POLITECNICO

MILANO 1863

Exploring the relation between soft lean practices and eco-efficiency performance: a case study of a manufacturing company in the Italian food industry

TESI DI LAUREA MAGISTRALE IN
MANAGEMENT ENGINEERING
INGEGNERIA GESTIONALE

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Academic Year: 2022-23

Acknowledgments

Grazie

Abstract

The aim of this study was to fulfil the gaps in literature about the relation of the soft practices of Lean Culture and the improvement of the eco-efficiency performance of a manufacturing company. The soft practices include principles, managerial concepts, people, and relations. To carry out the research, a case study of a manufacturing company operating in the Italian food industry was selected. 4 semi-structured interviews were performed to the top manager and employees belonging to different hierarchical levels of the organizational structure. The variables to be examined were mostly extracted by literature, and the interviews analyzed through deductive coding; only two of them were defined ex-post through inductive coding of interviews.

The results of this study consists in (1) a definition of the role of each soft practice analyzed in the context of a successful Lean project to improve the company eco-efficiency performance, (2) a distinction in the perception and the interpretation that different hierarchical levels have of the same soft practice.

The main limitation of this work is concerned with the fact that only one case study was analyzed and with the biases that may result by semi-structured interviews chosen as methodology.

Keywords – Lean Management, Lean Culture, soft practices, Eco-efficiency, Environmental Sustainability, hierarchical level

Abstract in italiano

Lo scopo di questo studio è stato quello di colmare le lacune della letteratura riguardo alla relazione tra le pratiche soft dell'approccio Lean e il miglioramento delle performance di eco-efficienza in un'azienda manifatturiera. Le pratiche soft includono principi, concetti manageriali, le persone e le relazioni.

Per realizzare la ricerca, è stato scelto il caso studio di un'azienda manifatturiera che opera nell'industria alimentare Italiana. Sono state condotte 4 interviste semi-strutturate al top manager e ad altri impiegati posizionati in diversi livelli gerarchici dell'organigramma dell'azienda. Le variabili da esaminare sono state estratte principalmente dalla letteratura, e le interviste sono state analizzate mediante una codifica deduttiva; solo due di loro sono state definite a posteriori attraverso una codifica induttiva delle intervista.

I risultati di questo studio consistono in (1) la definizione del ruolo di ogni pratica soft analizzata nel contesto di un progetto Lean che è riuscito nell'intento di migliorare le performance di eco-efficienza dell'azienda, (2) nella distinzione della percezione e dell'interpretazione che diversi livelli gerarchici hanno della medesima pratica soft.

Le principali limitazioni di questa ricerca riguardano il fatto che un solo caso studio sia stato analizzato e dai bias che potrebbero risultare dalle interviste semi-strutturate scelte come metodologia.

Parole chiave – Lean Management, Cultura Lean, pratiche soft, Eco-efficienza, sostenibilità ambientale, livelli gerarchici

Executive Summary

Introduction

Global Warming and climate change, as well as the shortage of resources are undoubtedly the epochal challenges faced by mankind. Nowadays, the achievement of environmental sustainability is a primary goal for society. Given the consequences it creates on nature, the manufacturing sector has the responsibility to adopt sustainability practices, like, for example, the maximization of the efficiency of resources used in the production process. Hence, the concept of eco-efficiency is introduced. Eco-efficiency refers to the ability to deliver value and satisfy human needs while simultaneously reducing the environmental impact and the resource intensity of processes. Lean Management is a powerful managerial approach widely recognized as improving the overall operational performance of a company (Shah and Ward, 2003), and aimed at eliminating all sources of waste (Womack and Jones, 1996). Lean management is also considered as an interrelated system of hard and soft practices: these latter are considered the critical success factors of Lean. The aim of this study is to explore the role of the soft practices of Lean in the improvement of the eco-efficiency performance for manufacturing companies.

