WORK IDENTIFICATION.

MOBFOOD/PPS 7 – Project Identification	
Project title	*MobFood project - Mobilization of scientific and technological knowledge in response to challenges*
Project start date	01/12/2017
Duration of the project	36 months
Composition of the consortium	Primor, PortugalFoods, Central Carnes, Frulact, Sugal, Vitacress, A POVEIRA, Cerealis, Fromageries Bel Portugal, ICM, Mendes Gonçalves, SONAE, Decorgel, BLC3 Evolution, Foodintech, I.T.S., Olano, SEBOL, Sense Test, Greenyard, Vizelpas, CATAA, CIIMAR, UCP-ESB, UP, IBET, INL, INS Doutor Ricardo Jorge, IPB, IPV, IPCB, UA, IPVC, IPC, IPL, IPS, ISA, IST, PIEP,UC, UM, UNL, UTAD
PPS	*7 – Logistics: Sustainable and Collaborative Agro-Food Chain*
Involved co-promoters	Olano, IST, FEUP, SONAE, Greenyard Group and Abapor
Allocated resources	IST: 1 doctoral fellow FEUP: 1 postdoctoral fellow Abapor: 1 human resource (dissertation's author) SONAE: 1 human resource Greenyard Group: 1 human resource
SONAE/ABAPOR Sustainable Collaborative Work	
Project title	Sustainable Collaborative Project - SONAE/Abapor
Project start date	19/02/2018 (dissertation's start date)
Duration of the project	3 months
Involved co-promoters	Abapor; and SONAE
Allocated resources	Abapor: 1 human resource (dissertation's author) SONAE: 1 human resource

The next step is to present the **goals** of the work, which focus on the specific objectives of the project presented in section 2.2. of the present dissertation. The objectives presented concerning the development of a macro perspective approach for the integration of the Abapor and SONAE chains, to improve both operations. This is based on the opportunities identified above by Abapor and others that could be identified together. This work aims to approach these opportunities in a collaborative perspective with the objective of increasing the sustainable performance of both partners.

The **advantages** presented through the development of this work are related to the study of interactions between SONAE and Abapor in order to find points of possible collaboration to optimize the chain, implying the construction of an approach plan that must be developed continuously. Being entities of the MobFood project, both have knowledge about the potential issues that can turn the engagement negative, with the non-achievement of the opportunities.

The **information sharing** was composed both by the Abapor's mapping presentation and the opportunities identified by Abapor allocated to SONAE (see Table 13) and its description (see Table

Suppliers	Inputs	Process	Outputs	Customers
CPC – SONAE's Meat Processing Center	Meat products	- Reception - Quality control - Cold storage - Retail sale	- Meat products - Meat by-products	- Meat consumers - Abapor (entity responsible for the by-products collection)

FIGURE 20 - SONAE'S MEAT CHAIN SIPOC ANALYSIS.

12). Additionally, the SONAE's responsible presented the retail chain with a general overview. Since the methodology proposed a **SIPOC analysis** to expose that overview it was performed (see Figure 20) considering the meat chain. Regarding this, all meat arriving at SONAE's food retail stores comes from its meat processing center. In the stores, the meat is received and subject to quality control. Since in most cases the meat is not put up for sale on the same day, it is stored in cold. When required, the meat is put up for sale and can be bought by the consumer or, when it is unfit for consumption, is marked as a by-product (waste). When the meat is sold, the customers will be the consumers. In the case of by-products, Abapor collects them as a competent entity.

Throughout a brainstorming between the interested parties focused on **opportunities identification**, in addition to all the other opportunities already mentioned, the lack of truck drivers was identified as a negative point for both entities. Thus, it was concluded that the sharing of transport resources could be a collaborative opportunity to explore.

The last phase of this kick-off meeting includes the **alignment of goals and policies** between SONAE and Abapor in order to identify possible restrictions at the collaborative level. No type of collaboration restriction was mentioned, so it was possible to conclude that both entities are willing to collaborate with total transparency and willingness for sharing relevant information. Later, the Gantt diagram (Table 16) presented when the project was applied was analyzed, where it was identified where this work will be inserted and the forward work steps were discussed. Considering the Gantt, this project fulfills the work

of characterizing supply chains (PPS7.A1.T4) and the identification of opportunities for optimization of the chains of SONAE and Abapor by collaboration between them. Taking into account the timing of the development of this work, it started before the stipulated and will have to continue to be developed beyond the month of October because this analysis will be only part of this task. Given the implementation of the proposed methodology, the following path proposes the development of three phases: integrated mapping; implementation plan; and control. Considering this, the next step is the development of an integrated mapping of both chains.

TABLE 16 - GANTT DIAGRAM PRESENTED IN THE PROJECT APPLICATION.

MobFood_PPS7		Responsible	Co-promotors	2017	2018											
				D	J	F	M	A	M	J	J	A	S	O	N	D
PPS7 - Logistics: Sustainable and Collaborative Agro-Food Chain				1	2	3	4	5	6	7	8	9	10	11	12	13
Activity PPS7.A1	Matrix for the sustainability and logistics chains mapping	IST	-													
PPS7.A1.T1	Stakeholders identification	IST	FEUP; Abapor													
PPS7.A1.T2	Identification of drivers, restrictions, conditionings and requirements	IST	FEUP; Abapor													
PPS7.A1.T3	Study of the stakeholders	IST	FEUP; Olano; Abapor; Sonae; Greenyard													
PPS7.A1.T4	Supply chain characterization	IST	FEUP; Olano; Abapor; Sonae; Greenyard													
PPS7.A2	Development of a processes's management methodology – supports by KPI	FEUP														
PPS7.A2.T1	Collaboration methodologies in the Agro-food industry	FEUP	IST; Olano; Abapor; Sonae; Greenyard													

5.2.4. INTEGRATED MAPPING

Considering the previous step, it was established as future work the development of the integrated mapping of SONAE and Abapor chains. In order to map the existing processes, since the link exists only in the chain of meat, only this one has been mapped. Therefore, the mapping was developed by both entities in the standard Excel sheet after a visit to both processes. The mapping of Abapor has already been presented in section 5.2.1.3.2. and the SONAE's mapping essentially comprises the operation in store. The meat-processing center (CPC) is SONAE's detention, but it is seen as a cutting room, and for that reason is not considered as a collection point for Abapor. Considering this the mapping presented in Annex 6 will be described, divided in four phases: reception operation; storage operation; sale operation; and SONAE and Abapor linkage operation.

Reception operation: The SONAE stores are located throughout the national territory and, although there were different insignia, regarding meat, the process is done in a similar way. The meat, coming from the CPC in Santarem, is received every day of the week except Monday, usually of dawn so that the store opens at 9 a.m. with the necessary stock. Once received, it is subjected to a weighting procedure followed by a visual quality control carried out by the operators. When an anomaly with the product is found, the store has 24 hours to complain and resubmit it to the CPC. The meat with proper quality control is stored cold.

Storage operation: This storage usually takes place in two cold rooms separating beef and pork from poultry meat. Additionally, exists also a cold room to support the butchery. From here, the meat is removed according to the First In First Out (FIFO) policy. When the stock is very high, and the stored product is near the end of the shelf life, a label is placed to warn the operator that the meat has the expiration date close.

Sale operation: The shipment of the product takes place in two ways: for the butcher's counter or for free service (where consumers serve by withdrawing the packaging from the coffers located in the store). However, prior to shipment, a quality control is performed which consists on the visual analysis of the labels and the products, verifying if they are still fit for consumption. When it is unfit for consumption, the product is named by-product, packed in a plastic bag and placed in the chest or cold room of its M3 by-products. When fit for consumption they may or may not be subject to cutting. This cut, as when occurs cutting into the butchery counter, generates meat shavings (pieces deposited in an M3 by-product deposit bag). In case of the cutting of the meat that will go for free service, it is packed, and only then placed in the coffers of free service. In the butcher, before the store opens, all the meat is inspected, the meat that is no longer fit for consumption is removed and the stock is restored. This also occurs in the free service taking special care to the end of the period of validity of the packages. The products unfit for consumption - meat and meat packaged - are packed in plastic bags and stored in the chest or cold room of M3 by-products. Although it does not happen often due to imposed laws, butchery waste and free service can be donated to institutions and the zoo. On the other hand, this by-product may be sent to organic waste. This occurs mostly when the by-product chests are full.

SONAE and Abapor linkage operation: Once the entire by-product of cold meat is processed the process becomes the responsibility of Abapor as described in section 5.2.1.3.2., where is the overall Abapor's mapping. After the mapping carried out, considering the opportunities identified previously, it is possible to obtain some conclusions about how operations actually take place:

- **Plastic reduction** – the plastic in SONAE, specifically in the meat chain, is generated in the unpacking of the meat for cutting and in the packaging of the products for free service. It can also come from products that are already packaged and put directly into the free service.
- **By-products weight information** – SONAE counts the by-products of meat by collecting the labels with the respective weight of the products that become by-products because they are no longer fit for consumption. The sum of these weights will give the total weight of nonconforming product for consumption. However, the weight of the chips is not accounted for, which generates a significant deviation in the amount of by-product generated in the store.

- **Improving accessibility** – The inaccessibility to the installations can occur in two ways: when operators have to go inside the store to access the room where the by-product is located; when the chests are inaccessible because they are covered by other objects or structures.
- **Scheduling of by-products collection** – SONAE is only aware of the days to which the Abapor collections are made since the hours of the same are variable. On the other hand, SONAE knows the frequency and the time at which the product discharges occur, being six times a week (except Monday) and usually at dawn.
- **Increase in the portfolio of by-products collected** – Only by-products of animal origin are sent to Abapor. However, SONAE has other products that generate a great flow of waste and are not valued, as is the case of fruits and vegetables.
- **Better retail waste control** – Taking into account the meat chain the waste generated is considered in terms of plastic and meat byproduct. This opportunity is related to the fate given to these two wastes. The loose plastic is currently deposited in a container and the packaging plastic is collected directly with the by-product. The by-product of meat is also collected by Abapor, however, it happens that when the chests are too full for lack of collection or because there was a greater flow of waste, the operators tend to put the surplus in organic waste.
- **Look at alternatives for products conditioning** – Abapor shall provide properly identified chests or containers for the by-product deposition. The chests can be installed in chilled rooms, but the containers do not have to be in cold rooms.
- **Transportation resources sharing** – At this moment SONAE has its fleet just like Abapor but it becomes increasingly difficult to hire drivers due to the nature of the work to be developed.

5.2.5. IMPLEMENTATION PLAN

After the integrated mapping is time to line up the action plan to each opportunity. This plan was developed during a meeting with stakeholders, supported by PowerPoint by designing the integrated mapping of the chains developed in the previous step.

5.2.5.1. IMPLEMENTATION PLAN DEVELOPMENT

Through the joint analysis of the mapping and brainstorming between the partners, the action plans for each of the identified entities were constructed considering the current state of the issue, the methodology to achieve the solution, the requirements, the solution to the issue and the KPI that must be applied to measure the performance of the implementation. In this process, at least two human resources must be involved: one from Abapor and one from SONAE.

