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Lean warehousing: A case study of a Greek warehouse

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situations in order for my twin brother and I to be happy and to achieve the best in our lives.

II. Abstract

Purpose: The purpose of this study is to firstly identify and illustrate the problems within a selected warehouse. This dissertation is based on the 5s lean tool and also aims to develop solutions in order the warehouse to work in a more efficient way.

Methodology: For this thesis, the observation method has been chosen as the most suitable way of gathering the necessary data. For 50 days, I had an active appearance in the warehouse where I observed the employees and the warehousing operations, I applied the 5s lean tool and finally the rest of the days I studied the results this tool brought both in the warehouse and employees as well.

Findings: The findings of this research indicate that a lean warehouse can finally exist with the help of a lean tool; in our case the 5s lean tool. In general, the warehouse does not remind the initial situation that I faced the first day. However, as every environment is different, great attention must be paid from warehouse managers, owners and lean practitioners on which methods and tools they will decide to apply in the warehouse.

Key Words: lean, wastes, lean warehousing, warehousing, 5s lean tool.

1. Introduction

This chapter provides the reader with the chance to become conversant with the topic and as well as the structure of the thesis. The reader will find a brief introduction around the lean framework and what remains unknown around this concept. This will lead me to the identification of the research questions as well as the aim of this thesis. Apart from that, the characteristics which adversely influenced the process, information of the selected company, and the structure of the remaining dissertation are also discussed at the end of this chapter.

1.1 Background

Nowadays, one of the fundamentals each company must follow, in order to achieve sustainability, is the right anticipation and estimation of customers wants and needs. It can be said that in today's world, the customer is the king, the one who pulls the strings in the business environment, and companies must exert themselves on how to maintain them in their quiver. However, phenomena such as globalization, the rapid increase of e-commerce and shortened product lifecycles, decelerate this situation, put extra pressure on companies and increase the level of competition (Russell & Taylor, 2008). Therefore, organizations are now seeking for innovative ideas and processes to stay competitive within the global sphere.

As a result, the solution that tends to dominate is the adoption of the lean framework, which has been used for some time in the past and continues to the present, and can help companies treat the problems they face (Bhamu & Sangwan, 2014; Shah & Ward, 2003); in other words, how to become lean.

The term "lean" firstly came to the surface through a bestseller book, "The Machine that Changed the World," which was published in 1990 by Womack, Jones, and Roos. In their book, the authors summarized the results from a research within the automobile manufacturing industry, which was hosted by the Massachusetts Institute of Technology University (MIT) and had started five years earlier (Stone, 2012). In simple words, lean is doing more and more with less and less, (Womack & Jones, 1996).

Lean, which was first applied to the auto-manufacturing industry, from its very beginning brought benefits such as better quality, higher productivity, and reduction of costs and waste (Womack, Jones & Roos, 1990). In addition to these advantages, lean holds the promise not only to improve quality and to decrease costs, but also to try to stabilize the operations (Drew, McCallum & Roggenhofer, 2016).

It is essential to underline here that lean is not only a practice, tool, or process that can immediately become applicable and bring results. Conversely, it is a whole mindset and philosophy, which these days has gradually been introduced to many countries, as well as organizations that are looking for ways to adapt it in their environment.

However, after a probe I did within few warehouses within my geographical area, I observed that this rapid expansion of lean's framework has not affected yet my country, Greece; or to be more precise the part where I live, as the managers haven't heard about this concept before.

This stagnation that I observed around the Greek logistics world and more specifically within my location, inspired me to conduct this thesis with the faith of finding and bringing new ideas that can convert this sector. As a result, after investigation, I decided to find a tool that can improve the operation of a warehouse, which, in my opinion, is the core foundation of any supply chain with the ability to run smoothly.

1.2 Problematization

As it has been underlined above, the lean framework has been used for some years in the past as early as the 1990s and it expanded to many Western industrial companies (Sanchez & Perez, 2001). However, through the book "The Machine that Changed the World", its reputation became diffuse, as many lean manufacturing practices were demonstrated by the biggest auto-manufacturing companies.

As a consequence, as its expansion generated from the auto- manufacturing environment, it was obvious that from its very beginning, authors would focus more on this industry. More specifically, within that sector, different writers such as Shah & Ward (2007) and Karlsson & Ahlstrom (1996) attempted to study and develop new lean operational models and tools, which first originated in the previous work of Womack et al. (1990) on the manufacturing companies.

As the results of this implementation were positive, lean's reputation did not take much time to spread out in other industries (Mustafa, Cagliano & Rafele, 2013) and hopefully elements of lean activities appear gradually in warehouses (Dehdari, 2013). However, for different reasons the situation around lean warehousing has not gained as much attention as in the manufacturing industry (Swart,2015)

To begin with, different authors (Sobanski, 2009; Cagliano, Grimaldi & Schenone, 2018) underline that both academic and profession literature do not abound and have poor structure especially on how to introduce lean tools and techniques in warehouses. Furthermore, articles around lean warehousing are not in abundance, as

authors underline that the operations in a warehouse are simpler in comparison to manufacturing processes and, thus, they are not considered for lean applications (Mustafa et al., 2013). Additionally, many practitioners, on their attempts to implement lean in warehouses, use the same methods and tools with those for their investigation within the manufacturing industry.

However, despite the fact that everything is about eliminating waste, according to Overboom, De Haan & Naus (2010), the major problem for implementing lean warehousing, is that every lean tool was only generated for the manufacturing industry. Consequently, a matter which started arising among writers is if lean or any other lean tool can become applicable to a warehouse as two different environments are presently considered, despite the fact that the lean framework is the same (Bozer, 2012).

An answer to the above inquiry can probably be given by Womack et al. (1990) statement, who firmly believe that lean is relevant to any company. However, the nature between a warehouse and a manufacturing industry is not relevant, as the latter focuses more on the production process. In contrast, there are not so many technical processes in a warehouse. Besides that, more manual work is needed in a traditional warehouse while the manufacturing industry stores many multifunctional machines.

To sum up, by taking into consideration the above statements from different authors, uncertainty is observed among writers around lean in a warehouse and its success. Companies believe that implementing a tool that brought prosperity into the manufacturing industry will bring the same results to the warehousing sector as well. Moreover, Billesbach (1994) mentions, that companies trust empirical evidence from other research papers which reveal a company's competitiveness and are led to the lean production formula. Apart from that, Mustafa et al., (2013) underline that the majority of the literature around lean warehousing is mainly academic and a gap is observed within practical approaches in order to be ensured that based on lean tools a lean warehouse can exist. Based on that, in order to bridge this gap between theory and practice a better and solid understanding of the lean theory needs to be established as well as practical applications of it. Without an established theory it is difficult to talk about practice, while without practice, theory has not any meaning (Moll 1992).

1.2.1 Aim and Research Questions

Even though the service sector has gained an enormous expansion globally, service productivity does not have a parallel line (Shahin, 2010). The improvement of management issues, such as supply chain management and inevitably, its dimensions such as logistics, warehousing, and information technology is becoming increasingly important (Shahin, 2010). Thus, the research problem underpinning this thesis is to investigate how a warehouse can work in a more efficient way, where the wastes will be minimized, the working environment will be different and based on the 5s lean tool to develop leaner solutions.

The focal point of this investigation is a warehouse in Greece. Warehouses are an integrant part of any supply chain. Its term in the past implied that something -good and/or service- could be stored for a long time (Bowersox, Closs, & Cooper, 2010). However, in today's fast-paced society its role is different, as goods and services should not be stored for a long period of time (Myerson, 2015). Consequently, in order to achieve that, the most important goal we have to accomplish is to increase the efficiency and flexibility within the warehouse and its operations as well (Bowersox et al., 2010). Handling, storage, inventory management, and shipping are some of many warehouse operations which take place on a daily basis.

Summing it all up, and based on the knowledge gap, the research questions this thesis will manage to answer are:

1. What are the typical problems the warehouse has in regard with its daily process and routine?
2. Will the 5s lean tool make the warehouse leaner when implementing the tool? If so, in what way the warehouse will be leaner?

To answer the questions above, I need firstly to analyze the operations of the Company 1 warehouse. This can be achieved through the observation method, as I am going to collect all the appropriate material in order to evaluate the warehousing processes, to find the weaknesses which need "treatment", and in the end, to conduct the case study. More information about how the observation method will be achieved is given in Chapter 4. Apart from that, theoretical concepts and materials such as ABC analysis, 5s lean tool, and warehousing are needed, in order to find answers for the

research questions. It is believed that the combination of these concepts together will enlighten the readers as to better understand the topic.

Each theoretical concept, individually and collaboratively, gives its accent to the thesis and contributes to the construction of the case study. For that reason, in the beginning I decided to analyze the warehousing concept, in order to display the processes that can be executed in a warehouse. This analysis aims to help us gain a general overview of how a warehouse works nowadays. Once all the appropriate materials around warehousing have been adequately presented, and the reader has gained an essential familiarization of warehousing, it is time to research the philosophy in its practical extensions. For that reason, a certain mindset is required so as to slip smoothly into the lean mentality. This can be accomplished through lean thinking philosophy, of which the principles will help us understand the lean philosophy which is needed before implementing the 5s lean tool in any warehouse.

Once all these materials have been displayed, the reader will be conversant with how a warehouse works, the lean mentality, and what types of waste a warehouse has. As soon as this process has been successfully achieved, tools such as ABC analysis and 5s tool will be introduced in this research and demonstrate the transformation of the warehouse in a leaner way.

The 5s concept, which originates from the Japanese culture, has as a primary objective to create a clean, safe, organized, and high-performance environment (Pasale & Bagi, 2013). Ultimately, a clean working environment plays a vital role in enhancing both working efficiency and productivity. As its name reveals, it is consisted of 5 steps, which are: 1) Short, 2) Set -in- order, 3) Shine, 4) Standardize, and 5) Sustain, while all of them cover different areas. However, detailed analysis within this tool is done in Chapter 3.

1.3 Limitations

The route for the conduction of this thesis was not without its difficulties and challenges. In the beginning, I had chosen a different warehouse to make my analysis and to apply the 5s lean tool. Even though there was willingness to coordinate with the warehouse manager, as the former had a basic knowledge around the lean

framework topic, finally it was not feasible due to the pandemic (COVID-19) which has affected the whole world.

For that reason, I had to find a new company to cooperate with, near the region I live, as my country was under lockdown for approximately 2 months. Eventually, after some rejections I received, I ended up with Company 1. I chose this company as from the very first days they were willing to co-operate with me, while at this moment, the company is one of the biggest logistics companies in the Eastern Makedonia and Thrace district within the food delivery sector.

However, the problems did not cease, and the difficulties could not be overcome. More specifically, the warehouse manager was not available during the period I wanted to make observations. Apart from that, as he was not familiar with the lean framework, I had to provide to him valuable time and material so he could be informed about the principles of lean and the tool I want to focus upon. Moreover, the fact that the government prohibited any needless movement outside homes in my region, made my plan more difficult.

1.4 Company's Background

The history of the company has its roots back in the distant past, when, in 1998, two businesses decided to merge and to establish the company as it is known today. The common denominator of this conflation was the emergence of a company that would dominate in the market arena and, more specifically, within the logistics environment.

The company's facilities are located some kilometers away from Kavala city, a region in the northern part of the country. Having a satisfactory annual turnover, the company belongs to the small and medium-sized enterprises, while the owners' target is to increase this number steadily.