Literature Review

Concerning the Literature Review, it was decided to focus on three streams: Environmental sustainability and Eco-efficiency, Lean Management and its soft practices, and the intersection between the two streams, that was aimed at identifying the gaps in the literature. In the first stream of literature, environmental sustainability was defined. Environmental sustainability practices are all those actions and methods having a positive impact on the environment. The drivers for a company to become more environmentally sustainable are described, like governments' regulation, an enhanced corporate reputation and the reduction of wastes and material and energy consumptions. Hence, the introduction of the concept of Eco-efficiency explained before, which solves the traditional trade-off

providing that environmental sustainability practices coincide with a deterioration of the firm's financial performance because it does not have a return in economic terms.

In the second stream of literature, Lean Management was defined. Lean Management aims to create more value for the end customer whilst consuming the less resources possible. There are however many barriers hindering the Lean adoption in companies: these were explained, and it emerged that Lean adoption is effective when a company can develop a Lean Culture thanks to the adoption of some hard practices (techniques and tools) and in particular of the soft practices of Lean.

In the third stream of literature, the papers treating together the topics of Lean and Environmental Sustainability or Eco-efficiency were analyzed. It emerged a synergy between the two concepts: a Lean company turned out to be more ready than a non-Lea one when it comes to implementing environmental sustainability practices. In particular, the case considered to bring the best possible outcome, is that of a simultaneous adoption of the two principles within a company. Also, the barriers hindering the integrated approaches' implementation related more to the soft side of the organization than to the techniques and tools adopted.

Research Questions

Having identified the gaps in literature, it was possible to define the research questions for the study.

RQ1: how can the soft practices of the Lean Culture allow a company to achieve better results in terms of eco-efficiency performance?

Soft practices magnify Lean implementation and the effect of hard practices in a company (Matsui, 2007). However, in literature, there is no study trying to explore the link between soft practices and the achievement of a certain performance; in particular, in this case the performance chosen is the eco-efficiency one, given its relevance for manufacturing companies in today's world and the synergies between the two concepts

RQ2: how are the soft practices of Lean implemented to achieve a better eco-efficiency performance perceived by different hierarchical levels?

This second question aims to dig deeper in the different role that soft practices play for different hierarchical levels within a manufacturing company, since no study with this specific aim was found in literature.

Methodology

The variables to be investigated were defined partially through the soft practices found in literature; in particular, the framework by Costa et al. (2019) was used as a reference to build the research framework. Then, the practical phase started. A manufacturing company operating in the Italian food sector was selected as a case study for the research because of a specific project that was carried out in the recent past. This project used the Lean methodology with the aim to improve the eco-efficiency performance of the company; the project was successful, and the company was able to reduce the plastic consumption in the production process. Semi-structured interviews were chosen as a method to carry on the research. The top manager, one shift supervisor and two line supervisors were interviewed: the top manager and the line supervisors, in particular, were part of the team created specifically for the project. the Variables were addressed by prepared questions in the interview protocol; however, some new variables were defined ex-post by the author in an inductive way. Before the analysis of the results, the variables extracted from literature (11) plus the ones obtain through inductive coding (2 variables) were the following:

Employee engagement	Consultants	Rewards
Top management Commitment	Teamwork	Kaizen event
Leadership	Training	Environmental commitment
Communication	Working conditions	CI culture
Mixed top-down and bottom-up approach		

Results and Discussion

In this section it is highlighted the way in which results were presented and discussed. Conclusions are left to the following paragraph.

RQ1: how can the soft practices of the Lean Culture allow a company to achieve better results in terms of eco-efficiency performance?

The author dug deeper into each variable. It was possible to understand how each variable is linked with the others. Then, according to their impact on the eco-efficiency performance and to their relation with other practices, analyzed variables were categorized in 4+1 layers. "Employee engagement" resulted to be the variable which is the most affected by the others, and also the one with the most direct impact on the eco-efficiency performance. "Environmental Commitment" was instead the prerequisite, the input of the project.
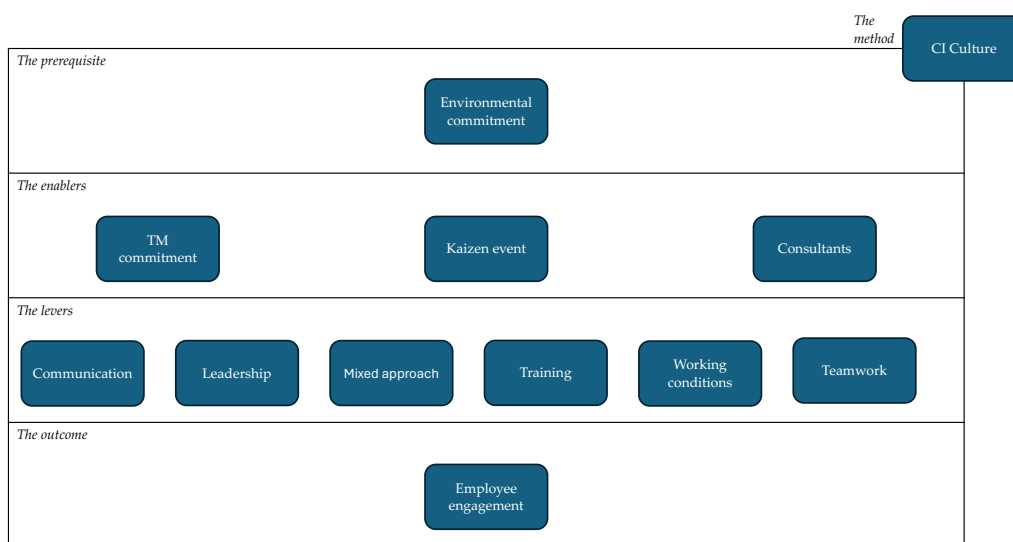
RQ2: how are the soft practices of Lean implemented to achieve a better eco-efficiency performance perceived by different hierarchical levels?

Through interviews it was possible to assess whether each soft practice had a role or not for each hierarchical level in the project. The top manager and the line supervisors, that were directly involved in the project, considered all the practices necessary for their role in the project implementation. Instead, the shift supervisor, who was marginally involved, considered only some of them as necessary; in particular, those regarding his role within the project, as "Employee engagement", "Top manager commitment", "Leadership" and "Communication".

TOPIC	Top manager	Shift supervisor	Line supervisor
Employee engagement	N	N	N
Top manager commitment	N	N	N
Leadership	N	N	N
Communication	N	N	N
Teamwork	N	U	N
Consultants	N	U	N
Working conditions	N	N	N
Training	N	U	N
Mixed Approach	N	N	N
Kaizen events	N	N	N
Rewards	U	X	X
Environmental commitment	N	U	N
CI culture	N	N	N

Conclusions

This study aims to explore the relation between soft practices of Lean and the improvement of eco-efficiency performance of a manufacturing company. To do this, a case study of a manufacturing company in the Italian food industry was analysed. This company implemented a successful Lean project to reduce the plastic consumption in the production process. As previously mentioned, "Employee Engagement" resulted to be the variable that most directly affected the eco-efficiency performance of the company, thanks to the role in the proposal of new solutions of line supervisors and the active role of line operators in the production process. It was also the variable that was the most affected by others. Variables as "Teamwork", "Communication", "Mixed Approach", "Training", "Leadership" and "Working conditions" were considered levers to engage employees or to overcome the resistances of line operators that were hindering the improvement of the performance. "Top management Commitment", "Consultants" and "Kaizen event" are considered the variables necessary to the presence of all the following layers of soft practices. Particular prominence with respect to the rest of the literature was given to the role of consultants, which brought the rigor and methodology necessary to the project success. The "Environmental Commitment" was the reason why the project was planned in the first place and also why it was chosen Lean as a way to implement it. "Continuous improvement

Culture" is instead in parallel to all the other variables; the more soft practices are used and effective, the more Lean culture grows and permeates all the levels of the company.

Concerning the second research question regarding the different perception of soft practices by different hierarchical levels, different insights emerged. It is possible to affirm that the soft practices of Lean are necessary in the implementation of a successful Lean project for improving the eco-efficiency performance of a manufacturing company. The author also dug deeper in the different interpretation that the three hierarchical levels gave to the same practices. The main difference highlighted was in "Leadership": all the three interviewees had to exert their leadership over their subordinates. From the analysis, it emerged that they interpreted leadership in different and complementary ways. The top manager acted as a leader mainly in the Lean team, where he could have a more direct relation with the members; then, the supervisors were delegated the task to lead operators more closely to overcome their difficulties and integrate the new procedures successfully in the process. Relevant differences were also found in the relation that the interviewees had with the variable "Environmental Commitment". Line supervisors mentioned that this was one of the main motivations for their commitment to the project; instead, the top manager, despite recognizing its relevance, equated it to other motivations, like the financial one. This is consistent with the idea that manufacturing companies have the most incentive in engaging in environmentally sustainable activities when these have also a positive impact on other company dimensions. The last remark regards the variable "Continuous Improvement Culture": all the three hierarchical levels showed to have developed a certain degree of comprehension and to have internalized elements of the Lean approach. For this reason, we may say that the project, beyond the success in the improvement of the eco-efficiency performance, made the way for a shift in the company's cultural mindset towards continuous improvement and waste reduction.

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1. Introduction

1.1. The Environmental Challenge

There is no topic that can be considered as current and of common interest as the future of the planet. Global warming and climate change, as well as the shortage of resources are undoubtedly the epochal challenges faced by mankind. Nowadays, the achievement of environmental sustainability is a primary goal for society.

The World Commission on Environment and Development has defined sustainability as "economic development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs". According to this definition, sustainability integrates three main dimensions, the economic, the social and the environmental one, in the so-called Triple Bottom Line. Indeed, sustainability is a sort of equilibrium, defining the practices that can be put in place and bring benefits today, and will not have to be dismissed in the future because of their bad impact on the different stakeholders.

A system is considered environmentally sustainable if the exploitation of the resources is not faster than the time needed for those resources to regenerate. A report from the United Nations, "The World Population Prospects" (2019), predicts that by 2050 the world population will reach 9.7 billion people. This will result in natural resources being even more scarce, to the point that not everyone will have at least what is needed to survive.

The manufacturing industry provides goods and jobs to the economy; on the other hand, it affects nature and human health. The main concerns are the emissions to the atmosphere and water ecosystems, waste generation and resource consumptions. In 2020, for example, the 24% of the greenhouse gas emissions came from factories; in Italy, this percentage is similar. Another huge reason of worry comes from the developing countries, where the technology is still lagging with respect to the more developed ones, and this, combined with

a higher growth rate of population, results in even more serious damages to nature and its resources.

Environmental sustainability practices are all those actions and methods having a positive impact on the environment (Alhaddi, 2015). Given the consequences it creates on nature, the manufacturing sector has the responsibility to adopt sustainable practices. The changes in legislation have increased the overall attention that companies pay to the health status of the environment with the goal of preserving it; moreover, the raising awareness and attention of public opinion over this topic is obviously influencing companies, since customers are now concerned with what they are buying and how this is produced. They are even willing to pay a premium to those companies whose products are compliant with sustainable practices. For this reason, implementing environmentally sustainable practices is not only a duty for companies, but also an opportunity to gain competitive advantage over competitors. The advantage is achieved in two ways: the first one is through an enhanced corporate reputation; the second, through cost reductions, perhaps from material substitution, less packaging or reduced energy consumption.

There are many ways for an organization to become more environmentally sustainable, for example by encouraging the minimization of energy, goods, or water consumption, thus maximizing the efficiency of resources. Nowadays, with the scarcity of resources becoming more acute and the energy prices skyrocketing, this focus is likely to increase. For this reason, eco-efficiency concept is introduced. