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A Journey Towards Lean: The case of a Small-Medium Enterprise (SME)

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Master Dissertation in Accounting

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Abstract

Purpose: The purpose of this paper is to examine whether it is feasible to implement Lean in a small and medium-sized enterprise (SME), although literature mentions that it is uncommon and unlikely. Additionally, this paper explores how Lean has been progressively applied to a single SME, if there is room for improvement and how it can be accomplished. Finally, this paper seeks to understand if Lean can be a part of the management system.

Methodology: This investigation covers one SME in Portugal. It operates in the cold-refrigerator industry. A qualitative methodology was used to conduct the research, supported on a case study. Data were collected from tape-recorded interviews and from written documentation provided by the company.

Findings: It was found that it is possible to implement Lean in a SME, despite some difficulties. Moreover, improvements on how to implement Lean in the field site were suggested, based on literature and on innovative practices found in the organization. Concluding, Lean proved to be crucial to successfully implement a quality management system, dully integrated into the management system.

Research Implication: This paper shows that SME's can also apply Lean processes and techniques. This conclusion is very important for academics and for practitioners, particularly in manufacturing organizations.

Originality/Value: There is a gap in the literature regarding the application of Lean in SME's. Very little research has been conducted on this subject. This paper shows that SME's can successfully implement Lean techniques.

Keywords: Lean; Quality Management; Total Quality Management; ISO 9001; ERP

Case study

Resumo

Objetivo: O principal objetivo deste trabalho é examinar se é viável a implementação de Lean numa pequena e media empresa (PME), apesar da literatura sugerir que tal implementação é pouco comum e provável. Além disso, este papel explora com o Lean tem sido progressivamente aplicado a uma PME, se há espaço para melhorias e como podem ser alcançadas. Finalmente, este trabalho procura perceber se o Lean pode fazer parte do sistema de gestão.

Metodologia: Esta investigação foca-se numa PME em Portugal, a qual opera na indústria de refrigeração. Foi utilizada uma metodologia qualitativa na elaboração deste trabalho e foi suportada com um estudo de caso. Foi colecionada informação através de entrevistas gravadas e documentação fornecida pela empresa.

Conclusões: Concluiu-se que é possível implementar Lean numa PME, apesar das dificuldades encontradas. Ainda, baseado na literatura e práticas encontradas na empresa foram sugeridas melhorias como implementar Lean. Concluindo, o Lean mostrou-se crucial para implementar com sucesso um sistema de gestão de qualidade, integrado no sistema de gestão.

Implicações de Investigação: Este trabalho mostra que PMEs também podem implementar processos e técnicas Lean. Esta conclusão é muito importante para os académicos e para os práticos, particularmente em empresas industriais.

Originalidade/Valor: Existe um gap na literatura no que toca à aplicação de Lean em PMEs. Muito pouca investigação é está feita nesta matéria. Este trabalho mostra que PMEs podem implementar técnicas Lean com sucesso.

Palavras-Chave: Lean, Gestão de Qualidade, Total Quality Management, ISO 9001, ERP

Estudo de Caso

List of Abreviations

ERP – Enterprise Resource Planning

GLOBE – Global Leadership and Organizational Behavior Effectiveness

HRM – Human Resource Management

ISO – International Organization for Standardization

JIT – Just in Time

SAP - Systems, Applications & Products in Data Processing

SME – Small Medium-Enterprise

TPM – Total Preventive Maintenance

TPS – Toyota Production System

TQM – Total Quality Management

VSM – Value Stream Mapping

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Chapter 1 – Introduction

1.1. Purpose of Investigation and research questions

In the current industrial era, characteristics such as concerns with environmental issues and quality management are possible quite valued within any company. It becomes important that companies seek higher performance and profitability with the use of smart tools and skilled management, Lean management can be the answer.

When deciding my master thesis subject, the interest in Lean originated from Management Accounting classes and later increased by a presentation about the production system (Lean) used in "Autoeuropa" factory (Volkswagen factory in Portugal).

Lean, is a theme not often researched. However, this tendency has been contradicted, since in the past years, an exponential growth on Lean research has been conducted (Jasti and Kodali, 2015).

This master thesis concerns an investigation about whether it is possible to implement Lean in a SME despite some researchers suggesting that such an implementation is uncommon and that these types of companies are at a clear disadvantage in doing so (Bhamu and Sangwan, 2014; Hu, Mason, Williams and Found, 2015). This statement shows that a possible gap exists in scientific literature regarding the Lean implementation in SME's.

Additionally, this work aims to investigate which road a Portuguese SME took in implementing Lean and how Lean has been applied in practice. Further investigation was conducted to understand if the Lean system can be integrated into the management system.

The main Lean objectives are to produce products and to provide services at the lowest cost and as quickly as possible to meet customer demands (Bhamu and Sangwan, 2014). Not fully understanding the concept of Lean, having a poor mind-set and lacking a well-structured implementation plan may make Lean practices less likely to be successful in Small and Medium Sized Enterprises (SME's) (Dora, Kumar and Gellynck, 2016; Mostafa, Dumrak and Soltan, 2013).

To accomplish the research objectives, a case-study was conducted in a Portuguese SME. OLITREM, a company that focuses on the design, commercialization and production of refrigeration equipment and commercialization and installation of hotel equipment, was selected because the company was looking to increase their market share and become a high-quality supplier. To do so, OLITREM was looking to improve their products and services which aligned with one of the most important Lean objectives, continuous improvement.

In fact, OLITREM did not have a production system capable of sustaining the exponential grow it was facing, and so the company decided to invest in the application of several Lean techniques. OLITREM started with simple methodologies that would later evolve into Lean practises.

Moreover, three research questions were posed which sustain the thesis main purpose: (i) are SME's less likely to implement Lean opposite to what the literature suggests? (ii) how has Lean been applied in a Portuguese SME (OLITREM)? And how can it be improved? and (iii) can the Lean system be integrated into the management system in this organisation?

On one hand this paper reveals importance on an academic level, mainly on the area of management accounting as there aren't many studies regarding the implementation of Lean manufacturing in SME. On the other hand, it also provides as an example to other companies, with identical characteristics and performing on the same sector or to distinct cases as long as the concepts and techniques are adjusted.

In addition, a paper was written alongside this thesis, which was presented in the 21st QMOD conference on Quality and Service Sciences ICQSS 2018, 22-24 August in Cardiff, UK.

1.2. Methodology adopted

A qualitative and longitudinal case study was carried out in a Small-Medium Enterprise in Portugal to understand how management started its journey towards Lean during the period under analysis (2008-2018), and how the company is overcoming the obstacles in implementing Lean in a SME and how it is putting in practice innovative practices.

The SME in study is OLITREM who focuses on the design, commercialization and production of refrigeration equipment and commercialization and installation of hotel equipment. OLITREM is one of the biggest companies in the refrigeration equipment sector in Portugal.

The main steps taken to develop the case study were the specification of the research questions, data collection, evidence assessing and writing of the case study (Ryan, Scapens and Theobald, 2002; Yin, 2018). The researcher role was "Visitor" since several visits happened on the field site and interviews were conducted (Ryan *et al.*, 2002).

The research took place between October 2016 and May 2018 and comprised two phases. The first phase, regarding the pilot case study, spanned from October 2016 to November 2016.

The main objectives of the pilot study were to refine the collection of data, and to identify and clarify the research questions (Yin, 2018). The main phase intends to answer the research questions and ran from January 2017 to May 2018. All these interviews were tape-recorded, transcribed, and most were followed up with an open discussion. These interviewees comprised two members of the board of directors (one is the production manager and the other is the financial manager) and other operational managers.

The collection of data was also supported by the collection of formal reports, statements and informal records provided by OLITREM.

1.3. Structure of the thesis

After the introduction, presented in chapter one, this thesis is structured as follows.

Literature review on Total Quality Management (TQM), Lean, ISO 9001, and Enterprise Resource Planning (ERP), is presented in chapter two. Within the literature of Lean some SME specific factors are introduced, such as, how is Lean implemented, which barriers can be encountered, how critical success factors play a role and what benefits can be achieved.

Chapter three describes the methodology adopted in the investigation, which includes a description of the field site, a theoretical approach to a quality research and an explanation of the methods used to gather data.

Chapter four describes how the case study is developed (empirical study), a detailed description of crucial management decisions is presented. Some of these decisions are, the implementation of ISO 9001 and the ERP system, the purchase of important production facilities and the operational refresh project.

Chapter five presents a discussion and the results of the findings. A comparison between the literature on Lean and the reality faced by OLITREM is made. This chapter also includes the answers to the research questions posed and what OLITREM has achieved and is going forwards.