With the constant improvement of its activities, contemporary facilities, and following the hygiene rules regulated by ISO 22000, at this moment, the company is one of the biggest logistics companies in the food delivery sector in the Eastern Makedonia and Thrace district. The Company's routes serve the districts of Drama, Xanthi, Komotini, and Kavala, while the Company's 3PLs are responsible for Serres, Thessaloniki, Evros, and Kilkis districts.

The Company 1 collaborates with firms such as Nounou, Dodoni, Pepsi, and Nikas, which are known not only in Greece but all over the world. Apart from that, the firm is trying to help the promotion of local dairy products as much as it can with the ambition to make them known in the whole country.

Finally, consistency, reliability, and ethics are the three principles that govern every facility of the company, which tries to “engrave” its route based on them.

1.5 Outline

Table 1: The structure of the Thesis

<p>1. Introduction</p>	<p>This chapter provides a brief introduction around the lean framework, as well as the reasoning behind its selection for research. In addition, the research questions and problematization section are mentioned in this chapter. A short description on the selected company is also stated.</p>
<p>2. Literature review</p>	<p>In chapter 2, the reader will have the first exposure to essential aspects of the lean framework. Historical background, and an introduction to lean environment in different sectors are also displayed in this chapter.</p>

3. Theoretical Framework	Chapter 3 elaborates on theories and concepts relevant to the study. It will help us to decode and answer the research questions.
4. Methodology	Chapter 4 includes the methods, that I used to collect all the appropriate materials for the conduction of the case study.
5. Outline of the case study	The fifth chapter illustrates the warehouse processes at Company 1. In addition, it provides information for the implementation of 5s.
6. Empirical Findings	This chapter is devoted to an analysis of the findings from the case study.
7. Discussion and Analysis of findings	This chapter aims to bind together the theory with the findings.
8. Conclusion and Future research	Chapter 8 includes suggestions for future research and a general resume around the 5s lean tool.
9. Reference List	This is the last chapter of the study, which refers to the articles that were used for this thesis.

2. Literature review – Previous research

This chapter is used as a summary of the research topic so as to present and inform the readers about it.

2.1 Lean Framework

2.1.1 Historical Background of the lean framework

The lean framework originates from the Toyota Production System and is a production method which was invented by a genius mechanic of Toyota, Taiichi Ohno, (Womack et al., 1990). After the Second World War, the situation in Japan was not the anticipated one, as the capital was minimized, and the country's economy was demolished. As a result, the Toyota company started facing some business challenges, which motivated them to start the journey to the lean strategy (Drew et al., 2016).

After a trip Eiji Toyoda and Taiichi Ohno did in the world's largest automobile economy in the USA, they realized that if Toyota wanted to win the battle against the Western automobile organizations, then they should integrate both mass production and craft production, (Womack et al., 1990). After a series of experiments they did, these started bearing fruits and after a short period the TPS brought competitive advantages to Toyota and other Japanese car manufacturers, (Dahlgaard-Park & Dahlgaard, 2006). This regeneration of the Toyota company caused a diffusion of lean practices within the Western automobile companies firstly, while throughout the years in different environments and organizations as well (Shah et al., 2007).

The mindset of TPS which has its roots in the Japanese philosophy, is on how to reduce Muda; in simple words how to eliminate waste (Dahlgaard-Park et al., 2006). As stated by many authors (Salhieh, Altarazi & Abushaikha, 2018; Womack et al., 1996), the wastes are:

1. Over-production
2. Defects
3. Waiting
4. Motion
5. Inventory

6. Transportation
7. Over-processing

The TPS was introduced and became known to the public through the book “The Machine that Changed the World”, where the results of a benchmark study from a research team from the MIT University- with John Krafcik as a leader- were illustrated (Dahlgaard-Park et al., 2006). Toyota applied lean methods in both its supply chain and warehouse but in different ways (Jones, Hines & Rich, 1997). By doing so, the company achieved to minimize its stock 6 times, while productivity improved up to 3 times (Jones et al., 1997).

2.2 Lean in Supply Chain

2.2.1 Lean in different environments.

As it has mentioned above, the mindset of TPS is derived from the auto-manufacturing environment and delivered Toyota with competitive advantages. However, one thing which must be stated here is that not all the practices which have been applied from Toyota, can become applicable to other environments. More specifically and due to the fact that every organization differs on each other, some practices can be applied to other environments without the anticipated results, while some others can be applied easier, better and in a more efficient way to other industries. For that reason, Wilson (2010) believes that lean practices can be partly efficient to other companies beyond the manufacturing industry only if firms do not diverge significantly from the business conditions. As a consequence, according to Wilson (2010:33) “enterprises in order to adopt lean must be driven by four basic concepts:

- The enterprise must be in a competitive free-market environment. For those entities that are not struggling for profits and or survival, there is simply insufficient motivation to undergo the discomfort of the huge cultural changes it takes to implement a lean initiative.
- There must be a clear customer focus. The enterprise must know who the customers are, what they need, and what they want. The enterprise must continually work to supply their needs and work to be ever improving in both finding and meeting the needs of the customer. In leanspeak, these needs and wants of the customer are value.
- In supplying value to the customer, a key strategy must be the elimination of waste.

- The business must have a long-term focus, even at the expense of short-term gains”.

Based on the criteria illustrated by Wilson (2010) it cannot also be concluded that lean is not applicable to warehouses. At first and without any doubt, warehouses work in a highly competitive environment as they are part of a whole supply chain. Secondly, they have a strong focus on customers as in many cases they are the final link with them. Lastly, as every firm has a strategy, a warehouse must focus on a management which has been followed for a short or long period of time.

2.2.2 Lean in logistics

For many organizations, the critical element for a lean system is the development of a sustainable supply chain (Cox, 1999). Logistics and supply chain refers to the management of a network that helps the combination of many players such as retailers, suppliers, distributors, and manufacturers to prepare and provide materials and products from a source to a user (Peng, Xu & Chen, 2001).

Logistics, which is a field on the ground of supply chain, is the most vital part of a company, aiming to get the right product in the right place and time, in the agreed quality and quantity, and at the lowest cost (Vasiliauskas & Jakubauskas, 2007). As a consequence of this, firms have already started to use lean practices in order to upgrade their logistics system (Jones et al, 1997).

Lean logistics operate in a similar overall fashion as traditional logistics. However, the main challenge of the former is to enhance the control of the movement of goods and products to the customers with the lowest cost; in simple words lean distribution, (Overboom et al., 2010). Nevertheless, how this improvement can be achieved?

Lean supply chain focuses on waste reduction and helps firms to eliminate any nonvalue added activity related to space, equipment, set up time, and inventories, (Corbett & Klassen, 2006). All these strategies can create value to the customers, as the service will be improved, the costs will be decreased, and the quality will be enhanced (Larson & Greenwood, 2004). However, the inbound and outbound movement of goods and products are two major processes within a warehouse.

Based on specific findings from different researchers, in the United States, 23% of the total logistics costs refer to warehouse costs (Baker & Canessa, 2009), while in Europe, this rate

has launched to 39% (Fumi, Scarabotti & Schiraldi, 2013). As a consequence, and based on the above rates, an innovative warehouse is needed in order to ensure a lean supply chain and a muscular logistics system.

2.2.3 Lean warehousing

Traditionally, there is the belief that warehouses are places, rooms or departments to hold and storage products and/or materials. However, beyond the storage of inventory, warehouses add an extra value to customers and play a vital role that have never had before.

As it has been underlined in the problematization part, research around lean warehousing has been lagging and more practical approaches are needed in order to be believed by different authors, writers and lean practitioners that a lean warehouse can finally exist.

According to Dehdari (2013:20), "lean warehousing is a leadership concept. This concept aims at a permanent, systematic, analytic, sustainable, and measurable improvement of processes in the warehouse environment. This happens with the contribution of all employees and with the goal of gaining awareness of perfection in each corporate action". Moreover, Mahfouz (2011) believes that the role of a lean warehouse is to increase the responsiveness to the customers. It must be underlined here, that being responsive to customers in warehousing terms means to deliver the right order, without any delay and missing quantities. All these activities can increase the value of customers and help the warehouse to develop.

The vital task in a warehouse is to assemble the orders in an efficient way and to minimize inventory levels. For that reason, lean warehouses demand the optimization of essential activities such as replenishment, dock operations, order picking, material flow, kitting, and shipping (Garcia, 2004; Bartholomew, 2008). Apart from that, lean in a warehouse demands the reduction of non-value adding activities in receiving, storage, picking, and shipping processes (Myerson, 2015). As a result, in order to minimize these activities, it is important to focus on the resources which generate the wastes. The identification and minimization of the wastes in a warehouse is very crucial, as their elimination can improve the productivity levels which can lead to leaner operations (Hines & Rich, 1997).

As stated by many authors (e.g., Hines et al., 1997; Salhieh et al., 2018; Womack et al., 1996), the resources which create wastes in warehouses are the following:

1. **Over-processing.** *It occurs from unnecessary activities that do not add extra value not only to the item or product being produced but also to the customer (Domingo, 2015).*
2. **Waiting.** *Waiting is a waste which occurs due to the inertia of both machine and workers (Hines et al., 1997).*
3. **Transportation.** *This waste occurs anytime goods or materials are being moved about (Pereira, 2009).*
4. **Motion.** *The waste of motion refers to any unreasonable movement of personnel in the aisles of a warehouse and ultimately occurs due to the poor layout, organization, and sorting of the SKUs.*
5. **Defects.** *Defects waste occurs when any task or finished product is less than the level of customer expectations and needs to be re-made or shipped back (Pereira, 2009).*
6. **Over-production.** *Over-production results from producing more or faster than the customers' needs. The reason this is called the mother of all waste is that it has an impact on other waste (Pereira, 2009).*
7. **Inventory.** *Inventory is the unnecessary accumulation of components needed to produce a product, work-in-progress, and finished goods held in a warehouse (Okpala, 2014).*

One way to identify the above scraps in a warehouse before implementing any lean tool, is to create a value stream map (Garcia, 2004). Wilson (2010:36) in his book posits that “wherever there is a value stream, lean will apply”. In simple words, a VSM (visual stream map), is a method of designing and placing a picture in a large piece of paper including all the processes within a warehouse, where both value added and non-value added activities among the processes must be illustrated (Garcia, 2004). The map below (Figure 1), depicts how the warehouse operates, while it also displays some actions within the processes, both value-added and nonvalue added.

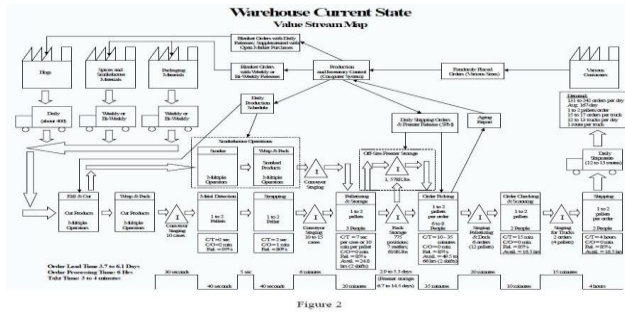


Figure 1: Warehouse Current State Value Stream Map, Figure 2 (Garcia, 2004)

Jones et al. (1997) on their article, focused on Toyota’s supply chain and the methods which led to lean logistics (Figure 2). Toyota, in its warehouse, applied the same type of logic as within the production sector, but in different ways. In the beginning, they focused on how to reduce bin sizes and how to store materials by the type with the most frequent usage. Apart from that, they organized standard binning and picking routes for each part and divided the working day and tasks into standard work cycles. Moreover, Toyota aimed to synchronize order-pick-pack-dispatch and delivery steps for every journey (known as milk round) to local drivers. In order to avoid any irregularities, the process was controlled through binning or picking ticket bundles and visual control. Finally, recording defects and prioritization of conduct root brought elimination of the most frequent problems to prevent recurrences and improve the process. With the implementation of these methods, Toyota's stock was down from 24 to 4 weeks, while productivity improved to three times (Jones et al., 1997).

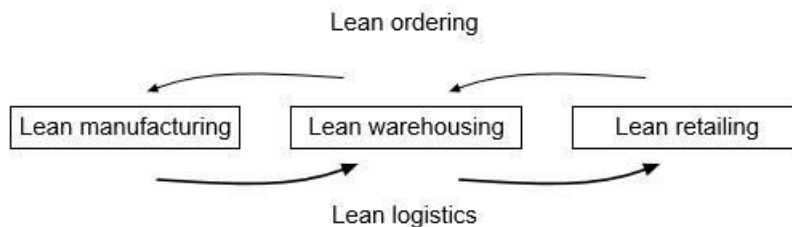


Figure 2: The downstream lean value stream, Jones et al. (1997).

By analyzing Toyota's lean warehouse, its theoretical concept and making a research on his own around this topic, Bozer (2012) achieved to complete a clear perspective around lean warehousing. More specifically, Bozer (2012: 26) "summarizes some principles in order to create a lean warehouse:

- Use 5S, visual management, problem-solving, and kaizen.
- Use status at a glance boards and scoreboards—Is the system on track or behind? Are we winning or losing? Can we go on a self-guided tour of the site? Use standard signage throughout the facility.
- Use standardized work, and standardized equipment by zone/area of warehouse.
- Establish one-piece flow in receiving, put-away, picking, packing, and loading.
- Level the flow throughout the facility; reduce unevenness or overburdening.
- Implement pull system based on order due dates.
- Minimize or eliminate staging locations in receiving, put away, and shipping.
- Eliminate or reduce "touch points" or "hand-offs" between process steps.
- Establish pacemakers. How is work dispatched to the floor?
- Schedule inbound/outbound shipments by time windows.
- Eliminate all excess inventories.
- Use Lean storage—commodity code slotting and velocity slotting.
- Measure, improve, and justify cubic and square-foot storage density with the intent to improve storage as well as travel times.
- Use small-lot packaging, pre-sorted by commodity inbound from suppliers.
- Perform smaller, more frequent replenishments.
- Pick to shipping container without handing over to another person or department.
- Promote continuous improvement and learning.
- Train local leadership on Lean principles, and identify a pilot facility for Lean.
- Perform shift start meetings, and identify/track progress on current challenges".

2.3 Summary

The conducted literature review aims to provide an overall study around the lean history and the lean framework in different environments. From the retrospection of lean manufacturing until lean warehousing, it can be concluded that lean is not only applicable to manufacturing sectors. Different environments can gain a lot from the implementation of lean framework. Although the mindset behind lean is the same, the methods within environments vary. The adoption of appropriate practices is crucial and can lead to the success or failure of a company. It cannot be said that Toyota was lucky. However, after many years of experiments from Ohno, they managed to find the best practices.

3. Theoretical Framework

The theoretical framework in comparison with the literature review is used so as to display all those relevant theories, concepts, and models around the research problem, and are operated as the foundation for the analysis part and answers to the research questions. Apart from that, the materials which are used in this chapter helped me to “establish” the case study.

3.1 Warehousing

3.1.1 Warehouse processes

With such an enormous growth in the global SC (supply chain), the importance of warehouses has changed, while their necessity to work better, faster, and more effectively, put them under large pressure. A result of this pressure is the gradual transformation of warehouses to a more efficient and leaner environment which certainly requires the reorganization and optimization of all the warehousing processes (Jones et al., 1997).

The new market forces together with the fast technological developments, have changed the services inside a warehouse (Van den Berg & Zijm, 1999). The

complexity within warehouse activities is mainly shaped by: "1) the number of different products handled in the warehouse, 2) the number and the variety of the processes outside the warehouse, and 3) the number of order lines processed by the warehouse per day", (Faber, De Koster & Smidts, 2013:1235).

Even though different types of warehouses exist and consequently, different types of activities are required, the majority of researchers conclude that all warehouses must execute at least some basic operations (Gu, Goetschalckx & McGinnis, 2007; Van den Berg et al., 1999).

According to Van den Berg et al. (1999), these operations are: 1) Receiving, 2) Storage, 3) Order-picking, and 4) Shipping. Furthermore, many times packaging is also listed as part of these processes and mostly takes place before the shipping process. For better facilitation, Bartholdi & Hackman (2008) underline that these operations can be divided into 1) Inbound activities, and 2) Outbound activities. The former group of activities includes receiving and storage processes, whereas the latter, order-picking, and shipping operations.

1. **Receiving:** It is a common fact that this activity entails the first encounter between the warehouse and the merchandise that is carried. Most of the products, materials, items, and so forth, are commonly transported by large trucks, in large quantities or small quantities -it depends on the business policy- and are stored on pallets.

Once the shipment has arrived, the first activity is to unload it into the warehouse (Bowersox et al., 2010). For the unloading process, many warehouses prefer to use a combination of forklifts and conveyors. When the freight has been unloaded, and before its allocation, the products are inspected through random quality checks, quantities are verified, and any exception such as damage, missing portions, and wrong products are noted (Bartholdi et al., 2008; Van den Berg et al., 1999). Once the warehouse staff ensures that nothing is missing, products are put on pallets or containers, and a label (e.g., barcode) is attached on the shelves or in every carton individually (Van den Berg et al., 1999). This will help the warehousing staff to find where the product is located immediately. In the receiving process, there is an assignment policy that can determine the allocation of trucks to docks (Rouwenhorst, Reuter, Stockrahm, van Houtum, Mantel & Zijm, 2000). After this procedure, the load is ready to be transported to the next area.

2. **Storage:** During this process, the load is held in the warehouse and is stored in a determined location within the warehouse which is used only for the storage of products and/or goods. This may be bin shelves and modular storage drawers for small items, pallet racks, gravity flow racks, or mobile storage racks if the products are bulky or even on the floor (Myerson, 2015).

An SKU (stock keep unit) is possible to be stored in more than one place in a warehouse. For that reason, the storage area must be divided into zones, a process that can facilitate the next operation. Apart from that, Rouwenhorst et al. (2000) claim that the storage area must encompass two parts: a) reserve area, and b) forward area. High demand and fast-moving products must be stored in the former, whereas the latter is responsible for the bulk storage (Van den Berg, Sharp, Gademann & Pochet, 1998).

Storage is a significant activity and closely related to inventory management.

Consequently, how much inventory can be kept, how frequently should the SKU be replenished and where should the SKU be stored in the warehouse, are questions which can determine not only the smooth flow of this process but also the warehouse operation as a whole (Gu et al., 2007).

3. **Order-picking:** This process occurs when a customer demands a product -in simple words when articles must be delivered to customers- or when the forward area must be replenished (Myerson, 2015). It can be performed both manually (by one or more order-pickers) or it can be partly automated, while an order-paper presents the quantities and the code of the required product (Rouwenhorst et al., 2000; De Koster, Le-Duc & Roodbergen, 2007). Orders can be collected through different methods such as single-order picking, batching with sort-whilepicking, batching with sortafter-picking, etc., (Gu et al., 2007).

The order-picking process is the most complicated process of a warehouse as it consumes between 50% to 60% of all labor activities (Drury, 1988 in Manikas & Terry, 2009). However, this percentage maybe vary among the companies as the storage policy differs. As a result, the picking process is more complicated and time-consuming in some companies while not in others. For example, warehouses prefer to store the goods based on the merit of each product, or brand names, or frequency sales rate, while others have not any policy. Consequently, when there is not a hierarchy in the storage area, employees face many problems such as many back and forth

movements. For that reason, the segregation of the storage area in zones constitutes an advantage for the order-picking process, as it can minimize the time which an employee needs for the gathering of the products. In order to achieve this segregation in zones, ABC analysis will play vital role in this dissertation as it will facilitate the author's intention of dividing the products based on the frequency sales rate and of storing them in three different aisles.

4. **Shipping:** This process encompasses the scheduling of the carrier, the placing of products on the shipping docks, and their loading into the mean of transport (Myerson, 2015).

Shipments must be firstly checked for their accuracy and later be packed. Efficiency and packaging are critical measures of customer satisfaction (Bartholdi et al., 2008). Inaccurate orders not only are annoying for the customers but also generate returns, which are expensive for the company (Reverse Logistics). Furthermore, customers prefer to receive the products in as few parcels as possible, because it minimizes the shipping fees. Packed products must be scanned in order to inform the warehouse system that something has been dispatched and to renew the inventory system.

Summarizing each warehousing activity, it is a common fact that both receiving and shipping processes pull the strings in any warehouse. It is fundamental to record each incoming or outgoing unit of the warehouse for both cases. This will contribute to the constant update of the inventory, which is an integral part of the warehouse and a significant threat (Staudt, Di Mascolo, Alpan & Rodriguez, 2014). Thus, good execution of inventory management can lead to a lean warehouse.

3.2 Lean Thinking

3.2.1 Lean Principles

As it has been mentioned, lean thinking strategy is not an easy task, and for that reason authors and lean practitioners tried to find ways on how to become fully comprehensible by everyone.

Womack et al. (1996) in their article address five fundamental lean principles that must be comprehended and evaluated from the companies before making the decision

to implement any lean activity. In more simple words, lean principles are some tools that are used in order to execute the lean thinking strategy in any environment, (Stone, 2012) and for that reason they have been selected for our case as well.

These lean principles are:

1. **Define value from the customer's perspective.** That means that companies need to identify to whom they address and what they regard as value.
2. **Identify the value streams.** That means eliminating everything which does not give value to the end product. More specifically, organizations need to stop production when they realize that a process or something else is going wrong and change it as soon as possible. Procedures that can be avoided are overproduction, storage of unnecessary materials, unreasonable movement of products and workers and others (Aziz & Hafez, 2013).
3. **Make the value flow.** It means that companies must ensure that there is a continuous flow within the whole value chain. Organizations need to focus on each step of the process and not on the product. However, this can be achieved if we have identified the value stream and the customer's value (Aziz et al., 2013).

At this point, the researcher feels the necessity to underline the difference between principle 2 (Identify the value stream) and principle 3 (Make the value flow). To begin with, as far as the second principle is concerned and as it has mentioned in section 2.2.3, identification of the value stream is the mapping of all the processes and steps of an organization (in our case it is a Greek warehouse), where both value added and non-value added activities take place, (Garcia, 2004). This principle, by analyzing each step, aims to identify all the wastes that cause problems and create a delay on each process. Once the wastes have been identified through the VSM tool, it is necessary for the company to ensure that the remaining activities on each process run smoothly. For that reason, principle 3 is responsible for that. Managers need to have a close eye on each task and once something get stuck, they need to know why that occurs.

