Costing Model applied to Contract Logistics Activities

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To my parents and sister

Resumo

O setor das atividades logísticas, tal como toda a economia nacional, tem vindo a sofrer uma alteração constante nos últimos anos, forçando as empresas do setor a adaptarem-se à mudança. Para este fim, as empresas estão recorrentemente a adotar medidas de gestão empresarial cada vez mais atualizadas para alcançar a eficiência e competitividade necessárias à sua permanência no mercado.

Este trabalho de investigação visa propor um modelo de Custeio Baseado em Atividades (ABC), também apoiado pelo modelo de Custeio Baseado em Atividades Induzido pelo Tempo (TDABC) para a Rangel, uma empresa que procura dar respostas dedicadas aos clientes no âmbito das várias atividades logísticas que realiza. A criação do modelo foi apoiada por uma revisão bibliográfica tanto nas áreas de logística como de contabilidade, a fim de satisfazer as necessidades da empresa.

Na primeira fase do estudo, foram analisadas as atividades desenvolvidas na operação logística contratual da Rangel desde os processos de entrada até aos processos de saída que ocorrem nos armazéns da empresa, o que envolveu visitas aos armazéns, recolha de uma elevada quantidade de dados relativos a custos, utilização dos sistemas de informação presentes na empresa, e comunicação com funcionários de várias áreas.

Posteriormente, todas as equações, grelhas e matrizes foram formuladas utilizando os métodos estudados para obter o resultado final deste estudo de caso, o modelo de cálculo de custos.

A informação gerada pelo modelo de custeio permite uma melhor visibilidade da rentabilidade dos vários projetos desenvolvidos, comparações entre eles e promove a melhoria contínua dos processos através da compreensão das atividades desenvolvidas e da dinâmica dos custos.

Palavras-chave: modelo de custeio, custeio baseado em atividades, custeio baseado em atividades induzido pelo tempo, logística, logística contratual, Rangel.

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Abstract

The sector of logistics activities, like the entire national economy, has been undergoing constant metamorphosis in recent years, forcing companies in the sector to adapt to change. To this end, companies are constantly adopting increasingly up-to-date business management measures to achieve the efficiency and competitiveness necessary for their permanence in the market.

This research work aims to propose an activity-based costing (ABC) model and is also supported by Time-Driven Activity-Based Costing (TDABC) in a company that seeks to provide dedicated responses to customers within the various logistics activities it performs. The creation of the model was supported by a literature review in both the logistics and accounting areas in order to meet the needs of the company.

In the first phase of the study, the activities developed in the logistics operation were analyzed in the inbound and outbound processes that take place in the company's warehouses, which involved visiting the warehouses, collecting a large amount of data concerning costs, using the information systems present in the company, and communicating with employees from various areas.

Afterwards, all the equations, grids, and matrices were formulated using the methods studied to get the final output of this case study, the costing model.

The information generated by the costing model allows a better visibility of the profitability of the various projects developed, comparisons between them and promotes the continuous improvement of processes through the understanding of the activities developed and the dynamics of costs.

Key-Words: Costing Model, Activity Based Costing, Time-Driven Activity Based Costing, Logistics, Contract Logistics, Rangel.

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Acronyms

ABC – Activity based costing
FSE – External Supplies and Services
FTE – Full Time Equivalent
TDABC – Time-Driven Activity based costing
CAPEX – Capital Expenditure
OPEX – Operational Expenditure
PBL – Picking by Line
PBS – Picking by Store
WAN – Wide Area Network
RF – Radio-Frequency
WMS – Warehouse Management System
TMS – Transportation Management System
ERP – Enterprise Resource Planning
FTE – Full Time Equivalent

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1. Introduction

The main challenge for companies during their growth has been to know how to control and reduce their costs.

Given that logistics management is a flow-oriented concept with the objective of integrating resources throughout the supply chain, it is essential that there is a way to evaluate the costs and performance of this flow.

In this way, new tools and new methods have been developed to be able to respond to the new market demands. One of these techniques was Activity Based Costing (ABC), pointed out as one of the main tools for a cost management information system.

The project presented below was developed as part of the Dissertation Project in the 2nd semester of the 5th year of the Mechanical Engineering course at FEUP in the specialization of Production Management, it took part in the company Rangel Logistics Solutions. The objective was to develop a model that would allow to know all the costs of the logistics operations of the company, more properly, associate the costs with each different activities developed.

In this chapter the developed dissertation project is introduced, being firstly presented the company where the project was carried out, followed by the main reasons that led to the realization of the same, the structure of this report is presented in order to facilitate its reading, and finally the research methodology used and the structure of this dissertation will be addressed.

1.1. Company Outline – Rangel Logistics Solutions

Rangel, a company that has been in the logistics industry for 42 years and has quickly established a position in the market, is now recognized as a global logistics partner capable of integrating a wide range of transport and logistics services, offering the market a One Stop Shop solution, and is currently ranked among the top companies in Portugal in this sector. It began as a corporation specializing in customs activity. It swiftly established an international distribution and logistics network, and in 1998 it was named the Global Logistics Operator of Expo 98.

With the growth of the business, it was able to attain global coverage, always supported by a network of global partners. The company now transports goods between over 220 countries and territories by land, sea and air. In addition to Portugal, they are directly present in Angola, Mozambique, Cape Verde, Brazil, South Africa, Mexico and Zambia. In Figure 1 it is shown all the services provided by Rangel.

Currently Rangel offers a variety of services: Customs Services, Contract Logistics, eCommerce, Feirexpo, Transport, Project Cargo, Special Logistics and Customer Portal.

Figure 1- Rangel Services

Rangel has grown sustainably over the last 42 years as a result of its capacity to adapt and respond to the challenges and strategic decisions faced by its varied customers. It is a company that creates customized solutions to each industry, optimizing the complete logistical cycle. It underwent a massive expansion and, as a result, a significant change in terms of its business area, and this expansion continues today as the company continues to grow. The project developed in response to a challenge presented by the company's continuous growth, as it is critical to develop and develop resources and tools to support this expansion.

1.1.1. Mission

Rangel has as mission: “We aspire to be a strong partner of the companies, helping them to obtain sustainable competitive advantages, through logistics solutions able to position their products in the market quickly, efficiently, and safely”. (Rangel 2017)

1.1.2. Vision

The Vision of Rangel is “The ability to offer an integrated and global logistics solution is our main asset. More than 37 years of experience, innovating systems and a team of passionate professionals, allow us to create value, innovation, a unique offer and contributing for our client’s success. Be an integral part of our customers' business, understanding the industry where they operate, offering the best logistics solutions that suit the needs of each vertical market (or industry). Develop mutually rewarding relationships with employees, partners, suppliers and customers.” (Rangel 2017)

1.2. Statement of the Problem

The project is part of Rangel's Logistics and Contract Storage unit, which focuses on the in-house logistics process and offers the customer a variety of services and integrated supply chain solutions.

As mentioned before, Rangel is in constant growth and responds to the demands of a wide and varied range of clients, each one with its own specificities. In order to make all projects as uniform as possible in terms of costs and tariffs, we proposed the development of a global commercial model that would take into account all costs, respective generators and cost units that would allow the calculation of a tariff that would be calculated according to the same criteria for each client, and of course a competitive tariff for the market.

The company did not have a model that was used for all customers at the start of the project, instead, a model was established for each customer, which meant that different methodologies were used to determine the rates based on specificities, which might lead to huge differences between projects.

It was necessary to acquire knowledge of the many sorts of operations and projects that Rangel develops in its Contract Logistics domain to realize this model.

It was critical to observe and analyze the actions of the “Guardeiras” warehouse that is a Rangel warehouse for data collecting. It is a multi-client warehouse, and the logistics approach for each customer can differ, particularly in the case of an e-Commerce client who, as one might think, has costs that are quite different from the other clients.

A dashboard was created in conjunction with the model to track and compare the various projects. The project objectives, as well as the model's primary functions, are listed below:

- Cost classification - Research and analysis of various logistics project processes to identify cost sources and cost units;
- Development of a costing model for analyzing the profitability of logistics operations;
- Development of a dashboard for comparing various projects.

Because the project was developed in the logistics sector, understanding this area was essential for a proper understanding of the company's operations. This understanding enabled for a more thorough description of the process's operations, allowing for a more thorough investigation of the situation at hand. Following an understanding of the company's logistics process, the development of the costing model itself necessitated extensive accounting knowledge. The methods used to develop the project are detailed in the following section.

1.3. Methodology

A work technique was used to complete this project, which is depicted in Figure 1 as a diagram. The first stage was to thoroughly characterize the company's problem, which led to the request for the current project. Following this task, field work was conducted to gather information on the company's logistics activity, and data relating to the logistics operation's costs was assessed using data already on hand. Observation and conversations with employees were the mainstays of this strategy.

With more detailed information, it was possible to define an action plan, which served as the project's guiding light. This approach, shown in Figure 2, was based on the resources available, followed by the initial development of the model and subsequent refinements. Finally, after a massive amount of data collection and analysis, the strategy was put into action. Even though no evidence of data treatment was provided throughout the project, as this was not the goal, it is crucial to remember that a significant amount of time was spent gathering, processing, compiling, and putting data into the format required by the model. Finally, the developed model was evaluated at the end with the help of the operations manager, Eng. Artur Sousa.

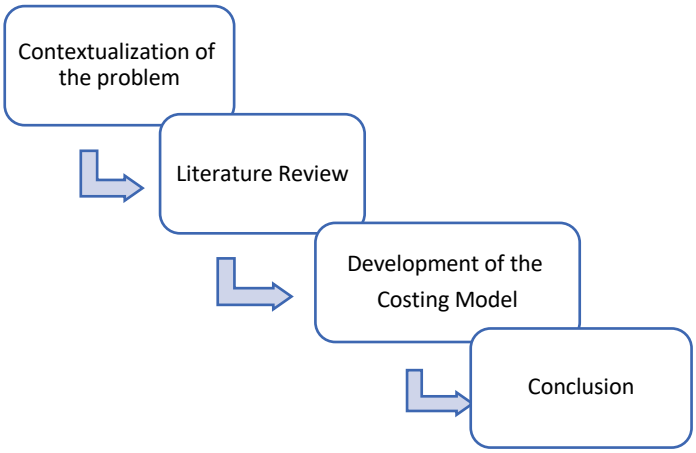


Figure 2 - Methodology used

1.4. Outline

Following the presentation of the project, the next section will provide a brief theoretical framework that allowed for the collection of information for the project's development.

In section 3, the problem to be handled with the project in question will be explored further, with the company's processes and costs being discussed. After acquiring a better understanding of the problem, the approach employed in the project's creation is outlined in section 4, and the costing model is provided. In section 5 the results of the implementation of the model will be analyzed. Finally, in the last chapter, some conclusions and prospective future research are presented.

2. Literature Review

This study's chapter focuses on a review of key conceptual concerns, a review of theoretical literature, an empirical review, and conceptual frameworks connected to the topic. This chapter also addresses logistics management subjects and builds on logistics management activities and organizational performance by focusing on prior research in this area and reviewing relevant literature.

2.1. Logistics

Logistics emerged thousands of years ago in the first forms of organized commerce, although it only appeared in the 20th century as an individualized area of study, contributing to the development of business strategies and the creation of temporal and spatial utility. (Lambert & Stock, 1999).

The concept of logistics has been evolving over time and no single definition has been attributed to it. Merriam-Webster defines logistics as "the handling of the details of an operation" and according to Christopher (1999), it consists of a strategic management process given that it enables the creation of value, differentiation and consequently, competitive advantage. For the same author, the field of logistics encompasses the planning, movement and storage of raw materials, components, and finished products, as well as the transfer of the respective flows of information, throughout the organization and its distribution channels. As an operation of companies that provides so much value to customers and ultimately to the company, logistics is an often-overlooked aspect in the business world.

For Mangan, Lalwani and Butcher (2008, p.9) logistics involves getting the right product in the right form, in the right quantity and quality, in the right place and time to the right customer at the right cost. According to the Council of Supply Chain Management Professionals, Logistics Management is defined as "the part of the supply chain that is responsible for planning, implementing, and controlling the efficient, and effective, forward and reverse flow and operations of storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customer requirements/needs. According to Porter (1985, pp.60-78), in the Value Chain, logistics appears as the management of supply (inbound logistics) and as the management of distribution to the customer (outbound logistics), both considered as primary activities in the generation of entrepreneurial value.

The environment in which businesses operate is always changing; examples include customer service, which has undergone significant changes; worldwide performance; and organizational integration to attain the ultimate aim of customer satisfaction. However, one of the most noticeable developments is the way time has become a significant topic in management. Customers and distributors expect just-in-time deliveries these days, and end users are more likely to accept a substitute if their initial option is not available right away.

Previously, a company's capabilities were limited to competing with the actual product and the functioning of that product.

2.1.1. Contractual Logistics

All companies are seeking a path to a differentiating and unique operational model that will provide them with competitive advantages in the markets where they operate. However, this change requires the various participants, namely the logistics operators, to be flexible, agile and precise.

The Logistics and Contract Warehousing unit integrates a diversified experience that allows the implementation of a wide range of services and integrated solutions for the Supply Chain. It can be considered that solutions for e-Commerce, Production, Warehousing, Pharmaceutical and Health Care, Marketing Materials, Savings, Wine and Consumer Electronics, have nothing much in common, however, in the Contract Logistics area, we develop solutions adapted to each activity sector, optimizing the logistic processes of our clients.

It is important to keep abreast of new technological trends and the ability to continuously improve processes in an integrated and sequential manner, in order to improve the experience and value generated by operational processes.

2.1.2. Logistics Management

Logistics is increasingly a sustainability tool for organizations. With the increase in competitiveness experienced in recent years, a correct logistics management becomes essential to achieve competitive advantages in relation to competitors. For this reason, organizations have been forced to improve internal processes to better satisfy customer needs as well as the growing number of competitors" (Monczka et al; 2011, p.11).

According to the logistics definition given by the Council of Supply Chain Management Professionals, Logistics Management in the logistic management activity it is involved all levels of planning and execution (strategic, tactical and operational planning). It is an integrator and coordinator, seeking to improve logistics activities and integrate logistics with the other functions of the company, including marketing, sales, production, the financial area and information technologies" (CSCMP, 2010).

Logistics management has human, natural, financial, and informational resources as "inputs", being responsible for managing the respective flows (physical and information flows) throughout the supply chain, from the planning stage, through implementation and ending with control. Excess, defective, broken, outdated, obsolete, delivered in error materials go through the reverse cycle (reverse flow).

In the end, logistics management has as "outputs" the acquisition of competitive advantages, that is, the acquisition of logistical attributes for the products (use of time and utility of place) that increase their value, and an efficient product, thus offering a high level of customer service.

Logistics Management Dimensions

In logistics management the goal is to obtain the best possible combination of response time, cost and service level, resulting in the following three variables:

- The agility variable (agility) - is based on a good combination between time and cost, the logistical system to react quickly and efficiently when an external stimulus arises external stimulus;
- The leanness variable (leanness) - consists of a good combination between cost and quality of service, allowing to provide a high level of customer service associated with an efficient system efficient system;
- The responsiveness variable - resides in a good combination between cost and quality of service, allowing the logistical system to be able to react quickly and with a high and with a high level of service to the customer.

Every project needs to have these three variables very present to get the result wanted.

2.1.3. Logistics Activities

Logistics activities includes material planning, purchasing goods or supplying raw materials, internal transportation, warehouse (storage) and physical distribution. Material requirement planning is also known as a micro level of managing inventory (Weele, 2002).

Because logistics extends far beyond physical distribution, there are multiple roles and activities of logistics. There's a bit of a controversy on how many activities of logistics there are, depending on whether you're grouping similar logistics activities or not.

For the purposes of this study, we'll be talking about 6 activities of logistics that reflect its role in the supply chain.

All logistics operations, regardless of the size of the organization they serve, fulfill certain roles that support the movement of goods or services.

The activities of logistics below come in chronological order rather than in order of importance to logistics management. Therefore, transportation and the actual movement of goods come last on the list.

Order Processing

The logistics activities begin with order processing, which may be handled by a company's commercial department. The sales department is responsible for ensuring that payment and delivery terms are met before processing the order within the company.

Essentially, the sales department approves the customer's order and sends it to the warehouse. If the consumer has made the payment, a sales department enters the data into the system and informs the customer about the order.

In many companies, the commercial team also deducts the warehouse inventory. So, if the commercial team approves a purchase order for 100, the available inventory will be decreased by 100 to avoid double ordering. This is a crucial stage in logistics because any mistakes there (inaccurate quantity, delivery address, etc.) can interrupt the normal logistics process.

Material Handling

The movement of goods within a warehouse is defined as material handling. It involves handling the goods in a manner that allows the warehouse to fulfill orders quickly. Although it may seem to be a complicated task, it is an essential one that occurs on a daily basis in any warehouse.