Finally, chapter six summarizes the contributes of this thesis, the limitations encountered while it was being developed work and suggests opportunities that can be applied in future research.

Chapter 2 – Literature Review

2.1. Quality and Total Quality Management

According to Cameron and Sine (1999) quality is seen as "an ultimate outcome" linked to the general functioning of the organisation. To access quality nowadays the entire organization must be addressed because each area contributes to produce a product or provide a service, being a vital supporting process to achieve quality (Sousa and Aspinwall, 2010).

Total Quality Management (TQM) is an approach that is linked to quality through increased customer satisfaction as defined by Dahlgaard and Dahlgaard-Park (2006, p. 266): *"TQM is a corporate culture characterized by increased customer satisfaction through continuous improvements, in which all employees actively participate."*.

The main objective of the TQM philosophy is to transform an organizational culture from a passive and defensive into a pro-active and open culture, to ensure that core TQM principles (strong commitment, continuous improvement and focus on customers) are applied to the whole organization (Dahlgaard and Dahlgaard-Park, 2006; see also Dahlgaard-Park, 2011; Pimentel and Major, 2016).

The Lean concepts and tools should be seen as supportive to the overall objectives of TQM and not as an alternative (Dahlgaard and Dahlgaard-Park, 2006).

2.2. Lean

The Lean production system had its origins in Japan, primarily known as Toyota Production System (TPS), and later on popularized by the famous books "The Machine That Changed the World" by Womack, Jones and Roos in 1990 and "Lean Thinking: Banish Waste and Create Wealth in Your Corporation" by Womack and Jones in 1996.

Lean production combines the best of mass production (the ability to reduce costs by unit through large scale production) and craft production (increased product quality). The goal is to

achieve perfection through lower costs, no defects, no inventories and the capability to offer an endless variety of products (Womack *et al*., 1990).

According to the literature Lean is a hard concept to define (Hines, Holwe and Rich, 2004; Shah e Ward, 2007; Petterson, 2009; Bhamu & Sangwan, 2014). Not understanding the concept clearly can cause confusion at a theoretic level and specifically at a practical level when organizations try to implement Lean (Petterson, 2009).

"According to Hines et al. (2004) lean is constantly evolving, implying that any "definition" of the concept will only be a "still image" of a moving target, only being valid in a certain point in time." (Petterson, 2009)

Shah and Ward (2007) suggest that Lean can generally be described from two different perspectives, a philosophical one that relates to the guiding principles and general goals described by Womack and Jones (2003), and a practical one that includes management practice tools and techniques (Shah and Ward, 2003).

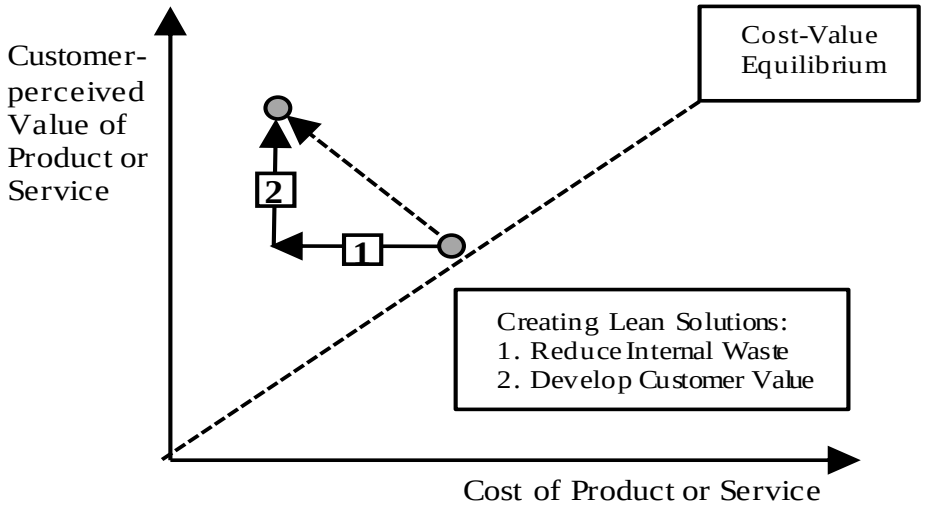
Womack and Jones (2003), suggest that Lean should follow five guiding principles: precisely define **value** in terms of specific products or services that meet customer's needs such as price and availability; identify the **value stream** for each product, which actions is the product subject to during its conception, production and ordering, which allows the elimination of actions that do not add value; make these actions that create value **flow** without interruptions; let the customer ***pull*** value from the producer and continue the pursue for **perfection** through the reduction of waste.

In order chase perfection by reducing waste, first it is important to understand what exactly is waste. Womack and Jones (2003) introduce Taiichi Ohno (1912 – 1990) as one of the executives behind the Toyota Production System that was the first to identify the first seven types of waste, or in other words any activity that doesn't create any value. These seven types of waste are: mistakes that need rectification, producing undesirable products, irrelevant process steps, useless movement of employees, useless transport of goods, waiting time from upstream activity and good or services that don't meet customer demands.

The same authors highlight the importance of understanding these principles and their correlations, so that managers can avail the full benefits from lean practices and go forward in their lean journey.

Building on Womack and Jones principle of value creation, Hines (2004) proposed a Cost-Value proposition based on customer perceived value of products or services (Figure 1).

Figure 1: Relation of Value, Cost and Waste



Source: Hines (2004)

According to Figure 1, as the wasteful activities and their costs are reduced, the value proposition for the customer is higher and so it creates value. With the addiction of features and services (for example: shorter deliveries) that are in the customer interest, value is also created. The higher a product or service is in the cost-value equilibrium, the more attractive it is for a customer (Hines, 2004).

On a more practical perspective Shah and Ward (2003) did a literature review on lean production and found the most commonly associated practises used. From these practises they developed four lean bundles. All practises related to production flow (example: reduction of lot size and cycle time reduction) were combined to form the just-in-time (JIT) bundle. Practises such as continuous improvement, quality management programs were combined to form the

total quality management (TQM). The total preventive maintenance (TPM) bundle consists of practises like equipment effectiveness and maintenance optimization techniques. Finally, the human resource management (HRM) bundle relies on practises involved with people, such as job rotation, formal training programs and problem-solving groups.

(Hu *et al*., 2015) share the idea that Lean has many different meanings to different people and thus there is no correct way of defining it, however these researchers acknowledge some common features that are inherent to Lean. These common features are: i) a continuous focus on customer values, ii) the alignment of core and support processes to provide such values, iii) ensuring an organization is concentrated on optimizing the same processes through the reduction of waste, iv) empowerment of quality, individuals and building inter-organization relationships and v) finally creating a mentality of continuous improvement.

2.3. Lean in SME's

The implementation of Lean in SME's focuses more on an operational level and internally (production and operation processes), whilst the implementation of Lean in large entities usually takes a more strategic philosophy (implementation of Lean across the entire supply chain). Regarding the application of Lean in the supply chain of SME's, little evidence can be found, in addition, SME's tend to choose more prudently which tools and techniques to use then large entities do (Hu *et al*., 2015).

The cautious decisions SME's must take when implementing Lean tools are justified given the time and financial constraints these companies face. Thus, SME's should first apply tools that are simple to use and understand and are sustainable (Mathur, Mittal and Dangayach, 2012).

Matt and Rauch (2013) in their study analysed the suitability of the most common Lean production methods across different company sizes. They found that the most recommended methods applicable to SME's (among others) are: i) 5S, ii) Kaizen, iii) Just in Time, iv) Pull and Kanban, v) Value Stream Mapping, vi) Poka Yoke and vii) Quicker Set ups.

Moreover, Rose, Rahman and Nordin (2011) conducted a study in which they suggest 17 best practices for implementing Lean in SME's (5S, Kanban, Set Up Time, Continuous

Improvement, Visual Control, Cell Layout, Standard Operation, Continuous Flow, Uniform Workload, Small Lot, TQM, Quality Circle, Multifunction Employee, Training, Teamwork, Supplier Management and Preventive Maintenance), these practices were split into three categories, less investment, feasible to apply in SME's, and recommended by researchers.

Based on the suggestions of the authors referenced above, with respect to the most recommended techniques for SME's, some are described below:

The **5S** technique has its origins in a Japanese acronym: in English the 5S stand for organization, neatness, cleaning, standardization and discipline. This can be used to have each factory section clean or an office desk. Successfully implementing this tool has several benefits such as discovering hidden problems, ensuring a good impression when the workplace is visited by customers or clients and increasing productivity and operational efficiency (Kobayashi, Fisher and Gapp, 2008). Most importantly, this technique may assist in employee motivation and empowerment.

