Development of an ABC cost model for the application in supply chains - AKI Portugal

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Abstract

One of the main challenges that large retailers face, such as AKI which operates in the DIY market, is to be able to meet the needs of demand for all the stores efficiently and effectively, in other words, at the lowest possible cost without compromising the level of service. For this reason AKI has 3 main supply chains. One way to distinguish and evaluate the three types of supply chain is through the costing of the operations involved. It is in this context that the present article comes and whose main objective was the development of a costing model using the Activity-based costing methodology (ABC). The main purpose of ABC is to overcome the shortcomings of traditional costing, making costing more precise, clear, and objective, through the way it allocates the indirect costs to products and services.

The results show significant differences between the cost of the orders given by the model and that calculated by the company. Also highlighted are the most costly activities for each of the logistics circuits and also pointed out are the features of the stores that require a higher consumption of resources. In addition, the ABC costing method developed is also a valuable tool for making management decisions once activities with no added value that can be minimized or improved were identified. It also help the company in the reallocation of its resources. Finally, this article reinforced the adequacy of the ABC methodology in the costing of logistics operations.

Key-words: activity-based costing; supply chains, costing model, AKI, distribution centre

1. Introduction

The current scenario where organizations operate are filled with numerous challenges, barriers and opportunities. Global competition is increasingly intense, customers are more demanding, the development of technology grows exponentially, and the life cycle of products is becoming smaller (Al-Omiri and Drury, 2007). All these factors increase the need for better costing systems for companies in order to calculate the real cost of a product or service, and the cost to serve a particular market or customer. It turns out that traditional accounting systems, used by most companies, are sufficient to value stocks and determine production costs. However they are not suitable for determining the actual costs of products or services. This is due to the fact that traditional accounting does not consider differentiated overhead costs for specific products or services. It accumulates the costs into cost centres and then allocates them later according to the labour work or through production volumes. As a result, companies are not able to differentiate the losers of the winning products or identify markets and customers that make the business profitable (Themido et al., 2000). For this reason Cooper and Kaplan developed a costing methodology called activity-based costing (ABC) representing a break with the traditional costing systems and which adapts to the volatility of the situation. ABC assumes to produce a product or service it is necessary to perform certain activities which, in turn, consume resources. Thus, this costing system accumulates overhead costs from the resources on the related activities, followed by the implementation of the cost of these activities to the costing objects through cost drivers. Cost derivers are crucial variables for this approach since they demonstrate and quantify the cause-effect relationship between the use of resources, the performance of the activities and

the final object (product, service, supply chain, etc.).
Information extracted from the ABC model system enables the identification of activities that add value and those that do not add it, and thus can be reduced or eliminated (Baykasoğlu and Kaplanoglu, 2008).
It is in this context that the present work comes which aimed to develop an ABC model on the distribution logistics operations of AKI, which operates in the DIY market, as a retailer. In order to fulfil all the 32 stores demand the company has 3 main supply chains: a direct supply chain from the supplier to the store; a cross-docking platform; and a warehousing supply chain where the products (after being delivered from suppliers) are kept in the warehouse until the receipt of an order by the stores.
One way to differentiate and assess the three types of supply chains is through the costing of the operations involved. Given the success of the ABC methodology, as can be seen by the numerous published cases, the application of this methodology will compare the different types of supply chains for a set of points of sale and, for a given level of service, realize what impact each distribution circuit has on their products.
In section 2, a brief review will be made about the main themes related to this case study;
In section 3, the case study, and the main steps of the ABC model are described;
In section 4, the results achieved with the ABC model and its discussion will be presented;
In section 5, the main conclusions of this case study will be shown.

2. Literature Review

In this section a literature review is presented about the main topics related to this case study, which are: Supply Chain Management (2.1); Cross-docking (2.2); and Activity-based Costing (2.3).