Sustainable Collaborative Goal 1: Plastic reduction

- **Current state:** The plastic in the stores of SONAE is generated both in the unpacking of the meat for cutting, and in the packaging of the products for the free service. It can also be sourced from products that already come packaged from the supplier directly to the free service. Abapor collects the by-product and with it comes the plastic packaging that in the sorting are separated from the by-product and subjected to a compacting process in the plastic compactor, exclusive to the treatment of this residue. It should be mentioned that packaging from the packaging of meat by-products

cannot be reused for the packaging of the product for human consumption. In addition, although this value is not related specifically to SONAE, the performance indicator presented in Table 8, representing the waste generated, translates to 2,179.93 tons/year.

- **Methodology:** The proposed methodology comprises four steps. The first step is the quantification of plastic that is generated in SONAE and sent to Abapor. Then, given the intention to reduce this amount, more sustainable alternatives for the packaging of meat products should be found, reducing plastic waste. Given the solutions found, the seemingly most effective approach should be selected and implemented. The fourth and last step should control this implementation, resorting to control it with KPI.
- **Requirements:** For the quantification it is necessary that, taking into account the operation of collection of the by-products, Abapor allocates efforts, within a time horizon of one week, for the separation and quantification of the plastic sent from SONAE. On the other hand, SONAE must quantify the waste of plastic coming from the meat chain that does not go to Abapor. The research requires access to publications or studies on the reduction of plastic in the chains, as well as access to information on the same type of implementation in other companies.
- **Solution:** The Life Without Plastic [144] is a webpage that promotes solutions to accomplish the plastic elimination. In view of this, the present solution to store meat is a stainless steel airtight watertight storage container. The drawback to retailing, especially regarding free service is the non-transparency of the packaging, which will avert the consumer from seeing the product before buying it. In the butcher this would not be applied because the meat would be displayed on the counter and only packed after being chosen and arranged for the consumer. On the other hand, ABB [145], a pioneering technology leader that works closely with utilities, industry, transportation and infrastructure customers, proposed three alternatives for replacing plastic in the packaging of products: glass, aluminum and biopolymers. For the packaging of meat, the biopolymers are the most advised. Surprisingly these can be sourced from by-products from other industries. Liquid wood is derived from lignin, a waste product created in paper processing, while other bioplastics are known to use casein from dairy production or keratin derived from chicken feathers from poultry farms. But, by far, the most popular are plant-based polymers, typically from sugarcane or potato starch. As an example, a Dutch supermarket chain *Ekoplaza* opened the world's first plastic-free aisle in one of its stores in Amsterdam, which sent ripples through the food packaging industry.
- **KPI:** Amount of plastic collected (tons) – Given the initial quantification of the amount of plastic generated, this performance indicator allows the comparison of the future current state to the initial state.

Sustainable Collaborative Goal 2: By-products weight information

- **Current state:** The opportunity identified relates to the quantification of meat by-product. Both SONAE and Abapor do not make this quantification effectively given the absence of quantification of the meat shavings generated in the cutting process.
- **Methodology:** To achieve this goal, the solution must first be implemented in a test pilot shop. During this implementation the process must be controlled, and SONAE should verify the feasibility

of this activity in the meat retail operation. When the solution is optimized and accepted, the implementation in the remaining SONAE stores must occur.

- **Requirements:** SONAE should be willing to include a new weighing activity in the retail meat operation, as well as the total sharing of information on the amount of meat by-product generated. On the other hand, Abapor must rely on the values provided by SONAE.
- **Solution:** To the meat by-products that are sent to the chests or chambers of M3 by-products are withdrawn the labels that discriminate the actual weight of meat waste (the packaging is not counted). However, as previously identified, the waste generated from the cut of meat is not accounted for. The solution is to weigh this waste before shipping it to Abapor. After weighing the whole meat by-product is accounted for: meat not fit for human consumption and butchery wastes. For this weighing process, be facilitated a balance can be installed at the foot of the by-product chests or in the cold rooms.
- **KPI:** By-product weight per collection point (tons) - This indicator aims to obtain the value relative to the weight of by-product per collection point, in order to consider the waste flow generated in each store.

Sustainable Collaborative Goal 3: Improving accessibility

- **Current state:** The inaccessibility to the by-product chests or the rooms where they are stored is a relevant problem in the Abapor collection process. On the other hand, SONAE would benefit from this collaboration by the rapid collection of the by-product and reduction of the cross-process of collecting by-products with customers or in-store products.
- **Methodology:** Taking into account that this negative point does not occur in all stores, the first step will be to study in which stores the collection process has total accessibility and does not cross with the SONAE processes. After knowing this process, the best solution should be reproduced in the remaining stores as much as possible.
- **Requirements:** SONAE and Abapor must be willing to invest in new infrastructures or optimize the location of the existing ones.
- **Solution:** After visits to SONAE stores, the store located in Telheiras had a very effective approach in this aspect - the location of an exterior cold room where all the animal by-products collected by Abapor are stored. This allows full access to the collection of by-products and non-entry of the Abapor operators in the store premises.
- **KPI:** Waiting dead time (minutes) - This indicator measures the time that the operator must wait or the time it takes in excess to perform the collection process due to the inaccessibility of the collection points. For measuring the time, the operator takes the most it is necessary to know the average time of the collection process.

Sustainable Collaborative Goal 4: Scheduling of by-products collection

- **Current state:** The schedule of the collection of by-products is only shared with SONAE in terms of week days. One of the negative points are the time breaks in the process of the Abapor given the wait that often occurs, since the collection coincides with the delivery of merchandise to the stores.

- **Methodology:** The methodology will be based on the sharing of information in two ways: one from SONAE regarding the schedule of the usual times of delivery of merchandise in each store; another from Abapor in sharing the stipulated collection times by optimizing the routes from the hourly availability reported by SONAE.
- **Requirements:** The only requirement is the total information sharing, accomplishing the overall goal to schedule the by-products collection in each retail store.
- **Solution:** Knowing the schedules of merchandise deliveries in each store, the solution is the optimization of routes of Abapor and sharing these with SONAE. Any adjustment to the resulting routes must be reported to both entities. Given that there is a day when deliveries of goods in SONAE mostly do not occur (Monday), Abapor could increase the flow of collections on this day.
- **KPI:** Collection time breaks (minutes) - This indicator measures the time that the operator must wait or the time it takes in excess to perform the collection process due to the delivery of the goods and by-product collection. For measuring the time, the operator takes the most, as said above, it is necessary to know the average time of the collection process.

Sustainable Collaborative Goal 5: Increase in the portfolio of by-products collected

- **Current state:** The by-products collected by Abapor are all of animal origin. However, and as the MobFood project suggests, it is important to collect and transform other types of products like fruits and vegetables.
- **Methodology:** The first step would be to identify the products that generate the most waste in the retail chain. However, taking into account the objectives of the project, the fruits and vegetables have already been identified. Thus, the first step becomes the total quantification of wasted fruits and vegetables. Later it is necessary to arrange ways of processing this waste. When the operation is planned, a pilot project should be initiated taking into account the collection and transformation process. When approved, this measure should be implemented at national level.
- **Requirements:** The needs to achieve this goal are essentially two. One is the sharing of information regarding the amounts of waste by SONAE. The other is related to investment, especially when the pilot project. On the other hand, members of this project should have access to relevant academic information on this topic and look for reverse chains that have already addressed this type of byproduct.
- **Solution:** A possible solution is the utilization of the black soldier fly larvae's ability to transform organic waste into a sustainable protein source. This highly efficient natural process has been beneficial for organic farmers on small scale. Through the bioconversion by insect farming the organics that retrieved in the up-cycling process feed a mini-livestock. Insects rapidly increase their body mass decomposing organic waste. Insect derived nutrients open new horizons in the global agribusiness.
- **KPI:** Collected fruit and vegetables by-products (tons) - This indicator is intended to measure the amount of fruit and vegetables collected by Abapor. In case it remains null, it means that implementation was not performed.

Sustainable Collaborative Goal 6: Better retail waste control

- **Current state:** When the chests are full of by-products or there is no longer any capacity to store the by-product to be collected later, SONAE may choose to ship this by-product for organic waste. This is not sustainable, and both entities enjoy greater information sharing to fight this occurrence.
- **Methodology:** The first step is the continuous information sharing by SONAE to Abapor in terms of the by-products flow. Taking this flow into account, Abapor should expedite the collection, thus optimizing routes as well.
- **Requirements:** The only requirement of this process is the information sharing.
- **Solution:** The solution found is the sharing of information on two factors. When the by-product flow is reaching the maximum storage capacity, this information should be shared with Abapor. If it is not recurring, an emergency recall shall be carried out. If you are recurring, Abapor should optimize the routes and add more frequency in the collection. When the by-product on the previous day of collection is null, the store must contact Abapor to not carry out the collection process. Abapor removes the store from the route sheet and there are no void collection points.
- **KPI:** Empty collection points (unit) - This indicator is intended to indicate how many collection points were empty at the time of collection. This will replicate the information sharing relative to the byproduct flow generated in the store. A similar indicator can be considered in terms of excess store by-product.

Sustainable Collaborative Goal 7: Look at alternatives for products conditioning

- **Current state:** The by-product of animal origin is packaged in cold stores or chambers. However, Abapor intends to optimize this process by meeting other forms of product packaging, which facilitate both in-store operations and the collection process.
- **Methodology:** In order to facilitate the process of implementing by-product packaging alternatives, although new ways of doing so can be identified, the way they currently do must also be analyzed. Taking into account the two aspects of current packaging, the most sustainable and operational must be identified. When identified, it should attempt to be implemented at all collection points.
- **Requirements:** Regular visits to retail stores should be made to evaluate and effectively characterize the byproduct packaging process.
- **Solution:** After the visits made to the stores in this period of time it was verified that the most effective process for the packaging would be the cold rooms and the pallets with the by-product M3 separated by product type. Thus, Abapor would not have to make refrigerators available and collection would be less physically demanding and faster (only the exchange of containers would be necessary) and SONAE would always have the by-product separated in cold and would not have to sanitize the chests. just clean the camera.

Sustainable Collaborative Goal 8: Transportation resources sharing

- **Current state:** Both Abapor and SONAE have their own fleets but, at the moment, they run the risk of not having drivers to drive the trucks given the trend that is occurring in terms of hiring them for the requirement of this type of work.

- **Methodology:** The first step will be to check for human resource failures in both transportation processes. Subsequently, the reasons for these failures must be identified, and if it is not possible to solve these problems internally, considering the availability of human resources of both companies, they can be shared when required.
- **Requirements:** To have the sharing of transportation resources it is crucial that there are enough human resources to cover all the existing moment sharing needs.
- **Solution:** When required by both Abapor and SONAE, if there is any possibility of sharing human resources, this should occur. All responsibility for human resource must be effectively negotiated between entities.

5.2.5.2. SCHEDULE PLAN DEVELOPMENT

For the intervention schedule for these opportunities it is necessary to keep in mind both the time frame of the project (3 years) and the small proportion of this work in the total project. Considering these points, it is suggested that all the opportunities be addressed in a maximum of 6 months, specifically until April 2019. However, since this date is only suggestive, a timetable has not been developed since it was not possible to meet with the entities in order to take into account all variables and availabilities. On the other hand, and in order to prevent future incidents, given the diversity of the opportunities identified, a prioritized list of opportunities may be developed.