Material handling can also be defined as the movement, protection, storage, and control of materials and products throughout the manufacturing, distribution, consumption, and disposal processes. Every time an item is moved, it's expensive, takes time, and raises the risk of damage, so an efficient warehouse reduces movement and only transfers what's absolutely necessary. A reasonable set of material handling objectives can include: only transferring material if strictly necessary, adopting proper machinery to reduce time length, greater storage density by reducing waste space, increasing material flow, and proper equipment selection and maintenance (Waters, 2009)

Warehousing

Warehouse is all the space that is intended for the waiting of materials until their use, the space for storing products from their entry to their shipment. "The storage itself does not add value to the product but contributes to the entire logistics system can fulfill the value proposition, and a logistics system without storage would only be possible if there was a perfect synchronization between production and consumption (Carvalho, 2010)".

Also, according to the same author "Warehouse management has as its main objective the rationalization of stock levels and consequently its decrease, promoting in this way the reduction of the number of days of stock contributing to the drastic reduction of the time origin-destination, in parallel one should promote a greater rotation of materials/products (Carvalho, 2002)".

Inventory management and order fulfilment are examples of warehousing, often known as warehouse management. It also includes managing warehouse infrastructure and operations, such as in a fulfilment center where orders are received, processed, and delivered (shipped to the customer). To manage the flow of goods, warehouse them, and track inventory, several companies use warehouse management system (WMS) software. TMS and WMS modules, as well as more specialized components for inventory management as well as other logistics operations, are accessible mostly from ERP software providers.

Inventory Management

Inventory management has become one of the most significant roles of logistics, particularly with the introduction of various production strategies such as Just-in-Time manufacturing, lean manufacturing, and other manufacturing procedures that have reduced the cost of inventory management.

Inventory management is one of the logistics functions that is frequently grouped in with inventory/warehousing.

Stocking finished goods in a storage facility is referred to as inventory. Inventory control involves information for maintaining inventory records, ensuring safety, forecasting demand for goods, and, of course, reordering stock in order to support the transportation and delivery processes.

Inventory logistics straddles the line between inbound and outbound logistics, requiring both supplier relationship management (inbound logistics) and customer order (outbound logistics). As a result, inventory management is an essential component of supply chain management and must be utilized effectively.

Both inventory and warehousing require sophisticated tools that support the main functions and help reduce costs via automation. Especially if your company delivers from multiple warehouses and needs complex logistical solutions

Packaging

Packaging encompasses all activities and procedures undertaken to prepare items for handling and transportation to and from clients, particularly in the event of reverse logistics and returns. One important logistic role is packaging, which impacts delivery success.

First and foremost, packaging must adhere to all safety and customs rules that may cause your delivery service to be halted. Furthermore, packaging must fulfil your storage and transportation requirements, as well as the demand for sustainable materials and other green logistics considerations.

Transportation

Finally, there is transportation. Transportation is, without a doubt, one of the most important logistical functions, if not the most important. It is necessary at every step of the supply chain, and the success of supply chain management is determined by how organizations design their transportation management systems and operations.

Transportation management is concerned with the planning, optimization, and execution of the movement of commodities between warehouses, retail locations, and customers using vehicles. Ocean, aviation, train, and road transit are all possible modes of transportation.

Transportation management is a complicated process that includes route planning and optimization, order management, freight auditing, and payment, among other things. Yard management, for example, is a process that oversees vehicle circulation through yards outside of manufacturing plants, warehouses, and distribution centers. Because transportation carriers' prices, availability, and capacity can vary greatly, carrier management is critical.

2.1.4. Logistics Costs

For Viana (2008, p. 45) “logistics is part of an integrated system that aims, in addition to transporting people and goods, to reduce costs to increase competitiveness, since logistics is an integrated operation that includes the distribution of products in a rational way, which means planning, coordinating and executing the entire process, aiming to reduce costs and increase the company's competitiveness.”

Managing the cost drivers or achieving an advantage in efficiently controlling the primary costs of the firm's value operations, according to Porter (1985, p.99), is a key technique to gain a cost advantage. Knowing how much money goes to specific (main) activity and how much of their total costs are covered.

Storage and inventory cost is the cost of logistics inventory is determined by the number of products handled by the company and the length of time the material is kept in the warehouse. As a result, the higher the logistical costs, the longer the time and number of items are.

It's also worth noting that inventory costs are broken down into three categories: product costs, product shortage costs, and maintenance costs. The first is concerned with the providers' investment in each material obtained, while the second is concerned with the shortage of products in stock and the potential consequences. Finally, the third category includes labor, taxes, physical space rental, inventory, and paused inventory spending. Working on good inventory control is also critical for the organization to develop a supply-demand balance.

Inventory carrying costs are the variable costs of maintaining inventory in a warehouse. They include the costs of holding goods in inventory (capital costs, labor, warehousing, depreciation, insurance, taxation, and obsolescence) as well as the physical handling of goods, including tasks such as packaging and labeling. Inventory carrying costs vary according to the volume handled and are commonly expressed as a share of the inventory value.

Warehousing costs are the fixed costs of owning or leasing warehousing space, including maintenance and utilities. They vary according to the number and the size of facilities and are irrespective of the amount of inventory being handled.

Packaging Costs are fundamental to make a good impression on the customer who receives your product, the packaging acts on the correct packaging of the items. Thus, it is possible to redouble safety and avoid risks of accidents and defects in goods. With this factor, it is also feasible to save and optimize the use of space. This is because proper packaging can be a great differentiator and generate savings in costs and storage space.

Administrative costs include managerial overheads such as customer service, receiving and processing orders, and managing the workforce. They also include information technologies such as computer equipment and software.

Transportation costs the transportation expenses continue to be the most important factor, accounting for more than half of all logistic costs. They include the costs of operating and maintaining the various modes of transportation and terminals employed in the supply chain. They are the costs of transporting commodities from the point of manufacture to the point of distribution and consumption.

2.2. Logistic Costing Systems

In a company or in a specific company project it is necessary to quantify customer service, resource utilization, unit costs and stocks (amongst others) so that these may be relevant indicators when managing or evaluating the logistics chain (Guedes, 2000). Furthermore, it is of utmost importance to quantify the total costs inherent in a given organization so that decisions can be made or changes can be made in it. To this end, there are different costing models that can be used by companies, such as traditional costing and ABC costing.

For a costing system to be suitable for logistics costing it must allow the following aspects (Arantes, 2004):

- Reflect the flow of materials and services, that is, it should identify the costs resulting from making products or services available to the customer;
- Analyze the costs and revenues according to the type of customer and the operation.

Therefore, the work concerning logistics costs is carried out in two main stages. In the first stage the companies' logistics operations are analyzed and their logistics costs are calculated. In the second stage the customer order structure is analyzed in order to get an idea of cost behavior and to find a basis for the costing model, performing the necessary calculations to obtain a competitive rate.

Another important aspect in logistics costing is the concept of mission, which can be defined as a set of objectives concerning customer service, which the logistics system must associate with a specific market segment (Arantes, 2004). For a logistics system to be

effective it is necessary to determine the total cost of the system so as to achieve the established objectives, that is, the desired results for the logistics system (Arantes, 2004).

Some companies still consider the logistics operation as a cost and not as an added value to their activity. In markets where the difference between offers is insignificant it is possible for a company to distinguish itself from its competitors by adding value to its products and services.

There are at least three ways of attributing value to the production of goods and services, that is, how to cost these products and services: absorption costing (leone, 1997; garrison; noreen, 2001), variable costing (martins, 2003; crepaldi, 1999) and the ABC method (martins, 2003; kaplan; cooper, 2000), also known as activity-based costing. The first two methods are the ones that are traditionally adopted by companies in general; they are the traditional costing forms, which have shown to be inappropriate for companies that operate in unstable markets or that supply innovative and quite diversified products, in which resource costs are relevant and difficult to determine. Companies with these characteristics need a costing system better suited to their needs, and in this sense, the ABC method is an excellent option.

2.2.1. Traditional Costing System

Traditional Costing System is related to Functional/departmental costing. This type of costing is essentially divided into two major cost categories: direct costs and indirect costs.For Parkin (2005) within the production process of companies that engage in industrial and service activities, there are different classifications for each type of cost. This classification is made according to the nature of the cost, its relationship with the production process, or even related to the quantity produced, among others. Depending on these factors, the following definitions can be distinguished:

Fixed Costs: these costs are not related to the volume of production or service, that is, regardless of the volume produced the fixed costs do not vary. For example, the rent of a warehouse will be the same if it produces 10 or 1,000 units.

Variable Costs: these costs are directly related to the volume of production or service, that is, the more the company produces, the greater they will be. A typical example is the case of raw materials used in production.

Direct Costs: these are distributed among the products or services in a simple and objective manner, that is, they are easy to be assigned to the respective products. Most common examples: raw material and labor applied directly to products or services.

Indirect Costs: not directly attributable to a product or service. That is, labor and materials consumed that are not directly visible in the product or service rendered, associated with transportation, reception, handling, storage, repair and maintenance of facilities, etc. (Themido & Arantes, 2004).

Traditional costing has four main functions: the valuation of inventories (assets) and goods sold (income) for financial reporting purposes; the cost estimation of products, services, activities, and customers in order to justify those costs in the organization's budget; to provide managers with the necessary information about the efficiency of processes; and also to support the decision-making process in the organization.

On the other hand, Themido and Arantes (2004) state that this type of traditional accounting does not consider differentiated costs per specific product or service, although it recognizes their existence. Thus, these indirect costs end up being accumulated in cost centers and allocated to products or services according to direct labor, direct materials consumed, or production volumes. Nowadays, this method of allocating indirect costs is less correct, although for some components of these indirect costs, this allocation is still a preferable alternative (Themido & Arantes, 2004).

However, traditional costing, besides not working well, particularly in activities that are oriented to flows and processes that are transversal to the organization, as is the case of logistics management and supply chain management, also has not followed the productive and technological evolution of organizations (da Silva et al., 2015). This is because this method of allocating indirect and shared costs often distorts the true profitability of products, customers, or markets when there is a significant increase in indirect costs, an increase in fixed costs, a significant increase in the number of alternative distribution channels, a large diversification of products and services, etc.

Although, this traditional method only takes into account departmental cost control and how the organization allocates its costs for financial reporting purposes, while the ABC costing model already requires another type of reasoning and ends up supplying the need for more accurate information about the costs of products or services, contributing to improving the production process (da Silva et al., 2015). It is necessary to have a more attractive and dynamic method of information that meets the current market demands.

2.2.2. ABC Costing

The activity-based costing method, or ABC (Activity-Based Costing), emerged in the United States through two professors, Robert Kaplan and Robin Cooper, in the 1980s and quickly spread around the world as a revolutionary tool, being evaluated by some professionals as a new management philosophy.

One of the main factors that contributed to the leverage of the ABC technique was the increase in the participation of indirect costs in companies, known as overhead costs. In the 1960s, these costs did not represent 25% of total costs; in the 21st century, they already represent 50% to 70% of total costs. In the mid-1990s, ABC lost importance with the rise of the EVA (Economic Value Added) concept and the BSC (Balanced Scorecard). The current reality, however, contributes to the rebirth of the ABC costing technique. The diversity of products and distribution channels, the high overhead costs, the difficulty of developing prices due to the differentiated cost structure of the products, etc., contribute directly to the use of ABC (NEVES, 2007).

The ABC logic starts from the assumption that cost objects consume activities and that these activities consume resources. The allocation of the indirect costs to the cost objects occurs in two stages: the first emphasizes the determination of the costs of the activities by their consumption of resources; the second allocates the costs of the activities by their consumption by the cost objects (LA LONDE AND POHLEN, 1994). Therefore, the links between the costs of the objects and the activities performed are performed by the cost drivers.

The important point of the ABC costing system is that it appropriates costs to products or customers based on the resources they actually consume, thus avoiding distortions in the apportionment and in the final cost. Medeiros (1999) ratifies this information by stating that

an ABC system assesses the costs of a company's activities based on the real consumption of resources and time when performing them. He also states that one can, and ideally should, apply the ABC methodology to all major processes and activities of an organization and certainly to all elements of a supply chain.

According to Neves (2007), the basis of allocation of cost indicators used in ABC are measurements of the activities performed, such as the number of pallets received in the receiving operation. Thus, for each final product, you can evaluate what its cost was in the various stages of its production. This method is useful for establishing prices in the market and also for identifying opportunities. In fact, the main factor in the success of the ABC method is the correct definition of the cost drivers. These drivers, according to Martins (2003), can be:

(a) resource drivers (cost drivers)-determine the occurrence of an activity;

b) activity drivers-discover how products or services consume activities.

An important point to be highlighted is the need for the drivers to be able to capture the cause and effect cost relationships, because it is through them that efforts to reduce and control costs will be conducted, aiming at efficient management. The ABC method, through the system of attributing costs to activities, through the use of resource drivers, and of activity costs to products using activity drivers, as you can see in the Figure 3, seeks to reduce the harmful effects of arbitrary assessments common in traditional systems, providing more adequate cost calculations for both activities and products, and thus implementing more adequate cost management.

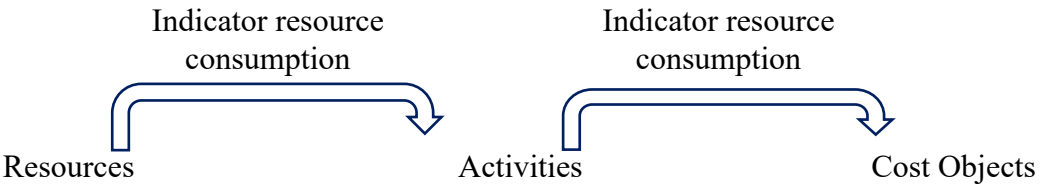


Figure 3 - ABC method.

The premise that activities cause costs allows Activity-Based Costing to adopt a process to allocate costs to cost objects in two stages (POHLEN and LA LONDE, 1994). The first stage has the purpose of determining the costs of the activities performed in the organization. The second stage allocates the costs of the activities to the products or services that consume the respective work performed. The drivers are used for the allocation of these costs. Nakagawa (2001) explains the use of the cost driver. It is used as a mechanism to characterize two situations within the Activity Based Costing method. One is to track and indicate the resources consumed by the activities, called Resource Cost Drivers, applied in the first stage of the methodology. The other way to use a cost driver is to track and indicate the activities required to manufacture a product or perform a service, called Activity Cost Drivers, applied in the second stage of the methodology.

Advantages and Limitations

The decision to adopt an ABC costing system must go through an analysis of the costs and benefits intrinsic to its implementation. In this context, the advantages of implementing

this method, as previously discussed, depend on numerous factors related to the company, such as its level of competition, production volume, and product diversity.

In view of the above, it can be verified that companies that are acting in a more competitive market give greater relevance to the need to implement a costing system that can provide more accurate and reliable information regarding product costs, so that they can make the most favorable decisions regarding the determination of sales prices as well as regarding the implementation of cost management measures. Besides the company's characteristics, it is also necessary to pay attention to the way the costing system is implemented, as well as the system's degree of sophistication.

According to Weygandt et al. (2009), we can list the following advantages and limitations of this method (Table 1):

Table 1 - ABC Advantages and Limitations

Advantages	Disadvantages
This procedure consumes unitary cost, or marginal cost as the calculation base in comparison to the conventional cost accounting techniques which employ total cost.	Data collection procedure for this system is very time consuming.
This system better helps in the procedure of understanding the concept of overhead costs i.e. the distribution of common business resources as they are utilized by particular product lines and their association to particular cost driver.	Reports from ABC don't always conform to generally accepted accounting principles and can't be used for external reporting.
The system is simple to interpret and understand is it is available, useable and specifically implement capable across all norms of business set-ups.	Data produced by ABC may conflict with managerial performance standards previously established from traditional costing methods.
This system aids in the procedure of benchmarking which is a vital part of the quality control procedure.	May not be as useful for companies where overhead is small in proportion to total operating costs.

However, the implementation of this method is most appropriate in organizations that have a high focus on support activities focus on support activities, a high level of technology, varied and varied and customized products, and high set-up costs. Thereafter, we will present some definitions of basic concepts that should be understood in order to be able to explore the ABC costing methodology.

Activities Analysis

Applying the ABC method, one begins by identifying the activities present in the process, whose realization causes the consumption of economic resources. It is important to analyze how the resources are routed to the cost objects, considering the activity, for which observation techniques, questionnaires and interviews can be used.

Activities

An activity, according to Kaplan, is "a set of actions or tasks whose purpose, in the short term, is to add value, or to enable that addition of value, to an object." A process is a set of activities that have the purpose of consuming resources and have a non-unique way of using those resources to achieve an objective.

By decomposing a large company into processes, we see that it accomplishes its objectives through activities. Each activity is divided into tasks or operations that materialize in the production of goods or the provision of services. We can, then, conclude that managing costs will be managing activities, because they are the ones that, when developed, carry costs. If we can eliminate an activity, we can eliminate the costs associated with this activity in a rational way. Each activity can be measured in units of work.