Just in Time (JIT) can be defined as a manufacturing philosophy that seeks to reduce waste, since waste does not add any value to a product, such as the transport of inventories between warehouses just for storing (Madanhire and Mbohwa, 2016). JIT is based on small and permanent adjustments in the manufacturing process, its goal is to provide every process with one part at a time, exactly when there is a need for that part (Gupta and Jain, 2013, see: Shah and Ward, 2003).

Kaizen is another method that is common associated with Lean. Kaizen is the Japanese word for improvement, and so this method refers to the continuous improvements of everything, ranging from production cost incremental improvements to both managers and employee's participation (Gupta and Jain, 2013, see also: Modarres, Ansari and Lockwood, 2005). Kaizen is used to eliminate problems, through the collection of data, analysis of a problem and the selection of the best solution (Gupta and Jain,2013).

Kanban is a tool (for example a card/token) which helps a company to control its inventory levels and regulate production. Some benefits attached with Kanban are improved productivity

and cost reduction through the reduction of wastes in the production line (excess inventory) (Rahman, Sharif and Esa, 2013).

The Value Stream is the entire process a specific product, service, or both are subject to from the very early design stages all the way to the end when it is ready to satisfy the customer needs. The **Value Stream Mapping** is usually designed as a graphical tool that allows a detailed analysis of which activities are adding value and those that are not (Gupta and Jain, 2013, Womack and Jones, 2003).

2.3.1 Benefits

However, there is a clear scepticism in SME's regarding Lean benefits, which imposes an obstacle (Achanga, Shebab, Roy and Nelder, 2006). To overcome this obstacle, it is important to understand how SME's can benefit from Lean.

Zhou (2016) did a study in SME's in the US regarding the implementation of Lean, identifying fourteen benefits of Lean (increased productivity and efficiency, increased customer satisfaction, reduction in manufacturing and inventory costs, reduced waste, improved profitability, improved product/service quality, becoming more competitive, cultural change, ability to handle unexpected events, increased Just-in-time service, improved market penetration, reduced logistics costs, improved product development and reduce purchasing costs). Zhou (2016) highlighted increased productivity and efficiency, improved customer satisfaction and reduced manufacturing and inventory costs as primary benefits achieved by Lean.

Despite the common benefits encountered with the application of Lean, some authors identified other benefits that are less obvious and are a by-product of the implementation itself or sometimes are hidden.

Gupta and Jain (2013) mention improvements in quality and safety (safer working areas, less mistakes can lead to less accidents), reduction time in traceability (with the help of the 5S tool, there is a better visual control of everything in the factory making items quicker to find), cultural change (with a Lean culture, communication increases within the workforce and each employee feels they play a role) and reduction of fatigue and stress.

Other indirect benefits brought up by Hu *et al.* (2015) are a closer integration with supply chain members as Lean implies changes in an organisation which includes suppliers, and thus shared experience and mutual trust among suppliers can be beneficial. Organisations following the Lean journey are quicker at identifying and solving problems, which enables a quicker learning that can give a competitive advantage over the competitors.

2.3.2 Critical Success Factors

To succeed in implementing Lean, SME's should understand which factors are critical to do so. Four critical factors for the implementation of Lean manufacturing within SME's were suggested by Achanga *et al*. (2006). These factors are: i) leadership and management, ii) finance, iii) skills and expertise, iv) organisational culture. Consequently, a strong leadership and a committed management are the basis to successfully implement Lean in a SME, of the organization size (small or large company), of the national culture, and whether Lean is already developed or in a development stage (Netland, 2016, see also Achanga *et al*., 2006). In line with this approach Assen (2016) explored the impact of leadership in Lean management and concluded that top management should not be afraid of Lean initiatives. Instead, top management should embrace them to continuously improve processes and activities, as well as assuring the Lean initiatives work as a compass to lead the organization towards Lean.

Additionally, top management should keep employees updated on high company expectations and should answer any concerns or resistance employees show towards Lean, to assure everyone is on the same page (Assen, 2016). To successfully implement Lean, a supportive, sustainable and proactive culture in improving, communicating and reducing waste is essential (Achanga *et al*., 2006; Dahlgaard and Dahlgaard-Park, 2006).

Using the Global Leadership and Organizational Behavior Effectiveness (GLOBE) model of organizational culture (House, Dorfman, Javidan, Hanges and Sully de Luque, 2014) that describes culture into nine different dimensions (Table 1), Bortolotti, Boscari and Danese (2015) investigated if there was a specific organizational culture associated with lean plants that successful implemented lean. The authors concluded that successful lean plants were

characterized by higher Institutional Collectivism, Future Orientation, Humane Orientation and a lower Assertiveness.

Table 1: GLOBE Culture Dimensions

Culture dimensions	Definitions
Performance Orientation	The degree to which a collective encourages and rewards (and should encourage and reward) group members for performance improvement and excellence
Assertiveness	The degree to which individuals are (and should be) assertive, confrontational, and aggressive in their relationships with others.
Future Orientation	The extent to which individuals engage (and should engage) in future-oriented behaviours such as delaying gratification, planning, and investing in the future.
Humane Orientation	The degree to which a collective encourages and rewards (and should encourage and reward) individuals for being fair, altruistic, generous, caring and kind to others.
Institutional Collectivism	The degree to which organizational and societal institutional practises encourage and reward (and should encourage and reward) collective distribution of resources and collective action.
In-Group Collectivism	The degree to which individuals express (and should express) pride, loyalty, and cohesiveness in their organizations or families.
Gender Egalitarianism	The degree to which a collective minimizes (and should minimize) gender inequality
Power Distance	The degree to which member of a collective expect (and should expect) power to be distributed equally.
Uncertainty Avoidance	The extent to which a society, organization, or group relies (or should rely) on social norms, rules and procedures to alleviate unpredictability of future events.

Source: (House *et al*., 2014)

However, only lower assertiveness is exclusive to the success of lean implementation, as the other cultural dimensions are also a common trait in high performers, regardless if they are lean or not, which does not guarantee that identical organisational cultures are critical to the implementation success.

Bortolotti *et al.* (2015) also concluded that successful lean plants in terms of soft practises (those that concern people and their relations) implemented the following practises: employee

training, small group problem solving, customer involvement, supplier partnership and continuous improvement.

2.3.3 Barriers

In addition to the critical factors, any entity willing to take the Lean journey should be aware that there are several constraints that make Lean very tough or difficult to implement.

In fact, implementing Lean implies large financial costs, time and effort investment costs which can be daunting for SME's small budgets (Hu *et al*., 2015). As an example of time and effort investment costs, Achanga *et al.* (2006) stated that to achieve the "skills and expertise" critical success factor, employees must acquire Lean knowledge and to do so, they must stop production temporarily which, in a SME's perspective, may be an unnecessary loss of resources (when immediate returns are not particularly foreseen).

Additionally, lack of financial and organizational resources makes it hard for SME's to hire qualified staff, which usually means that the implementation of Lean lies on the shoulders of a single person (Achanga *et al*., 2006; Matt and Rauch, 2013; Netland, 2016).

Not fully understanding the concept of Lean, having a poor mind-set and lacking a well-structured implementation plan may make Lean practices less likely to be successful in SME's (Dora *et al.*, 2016; Mostafa *et al*., 2013). Despite agreeing with the barriers mentioned above, Zhou (2016) identifies management inability to adapt to change as the key inhibitor factor.

Hu *et al*. (2015) believe that, although SME's have some benefits from being smaller (quick at adapting and change) SME's are in a disadvantage to implement Lean. Bhamu and Sangwan (2014) suggest that the large costs implied in Lean make its adoption in SME's uncommon.

2.4 Quality Systems/Supporting Tools

2.4.1 ISO 9001

Zhou (2016) performed a survey which included a total of two hundred SME's in the northeast region in the U.S. In this survey, 20 Lean tools and programmes were included. Quality

certifications (for example ISO 9001) were ranked 2nd in general. Additionally, two different clusters were ranked, one cluster as the "Lean group" and the second cluster as "Somewhat Lean group". The latter quality certification, ranked as the most valuable tool, indicates that certifications like ISO 9001 are perceived as even more important on entities that are on the path to start Lean (Zhou, 2016).

ISO (International Organization for Standardization) is the world's largest developer of voluntary International Standards. It acts as an independent, non-governmental international organization with a membership of 162 national standards bodies (ISO, 2017).

The ISO 9001 addresses various aspects of quality management. The standard provides guidance and tools for companies and organizations, which intend to ensure that their products and services consistently meet customer's requirements, and that quality is consistently improved (ISO, 2017).