5.2.5.3. SUSTAINABLE COLLABORATION COMPROMISE

After developing the implementation plan, the methodology proposes the establishment of a collaborative commitment to the implementation process. However, in this specific case this commitment has already been fulfilled since, since it is part of the MobFood project, documents have already been signed which aim at the sustainability of this commitment.

5.2.6. CONTROL

With this it is time to move on to the last phase of implementation, the control phase. This is not supported by any work developed, so it will be part of the future work. However, at this stage it is foreseen to share information on the progress of the work between the entities involved - SONAE and Abapor - as well as with the other partners of the MobFood project. The monitoring of individualized KPIs and those relating to the control of identified opportunities should be carried out at specific time horizons.

If negative results occur, the implementation plan should be reviewed. The inclusion of new opportunities is valid, and if it occurs the process of the new opportunity should begin in the fourth step of the methodology.

5.3. CHAPTER CONCLUSION AND METHODOLOGY LIMITATIONS

After implementing the entire methodology, even though it has not been completely implemented in the last two phases, the results obtained can be summarized mentioning the positive points and limitations of the implementation. It is recalled that: (i) these limitations are due to the time horizon stipulated for

the conclusion of the dissertation; and (ii) the methodology took into account the meat chain in the SONAE-Abapor relation.

As a **contextualization of the case study** an overview of Abapor was presented, considering the products with which it deals, its infrastructures and the SWOT analysis developed. It was concluded that: (i) Abapor deals mainly with the M3 by-products, characterized by a negligible risk of disease transmission (low risk); (ii) it has four infrastructures in the territory of Continental Portugal to centralize the collections by zones given the decentralization of the collection points. In view of this, Abapor has collection and sorting centers in Vila Nova de Gaia, Coruche and Loures and a collection center in Tunes; and (iii) SWOT analysis supports the implementation of the methodology as well as the development of PPS-7. The SWOT suggests the intention of Abapor to explore new markets, optimizing operations in the meat chain and improving relations with stakeholders.

With the goal of developing a collaborative-sustainable work, the methodology developed in chapter 4 was implemented in this case study. With this implementation it was possible to draw some conclusions and also limitations, both at the methodology and implementation level.

In the **first step**, (i) the methodology was validated considering the strategic and sustainable objectives of Abapor; (ii) the work team was assigned to Abapor consisting of a member working full time with direct collaboration with the Logistic Director; (iii) the macro and micro mappings were built taking into account the global chain of Abapor; (iv) the analysis of Abapor's sustainable performance was developed; and (v) with the data related to mappings and the analysis of sustainable performance were identified opportunities for improvement in the chain. The limitations identified at the methodology level include the non-adequacy of all proposed KPIs from a general perspective, and the identification of opportunities to be addressed both internally and collaboratively, due to the fact that the internal ones will not be approached, considering the collaborative basis inherent to the implementation of the methodology. In terms of limitations in the application of the methodology, conclusions were drawn regarding values taking into account the ETSA Group and an individual analysis of Abapor should have been achieved. However, given the time horizon of this study, this was not possible.

In the **second step**, the project partners were analyzed and prioritized through three criteria: the allocation of partners to the opportunities; the study of their contribution, influence and need for involvement; and the evaluation of the partners taking into account the power/influence matrix. With this, SONAE was the chosen partner for the development of the remaining methodology due to its results. In terms of limitations of the methodology, we can consider (i) the development of it in order to think only in collaboration with stakeholders of the base company, and not with external entities; (ii) the difficult measurement of factors such as legitimacy and willing to engage; and (iii) the limitation of the power/influence matrix considering the historical performance evaluation. Considering the limitations of implementation, it is possible to mention that the partners of the project, Olano and Greenyard, are external partners, that is, an adaptation had to be made to be possible to implement this step; and, given the time horizon, only the remaining methodology was developed with SONAE, leaving Olano and Greenyard for future work.

In the **third step**, Abapor performed a meeting with SONAE to initiate the project. In this one the PPS-7 was remembered and presented the collaborative-sustainable work to be developed with the interaction SONAE-Abapor. In addition to these entities, FEUP and IST were also mentioned as partner entities in order to promote the sharing of academic knowledge in the development of new knowledge. As a final product of this step, a SIPOC analysis of SONAE was constructed taking into account the meat chain. No methodological limitations were identified, however taking into account the implementation from this stage only the meat chain will be explored in detail given the stipulated time horizon.

In the **fourth step**, the integrated SONAE-Abapor mapping of the meat chain was constructed, which can be found in Annex 6 and described at this stage. This step should include the sustainability analysis of SONAE, but this was not possible given the lack of data, which constitutes a limitation of implementation. The methodology has as a limitation the lack of operationality of this phase when dealing with large and complex chains, being necessary to separate the overall processes into specific operations.

In the **fifth step**, the implementation plan for the opportunities was built. Taking into account each of them has been described their initial state, the methodology that involves their approach, the requirements, the solution that can be addressed and the KPIs that can be used to monitor progress. The limitations of the methodology take into account the inexistence of a framework that integrates this plan and its schedule in an effective way and with control and adjustments in real time. In the implementation, given the stipulated time horizon, the design approach of the implementation plan was simple, having as main limitations (i) the suggested solutions that were not studied in terms of operational and sustainable impact with concrete values, (ii) the absence of some operational and operational KPIs sustainability to measure performance, as well as their measurement in the initial situation. On the other hand, it was also not possible to build a schedule for scheduling activities.

In the **sixth and final step** of the methodology there was no implementation since the work has not yet been developed. Thus, there are no limitations of implementation, but in terms of methodology fails to develop a collaborative platform for real-time control of these activities, accessible to all partners.

The application of this methodology promoted the collaborative work with a view to improving the sustainability of the SONAE and Abapor chains. An initial link was established for the companies in the work to be developed in PPS-7.

CONCLUSIONS AND FUTURE WORK

The challenges of the Agro-food chain related to the fragmentation of the entities involved and the lack of synchronization between the direct and inverse flows led to the elaboration of the PPS-7. It aims the collaboration into the chain, guided by the sustainability pillars. The partners involved – SONAE, Abapor, Olano and Greenyard – are present in different logistics activities of the chain that promotes different levels of collaboration and intervention for the improvement of global sustainability. In addition, two non-business partners – IST and FEUP – are involved in developing and mastering state-of-the-art investigations, adapting the application to the case study more easily.

Once the problem was identified, a review of the existing literature, relevant to the subject under study, was carried out. With this, the themes related to the Agro-food industry, SCM, sustainability and collaboration were explored. In this way, the work to be developed was sustained and it is relevant to mention that the three pillars of sustainability are not approached in the same way, and there is a gap in the literature regarding the social perspective. Subsequently, and in order to support the design of the methodology created in chapter 4, two methodologies were developed that take into account the implementation of sustainability and collaboration in the chains in an isolated way. There was thus a gap in the literature regarding the integration of collaboration, and at the same time, of sustainability in the chains. In this way the value added to the academic community of the development of a collaborative-sustainable methodology presented in this thesis is verified.

Considering the objective of developing a collaborative-sustainable work, a methodology for its implementation was constructed. It promotes the collaboration of the entities involved, aiming at identifying opportunities for joint improvement so that, through their implementation, the processes of both entities can be optimized. According to this, the methodology developed consists of six steps: internal company's alignment; stakeholders' analysis and selection; kick-off meeting; integrated mapping; implementation plan; and control. In the course of these steps it is intended: identification of opportunities taking into account the mapping of the study base as well as the analysis of its sustainable performance; the selection of stakeholders to collaborate through evaluation criteria, including factors such as allocation with identified opportunities, contribution, legitimacy, willingness to engage, influence and need for involvement, as well as the power/influence matrix; with selected stakeholders, the methodology foresees the investigation of their interest to collaborate by calling them to a kick-off meeting of the collaborative-sustainable work. At the end of this, the partners will confirm their interest in collaborating; the construction of an integrated mapping, considering the integration of the operations of the different entities involved and analyzes of sustainable performance. This will provide a holistic mapping of the integrated chains as well as a final list of the opportunities to be addressed; the development of an implementation plan considering aspects such as the initial state of the opportunity, implementation methodology, requirements for such, solutions to achieve the opportunity and KPI for process monitoring. Additionally, an intervention schedule is also made at every opportunity; the commitment between the collaborating entities in order to guarantee the commitment in the course of the implementation of the opportunities; and the control the implementation of opportunities by

monitoring the implementation plan by measuring KPI and sharing performance information among partners.

After the methodology delineated, this was applied taking into account the actual case-study, required by Abapor in the context of PPS-7. As final product we obtained:

- The mapping of Abapor as well as the analysis of its performance in terms of sustainability.
- The mapping of meat retail operations of SONAE stores.
- The integrated mapping of both entities.
- Identification of opportunities to improve the global meat chain, taking into account the operations of SONAE and Abapor.
- The implementation plan of identified opportunities.

After completing the work developed in the dissertation it is possible to verify not only the contribution of this to the academic community for the development of the methodology presented, but also the contribution to the PPS-7 with the characterization of the meat SC through the data presented, the mappings developed, as well as the KPIs proposed for monitoring the chain.

As future work it is necessary to continue with the work stipulated in PPS-7, considering:

- The optimization of the application of the methodology to the interaction SONAE-Abapor presented;
- The application of the methodology to the other PPS-7 partners;
- The construction of a framework and dashboard to support implementation management by monitoring identified opportunities.

Taking into account the base company of the case-study and considering that the opportunities exclusively related to Abapor were not approached by limitation of the methodology and recommended as future work the approach of the same ones internally.

In relation to academic knowledge it is important to promote the sharing and consequent publication of the implementation of this methodology in other case studies. This will lead to the optimization of the presented methodology promoting the collaboration among different companies for the improvement of global sustainability. As a general approach, this can be applied not only to the food industry but also to other areas or industries.

REFERENCES

[1] McKinsey Center for Business and Environment. Special edition. The circular economy: Moving from theory to practice; October 2016.

[2] Toop, A., Ward, S., Oldfield, T. AgroCycle – Developing a circular economy in agriculture. Energy Procedia 00 000-00; 2017.

[3] Santos, Sousa, C. Uma Análise do Setor Agroalimentar Português: Estrutura Empresarial e Exportações, 69; 2014.

[4] Santos, K., Loures, E., Piechnicki, F., Canciglieri, O. Opportunities Assessment of Product Development Process in Industry 4.0. Procedia Manufacturing, 11 1358-1365. https://doi.org/10.1016/j.promfg.2017.07.265; June 2017.

[5] Supino, S., Malandrino, O., Testa, M., Sica, D. Sustainability in the EU cement industry: The Italian and German experiences. Journal of Cleaner Production, 112 430-442. https://doi.org/10.1016/j.jclepro.2015.09.022; 2015.

[6] Trochu, J., Chaabane, A., Ouhimmou, M. Reverse logistics network redesign under uncertainty for wood waste in the CRD industry. Resources, Conservation and Recycling, 128 32-47. https://doi.org/10.1016/j.resconrec.2017.09.011; July 2017.

[7] MobFood – Mobilização de conhecimento científico e tecnológico em resposta aos desafios do mercado Agroalimentar. PPS 7 LOGÍSTICA - Cadeia Logística Agroalimentar Sustentável Colaborativa. Portugal 2020; 2017.

[8] Portugal 2020, União Europeia. https://www.portugal2020.pt/Portal2020/o-que-e-o-portugal2020. Acessed in 07/03/2018.

[9] Sonae SGPS, https://sonae.pt/pt/. Updated in 2018. Acessed in 07/03/2018.

[10] Sonae SGPS, https://www.sonae.pt/pt/media/press-releases/sonae-distinguida-nos-edie-sustainability-leaders-awards-2018/. Available in 2018-01-29. Acessed in 12/03/2018.

[11] Greenyard Group. https://www.greenyard.group/innovation.html. Acessed in 13/08/2018; 2018.

[12] OLANO. www.groupe-olano.com. Acessed in 12/03/2018.

[13] Ginting, G. Open Innovation Model: Empowering Entrepreneurial Orientation and Utilizing Network Resources as Determinant for Internationalization Performance of Small Medium Agroindustry. *Agriculture and Agricultural Science Procedia 3* 56-61; 2015.

[14] ENEI, IAPMEI, FCT, ANI, COMPETE. Estratégia de Investigação e Inovação para uma especialização inteligente. EI&I, 2014-2020. November 2014.

[15] FoodDrink Europe. Economic Bulletin Q1 2017. July 2017.

[16] FIPA – Federação das Indústrias Portuguesas Agro-Alimentares. Políticas de Competitividade para o Setor Agro-Alimentar. May 2012.

[17] Yakovleva, N. Measuring the sustainability of the food supply chain: a case study of the UK. *J. Environ. Policy Plan. 9 (1), 75-100*; 2008.

[18] Zanoni, S., Zavanella, L. Chilled or frozen? Decision strategies for sustainable food supply chains. *Int. J. Prod. Econ. 140 (2), 731-736*; 2012.

[19] Alberto, D. Setor Agroalimentar Em Portugal: Construção das Vantagens Competitivas. Instituto de Ciências Sociais (ICS-UL); 2015.

[20] Brown, C., Longworth, J., Waldron, S. Food safety and development of the beef industry in China. 25, pp. 269-284; 2002.

[21] GPPQ. Horizonte 2020 – Programa-Quadro de Investigação e Inovação da EU (2014-2020); 2018.

[22] Kirwan, J. The interpersonal world of direct marketing: examining conventions of quality at UK farmers' markets. *J. Rural Stud. 22, 301-312*; 2006.

[23] Manning, L., Baines, R. N., Chadd, S.A. Deliberate contamination of the food supply chain. Br. Food J. 107 (4), 225-245; 2005.

[24] Manning, L., Baines, R. N., Chadd, S.A. Quality assurance in the food supply chain. Br. Food J. 108 (2), 91-104; 2006.

[25] Wang, X., Li, D., O'Brien, C. Optimization of traceability and operations planning: an integrated model for perishable food production. Int. J. Prod. Res. 45 (11), 2865-2886; 2009.

[26] Shandong, Mou, David J. Robb, Nicole DeHoratius. Retail Store Operations: Literature Review and Research Directions. *European Journal of Operational Research*. Doi: 10.1016/j.ejor.2017.07.003; 2017.

[27] Van Woensel, T., M. Fisher, and J.C. Fransoo. Teaching retail operations in business and engineering schools. INFORMS Transactions on Education. 11(1); 29-34; 2010.

[28] PwC. Total retail 2015: Retailers and the Age of Disruption. Available from: http://www.pwc.com/gx/en/industries/retail-consumer/global-multi-channel-consumer-survey.html; 2015.

[29] Fisher, M. To me it's a store. To you it's a factory. International Commerce Review: ECR Journal 4(2): 9-18; 2004.

[30] Reiner, G., C. Teller, and H. Kotzab. Analyzing the efficient execution of in-store logistics processes in grocery retailing – the case of dairy products. Production and Operations Management 22(4): 924-939; 2013.

[31] Das, S. How breakthrough technology could significantly reduce plastic waste. Available from: https://www.unilever.com/news/news-and-features/Feature-article/2018/sanjeev-das-howbreakthrough-technology-could-significantly-reduce-plastic-waste.html; 2018.

[32] Marques, N. Apresentação ETSA NM; 2017.

[33] Marques, N. Rendering; February 2017.

[34] Oliver, R.K., Weber, M.D. Supply chain management: Logistics catches up with strategy. *In M.L. Christopher (Ed.). Logistics: The strategy issues (pp. 63-75). London: Chapman&Hall*; 1982.

[35] Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E. Designing and Managing the Supply Chain. *Second ed. McGraw-Hill, IL*; 2003.

[36] Barbosa- Póvoa, A., Silva, C., Carvalho, A. Opportunities and Challenges in Sustainable Supply Chains: An Operation Research Perspective. *European Journal of Operational Research, doi: 10.1016/j.ejor.2017.10.036; 2017*.

[37] Hassini, E., Surti, C., Searcy, C. A literature review and a case study of sustainable supply chains with a focus on metrics. *International Journal of Production Economics 140 (1): 69-82*; 2012.

[38] FoodDrink Europe – Official Site. http://www.fooddrinkeurope.eu/; 2018. Accessed in 12/04/2018.

[39] Banco de Portugal. Quadro do Setor: 4722 – Comércio e retalho de carne e produtos à base de carne, em estabelecimentos especializados; 2016. Accessed in 20/11/2018.

[40] Santos, S. https://ionline.sapo.pt/554619; 22/03/2017. Accessed in 10/05/2018.

[41] Hanjra, M.A., Ferede, T., Blackwell, J., Jackson, T.M., Abbas, A. Global food security: facts, issues, interventions and public policy implications. In: Hanjra, M.A. (Ed.), Global Food Security: Emerging Issues and Economic Implications. Nova Science Publishers, New York, NY, USA, pp. 1–35; 2013.

[42] Wheeler, T., von Braun, J. Climate change impacts on global food security. Science 341, 508–513; 2013.

[43] De Steur, H., et al. Applying Value Stream Mapping to reduce food losses and wastes in supply chains: A systematic review. Waste Management. http://dx.doi.org/10.1016/j.wasman.2016.08.025; 2016.

[44] Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R., Meybeck, A. Global Food Losses and Food Waste: Extent, Causes and Prevention. Report by the Swedish Institute for Food and Biotechnology for the Food and Agriculture Organization of the United Nations, Rome; 2011.

[45] Kummu, M., De Moel, H., Porkka, M., Siebert, S., Varis, O., Ward, P. Lost food, wasted resources: global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use. Sci. Total Environ. 438, 477–489; 2012.

[46] Miller, D.D., Welch, R.M. Food system strategies for preventing micronutrient malnutrition. Food Policy 42, 115–128; 2013.

[47] Parfitt, J., Barthel, M., Macnaughton, S. Food waste within food supply chains: quantification and potential for change to 2050. Philos. Trans. Royal Soc. B: Biol. Sci. 365, 3065–3081; 2010.

[48] Richter, B., Bokelmann, W. Approaches of the German food industry for addressing the issue of food losses. Waste Manage. 48, 423–429; 2016.

[49] Willersinn, C., Mack, G., Mouron, P., Keiser, A., Siegrist, M. Quantity and quality of food losses along the Swiss potato supply chain: stepwise investigation and the influence of quality standards on losses. Waste Manage. 46, 120–132; 2015.

[50] Rutten, M.M. What economic theory tells us about the impacts of reducing food losses and/or waste: implications for research, policy and practice. Agric. Food Security 2, 13; 2013.

[51] Womack, J.P., Jones, D.T., Roos, D. Machine That Changed the World. Simon and Schuster; 1990.

[52] Rother, M., Shook, J. Learning to See: Value Stream Mapping to Create Value and Eliminate Muda. v. 1.1. Oct. The Lean Enterprise Inst., Brookline, Mass; 1998.

[53] Taylor, D.H. Value chain analysis: an approach to supply chain improvement in agri-food chains. Int. J. Phys. Distrib. Logistics Manage. 35, 744–761; 2005.

[54] Seth, D., Seth, N., Goel, D. Application of value stream mapping (VSM) for minimization of wastes in the processing side of supply chain of cottonseed oil industry in Indian context. J. Manuf. Technol. Manage. 19, 529–550; 2008.

[55] Darlington, R., Rahimifard, S. A responsive demand management framework for the minimization of waste in convenience food manufacture. Int. J. Comput. Integr. Manuf. 19, 751–761; 2006.

[56] Sathiyabama, C.N., Dasan, P. Optimum resource allocation and eliminating waste inside food industry. Central Eur. Business Rev. 2, 31; 2013.

[57] Klewitz, J., Hansen, E.G. Sustainability-oriented innovation of SMEs: a systematic review. *Journal of Cleaner Production*. http://dx.doi.org/10.1016/j.jclepro.2013.07.017; 2013.

[58] Hall, J.K., Daneke, G.A., Lenox, M.J. Sustainable development and entrepreneurship: past contribution and future directions. J. Bus. Vent. 25, 439-448; 2010.

[59] World Commission on Environment and Development (WCED). Report of the World Commission on Environment and Development: “Our Common Future”. General Assembly document A/42/427 http://www.wbcsd.org; 1987.

[60] Dyllick, T., Hockerts, K. Beyond the business case for corporate sustainability. Bus. Strat. Environ. 11 (2), 130-141; 2002.

[61] Organisation for Economic Co-Operation and Development (OECD). Oslo Manual. Guidelines for Collecting and Interpreting Innovation Data, third edition. OECD Publishing, Paris; 2005.

[62] Altham, W. Benchmarking to trigger cleaner production in small businesses: drycleaning case study. J. Clean. Prod. 15, 798-813; 2007.

[63] Hart, S., Milstein, M. Creating sustainable value. Acad. Manag. Exec. 17, 56-67; 2003.

[64] Noci, G., Verganti, R. Managing green product innovation in small firms. R&D Management 29, 3-15; 1999.

[65] Bianchi, R., Noci, G. Greening SMEs' competitiveness. Small Bus. Econ. 11, 269-281; 1998.

[66] Tilley, F. Small-firm environmental strategy: the UK experience. Greener Manag. Int. 25, 67-80; 1999.

[67] Schaltegger, S. A framework for ecopreneurship – leading bioneers and environmental managers to ecopreneurship. Greener Manag. Int. 38, 45-58; 2002.

[68] Hockerts, K., Wustenhagen, R. Greening Goliaths versus emerging Davids – theorizing about the role of incumbents and new entrants in sustainable entrepreneurship. J. Bus. Vent. 25, 481-492; 2010.

[69] Van Hooijdonk, R. Inspiration series: THE FUTURE OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT; 2018.

[70] Lee, J., Veloso, F.M., Hounshell, D.A., Rubin, E.S. Forcing technological change: a case of automobile emissions control technology development in the US. Technovation 30 (4), 249–264; 2010.