Themido, Arantes et al. (2000) also explain this concept as being a set of tasks that use resources and that have as a final result the realization of a service or the physical transition of a product between two states.

Cost-drivers

A cost-driver is defined as the "factor that causes a change in the cost of an activity" by the definition found in the "Business Dictionary" (2012) for this term. It is possible, for each activity or product, to find several cost drivers, and their choice depends on the accuracy required by the model. Themido and Arantes (2000) define a cost driver as a variable that shows the relationship between the use of resources, the execution of an activity, and the final cost of the cost object.

In short, a cost driver is a measure of the productivity of the activity to which it refers, representing its object, which allows for a reasonable allocation of the cost of these activities to the products.

Cost Centers

A cost center can be "the area, machine, or person to which direct and indirect costs are allocated." This is the definition found in the "Business Dictionary" (2012). They are groups of costs related to the same product, service, or activity.

Cost Object

Cost Object is the final good or service resulting from the execution of a set of activities (Themido, Arantes et al. 2000). It is important to mention that the quality of the Cost Object result will be directly proportional to the quality of the information used.

Resources

Resources are factors necessary to produce a good or service (Themido, Arantes et al. 2000).

There is a cause/effect relationship between activity and costs that have the purpose of consuming resources.

2.2.3. ABC and Logistics

With the changes that have occurred in the business world, the traditional costing tools have lost their space while others have been developed. Among these new methodologies, the ABC Method deserves a special mention. New concepts are currently emerging in the identification of supply chain costs, defining specific actions for the costing of these activities. Even so, despite all the efforts, there is still difficulty in identifying the expenses of the entire supply chain.

For Pohlen and Lalonde (1996), the problems of determining and evaluating the costs of a logistic chain have already been recognized since the 1930's. For the authors, since the beginning of the 1960's, a greater concern with the knowledge and analysis of costs in logistics is notorious. The increasing demand for the level of logistical service and the power of the transactions performed between the components of a chain have renewed the concern with the management of these costs.

The efforts made to increase the visibility of the costs involved in the supply chain led to the creation of tools such as Direct Product Profitability, Customer Profitability Analysis, Total Cost of Ownership, and Efficient Consumer Response. Some of these tools were only made possible after the implementation of ABC costing systems (Pohlen et al., 1996).

The ABC method is mostly applied in the production area, and the benefits derived from its use in services have been ignored (Roth and Sims 1991). An efficient implementation of the ABC model depends on the correct methodology followed when developing the model (Pirttila and Hautaniemi 1995). Depending on the intended purpose of the model, the type of cost information that should be collected will vary. If the purpose of the model is for strategic decision-making, updating cost data does not need to be done very frequently. However, if the model is developed for the purpose of activity control, it is necessary to ensure that cost data is updated quickly. This can be done by integrating the model with other accounting systems.

2.2.4. Implementing the ABC model in a logistics sector

The implementation of ABC requires a careful analysis of the company's internal control system. Without this procedure, which analyzes well-defined functions and process flow, it becomes impossible to apply ABC efficiently and effectively. ABC, because it is also a cost management system, can be implemented in greater or less detail, depending on the management information needs of the manager who is closely linked to the line of business.

The first activity to be performed will be to survey the main processes existing in the company and to identify the activities involved in these processes. Pirttila and Hautaniemi (1995) state that documenting the flow of materials in the company, following their path from input to shipment, allows the identification of the activities and resources needed to make the product available.

The definition of the cost drivers associated with the activities that will be identified by the previous method can be done using the company's existing cost information systems. After identifying the cost drivers that reflect the execution of the activities, the quantities corresponding to each one can be estimated, as well as their possible variations. In this way, companies can understand the impact of each activity on costs, which allows them to create a criterion for supplier or item selection.

Logistical activities should be carefully studied and defined, as should their relationship with the costs involved. The logistical activities mentioned above then lead to a set of costs. For example, the activity of storing products has implications for the company's storage costs, just as the activity of packaging has repercussions for the cost of keeping inventory. One can already assume that the activity of storing is usually associated with a large part of the logistics costs. The activities involved in receiving, storing, picking, checking, sorting, and shipping involve several resources and result in high costs (Varila, Seppänen et al. 2007).

The process should begin with the identification of the activities (as mentioned above), which will allow the resources involved to be recognized. Then the cost object must be defined, as well as the activities associated with it. Thus, the steps to be followed in developing the model are as follows:

1) Establish the company's flowchart and the centers where the activities that lead to the final product are developed and defined;

2) Identify the different activities: In this phase, we intend to identify and classify each of the different activities of the process. For this phase, we need the company's own information, which can be the procedures manual, employee questionnaire, process observation, evaluation of each worker's working time, and resource valuation.

3) Determine the costs incurred during the fiscal year in the various groups of activities mentioned in the first phase.In this phase, only the indirect costs are identified, since the direct costs affect the final product.

4) Constructing the ABC model, that is, identifying the cost drivers or cost generators that can be used as a measure of activity, an input, an output, or any other physical indicator.The fundamental characteristic that must be met when determining the cost drivers is that there must be a direct relationship between the measure and the final product.

5) Distribute the costs by activities. That is, once the indirect costs and the different sections are located, the company will establish criteria to classify these costs and the activities according to each cost center.

6) In this phase, the unit cost of the cost driver or cost driver is determined, as well as its unit of measurement.

7) Finally, the total cost of the product will be determined, being composed of direct costs that directly affect the final product and indirect costs that are allocated according to the necessary or used activities.

According to this model, an activity is the set of tasks that are necessary to obtain a final product and that aim to increase the company's added value. While activities generate costs, tasks are an intermediate step to achieve an activity. The objective of all activities defined in the model is to generate added value to the final product, having the same three specific characteristics: they have a concrete objective which is to generate costs; they must consume a set of inputs or factors; they must be able to relate to the final product through

Cost Drivers. When a company defines its activity map it must first consider that the tasks that make up this activity are homogeneous and that, at the same time, all tasks of the same activity can be quantified using the same unit of measurement, that is, the same Cost Driver.

2.2.5. Difficulty of implementing costing methods in logistics

The success of implementing an ABC costing system depends on how well it meets the company's preferences, goals, strategies, skills, and resources.

In this regard, Drury (2013) points out that an ABC system should have greater utility for companies that have the following characteristics:

- Intensive competition;
- Overhead costs that are not variable with production volume and that represent a large percentage of total overhead costs;
- A diverse range of products that consume resources in significantly different proportions.

However, when using this system, the same author points out that the main factor for its success is the periodic review of the database, which should be reviewed once or twice a year. Similarly, cost and profitability audits should also be conducted periodically in order to conduct a strategic review of the costs and profitability of products, consumers, and sales.

McGee (2008) also argues that the success of the implementation of a costing system depends on whether its design is appropriate to the problems present in the company as well as the inherent factors. Thus, a successful implementation depends on an average of 5% on the software and 95% on the combination of the system design and the management of the difficulties at the personal, organizational, and financial levels.

In this sense, Arora (2013) points out what he considers the essential principles for the successful implementation of a costing system:

- The costing method must be appropriate to the industry it is intended for and must meet the objectives for which it was installed;
- A pre-programmed system may not be suitable for all companies, so it must be customized to meet the company's requirements;
- The cost of installing and operating the system must be justified by the results it produces; o Cost centers as well as responsibility centers must be clearly defined within the company;
- The controllable and non-controllable costs of each cost center should be presented separately;
- There should be cooperation and coordination between the cost accounting and financial accounting departments in order to avoid duplication of accounts;
- Continuous training is essential, and the system should be operated by employees who are competent in this field;

- The accounting department should prepare accurate reports, which should be sent promptly to the decision-makers, so that actions can be taken as quickly as possible;
- No resources should be wasted in collecting and compiling information that is not needed. Only useful cost information should be collected, to be used whenever necessary.

For the costing system to be successful, it must have the participation of executives from various departments.

2.2.6. From ABC model to TDABC

The ABC costing model is constantly being developed and updated, and some adaptations of the ABC model have been used recurrently, because they are more appropriate for some specific cases. The use of these adaptations, mainly in the measurement of cost drivers, has given rise to models that derive from the ABC costing model itself. One such case, which applies to the project under development, is the TDABC model.

The TDABC (Time-driven-activity-based costing) model has renewed and given a different perspective to the ABC model; this version is based on the simplification of the whole process and allows overcoming some limitations of the ABC model.

In deciding on the selection of some cost drivers, we chose to apply the TDABC model because it has the ability to overcome the shortcomings of traditional models, making costing more precise and objective through the way it allocates indirect costs to services based on time.

This methodology also allows for the determination of costs by activities, making it possible to have a better visibility on their importance along the value chain, providing relevant information that helps in the decision-making process. This methodology is more appropriate for the service sector, since most costs come from the time it takes to provide the service.

2.2.7. Methodology TDABC

The TDABC methodology was developed in the late 1990s by Robert Kaplan and Steven Anderson. However, it was only presented in 2004. This methodology is a simplified process that, according to Kaplan and Anderson (2004), is characterized by using the time spent to complete activities as input and by the fact that this model is able to take advantage of the information generated by the management models already implemented by the company.

One of the barriers to the ABC costing system is the fact that it involves analyses that are sometimes costly and time-consuming. However, TDABC can facilitate the costing process by reducing these analyses to allocate resource costs to the respective activities (Dalci, Tanis, and Kosan, 2010).

According to the previous authors and Namazi (2009), this system determines and directly allocates costs to costing objects based on time units consumed by activities, i.e., in a first stage, the cost driver of this system is time, since there are numerous resources that can be measured in terms of time. To this end, it is essential to estimate two parameters, which are the capacity cost rate of a given activity and the time spent to perform a given procedure of an activity.

For the calculation of the first estimate, it is necessary to determine the capacity costs and the practical capacity. One can deduce that capacity costs are those that are inherent to the resources used to perform a given activity, such as, for example, the costs of wages, equipment, and space used, among others. On the other hand, there is the practical capacity, which is translated by the estimate of the time that employees need to perform the activity with all the resources available in a given cost center, and this estimate refers to the amount of time strictly dedicated to performing the activity and not the amount of time available for this same activity. In turn, the second parameter (times spent to perform a certain procedure of an activity), as its name indicates, refers to the times that are actually required to perform a unit of each type of activity. It should be noted that these times should be provided by the employees assigned to each activity in order to obtain the most accurate times (Kaplan and Anderson, 2004).

According to the aforementioned authors, after defining and determining the parameters described above, it becomes possible to allocate costs to products and/or services, and the product of the calculated parameters is called cost-driver rates. The authors point out that activities can be quite distinct from one another, hence the need to estimate time equations (discussed later in this chapter).

Implementation steps of the TDABC model

To be able to implement the TDABC model, according to Antić and Georgijevski (2010) it is essential to go through the identified steps:

1. Identify the groups of resources and their activities;
2. Calculate the total cost of the resource groups;
3. Estimate the practical capacity per time unit of the resource groups;
4. Calculate the unit time cost of each resource group;
5. Determine the estimated time for each activity;
6. Calculate the cost of each activity.

The first step of this model is the same as the first two steps of the ABC model, analyze the process and identify the activities by assigning to them the resources necessary for their execution. Subsequently, it becomes necessary to calculate the total cost of the groups of resources, as well as to estimate their practical capacity. In relation to this estimate, this presents the maximum theoretical capacity that can vary depending on the nature of the resource and the estimate of managers, usually ranging between 80% and 85% Kaplan and Anderson (2004).

The same authors point out that it is usually considered 20% for downtime when these are related to people, on the other hand, the difference between practical and theoretical capacity can be set at 15% when it comes to machines, because these require for example repairs and maintenance, among others.

The TDABC also recognizes that there are resources where their capacity can be evaluated through other indicators, such as the square meter (m^2) which is used to measure the space in a warehouse (Kaplan and Anderson, 2004). Regarding the calculation of the unit time cost of each resource group, it is presented by the following equation:

$$Custo\ do\ recurso\ por\ unidade\ de\ tempo = C_{tr} / C_{dr} \quad (1)$$

Where:

- C_{tr} – Custos total do recurso;
- C_{dr} – Capacidade prática disponível pelo recurso.

Then we proceed to determine the estimated time for each activity that, according to Kaplan and Anderson (2004), although it is sometimes complicated to determine this parameter due to the complexity of some activities, the authors argue that it can be determined through direct observations. In cases of difficult observation, it becomes necessary to add additional times according to the circumstances involved. To help determine the time required to perform an activity, Everaert and Bruggeman (2007) and Kaplan and Anderson (2007), advocate using the following equation:

$$T_{j,k} = \beta_0 + \beta_i.X_i + \cdots + \beta_\rho.\ X_\rho \quad (2)$$

Where:

- $T_{j,k}$ – Tempo requerido para a realização da atividade j, com base nos eventos k;
- β_0 – Constante de tempo da atividade j, independente das características do evento k;
- β_i – Consumo de tempo por uma unidade de time driver i (i=1, …, ρ);
- X_i – Time driver i (i=1, …, ρ);
- ρ – Número de time drivers que determinam o tempo requerido para a execução da atividade j.

The last step involves calculating the cost of each activity, which as mentioned above, involves multiplying the unit cost of each resource group by the estimated time for each activity, according to the following mathematical expression (Kaplan and Anderson, 2004):

$$Custo\ da\ execução\ da\ atividade = C \times T \quad (3)$$

Where:

- C – Custo do grupo de recursos por unidade de tempo;
- T – Tempo requerido por atividade.

According to Everaert and Bruggeman (2007), one of the advantages of TDABC is that it allows the multiplication of several drivers to define the cost of a given activity, i.e., if an activity has more than one driver it is possible to include these drivers in the equation of time, and thus more accurately determine the cost and time required to perform that activity.

Time Equations

A characteristic associated with these time equations is that they are able to include the interactions that may exist between drivers (Siguenza-Guzman et al, 2013), that is, the occurrence of an activity may depend on another activity and thus the time of the activity is also influenced by this interaction. This is expressed by the following equation:

$$T_{j,k} = \beta_0 + \beta_1.X_1 + \beta_2.X_2 + \beta_3.X_3 + \ldots + \beta_p.X_p \quad (4)$$

Where:

- $T_{j,k}$ - Time required to perform activity j, based on k events;
- β_0 - Time constant of activity j, independent of the characteristics of event k;
- β_1 - Time consumption by a unit of time driver 1 (and so on);
- X_1 - Time driver 1 (and so on);
- p - Number of generators required to determine the time to execute activity j.

As shown above and also mentioned in the previous section, to estimate time it is only necessary to describe the main activity and all the interactions that may exist around it (Kaplan and Anderson, 2004). According to the same authors, to correctly determine the time equations it is necessary to consider the following aspects:

- prioritize the most time-consuming and costly processes;
- be able to accurately define the entire length of the process;
- determine for each activity the key drivers;
- use drivers for which information can be gathered internally;
- initially use only one driver, then use other drivers if necessary.

According to Everaert and Bruggeman (2007), after determining the time of each activity and calculating the unit cost of each set of resources, the activity cost is calculated using the following equation:

$$a_j = t_{j,k} \times C_i \quad (5)$$

Where:

- α_j – Cost of an individual event k of activity j performed by resource i;
- $t_{j,k}$ - The time consumed by event k of activity j;
- C_i - The cost per unit time of the set of resources i.

Time equations allow the whole process used to estimate time to be simplified and have the ability to facilitate the updating of the model, and thus express a more accurate costing system.

3. Objective, Methodology and Data Collection

This dissertation is based on a case study, since it is the most appropriate empirical research method given the intended objectives and the research questions formulated. The case study allows minimizing one of the most important criticisms in theoretical research in Management Accounting, the gap between theory and practice, which often compromises the implementation of the solutions presented. Ryan et al., (2002) and Scapens (2004) indicate six steps in conducting a case study:

1) Development of the research project;

2) Preparation for data collection;

3) Collection of evidence;

4) Evaluation of the evidence obtained;

5) Identification and explanation of patterns;

6) Writing the dissertation.

This research project followed these phases, described below, although, they were not always followed in this order, but interactively as appropriate.

3.1. Objective

This dissertation has as its main objective the development of a costing model; for that it is necessary to characterize the costs, their generators, as well as the measurement units to be able to account for them. With the increase of competition and competition in the markets, the need to differentiate products and services and make them more oriented to customer requirements has become crucial for the sustainability of many companies. In the specific case of Rangel, due to its rapid growth, it is necessary to use uniform methods to standardize processes and save time in calculating the suggested tariff to customers.

Currently, there is no model implemented in the company that allows costs to be evaluated in a global way and that can generate a tariff according to the same criteria for each distinct operation. Today, the tariff is calculated specifically for each project. By making a costing model for each operation, not only is time wasted, but there is also the risk that each operation manager will use different criteria, making projects uneven within the same company.