4. **Implement pull-based production.** Here, we have a transformation from the push to the pull system. The former relies on a predetermined schedule while the latter on customer requests (Russell et al., 2008). In other words, it means to produce what

customers want at the time they want it and to be ready for any change from the customer (Aziz et al., 2013). With the pull system, waste can be the most easily eliminated as when a customer orders a product, workers go back to previous stations and take only the parts or materials they need. Consequently, when something has been taken away, workers of earlier stations know that it is time to replenish the quantity that has been removed and to start producing (Russell et al., 2008).

5. **Continuously strive for perfection.** Once all the previous stages have been performed to a great extent, organizations need to find ways on how to improve them even more as now they have been more transparent.

The principles above indicate that lean thinking is a long journey based on three goals: 1) Flow, 2) Harmony, and 3) Synchronization (Elliot, 2001 in Bhasin & Burcher, 2006). Moreover, it is vital for organizations to understand that lean is a whole mindset and not only a simple tool, process, or practice before implementing it (Atkinson, 2004).

However, even though the above principles are characterized by many authors as the foundation for implementing lean in any environment, Basl & Sasiadek (2014) and Womack et al. (1990:59) underline that “the dynamic work team is at the heart of lean.” Additionally, a survey from Angelis, Conti, Cooper & Gill (2011) confirms the previous statement, as they also concluded and verified that workforce commitment is crucial for the implementation of lean thinking into a lean organization.

Workforce commitment adds a feeling of loyalty to workers towards organizations and leads them to remain in the same organization (Meyer & Allen, 1997). It is a common fact that workers, as human beings, would like to be treated equally and with respect in order to be more determined, productive and proactive. The three types of workforce commitment are 1) Affective, 2) Continuance, and 3) Normative (Angelis et al., 2011).

Affective workforce commitment has to do with the attachment a worker has with an organization and how amenable it is to take part in activities beyond job boundaries. On the other hand, continuance workforce commitment is a decision an employee makes to remain in an organization due to the lack of alternatives he/she has. Finally, normative workforce commitment is linked to the obligation feeling the employee has. Consequently, only the affective workforce commitment is positively associated

with lean thinking, as it motivates the employees to go beyond the traditional routine and to find ways to evolve themselves and the organization (5th lean thinking principle).

3.3 The 5s lean tool

According to Sumant & Patel (2014), lean tools play a vital role as they deal with the practical perspective of the lean framework. The scientists (e.g., Lanigan, 2004; Bartholomew, 2008) have agreed that there are many tools such as Kaizen, Kanban, Pull system, and Heijunka. However, based on an analysis which has been executed from Sumant et al. (2014), the 5s lean tool looms among the others. The result of this analysis motivated me to particularly focus on this tool, and for that reason, it has been decided for it to be applied in the selected warehouse.

The 5s concept, which originates from the Japanese culture, has as a primary objective to create a clean, safe, organized, and high-performance environment (Pasale et al., 2013). Ultimately, a clean working environment plays a vital role in enhancing both working efficiency and productivity. Apart from that, except the increase in the profit the 5s lean tool can bring in a company, another main objective of this tool is the improvement and maintenance of employees morale and motivation (Wojtynek, Kulinska E, Dendera-Gruska & Kulinska K., 2018)

Pioneer of the 5s concept was Takashi Osada in the early 1908s (Pheng, 2001). In Japan, this tool is recognized as “a group of organizational and cleaning activities that shape basic morality and ethics in the workplace, at school, and in the home” (De Mente, 1994 in Kobayashi, Fisher & Gapp, 2008:246).

The literature indicates that around the 5s lean tool, two frameworks have emerged. According to Kobayashi et al. (2008), the first view 5s as a philosophy, whereas the second as a technique or tool. As its name reveals, this tool consists of 5 steps which are: 1) Sort, 2) Set-in-Order, 3) Shine, 4) Standardize, and 5) Sustain (Pasale et al., 2013).

Sort: Sort, is the first step and refers to the separation of items, products, or materials in three categories (required, may be required, not required), (Pasale et al., 2013). During the implementation of the sort step, questions such as why it is needed, how often it is needed, and when it is needed, are necessary to be addressed (Filip &

Marascu-Klein, 2015). Hence, a useful method that can support this step is the ABC classification analysis, which in this thesis helps us sort the products based on the frequency sales rate.

Set-in-Order: This step is required in order to put the products in assigned places while efficient and effective storage methods are needed. Activities such as floor and aisle markers, maps, signs, labels on the shelves, and inventory tags, are some out of many storage methods (Filip et al., 2015). Once this step has been implemented and products have been sorted and adequately arranged in zones, the order-picking time will be shortened, and the inventory control will be better (Pasale et al., 2013; Filip et al., 2015).

Shine: At this stage, the warehouse, the floor, the forklifts, the working area, and any other items are cleaned. Quality can be achieved only through regular cleaning (Filip et al., 2015). During the shining stage, it is possible to detect any problem in the machines, shelves, equipment, and every source of disorder. By maintaining the warehouse clean, the accidents will be eliminated, the working environment will be improved, and instant documentation about damages will be achieved (Michalska & Szewieczek, 2007).

Standardize: After the correct implementation of previous steps, this stage requires that the previous three activities be maintained through a continuous practice from workers, (Titu, Oprean & Grecu, 2010). Standardization of working activities provides transparency and quicker completion of different tasks (Liu, 2006).

Sustain: This stage requires the mental and physical discipline of workers to maintain the 5s strategy (Pasale et al., 2013). Without having the self-discipline, it is easy to slip back to old habits and ruin anything you had achieved. “Continuous reinforcement and communication with staff members help to build up and promote a culture of self-discipline” (Liu, 2006:4).

Even though the methodology and the steps of the 5s lean tool are the same universally, the way companies view this concept is different. After a research which was conducted by Kobayashi et al. (2008), it became clear that the mindset between Japanese and Western organizations differs. For the Japanese organizations, the 5s is a philosophy that helps not only the workplace but also the actual organizations by changing the way they think (Peng, 2001). On the other hand, Western organizations

utilize 5s as a technique. However, using 5s in this way provides only short-term results without guaranteeing the improvement of the company in the future (Kobayashi et al., 2008).

3.4 ABC Analysis

As customers are becoming more demanding, and product complexity increases, organizations are obligated to stock a wide variety of units. Additionally, due to the rapid increase in technology, the products life cycle is minimizing, and the danger of unsold products is increasing. Under these circumstances, advanced inventory management activities are needed in order to help firms obtain their competitive advantage (Chen, Li, Kilgour & Hipel, 2008).

The number of SKUs (Stock Keeping Units) held by any firm can quickly launch to enormous levels. From an economic point of view, it stands to reason that it is not realistic to implement different inventory activities for each SKU. Apart from that, each product has different roles and importance for a firm, and hence different levels of management treatment.

In order to run a reasonable inventory control, it is useful for any firm to group its SKUs into manageable and meaningful categories based on criteria of its choice (Chakravarty, 1981). Based on a survey, which was hosted by Zhan, Hoop & Supatgiat (2001), 11 out of 12 participated companies, use the simple form of ABC analysis for their SKUs classification. It can be said that ABC analysis can only eliminate inventory waste, as its key spot is the inventory control. However, in our case, the use of ABC analysis aims to categorize the products in three parts, based on their frequency sales rate.

According to (Blackstone & Cox, 2008 in Teunter, Babai & Syntetos 2010:343), ABC analysis is defined as “the classification of a group of items in decreasing order of annual dollar volume or other criteria. This array is then split into three classes, called A, B, and C”. The “A category” products correspond to 70%-80% of the annual consumption value of the company. Consequently, better inventory control, more storage area, and avoidance of stock-outs on A products are required from managers and employees. Furthermore, category B stands for 15%-25% of the annual

consumption value of the firm, while category C has the lowest annual consumption value, which is equal to 10%-15%.

Depending on what part of the company is concerned, the classification of the SKUs is a subjective decision and varies among firms (Flores & Whybark, 1987).

Traditionally, the classification approach is based on a single criterion, where demand value and demand volume are the most preferable variables (Teunter et al., 2010).

Although a significant advantage of choosing a single criterion is simplicity, many authors prefer multiple criteria including lead time, rate of obsolescence, customer complaints received on product items, etc. (Teunter et al., 2010).

ABC analysis is beneficial in many ways, and that is why it is widely adopted by organizations. Firstly, not only managers but also employees can have better inventory control, especially on high-demanding products. Secondly, it can define products generating maximum profit for the company and provide safeguard control over them (Mahagaonkar & Kelkar, 2017). Lastly, efficient management of the storage area can be provided by focusing on the critical activities of the company.

All organizations need an appropriate activity in order to manage their inventory control and planning system. Inventory is a significant asset in most organizations and one of the primary wastes in a warehouse. Therefore, efficient management is a crucial task for every organization.

In this thesis, ABC analysis is conducted in order to sort the products of the selected company's warehouse based on the frequency sales rate variable. By following this method, I will classify the products in three groups (High, Moderate, and Low frequency).

4. Methodology

In this chapter, the methodological approach applied upon this thesis is discussed and explained within different sections.

4.1 Research strategy

Before conducting any type of research, it is crucial to bear in mind a plan, which can establish the direction of one's thoughts and efforts. Under these circumstances, the

research strategy acts as an orientation map and helps the researcher to reach the accomplishment of the research.

Many writers within methodological studies find useful and essential to distinguish the research strategy in qualitative and quantitative research (Bryman, 2012).

However, this distinction has an unclear character yet, while its necessity is very controversial among methodological issues (Layder, 1993 in Bryman, 2012).

Traditionally, the difference between these strategies is depicted in the fact that qualitative research has to do with words while quantitative is concerned more with numbers. Furthermore, qualitative research helps the researcher understand phenomena, reasons, and trends, while quantitative research measures facts.

Consequently, based on these explanations, and as the conclusion of this thesis is to verify if a lean warehouse can be developed or not with the help of the 5s lean tool, it was decided by myself to follow the qualitative way.

4.2 Research philosophy

Research philosophy and its consideration is a crucial part of understanding a research and refers to “a system of beliefs and assumptions about the development of knowledge” (Saundres, Lewis, Thornhill & Bristow, 2015:124). According to Bryman (2012), traditionally, there are epistemological and ontological considerations.

The epistemological point of view is concerned with what is accepted as knowledge and how we come to know things (Zillinger & Bommenel, 2019). On the other hand, the ontological position is concerned with the question of whether social phenomena and their meanings have an existence independently of their social actors (Zillinger et al., 2019). In short, it can be said that the epistemological perspective deals with “how we know things”, while the ontological perspective is concerned with “what is reality”.

However, there is a wide range of positions which help us to understand the meaning and the purposes of these two research perspectives. Among many of them, the main positions for the epistemological perspective are positivism and interpretivism, while for the ontological point of view are objectivism and constructivism (Bryman, 2012; Al-Saadi, 2014).

By taking into consideration the aim and the research questions, from the one hand this thesis embraced the principle of positivism as an epistemological approach, as this term states that knowledge is developed by experiencing natural phenomena included the application of methods derived from the natural science field (Bryman, 2012; Macionis & Gerber, 2010). On the other hand, this thesis follows a constructionist ontology position, which means that people construct their research and understandings through experiencing things (Honebein, 1996 in Adom, Yeboah & Ankrah, 2016). These positions display the idea that learning occurs when the researcher on their own discovers the knowledge through the spirit of doing and not by waiting from others (Dogru & Kalender, 2007). It can be concluded that these are the most suitable philosophical paradigms for this thesis among the others that are mentioned above, as I will have a participant observation and an active role to experience things and situations.