[71] Soylu, A., Oruc, C., Turkay, M., Fujita, K., Asakura, T. Synergy analysis of collaborative supply chain management in energy systems using multi-period MILP. Eur. J. Oper. Res. 174 (1), 387–403; 2006.

[72] Chen, L. Supply chain collaboration for sustainability: A literature review and future research agenda. International Journal of Production Economics. http://dx.doi.org/10.1016/j.ijpe.2017.04.005; 2017.

[73] B, Ben. https://www.supplychainopz.com/2012/04/what-is-logistics-and-supply-chain-management.html. Accessed in 09/07/2018.

[74] Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., Zacharia, Z. G. "Defining supply chain management", Journal of Business Logistics, Vol. 22, No. 2, pp. 1–25; 2001.

[75] Fawcett, S.E., Magnan, G. M. & McCarter, M. W. A three-stage implementation model for supply chain collaboration. Journal of Business Logistics, 29(1), 93-112; 2008.

[76] Morgan, R.M. & Hunt, S.D. The commitment-trust theory of relationship marketing. *Journal of Marketing, 58, 20-38*; 1994.

[77] Dyer, J.H. Does governance matter? Keiretsu alliances and asset specificity as sources of Japanese competitive advantage. *Organization Science, 7(6), 649–66*; 1996.

[78] Manthou, V., Vlachopoulou, M. & Folinas, D. Virtual e-Chain (VeC) model for supply chain collaboration. *International Journal of Production Economics, 87(3), 241–250*; 2004.

[79] Barratt, M. Understanding the meaning of collaboration in the supply chain. Supply Chain Management: *An International Journal, 9(1),30-42*; 2004.

[80] Simatupang, T.M. & Sridharan, R. The collaborative supply chain. International Journal of Logistics Management, 13(1), 15-30; 2002.

[81] Beth, S, Burt, D, Copacino, W, Gopal, C,Lee, H, Lynch, R, & Morris, S. Supply chain challenges: building relationships. Harvard Business Review, July 1-10; 2003.

[82] Arli, V., Dylke, S., Burgess R., Campus, R. & Soldo, E. Woolworths Australia and Walmart US: Best Practices in Supply Chain Collaboration. Journal of Economics, Business, and Accountancy Ventura,16(1), 27-46; 2013.

[83] Handfield, R.B. A resource dependence perspective of just-in-time purchasing. *Journal of Operations Management, 11(3), 289-311*; 1993.

[84] Heikkilä, J. From supply to demand chain management: efficiency and customer satisfaction. *Journal of Operations Management, 20, 747-67*; 2002.

[85] Heide, J.B. & John, G. Alliances in industrial purchasing: the determinants of joint action in buyer-supplier relationships. Journal of Marketing Research, 27, 24-36; 1990.

[86] Mohr, J.J. & Spekman, R. Characteristics of partnership success: partnership attributes, communication behavior, and conflict resolution techniques. Strategic Management Journal, 15, 135-52; 1994.

[87] Lee, H.L, Padmanabhan, V. & Whang, S. The bullwhip effect in supply chain. *Sloan Management Review, 38(3), 93-102*; 1997.

[88] Min, S., Roath, A., Daugherty, P.J., Genchev, S.E., Chen, H. & Arndt, A.D. Supply chain collaboration: what's happening? *International Journal of Logistics Management, 16(2), 237–256*; 2005.

[89] Benavides, L., De Eskinazis, V. & Swan, D. Six steps to successful supply chain collaboration. McKinsey&Company; July 2012.

[90] Simatupang, T.M. & Sridharan, R. An Integrative framework for supply chain collaboration. International. *Journal of Logistics Management, 16 (2), 257–274*; 2005.

[91] Brewer, P. & Speh, T. Adapting the balanced scorecard to supply chain management. *Supply Chain Management Review, march/ april, 48-56*; 2001.

[92] Singh, K. & Mitchell, W. Precarious collaboration: business survival after partners shut down or form new partnerships. *Strategic Management Journal, 17(7), 99–115*; 1996.

[93] Park, N.K., Mezias, J.M. & Song, J. A resource-based view of strategic alliances and firm value in the electronic marketplace. *Journal of Management, 30(1),7–27*; 2004.

[94] Dubey, R., Gunasekaran, A., Papadopoulos, T., Childe, S., Shibin, K., Wamba, S. Sustainable supply chain management: framework and further research directions. *Journal of Cleaner Production 142 (2017) 1119 -1130*; 2017.

[95] Togar, M.S. & Sridharan, R. The collaborative supply chain. *International Journal of Logistics Management, 13(1), 15-30*; 2002.

[96] Chopra, S., & Meindl, P. Supply Chain Management: Strategy, planning and operations. 6th Global Edition. Pearson Education Limited; 2007.

[97] Korhonen, J., Honkasalo, A., Seppälä, J. Circular Economy: The Concept and its Limitations. Ecological Economics 143 (2018) 37–46; 2018.

[98] Ivo de Carvalho, M. Gestão colaborativa de fornecedores como variável de eficácia e eficiência na cadeia de abastecimento do retalho alimentar; 2017.

[99] Bailou, R.H. Logística: Administración de la cadena de suministro (5th edition). México: Pearson education; 2004.

[100] Chopra, S., Meindl, P. Supply chain management: strategy, planning and operations. 6th Global edition. Pearson education limited; 2007.

[101] Min, H. The essentials of supply chain management (53). Pearson education; 2015.

[102] Rodrigues, E. Supply chain and Transports optimization: Volkswagen Autoeuropa case study; November 2016.

[103] Beamon, B.M. Designing the Green Supply Chain – Logistics Information Management.

Vol.12, nº 4, pp. 332-342; 1999.

[104] Fernandes, M. Logística e Sustentabilidade: Análise de casos de estudo e tendências; Abril 2008.

[105] Kopczak, L., Johnson, M. The supply chain management effect. MIT Sloan Management review, Spring 2003 Vol. 44 nr. 3 pp. 27-34; 2008.

[106] Wu, H., Dunn, S. Environmentally responsible logistics systems. International Journal of Physical Distribution & Logistics Management, Vol.25 nº 2, 1995, pp.20-38. University Press, 0960-0035; 1994.

[107] Ahi, P., Searcy, C., (2013). A comparative literature analysis of definitions for green and sustainable supply chain management. J.Clean. Prod. 52, 329-341; 2013.

[108] Kotler, P., Armstrong, G. Principles of Marketing. 12th European Edition. Edimburg. Prentice Hall Europe. ISBN 0132390027; 2007.

[109] Polonsky, M., Ottman, J. Developing Green Products: Learning From Stakeholders. Journal of Sustainable Design. pp.22-43; April 1998.

[110] Finisterra, A. Marketing verde: uma aplicação da segmentação de mercado aos consumidores portugueses. Tese de Doutoramento. Departamento de Economia e Gestão da Universidade da Beira Interior; 2005.

[111] Magalhães, C. Obstáculos à implementação da Responsabilidade Social em Portugal – site Expresso Emprego [Em Linha]. http://www.expressoemprego.pt; 2007.

[112] Van Weele, A.J. Purchasing Management – Analysis, Planning and Practice. International Thomson Business Press. London ISBN 1-86152-237-1; 1997.

[113] European Comission. Comprar ecológico! Manual de contratos públicos ecológicos – Serviço das Publicações Oficiais das Comunidades Europeia, Luxemburgo 2005 ISBN 92-894-8995-2; 2005.

[114] Gilbert, H. Costing the Earth. Supply Chain Management. 18 January 2007. Disponível em www.supplymanagement.com; 2007.

[115] González-Benito, J. et al. The role of stakeholder pressure and managerial values in the implementation of environmental logistics practices. International Journal of Production Research, Vol.44, Nº 7 April 2006 pp.1353-1373; 2006.

[116] European Communities Comission. Relatório da comissão ao Conselho e ao Parlamento europeu sobre a aplicação da directiva 94/62/CE relativa a embalagens e resíduos de embalagens e ao seu impacto no ambiente, bem como sobre o funcionamento do Mercado interno. Bruxelas 6.12.2006. COM(2006) 767 final; 2006.

[117] Portugal automotive commerce association. [Em Linha]. Disponível na http://www.acap.pt/; 2007.

[118] Portuguese association of electric vehicles. [Em Linha]. Disponível na http://www.apve.pt; 2007.

[119] Pourmohammadi, H. Green Logistics for regional industrial waste materials and by products. – Dissertation for the Degree Doctor of Philosophy, University of Southern California; August 2005.

[120] Freitas, S. Biodiesel à base de óleo de soja é a melhor alternativa para o Brasil?. Informações Económicas, SP, v. 34, nº 1; January 2004.

[121] Skjoett-Larsen, T. European logistics beyond 2000. International Journal of Physical Distribution & Logistics Management, Vol.30, Nº 5, 2000 pg. 377-387. MCB University Press, 0960-0035; 2000.

[122] Mendes e Silva. Logística Reversa – Uma visão de gerenciamento de suprimentos para a questão ambiental, suas práticas e seus conceitos operacionais. Irvine Califórnia. Tese de Pós-Graduação da FGV Management. Fundação Getúlio Vagas; 2005.

[123] Keebler, J.S. The State of Logistics Measurement. The Supply & Logistics Journal Vol 3, No. 2, 2000, 1-7; 1999.

[124] Liebetruth, T. Die Informations basis des Supply Chain Controllings. Köln: Kölner Wissenschaftsverlag; 2005.

[125] Weber, J., Wallenburg, C.M., Bühler, A., Singh, M., Logistik-Controlling mit Kennzahlensystemen, Koblenz: Görres-Verlag GmbH; 2012.

[126] Esty, D. C., & Winston, A. S. Green to Gold. John Wiley & Sons; 2009.

[127] Nulkar, G. SMEs and environmental performance – A framework for green business strategies. Procedia - Social and Behavioral Sciences 133 (2014) 130 – 140; 2013.

[128] Fallon, N. SWOT Analysis: What It Is and When to Use It. https://www.businessnewsdaily.com/4245-swot-analysis.html; 2018. Accessed in 05/08/2018.

[129] What is PESTLE Analysis? A Tool for Business Analysis. http://pestleanalysis.com/what-is-pestle-analysis/; Accessed in 05/08/2018.

[130] SIPOC diagram. https://www.isixsigma.com/tools-templates/sipoc-copis/sipoc-diagram/; Accessed in 05/08/2018.

[131] AR, R., al-Ashraf, M. Production Flow Analysis through Value Stream Mapping: A Lean Manufacturing Process Case Study. Procedia Engineering 41, 1727-1734; 2012.

[132] Liker, J., & Meier, D. The Toyota Way Fieldbook. New York: McGraw-Hill; 2006.

[133] Ōno, T. Toyota Production System: Beyond Large-Scale Production. Productivity Press; 1988.

[134] William C. Thorsen, Value Stream Mapping & VM, General Motors Corporation.

[135] AR, R., al-Ashraf, M. Production Flow Analysis through Value Stream Mapping: A Lean Manufacturing Process Case Study. Procedia Engineering 41, 1727-1734; 2012.

[136] Harry, M. et al. The Practitioner's Guide to Statistics and Lean Six Sigma for Process Improvements. John Wiley; 2010.