In addition to this, the costing models used for each operation are still based on traditional methodologies that were previously described. Therefore, to keep up with the growth of the company, it is also necessary to keep up with the development of technology, using more current costing models such as ABC or TDABC itself.

However, as Rangel presents solutions dedicated to the specificities of each client, it is a great challenge to make a model that can be adapted to all operations. That said, the main characteristic that must be taken into consideration when preparing the model is easy to identify -flexibility.

When approving a project, to calculate the tariff, even if using the same costing model, each user will have considered the peculiarities requested by the client in order to respect them. The more detailed and thorough the operation is, the higher the applied tariff will be. For this, the model needs to be easy to handle because many times the users themselves will change small details. However, the logic of calculating the costs will always be the same.

The development of the model will focus on the analysis of the activities of multi-client warehouses, that is, customers with very different operations, including e-commerce customers.

3.2. Methodology

In this chapter the main tasks to develop the model are referred. The first step in the implementation of the model is the analysis and identification of the activities. These may vary from project to project, the number of activities performed may be increased or decreased, it may be necessary to change the order of existing activities, or even within an activity to add or remove resources used. The next step is gathering all the information about the resources needed to be able to allocate them to the respective activities where they are used. Finally, the last step is to determine the cost driver coefficients and their measurement units and the percentage representation in the Resource-Activity matrix, that is, the weight of the resources in each of the activities

In the following sections, important concepts will be presented for a better understanding of the problem and its consequent resolution. First, the various activities taking place in the different warehouses will be analyzed in order to easily understand the logistics process performed in the company. Next, all the costs involved in the operation through the resources used will be presented and briefly explained. Finally, the calculation process that allows obtaining the rate that will be proposed to the customer will be explained.

3.3. Data Collection

For the data selection process of this study and in order to carry it out as accurately as possible, it became necessary to use several sources of information, namely, interviews, document analysis, and direct observation.

The identification of resources, activities, cost objects and cost drivers were carried out by cross-referencing different accounting statements associated with each of the projects, as well as based on the interviews.

3.4. Company's Processes Analysis

As shown in chapter 2, when developing the ABC costing model, two phases of the process are the identification of activities and the identification of the resources used in each activity. First, it is necessary to know the process that takes place in the warehouse from the

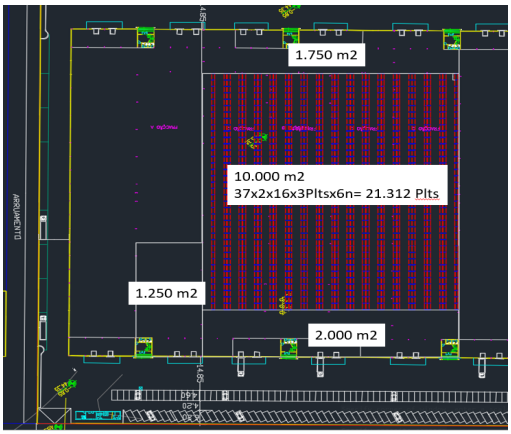
arrival of a vehicle to its departure, as well as the layout of the warehouse to know its dimensions and be able to manage the spaces according to the activities performed in the best possible way. The next chapter is an explanation and description of the above-mentioned steps.

3.4.1. Warehouse layout

The warehouse layout challenge, as defined by Koster et al. (2007), is the decision to divide distinct logistical execution operations into zones. The link and dependency between each of these zones and intrinsic operations is usually noticed. The major goal is to reduce material handling costs, which are often a linear function of the distance travelled in the warehouse. The picking zone is often sized to make this logistical activity as efficient and rigorous as possible. In many cases, high-volume storage zones and picking zones, also known as tension flow zones, are established, with high-turnover items being stored in zones closer to the Reception/Expedition bays.

It was vital to acquire a sense of all the activities that take place in the warehouse and understand what expenses each one implies to know which costs to include in the model. The best approach to achieve this was to examine and map all the logistics operations that were performed on the various customers' items. The many logistical activities done in Rangel's multi-client warehouses will be presented in this section. When processing items inside the warehouse, there are two sorts of procedures: inbound processes and outbound processes, each of which is made up of the actions listed below

It is important to understand how multi-client warehouses work in Rangel, so besides the different divisions of the warehouse as is present in Figures 4 and 5, the main process flows are going to be analyzed as well.



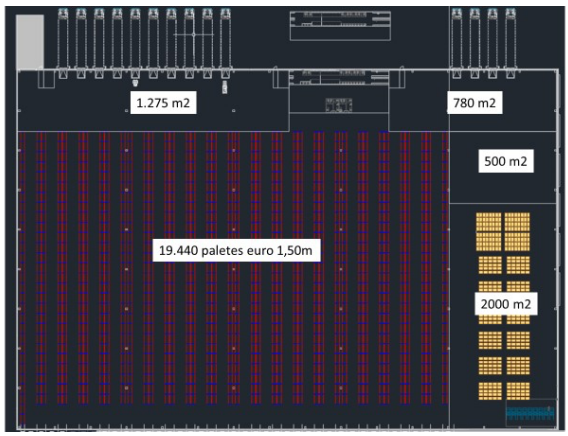


Figure 4 and 5 - Warehouse Layout

For the inducers of activities, it is very important to understand how much space is dedicated to each of them, in order to calculate the cost per m2 of each of the different warehouse divisions.

A very important aspect that should not be forgotten when calculating the costs of the facilities is the fact that only the floor area of each room is considered, that is, in height, the taller the warehouse is, the more pallets fit for the same floor area.

It is necessary to know the length and width dimensions to calculate the area of the following rooms where the activities are carried out (these areas are represented in the figures 4 and 5):

- Reception Area;
- Handling in Area;
- Handling Out;
- Storage Area;
- Picking Area;
- Expedition Area;

Although it cannot be seen in the figures, the planning areas are also part of the process; these activities are developed in offices, where the orders are entered into the system, and customer service. It is also important to mention the existence of a quality department where samples of merchandise are checked, guaranteeing the quality of the product.

3.4.2. Inbound and Outbound Processes

The two main flows of goods in the warehouse are inbound process and outbound process. In these processes, the activities described previously are executed following the order described below.

Inbound

The planning, discharge, reception and conference, purchase order entry and finally the storage activities developed by the company are referred as inbound logistics. For supply chain cost reduction, inventory optimization, and customer service, these operations are a key emphasis area. Inbound logistics is used by supply chain management to get rid of inventory in the warehouse and fulfill client orders.

Effective inbound logistics can aid in the procurement of high-quality items, the reduction of overhead costs, the avoidance of material waste, the expansion of sales, and the reduction of production time. The link between enterprises and suppliers is the foundation of inbound logistics.

- Inbound Processes: Planning; Discharge; Reception and Conference; Purchase Order Entry and Storage (Figure 6).

Figure 5 - Inbound Process.

There is a delivery timetable that provides for the systematic planning of supplier arrivals throughout the day before the actual unloading begins. Normally, the suppliers stick to this plan, with minor alterations made when things change. This schedule is necessary

because it prevents a big number of suppliers from arriving at the same time, making the discharge and reception procedure easier.

The arrival time should be considered to avoid congestion on the unloading docks and in the welcome area, facilitating not only the administration of the unloading docks, but also the job of operators, and this should be with time. The merchandise is checked against the order after it is unloaded. If no non-conformities are discovered after this, the second and third stage, more specifically the reception and conference of goods, encompass 7 steps (Ramos, 2010):

1. Schedule of arrivals;
2. Arrival of the vehicle and allocation of the same to an unloading dock;
3. Physical unloading of the goods;
4. Checking the commodity;
5. Possible palletization/repalletization of the goods;
6. Updating the computer stock.
7. Definition of the location of the goods in the storage area;

In terms of the storage step, this entails inspecting the product's location, movement, and placement in a storage position. Depending on the storage technique used, it may be necessary to create a new position for the object during the storage process. It is vital that a scan/register is performed throughout this procedure in order to maintain the information where the article was placed to know all of the spots where a particular product is placed at any given time.

This is a difficult operation because the product's storage location is sometimes far from where the reception takes place (Bartholdi and Hackman 2008). This activity typically accounts for 15% of warehouse operating expenses (Frazelle 2001). However, because the number of picking lines per storage line is frequently considerable, closeness to the shipping region is prioritized over proximity to the receiving area.

Outbound

Outbound logistics is the movement of finished goods from a warehouse or distribution center to clients.

Picking, conference, sorting, expedition, and vehicle loading are the steps of outbound logistics. It's an important part of a supplier's entire customer relationship management strategy. Outbound logistics refers to how businesses deliver their products to their final customers.

- Outbound Processes: Picking; Conference; Sorting; Expedition and Vehicle Loading (Figure 7).

Figure 6 - Outbound Process.

The outbound process starts with one of the most important activities in the flow of goods, picking. After the products have been received and stored, the next step is the picking operation. According to Aguiar (2008) this activity can be considered as one of the most crucial in the process due to its impact on the order cycle time and the costs associated with it.

Picking is a vital component in any organization's value chain. De Koster, LeDuc et al. (2007) define picking as the process of retrieving products from storage (or buffer areas) in response to a specific customer order. A picking order aims to satisfy certain needs of a customer, resulting in the first contribution to the fulfillment of the organization's service level. Due to its importance, this activity has allocated a significant component of the operational costs of a warehouse. The methods used in this activity can be divided into two groups: Picking by line (PBL) and Picking by Store (PBS).

The expedition process in a warehouse is the interface for the outflow of material Orders are packed to ensure that they do not arrive damaged at the customer. Packaging can be carried out in boxes, pallets, padded envelopes, among others. After that, a labeling task can be performed and the transport documents are prepared (printing of the waybills, delivery note and invoice).

Finally, orders are organized by destination route and loaded onto the respective transports. To improve the visualization of what happens in the warehouse, the activities were mapped, relating them to the places where they take place. This mapping can be seen in Figure 8.

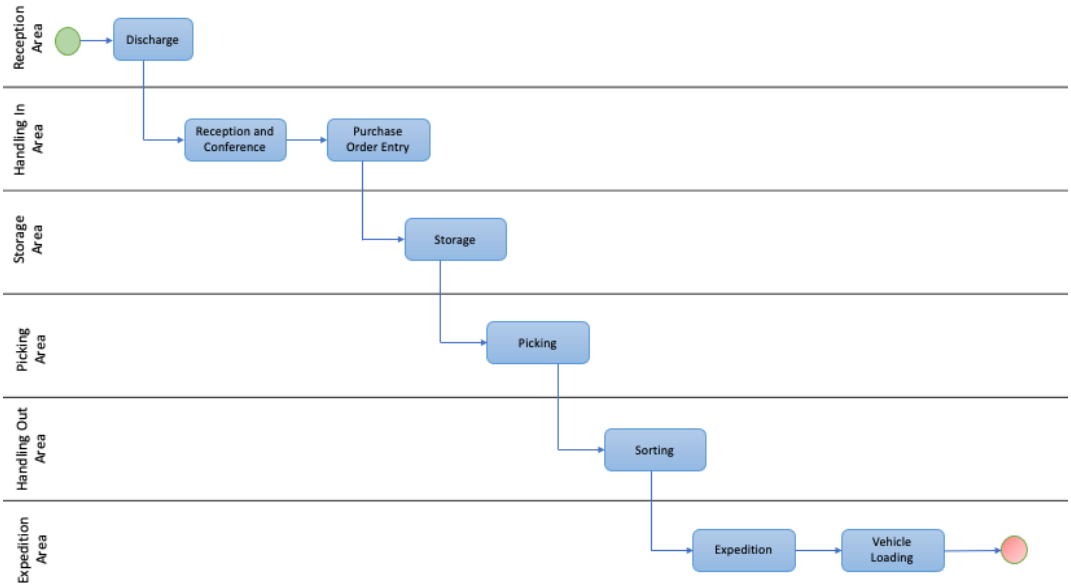


Figure 7 - Mapping of activities in the warehouse

Therefore, after identifying the activities that take place in the warehouse, as well as the space allocated to it, it is necessary to assign the resources used to determine the cost drivers and their respective units of measurement.

3.4.3. Reverse Logistics

Despite not being the object of study for the costing model, it is important to mention the Reverse Logistics process, that is, in the case of returns in which the process occurs in the opposite order to that studied. The activities identified for this process Communication between Rangel and Client, Planning, Check-In, Unloading, Check-Out, Reception, Identification and Segregation, Return Processing and Final Destination.

3.4.4. Costs involved in logistics operations

In sections 2.3 and 2.4 some of the costs that are present in logistical activities were already named. In the specific case of Rangel it is possible to identify a large number of cost sources which are associated with the activities practiced in the company. In the following sections, the main costs involved in the entire logistics operation of the company will be presented. These will be divided into large groups, some of which are composed of several items.

To identify the costs presented below, the company's processes were studied in detail. To begin, we will detail the costs involved in the entire process from the arrival of goods to their shipment, as well as the investment costs necessary to start the operation of the warehouse. As it is easy to understand, obtaining a cost advantage requires a rigorous analysis of each activity of the company in search of maximum efficiency with respect to the associated cost, without quality or differentiation capacity being negatively affected.

3.4.5. Activity Costs

To build the model the different groups were divided into two large groups: the profit centers and the cost centers. As the model evaluates inhouse operations, two large profit centers were considered: handling and storage. So, when considering investment costs, in addition to assigning them a cost center and a profit center, it is also important to identify the corresponding typology: CAPEX OR OPEX.

While CAPEX or Capital Expenditure means capital expenditures and refers to expenditures for the acquisition of goods, and therefore relates to investment in the companies' machinery, equipment and facilities. OPEX or Operational Expenditure means operational expenses, and is related to operational costs: maintenance, employee salaries, hiring services, consumption expenses, etc. In this chapter were considered the main cost centers of this company:

Warehouse Costs

The warehouse expenses, derive from depreciation of buildings, equipment, the pallets themselves, installation of systems, protection of the quay, construction work, signaling, and audits. In short, everything that is necessary for the projects to run (Table 2).

Table 2 - Warehouse Costs

Warehouse
Conventional Shelving
Picking Racks Euro-Pallets Euro (0.8x1.2x1.2)
Picking Racks Euro-Pallets Euro (0.8x1.8x1.2)
Picking Racks Euro-Pallets EUA (1.0x1.8x1.2)
Picking Racks Dynamics (50x30x40) / LxAxP
Picking Shelves (50x30x40) / LxAxP
Pallets for Storage
Audits and Certification of Ships - ANPC + Self Protection Measures

Warehouse
Signaling and protection of the warehouse + Emergency Plants
Installation of CCTV Systems + Intrusion + Access Control
Implementation of the Communications Model and Network Infrastructure - Assets and Cabling
Wharf protection
Changes/works
Automatic sorters/sorting systems
Other Automatisms
Multi-order System

Office Costs

The investments to be considered for costing are mainly computers (Table 3), telephones and workstations used for order management, customer service, receipt and shipment of goods and their follow-up.

Table 3 - Office Costs

Portátil + Software
Operations Computer
DAF Computers
RF Terminals
Lexmark printer
Operation workstations (table + chair + drawer module)
Phones
Office Reception
Offices-Cabinets
Offices-Workplaces Admin
Offices-Operation Workstations

Human Resources

The implementation of activities in the warehouse is guaranteed by the professionals who are in charge of them. For this, depending on their function and task performed, the respective cost is associated (Table 4).

Table 4 - Human Resources Costs

Job Role
Operations director
Operations Manager
Supervisor Continuos Improvement
Operations Supervisor
Team Leader
Administative
Warehouse Operator
Undifferentiated Operator

Security

Given the scale of warehouses and the number of operators and commodities from various clients that pass through them on a regular basis, the need for movement management within the warehouse is obvious. The warehouse has a variety of security measures in place, including video surveillance and people in charge of entry and exit control. This work is delegated to a security team, resulting in manpower and material costs.

Consumables

Among the existing expenses with materials, we highlight the expenses with rolls of film, boxes and labels. Regarding rolls of film, these are used in the consolidation of pallets prepared for the stores. Labels are consumed both at reception and in shipping. Table X details the elements of this item.

Insurances

Insurances (Table 5) are taken out to protect the goods that pass through the warehouse. All expenses related to this process are detailed in the table below.

Table 5 - Insuraces Costs

Insurances
Civil Liability - Exploitation
Liability - Professional
Multi Risk Insurance

Equipment and maintenance

Equipment is the resource that accompanies the goods through all the stages of the logistics process in the warehouse. It is important to understand the function of each of them (Figure 9) and when they are used.

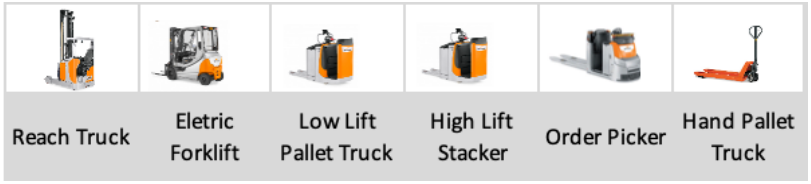


Figure 8 - Equipments used.

Several are the equipment needed for the activity in the warehouse, as presented in Table 6. From equipment such as Hand Pallet Truck to other work tools. It's very important to considerate the fact that we need to pay attention that some of the equipment are rented or need reparations every month.

Table 6 - Machines Costs.

Equipment and maintenance
Electric pallet truck + preservation
Stacker + preservation
Conventional Forklift (1.6T) + preservation
Conventional Forklift (2.6T) + preservation
Conventional Forklift (2.5T) + preservation
Conventional Forklift (3.5T) + preservation
Zorras Tractors + preservation
Retractile + preservation
Porta paletes manual + preservation
Trilateral Stacker + preservation
Order picker + preservation

External supplies and services (FSE)

There are some activities in the warehouse that are not central to the main function of the logistics operation but rather to make the product available to the consumer. The expenses generated by these activities are recorded in an account of other FSE (Table 7). Examples of such activities are warehouse rent, cleaning services, etc.

Table 7 - FSEs Costs

FSEs
Warehouse Rent - Inbound / marshalling area
Warehouse Rent - Outbound / marshalling area
Warehouse Rent - Ambient storage area
Warehouse Rent - Repacking / Copacking area
Warehouse Rent - Utilities and facilities (charging room, social area, etc.)
Warehouse Rent - Dedicated offices for Nestlé team
Cleaning
Cleaning Products
Electricity
Water
WAN access services and terminal equipment
Communications
Printer
Pest Control System
Waste Management
Facility Preservation
Office Material
Active Security (Security Guards)

Informatics

The entire activity is supported by a vast computer network. ICOL is the main software used in the warehouse and with several features, all logistics activity is based on it. The services performed are listed in the system's database, as well as customer orders and their status, from their reception in the warehouse to their expedition. It is a key tool to monitor the status of the goods. Besides the cost of maintaining this system, there are several other costs associated with the entire computer network implemented in the company, including data communication itself.

4. Costing Model Development

This chapter presents a practical study on the development and implementation of an activity and time-based costing model.

The implementation stage of the method consisted of analyzing the company, at this point the organization was investigated, getting to know the work philosophy adopted, the way the company approached the client, the facilities used, the products and services offered, and the main processes in the areas involved.

Faced with such a large and diverse set of resources and, consequently, costs involved in the logistics operation, it is perceptible the need to allocate these resources to the activities that effectively use them and to the products that use these activities. Therefore, and considering the advantages and indications from several authors, we chose to develop a costing model based on the principles of the ABC method without forgetting the support of the TDABC method, because in many cases it makes more sense to measure costs based on time.

As previously mentioned, the ABC method involves four fundamental steps to determine the costs inherent to the logistics operation and following the rationale of Mendes, (2012), the ABC method is based on the following steps:

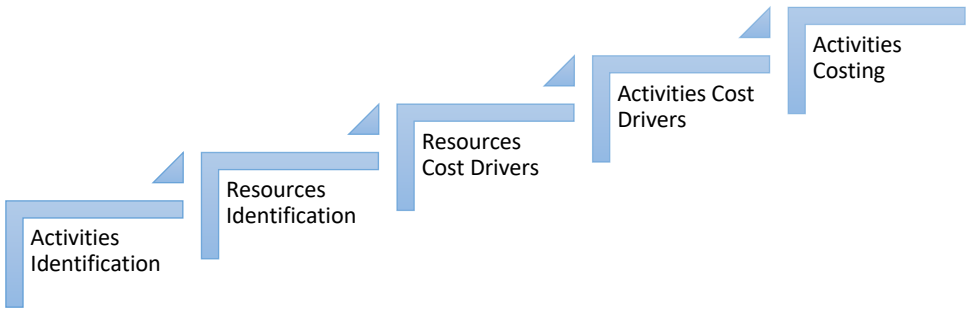


Figure 9 - Model Development.

The first step consists in identifying the activities involved in the distribution of the product. For the survey of these activities, it is necessary to resort to reliable sources such as documentary analysis, interviews or direct observation.

In the second step it is intended to identify the resources involved in the execution of the activities identified in the first step and through a process analogous to the previous one.

After the identification of activities and resources, the third stage comprises the determination of resource and activity drivers, where the costs are associated with the resources used in each activity and subsequently associate the activities to the cost objects.

Finally, the fourth step is the costing of activities, where the costs of the activities are determined.

4.1. Activities Identification

Initially the process flow was analyzed, from the activity of receiving the goods to their shipment. To define the activities to be considered in the model, it was necessary to spend a few days analyzing and visualizing the tasks performed in each of the company's warehouses, identifying the physical flow of the articles. With this analysis it was possible to define which activities would make sense to be costed considering the necessary investments in capital and labor dedicated to the project.

As mentioned in chapter 3, the analyzed activities belong to the inbound and outbound processes that take place in the company's warehouses. The processes presented below in Table 8 and 9 give an idea of the sequence of activities as they occur on a day-to-day basis, subject to change if the projects require it:

Inbound

Table 8 - Inbound Activities

Planning	- Check for planned deliveries
Discharge	- Carry out Car Check-in - Unload merchandise - Check-out Vehicle
Reception and Conference	- Checking the merchandise - Incident handling
Purchase Order Entry	- Confirm which of the PO lines were received
Storage	- Move the goods to the storage location - Read the respective code

Outbound

Table 9 - Outbound Activities.

Picking	- Reprovisioning - Order and choose which orders to produce first - Box preparation - Car preparation - Label printing - Printing of AT Guides - Picking
Conference	- Manual Conference
Sorting	- Pallets Assembly
Expedition	- Creating the order - Print Documentation - Filming Pallets
Vehicle Loading	- Load truck and print shipping documentation

The more detailed the activities are, the greater the possibility of detecting improvements and generating more accurate cost estimates, but implementation and maintenance become more expensive. Thus, the degree of detail of the activities will depend on the accuracy required by the company and how much it is willing to invest in the implementation and maintenance of the model. In this step the tasks performed within the groups of activities were then defined.

4.2. Resources Identification

The second stage of this costing model development consists of identifying and determining the resources associated with the activities, as well as the associated costs. To this end, and through interviews with people specialized in the area, we collected some information necessary for the presentation of the activities and the respective resources consumed.

Table 10 - Inbound Resources

Activity	Task	Resource
Planning	Check for planned deliveries	Supervisor Computer
Discharge	Carry out Car Check-in	Operator Computer Printer
	Unload merchandise	Operator Pallets Electric Pallet Rack (palletized load)
	Check-out Vehicle	Operator
Reception and Conference	Checking the merchandise	Operator
	Incident handling	Operator
Purchase Order Entry	Confirm which of the PO lines were received	Administrative Computer
Storage	Move the goods to the storage location	Operator Pallet truck Stacker
	Read the respective code	Operator RF Scanner

Table 11 - Outbound Resources

Activity	Task	Resource
Picking	Reprovisioning	Operator Pallet Box RF Scanner
	Order and choose which orders to produce first	Operation Manager Computer
	Box preparation and Cart Preparation	Operator Eletric Pallet Truck Boxes Labels

		Finger Cart Display
	Label printing and Printing of AT Guides	Operator Computer Printer Labels
	Picking	Operator Labels Printer RF Scanner
Conference	Manual Conference	Operator RF Scanner
Sorting	Pallets Assembly	Operator RF Scanner Pallets
Expedition	Creating the order	Operator RF Scanner
	Print Documentation	Operator Computer Printer
	Filming Pallets	Operator Pallets Film
Vehicle Loading	Load truck and print shipping documentation	Operator Computer Printer

In these tables it is possible to observe the weight of each of the resources used in the operation

Analyzing the influence of each of the items in the inbound and outbound processes it is possible to see that the most prominent are common to both processes and are the personnel and machinery. When analyzing the logistics operation, the resources found to be the most significant are congruent with the activity of the operation, because the implementation of all activity is dependent on personnel and requires a large number of working machines.

4.3. Resources Cost Drivers

After listing the resources and activities it is important to proceed to the distribution of each of them and make an estimate of the balance of resources by activities, to estimate the practical capacity by time and unit of the resource used in the activity in question. For this purpose, an excel sheet is constructed that calculates this necessary estimate for each of the processes.

In addition to the allocation of resources (Figure 11), it is also important to identify the cost drivers of each activity, i.e., the relationship between the use of resources and the execution of the activity, for example, in the table below, for planning, check-in and check-out activities the most appropriate cost driver is the document, for unloading, quantity and quality check, put-away and damaged goods handling activities the selected cost driver is the pallet and for the Quality/Inspection activity the cost driver that makes most sense to measure is the box.

Process: INBOUND							0,00	
Subprocess	Cost Driver	HR Catg.	Qty/day	Time un (sec.)	Prod./hr	hr total	FTE	hr/MHE
1 - Planeamento	DOC	ADM	0	600	6,00	0,00	0,00	
2 - Check-in Viatura	DOC	ADM	0	900	4,00	0,00	0,00	
3 - Unloading	PLT	OPM	0	67	53,73	0,00	0,00	0,00
4 - Quantity and quality check & Data Entry	PLT	OP	0	30	120,00	0,00	0,00	
5 - Qualidade/Inspeção	CX	OP	0	0	0,00	0,00	0,00	
6 - Put-away	PLT	OPM	0	114	31,70	0,00	0,00	0,00
7 - Check-out Viatura	DOC	ADM	0	900	4,00	0,00	0,00	
8 - Tratamento danificados (manipulações de incidências à descar	PLT	OPM	0,0	900	4,00	0,00	0,00	0,00

Figure 10 - FTEs Determination

After filling out the following Table 12 that contains data provided by the customers:

Ano 2021	Quantidade	Qtd/dia
Nº de Paletes Recebidas		0
Nº de Ordens de receção (PO)		0
Nº Viaturas *		0
Nº de Entregas Expedidas		0
Nº de Linhas Expedidas		0
Nº Caixas Picking		0
Nº de Unidades Picking		0
Nº Paletes Completas Expedidas		0
Nº Paletes Mistas Expedidas		0
Nº de Caixas Recusas e Devoluções		0
Nº Encomendas		0

incidências	0

Figure 11 - Customers Data.

It is possible through the amount of resources used in each activity, as well as the execution time of each activity, to calculate the FTEs of each activity, that is the indicator chosen to measure the resources cost drivers. An FTE is a full-time equivalent that is a unit to measure employed persons or other resources in a way that makes them comparable although they may work different number of hours per week.

$$FTE = (Quantity\ per\ day\ /\ production\ hours)\ /\ 7.5\ hours \quad (6)$$

The next step is then to assign and divide the human resources by shifts, as well as the machines needed by tasks, using the previously calculated FTEs (Figure 13).

	50%	0%	0%	0%	50%	FTE per MHE					
Tempo Atividade (hr)	ShiftC	Shift1	Shift2	Shift3	Shift4	Low lift pallet truck	Order Picker (double pal)	High Lift Stacker	Reach Truck	Forklift	Forklift w/ Clamp
10	0,00										
10	0,00										
10	0,00				0,00					0,00	
10	0,00				0,00						
10	0,00				0,00						
10	0,00				0,00				0,00		
10	0,00										
10	0,00				0,00	0,00					
ADM	0,00				0,00						
OP	0,00				0,00	0,00	0,00	0,00	0,00	0,00	0,00

Figure 12 - Resources Balance

To achieve this balance, it was necessary to evaluate and study the performance of the machines (Figure 14), that is, the study of the times through the distances traveled and speeds reached by each machine during its use.

		Low Lift pallet truck		Order Picker		Stacker		Stacker		Reach Truck		Forklift	
		EXH-S 20/Li-Ion		OPX 20 (double pal)		EXD-SF 20/Li-Ion		EXD-S 20/Li-Ion		FM-X 17W / Li-Ion		RX 20-18L/Li-Ion	
		c/carga	s/carga	c/carga	s/carga	c/carga	s/carga	c/carga	s/carga	c/carga	s/carga	c/carga	s/carga
Velocidade de deslocação	km/h	8	8	9	12	10	10	10	10	14	14	16	16
Velocidade de elevação	m/s	0,036	0,046	0,07	0,111	0,14	0,22	0,14	0,22	0,45	0,68	0,52	0,75
Velocidade de descida	m/s	0,09	0,089	0,084	0,067	0,49	0,2	0,49	0,2	0,55	0,52	0,52	0,5
Tempoi de aceleração(mais de 10m)	s	4,5	4	6,1	4,8	4,5	4	4,5	4	4,5	4	5,5	5,1
Distância ponto médio armazenagem	m	100											
Altura média elevação	m					1,40	1,40	1,40	1,40	4,65	4,65	4,65	4,65
Tempo de viagem até ponto médio armazenagem	s	45,9	43,6	42,9	31,2	37,6	35,7	37,6	35,7	28,2	26,6	26,2	24,9
Tempo de elevação até ponto médio nível racks	s					10,0	6,4	10,0	6,4	10,3	6,8	8,9	6,2
Tempo de descida do ponto médio nível racks	s					2,9	7,0	2,9	7,0	8,5	8,9	8,9	9,3

Figure 13 - Machines working times.

According to Article 203 of the Labor Code, the normal working period cannot exceed 8 hours of work per day and 40 hours per week (DRE, 2018). Taking this information into account, it is possible to estimate the theoretical maximum capacity of working hours for a worker integrating this business as follows:

- Number of theoretical daily working hours: 8 hours per day
- Number of theoretical working days per month: 22 days per month
- Number of theoretical working months per year: 11 months per year

Maximum theoretical work capacity per worker per month= *8 hours × 22 days = 176*

$$\text{Hours/worker} = 10\,560\ \text{min/worker} \qquad (7)$$

Through this equation, the maximum theoretical work capacity per worker is 1936 hours per year. It should be noted that for the calculation of these costs only the workers belonging to this business and study are considered.

Table 15 shows example wage rates for the costs of the workers in this business. These monthly remunerations include the sum of the monthly remuneration, allowances, vacation and Christmas bonuses and social security.

Labour	HC / FTE	Sal Base	IHT	SS	Seguros	SA	Premio	CT_Ano	Factor	CT/mês	
	Operador -	725 €	- €	172 €	15 €	105 €	50 €	14 440 €	1,66	1 203 €	Operador
	Chefe Equipa -	800 €	- €	190 €	16 €	105 €	75 €	16 032 €	1,67	1 336 €	Chefe Equipa
	Supervisor -	1 300 €	325 €	309 €	26 €	105 €	110 €	29 750 €	1,91	2 479 €	Supervisor
	Administrativo -	725 €	- €	172 €	15 €	105 €	50 €	14 440 €	1,66	1 203 €	Administrativo
	GO -	2 300 €	575 €	546 €	46 €	105 €	- €	49 605 €	1,80	4 134 €	GO

Figure 14 - Labour Costs.

After the equipment resources were identified, they were calculated. In this Thus, it took into account the cost of acquisition, maintenance, time of use and duration. (Figure 16).

MHE	Nº MHE	CF_mensal	horas_Inc	€ hextra	hextra	CV_mensal	CT/mês	
	Trilateral 3	1 530 €	1 500	€ 3,00	-	- €	1 530 €	Trilateral
	Retractil 2	608 €	1 500	€ 1,39	-	- €	608 €	Retractil
	Preparador 0	- €	1 500	€ 1,00	-	- €	- €	Preparador
	PPE 10	232 €	1 500	€ 0,99	-	- €	232 €	PPE
	Contrapeso Sim 2	402 €	1 500	€ 0,99	-	- €	402 €	Contrapeso Simples
	Contrapeso Pin 2	550 €	1 500	€ 0,99	-	- €	550 €	Contrapeso Pinças

Figure 15 - Machines Costs.

Thus, using this procedure, it is possible to derive the unit cost per card and per equipment.

4.4. Costs Centers

Next, a collection was made of the investment costs (Figure 17) that are usually made in all projects and classified according to their typology (OPEX or CAPEX), cost center (Storage, Machinery, Safety, Security, Infrastructure, Equipment, IT, Consumables, Transportation, Deliveries, FSEs, Insurance, Human Resources and Structure) and profit center (Storage or Handling). To make it easier to understand, the costs were divided into different groups of categories: Warehouse, Office, Equipment, Consumables, Machinery, Deliveries, ESFs, Insurance, Human Resources, Structure Costs and Start-up Costs.