2.1Supply Chain Management (SCM)

The supply chain management term was first introduced by consultants in the early 1980s (Stock et al,. 2000). However, it is only since 1990 that SCM began to be the focus of attention by the top executives of most companies. They began to recognize the power and potential to make organizations more competitive globally, allowing increased market share and thereby improve shareholder value (Coyle et al., 2013).
Given the age of this topic it is not surprising the lack of an agreed definition of SCM (Gibson et al., 2005). Thus, in literature and professional associations there are different definitions and perspectives. According to CSCMP (Council of Supply Chain Management Professionals), Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies (CSCMP, 2013).
For Chopra and Meindl (2014) in every business transaction there is a supplier and a customer, as well as activities and processes that link them. This whole process of management of linkages to generate the most value for the customer, at a minimum cost and effort for the supplier is the SCM.
The SCM can also be characterized as the management of material, money, people and information within and along the supply chain, in order to satisfy customers and gain a competitive advantage over competitors (Shukla et al. 2011). In the same line of thought Chopra and Meindl (2015) suggest that the value generated in supply chain management is defined as the difference between what is the final product to the client (his perception) and the cost that the upstream entities had to meet the request.
For Ayers (2006) the SCM aims towards three major purposes which are; reduce stock; increase speed of the transaction; and raise sales (Ayers, 2006).

2.2 Cross-docking

Cross-docking is a logistics concept that integrates intermediate points on the transport network. It can be described as a cargo consolidation process (from multiple sources) to a particular destination, with minimal handling and with little or no storage between the loading and unloading of goods (Belle et al., 2012). This system requires a substantial synchronization of all movements related to the shipment of products, whether inbound or outbound (CSCMP, 2013).
Currently, inventory costs are one of the major supply chain costs. In this sense, the cross-

docking system becomes a pleasant alternative to traditional storage systems, since the products from suppliers are transported quickly and directly to the truck after having been consolidated and rearranged with a time in storage. This time is limited and usually does not exceed 24 hours (Belle et al., 2012). Consequently, there is a reduction in the level of inventory in warehouse, substantial space and achieving a reduction of the equipment required for handling and storing goods (Ray, 2010). Yet a substantially increased level of service is obtained, since there is a reduction in lead time. This reduction is critical when the products are perishable, due to rapid transport along the supply chain in order to meet customer's needs (Richards, 2014).

Another advantage of the implementation of this system is to obtain economies of scale, because instead of transporting small quantities of goods which do not meet the capacity of the truck (less-truck-load), cross-docking consolidates small amounts of order in a single shipment (full-truck-load), thus reducing the cost of transport (Manzini, 2012).

From what has been said, there are several benefits obtained with the implementation of a cross-docking system, however, there are barriers that may challenge its success. According to Simchi-Levi (2008), the cross-docking strategy is only effective for large distribution systems, where there are numerous vehicles that deliver and collect goods in distribution centres, adding that it is only possible if every day there is a sufficient volume of products that fill trucks completely.

In summary, when the cross-docking system is properly deployed, the supply chain becomes directly connected from the point of origin (supplier) to the point of sale (retail). As a result the product is transported faster, inventory costs, transportation and handling are reduced and customer demand is met most effectively (Stephan and Boysen, 2011). Richards (2014) states that cross-docking is seen as the future of storage.

2.3 Activity-based Costing (ABC)

The activity-based costing methodology was introduced in accounting literature in the late 1980s. Although there is no consensus on the true creators of the system, it is unanimous that this technique has gained popularity with the work of Johnson and Kaplan (1987) "Relevance Lost", and later developed by Cooper and Kaplan (Monroy et al., 2014).

The main purpose of this management accounting technique is to overcome the shortcomings of traditional costing. Notice that most of the traditional costing systems allocates indirect costs through labour work or production volume, which are sufficient for valuing inventory and dealing with production costs. However, this allocation basis is poorly designed to accurately report the cost of individual products to serve each customer segment (Themido et al., 2000). As a result companies are not able to distinguish the losers of the winning products or identify markets and customers that make business profitable (Themido et al., 2000). For these reasons, the ABC aims to make the most accurate costing and objective, through the way it allocates indirect costs on the products and services (Kim, 2009). ABC has the premise that to produce a product or service it is necessary to perform certain activities which consume resources. Thus, this costing system accumulates overhead costs from the resources on related activities, followed by the implementation of cost activities to cost objects through cost drivers (Major, 2007). Cost Drivers are critical in the ABC methodology, not only because they target and drive costs to reflect the diversity of products and services but they are also responsible for the accuracy of costing (Cooper and Kaplan, 1997).

To sum up, for ABC the product cost is equal to the direct costs plus the sum of all the activities required to produce the product or service (Tseng and Lai, 2007), as is illustrated in figure 1.

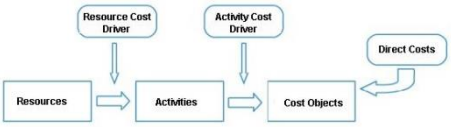

Figure 1 - ABC costing system basis

From the analysis of Figure 1, it indicates that ABC is a method with two main steps (Major, 2007):

1. Firstly, the costs of the consumed resources are allocated to the various activities of the organization. In this step resource drivers (consumption indicators) are used to distribute the costs consumed by more than one activity. Thus, the activities are the first cost object;
2. Secondly, the costs of activities are allocated to cost objects based on consumption that the latter has on the first. This allocation is

made with the use of activity cost drivers (also known as activity consume indicators).

For the implementation of the two above-mentioned steps the following four sequential steps are essential (Major, 2007) (Cooper and Kaplan, 1997) (Tseng and Lai, 2007):

1. Activities Identification
- In this first phase it is important to go to the starting point of the process where each activity occurs, in order to examine the inherent physical conditions. The activities chosen must have a reasonable level of aggregation. Previously, there should have been a trade-off between the benefits and the difficulties that the definition of each activity will bring to the information system;

2. Determination of the cost of each activity
- After the definition of the activities it is necessary to understand what resources each activity consumes, for that the resource cost drivers must be defined. For quantification and identification of these indicators interviews with the staff of the company should be conducted, since the experience they have acquired can provide reasonable estimates of the consumption of resources by the different activities. Having finalized the definition of indicators of the resources, establishing the cause-effect relationship between the consumption of resources and their activities, the cost that the company has in each of the activities defined in the previous step is calculated;

3. Selection of activities cost drivers
- Once calculated the cost of each activity it is necessary to define the criteria to allocate them to the cost objects, in other words, what activities the cost objects consume. Again the information collected from the interviews will be critical.

4. Valuation of the cost objects
- The Last step consists of applying the activity cost drivers to the costing objects, it is essential that these indicators are easily measurable and identifiable as cost objects.

The well-developed ABC model provides information related to control and cost management, since it facilitates the identification of resources which are not required, as well as non-productive or redundant activities (Tseng and Lai, 2007).

3. Case Study

3.1 AKI

AKI is a DIY retail company and it makes part of ADEO group, belonging to the Mulliez family association. Adeo Group is the market leader in Portugal and Europe and its main brands are AKI, Leroy Merlin and Bricocenter.
Currently, AKI has approximately 25,000 SKUs and 32 stores spread throughout Portugal and Madeira. Its core business is retail and not the production. In this sense, most of the items (finished products) are then transported from the supplier to a distribution centre, located in Póvoa de Santa Iria, and later to the respective stores. In some cases the products are distributed directly from suppliers to stores.
Transport and warehouse operations are outsourced by the company Logic also contracted in 3PL regime. Logic is responsible for operating all activities in warehouses and distribution operations from the distribution centre to the stores. Those responsible for the transport of the products to the distribution centre are the suppliers.
One of the main challenges that the logistics department of AKI faces is to be able to meet the needs of demand for all the stores efficiently and effectively, in other words, at the lowest possible cost without compromising the level of service. For these reasons AKI has 3 main supply chains which are: a direct supply chain from the supplier to the store; a cross-docking platform; and a warehousing distribution chain where the products (after being delivered from suppliers) are kept in the warehouse until the receipt of an order by the stores. A schematic flow of these supply chains is represented in the figure below.

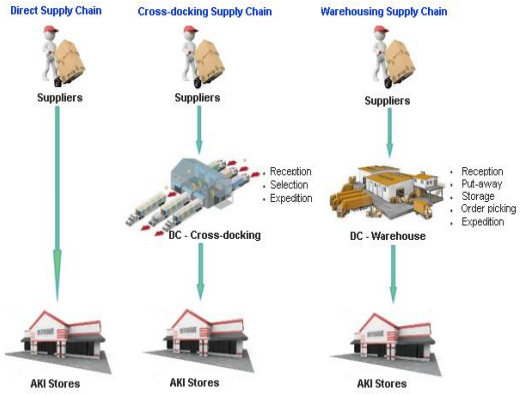

Figure 2 - The 3 Supply Chains of AKI

One way to distinguish and evaluate the three types of supply chain is through the costing of the operations involved. For that an ABC model was developed in order to realize the efficiency of the chains through the quantification of the impact on the products' cost.

3.2 Development of an ABC model.

3.2.1 Structure of the model

The ABC model was developed in five main steps, following the instructions of Major (2007), Themido et al (2000), and Cooper and Kaplan (1999):

1- Definition of the cost objects;
2- Identification of the activities
3- Identification of the resources and its cost;
4- Allocation of the resources cost to the activities;
5- Allocation of the activities to cost objects;

3.2.2 Definition of the cost objects

The construction of the ABC model began with the definition of cost objects. In order to capture the complexity of AKI's environment 3 different products were chosen, all from different suppliers, and each belonging to one of the supply chains. The items chosen were: wood pellets, which belongs to the direct supply chain and wich have annual sales of 190.000 units; wild arugula seeds, which belong to the cross-docking supply chain and have annual demand of 2300 units; and a wardrobe, which is part of the warehousing supply chain and whose sales are in average 1800 units per year.

Once the 3 products ere chosen, 2 AKI stores with completely different characteristics were also defined. The stores chosen were: one located in Parque das Nações (Lisbon) and the other in Setúbal. The first store has two floors and a total area of 2620 square meters, of which 180 square meters are for storage of materials. The Setúbal store has only one floor with a total area of 6700 square meters, of which 600 square meters for storage.

Note also that Parque das Nações store is located 13.7 km from the distribution centre and Setubal store is 55 km away.

3.2.3 Identification of the activities

After defining the cost objects described above, the next step was to identify the activities consumed by them. Thus, some employees of AKI and Logic were interviewed, in order to collect information about the activities they perform dayly. Their experience and perception were crucial in this phase. The interviews also aimed to further understand the distribution of their working time, as well as the equipment used for the execution of activities. These data would turn out to be important for the next steps. In the following table is shown the activities related to the cost objects of the case study. Note that the activities were divided into groups of activities, main activities and secondary activities.

Group of activities	Main Activities	Secondary activities
Back office	Ordering	
Cross-docking in the DC	Reception and Input Handling	
	Placeholder to Cross-docking	
	Picking and Output Handling	
	Transport	
Warehousing in the DC	Reception and Input Handling	
	Warehousing	
	Picking and Output Handling	
	Transport	
Pellets stored in Logic	Transport from store to DC	
	Warehousing in DC	
	Transporte from DC to Store	
Store	Reception	Input File Creation
		Unload Products
		Visual Products Conference
		Physics Conference of Products
	Put Away	
	Storage in Store	
	Picking and Replenishment in Store	
	Exhibition at the Store	
	Customer assistance	
	Payment	

Table 1 - Activities consumed by the cost objects.

As it can be seen 5 group of activities, 19 main activities, and 4 secondary activities were identified.

Making a brief explanation, the back office group and the store group are related to the 3 products. The Cross-docking group contemplates the wild arugula seeds, and the warehousing group is related to the wardrobe.

There was also a group called pellets (wood pellets abbreviation) stored in Logic. Although the pellets are associated with the direct supply chain, once the Parque das Nações store does not have the necessary space to store all the orders of the product, it has a contract with Logic, where it is responsible for the transport and storage of pellets over the year. Such activities could have a substantial impact on the cost of the product and for this reason were considered in the model.

3.2.4 Identification of the resources and its cost;

The third step of the ABC model is the identification and determination of the cost of resources consumed by the activities. In order to identify the resources the financial information of the company for the year 2015 was analysed, as well as the information gathered from the interviews. After that it was decided to group the resources by categories according to their nature, namely human

resources, infrastructure, equipment, and resources provided by Logic.

- The human resources category encompasses all the employees of AKI that perform the various activities in the store;
- Infrastructure resources are related to the two stores, such as surveillance costs, cleaning, electricity, management and treatment of waste, and maintenance of the store;
- Equipment resources as the name indicates are related to the equipment used by the employees of AKI, such as forklifts, PDAs (personal digital assistant), electric pallet trucks, computers, printers, and others. For that the cost of acquisition, maintenance, use time, duration, and the cost of energy consumed (for the electric equipment) were taken in consideration;
- The last category is the resources provided by Logic and it considers either resources of the input and output handling activities in the distribution centre or the space occupied for cross-docking and warehousing operations. It also contemplates the resources associated with transportation. In this category the resources had to be measured in a different way since they don´t belong to AKI. All these resources were calculated from the contract clauses.

The following table shows the relevant resources to the ABC model.

Resources	Cost per unit	Cost per minute	Cost per m^2	Cost per m^3
Store Manager	_	0,25 €	_	_
Department head	_	0,19 €	_	_
Receptionist	_	0,15 €	_	_
Salesman	_	0,12 €	_	_
Checker	_	0,11 €	_	_
Sales area - Parque das Nações Store (monthly)	_	_	14,82 €	_
Sales area - Setúbal store (monthly)	_	_	2,75 €	_
Storage area - Parque das Nações Store (monthly)	_	_	18,95 €	_
Storage area - Setúbal store (monthly)	_	_	0,91 €	_
Forklift	_	0,09 €	_	_
PDA	_	0,06 €	_	_
Electric pallet truck	_	0,01 €	_	_
Cross-docking handling	0,09 €	_	_	_
Cross-docking space	_	_	4,85 €	_
Warehousing handling	0,12 €	_	_	_
Warehousing picking	0,11 €	_	_	_
Storage space in Logic (monthly)	_	_	_	2,52 €
Transport - Parque das Nações store	_	_	_	2,97 €
Transport- Setúbal store	_	_	_	7,00 €

Table 2 - Resources of the ABC model

3.2.5 Allocation of the cost of resources to activities;

Before allocating the cost of resources to activities the resource driven indicators had to be identified. Four types of resource indicators were then recognised, namely the time spent, the area occupied, the volume occupied, and the average of monthly levels of units handled.

- Time spent is associated with the consumption of human resources and equipment and has a linear relationship with its activities and the cost objects, since they are allocated directly through the time spent.
- Area occupied is linked to AKI facilities resources and some DC resources;
- The volume occupied. This resource consumption indicator is used on the transport resources and space occupied for storage in the distribution centre.
- The average of monthly levels of units handled is used to drive the handling and picking resources that occur in the Logic's distribution centre. As stated above, all these tasks are also stipulated in the contract.

Now it is possible to understand why in table 2 these 4 types of resource drivers were taken into account when calculating the cost of resources.

Having identified the resource drivers a realistic cost for each activity can be determined. For that it was only necessary to measure the level of resources consumed by the activities, through time of use, space (in m^2 or m^3) it takes or number of units handled.

The next table which shows the cost of the activities related to the wild arugula seeds for both stores is represented. Notice the same procedure was done to the remaining activities of the ABC model.

Activities	Activity costs - Parque das Nações store	Activity costs – Setúbal store
Ordering to Logic	0,37 € / order	0,37 € / order
Reception and input handling	0,09 € / box	0,09 € / box
Placeholder to cross-docking	0,15 € / box	0,15 € / box
Picking and output handling	0,09 € / box	0,09 € / box
Transport	0,01 € / box	0,02 € / box
Reception		
Input file creation	0,31 € / reception	0,31 € / reception
Unload products	0,08 € / box	0,08 € / box
Visual Products conference	0,08 € / reception	0,08 € / reception
Picking and replenishment in store	0,37 € / replenishment	0,25 € / replenishment
Exhibition at the store	0,57 € / box x month	0,08 € / box x month
Costumer assistance	0,12 € / client	0,12 € / client
Payment	0,12 € / client	0,12 € / client

Table 3 - Cost of the activities related to the wild arugula seeds for both stores

3.2.6 Allocation of the cost of the activities to cost objects

Having determined the cost of the activities, the last step of the ABC model was the allocation of them into their cost objects, based on consumption that the latter has on the first. This allocation is made through activity drivers indicators, which in this case are the number of orders, receptions, clients, replenishments in store, average of products in the warehouse, average of products in the DC; average of products exposed in the store, and others that happened in 2015.

In the following table is shown the activity drivers related to the wild arugula seeds for both stores.

Activity Driver	Parque das Nações Store	Setúbal Store
Nº of Orders	3	3
Nº of Boxes ordered	3	5
Nº of Receptions	3	3
Nº of Replenishments	3	5
Monthly average of boxes exposed in the store	1	3
Nº of Clients	47	44
Nº of Units sold	62	66

Table 4 - Activity drivers of the wild arugula seeds for both stores

Having identified and quantified the activity drivers it was possible to determine the cost of the 3 products in each store, as well as the annual costs of the activities. For that, it was only necessary to multiply the activity driver by the related activity cost.
The main results of this ABC model will be shown in the next chapter.