[137] GRI Sustainability Reporting Guidelines G3.1 – Reference Sheet. https://www.globalreporting.org/resourcelibrary/G3.1-Quick-Reference-Sheet.pdf; Accessed in 06/08/2018.

[138] Thompson, R. Stakeholder Analysis. https://www.mindtools.com/pages/article/newPPM_07.htm; Acessed in 06/08/2018.

[139] Morris, J., Baddache, F. Back to Basics: How to Make Stakeholder Engagement Meaningful for Your Company. Europe, BSR; January 2012.

[140] Contributor. What is SCRS and How Walmart and Netflix should Use it. In http://pestleanalysis.com/scrs/; September 2015. Accessed in 07/08/2018.

[141] Deloite Consultores, S.A. Enquadramento Macro-económico da Indústria Agro-alimentar em Portugal; 2012. Available in http://www.anilact.pt/documentos/deloitte001.pdf. Accessed in 14/09/2018.

[142] Liebetruth, T., (2017). Sustainability in performance measurement and management systems for supply chains. Procedia Engineering 192 (2017) 539 – 544.

[143] Craig R. Carter, Dale S. Rogers, (2008) "A framework of sustainable supply chain management: moving toward new theory", International Journal of Physical Distribution & Logistics Management, Vol. 38 Issue: 5, pp.360-387, https://doi.org/10.1108/09600030810882816

[144] Life Without Plastic. https://www.lifewithoutplastic.com/store/catalogsearch/result/?q=airtight+AND+rectangular&acc=502e4a16930e414107ee22b6198c578f. Accessed in 30/09/2018.

[145] Packaging news. http://www.packagingnews.com.au/sustainability/three-plastic-substitutes-that-are-taking-off. Accessed in 30/09/2018 [146] ETSA Group. https://www.etsa.pt/grupo-etsa. Accessed in 07/03/2018

[146] Ellen MacArthur Foundation (2012) Towards the Circular Economy: Economic and business rationale for an accelerated transition.

[147] International Sustainability and Carbon Certification. https://www.iscc-system.org/. Accessed in 13/10/2018.

ANNEX 1 - GRI SUSTAINABILITY REPORTING GUIDELINES G3.1 - REFERENCE SHEET. ADAPTED FROM [137].

GRI Sustainability Reporting Guidelines	
Principles for Defining Report Content	Materiality: The information in a report should cover topics and indicators that: reflect the organization's significant economic, environmental, and social impacts, or that would substantively influence the assessments and decisions of stakeholders.
	Stakeholder inclusiveness: The reporting organization should identify its stakeholders and explain in the report how it has responded to their reasonable expectations and interests.
	Sustainability context: The report should present the organization's performance in the wider context of sustainability.
	Completeness: Coverage of the material topics and indicators and definition of the report boundary should be sufficient to reflect significant economic, environmental, and social impacts and enable stakeholders to assess the reporting organization's performance in the reporting period.
Principles for Ensuring Report Quality	Balance: The report should reflect positive and negative aspects of the organization's performance to enable a reasoned assessment of overall performance.
	Comparability: Issues and information should be selected, compiled, and reported consistently. Reported information should be presented in a manner that enables stakeholders to analyze changes in the organization's performance over time and could support analysis relative to other organizations.
	Accuracy: The reported information should be sufficiently accurate and detailed for stakeholders to assess the reporting organization's performance.
	Timeless: Reporting occurs on a regular schedule and information is available in time for stakeholders to make informed decisions.
	Clarity: Information should be made available in a manner that is understandable and accessible to stakeholders using the report.
	Reliability: Information and processes used in the preparation of a report should be gathered, recorded, compiled, analyzed, and disclosed in a way that could be subject to examination and that establishes the quality and materiality of the information.
Strategy and Analysis	Statement from the most senior decision-maker of the organization (e.g., CEO, chair, or equivalent senior position) about the relevance of sustainability to the organization and its strategy. The statement should present the overall vision and strategy for the short-term, medium-term (e.g., 3-5 years), and long-term, particularly regarding the management of the key challenges associated with economic, environmental, and social performance. The statement should include: strategic priorities and key topics for the short/medium-term with regard to sustainability, including respect for internationally agreed standards and how they relate to long-term organizational strategy and success; broader trends (e.g., macroeconomic or political) affecting the organization and influencing sustainability priorities; key events, achievements, and failures during the reporting period; views on performance with respect to targets; outlook on the organization's main challenges and targets for the next year and goals for the coming 3-5 years; and other items pertaining to the organization's strategic approach.
	Description of key impacts, risks, and opportunities. The reporting organization should provide two concise narrative sections on key impacts, risks, and opportunities. Section 1 should focus on the organization's key impacts on sustainability and effects on stakeholders, including rights as defined by national laws and relevant internationally agreed standards. This should take into account the range of reasonable expectations and interests of the organization's stakeholders. This section should include: A description of the significant impacts the organization has on sustainability and associated challenges and opportunities. This includes the effect on stakeholders' rights as defined by national laws and the expectations in internationally-agreed standards and norms; An explanation of the approach to prioritizing these challenges and opportunities; Key conclusions about progress in addressing these topics and related performance in the reporting period. This includes an assessment of reasons for underperformance or overperformance; and a description of the main processes in place to address performance and/or relevant changes. Section 2 should focus on the impact of sustainability trends, risks, and opportunities on the long-term prospects and financial performance of the organization. This should concentrate specifically on information relevant to financial stakeholders or that could become so in the future. Section 2 should include the following: a description of the most important risks and opportunities for the organization arising from sustainability trends; prioritization of key sustainability topics as risks and opportunities according to their relevance for long-term organizational strategy, competitive position, qualitative, and (if possible) quantitative financial value drivers; table(s) summarizing: – Targets, performance against targets, and lessons learned for the current reporting period; and – Targets for the next reporting period and mid-term objectives and goals (i.e., 3-5 years) related to key risks and opportunities; concise description of governance mechanisms in place

	to specifically manage these risks and opportunities; and identification of other related risks and opportunities.	
Organizational Profile	Name of the organization.	
	Primary brands, products, and/or services. The reporting organization should indicate the nature of its role in providing these products and services, and the degree to which it utilizes outsourcing.	
	Operational structure of the organization, including main divisions, operating companies, subsidiaries, and joint ventures.	
	Location of organization's headquarters.	
	Number of countries where the organization operates, and names of countries with either major operations or that are specifically relevant to the sustainability issues covered in the report.	
	Nature of ownership and legal form.	
	Markets served (including geographic breakdown, sectors served, and types of customers/ beneficiaries).	
	Scale of the reporting organization, including: number of employees; number of operations; net sales (for private sector organizations) or net revenues (for public sector organizations); total capitalization broken down in terms of debt and equity (for private sector organizations); and quantity of products or services provided. In addition to the above, reporting organizations are encouraged to provide additional information, as appropriate, such as: total assets; beneficial ownership (including identity and percentage of ownership of largest shareholders); and breakdowns by country/region of the following: sales/revenues by countries/regions that make up 5 percent or more of total revenues; costs by countries/regions that make up 5 percent or more of total revenues; and employees.	
	Significant changes during the reporting period regarding size, structure, or ownership including: the location of, or changes in operations, including facility openings, closings, and expansions; and changes in the share capital structure and other capital formation, maintenance, and alteration operations (for private sector organizations).	
	Awards received in the reporting period.	
Report Parameters	Report profile	Reporting period (e.g., fiscal/calendar year) for information provided.
		Date of most recent previous report (if any).
		Reporting cycle (annual, biennial, etc.)
		Contact point for questions regarding the report or its contents.
	Report scope and boundaries	Process for defining report content, including: determining materiality; prioritizing topics within the report; and identifying stakeholders the organization expects to use the report.
		Boundary of the report (e.g., countries, divisions, subsidiaries, leased facilities, joint ventures, suppliers).
		State any specific limitations on the scope or boundary of the report. If boundary and scope do not address the full range of material economic, environmental, and social impacts of the organization, state the strategy and projected timeline for providing complete coverage.
		Basis for reporting on joint ventures, subsidiaries, leased facilities, outsourced operations, and other entities that can significantly affect comparability from period to period and/or between organizations
		Data measurement techniques and the bases of calculations, including assumptions and techniques underlying estimations applied to the compilation of the Indicators and other information in the report.
		Explanation of the effect of any re-statements of information provided in earlier reports, and the reasons for such re-statement (e.g., mergers/ acquisitions, change of base years/periods, nature of business, measurement methods).
		Significant changes from previous reporting periods in the scope, boundary, or measurement methods applied in the report.
	GRI content index	Table identifying the location of the Standard Disclosures in the report. Identify the page numbers or web links where the following can be found: Strategy and Analysis 1.1 – 1.2; Organizational Profile 2.1 – 2.10; Report Parameters 3.1 – 3.13; Governance, Commitments, and Engagement 4.1 – 4.17; Disclosure of Management Approach, per category; Core Performance Indicators; Any GRI Additional Indicators that were included; and Any GRI Sector Supplement Indicators included in the report
	Assurance	Policy and current practice about seeking external assurance for the report. If not included in the assurance report accompanying the sustainability report, explain the scope and basis of any external assurance provided. Also explain the relationship between the reporting organization and the assurance provider(s).