ISO 9001 sets out specific requirements that a company should follow to implement a quality management system. It is the only standard in the quality family that can be certified (although this is not a requirement). ISO 9001 can be used by any organization, large or small, regardless of field of activity. In fact, there are over one million companies and organizations in over 170 countries certified to ISO 9001 (ISO, 2017).

The most updated version is ISO 9001:2015, replacing ISO 9001:2008. Companies will be able to keep using ISO 9001:2008 certification for a transition period of 3 years until they must adjust to the new standard by 15 September 2018 (ISO, 2017).

The ISO 9001 standard follows seven quality management principles defined by ISO (2017):

- **Customer Focus:** Meeting and exceeding customer expectations goes a long way to achieve sustained success within an organization;

- **Leadership:** A clear purpose and direction enables an organization to work towards their objectives;

- **Engagement of People:** Involvement and empowerment of all people across all levels allows an effective and efficient management;

- **Process approach:** Understanding all the interrelated processes makes it easier to achieve consistent and predictable results (encompassing system approach to management – principle in previous version);

- **Improvement:** Promotion of continuous improvement;

- **Evidence-based decision making:** Taking decisions based on facts, evidence and data analysis to accomplish better results;

- **Relationship management:** Keeping healthy relationships with suppliers and partners in order have sustained success.

The most common benefits according to Chiarini (2011) in implementing ISO 9001 are the standardization and repeatability of processes, improvement in customer satisfaction and reduction of costs of poor quality. In addition, in her study, Chiarini (2011) suggests a guideline that correlates ISO 9001 requirements to Lean tools and principles.

Tarí, Molina-Azorín and Heras (2012) compiled a list of the most common benefits of ISO 9001, though the examination of 82 studies. The most common benefits are: i) improved customer satisfaction, ii) improvements in relations with employees, iii) profitability and improved systematization, iv) improvement in market share, sales and image and v) improved product quality.

2.4.2 Enterprise Resource Planning (ERP)

An ERP system is a software that supplies a company with integrated information, which supports daily business operations and helps top management to make better decisions. Investing in an ERP typically implies large financial costs both to develop and maintain, as it is unique, and evolves alongside the company (Parry and Graves, 2008).

Nowadays, many companies try to apply both Lean and ERP systems to obtain a competitive advantage in the market. Some authors suggest the need that ERP systems and Lean work together (Hu *et al.*, 2015; Powell, 2013).

Powell, Riezebos and Strandhagen (2013) suggest that every Lean endeavour should consider the ERP system as an essential tool in a Lean tool kit. In fact, they state that the implementation of an ERP works as a catalyst to implement Lean (most of the activities involved in the ERP implementation were found to highly influence the implementation of Lean practices, which is mostly explained by both implementations, having very similar or the same tasks). They highlight the fact that SME's usually struggle to implement some of these systems alone. Applying them together can give rise to a potential gain. Iris and Cebeci (2014) recommend that the effective usage of ERP system can contribute to applying Lean principles.

Chapter 3 – Methodology

3.1. The field Site

SME's play a fundamental role in Portugal and in the European Union (EU). According to the Portugal Statistics Report (2017) in 2016, these represented 99,9% of all companies, which meant 80% of employed people and 67% of the total turnover.

OLITREM belongs to this group of companies and focuses on design, commercialization and production of refrigeration equipment and commercialization and installation of hotel equipment.

OLITREM is one of the biggest companies in this sector in Portugal. The company thrive to maintain and develop their market position, by increasing their market share, which shall be accomplished through continuous improvement and new models.

OLITREM is organized in six different departments (see Appendix 4): (i) Quality Management – quality management system (ISO 9001), quality control and customer satisfaction; (ii) Procurement – stocks management; (iii) Planning and Management – control of the whole organization; (iv) Production management – technical assistance, production control and R&D; (v) Sales and Marketing Department; (vi) Financial management –accounting and finance.

In 2016, OLITREM had a turnover of about 12,3 million euros, a total production of 17,344 refrigerators and a total operating income of 736,8 thousand euros (see Table 2), and about a hundred and sixty collaborators. The company complies all legal requirements that are relevant to the certification of the system of quality management (ISO 9001) and the SME-Leader certification ('PME –Líder') in Portugal.

3.2. Research methods

A qualitative and longitudinal case study was carried out in a Small-Medium Enterprise in Portugal to understand how management started its journey towards Lean during the period under analysis (2008-2018), and how the company is overcoming the obstacles on implementing Lean in a SME and how it is putting in practice innovative practices.

This work is based on an Interpretive research that is concerned with the understanding of the social world and attempts to understand the social nature of accounting practises. Interpretive research believes that management accounting is not a natural phenomenon but rather socially constructed (Ryan, Scapens and Theobald, 2002).

The main steps taken to develop the case study were the specification of the research questions, data collection, evidence assessing and writing of the case study (Ryan *et al.*, 2002; Yin, 2018). The researcher role was "Visitor" since several visits happened on the field site and interviews were conducted (Ryan *et al.*, 2002).

The research took place between October 2016 and May 2018 and comprised two phases. The first phase, regarding the pilot case study, spanned from October 2016 to November 2016 and comprised 4 interviews, with a total of 3 hours and 53 minutes. The last two interviews were structured and tape-recorded and transcribed.

The main objectives of the pilot study were to refine the collection of data, and to identify and clarify the research questions (Yin, 2018).

After the pilot phase, three research questions were posed: (i) are SME's less likely to implement Lean opposite to what the literature suggests? (ii) how has Lean been applied in a Portuguese SME (OLITREM)? And how can it be improved? and (iii) can the Lean system be integrated into the management system in this organization?

Finally, the main phase intends to answer the research questions and ran from January 2017 to May 2018. This phase comprised 9 semi-structured interviews, lasting 5 hours and 54 minutes.

All these interviews were tape-recorded, transcribed, and most of them were followed up with an open discussion (see Appendix 1).

Globally, 13 interviews were conducted, lasting 9 hours and 47 minutes. The interviewees comprised two members of the board of directors (one is the production manager and the other is the financial manager). As can be seen in Appendix 1, other operational managers were interviewed. The average was 35 minutes per interview. Interview guidelines can be found in Appendix 2.

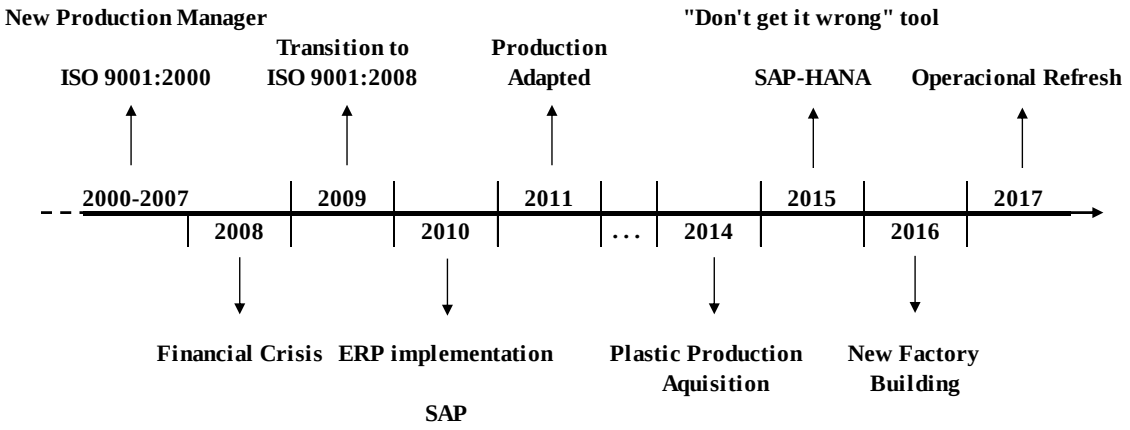
The collection of data was also supported by the collection of formal reports, statements and informal records provided by OLITREM (See Appendix 3).

In addition, a paper was written alongside this thesis, which was presented in the 21st QMOD conference on Quality and Service Sciences ICQSS 2018, 22-24 August in Cardiff, UK.

Chapter 4 – Empirical Study

Over the years, OLITREM has thrived to increase customer satisfaction by improving its processes, services and quality while complying to the legal requirements. In order to do so several key management decisions were taken in light of these objectives (see Figure 2). These decisions are described in depth below and are important to understand how OLITREM is pursuing the Lean dream today.

Figure 2: Time line diagram of critical changes in OLITREM



Source: Elaborated by the author.

In 2000, OLITREM was going through some difficult challenges as a business. Thus, some changes had to be made. At the time, the production manager, who had just started working in the company, was in a training program related to top managers, where the quality management standard ISO 9001:2000 (3rd edition) was being discussed. The organization which was in charge of the program was IAPMEI – Institute of Small and Medium Companies Support and Innovation - and they were selling a ISO 9001 implementation plan, which included the support of an auditor to conclude the project.

As a consequenc,e OLITREM decided to adopt ISO 9001, reorganizing the entire company, and followed the standard requirements to be internationally competitive and provide the customers with good standards and practices. OLITREM was among the first 500 companies to adopt this standard certification in Portugal. The entire implementation process took about two years.

The certification implied several benefits to OLITREM. It worked as a reorganizational method and a marketing brand.

Additionally, as described in the company strategy program, the ISO 9001 certification transmits to customers an image of credibility and trust (crucial factor to find and retain customers). The certification was also important to assure that the customers' and the company's quality requirements were being achieved across all products and services offered. Lastly, it allows for the collection and analysis of important data (for example, customer satisfaction, suppliers quality, productivity) to help management to take good decisions.

In 2008, the global financial crisis had massive repercussions, and Portugal was affected by this crisis. Between 2008-2012 around a hundred and seventy-five thousand companies were closed (Pordata, 2018).

Many of OLITREM suppliers and customers were small companies, which were forced to close or significantly reduce productivity during the financial crisis, and so suppliers started running short and sales started to slow down. OLITREM had to increase inventories to avoid breakdowns (which implied extra costs) and rearrange production capacity which was generating a surplus, since the company was only producing one single model.

However, OLITREM flexibility allowed the organisation to stop producing just one single model and began producing 10 similar models with distinctive characteristics, whilst maintaining a similar production capacity.

In 2009, the quality management system ISO 9001 transitioned to 2008 version, which proved to be another crucial factor to survive during the financial crisis, as stated by the production manager:

"Before the crisis of 2008, the only way to sell a product was being certified by ISO 9001. During the crisis, the only deciding factor was how cheap could you sell a product and nowadays when the crisis effect is looming away, the first thing customers ask for is if the price is competitive. If so, then they ask if you are certified" (July 2017).

Thus, OLITREM managed to retain most of the customers, and draw in new ones. Consequently, the company surpassed the crisis with just a small rupture on revenues/invoicing. The production manager, who is also a member of the board, knew that from the moment he began working in the company. He knew that the way the organisation was being run had to be improved. With a background in engineering and with the support of the other members of the board (same family), he triggered a journey towards a better tomorrow.

Most of the production manager knowledge about business excellence/quality is self-taught alongside a common sense on how a company should work. According to him, so that an enterprise is in the vanguard, all information must be challenged (is it enough, or is it needed more?). He described why information plays such a crucial role:

"There are two distinct kinds of business – one that makes a lot of money regardless of how well it is managed or how organized it is, while the other kind of business requires good management to be successful and profitable and, to achieve this, it is important to have as much information available as possible" (Production manager, January 2017).

Until 2009, OLITREM was very disorganized, and the information wasn't enough to make the right and timely management decisions as the production manager very well described:

"*Information has to be timely, so you won't reach the end of the year and realise loss of money. By then it is irrelevant to know because it is in the past, which makes timely and reliable information of the utmost importance"* (January 2017).

A clear example of the above mentioned was the fact that the company did not have an integrated management. Departments like accounting, production and logistics did not work in sync. For example: i) the logistics department would tell a customer they had a product ready to deliver without knowing if it was already produced or paid for; ii) the production department would start producing an order for a customer who was in debt.

There was a need to create a sustainable company, to make information flow between departments and to store the information. Thus, it wouldn't be lost as stated in this example presented by the production manager.

"If an experienced salesman would leave the company, he would take valuable information with him (for example, information regarding each customer desires and needs and how to best sell him a product) and the company would be left with nothing" (July 2017).

For these reasons, towards the end of 2009, OLITREM started looking at ERP systems. The chosen ERP system was SAP (Systems, Applications & Products in Data Processing), because most of OLITREM customers and suppliers already worked with this ERP, which would allow a full integration system with customers and suppliers.

After the trial period at the start of 2010, the company decided to invest in the SAP software and bought all modules, which are currently used by all the departments in the company.

SAP did exactly what was expected by the managers, all the information regarding the business was finally organized (managers could access to any kind of information; for instance, who ordered each unit, at what price, who decided it, which components has it, how much did it cost, how much was it sold for and how much was the profit?). The company managers had any kind of indicators (quality, production capacity) on the tip of their fingernails. Because all the information is recorded in the system, SAP allowed OLITREM to have better planning and management (example mentioned by the production manager):

"If a client complains, it is possible to go backwards in the production process and trace problems to later find solutions" (January 2017).

Nowadays, OLITREM recognizes that, having a system like SAP has many benefits as stated by the planning and control manager:

"We are so pleased with the functionality of SAP that as soon as SAP develops a new specific module for us, we start asking for another" (January 2017).

This ERP system became so important that the company fully relies on it and cannot operate without it.

In 2011, when the financial crisis started looming away companies started to grow again, but OLITREM faced another problem. Customers started buying normal quantities of products again and production capacity suddenly became too small.

Nevertheless, the production manager knew that, to increase production capacity, the only solution in short term was to rearrange the production line in more effective ways, as other ways of increasing production capacity required substantial amounts of money, space and time. Using a designer software (SolidWorks), countless layouts were tried until he found the one thought to be most effective (arranged each different section in order that the next section works as a client of the previous one and so on. So, each section only produces what is needed, reducing waste).

In 2014, a crucial decision was taken, when the plastic supplier decided to increase the price and disregard that business section. OLITREM strategically decided to acquire the plastic supplier. Integrating the plastic production, not only it reduced supplier reliability by supplying the own internal production (thus obtaining a better margin on each unit) but also allowed a control over competitors as a plastic mould supplier, which implied a competitive edge. Nowadays, OLITREM plastic production is 80% internally supplied and 20% sold to the market. The company is slowly looking to enter this segment with the objective of doubling the current revenue within 2 years. To do so, the company recently changed the machinery schedule never to stop during lunch break, which reduces electricity costs and increases effectiveness.

At the beginning of 2015, OLITREM started experiencing some setbacks caused by SAP as the system was getting overloaded by too much information. There were more than 40 computers working on SAP sending information to each other, which was overwhelming. Additionally, SAP required another system to store data. Day-to-day operations with SAP started taking so long which caused delays at the production level.

So OLITREM decided to invest in SAP HANA (a more advanced version), which has everything integrated (servers on site linking all computers) removing the need for an additional system. Moreover, it increased network speed to optic fibre for further speed.

When asked about Lean management, the production manager admits it has always been in the back of his mind ever since he heard about it. He acknowledges that Lean is a weapon that helps to control costs. Thus, he even thought about hiring a company to help in this long process.

However, OLITREM had some struggles at the beginning of the century and later got affected by the financial crisis. Despite surviving the harsh environment, the company had to rely on many production orders which made production non-linear. In other words, the customer portfolio was very unstable as the production manager explains:

"Lean is only worth when you have the capacity to sell products. When you can't sell anything, Lean will hardly bring any improvement. Lean is very expensive and you need to know how to take advantage of it" (July 2017).

To overcome what is mentioned above and inspired by Lean management tools and some requirements of ISO 9001 regarding corrective actions (see Appendix 6), in late 2015 the company went further and implemented an advanced method that helps to avoid mistakes in the future. This method was named after a Portuguese saying ('Don't Get it Wrong'[1]) and was created by the production manager. Thus, employees can better assimilate and remember what the purpose is. The implementation of this method was successful and helped to develop the culture into a quality continuous improvement.

In 2016, OLITREM managed to negotiate a large deal of pharmaceutical refrigerators with an English customer. This deal was very good for OLITREM but had implications in the production capacity. In 2017 the company would have to produce 25,000 units to meet the customer needs (10,000 units more than in 2015). At this point, OLITREM knew it had to increase its factory size. A new factory building was built, and it allowed the production manager to reorganize the factory's layout to maximize efficiency and reduce waste.

[1] "Don't Get it Wrong" translated from "Não pôr o pé na poça", official term given by OLITREM is "Patómetro".

In 2017, OLITREM management knew the business was going well. However, it was recognized that the company had many aspects that could be improved and so, OLITREM decided to invest in a new project called "Operational Refresh". The main objectives of this project were to continously improve OLITREM processes and productivity, which would be achieved mainly with continously waste reduction, reorganization of the factory sections downstreaming responsabilities to release top managers, reducing intermediate stocks, and improving the information flow.

At the time, the production manager was fully aware of Lean management principles and some of its tools. However, he lacked the full knowledge to apply these concepts any further efficiently and so, help from an external consulting company was needed and reached. The consulting company set out to help in several aspects such as, professional training, productivity management (including OEE – Operational Equipment Effectiveness), process management (efficiency and lead time), and implementation of some Lean tools, like 5S (see Figure 3) and Kanban (see Figure 4). An initial detailed draft plan of the consulting company can be found in Appendix 5.

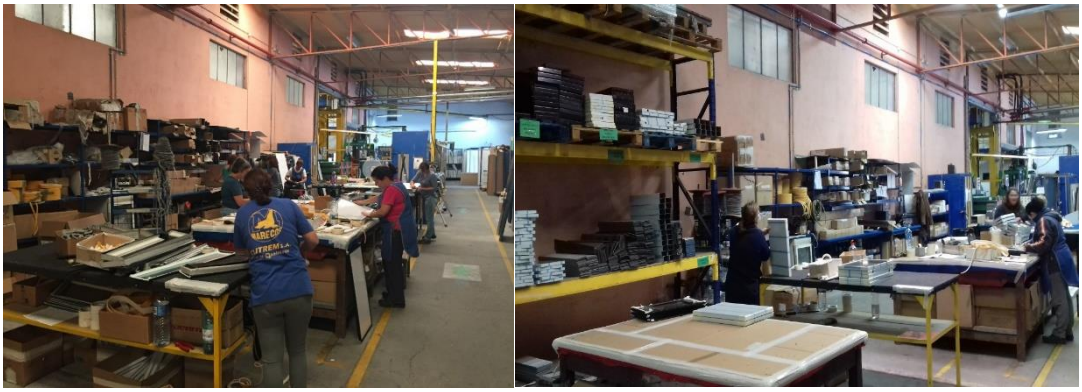


Figure 3: Example of 5S (Before – After)

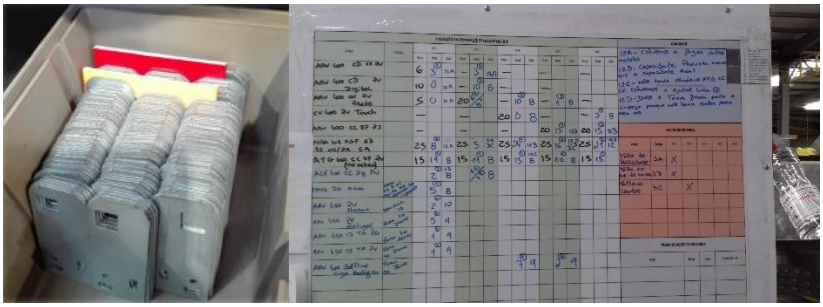


Figure 4: Kanban (Left) and Production Board (Right)

Initially, the consulting company studied OLITREM deeply to better understand what was working as intended and what were the improvement needs in the production line. OLITREM showed good prospects in some aspects such as an organized and efficient production, excellent quality principles and a strong commitment from management to succeed.

In the production section, alongside OLITREM production line, some boards were placed in each working section to increase productivity as shown in figure 4. These boards include each product production planning, actual production, quality indicators, missing stocks and improvement plans of actions that are filled by each section manager (downstreaming some responsibility of the production manager). The quality assistant states:

"Several weeks of training programs were deployed by the consulting company regarding 5S and Kanban, and quality and production efficiency measures. OLITREM implemented 5S in every work section gradually. However, as soon as some sections began to be more organized and cleaner, other sections started applying 5S on their own because the culture for quality quickly spread" (April 2018) (see figure 3 on how materials are more organized and easier to reach and find).

Additionally, OLITREM started the implementation of Kanban in one section, as can be seen in figure 4. When the first card is reached, it means the materials that the next section needs are at a low level, and if it reaches the last card, the materials are at a critical level, and the production in the next section will have to stop. The company must ensure that this section is working 100% before implementing the tool in the following sections where Kanban makes sense.

The application of these tools allowed OLITREM to have a better oversight over the production sections and its management. In addition, a new manager was assigned to assist in implementation of Lean going forwards. According to project manager, an exhaustive work on data collection and structuring at the factory level has enabled the company to have a clearer view of production performance which highly improves the decision-making process. As such, the application of Lean tools can easily be integrated with the management system of the organisation.

"At an organisational level, we can now look at concrete data and take better decisions" (Project manager, June 2018)

Thus, Lean principles began to be translated, even if not formally, into practical implementation of techniques and operational measures linked with quality management.

Key Performance Indicators (KPI) show quite well the improvement in financial and operational indicators, as shown in Table 2. Indeed, after the implementation of Lean and ERP tools (including 'Don't Get it Wrong') (2013-2016) as frameworks linked to quality management, effectiveness, efficiency and productivity increase a lot.

Table 2: Key Performance Indicators

	2013	**2016**
Sales (€)	10 792 810	12 303 438
Operating Income (€)	68 574	736 776
Units Produced (number)	13961	17344
Productivity#	279	347

#Output/Input = Units produced/direct labour hours

Source: Elaborated by the author based on OLITREM indicators.

More and more customers have a greater access to a variety of choice in supply seeking better and better values when selecting products (Hu *et al*., 2015). With that in mind OLITREM production manager believes that the next generation of success is the ability to produce a product or service with different attributes, which goes along side Lean crafting production (more quality attached to each product which satisfies demanding customers).

"Factories in India and China can make products much cheaper than I will ever be able to, however we can succeed because our products are unique and offer more quality than our competition" (July 2017).

Going forward, OLITREM has established an on-going focus on each individual working section to evolve and keep working towards the reduction of the seven wastes. To do so, the

company is going to implement relevant improvements based on a further analysis of the production processes and labour post.

In conclusion, OLITREM already took a huge step towards Lean but despite great improvements in production is organisation and management, the company knows that there is still a long journey ahead they plan to continue.

Chapter 5 – Discussion and results

Ever since OLITREM has had a change on management, it thrived to continously increase customer satisfaction, quality of all products and services over the course of time. The implementation of the quality system ISO 9001 prooved to be a great asset on increasing quality across the organization and thus increase customer satisfaction (Chiarini, 2011; Tarí *et al.*, 2012). OLITREM took another important step when the SAP-ERP was implemented. Indeed, it revolutionized the company's communication. Both ISO 9001 and ERP were a stepping stone in OLITREM's Lean journey (Chiarini, 2011; Powell *et al.*, 2013).

OLITREM decided to follow the Lean journey because they felt that the company processes and productivity needed some improvements, visualized as some Lean benefits Zhou (2016).

According to literature and comparing it with the reality lived in the company, it is possible to conclude that OLITREM has been able to implement some techniques that are in line with Lean, such as the 5S concept that has been implemented in some sections progressively. The employees also started working towards this techinique ahead of time as mentioned by Ablanedo-Rosas, Alidaee, Moreno and Urbina (2010). Indeed, this tool plays an important role in continous improvements. Rose *et al.* (2011) categorized 5S as one of the least investment tools, and recommended SME's should start applying it firstly. Thus, production sections began to be more efficient due to 5S. Kanban was the next step for OLITREM. As Kanban is somewhat difficult to implement in SME's which have a poor inventory management (Rahman *et al.*, 2013), the company decided to start with a single section until it was fully operational, before implementing in other sections or departments.

Besides these tools, OLITREM went further and, based on corrective actions requirement from ISO 9001, applied an improved method that prevents mistakes. The method was named, following a Portuguese popular saying, ('Don't Get it Wrong'), to create awareness so employees would be more involved. This turned out to be quite successful, as production line quality improved (less defects) and imbued a quality continous improvement culture in the workforce.

Consequently, the organisation began to assume and recognize Lean principles and philosophy, trasnlated into practical implementation of techniques and operational measures to increase quality, productivity and performance.

Despite the succesful aplication of 5S and Kanban, OLITREM has managed to create a culture of quality into the whole organization which, according to Hines, Taylor and Walsh (2018), is the hardest hurdle to overcome in a Lean journey.

However, OLITREM still has a long journey ahead, as Lean is an ending cycle of continous improvement. OLITREM has the necessary tools to prosper in this journey as the management and leadership are commited to improve. Thus, this is the most critical success factor (Netland, 2016).

There are some authors that mention that large investment costs and the inability to adapt, make implementation of Lean in SME's harder (Hu *et al.*, 2015; Zhou, 2016). OLITREM is likely facing certain difficulties specially when it comes to financial investment, but surely will find ways to overcome such difficulties. Answering research question number one, this paper shows that SME's can also apply Lean processes and techniques.

To conclude, the company managed to implement some Lean tools and is proactively seeking continuous improvement in their processes and quality. Management has a strong commitment to keep implementing new tools and broaden the Lean philosophy to every collaborator, which suggests that, despite being a challenge, SME's can implement Lean.

According to the findings in this case study, and regarding the second research question, some tools from the vast Lean tool kit have been applied, namely 5S's and Kanban. Additionally, other productivity improvements have been developed to increase productivity and reduce intermediate stocks, such as Section Productivity Boards. OLITREM took some of the requirements from ISO 9001 and improved them to increase quality even further. OLITREM, however, still has a long road to become fully Lean.

Answering the third research question, findings indicate that the Lean tools and some of its principles, mainly the continuous improvement, are constantly part of the organizational management frameworks. With the Lean implementation OLITREM now can have a clearer vision regarding production performance, which means more valuable and reliable decisions can be made both at the factory level as well as at the organization level.

Chapter 6 – Conclusions

6.1. Study contributions

This thesis had as main objective to explore how a Portuguese SME started working towards implementing Lean SME's play a crucial role in any country as they are the backbone of the economy, in Portugal SME's represent 99,9% of all entities.

OLITREM was the company chosen as the research subject, it's one of the biggest companies in Portugal in the refrigeration equipment sector and it's also a family company. OLITREM thrives to maintain their high market position with continuous improvements.

To understand how a SME started their journey to Lean, it became important to know how Lean was applied in practise, which tools and principles were used. Further investigation was conducted to identify if the Lean system could be integrated into the management system, or in other words, if Lean was significantly important in the decision-making process.

In light of the previous objectives, three research questions were posed: i) Are SME's less likely to implement Lean opposite to what the literature suggests?; ii) In this company how has lean been applied in practise? And can the lean process be improved and how?; iii) Can the lean system be integrated with the management system?.

Answering the first research question, OLITREM managed to implement some Lean tools, with the help of a consulting company, and is proactively seeking continuous improvements in their processes and quality. Management has a strong commitment to keep implementing new tools and broaden the Lean philosophy to every collaborator, which suggests that, despite being a challenge, SME's can implement Lean.

Regarding the second research question, some Lean tools have been applied, namely 5S's and Kanban. Additionally, other productivity improvements were developed to increase productivity and reduce intermediate stocks, such as Section Productivity Boards. OLITREM is determined to keep working towards the reduction of the seven wastes, however relevant improvements linked with the elimination of waste are being drafted for future application.

Answering the third research question, the implementation of tools like 5S and Kanban have enabled OLITREM to be a more organized company and have better management across all working sections. With the help of extensive structuring and data collection, OLITREM has a more realistic perception of the production performance which allows much better decisions. Thus, Lean has been integrated with the management system as it has had a positive effect on the decision making.

The implementation of Lean by OLITREM may serve as an example for others that are looking to face the same challenge, of any business sector, size or market in which they operate. To academics researching the implementation of Lean in SME's, this research proves it is possible to implement certain techniques despite the tough barriers SME's need to overcome. One important contribution regards the closing of a gap. Indeed, SME's can implement successfully Lean, overcoming some obstacles, oppositely to evidence found in some literature (Bhamu and Sangwan, 2014; Hu *et al*., 2015).

Another important contribution regards the fact that SME's can implement Lean after a direct approach based on accurate practices on quality management (5S, Kanban, 'Don't Get it Wrong'). Both Kanban and 5S were implemented with the help of the consulting company, however OLITREM was receptive to these tools. Later, 'Don't Get it Wrong' was formally identified as a Lean practice. These conclusions are very important for academics and for practitioners, particularly in manufacturing organizations.

6.2. Limitations of the study

The strongest limitation of this study is perhaps the fact that it only involves a single case study, which implies that techniques used by OLITREM in the search of Lean may not be usable for other companies in the same or different business sectors. Thus, some techniques that were helpful in achieving Lean in OLITREM might not apply properly in other companies that have different characteristics and objectives.

Some information from interviews and documents, for confidentiality reasons, were not mentioned, which may pose a limitation regarding the empirical study.

Other limitation arises from a gap in the literature as there aren't many articles referring successful Lean implementation cases on SME's and those that exist are not very detailed in how Lean was achieved and what benefits were obtained.

6.3. Future Research

Despite some limitations, it is possible to identify several opportunities for future research.

It would be interesting to develop a research in OLITREM a few years from now to understand how Lean has evolve, what is the reality lived in the company, how was the organisational culture affected, which tools were further implemented and what benefits were accomplished.

Other suggestion would be to understand what role ISO 9001 and ERP implementations plays on quality management and Lean.

Following Powell (2013) study, it would be interesting to explore if a competitive advantage was obtained from applying both Lean and an ERP system, when Lean reaches a maturity stage in OLITREM or in other entities.

No research was found on Lean implementation on a company managed by a family. So, it would be relevant to analyse if there is a positive correlation between Lean implementation and a family-run business.

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Appendixes

Appendix 1: Interviews Conducted

No.	Interviewee	Date	Duration	Recorded and Trasncribed
Pilot Study:				
1	Financial Manager/Administrator	2016-10-24	40m.	No
2	Commercial/Sales Manager	2016-10-24	1h30.	No
3	Financial Manager/Administrator	2016-11-14	1h09m.	Yes
4	Quality Manager	2016-11-14	34m.	Yes
Main Study:				
1	Production Manager/Aministrator	2017-01-17	26m.	Yes
2	Quality Manager	2017-01-17	35m.	Yes
3	Planing and Control Manager	2017-04-19	47m.	Yes
4	Quality Manager	2017-04-19	40m.	Yes
5	Production Manager/Aministrator	2017-07-21	1h14m.	Yes
6	Quality Manager	2017-07-21	48m.	Yes
7	Financial Manager/Administrator	2017-07-21	24m.	Yes
8	Quality Manager	2018-04-24	10m	Yes
9	Quality Assistant	2018-04-24	50m	Yes
Total = 13	**Average per interview**		**35 minutes**	

Source: Elaborated by the author.

Appendix 2: Samples of Interviews Guidelines

Interview guideline, on 2014/11/14, with the Quality Manager and one member of the Board (responsible for the financial area):

1. What is your role inside the organization?
2. How does the decision-making process works?
3. How is the information system organized?
4. Is information timely, viable and matches the needs?
5. Are there any gaps in the information? Can you give me some examples? How are they solved?
6. What tools if any are used to increase the quality of products and services?

Interview guideline, on 2018/04/24, with a Quality Assistant:

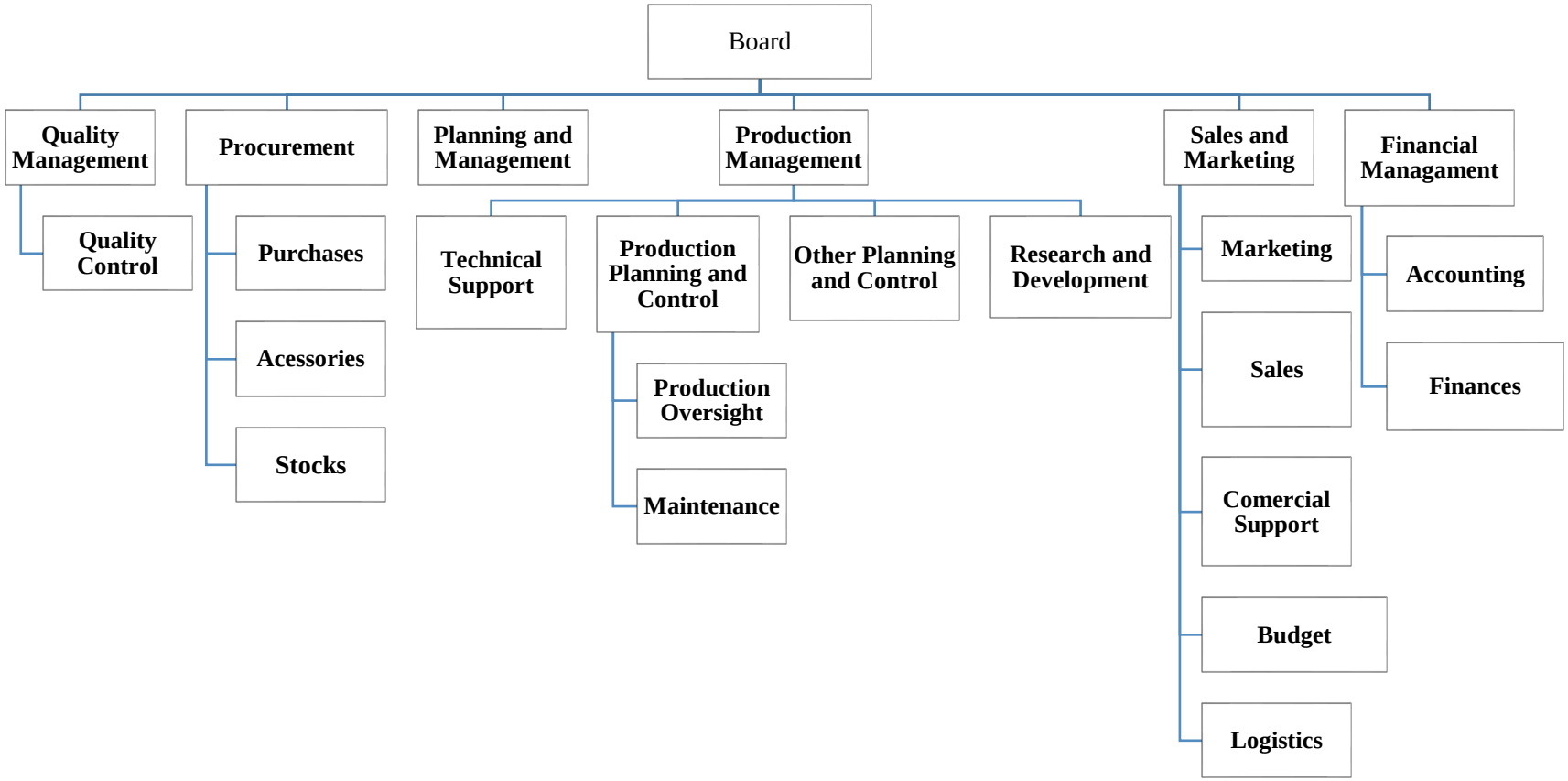
1. What is your role inside the organization?
2. Regarding Kanban, which departments use it? What documentation you have?
3. Regarding 5S, which departments use it? What documentation you have?
4. Regarding VSM, is there a plan to start applying it?
5. Regarding "Don't Get It Wrong" tool, how many corrective actions exist?
6. Are there other tools used to avoid errors/defects?
7. Did the transition to ISO 9001:2015 has started? What are the main differences?
8. What benefits did the Consulting Lean company have brought?

Appendix 3: Documents Consulted

Documents Retrieved from OLITREM
Quality Policy
Organizational Chart
Company Strategy
Quality Objectives 2016
Quality Manual
Processes Efficiency Monitoring - 2nd Quarter 2016
Maintenance Plan - Equipment
Corrective Actions Sheet
Consulting Company Proposal and Contract
Quality Objectives 2017
Processes Efficiency Monitoring -1st quarter 2017
Kanban / 5S's / Production Planning Pictures
Graphics (Sales, Production, Workers)
Management Report 2016 and 2017

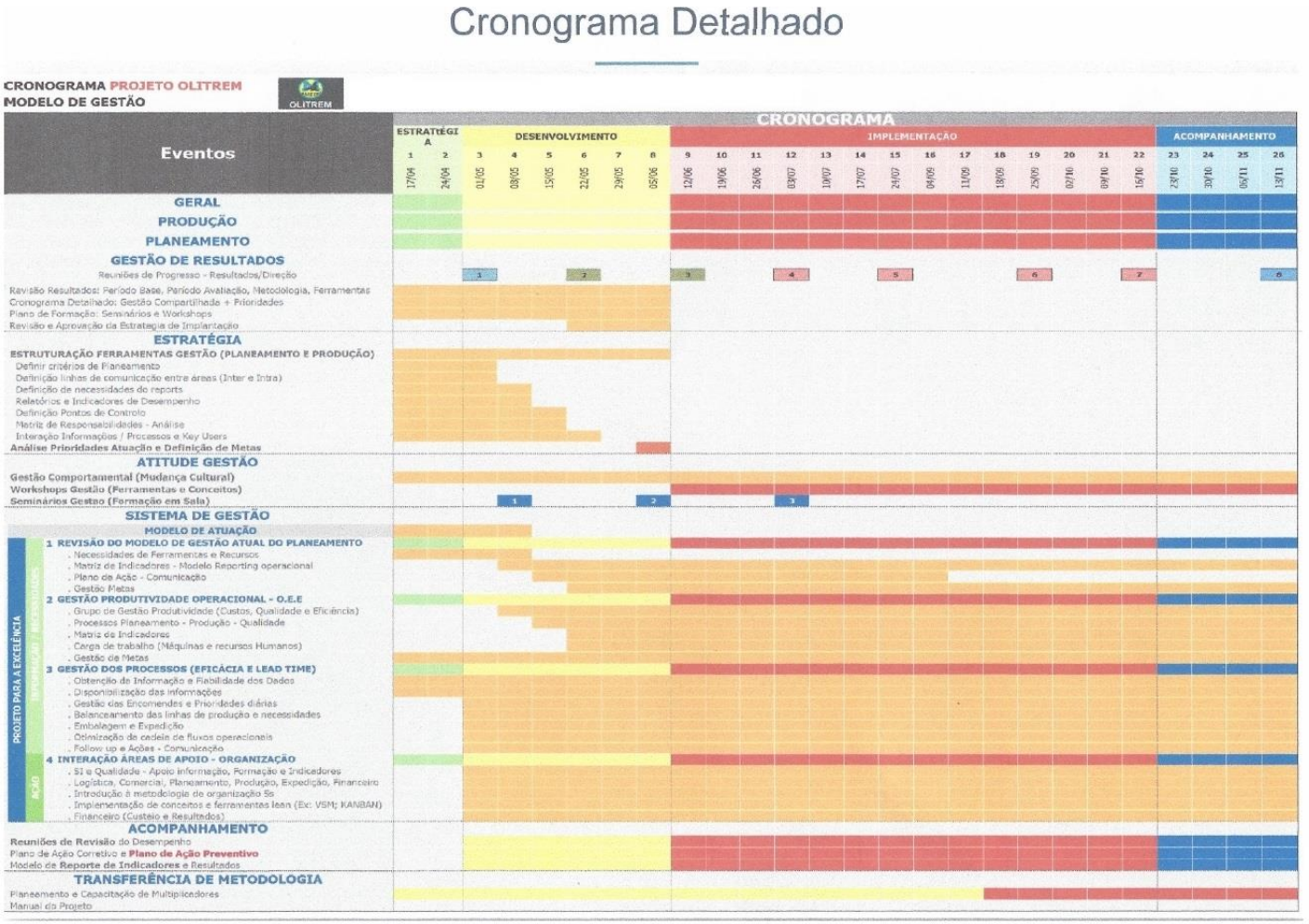
Source: Elaborated by the author.

Appendix 4: Organization Chart of OLITREM



Source: OLITREM, SA.

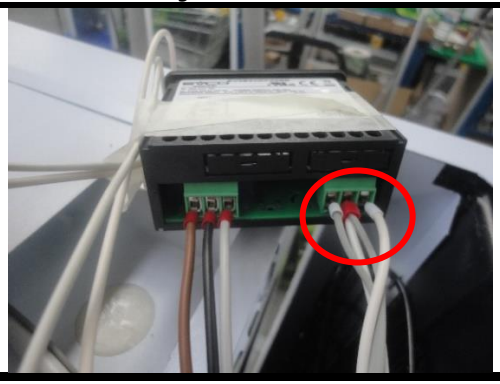
Appendix 5: Consulting Company Detailed Chronogram



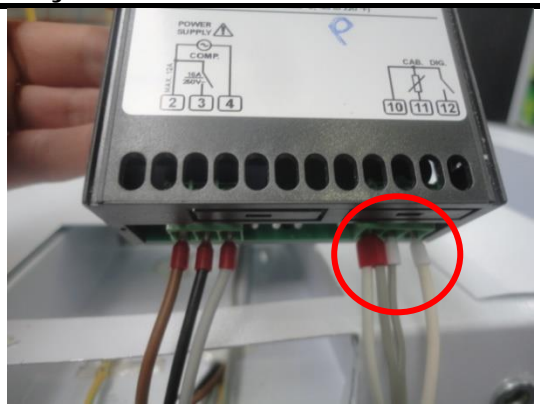
Source: OLITREM, SA.

Appendix 6: Example of a Plan for Corrective Action used by OLITREM

<table>
<tr><th colspan="3">Situação Inicial</th></tr>
<tr><td>Descrição:

As ligações dos digitais utilizados no modelo **** do cliente **** estavam mal efetuadas.</td><td>  </td><td><u>Causas</u>:

Os fios do molde utilizado pela cablagem estavam mal ligados, consequentemente, todos os digitais, ligados tendo por base esse molde, estavam mal ligados.</td></tr>
<tr><th colspan="2">Ação</th><th>Resultado Final</th></tr>
<tr><td>Descrição:

Correção das ligações dos fios do molde e dos armários já em linha.</td><td>  </td><td>Verificados equipamentos seguintes

OK

03-03-2017</td></tr>
<tr><td colspan="3">Observações:</td></tr>
</table>

Source: OLITREM, SA.