4.3 Research approach

As Bryman (2012) posits, the research approach is related to the correlation between theory and research. Customarily in social research, writers tend to believe that the qualitative research strategy follows an inductive approach rather than a deductive approach (Bryman, 2012). As a result, this dissertation will abide by this tendency.

The purpose of an inductive approach is to construct a theory upon the research area that is investigated (Bryman, 2012). In more simple words, by following the inductive approach, the researchers based on the observations they make and the data they gather, they try to come up with a theory. In this thesis, both the knowledge gap and the fact that there is not any confirmation or acceptance around lean warehousing, are the two determining factors that affected my decision. Moreover, I chose the inductive way as it is crucial for this thesis to come up with whether lean warehousing can be created or not, and this approach can serve this achievement.

4.4 Research method

The rationale behind this thesis is to get an overview of how processes roll in a selected Greek warehouse, find the weaknesses, and finally investigate how it can

become leaner based on the 5s lean tool. Consequently, it was decided that the most suitable research method is a case study.

A case study is the most popular and appropriate research method within a variety of academic disciplines (May, 2011). It allows researchers to carefully examine and understand the situation in depth (Bryman, 2012). Furthermore, according to Zainal (2007: 1), “a case study allows the exploration and understanding of complex issues. It can be considered a robust research method, particularly when a holistic, in-depth investigation is required.

As Bryman (2012) presents in his book, there are various types of case studies. To begin with, the first type of case study which is underlined is the critical case study. This type is selected on the ground that the researcher has a well-developed theory around a phenomenon or concept, and they may want to give a deeper and better understanding around this theory (Yin, 2009 in Bryman, 2012). Secondly, the next type of the case study is the revelatory one, and it is selected when the researcher wants to observe and analyze a new phenomenon that was inaccessible before for academic investigators (Sammut- Bonnici & McGee, 2015). Thirdly, it is the unique or extreme case study which is mostly concerning around clinical studies (Yin:2009 in Bryman:2012). Fourthly, the longitudinal case study is chosen when the researcher wants to observe a phenomenon for a long period of time (Sammut- Bonnici et al., 2015). Moreover, according to Kahkonen (2014:35) “this type is used when the aim is to define how certain conditions change over time”. Lastly, the final one is the exemplifying case study, and according to (Yin, 2009 in Bryman, 2012:70) “is aiming to capture the circumstances and the conditions of an everyday or commonplace situation”. The rationale behind the selection of this type is because it can “supply” the researcher with a suitable content for the researcher questions to be answered (Bryman, 2012). Apart from that, this type of case study allows the researcher to examine key processes as for example the impact of a new technology within an organization (Bryman, 2012).

All in all, after an investigation of all of them, it was decided that the most appropriate form is the conduction of an exemplifying case study. The rationale behind the selection of this type is that as it has mentioned above, it provides a chance to the

researcher to inspect key processes and capture the conditions of an everyday situation (Bryman, 2012).

4.5 Data collection

The data collection process is characterized by many authors as the dominant point of any research project, as it refers to the process of gathering information that enables the researcher to answer the research questions and to evaluate the situation (Bryman, 2012). For this dissertation, the participant observation was selected for the data gathering.

4.5.1 Observations

As May (2011) underlines, interviews play a vital role as they help the researchers impose their reality on the process or situation they try to investigate and understand. During interviews, people or employees might feel uncomfortable and not compliant to talk about the “secrets” of the company and/or are unwilling to talk about different issues. As a result, observations can act as a tool to uncover any missing information.

In this dissertation, the observation method was used to identify the problems each warehousing process faces, to survey how employees behave (the 4 observed participants) and finally to observe how the staff acts and the warehouse operates after the implementation of the 5s lean tool. This activity lasted 50 days and took place in three different phases.

Firstly, 22 days were devoted to observe how processes roll in the warehouse and how employees act. Secondly, and for the next 7 days, I applied the 5s lean tool in the warehouse, while thirdly, for the rest 21 days I observed the accomplishment of the new model in the warehouse. Detailed analysis on how the 5s lean tool was applied is explained during the next chapter. Moreover, my presence in the warehouse was on a daily basis, and more specifically from Monday to Friday from 10:00 a.m. until 17:00 p.m. During my appearance, there were times that I was side by side with workers while other times I was observing their working process from afar. Furthermore, my appearance was lasting for many hours, as I believe that the more time I could stay in the warehouse, the better conclusions I could get for my analysis.

From the beginning, I took the initiative to clarify my purposes not only to the owners, but to employees as well. Despite the fact, they have not heard about this tool before, through some videos I saw to them, they understood what I wanted to achieve. Also, I explained my thoughts on how I will apply the model (Section 5) and I clarified that I would do it on my own, as I did not want to distract them from their tasks. However, when I wanted to ask something or I wanted any help, they were willing to assist. Apart from that, we had a friendly relationship, and from the beginning they “hug” my work, hoping to bring positive results.

Before every visit in the company, and in order to serve the observation process to the highest extent, I assumed that it would be beneficial for me to conduct an observation protocol, where I underlined the points I wanted to focus upon every day. In simple words, an observation protocol can be perceived as a guide, as it helps the researcher to plan their observations - for example what they want to observe, where, who, when, and etc. In my case, this protocol helped me a lot not to deviate from my target and to always be concentrated. However, despite the fact that in the beginning it seemed to be quite difficult as it is impossible to underline everything, at the end this protocol ensured my consistency and that I can gather all the appropriate data for my research and analysis. Moreover, most comments were written down in a notebook immediately after something was observed. However, as soon as a complicated event took place, I decided to monitor the thought process on his mobile phone and to analyze it later.

At this point, the author feels the necessity to give more details about the actual process of the daily observation. As, it has been mentioned above, before every visit the author made clear to his mind where to focus on and which tasks should have been accomplished by the end of the working day. Moreover, time was devoted to analyzing the notes that had been collected during the onsite visits and to compare them with the ones of the previous day(s). This could help me to spot the differences that were achieved within the days. Examples of notes can be found in the appendix section.

I used the Cornell- note taking system which according to (Pauk, 1997 in Evans & Shively, 2019:10) “provides the students with a way to engage in a completely natural learning cycle using the same document”. By using the Cornell-note system the

observer has to divide the paper – in our case it is a word sheet and is named as observation protocol- into 3 or sometimes 4 unequal subsections, where on the right side the observer takes their notes, on the left side any keyword or question that can arise during analyzing the notes and at the bottom is the summary (Evans et al., 2019). The notes the author used to keep had to do with the problems he used to see in the warehousing process and in the employees' behavior (it depends on where he wanted to focus day by day). Some examples of the observation notes can be found in the appendix section.

Apart from that, it is also important to underline that before the beginning of the observation method, much time was devoted by myself to comprehend at a good extend the dangers (wastes) that are lurked in a warehouse and within its processes. Based on that and by making a simple VSM, before the 5s implementation I could identify a number of wastes the warehouse has. As it has been mentioned earlier some wastes are observable while some others are difficultly spotted and need a different approach to be identified (Domingo, 2015).

Among different types of observation, I decided to choose participant observation, while I assumed the role of a participant as an observer. Participant observation is “the process in which an investigator establishes a many-sided and relatively long-term relationship with the human association in its natural setting, to develop a scientific understanding of that association” (Lofland & Lofland 1984 in May, 2011:166). Moreover, I took the complete participant role since, from the very first days, I was fully engaged with the activities of the organization under investigation. Although this role indicates that the researcher will not reveal his intentions, I decided to announce it to everyone in the warehouse since I observed that they were very hesitant towards me and was afraid that the results would be different. Consequently, I had an overt role.

4.6 Data analysis

For more accurate results, the author decided to analyze the data into two different phases (before and after the implementation of 5s) and to write down everything in a word sheet. For that reason, two separate observation protocols were created in order to serve two different tasks.

More specifically, in the first protocol, all the problems of the warehouse and the behavior of each employee individually were underlined. Eight categories were designed for the researcher's facilitation. The first four are related to the warehousing processes (receiving, storage, picking, and shipping), while the rest correspond to four employees, whose behavior was observed for 43 days. The purpose of this protocol is to help the author conduct a case study. On the other hand, the second protocol is related to the results of the implementation of the 5s lean tool. As in the first one, four categories correspond to four employees, and their variation in behavior, while the rest four to the warehousing processes.

The separation of this task into two different protocols, served my data analysis processes better. By having gathered every information, at the end I could compare the situations, behaviors, and facts from how it was and how it is after the 5s implementation.

Finally, the VSM was conducted once after the first observation protocol was done, as this helped me to summarize the wastes I found. An illustration of the VSM is in the Appendix section.

4.7 Research Quality

As Silverman (2016) underline, the clarification of the measurements of the research quality, is an important task within the qualitative research. However, there are not specific measurements that every author must follow. For example, some writers include validity – both internal and external- and reliability while some others refer to conformability, dependability, transferability, and others (Bryman, 2012; Silverman,2016). In this thesis, the measures which will ensure the quality of my research are:

Credibility: This measure is used so at to confirm that the data were collected in a credible way (Goffin, Raja, Claes, Szejczewski & Martinez, 2012). In my dissertation, I used 2 observation protocols; the one for the wastes and the problems while in the second I summarized the results the 5s tool brought in the warehouse. Apart from that, I had a notebook where I compared situations, behaviors and wrote down whatever has been changed.

Conformability: Conformability is the way of understanding the data in a logical way so as to assure the impartiality of the collected data and findings (Goffin et al., 2012). Firstly, I did not have any experience on applied this tool before and as a consequence could not predict any result or finding. Secondly, I did not have any personal values or emotions if my plan will not bear fruits while thirdly, I had not co-operated with the company before.

Transferability: The transferability entails that the results of the study can be used to other contents and provide a detailed analysis (Bryman, 2012). In that way, the results of this study can be certainly used, analyzed, and assessed from different managers while the methods used can be also applied to other warehouses as well.

4.8 Sample

For this research, the selection of the appropriate sample was totally dependent on me. The choice of the best participant is not a task that has to be underestimated by the researcher, but according to Bryman (2012), it is a crucial mission. For that reason, among eleven employees in the warehouse, I decided to focus on and observe four, who, in my opinion, suit my topic better and represents approximately 40% of the employees.

More specifically, it can be said that the first employee is the foundation of the company as he works for this company for more than ten years, and I wanted to see how he can adjust in a new change. Furthermore, the second participant is a seasonal employee, while the third one is a new employee who, in the first two days of my appearance in the warehouse was all at sea. After a small conversation I had with him so as to find out what is going wrong, he claimed that the disorganization of the warehouse creates many problems to him, and for that reason it will be advisable to see how his performance would be after the new changes. Finally, the last participant was an experienced employee (I asked the owners), but he could not yield well in this warehouse.