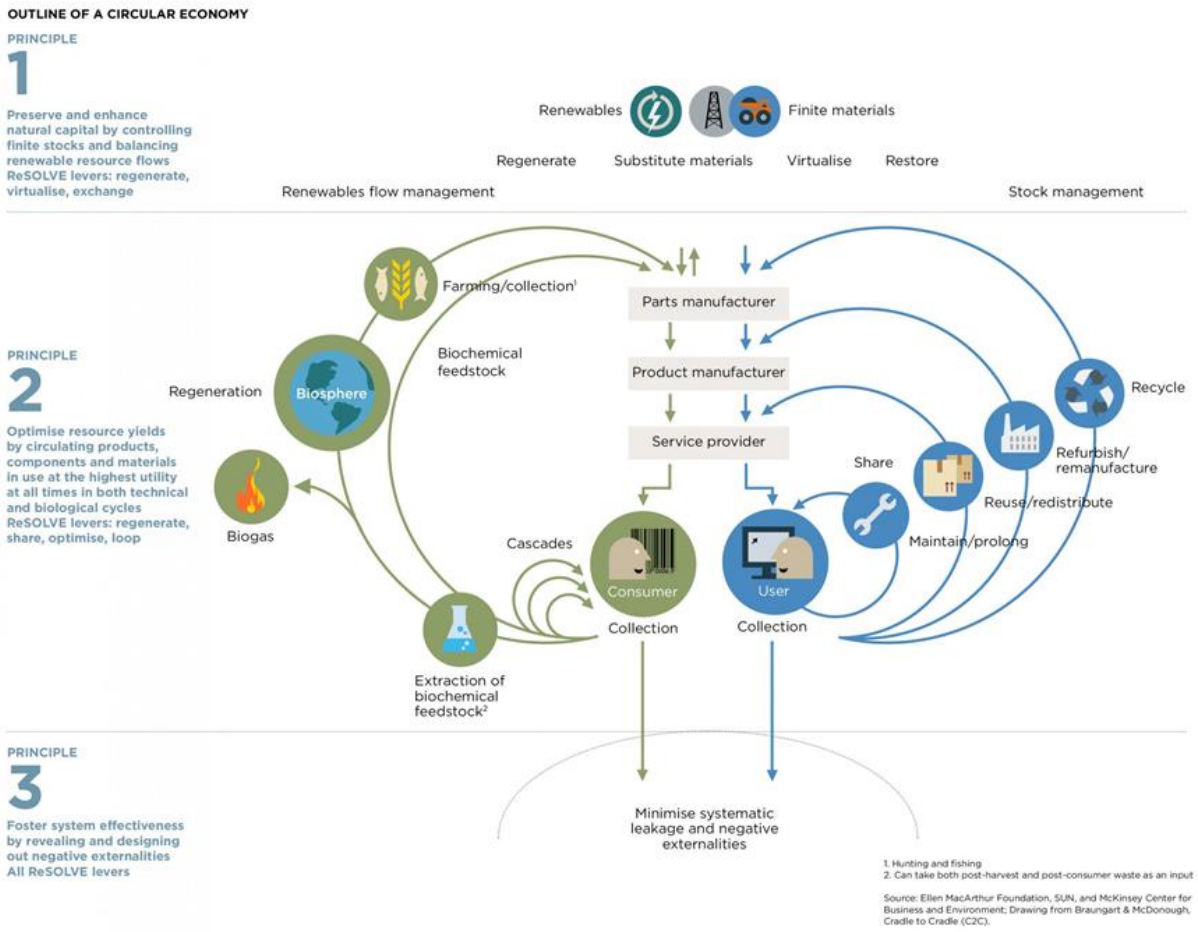
Governance, Commitments, and Engagement	Governance	Governance structure of the organization, including committees under the highest governance body responsible for specific tasks, such as setting strategy or organizational oversight. Describe the mandate and composition (including number of independent members and/or non-executive members) of the highest governance body and its committees and indicate each individual's position and any direct responsibility for economic, social, and environmental performance. Report the percentage of individuals by gender within the organization's highest governance body and its committees, broken down by age group and minority group membership and other indicators of diversity.
		Indicate whether the Chair of the highest governance body is also an executive officer (and, if so, their function within the organization's management and the reasons for this arrangement).
		For organizations that have a unitary board structure, state the number and gender of members of the highest governance body that are independent and/ or non-executive members. State how the organization defines 'independent' and 'non-executive'. This element applies only for organizations that have unitary board structures. See the glossary for a definition of 'independent'
		Mechanisms for shareholders and employees to provide recommendations or direction to the highest governance body. Include reference to processes regarding: the use of shareholder resolutions or other mechanisms for enabling minority shareholders to express opinions to the highest governance body; and informing and consulting employees about the working relationships with formal representation bodies such as organization level 'work councils', and representation of employees in the highest governance body. Identify topics related to economic, environmental, and social performance raised through these mechanisms during the reporting period.
		Linkage between compensation for members of the highest governance body, senior managers, and executives (including departure arrangements), and the organization's performance (including social and environmental performance).
		Processes in place for the highest governance body to ensure conflicts of interest are avoided.
		Process for determining the composition, qualifications, and expertise of the members of the highest governance body and its committees, including any consideration of gender and other indicators of diversity.
		Internally developed statements of mission or values, codes of conduct, and principles relevant to economic, environmental, and social performance and the status of their implementation. Explain the degree to which these: are applied across the organization in different regions and department/units; and relate to internationally agreed standards.
		Procedures of the highest governance body for overseeing the organization's identification and management of economic, environmental, and social performance, including relevant risks and opportunities, and adherence or compliance with internationally agreed standards, codes of conduct, and principles. Include frequency with which the highest governance body assesses sustainability performance.
		Processes for evaluating the highest governance body's own performance, particularly with respect to economic, environmental, and social performance.
	Commitments to external initiatives	Explanation of whether and how the precautionary approach or principle is addressed by the organization.
		Externally developed economic, environmental, and social charters, principles, or other initiatives to which the organization subscribes or endorses. Include date of adoption, countries/operations where applied, and the range of stakeholders involved in the development and governance of these initiatives (e.g., multi-stakeholder, etc.). Differentiate between nonbinding, voluntary initiatives and those with which the organization has an obligation to comply.
		Memberships in associations (such as industry associations) and/or national/international advocacy organizations in which the organization: has positions in governance bodies; participates in projects or

		committees; provides substantive funding beyond routine membership dues; or vews membership as strategic. This refers primarily to memberships maintained at the organizational level.
	Stakeholder engagement	List of stakeholder groups engaged by the organization. Examples of stakeholder groups are: civil society; customers; local communities; shareholders and providers of capital; suppliers; and employees, other workers, and their trade unions.
		Basis for identification and selection of stakeholders with whom to engage. This includes the organization's process for defining its stakeholder groups, and for determining the groups with which to engage and not to engage.
		Approaches to stakeholder engagement, including frequency of engagement by type and by stakeholder group. This could include surveys, focus groups, community panels, corporate advisory panels, written communication, management/union structures, and other vehicles. The organization should indicate whether any of the engagement was undertaken specifically as part of the report preparation process.
		Key topics and concerns that have been raised through stakeholder engagement, and how the organization has responded to those key topics and concerns, including through its reporting.
	Aspects	Core Indicators are those Indicators identified in the GRI Guidelines to be of interest to most stakeholders and assumed to be material unless deemed otherwise on the basis of the GRI Reporting Principles.
Economic	Economic performance	Direct economic value generated and distributed, including revenues, operating costs, employee compensation, donations and other community investments, retained earnings, and payments to capital providers and governments
		Financial implications and other risks and opportunities for the organization's activities due to climate change.
		Coverage of the organization's defined benefit plan obligations.
		Significant financial assistance received from government.
	Market presence	Range of ratios of standard entry level wage by gender compared to local minimum wage at significant locations of operation.
		Policy, practices, and proportion of spending on locally-based suppliers at significant locations of operation
		Procedures for local hiring and proportion of senior management hired from the local community at locations of significant operation.
	Indirect economic impact	Development and impact of infrastructure investments and services provided primarily for public benefit through commercial, in kind, or pro bono engagement.
		Understanding and describing significant indirect economic impacts, including the extent of impacts.
Environmental	Materials	Materials used by weight or volume.
		Percentage of materials used that are recycled input materials.
	Energy	Direct energy consumption by primary energy source.
		Indirect energy consumption by primary source.
		Energy saved due to conservation and efficiency improvements
		Initiatives to provide energy-efficient or renewable energy-based products and services, and reductions in energy requirements as a result of these initiatives.
		Initiatives to reduce indirect energy consumption and reductions achieved.
	Water	Total water withdrawal by source.
		Water sources significantly affected by withdrawal of water.
		Percentage and total volume of water recycled and reused.
	Biodiversity	Location and size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas.
		Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas.
		Habitats protected or restored.
		Strategies, current actions, and future plans for managing impacts on biodiversity.

		Number of IUCN Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk.
	Emissions, effluents and wastes	Total direct and indirect greenhouse gas emissions by weight.
		Other relevant indirect greenhouse gas emissions by weight.
		Initiatives to reduce greenhouse gas emissions and reductions achieved.
		Emissions of ozone-depleting substances by weight.
		NO, SO, and other significant air emissions by type and weight.
		Total water discharge by quality and destination.
		Total weight of waste by type and disposal method.
		Total number and volume of significant spills.
		Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of the Basel Convention Annex I, II, III, and VIII, and percentage of transported waste shipped internationally.
		Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the reporting organization's discharges of water and runoff.
	Products and services	Initiatives to mitigate environmental impacts of products and services, and extent of impact mitigation.
		Percentage of products sold and their packaging materials that are reclaimed by category.
	Compliance	Monetary value of significant fines and total number of non-monetary sanctions for noncompliance with environmental laws and regulations.
	Transport	Significant environmental impacts of transporting products and other goods and materials used for the organization's operations and transporting members of the workforce.
	Overall	Total environmental protection expenditures and investments by type.
Labor Practices and Decent Work	Employment	Total workforce by employment type, employment contract, and region, broken down by gender
		Total number and rate of new employee hires and employee turnover by age group, gender, and region.
		Benefits provided to full-time employees that are not provided to temporary or part-time employees, by significant locations of operation.
		Return to work and retention rates after parental leave, by gender.
	Labor/Management relations	Percentage of employees covered by collective bargaining agreements.
		Minimum notice period(s) regarding operational changes, including whether it is specified in collective agreements.
	Occupational health and safety Training and education	Percentage of total workforce represented in formal joint management–worker health and safety committees that help monitor and advise on occupational health and safety programs.
		Rates of injury, occupational diseases, lost days, and absenteeism, and number of work-related fatalities by region and by gender.
		Education, training, counseling, prevention, and risk-control programs in place to assist workforce members, their families, or community members regarding serious diseases.
		Health and safety topics covered in formal agreements with trade unions.
		Average hours of training per year per employee by gender, and by employee category.
		Programs for skills management and lifelong learning that support the continued employability of employees and assist them in managing career endings.
		Percentage of employees receiving regular performance and career development reviews, by gender.
	Diversity and equal opportunity	Composition of governance bodies and breakdown of employees per employee category according to gender, age group, minority group membership, and other indicators of diversity.
	Equal remuneration for women and men	Ratio of basic salary and remuneration of women to men by employee category, by significant locations of operation.
Human Rights	Investment and procurement practices	Percentage and total number of significant investment agreements and contracts that include clauses incorporating human rights concerns, or that have undergone human rights screening.
		Percentage of significant suppliers, contractors and other business partners that have undergone human rights screening, and actions taken.

		Total hours of employee training on policies and procedures concerning aspects of human rights that are relevant to operations, including the percentage of employees trained.
	Non-discrimination	Total number of incidents of discrimination and corrective actions taken.
	Freedom of association and collective bargaining	Operations and significant suppliers identified in which the right to exercise freedom of association and collective bargaining may be volatile or at significant risk, and actions taken to support these rights.
	Child labor	Operations and significant suppliers identified as having significant risk for incidents of child labor, and measures taken to contribute to the effective abolition of child labor.
	Forced and compulsory labor	Operations and significant suppliers identified as having significant risk for incidents of forced or compulsory labor, and measures to contribute to the elimination of all forms of forced or compulsory labor.
	Security practices	Percentage of security personnel trained in the organization's policies or procedures concerning aspects of human rights that are relevant to operations.
	Indigenous rights	Total number of incidents of violations involving rights of indigenous people and actions taken.
	Assessment	Percentage and total number of operations that have been subject to human rights reviews and/or impact assessments.
	Remediation	Number of grievances related to human rights filed, addressed and resolved through formal grievance mechanisms.
Society	Local community	Percentage of operations with implemented local community engagement, impact assessments, and development programs.
		Operations with significant potential or actual negative impacts on local communities.
		Prevention and mitigation measures implemented in operations with significant potential or actual negative impacts on local communities.
	Corruption	Percentage and total number of business units analyzed for risks related to corruption.
		Percentage of employees trained in organization's anti-corruption policies and procedures.
		Actions taken in response to incidents of corruption.
	Public policy	Public policy positions and participation in public policy development and lobbying.
		Total value of financial and in-kind contributions to political parties, politicians, and related institutions by country.
	Anti-competitive behavior	Total number of legal actions for anticompetitive behavior, anti-trust, and monopoly practices and their outcomes.
	Compliance	Monetary value of significant fines and total number of non-monetary sanctions for noncompliance with laws and regulations.
Product responsibility	Customer health and safety	Life cycle stages in which health and safety impacts of products and services are assessed for improvement, and percentage of significant products and services categories subject to such procedures.
		Total number of incidents of non-compliance with regulations and voluntary codes concerning health and safety impacts of products and services during their life cycle, by type of outcomes.
	Product and service labelling	Type of product and service information required by procedures, and percentage of significant products and services subject to such information requirements.
		Total number of incidents of non-compliance with regulations and voluntary codes concerning product and service information and labeling, by type of outcomes.
		Practices related to customer satisfaction, including results of surveys measuring customer satisfaction.
	Marketing communications	Programs for adherence to laws, standards, and voluntary codes related to marketing communications, including advertising, promotion, and sponsorship.
		Total number of incidents of non-compliance with regulations and voluntary codes concerning marketing communications, including advertising, promotion, and sponsorship by type of outcomes.
	Customer privacy	Total number of substantiated complaints regarding breaches of customer privacy and losses of customer data.
	Compliance	Monetary value of significant fines for noncompliance with laws and regulations concerning the provision and use of products and services.

ANNEX 2 - CIRCULAR ECONOMY PERSPECTIVE [146].



ANNEX 3 - GENERAL KPI SELECTION TO THE COMPANY'S SUSTAINABLE PERFORMANCE ANALYSIS.

Perspectives	KPI	Definition	How to measure
Operational	Inputs/outputs	It gives information about the degree of products (inputs) transformation into outputs. It can be measured through the total weight of the inputs and outputs or can be presented through product composition parameter (e.g. % water and % solids). If the conversion is low, the team work must accurate which are the cause for it happening.	Degree of conversion = $\frac{\text{Outputs (tons)}}{\text{Inputs (tons)}}$
	Lead time	This indicator accurate the latency between the initiation and execution of a process. The team work must study the lead time in the overall operation but also in each activity. It provides a basis value to take some conclusions comparing it to other indicators.	Lead time value (in minutes or hours)
	Idleness	It is the time an equipment, department or team stand still. Through the comparison of this indicator to the lead time indicator, the team work can take conclusions about the processes' efficiency.	Idleness time value (in minutes or hours)
	Failures	It indicates the number of failures that occur during activities/processes. These failures are, for example, routes failures, vehicle damages, administrative failures, scrap or production line failures. In view of this, these failures must be well-defined and measured by each category. It provides to the team work an opportunity to identify practices that must be optimized.	Number of failures (unit)
	Downtime	It allows team work to understand how much time is available to, for example incorporate new activities. Time horizon: week.	Downtime = 1 - $\frac{\text{Available time (hours)}}{\text{Total time (7 days a week)(hours)}}$
	Fuel consumption	Some resources are crucial to the sustainable management of a company. The fuel consumption is an important indicator to study both the environmental impact and the operational efficiency.	Fuel consumption value (liters)
Environmental	Raw materials	Due to the scarcity of resources it is important to understand the flow of raw materials as well as their qualitative analysis. In this view, the work team should measure this indicator by quality of raw material, taking into account its origin.	Quantity of raw materials (in tons)
	Waste generated	This parameter is important, especially considering the waste stream generated for landfill. The challenge here will be for the team to quantify and classify these wastes as well as to realize where they are generated. The degree of conversion of inputs into outputs can be a starting point for obtaining the value of waste.	Waste generated (tons) = Inputs - Outputs
	Energy expenditure	This indicator aims at the knowledge of energy consumption. The team must know this value and, if relevant, quantify it by activity/operation. This will lead to a more specific approach if this indicator is critical.	Energy consumption value (GJ)
	CO_2 emissions	It is a measure of how much CO_2 is created and how much the company contributes to the climate change. The goal is always to reduce this value.	CO_2 emissions value (tons)
	Water expenditure	This parameter measures the quantity of water consumed by the company. The team must know this value and, if relevant, quantify it by activity/operation. This will lead to a more specific approach if this indicator is critical.	Water consumption value (m^3)
Economic	Turnover ratio	It measures the value of a company's sales or revenues generated relative to the value of its assets. The analysis of this indicator should be done considering the specific sector. It happens because this ratio tends to be higher for companies in certain sectors than in others.	Turnover ratio = $\frac{\text{Sales}}{\text{Average total assets}}$ The result must be presented in percentage.

	EBITDA	"Earnings Before Interests, Taxes, Depreciation and Amortization" It represents how much a company generates through their operational activities, without financial responsibilities. This indicator is important due to the possibility of, not only looking for the final result of the business, but also looking for the process final result.	EBITDA = Operational profit + (Interest + Taxes + Depreciation + Amortization)
	Liquid result	It is the residual value that is obtained by the company, in a certain period of time (in a general way, one year), after deducted all earnings and all the expenses or losses. This value indicates a surplus, which can be applied into the company (e.g. for the R&D department) or distributed by the shareholders.	Liquid result = Total income – Total expenses
	Financial debt	It indicates the amount of money borrowed by one part from another. The companies must have a lot of attention because a company that has a high value of debt may not be able to make its interest payments if sales drop. This put the business in a bankruptcy danger.	Debt value
	Innovation spending	This metric shows the amount of money spends on innovation. It will say if the company values or not the innovation integration.	Value of the investment in innovation
Social	Total of collaborators	This metric is important because the increase or decrease of this parameter can provide some conclusions. For example, if occurs an increase, the team work is interested to understand the causes for the need of more human resources are (e.g. a new production line or an increase of the supply flow).	Total number of collaborators (unit)
	Collaborators with permanent contracts	It will indicate if the company had a high or low turnover of human resources. This analysis is important because, if the turnover is high, the team work must identify whether it occurs throughout the company or in specific areas and must understand why it occurs.	Collaborators with permanent contracts = $\frac{\text{Collaborators with permanent contracts}}{\text{Total number of collaborators}}$ The result must be presented in percentage
	Accidents at work	This indicator reflects a concern both at the social level and at the company level. A high number of work accidents means that there are activities/operations with a high risk of accidents, which must be explored by the work team. On the other hand, this fact requires that the human resources management work be redoubled because the employees are absent, but the work has to be done, so that replacement employees are hired, raising the costs of resources.	Number of accidents at work (unit)
	Distribution by gender/age	This factor is seen as an inclusion evaluator. Increasingly there is a gender balance, however, some companies still value men's work more than women's, which promotes a sexist perspective. With this, the team must know if this ratio is balanced and, if it is not, what are the reasons for the imbalance. In terms of age range the perspective is similar.	Distribution by gender = $\frac{\text{Number of women}}{\text{Total number of collaborators}}$ Distribution by age = $\frac{\text{Number of collaborations in a range of age}}{\text{Total number of collaborators}}$ Both results must be presented in percentage
	Academic education	In order to establish collaborations, it is necessary to validate if the company has human resources with the necessary academic training and knowledge in order to transmit valuable contributions for the development of the methodology. If the work team finds that there is no relevant knowledge internally, it must allocate external human resources.	Academic education = $\frac{\text{Collaborators with academic education}}{\text{Total number of collaborators}}$

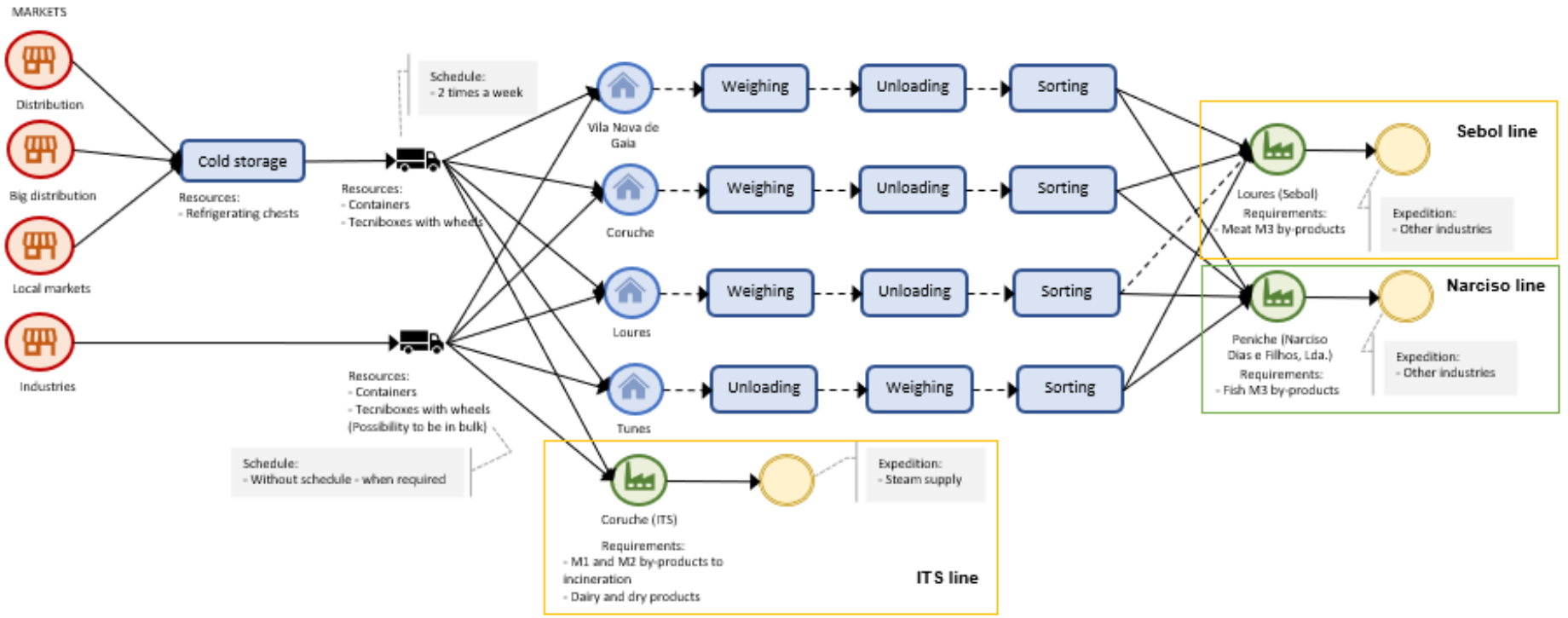
ANNEX 4 - RESUME TABLE OF THE STAKEHOLDERS' PRIORITIZATION REASONS.

Stakeholder	Morris' approach					Power/Influence matrix	Prioritization rate
	Contribution	Legitimacy	Willingness to engage	Influence	Involvement need	Business impact	
S1							1
S2							2
							3
							4
							5
							6
							7
							8
							9
							10

Selected stakeholders (maximum number)

Excluded stakeholders

ANNEX 5 - ABAPOR'S OPERATIONS MAPPING.



ANNEX 6 - SONAE/ABAPOR INTEGRATED MAPPING.