INVESTIMENTOS

Descrição do Equipamento	€ Unit	QTD	Tipologia	Custo Anual	Centro de Custo	Centro de Lucro	ITEM
ARMAZÉM							
Estanteria Convencional			CAPEX	0	ESTANTERIA	ARMAZENAGEM	Generic storage means - Specify in the comments section
Picking Racks Euro-Paletes Euro (0.8x1.2x1.2)			CAPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section
Picking Racks Euro-Paletes Euro (0.8x1.8x1.2)			CAPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section
Picking Racks Euro-Paletes EUA (1.0x1.8x1.2)			CAPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section
Picking Racks Dinâmicos (50x30x40) / LxAxP			CAPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section
Picking Prateleiras (50x30x40) / LxAxP			CAPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section
Paletes para Armazenagem			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section
Auditorias e Certificação das Naves - ANPC + Medidas de Auto Proteção			CAPEX	0	SAFETY	ARMAZENAGEM	Other startup cost - please specify in commments
Sinalização e protecção do armazém + Plantas Emergência			CAPEX	0	SAFETY	ARMAZENAGEM	Other startup cost - please specify in commments
Instalação de Sistemas de CCTV + Intrusão + Controlo de Acessos			CAPEX	0	SECURITY	ARMAZENAGEM	OR
Implementação de Modelo de Comunicações e Infra-estruturas de Rede - Activos e Cablagens			CAPEX	0	INFRA	ARMAZENAGEM	OR
Proteção cais			CAPEX	0	EQUIPAMENTOS	ARMAZENAGEM	Other startup cost - please specify in commments
Alterações/obras			CAPEX	0	EQUIPAMENTOS	ARMAZENAGEM	OR
Sorters/sistemas de classificação automáticos			CAPEX	0	EQUIPAMENTOS	ARMAZENAGEM	Other startup cost - please specify in commments
Outros Automatismos			CAPEX	0	EQUIPAMENTOS	ARMAZENAGEM	Other startup cost - please specify in commments
Sistema Multi-order			CAPEX	0	EQUIPAMENTOS	ARMAZENAGEM	Other startup cost - please specify in commments
ESCRITÓRIO							
Portátil + Software			CAPEX	0	IT	MANIPULAÇÃO	Other startup cost - please specify in commments
Computador Operações			CAPEX	0	IT	MANIPULAÇÃO	Other startup cost - please specify in commments
Computadores DAF			CAPEX	0	IT	MANIPULAÇÃO	Other startup cost - please specify in commments
Terminais RF			CAPEX	0	IT	MANIPULAÇÃO	Other startup cost - please specify in commments
Impressora Lexmark			CAPEX	0	IT	MANIPULAÇÃO	Other startup cost - please specify in commments
Postos de trabalho operação (mesa + cadeira + módulo gaveta)			CAPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	Other startup cost - please specify in commments
Telefones			CAPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	Other startup cost - please specify in commments
Escritório Receção			CAPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	Other startup cost - please specify in commments
Offices Armários			CAPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	Other startup cost - please specify in commments

Figure 16 - Investments.

At this stage it is also necessary to consider the amortization period of the investments inserted in the CAPEX typology. For these periods we normally consider: 8 years if they are "storage means", 1 year if they are start-up costs, and 5 if they are OR.

To calculate the monthly value of each of the Capex investment costs it must divide the annual cost / amortization period/twelve to get the monthly value of each of them.

CC - CENTRO DE CUSTO

Section	Sub-section	Item	INPUTS FOLHA INVESTIMENTO
1. Building Surfaces	Marshalling area	Inbound / marshalling area	0
1. Building Surfaces	Marshalling area	Outbound / marshalling area	0
1. Building Surfaces	Storage area	Ambient storage area	0
1. Building Surfaces	Co-packing/Repacking area	Repacking / Copacking area	0
1. Building Surfaces	Additional Surfaces	Utilities and facilities (charging room, social area, etc.)	0
1. Building Surfaces	Offices	Dedicated offices for Nestlé team	0
TOTAL Building Surfaces			0
2. Equipment	Storage means (racks, bulk storage, etc.)	Generic storage means - *Specify in the comments section*	0
2. Equipment	Storage means (racks, bulk storage, etc.)	Specific storage means - *Specify in the comments section*	0
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Counter Balance Truck	0
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Order Picker	0
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Reach Truck	0
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Hand Pallet Truck	0
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify - Highlift stacker	0
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify - Eletric pallet jack	0
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify - Automatic box making machine	0
TOTAL Equipment			0
3. Labour - indicate % temp vs fix in comments section	Inbound	Unloading, control & put-away	0
3. Labour - indicate % temp vs fix in comments section	Outbound	Homogeneous pallets retrieval & Loading (homogeneous pallets	0
3. Labour - indicate % temp vs fix in comments section	Outbound	Picking, pallet wrapping & Loading (mixed pallets)	0

Figure 17 - Cost Centers.

Next, after having assigned the respective cost center to each resource, the respective cost centers are grouped by section (Figure 18): building surfaces, equipment, labor, management and other fixed cost in order to understand the total costs of each group of resources.

4.5. Activity Cost Drivers

Finally, after the cost drivers have been selected, the most correct cost indicators/generators are assigned to measure the costs of each activity, in a kind of "Price Grid". For the "building surfaces" cost center the most correct unit of measurement is the "m2" available for each activity, and to calculate this cost after obtaining the measurements in m2, the percentage occupied by them was multiplied by the monthly rent value and the monthly cost for each of the rooms was obtained.

Table 12 - Activities Areas.

	Area	*%*	*Cost*
Inbound	0	0	0!
Outbound	0	0	0
Storage	0	0	0
Repacking	0	0	0
Social areas	0	0	0
Offices	0	0	0
TOTAL	0	m2	

For this, like it is shown in Table 12, each warehouse must have defined the area available for the activities: inbound, outbound, storage, repacking, social areas, Offices, which are the areas in which the activities take place, and the areas by which the warehouse is divided.

As for the resources grouped in the equipment group, the measurement unit selected was the quantity used in each operation, thus accounting for the cost per unit and the

amortization period. Regarding the labor unit of measure, according to the percentage % of time spent on each activity and task, the respective FTEs are assigned.

For this, it is necessary to calculate the working time of each activity, i.e., the number of working hours of each operator for each of them.

Being:

$$Working\ time = 8hours * 5\ days * 52\ weeks = 2008\ h/FTE/year \quad (8)$$

That when multiplied by $12/(250*8)$ gives the cost per unit per hour.

As for the work performed by functions other than those of the operators, the working hours dedicated to each activity cannot be counted, because the administration and management positions do not perform only one activity, only the Nº of FTES is considered and, to calculate the cost per unit, the salary is multiplied by 12 months obtaining the value per unit/FTE/year. Regarding the "other fixed costs", such as energy, facility management-cleaning, security, and IT management system, we consider as units of measurement 1 yearly cost or 1 monthly cost, that is, costs that are made once a year or once a month. These are recurring amounts that recur annually or monthly and they are charged to the cost of m^2.

Productivities, which are one of the most important cost indicators in each project and allow us to arrive at the desired operation rates, evaluate the number of pallets/boxes or units moved in each of the activities per FTE/hour.

The calculation of productivity is:

$$Productivity = Quantity/(No.\ FTEs * 7.5 * 252). \quad (9)$$

Since the Productivities refer to the following tasks:

- Inbound - Unloading homogenous pallet, control & put-away
- Storage - Storage EUR Pallets - Ambient
- Outbound - Handling out of homogenous pallet - Single pallet
- Outbound - Handling out Mix pallets - Case picking, pallet wrapping & Loading
- Outbound - Handling out Mix pallets - Each picking, pallet wrapping & Loading
- Returns - Reception and segregation of returned cases

4.6. Total Budget

Finally, after calculating the throughputs, the desired rates are obtained: cost per pallet/box/unit of each activity. Applying the desired markup, which is usually between 5% and 15% in the logistics area, the total budget for the project is then obtaine.

Figure 18 - Price Grid.

Section	Sub-section	Item	Quantity	Amortization period / working time	Cost per unit	Annual cost
1. Building Surfaces	Marshalling area	Inbound / marshalling area	0 m2	NA	#DIV/0!	#DIV/0!
1. Building Surfaces	Marshalling area	Outbound / marshalling area	0 m2	NA	#DIV/0!	#DIV/0!
1. Building Surfaces	Storage area	Ambient storage area	0 m2	NA	#DIV/0!	#DIV/0!
1. Building Surfaces	Co-packing/Repacking area	Repacking / Copacking area	0 m2	NA	#DIV/0!	#DIV/0!
1. Building Surfaces	Additional Surfaces	Utilities and facilities (charging room, social area, etc.)	0 m2	NA	#DIV/0!	#DIV/0!
1. Building Surfaces	Offices	Dedicated offices	0 m2	NA	#DIV/0!	#DIV/0!
TOTAL Building Surfaces			0 m2		0,00/m2	#DIV/0!
2. Equipment	Storage means (racks, bulk storage, etc.)	Generic storage means - *Specify in the comments section*	1 investement cost	8 years	-	-
2. Equipment	Storage means (racks, bulk storage, etc.)	Specific storage means - *Specify in the comments section*	1 investement cost	8 years	-	-
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Counter Balance Truck	0 Units	1 years	0 Units	-
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Order Picker	0 Units	1 years	-	-
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Reach Truck	0 Units	1 years	-	-
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Hand Pallet Truck	0 Units	8 years	-	-
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify	0 Units	1 years	-	-
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify	0 Units	1 years	-	-
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify	0 Units	8 years	-	-
TOTAL Equipment						-
3. Labour - indicate % temp vs fix in comment	Inbound	Unloading, control & put-away	0 FTEs	1 890 h/FTE/year	0,00/h	-
3. Labour - indicate % temp vs fix in comment	Outbound	Homogeneous pallets retrieval & Loading (homogeneous pallets)	0 FTEs	1 890 h/FTE/year	0,00/h	-
3. Labour - indicate % temp vs fix in comment	Outbound	Picking, pallet wrapping & Loading (mixed pallets)	0 FTEs	1 890 h/FTE/year	0,00/h	-
3. Labour - indicate % temp vs fix in comment	Copacking / Repacking	Repacking - Co-packing	0 FTEs	1 890 h/FTE/year	0,00/h	-
3. Labour - indicate % temp vs fix in comment	Return	Return management	0 FTEs	1 890 h/FTE/year	0,00/h	-

With the construction of the Price Grid like it is observed in Figure 19, the total annual budget for a given operation is available, as well as the previously mentioned rates, which must be competitive considering the market.

4.7. Dashboard Development

For the continuation of the project studied, the perspectives that best fit are the financial and internal processes perspectives.

During the realization of this project, we found it interesting to develop a dashboard as a tool to compare some important indicators for the business among the different customers and operations of Rangel. For this, it was fundamental to be very careful in choosing the indicators that would make sense and that would allow us to evaluate such distinct operations.

It should be noted that these indicators are focused on evaluating the projects from the business point of view, as indicators could, for example, have been chosen to evaluate customer satisfaction, the environmental impact of the operations, among others.

Andra & Hollington (2006) determine that for the creation of a Dashboard, it is necessary that:

- Be defined what one wants to achieve, i.e., the desired objectives;
- Understand what is done; in other words, what products or services are performed;
- Understand the costs associated with assets and resources;
- Decide which key areas to focus on so that these are measured, i.e., defining the scope of the Dashboard;
- Identify who needs to have knowledge, as it is important that there is vertical and horizontal communication in the company;
- Define the performance criteria to be measured;
- Select the tools in order to create a methodology to facilitate the process;
- Manage the results, performing a proactive management to improve performance.

In Figure 20, a mockup is presented with the type of dashboard that best fits the activity, the selected tariffs are those that incur a higher cost across all operations, that could be proved after the model was drawnup.

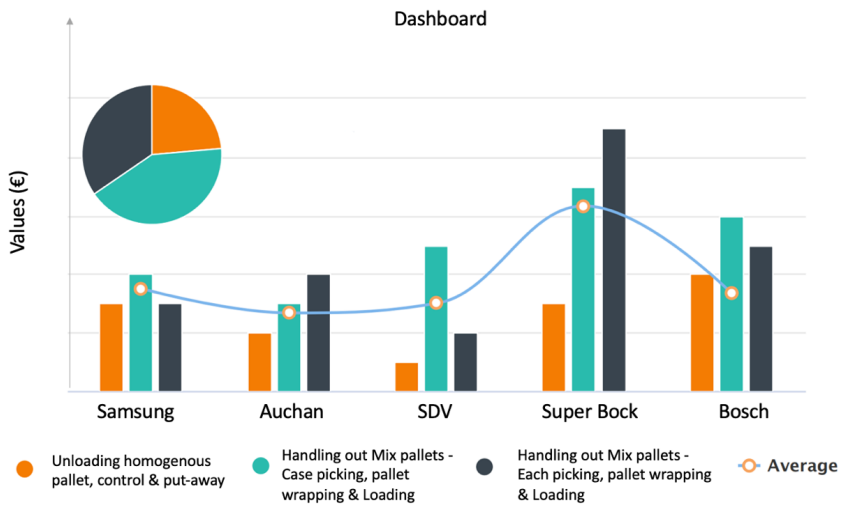


Figure 19 - Dashboard Mockup

From the wide range of clients for whom Rangel meets the needs, the following were selected: Samsung, Auchan, SDV, Super Bock, Bosch. The operations of these clients can be done at the client's home, as in the case of Super Bock, or not. It was decided to choose these clients to have a visibility of operations of different types.

It was considered that the indicators that would make the most sense to be compared, besides the ones in addition to those mentioned above by directanalysis of the model, are:

- Order processing time - measures the average time from when an order is received in the warehouse to the time when it is shipped to the customer.
- Cost of storage investment -measures the cost of m^2 of each warehouse compared.
- Predicted revenue per FTE: by considering each FTE, you can measure the revenue of the project.
- -Profit margin: it is important to measure the project not only at the operational level but also at the financial and strategic level, in Figure 21 it is exposed a mockup of how the dashboard should look like.

Figure 20 - Profit Margin Dashboard Mockup

With data for these indicators, the company will have a clearer idea of its problems, to which level they belong (strategic, operational, or tactical) and which of them deserve more attention and resources. The use of a dashboard presents itself as the best tool to facilitate consultation and monitoring of the information collected, so it would be interesting if the company could use live data to develop dashboards updated to the second and obtain dashboards like the ones presented in Figures 20 and 21.

In view of the activity costs generated through the activity-based costing model, it becomes necessary to reflect on the information generated. Thus, analysis of evidence from the case study will be carried out in chapter 5.

5. Presentation of the activity-resource matrix

Once all relationships among activities, resources, and cost objects have been obtained and each of the selected cost drivers quantified, the final step is to calculate the total cost of each activity. For this, using the resource-activity matrix and the total costs of each of the resources, multiplying the vector of resources used by activity by the vector of costs, the total cost of each activity is determined, as represented in Figure 22.

$$total\ cost\ of\ activity\ i = \sum_{i}^{n} \text{weight of resource j in activity i x cost of resource j} \qquad (10)$$

Where:

- n = number of resources

	Custo Total do Recurso	Inbound								Outbound											
		Planeamento	Check in Viatura	Unloading	Quantity and quality check & Data Entry	Qualidade /Inspeção	Put-away	Check out Viatura	Tratamento danificados	Planeamento	Submeter picking para produção	Picking unidade	Picking caixa	Picking palete	Setup Picking	Movimentação zona de embalamento	Filmagem palete; etiqueta expedição; mov.posição	Carregamento (mixed pallets)	Carregamento (homogeneous pallets)	Check-out Viatura	Reaprovisionamentos
Recursos Humanos																					
Generic storage means - *Specify in the comments section*																					
Specific storage means - *Specify in the comments section*																					
Counter Balance Truck																					
Order Picker																					
Reach Truck																					
Hand Pallet Truck																					
Other (please specify																					
Other (please specify																					
Other (please specify																					
Unloading, control & put-away																					
Homogeneous pallets retrieval & Loading (homogeneous pallets)																					
Picking, pallet wrapping & Loading (mixed pallets)																					
Repacking - Co-packing																					
Return management																					
Operations manager																					
Supervisor																					
Team leader																					
Administration																					
Pinter																					
PC																					
Quality Safety, Health and Environment manager																					
IT																					
Other - *Specify in the comments section*																					
Other - *Specify in the comments section*																					
Energy																					
facility management - cleaning, security, etc.																					
IT management system - running cost																					
IT interface																					
Other startup cost - please specify in commments																					
Custo Total da Atividade																					

Figure 21 - Activity-Resources Matrix.

With the development of the matrix, the model is finally ready to be used and to meet the proposed objectives. The following is an analysis of the results obtained with the use of the model.

5.1. Analysis of the results

With the follow-up of the objectives recommended by the application of the ABC model, it was possible to obtain an understanding of what causes the costs in the company, as well as to evaluate the services, processes, activities, resources and value generators, not having, however, extended this analysis to customers, for not being the objective of this study.

Despite some difficulty encountered in the implementation due to the large amount of information needed to obtain data, the implementation of the ABC model created indicators that allow the control, tracking, and management of processes and their involved resources. And, consequently, there was an increase of information available to the company regarding the performance of activities.

With the implementation of the developed model it was possible to fulfill the main objective of this project, which is the use of only one model that adapts to the different operations developed by Rangel, according to the client, without forgetting the specificities of each one. The use of this model makes it possible to reduce tariff calculation variations between different projects and to reduce the implementation time of each operation, because the model is ready to be used, thus excluding the time of creation and development of it according to the project.

As explained in chapter 2, the ABC costing model improves the perception of the costs that are being generated per activity, and thus, it was thought that it would be interesting to compare two projects developed by Rangel, in terms of the costs allocated to each activity in relation to their billing volume. To analyze a comparison that makes sense, two similar operations were selected. These operations concern the clients Auchan and Bosch. The three-month volumes of the operations of each of the clients were analyzed, and Figure 23 is an outline of the results of this analysis, using the model.

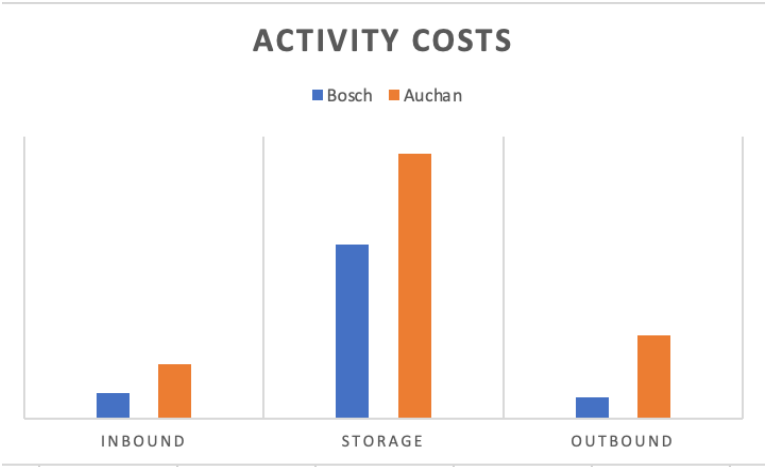


Figure 22 - Bosch and Auchan Activities.

Analyzing the total cost of each of the activities developed in the warehouses, it can be seen that the activity that represents the highest costs for the operation is storage. This result can be explained by the fact that it is the activity that presents the largest number of FTEs, that is, it consumes a larger number of resources.

In the projects developed by Rangel, the inbound can be done by pallet or by box, as well as the outbound.

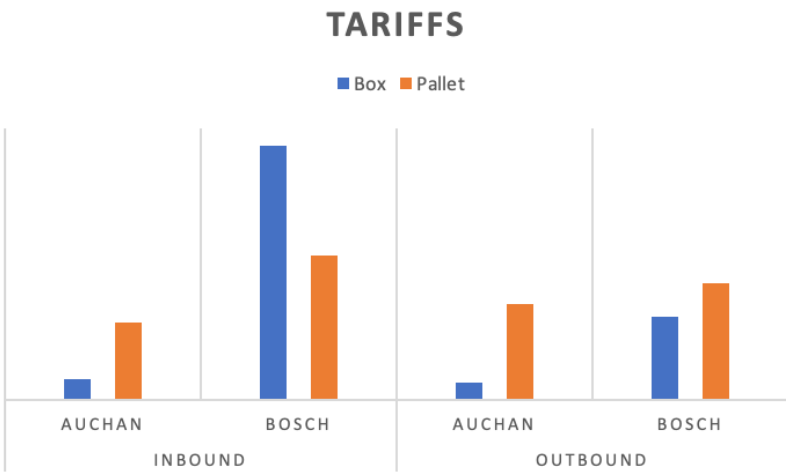


Figure 23 -Auchan and Bosch Tariffs.

Figure 24 shows the relationship between the inbound and outbound rates at Auchan and Rangel, analyzed for the case of being made by pallet or by box. By analyzing the graph one can conclude that, the rate considering the pallet is always higher, except in the inbound process of Bosch.

In addition, the implementation of the ABC method allowed a new approach in the calculation of costs per project. This new method allowed for much more detailed costing at the cost object level and for the realization that there are projects with negative margins, after the implementation of ABC, which, with the system the company uses, have positive margins.

It was also interesting to make a classification of the different projects already mentioned before: Samsung, Auchan, SDV, Super Bock, Bosch, represented in Figure 25.

Project Classification

	Pallet Storage	Pallet Expedition	Box Storage	Box Expedition	Logistics in house
Samsung	Yes	Yes	Yes	Yes	Yes
Auchan	Yes	No	Yes	Yes	Yes
SDV	Yes	Yes	Yes	Yes	No
Super Bock	Yes	Yes	Yes	Yes	Yes
Bosch	Yes	Yes	Yes	Yes	No

Figure 24 - Project Classification.

Through this study, it is possible to measure if the project has only storage and shipping by pallet, if it has preparation by box, if it includes distribution, in-house logistics, etc. In Figure 25 we can conclude that the most complex processes are Samsung and Super Bock.

6. Conclusions, Future Work and Limitations

The current economic scenario is increasingly demanding, which highlights the need for the company to constantly evaluate its actions, assessing its activities and their costs, allowing better management and allocation of its resources and ensuring its competitiveness in the market. In the ABC system, all costs tend to be treated and allocated to projects. This vision is very relevant for the company, offering an analysis by project, with the allocation of all costs and thus the determination of a more rigorous margin for each project, which better reflects the consumption of resources of each one. The biggest challenges in this dissertation occurred in the definition of the company's activities and their drivers. The choice of these was made with much thought and critical thinking. This study was faced with limitations, which may call into question some of the results. Namely, given the dispersion of information, the process of collecting and systematizing the information proved to be quite lengthy and somewhat complex.

Besides this, depending on the specificities of each client, adaptations to the model may be more complex, which makes the creation of a global model difficult, although it is quite flexible. Obtaining information was also very much focused on interviews with managers and employees, containing data subject to some subjectivity and imprecision, which is a common limitation in the ABC model. As future work, some changes can be made to make the model richer and with more valuable information. Namely, the development of a system that could update the model data on a per second basis. In addition, in the future, the inclusion of the vacancy rate and the cost it creates in the storage activity could be evaluated.

As a large part of the project is based on the hours allocated by employees to projects and activities, this is also a limitation, since sometimes the registration of hours in projects or activities is not done with total accuracy, which naturally causes distortions. Another limitation of this project is that the model does not consider the vacancy rate, i.e., if the customer requests a certain number of pallets and does not occupy their space, the company may be turning down projects due to lack of space and thus losing money unnecessarily. This vacancy rate is usually 1/0.85 and is important in incrementing project storage rates.

In the commercial area, this information is important for ongoing projects to understand if they are running as planned and budgeted and also for new projects. If some current projects are experiencing significantly high margins, it may mean that prices have been exaggerated in relation to costs, and in this case, there is more room for negotiation. Better proposals to clients (with lower prices and margins per project) can be studied more closely, which could lead to greater overall gains through the awarding of a larger volume of business (projects). Another limitation of the research project that stands out is the limited time period to apply the implementation of ABC and the fact that this is a pilot project, because to obtain results it would be necessary to extend the time of the research project. Although it was possible to conclude the project and reach conclusions, if the analysis period was longer and the research time was longer, there would be more robust conclusions and deeper analyses of the projects and their respective margins. Another limitation of this work is

the non-automation of the system, because its construction in an excel tool does not allow easy and fast monthly insertion and allocation of expenses, making it difficult to provide information from the ABC system in a timely manner and along with the other monthly reports. Using this project as a pilot is a starting point for it to undergo changes that allow greater automation, so that in the future it will be possible to easily automate the tool and have a monthly ABC analysis.

One should try to maintain the ideal level of updating in order to be prepared for the reorganization of the costing system by the ABC method so that it can be adapted to the state and the demands of the environment.

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ANEXO A: <Activity-Resource Matrix>

	Custo Total do Recurso	Inbound								Outbound								
		Planeamento	Check in Viatura	Unloading	Quantity and quality check &	Qualidade/Inspeção	Put-away	Check out Viatura	Tratamento danificados	Planeamento	Submeter picking para	Picking unidade	Picking caixa	Picking palete	Setup Picking	Movimentação zona de embalament	Filmagem palete; etiqueta expedição;	Carregamento (mixed pallets)	Carregamento (homogeneou	Check-out Viatura	Reaprovisionamentos
Recursos Humanos																					
Generic storage means - *Specify in the comments section*																					
Specific storage means - *Specify in the comments section*																					
Counter Balance Truck																					
Order Picker																					
Reach Truck																					
Hand Pallet Truck																					
Other (please specify																					
Other (please specify																					
Other (please specify																					
Unloading, control & put-away																					
Homogeneous pallets retrieval & Loading (homogeneous pallets)																					
Picking, pallet wrapping & Loading (mixed pallets)																					
Repacking - Co-packing																					
Return management																					
Operations manager																					
Supervisor																					
Team leader																					
Administration																					
Pinter																					
PC																					
Quality Safety, Health and Environment manager																					
IT																					
Other - *Specify in the comments section*																					
Other - *Specify in the comments section*																					
Energy																					
facility management - cleaning, security, etc.																					
IT management system - running cost																					
IT interface																					
Other startup cost - please specify in commments																					
Custo Total da Atividade																					

ANEXO B: <Investments>

Periodo de contrato: 2 anos

INVESTIMENTOS

Descrição do Equipamento	€ Unit	QTD	Tipologia	Custo Anual	Centro de Custo	Centro de Lucro	ITEM	Período de /alor mensa		Rúbrica
ARMAZÉM										
Estanteria Convencional			CAPEX	0	ESTANTERIA	ARMAZENAGEM	Generic storage means - Specify in the comments section	8	0	Dep. AFix. Equi.
Picking Racks Euro-Paletes Euro (0.8x1.2x1.2)			CAPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section	8	0	Dep. AFix. Equi.
Picking Racks Euro-Paletes Euro (0.8x1.8x1.2)			CAPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section	8	0	Dep. AFix. Equi.
Picking Racks Euro-Paletes EUA (1.0x1.8x1.2)			CAPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section	8	0	Dep. AFix. Equi.
Picking Racks Dinâmicos (50x30x40) / LxAxP			CAPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section	8	0	Dep. AFix. Equi.
Picking Prateleiras (50x30x40) / LxAxP			CAPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section	8	0	Dep. AFix. Equi.
Paletes para Armazenagem			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Generic storage means - Specify in the comments section	8	0	Dep. AFix. Equi.
Auditorias e Certificação das Naves - ANPC + Medidas de Auto Proteção			CAPEX	0	SAFETY	ARMAZENAGEM	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Sinalização e protecção do armazém + Plantas Emergência			CAPEX	0	SAFETY	ARMAZENAGEM	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Instalação de Sistemas de CCTV + Intrusão + Controlo de Acessos			CAPEX	0	SECURITY	ARMAZENAGEM	OR	5	0	Dep. AFix. Equi.
Implementação de Modelo de Comunicações e Infra-estruturas de Rede - Activos e Cablagens			CAPEX	0	INFRA	ARMAZENAGEM	OR	5	0	Dep. AFix. Equi.
Proteção cais			CAPEX	0	EQUIPAMENTOS	ARMAZENAGEM	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Alterações/obras			CAPEX	0	EQUIPAMENTOS	ARMAZENAGEM	OR	5	0	Dep. AFix. Equi.
Sorters/sistemas de classificação automáticos			CAPEX	0	EQUIPAMENTOS	ARMAZENAGEM	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Outros Automatismos			CAPEX	0	EQUIPAMENTOS	ARMAZENAGEM	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Sistema Multi-order			CAPEX	0	EQUIPAMENTOS	ARMAZENAGEM	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
ESCRITÓRIO										
Portátil + Software			CAPEX	0	IT	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Computador Operações			CAPEX	0	IT	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Computadores DAF			CAPEX	0	IT	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Terminais RF			CAPEX	0	IT	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Impressora Lexmark			CAPEX	0	IT	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Postos de trabalho operação (mesa + cadeira + módulo gaveta)			CAPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Telefones			CAPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Escritório Receção			CAPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Offices-Armários			CAPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Offices-Postos de Trabalho Admin			CAPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
Offices-Postos de Trabalho Operação			CAPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	Other startup cost - please specify in commments	1	0	Dep. Inta. P. Ind
EQUIPAMENTOS										
EPIs			OPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	facility management - cleaning, security, etc.			
Ferramentas de trabalho			OPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	facility management - cleaning, security, etc.			
Robô de filmar			OPEX	0	EQUIPAMENTOS	MANIPULAÇÃO	facility management - cleaning, security, etc.			
CONSUMÍVEIS										
Etiquetas + papel + tinteiro + saco de enjoo			OPEX	0	CONSUMÍVEIS	MANIPULAÇÃO	NA			
MÁQUINAS										
Porta paletes elétrico + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Other (please specify - Eletric pallet jack			
Stacker + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Stacker			
Empilhador Convencional (1.6T) + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Counter Balance Truck			
Empilhador Convencional (2.0T) + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Counter Balance Truck			
Empilhador Convencional (2.5T) + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Counter Balance Truck			
Empilhador Convencional (3.5T) + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Counter Balance Truck			
Tratores de Zorras + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Other (please specify - XXX			
Retratil + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Reach Truck			
Porta paletes manual + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Hand Pallet Truck			
Empilhador Trilateral + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Counter Balance Truck			
Selecionador de encomendas (order picker) + conservação			OPEX	0	MÁQUINAS	MANIPULAÇÃO	Order Picker			

ENTREGAS							
Serviço entregas round-trip - semana			OPEX	0	TRANSPORTES	TRANSPORTE	
Serviço entregas round-trip - FDS			OPEX	0	TRANSPORTES	TRANSPORTE	
Serviço entregas individual - semana			OPEX	0	TRANSPORTES	TRANSPORTE	
Serviço entregas individual - FDS			OPEX	0	TRANSPORTES	TRANSPORTE	
FSEs							
Renda Armazém - Inbound / marshalling area			OPEX	0	RENDA	ARMAZENAGEM	Inbound / marshalling area
Renda Armazém - Outbound / marshalling area			OPEX	0	RENDA	ARMAZENAGEM	Outbound / marshalling area
Renda Armazém - Ambient storage area			OPEX	0	RENDA	ARMAZENAGEM	Ambient storage area
Renda Armazém - Repacking / Copacking area			OPEX	0	RENDA	ARMAZENAGEM	Repacking / Copacking area
Renda Armazém - Utilities and facilities (charging room, social area, etc.)			OPEX	0	RENDA	ARMAZENAGEM	Utilities and facilities (charging room, social area, etc.)
Renda Armazém - Dedicated offices for Nestlé team			OPEX	0	RENDA	ARMAZENAGEM	Dedicated offices for team
Limpeza			OPEX	0	FSE	ARMAZENAGEM	facility management - cleaning, security, etc.
Produtos Limpeza			OPEX	0	FSE	ARMAZENAGEM	facility management - cleaning, security, etc.
Electricidade			OPEX	0	FSE	ARMAZENAGEM	Energy
Água			OPEX	0	FSE	ARMAZENAGEM	facility management - cleaning, security, etc.
Serviços de acesso WAN e equipamento terminal			OPEX	0	INFRA	MANIPULAÇÃO	IT management system - running cost
Comunicações - Telemóvel			OPEX	0	INFRA	MANIPULAÇÃO	IT management system - running cost
Comunicações - Dados			OPEX	0	INFRA	MANIPULAÇÃO	IT management system - running cost
Impressora			OPEX	0	IT	MANIPULAÇÃO	IT management system - running cost
Sistema de controlo de pragas			OPEX	0	FSE	ARMAZENAGEM	IT management system - running cost
Gestão de resíduos			OPEX	0	FSE	ARMAZENAGEM	facility management - cleaning, security, etc.
Conservação instalações			OPEX	0	FSE	ARMAZENAGEM	facility management - cleaning, security, etc.
Material de escritório			OPEX	0	FSE	MANIPULAÇÃO	facility management - cleaning, security, etc.
Segurança Ativa (Vigilantes)			OPEX	0	FSE	ARMAZENAGEM	facility management - cleaning, security, etc.
SEGUROS							
Responsabilidade civil - Exploração			OPEX	0	SEGUROS	ARMAZENAGEM	facility management - cleaning, security, etc.
Responsabilidade Civil - Profissional			OPEX	0	SEGUROS	ARMAZENAGEM	facility management - cleaning, security, etc.
Seguros multi-riscos			OPEX	0	SEGUROS	ARMAZENAGEM	facility management - cleaning, security, etc.
Responsabilidade Civil - Excesso (Bosch e AE)			OPEX	0	SEGUROS	ARMAZENAGEM	facility management - cleaning, security, etc.
RECURSOS HUMANOS							
Gestor Operações			OPEX	0	RH	MANIPULAÇÃO	Site manager
Supervisor T1 e T2			OPEX	0	RH	MANIPULAÇÃO	Operations manager
Chefe de equipa TC + T1 + T2			OPEX	0	RH	MANIPULAÇÃO	Shift leader
Operadores - Inbound			OPEX	0	RH	MANIPULAÇÃO	Unloading, control & put-away
Operadores - Outbound (paletes completas) - com feriados			OPEX	0	RH	MANIPULAÇÃO	omogeneous pallets retrieval & Loading (homogeneous pallets)
Operadores - Outbound (picking à unidade) - com feriados e sub. turno (T2)			OPEX	0	RH	MANIPULAÇÃO	Picking, pallet wrapping & Loading (mixed pallets)
Operadores - Repacking/Copacking			OPEX	0	RH	MANIPULAÇÃO	Repacking - Co-packing
Operador devoluções			OPEX	0	RH	MANIPULAÇÃO	Return management
Gestor layout e inventário + operador inventário			OPEX	0	RH	MANIPULAÇÃO	Other - Layout and inventory management
Gestor de infraestrutura, recursos, consumíveis			OPEX	0	RH	MANIPULAÇÃO	Other - Infrastucture/facilities/suppliers manager
Health and Safety Manager			OPEX	0	RH	MANIPULAÇÃO	Quality Safety, Health and Environment manager
IT manager			OPEX	0	RH	MANIPULAÇÃO	IT
Administrativo + Key Account			OPEX	0	RH	MANIPULAÇÃO	Administration
CUSTOS DE ESTRUTURA							
Custos Gestão			OPEX	0	ESTRUTURA	MANIPULAÇÃO	facility management - cleaning, security, etc.
Custos Indiretos			OPEX	0	ESTRUTURA	MANIPULAÇÃO	facility management - cleaning, security, etc.
Custos Financeiros (recebimentos a 90+30 dias)			OPEX	0	ESTRUTURA	MANIPULAÇÃO	facility management - cleaning, security, etc.
MARKUP 1% - Energy			OPEX	0	ESTRUTURA	MANIPULAÇÃO	Energy
MARKUP 1% - IT running costs			OPEX	0	ESTRUTURA	MANIPULAÇÃO	IT management system - running cost
MARKUP 2% - Facility management			OPEX	0	ESTRUTURA	MANIPULAÇÃO	facility management - cleaning, security, etc.
CUSTOS ARRANQUE							
Formação			OPEX	0	RH	MANIPULAÇÃO	
Viatura para deslocação (aluguer, portagens e gasolina)			OPEX	0	RH	MANIPULAÇÃO	
Renda Armazém			OPEX	0	RENDA	ARMAZENAGEM	
Máquinas			OPEX	0	MÁQUINAS	MANIPULAÇÃO	
FSEs			OPEX	0	RENDA	ARMAZENAGEM	