4. ABC Model Results

The main objective of this work was to develop an ABC model in order to evaluate and differentiate the three main types of supply chains, realizing the impact that each circuit has on these 3 products.
In this section the results will be presented. Notice they are a direct consequence of the orders of the 3 products, made by the 2 stores during 2015.
The first results determined were the cost of each of the orders, which are equal to the cost of acquisition of the products plus the cost of its activities (along the supply chain).

4.1 Pellets – Direct Supply Chain

Parameters	Parque das Nações Store	Setúbal Store
Quantity ordered	46 pallets of wood pellets	44 pallets of wood pellets
Total cost of activities.	2.239,92 €	787,53 €
Difference on the profit margin	-0,3%	+10,53%

Table 5 - Pellets results

Table 5 shows that the Parque das Nações store had ordered 46 pallets and Setúbal store ordered 44. Contrary to what was expected before the development of the model, the total cost of the activities in the first store is 2.84 times greater than the Setúbal Store.
Regarding the difference in the profit margin, which consists of comparing the margin obtained by the ABC model and the profit margin considered by AKI, the results show that pallets from Parque das Nações are overestimated by 0.3 % and from Setúbal contrarily are 10,53% higher than what AKI considers. In other words, the ABC model shows pellets are substantially more profitable in Setúbal store than Parque das Nações. In order to understand the possible reasons for these differences it is necessary to analyse in greater detail the cost of the main activities for each store.

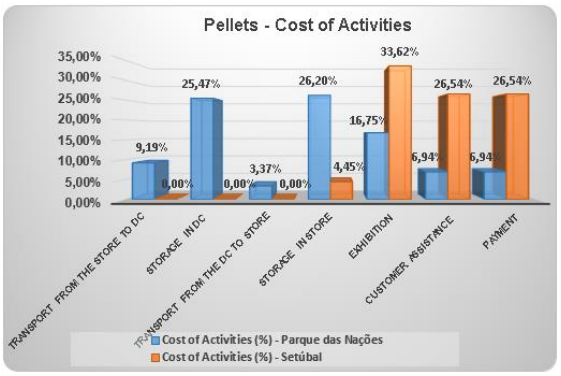

Figure 2 - Cost of activities of pellets

From figure 2, it can be observed that there is a substantial discrepancy in the percentage of the main activities for the two stores. In the Parque das Nações store the activities related to the transportation and storage of pellets on the DC have a huge impact on the cost of the product, together representing 38.03% of the total cost of the activities. In turn, the Setúbal store has no cost on these activities because they simply do not exist. The use of these activities by the Parque das Nações store is because of not having enough space to store the stock of this product. The store's warehouse area is 3.33 times smaller than the Setúbal store's and the client's exposed area is 2.62 times lower.
Concerning the activity 'Storage in Store', it is the most expensive activity for Parque das Nações, having a percentage of 26.20% (€ 586.81), while for the Setúbal store the percentage is 4.45% (€ 35.02). The reason for this difference is not related to the amount stored (as the average of pallets stored per month was equal in the two stores), but due to the fact the cost per square meter of Parque das nações being much higher than the Setúbal, namely 14.82 €/ month and 0.91 €/ month, respectively. The activity 'Exhibition' is revealed as the most expensive for Setúbal store, with a percentage of 36.62% (€ 264.33). The reason is that the average pallets exposed to clients amounts to 5 units, while in Parque das Nações only 1 unit is exposed.

4.2 Wardrobe – Warehousing supply chain

Having analysed the pellets follows the wardrobe, which is related to the warehousing supply chain.

Parameters	Parque das Nações Store	Setúbal Store
Quantity ordered	20 Wardrobes	50 Wardrobes
Total cost of activities.	897,30 €	426,36 €
Difference on the profit margin	-0,93%	+14,24%

Table 6 - Wardrobe results

Through table 6, it can be seen there was a total of 20 orders of wardrobes from Parque das Nações and 50 from Setúbal. It is also observed the total cost of activities was € 897.30 for the first store and € 426.36 for the second. As a result, the difference in profit margin determined for both stores are again dissimilar, -0.93% and 14.34%, respectively.

In order to understand if the reasons are similar to those observed in pellets, the most expensive wardrobe activities are shown in figure 3.