<i>Number</i>	<i>Name</i>	<i>Position</i>	<i>Age</i>	<i>Observation Period</i>
1	Employee 1	Factotum	55	43 days
2	Employee 2	Factotum	43	43 days
3	Employee 3	Factotum	29	43 days
4	Employee 4	Factotum	35	43 days

Table 2: Sample, own creation

4.9 Ethical consideration

Throughout all data collection methods, much attention was given by the researcher in order not to infringe any moral principle. It can be said that this process is much more painful in qualitative research rather than in quantitative, as, in the former, the researcher has a closer relationship with the participants (Bryman, 2012).

According to (Diener & Grandall, 1978 in Bryman, 2012:135) “encroachment of moral principles can be assumed, 1) whether there is harm to participants, 2) whether there is a lack of informed consent, 3) whether there is an invention of privacy, and 4) whether deception is involved’. In this thesis, the emphasis on ethical considerations achieved as follows:

Firstly, right from the start, I stick to my pledge towards the owners of the company not to reveal the exact appellation of the products. Instead, in the ABC analysis, the researcher uses different codes. Additionally, I gave my commitment not to display any price of the product anywhere else apart from this dissertation.

Secondly, as I mentioned earlier, I let everyone know of my presence and purposes, as I gave an overt role to myself. This happened because the BSA Statement suggested that “covert methods violate the principles of informed consent and may invade the privacy of those being studied” (Bryman, 2012:142).

Thirdly, the author validated the participants for their anonymity in the observation protocol. For that reason, instead of their full names, the researcher used four different nicknames.

Fourthly, from the beginning, I asked the owners for their permission to be at the company every day for 7 hours in order to observe not only the employees but the whole warehouse processes.

Fifthly, I informed the employees that I asked their supervisor some information about their working background in order to strategically select my sample.

Lastly, because of the GDPR (General Data Protection Regulation), I prefer to keep the anonymity of the company. For that reason, instead of the company’s official name, the author gave another nickname.

5. Outline of the case study

Within this chapter, I will try to build a case study in a way which can give the reader an overall picture of how the Company 1 warehouse is and works. For this attempt, the first observation protocol was vital. Apart from that, by the end of this chapter the reader will be able to understand how I applied the 5s lean tool.

5.1 Warehousing at Company 1

As it has been underlined earlier, nowadays warehouses play an essential role as they are the missing link in any supply chain. The complicated situation which mainly exists within the Greek logistics world, has as a result to actuate companies to alternative conditions that can make them more competitive and sustainable.

Based on the motto “Everything for the customer,” Company 1 always seeks for better solutions, which can increase its efficiency. Led by this principle, and having applied different methods in the past, where the results were not the anticipated, now

the owners of the company are searching for ways to implement the 5s lean tool in one out of the three warehouses they possess.

Being housed in a 2.500 square meters building, the receiving area is located in the center of the edifice. By having four door-docks, components, items, and any other type of merchandise arrives and is unloaded here. After the commodity comes, check control is performed by any randomly available employee or by the two storemen when they are available. As soon as the inspection is over and everything is identified, the merchandise is registered in the system by the logistics manager, the inventory is refreshed, and pallets are ready to be shipped. For the registration of the SKUs, the company prefers to use the Microsoft Excel software instead of an advanced one such as WMS or any other ERP system, which in our days is extremely popular and usually preferable.

Around the receiving area and in fabric direction, the three warehouses shape a triangle. The main warehouse (Warehouse #1) stores any dairy product the company sells. It can be said that it is the company's central warehouse (in terms of earnings), and for that reason, a small area has been designed so as all the orders to be collected, checked, and packaged there. Apart from that, four years ago, a new door-dock has been built to serve only the shipment and not the receiving process. However, due to the company's policy, this new door-dock serves the delivery for one specific destination; Kavala, which is the closet city to the company's headquarters. All the other shipments are performed from the other four door-docks in the receiving area. Moreover, the second warehouse (Warehouse #2), where I am applying the 5s lean tool, is devoted to the solid freight, includes around 55 types of merchandise and is the smallest warehouse in terms of size. Among these products, different types of oil, sugar, rice, spaghetti, olives, and sault are stored. Finally, through a small aisle, any employee can go through the third warehouse (Warehouse #3), where every frozen product such as meat, fish, or bread is stored. All the warehouses are "inspected" by the same storeman, who is responsible not only for the preparation of the orders but also for the inventory control, cleaning, as well as other tasks.

Finally, in every warehouse, the company has placed new pallet racks instead of small bins, which in most cases have two or three tiers. The company also has two significant reverse areas, where products are stored and serve the forward area when

the shelves are empty. However, during the summer period, where the company orders more quantities than they actually need, the last tier of every pallet rack can be used as a reverse area.

5.2 Warehousing processes in Company 1.

Receiving process

Once the truck arrives, there are four available door-docks which can serve this process. Two storemen or any other available personnel are responsible to unload the truck by using forklifts, high-lifters, or their hands.

Once the merchandise is unloaded, check control is performed from the one who is responsible to unload the truck. The inspector is important to make a good control in order to be ensured that quantities are correct, in the best condition, and etc. In rush hours and mainly when more than one truck has arrived, other employees accept the deliveries, and serve the previous activities. This process is performed manually, the driver is attendant, and when it is over, the logistics manager, who is responsible for the inventory, is informed for the incoming quantities. Finally, once the check control is over, the merchandize is ready to move on the storage area.

Storage process

In many cases, both pallets and boxes are delivered with a barcode and label from their origin. However, when a box does not have any name, the warehouse staff is obligated to open it and later, to sort it based on its content. Based on the label or the content of the box, the merchandise is sorted in the reverse or forward area by using forklifts (section 3.1.1).

Picking process

During this process, the logistics manager receives all the orders to every destination for the next day. Once the logistics manager has received an adequate number of

orders, an accumulative order sheet for every destination is created. This sheet displays the name and the quantities of products that are required by each destination (city). The picking process, which is allocated randomly to the warehousing staff, sometimes keeps more than two employees occupied. Furthermore, the products are stored on pallets, and in many cases these are collected manually.

As soon as the accumulative orders are performed, the employees prepare the order for every shopkeeper individually. For this stage and in comparison to the receiving process, employees use an RF gun, which automatically informs the system of the withdrawal of every quantity. Once all the orders for every shopkeeper have been prepared, employees pack them in cartons, which are imprinted with the name of the company, allocate them on pallets in front of door-docks, and are ready to be shipped the next morning.

Shipping process

Every door-dock serves the shipping process. Once all the goods have been placed inside the truck, the driver is ready to go and deliver the shipment. For the truck filling process, the driver sorts the orders inside the truck as he prefers, while one employee observes if everything has been placed inside the truck.

5.3 Implementation of 5s Lean tool at Company 1 warehouse

At the time of writing this dissertation, the appliance of the 5s lean tool in the solid freight warehouse (warehouse #2) is still in progress. Its implementation started on 10/3/2020, but due to the time pressure for the conduction of the thesis, 4/5/2020 was set as a time limit by the author. However, due to some external factors (COVID-19-) and the lockdown the government announced, this deadline was extended until 2/6/2020 June. Nonetheless, more accurate results will be visible in the long-term; some positive signs have already appeared on the horizon.

From the very first days, definite signs of 5s implementation came on the surface and revealed managers', employees', and the owners' exultation. Even though through the observations everyone was hesitant, now it seems that they enjoy their job more. The

first weeks were quite demanding and challenging, as almost none of them had heard about this model before, and valuable time had to be spent for their introduction to the philosophy of 5s. One of the crucial problems that appeared on the horizon was the disbelief some employees displayed, as they were quite skeptical of the final results. However, the steps for the implementation of 5s were performed in a comprehensible way, and as follows:

-Sort: For the sorting of the products, the researcher mustered the ABC classification analysis (Figure 3).

The primary variable for the product classification was their frequency sales ratio until 31/3/2020 and based on the results from the Excel sheet, products were divided into three categories: 1) High-frequency sales ratio (classification A), 2) Medium frequency sales ratio (classification B) and 3) Low-frequency sales ratio (classification C). The results which depicted on the table were done by the researcher and from the formula he used on the Excel sheet.

<i>Product</i>	<i>3Months Demand</i>	<i>Percentage</i>	<i>Classification</i>
Product 1	14.268	19,67%	A
Product 2	10.689	14,73%	A
Product 3	6.000	8,27%	A
Product 4	5.300	7,30%	A
Product 5	5.000	6,89%	A
Product 6	3.424	4,72%	A
Product 7	3.082	4,25%	A

Product 8	2.997	4,13% A
Product 9	2.000	2,76% B
Product 10	1.433	1,98% B
Product 11	1.359	1,87% B
Product 12	1.246	1,72% B
Product 13	1.092	1,51% B
Product 14	1.062	1,46% B
Product 15	1.051	1,45% B
Product 16	1.029	1,42% B
Product 17	1.000	1,38% B
Product 18	936	1,29% B
Product 19	833	1,15% B

Product 20	800	1,10% B
Product 21	753	1,04% B
Product 22	700	0,96% C
Product 23	627	0,86% C
Product 24	600	0,83% C

Product 25	600	0,83% C
Product 26	513	0,71% C
Product 27	507	0,70% C
Product 28	472	0,65% C
Product 29	447	0,62% C
Product 30	415	0,57% C
Product 31	396	0,55% C
Product 32	355	0,49% C
Product 33	275	0,38% C
Product 34	225	0,31% C
Product 35	180	0,25% C
Product 36	132	0,18% C
Product 37	120	0,17% C
Product 38	120	0,17% C
Product 39	112	0,15% C
Product 40	84	0,12% C
Product 41	62	0,09% C
Product 42	60	0,08% C
Product 43	50	0,07% C
Product 44	36	0,05% C

Product 45	30	0,04% C
Product 46	20	0,03% C
Product 47	15	0,02% C
Product 48	14	0,02% C
Product 49	12	0,02% C
Product 50	12	0,02% C
Product 51	10	0,01% C

Figure 3: ABC analysis results, own creation based on empirically gathered data

-Set-in-order: At this stage, the tidying of the products was achieved in different ways.

Firstly, being inspired by the red-tagging system, I incited the owners to separate the aisles of the warehouse based on the results from the ABC analysis. More specifically, the first aisle was devoted to the products with high-frequency sales ratio and had a yellow line on the floor, the second aisle with a brown line for medium frequency sales ration products, and the third for low-frequency sales products with a blue line on the floor. Even though the warehouse has five aisles, the other two include new types of products and are not involved in the research.

Secondly, labels for each product were printed and stuck on the pallet racks. In cases where different products were on the shelves and were disarranged, separating colorful strips were used and assisted the employees. Finally, footprints were designed to at the end of the shift, so as for high-lifters, forklifts, and pallets to be located there and not in the middle of the aisles.

-Shine: Having finished with the classification of products and their organization, it was time to proceed into the third step and to tidy up warehouse. During the cleaning process, many leaks were identified, and some detriments in the forklifts were inspected. Apart from that, some holes on the floor were identified, and a protecting

tape used for the employees' safety. Moreover, despite the author's willingness to paint the floor, and put some stickers, this was not feasible as the workload was too intensive, and owners did not want to change the schedule.

-Standardize: Having completed the first three stages (sort, set-in-order, shine), consistency is the key to maintaining efficiency. For that reason, the employees have agreed that every Friday, and when their shift is over, they will devote 2 hours to clean and tidy the warehouse. Apart from that, the researcher prepared a small information sheet, where all the products are displayed based on the aisle and the position they are. The purpose of this action is that employees, through training and reading, will become familiar with the products and locations, and as a result, their task will become easier.

-Sustain: One of the most natural things we can do in our life is to slip back to our old habits. This statement is also linked with warehouses, where the possibility to move back to old working ways is quite high. In order to avoid this drawback, owners of the company decided to visit the company on Saturday to observe the condition of the warehouse. When the warehouse is in a good situation, which means that employees did their job well, a bonus is given. However, on the other hand, when something is not executed correctly, a penalty is given.

5.3.1 Material



Before



After



Before



After



Before



After

6. Empirical findings

In this chapter, the findings from the research are presented and organized into two subsections, each of one corresponds to the two research questions displayed in the first chapter. In the first subsection, I tried to present all the wastes and problems the warehouse faces, while in the second subsection the changes the 5s lean tool brought in the warehouse are discussed.

6.1 What are the typical problems the warehouse has in regard with its daily process and routine?

6.1.1 Processing problems.

Receiving process

One of the main factors that affect this stage is the absence of a specific timetable for the delivery of the merchandise. Trucks arrive at any time, and in many cases more than two, which results in disorders; something effortlessly conspicuous almost every time. Apart from that, the drivers demand to be served as soon as possible without

being concerned about others; something which in many cases is impossible and as a consequence they have to wait for 2 or 3 hours in order the truck to be unloaded.

Moreover, another characteristic which affects this activity is that the unloading process is entirely depended on the drivers, and in many cases, valuable time is lost. More specifically, some drivers do not allow the entrance of the warehouse staff inside the truck and prefer to unload the merchandise on their own. On the other hand, some others are idle and do not participate in the process, while in the minority of cases, they act in concert. Additionally, as there is an absence in forklifts and high-lifters (four forklifts and two high-lifters for all the warehouses), sometimes both drivers and the staff of the company use their own hands for the unloading process. Consequently, not only is valuable time wasted, but also the possibility of injuries increases.

Furthermore, during the process of the check control, since the randomly available employee is not familiar with the process, they neither run the anticipated check nor inform their manager. This lack of control from the available personnel causes many problems as many damage products have been inspected on the shelves, while quantities are missing. Consequently, the false registration of numbers from the logistics manager leads to a false estimation of the SKUs.

Storage process

Based on the label or the content of the box, the merchandise is sorted in the reverse or forward area (section 3.1.3). However, this is something that is not performed explicitly from the employees, and pallets can be found everywhere in the warehouse. In this case, and as the company does not have any system to identify where the merchandise is instantly, it is a very time-consuming task for the employees to refill the forward area (section 3.1.1).

Picking process

As this also happens in the receiving process, there is not a specific time until when shopkeepers can fulfill their orders for the next day. As a result, it was a common fact

every morning to hear complaints from the staff that they stayed for an over-time in the warehouse.

Moreover, as it has been mentioned earlier, employees use an RF gun, which automatically informs the system of the withdrawal of every quantity. However, an interesting observation is that, even though the employees use this RF gun, when the storeman carried out the inventory control, it was observed that the amounts on the shelves were not equal to the quantities in the computer system. One explanation to this fact is that the access to the warehouse is easy to everyone. More specifically, it was observed by me that vendors go inside the warehouse at regular intervals and pick up necessary products without having informed the logistics manager or an employee. Consequently, this leads to inventory discrepancies, and therefore stock check control is performed daily.

Shipping process

As it has mentioned above, a specific timetable that specifies the point until which shopkeepers can order, is missing. As a result, every morning, the logistics manager receives late orders, which in most cases, are from the same late shopkeepers. While one employee is responsible for picking and preparing these orders, the rest of the staff with the driver supply the truck. However, due to late orders, the shipping process always slackens, the driver is belated, and customers complain.

6.1.2 Other defects at Company 1 warehouse

Despite the company's willingness to take small steps forward for its improvement, there are not only the dysfunctionalities in the warehousing processes that affect this advancement. As we know, a warehouse is a place where a variety of human-forces interact together, co-operate together, and try to establish the best environment for the company's purposes. However, each employee has a different personality and character, which often does not harmonize with others. As a result, the challenging point to the company's improvement is also some organizational disorders they have. To begin with, one of the biggest problems every warehouse of this organization has, is the absence of labels upon the pallet racks. Even though this method is used so as

any employee can identify the product instantly, this is something that is missing from the company. Additionally, another cause of disorganization and confusion is that the same product is stored on two or more different pallets inside the same warehouse. Consequently, it is inevitable for the employee not only to get confused but also to make many errors during the picking process.

Furthermore, the way employees locate the pallets and the products on the shelves or on the pallet racks is quite problematic. On the one hand, it can be said that this is a foregone conclusion as labels are missing, while on the other hand, a storage policy does not apply in this warehouse. Consequently, some employees place the products anywhere there is space, while others in the middle of the corridors. As a result, during the picking process, many back and forth movements are observed, and consequently, the waste of action is steadily increasing, while the time of preparing an order also rises.

Moreover, due to the poor layout, employees prefer to store three or more products of the same type but with a different brand name on the same pallet. Although this is devastating, they also do not have any sign or label on them, in order to help the new employee, identify the products. Furthermore, in the minority of the cases they use tags, these are in the wrong place, or they display the wrong products. Finally, as everyone knows, cleanliness is next to godliness. However, this principle seems to be absent from that company or is in progress.

6.1.3 Defects of observed participants

As a consequence of the problems mentioned above, is the performance of the observed employees. After the first draft of the observation period, it was noticed that the new employee was the one who brought up huge problems. More specifically, it was observed that when he was responsible for the receiving merchandise, his checking control was defective. For example, eight receiving attempts out of thirteen were faulty; there were wrong quantities registered by the logistics manager, and as a result, the inventory was incorrect. Apart from that, the majority of the orders for which he was responsible to prepare had multiple mistakes, as some of them had missing quantities while others more units than it actually needed. Consequently, it was a common sight for the drivers to return almost every order he had prepared. Furthermore, during the picking process, it was quite common from him to ask the

experienced personnel where the products are located. As a result, countless back and forth movements were written down in my notebook, while his average time for the collection of the order was 23'. It can be said that a redeeming feature to this average time is the fact that he is new in the warehouse and not familiar with the location. However, during the high season, this time is crucial, and I hope that the new model to be introduced will decrease his time.

On the other hand, employee 4 was more consistent when he had to work on the checking control. It was observed that he used to make double-checks on every pallet, and consequently, 11 out of 15 attempts were right. However, he was sloppy as far as the storage process is concerned. Characteristically, he used to repeatedly leave the pallets in the middle of the corridor or anywhere there was empty space. This caused problems not only to the other employees but to him as well, as he spent much time (around 13') in order to prepare an order. Despite the urging from the other employees not to insist on this bad habit, he was apathetic. Apart from that, he used to take many breaks, a fact which also caused commotion between the employees as the rest had to prepare the orders for which he was responsible. Extraordinarily, despite the fact that he used to spend much time on the preparation of every order (13'), almost all of them had missing quantities.

Moreover, as far as the seasonal employee is concerned, he was prohibited from the owners of the company to take part in the receiving process. It can be stated that this employee was very dutiful and always willing to help everyone. However, due to the warehouse layout and the lack of experience he had, many of the orders that he was responsible for were not executed correctly. The absence of labels on the pallet racks and the fact that in every pallet more than 1 product was stored, created many problems for him, since, as the new employee, he had to ask for extra help from others. His average time for gathering an order was 20', which is a very repulsive time for an employee in a warehouse. Apart from that, another negative issue is that he has not got a forklift license. More specifically, when a pallet from higher tiers had to be brought down to ground level, he always sought for other employees to accomplish that.

Finally, as far as employee 1 is concerned, not so many negative comments have been written down on my notebook. His experience in the same warehouse for more than a

decade is fruitful as he knows every corner of the warehouse. However, sometimes, his arrogance led to mistakes in the picking process. His average time was much better than the others' (6'). Not so many back and forth movements were underlined, while his familiarization with the forklift was an extra advantage.

6.1.4 Summary of problems

Problem 1: Lack of policies

One of the biggest problems, Company 1 faces is the absence of policies in almost every warehousing process. A policy is a guideline, statement, and rule which, if followed by the employees, then the prosperity of the warehouse is a "safe bet". However, even though the company has two storemen, it seems that they are not trained enough to manage the warehouse and the necessity of a warehouse manager is more than essential. The absence of a policy in each process can generate other problems, smaller or bigger, which in the first stages cannot be perceived by the employees. A classic example, which has been mentioned earlier, is the absence of a policy in the receiving process.

Problem 2: Careless staff

Another challenging point of the disorder of the company is the employees. During my presence at the company, I formed the opinion that no one of them cares about the company's improvement and its sustainability. However, their mistakes are those which generate more problems to the organization while some of them are unresolved. Poor check control, long breaks, delays, and many other problems make the company ponderous. Moreover, the disorder in the warehouse constitutes them as redundant and they are not willing enough to prepare any order.

Problem 3: Inaccurate inventory

One of the fallouts from the careless staff and the lack of policies is the generation of a problematic inventory. The inability of some employees to make an adequate check control and to register whatever comes or leaves from the warehouse and shelves,

always led the company to have faulty essence of its inventory. Moreover, the absence of policies, lead vendors to enter the warehouse and take products or goods without informing someone. Even though for the others inventory control is not vital, the inventory can determine the sustainability of the warehouse. Having surplus or deficit in goods may lead the company to bigger problems as it can easily translate in lost sales.

Problem 4: Lack of space

Even though the company is quartered in a large building, a lack of space has been generated through the inexistence of at least one policy for the storage of goods. Employees prefer to store pallets and products everywhere in the warehouse instead of the appropriate positions and aisles. However, it is not about the space the company has, but how one prefers to optimize it in order to avoid any clutter.

6.2 Research question 2: Will the 5s lean tool make the warehouse leaner when implementing the tool? If so, in what way the warehouse will be leaner?

The second research question aims to provide the reader with the results that the implementation of the 5s tool brought in the warehouse.

To begin with, one of the greatest achievements this implementation brought is the increase of the employees' morale. Employees have now realized that the company on the one hand wants to change its mentality, while on the other hand cares more about them, their working area, and their job. Consequently, the 5s leads employees to feel more confident, assertive, productive and to be more engaged with their job. In other words, their morale and efficiency have launched. A typical example is the new employee (participant observed), who now does not have any anxiety in preparing an order, while in the past he tried to hide himself away. Apart from that, the new working environment has led to better and closer relationships between employees, as now there is only one policy in the warehouse which everyone must follow, instead of many in the past, when everyone acted by their own volition.

Furthermore, another great achievement is that the 5s lean tool freed up a surprising amount of space in the storage area. By sorting and set-in-order the products in the

appropriate positions and by getting rid of clutter, 3 small pallets racks have identified and can now be used as a reverse or forward area.

Additionally, the neatness which has been achieved through the 5s, led to the improvement of the warehouse efficiency. Based on an informal timing experiment which was hosted by myself, it became known that after the implementation of the 5s lean tool, the time for preparing an order was minimized approximately by 40% in every observed participant. Guiding star is the new employee, who before the new model spent 23' for the picking process while now he spends only 13'. Even though it cannot be said that this experiment is 100% accurate as the orders might differ from each other, it is essential to underline that a decrease was certainly achieved in the picking process.

Moreover, the neatness which has been achieved through the 5s and led to the creation of a lean warehouse had as a result to decrease the rate of the returning orders. It can be assumed here, that this had a positive effect on customers as now they feel more secure about their orders and that the company is more responsible to them. However, aim of the company is to minimize this rate as much as it can.

Last but not least, despite the above privileges the 5s lean tool brought in the warehouse, findings of the case study display that now employees have a better sense of the inventory control. As every product is now in one position, instead of two or more like in the past, and the whole warehouse is neat, every problem can become obvious. Employees have now realized which products are more important for the company and when a decrease is observed on the shelves, the storeman or the logistics manager is informed.

7. Discussion and analysis

This chapter aims to bind the findings from research with the theory.

A warehouse is necessary to deliver items, products, and any other material in the right quantities, on time and under the right conditions to the end customer. However, in order the above to be accomplished, it requires the undiminished effort from both employees and owners in order to avoid any danger. Even though this achievement seems to be easy to follow, in working conditions it requires the best planning inside the warehouse

area and the highest drive from the employees. This comes to validate Basl et al. (2014) and Womack et al. (1990) statement, who underlined that workers are at the heart of lean and to any lean transformation.

In the beginning, this thesis aims to uncover any disorder there is in the warehouse while after and through the implementation of the 5s lean tool, my target was to transform the warehouse in a more efficient one. Besides, this dissertation contributes to the development of the research body within the lean framework around warehousing, logistics and supply chain as well. Short time in the past, multiple researchers have revealed that lean practices within warehouses have been lagging while articles around the effects of these practices in the warehouse is quite narrow. Adopters of lean in a warehouse (Garcia, 2004; Jones et al., 1997) strongly believe that lean practices can become applicable to warehouses and create a lean environment, while others address that lean practices are not suited to warehouses (Mustafa et al., 2013). However, the results of the study stand with the first aspect of adopters and attempt to verify that a lean warehouse can finally exist.

More detailed, by unrolling the skein of this thesis from its beginning, this dissertation comes to confirm authors such as (Gu et al., 2007; Van den Berg et al., 1999) who posit that the main activities which are executed in every warehouse must be receiving, storage, picking and shipping. From the observation process, it was observed that the selected warehouse executes every of each process, no matter if they are served in an efficient or a problematic way.

Moreover, the research complies with Pereira's (2009) statement who claims that waste is almost everywhere and inevitably in warehouses. Unfortunately, only 5 out of 7 warehousing wastes achieved to be identified. Other researchers such as (Womack et al., 1996; Hines et al., 1997; Doming, 2015; Salhieh et al., 2018) have contradicting findings as they have underlined that 7 wastes must be identified within warehouses. However, it can be concluded here that an explanation of this, is that the two missing wastes; over-production and over-processing, was quite difficult from the beginning to be identified, as the warehouse does not have a production line and as a consequence does not produce any good or product.

On the other hand, all the other wastes have been inspected and go along with statements from different authors. For example, as Domingo (2015) mentions, the

inventory waste is interrelated with the faulty recording of the SKUs and bad check control through the receiving process. The results of the study are fully complied with this statement as the research made clear, that neither employees make the appropriate check control, nor the SKUs control is served adequately. Furthermore, despite the fact that the warehouse has both reverse and forward areas; as it should be based on many authors these two are mandatory (Gu et al., 2007), the lack of policies in the reverse area increase the transportation waste. More specifically, findings of the study indicates that the warehouse has many storage areas within the reverse area as employees put same products in different pallets, something that increases the transportation waste as it is underlined by Pereira (2009). The author, by using the table below is trying to display the correlation among the wasteful activities concluded from the case study and the findings with the seven wastes analyzed in the theoretical framework.

The 7 warehousing wastes	Wasteful activities identified in the Company 1 warehouse
Over-processing	Did not identified.
Waiting	Delays in order-picking, bad communication between employees, mistakes in order preparing.
Motion	Many back and forth movements through aisles.
Defects	Missing and wrong quantities in customers' orders.
Inventory	Missing and wrong quantities in SKUs, bad check control.

Over-production	Did not identified, as the company does not produce any good.
Transportation	Multiple storage areas for same products, double handling.

Table 3: Wasteful warehousing activities in Company 1 warehouse (own creation)

It is essential to underline here that for the recognition of each waste the VSM played a crucial role. This, also comes to confirm Garcia's (2004) statement who underlined that VSM is a useful material and must be applied before the implementation of any lean tool. Apart from Garcia's (2004) statement, this also validates Wilson (2010) opinion, who claims that wherever a VSM is executed then lean can apply and bear fruits.

Once after the wastes were identified and the 5s lean tool applied, the results of the research are positive and go along with different authors statements around 5s lean tool and lean warehousing.

More specifically, the implementation of the 5s lean tool seems to have a positive effect on the employee's morale and motivation in the selected warehouse. As mentioned earlier, this is one of the main objectives the 5s lean tool must bring in the warehouse once after its implementation (Wojtynek et al., 2018). A typical example is the new employees who now does not have any anxiety in preparing any order as in the past they used to hide themselves.

Furthermore, findings of the study indicate that the customer's responsiveness has been increased. Once after the lean warehouse takes place, the order errors have been minimized, and the returning orders rate has been diminished to a great extent as well. This has certainly increased customers responsiveness; a great achievement which complies with Mahfouz (2001) announcement, as he underlines that the purpose of a lean warehouse is to increase customer's responsiveness.

Moreover, research suggests that the lean tool seems to have effect on the working environment and more specifically on the "release" of new space. Based on the

findings, the lean warehouse has now three reverse areas and each product its own position while before there were only two reverse areas and products could be identified in many places all around the warehouse. These positive results go along with Pasale et al., (2000) statement who underline that the implementation of the 5s lean tool is related with the creation of a well organized working environment and the freed up of space in the warehouse.

After the positive results this study illustrated and brought to the company, it cannot be challenged that this tool; 5s lean tool is probably, as Bartholomew (2008) believes, the foundation of any change to lean. From an outside glance and without having applied other lean tools, it is quite difficult to be absolutely sure that this looms among the others and to validate this statement.

To sum up, the findings of this study come to soothe Bozer et al. (2012) anxiety, as the results suggest that a lean warehouse can finally exist; with the help of other tools, while on the other hand come to confirm Womack et al. (1996) statement, who posits that lean is applicable in every environment.

8. Conclusion and future research

Since I was a child, I always used to hear from elderly people that it takes a lot to reach the top. Now, and after this effort I gave for the conduction of this project I can certainly confirm this statement. Even though it was tough, the positive results both employees, owners and I achieved and brought to the company paid us back.

The research provides both theoretical and practical framework to quantify lean warehousing with the help of the 5s lean tool. The new lean warehouse was constructed based on intensive research and exploration of both theory and other practices applied in other warehouses.

However, in the conclusion the author would like to address some negative impacts he has on his mind once after this study is over. At first, organizations must not copy exactly what other firms have done. The steps of the adopted tool are 5 and this cannot be changed, but on the other hand every firm is unique, with different problems to cope with and consequently the lean methods someone applies for every

step must differ. Apart from that, when you copy something from someone else, it generates disbelief of your creativity and abilities. Secondly, the 5s tool can be perceived as a program, with certain steps. However, this is a false impression as this tool must be seen by everyone as an ongoing process which must be articulated and assessed from both employees and owners. Based on the 5s lean culture, everyone in the company must have a good critical thinking and to seek always for solutions about how to improve it.

Lean warehouse is a powerful tool which can bring prosperity and improve quality in the warehouse by reducing errors and wastes. Due to the amount of resources this transformation requires, the warehousing organization needs to clarify its values and strategies in advanced.

To conclude, the discussion and the findings of this study “pass on the torch” to hypothesis and assumptions for future research. One hypothesis that should be tested is in what way a future research by using the same tool in a longer term than this thesis, can accept or reject the above findings. Another promising future research is to see how the lean framework can develop a company which uses more advanced ERP systems. Finally, another promising future research should be a test by using quantitative research to see lean’s results.

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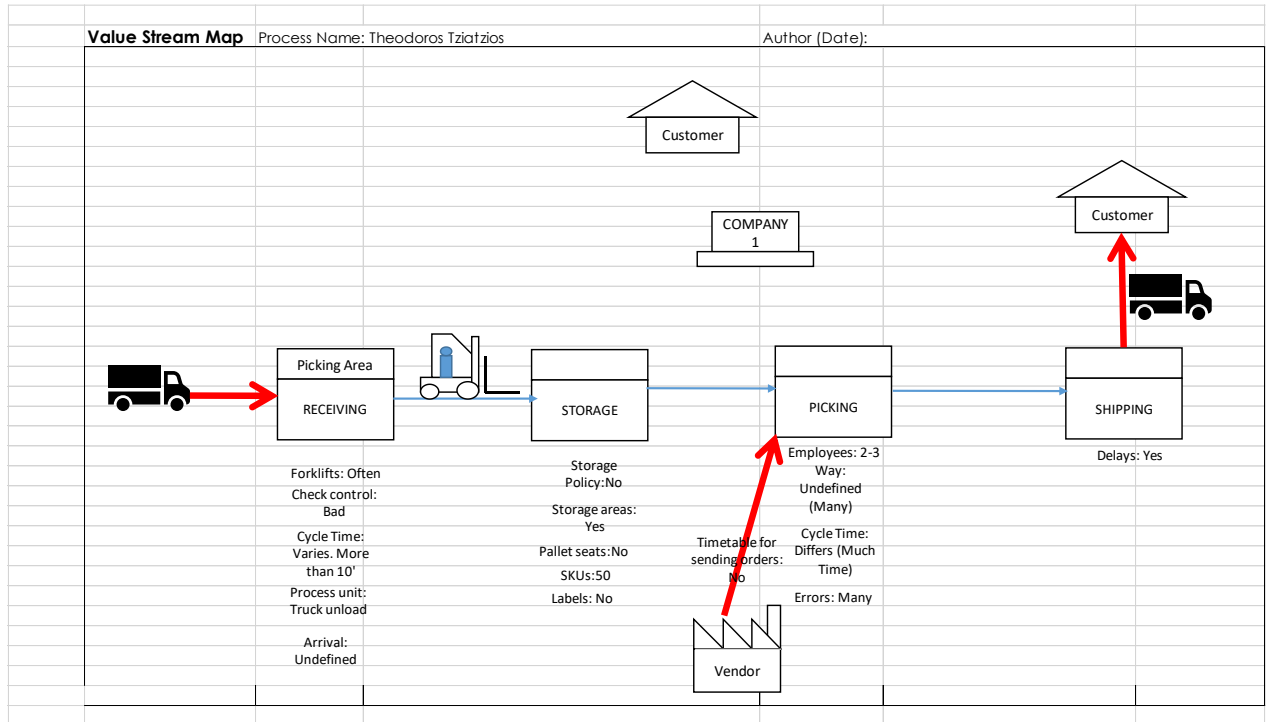
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Note: Own creation

VALUE STREAM MAP



Note: Own creation

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Figure 2: The downstream lean value stream (adapted from Jones et al., 1997)

Figure 3: ABC analysis results (own creation based on empirically gathered data)

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Table 2: Sample (own creation)

Table 3: Wasteful warehousing activities in Company 1 warehouse (own creation)

List of Abbreviations

SKU: Stock Keep Unit

VSM: Visual stream Map

SCM: Supply Chain Management

SC: Supply Chain

