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A JOURNEY TOWARDS LEAN: THE CASE OF A SMALL AND MEDIUM-SIZED ENTERPRISE (SME)

Luís Pimentel, Ph.D. in Management

Associate Researcher

BRU (Business Research Unit), ISCTE-IUL (University Institute of Lisbon) (Portugal)

Avª Forças Armadas, 1649-026 Lisboa, Portugal; e-mail: luis.pimentel@iscte-iul.pt; luisvilelapimentel@gmail.com

Assistant Professor

School of Economic and Social Sciences, Universidade Europeia (Portugal)

Quinta do Bom Nome, Estrada da Correia, nº53, 500212 Lisboa, Portugal; luis.pimentel@universidadeeuropeia.pt

Miguel Ribeiro Mendes, Msc in Accounting

Researcher

ISCTE-IUL (University Institute of Lisbon) (Portugal)

Avª Forças Armadas, 1649-026 Lisboa, Portugal; e-mail: miguelfr201@gmail.com

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 organisation. 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 organisations.

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

1. Introduction

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).

This paper 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 on 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.

The investigation is based on a qualitative approach. A case study was conducted as research method. The subject of the case study is a Portuguese SME (one of the biggest ones in the sector) which focus on the design, commercialization and production of refrigeration equipment.

The research 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.

After the introduction, presented in section one, the paper is structured as follows. Literature review on Total Quality Management (TQM), Lean, ISO 9001, and Enterprise Resource Planning (ERP), is presented in section two. Section three describes the methodology adopted in the investigation. Section four describes how the case study is developed (empirical study). Finally, section five presents a discussion of the findings and conclusions.

2. Literature Review

2.1. Quality and TQM

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 organisation 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).

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 TQM philosophy is to transform organisational quality management from a passive and defensive culture into a pro-active and open culture, ensuring that core TQM principles (strong commitment, continuous improvement and focus on customers) are

applied to the whole organisation (Dahlgaard and Dahlgaard-Park, 2006; see also Dahlgaard-Park, 2011; Pimentel and Major, 2016).

The Lean concepts and tools explained below must be understood 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).

Matt and Rauch (2013) analysed the suitability of the most common Lean production methods and techniques 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 up's.

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).

Based on the suggestions of the authors referenced above, the most recommended techniques for SME's are 5S and Kanban.

The 5S technique has its origins in a Japanese acronym: in English the 5S stand for organisation, neatness, cleaning, standardization and discipline. This can be used to have each factory section or an office desk clean. 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.

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 have improved productivity and cost reduction through the reduction of waste in the production line (excess inventory) (Rahman, Sharif and Esa, 2013).

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), out of fourteen identified benefits of Lean in SME's, highlighted the five most important ones: i) increased productivity and efficiency; ii) improved customer satisfaction; iii) reduced costs of production and inventory; iv) decrease in waste; and v) increased profitability.

Both Gupta and Jain (2013) and Hu *et al*. (2015) found similar benefits. They also identified other benefits that are less obvious or sometimes hidden, such as improvements in quality and safety, cultural change and a faster learning organisation.

To succeed in implementing Lean, SME's should understand which supporting 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): i) leadership and management; ii) finance; iii) skills and expertise; and iv) organisational culture. Consequently, a strong leadership and a committed management are the basis to successfully implement Lean in a SME, regardless of the organisation 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 organisation 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).

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 investment costs which can be daunting for SME's small budgets (Hu *et al*., 2015). As an example of time and 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 organisational 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.

2.3 Quality Systems/ERP

2.3.1 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).

The ISO 9001 addresses various aspects of quality management. This standard certification provides guidance and tools for companies and organisations, which intend to ensure that their products and services consistently meet customer 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 organisation, large or small, regardless of its field of activity. In fact, there are over one million companies and organisations 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).

2.3.2 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.

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% of all companies, which meant 80% of employed people and 67% of total turnover.

FROSKY (the name of the organisation is disguised due to reasons of confidentiality) is a SME and focuses on design, commercialization and production of refrigeration equipment and commercialization and installation of hotel equipment. FROSKY 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.

FROSKY is organised in six different departments: (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 organisation; (iv) Production management – technical assistance, production control and R&D; (v) Sales and Marketing Department; (vi) Financial management –accounting and finance.

In 2016, FROSKY 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 I), 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.

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 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 (FROSKY)? And how can it be improved? and (iii) can the Lean system be integrated into the management system in this organisation?

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.

The collection of data was also supported by the collection of formal reports, statements and informal records provided by FROSKY (See Appendix 2).

4. Empirical study

Over the years, FROSKY 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 1). These decisions are described in depth below and are important to understand how FROSKY is pursuing the Lean dream today.

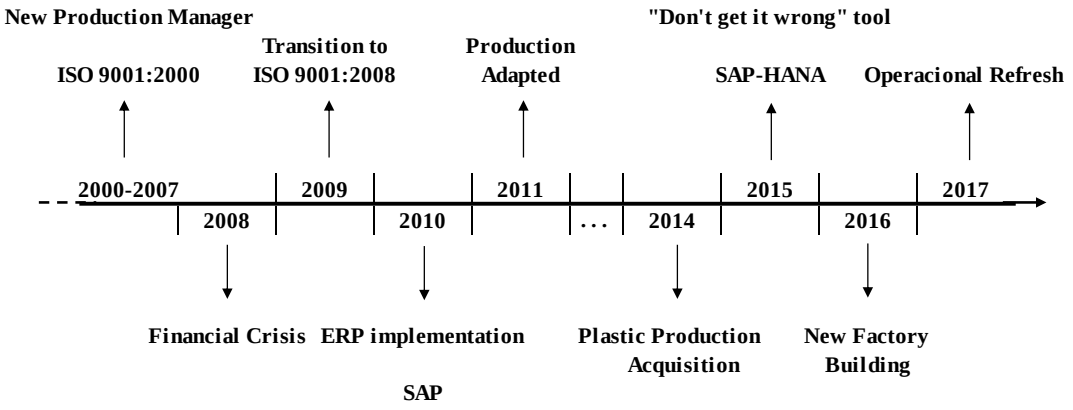

Figure 1 – Time line diagram of critical changes in FROSKY

In 2000, FROSKY 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 organisation which was in charge of the program was selling a ISO 9001 implementation plan, which included the support of an auditor to conclude the project.

As a consequence, FROSKY decided to adopt ISO 9001, reorganising the entire company, and followed the standard requirements to be internationally competitive and provide the customers with good standards and practices. FROSKY 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 FROSKY. It worked as a reorganisational 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 FROSKY 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. FROSKY 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, FROSKY 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, FROSKY 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, 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 organised 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, FROSKY was very disorganised, 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, FROSKY started looking at ERP systems. The chosen ERP system was SAP (Systems, Applications & Products in Data Processing), because most of FROSKY 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 organised (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 FROSKY to have better planning and management (example mentioned by the production manager):

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

Nowadays, FROSKY recognizes that 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 FROSKY 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. FROSKY strategically decided to acquire the plastic supplier. Integrating the plastic production, not only it eliminated supplier lack of reliability by supplying the own internal production (obtaining a better margin on each unit), but also allowed control over competitors as a plastic mould supplier, which implied a competitive edge. Nowadays, FROSKY 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, FROSKY 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 FROSKY 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 his mind ever since he heard about it. He knows that Lean is a weapon that helps to control costs. Thus, he even thought about hiring a company to help in this process for long.

However, FROSKY 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, in late 2015 the company went further and implemented an advanced method that helps to avoid mistakes in the future. This method was named following a Portuguese saying ('Don't Get it Wrong'). 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 quality continuous improvement.

In 2016, FROSKY managed to negotiate a large deal of pharmaceutical refrigerators with an English customer. This deal was very good for FROSKY 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, FROSKY knew it had to increase its factory size. A new factory building was built, and it allowed the production manager to reorganise the factory's layout to maximize efficiency and reduce waste.

In 2017, FROSKY management knew the business was going well. However, it was recognized that the company had many aspects that could be improved and so, FROSKY decided to invest in a new project called "Operational Refresh". The main objectives of this project were to continously improve FROSKY processes and productivity, which would be achieved mainly with continously waste reduction, reorganisation 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 2) and Kanban (see Figure 3).