Figure 3 - Cost of activities of wardrobe

As illustrated, the most expensive activities are the 'Storage in Store' and 'Exhibition'. It again reinforces the importance of the cost per square meter, as it has a huge impact on products' profitability. Note the activity 'storage in store' has a weight of 38,75% for Parque das Nações while for Setúbal is 25%. Although, the average stored wardrobes is 5 times higher in Setúbal store. The same trend is observed in the activity 'Exhibition' where it is cheaper for Setúbal, the average of wardrobes exposed to clients being 3 times higher.

About the 'Transport' activity, it is seen it had a higher weight for Setúbal. This is due to the fact that shipping to this store costs 7 € / m^3. In turn shipping to Parque das Nações has a cost of 2.97 € / m^3. This activity highlights the importance of the distance between the stores and the distribution centre.

4.3 Wild arugula seeds – Cross-docking SC

The last product is the wild arugula seeds which are associated with the cross-docking circuit and where the main activities that add value (in AKI's point of view) occur at the distribution centre.

Parameters	Parque das Nações Store	Setúbal Store
Quantity ordered	3 boxes	5 boxes
Total cost of activities.	23,11 €	18,86 €
Difference on the profit margin	-24,50 %	-11,8%

Table 7 - Wild arugula seeds results

In Table 7 the reduced demand of this product is explicit. However the main objective for this product is not to obtain a substantial profit but to satisfy and retain customers.

It is important to note that although the margins determined by the ABC model are lower than those calculated by AKI, the profitability of this product was assured.

Again it is necessary to look in greater detail at the activities of this product to understand the nature of these results, as is show in figure 4.

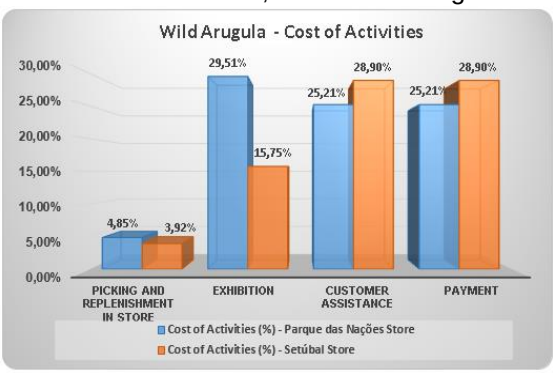

Figure 4 -Cost of activities of wild arugula seeds

Figure 4 shows that the most expensive activity for Parque das Nações is again the 'Exhibition', presenting 29.51% (6.82€). In turn, this activity has a weight of 15.75% (2.97 €) for Setúbal, confirming the importance of space and its optimization. The activity "Customer Assistance" also had a substantial weight for both stores. However, the time of these activities can hardly be improved, since the average of execution time is 1 minute for both stores. This product is part of a niche market and whose clients, most of the time, have a thorough knowledge of it. Through direct observation it was found great explanations weren't needed from AKI employees.

The last activity presented is the 'Picking and Replenishment in the Store' where the difference in percentages can be explained by the time taken to cover the distance between the area of reception and the exhibition area. In

the case of Parque das Nações the reception is located on floor -1 and the product is exposed on the floor number 1. In Setúbal both areas are located on the same floor. This activity demonstrates the relevance of the layout on the profitability of products.

4.4. Macro Analyses of the 3 Supply Chains

Until now the costs of the main activities related to the three products were analysed in detail. This in-depth analysis showed the impact that each activity has on the products. To complement this analysis it is necessary to look at these 3 supply chains with a more macro view of the processes. For this, the activities of each circuit were divided into two main groups, namely the common activities and core activities. The first activities, as the name implies, are the similar activities that occur in all supply chains. The core activities are activities that add value to the product and which are not common.

4.4.1 Macro Analysis of Direct SC

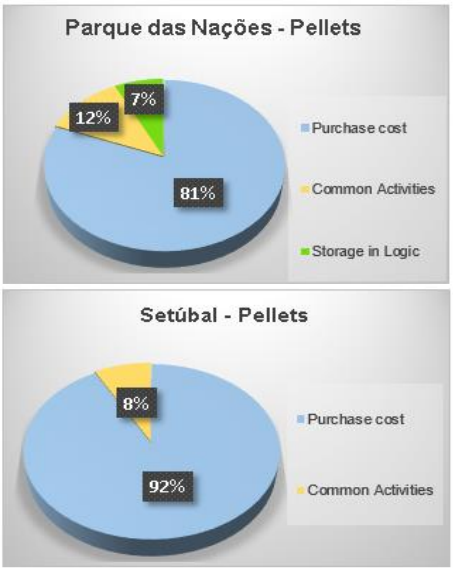

Figure 5 - Direct SC activities weight

Through figure 5, it is clear that the activities related to the direct SC have a substantial impact and so should be considered when determining the profit of the product. These activities were considered common activities since they also belong to the other 2 SC.
For Parque das Nações these activities costed 12% of the total cost of the orders. In Setúbal, these activities had 8% of weight. The figure above also shows the need for extra space to store the wood pallets in Logic Warehouse had an impact of 7%, and which Parque das Nações should take into consideration.

4.4.2 Macro Analysis of Warehousing SC

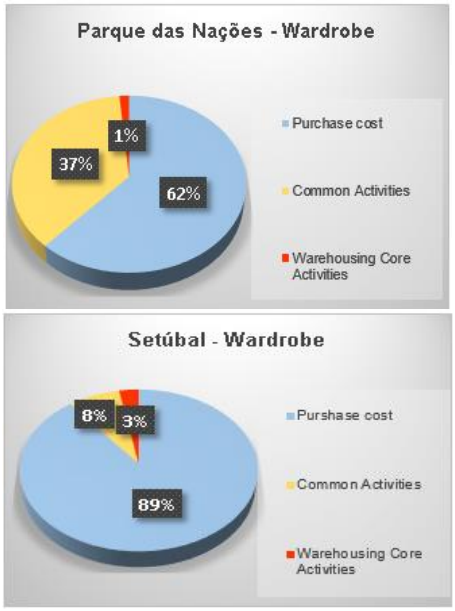

Figure 6 - Warehousing SC activities weight

Regarding the activities of the Warehousing SC, namely the activities related to the Wardrobe, It is found that the common activities costed 37% of the cost of the wardrobe orders for the Parque das Nações store, and 8% for Setúbal. Although the discrepancy in the percentage for both stores (reasons previously described) it was observed that the weight of the core activities varied from 1% to 3% and therefore had a lower impact on the product.

4.4.3 Macro Analysis of Cross-docking SC

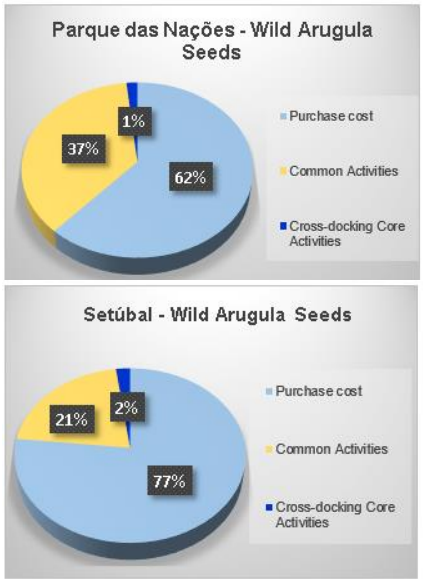

Figure 7 - Cross-docking SC activities weight

Concerning to the cross-docking activities, was observed that the common activities had a substantial weight in the cost of the orders of arugula seed, namely 37% for Parque das Nações and 21% for Setúbal. It was again shown that the core activities (activities in the distribution centre) had a limited impact, namely 1% for the first store and 2% for the second store (corroborating the pattern occurred in the Warehouse SC).

5. Conclusions

There are significant differences between the costs of orders determined by the ABC model and that calculated by AKI. However all products analysed are profitable. Still, because of the main characteristics of the Setúbal store, in particular the fact that it is a property of AKI (fully depreciated) and having a warehouse area sufficient to store all the stock, it was found that the three products are substantially more profitable when compared to the Parque das Nações store. The importance of the cost of square meter in the profitability of products and consequently on the profitability of stores is thus evidenced. It was also found that the core activities of the three SC had an impact ranging from 1% to 3% on the cost orders of the products. These results demonstrate that more important than the logistic supply chain used to fulfil the demand are the intrinsic characteristics of the stores (such as the size of the client's exposed area and the size of warehouse, the store layout, and the cost per square meter) since they have a significant impact on the profitability of products.

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