ANEXO C: <Price Grid>

Section	Sub-section	Item	Quantity	Amortization period / working time	Cost per unit	Annual cost	Comments
1. Building Surfaces	Marshalling area	Inbound / marshalling area	0 m2	NA	#DIV/0!	#DIV/0!	Includes site insfratucture, communications and security depreciations
1. Building Surfaces	Marshalling area	Outbound / marshalling area	0 m2	NA	#DIV/0!	#DIV/0!	Includes site insfratucture, communications and security depreciations
1. Building Surfaces	Storage area	Ambient storage area	0 m2	NA	#DIV/0!	#DIV/0!	Includes site insfratucture, communications and security depreciations
1. Building Surfaces	Co-packing/Repacking area	Repacking / Copacking area	0 m2	NA	#DIV/0!	#DIV/0!	Includes site insfratucture, communications and security depreciations
1. Building Surfaces	Additional Surfaces	Utilities and facilities (charging room, social area, etc.)	0 m2	NA	#DIV/0!	#DIV/0!	Includes site insfratucture, communications and security depreciations
1. Building Surfaces	Offices	Dedicated offices	0 m2	NA	#DIV/0!	#DIV/0!	Includes site insfratucture, communications and security depreciations
TOTAL Building Surfaces			0 m2		0,00/m2	#DIV/0!	
2. Equipment	Storage means (racks, bulk storage, etc.)	Generic storage means - *Specify in the comments section*	1 investement cost	8 years	-	-	Racks
2. Equipment	Storage means (racks, bulk storage, etc.)	Specific storage means - *Specify in the comments section*	1 investement cost	8 years	-	-	
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Counter Balance Truck	0 Units	1 years	0 Units	-	
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Order Picker	0 Units	1 years	-	-	
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Reach Truck	0 Units	1 years	-	-	
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Hand Pallet Truck	0 Units	8 years	-	-	
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify	0 Units	1 years	-	-	
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify	0 Units	1 years	-	-	
2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify	0 Units	8 years	-	-	
TOTAL Equipment						-	
3. Labour - indicate % temp vs fix in comme	Inbound	Unloading, control & put-away	0 FTEs	1 890 h/FTE/year	0,00/h	-	
3. Labour - indicate % temp vs fix in comme	Outbound	Homogeneous pallets retrieval & Loading (homogeneous pallets)	0 FTEs	1 890 h/FTE/year	0,00/h	-	
3. Labour - indicate % temp vs fix in comme	Outbound	Picking, pallet wrapping & Loading (mixed pallets)	0 FTEs	1 890 h/FTE/year	0,00/h	-	
3. Labour - indicate % temp vs fix in comme	Copacking / Repacking	Repacking - Co-packing	0 FTEs	1 890 h/FTE/year	0,00/h	-	
3. Labour - indicate % temp vs fix in comme	Return	Return management	0 FTEs	1 890 h/FTE/year	0,00/h	-	
TOTAL Labour						-	
4. management	management	Operations manager	0,0 FTEs	NA	0/FTE/year	-	
4. management	management	Supervisor	0,0 FTEs	NA	0/FTE/year	-	
4. management	management	Team leader	0,0 FTEs	NA	0/FTE/year	-	
4. management	management	Administration	0,0 FTEs	NA	0/FTE/year	-	
4. management	management	Quality Safety, Health and Environment manager	0,0 FTEs	NA	0/FTE/year	-	
4. management	management	IT	0,0 FTEs	NA	0/FTE/year	-	
4. management	management	Other - *Specify in the comments section*	0,0 FTEs	NA	0/FTE/year	-	
4. management	management	Other - *Specify in the comments section*	0,0 FTEs	NA	0/FTE/year	-	
TOTAL Management						-	
5. Other fixed cost	Energy	Energy	1 monthly cost	NA	0/year	-	
5. Other fixed cost	facility management	facility management - cleaning, security, etc.	1 yearly cost	NA	0/year	-	
5. Other fixed cost	IT management system	IT management system - running cost	1 yearly cost	NA	0/year	-	
TOTAL Other fiix cost						-	
Startup cost	IT interface	IT interface	1 time cost	NA	-	-	
Startup cost	Other startup cost - please specify in commments	Other startup cost - please specify in commments	1 time cost	NA	-	-	
TOTAL Startup cost						-	
Margin	Indicate the markup applied to the cost	Indicate the markup applied to the cost	markup percentage	NA	11,00%	#DIV/0!	
TOTAL BUDGET - EXCLUDING STARTUP						#DIV/0!	

Section	Sub-section	Item	Quantity year 1	Productivity	cost per unit	Annual cost	Comments	Subject to inde
Startup cost	IT interface	IT interface	1 time cost	NA	NA			NO
Startup cost	Other startup cost - please specify in commments	Other startup cost - please specify in commments	1 time cost	NA	NA			NO
Total startup cost						-		
Fixed cost	Building - excluding storage	Marshalling area, utilities and facilities	12 monthly cost	NA	#DIV/0!	#DIV/0!		NO
Fixed cost	Building - excluding storage	Co-packing area	12 monthly cost	NA	#DIV/0!	#DIV/0!		NO
Fixed cost	Equipment	Storage means	12 monthly cost	NA	0/month	-		NO
Fixed cost	Equipment	Handling means	12 monthly cost	NA	0/month	-		NO
Fixed cost	Management and administration	Management and administration	12 monthly cost	NA	0/month	-		NO
Fixed cost	Energy	Energy	12 monthly cost	NA	0/month	-		NO
Fixed cost	IT management system	IT management system - running cost	12 monthly cost	NA	0/month	-		NO
Fixed cost	facility management	facility management	12 monthly cost	NA	0/month	-		NO
Total fix cost						#DIV/0!		
Variable cost	Inbound	Unloading homogenous pallet, control & put-away	-	#DIV/0!	0,00/pal	-	is not included adm tasks	50% of labor index
Variable cost	Storage	Storage EUR Pallets - Ambient	-	NA	0,00/case	-		NO
Variable cost	Outbound	Handling out of homogenous pallet - Single pallet	-	#DIV/0!	0,00/pal	-	is included all outbound tasks (except adm)	50% of labor index
Variable cost	Outbound	Handling out Mix pallets - Case picking, pallet wrapping & Loading	-	#VALUE!	0,00/case	-	is included all outbound tasks (except adm)	50% of labor index
Variable cost	Outbound	Handling out Mix pallets - Each picking, pallet wrapping & Loading	-	#VALUE!	0,00/each	-	is included all outbound tasks (except adm)	50% of labor index
Variable cost	Returns	Reception and segregation of returned cases	-	#DIV/0!	0,00/each	-	is not included adm tasks	50% of labor index
TOTAL Variable cost						-		
TOTAL ANNUAL BUDGET - EXCLUDING STARTUP						#DIV/0!		

ANEXO D: <Cost Center>

CC - CENTRO DE CUSTO

	Section	Sub-section	Item	INPUTS FOLHA INVESTIMENTO
1.1	1. Building Surfaces	Marshalling area	Inbound / marshalling area	0
1.2	1. Building Surfaces	Marshalling area	Outbound / marshalling area	0
1.3	1. Building Surfaces	Storage area	Ambient storage area	0
1.4	1. Building Surfaces	Co-packing/Repacking area	Repacking / Copacking area	0
1.5	1. Building Surfaces	Additional Surfaces	Utilities and facilities (charging room, social area, etc.)	0
1.6	1. Building Surfaces	Offices	Dedicated offices for Nestlé team	0
	TOTAL Building Surfaces			0
2.1	2. Equipment	Storage means (racks, bulk storage, etc.)	Generic storage means - *Specify in the comments section*	0
2.2	2. Equipment	Storage means (racks, bulk storage, etc.)	Specific storage means - *Specify in the comments section*	0
2.3	2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Counter Balance Truck	0
2.4	2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Order Picker	0
2.5	2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Reach Truck	0
2.6	2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Hand Pallet Truck	0
2.7	2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify - Highlift stacker	0
2.8	2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify - Eletric pallet jack	0
2.9	2. Equipment	Handling means (forklifts, trucks, conveyors, etc.)	Other (please specify - Automatic box making machine	0
	TOTAL Equipment			0
3.1	3. Labour - indicate % temp vs fix in comments section	Inbound	Unloading, control & put-away	0
3.2	3. Labour - indicate % temp vs fix in comments section	Outbound	Homogeneous pallets retrieval & Loading (homogeneous pallets)	0
3.3	3. Labour - indicate % temp vs fix in comments section	Outbound	Picking, pallet wrapping & Loading (mixed pallets)	0
3.4	3. Labour - indicate % temp vs fix in comments section	Copacking / Repacking	Repacking - Co-packing	0
3.5	3. Labour - indicate % temp vs fix in comments section	Return	Return management	0
	TOTAL Labour			0
4.1	4. management	management	Site manager	0
4.2	4. management	management	Operations manager	0
4.3	4. management	management	Shift leader	0
4.4	4. management	management	Administration	0
4.5	4. management	management	Quality Safety, Health and Environment manager	0
4.6	4. management	management	IT	0
4.7	4. management	management	Other - *Layout and inventory management*	0
4.8	4. management	management	Other - *Infrastucture/facilities/suppliers manager*	0
	TOTAL Management			0
5.1	5. Other fixed cost	Energy	Energy	0
5.2	5. Other fixed cost	facility management	facility management - cleaning, security, etc.	0
5.3	5. Other fixed cost	IT management system	IT management system - running cost	0
	TOTAL Other fiix cost			0
6.1	Startup cost	IT interface	IT interface	0
6.2	Startup cost	Other startup cost - please specify in commments	Other startup cost - please specify in commments	0
	TOTAL startup cost			0

ANEXO E: <Measure Time Method>

Process: INBOUND		
Subprocess	Cost Driver	HR Catg.
1 - Planeamento	DOC	ADM
2 - Check-in Viatura	DOC	ADM
3 - Unloading	PLT	OPM
4 - Quantity and quality check & Data Entry	PLT	OP
5 - Qualidade/Inspeção	CX	OP
6 - Put-away	PLT	OPM
7 - Check-out Viatura	DOC	ADM
8 - Tratamento danificados (manipulações de incidências à descarga)	PLT	OPM

Process: OUTBOUND		
Subprocess	Cost Driver	HR Catg.
1 - Planeamento	ENC	ADM
2 - Submeter picking para produção	ENC	ADM
3 - Picking unidade c/ empacotamento	Un	OPM
4 - Picking caixa	Cx	OPM
5 - Picking Palete completa (inc. mov. Cais)	PLT	OPM
6 - Setup picking	ENC	OP
7 - Movimentação para zona de embalamento (cais exp.)	PLT	OPM
8 - Filmagem palete; etiqueta expedição; mov.posição embarque	PLT	OP
9 - Check-in Viatura	Viatura	ADM
10.1 - Carregamento (mixed pallets)	PLT	OPM
10.2 - Carregamento (homogeneous pallets)	PLT	OPM
11 - Check-out Viatura	ENC	ADM
12 - Reaprovisionamentos	PLT	OPM

Homogeneous pallets retrieval & Loading (homogeneous pallets)	#DIV/0!	
Picking, pallet wrapping & Loading (mixed pallets)	#DIV/0!	

Handling out of homogenous pallet - Single pallet		
Handling out Mix pallets - Case picking, pallet wrapping & Loading	#DIV/0!	
Handling out Mix pallets - Each picking, pallet wrapping & Loading	#DIV/0!	

				0,00	
Qty/day	Time un(sec.)	Prod./hr	hr total	FTE	hr/MHE
0	600	6,00	0,00	0,00	
0	900	4,00	0,00	0,00	
0	67	53,73	0,00	0,00	0,00
0	30	120,00	0,00	0,00	
0	0	0,00	0,00	0,00	
0	114	31,70	0,00	0,00	0,00
0	900	4,00	0,00	0,00	
0,0	900	4,00	0,00	0,00	0,00

				0,00	
Qty/day	Time un(sec.)	Prod./hr	hr total	FTE	hr/MHE
0	10	360,00	0,00	0,00	
0	10	360,00	0,00	0,00	
0	#DIV/0!	0,00	0,00	0,00	0,00
0	27	133,33	0,00	0,00	0,00
0	110	32,70	0,00	0,00	0,00
0	0	0,00	0,00	0,00	
0	0	0,00	0,00	0,00	0,00
0	90	40,00	0,00	0,00	
0	300	12,00	0,00	0,00	
0	54	66,67	0,00	0,00	0,00
0	45	80,00	0,00	0,00	0,00
0	180	20,00	0,00	0,00	
0	150	24,00	0,00	0,00	0,00

168		#DIV/0!	#DIV/0!	#DIV/0!	
			#DIV/0!	#DIV/0!	

	50%	0%	0%	0%	50%
Tempo Atividade (hr)	ShiftC	Shift1	Shift2	Shift3	Shift4
10	0,00				
10	0,00				
10	0,00				0,00
10	0,00				0,00
10	0,00				0,00
10	0,00				0,00
10	0,00				
10	0,00				0,00
ADM	**0,00**				**0,00**
OP	**0,00**				**0,00**

	0%	30%	70%	0%	0%
Tempo Atividade (hr)	ShiftC [08h-17h]	Shift1 [07h-16h]	Shift2 [14h-22h]	Shift3 [23h-07h]	Shift4 [10h-19h]
16		0,00	0,00		
16		0,00	0,00		
24		0,00	0,00		
16		0,00	0,00		
24		0,00	0,00		
24		0,00	0,00		
24		0,00	0,00		
24		0,00	0,00		
24		0,00	0,00		
16		0,00	0,00		
16		0,00	0,00		
16		0,00	0,00		
16		0,00	0,00		
24		0,00	0,00		
ADM		**0,00**	**0,00**	**0,00**	**0,00**
OP		**0,00**	**0,00**	**0,00**	**0,00**

FTE per MHE					
Low lift pallet truck	Order Picker (double pal)	High Lift Stacker	Reach Truck	Forklift	Forklift w/Clamp
				0,00	
			0,00		
0,00					
0,00	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**

FTE per MHE					
Low lift pallet truck	Order Picker (double pal)	High Lift Stacker	Reach Truck	Forklift	Forklift.Clamp
	0,00				
	0,00				
			0,00		
	0,00				
		0,00			
		0,00			
			0,00		

0,00	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**