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

In the production section, alongside FROSKY production line, some boards were placed in each working section to increase productivity as shown in figure 3. 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. FROSKY implemented 5S in every work section gradually. However, as soon as some sections began to be more organised and cleaned, other sections started applying 5S on their own because the culture for quality quickly spread"* (April 2018) (see figure 2 on how materials are more organised and easier to reach and find).

Additionally, FROSKY started the implementation of Kanban in one section, as can be seen in figure 3. 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.

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

Key Performance Indicators (KPI) show quite well the improvement in financial and operational indicators, as shown in Table I. 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 increased a lot.

	2013	**2016**
Sales (€)	10792810	12303438
Operating Income (€)	68574	736776
Units Produced (number)	13961	17344
Productivity#	279	347

#Output/Input = Units produced/direct labour hours

Table I - KPIs

Figure 2 - Example of 5S (Before – After)

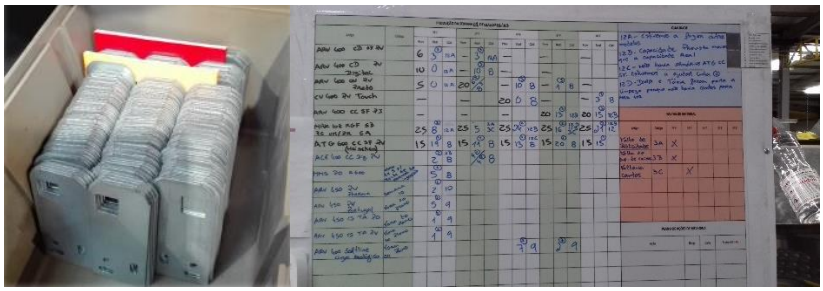

Figure 3 – Kanban (Left) and Production Board (Right)

5. Discussion and conclusions

Ever since FROSKY 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 organisation and thus increase customer satisfaction (Chiarini, 2011; Tarí, Molina-Azorín and Heras, 2012). FROSKY 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 FROSKY's Lean journey (Chiarini, 2011; Powell *et al.*, 2013).

FROSKY 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 FROSKY 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-Rosa, 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 FROSKY. 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, FROSKY 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 and 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, translated into practical implementation of techniques and operational measures to increase quality, productivity and performance.

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

However, FROSKY still has a long journey ahead, as Lean is an ending cycle of continous improvement. FROSKY has the necessary tools to prosper in this journey, as 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). FROSKY 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. FROSKY took some of the requirements from ISO 9001 and improved them to increase quality even further. FROSKY, 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 organisational management frameworks.

These conclusions are very important for academics and for practitioners, particularly in manufacturing organisations.

The implementation of Lean by FROSKY 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 paper 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'), later formally identified as Lean practices.

There were some limitations regarding this research. Being a single case study, techniques used in this example may not work successfully in other companies. For future research, it would be interesting to develop a research in the same company a few years from now on to understand how Lean has evolved and what benefits were accomplished. More case studies regarding Lean implementation on SME's are needed, specially to understand what role ISO 9001 plays on quality management.

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Appendix 1 – Interviews Conducted

No.	Interviewee	Date	Duration	Recorded and Trasncribed
Pilot Study:				
1	Financial Manager/Director	2016-10-24	40m.	No
2	Commercial/Sales Manager	2016-10-24	1h30.	No
3	Financial Manager/Director	2016-11-14	1h09m.	Yes
4	Quality Manager	2016-11-14	34m.	Yes
Main Study:				
1	Production Manager/ADirector	2017-01-17	26m.	Yes
2	Quality Manager	2017-01-17	35m.	Yes
3	Planning and Control Manager	2017-04-19	47m.	Yes
4	Quality Manager	2017-04-19	40m.	Yes
5	Production Manager/Director	2017-07-21	1h14m.	Yes
6	Quality Manager	2017-07-21	48m.	Yes
7	Financial Manager/Director	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**	

Appendix 2 – Documents Consulted

Documents Retrieved from FROSTY
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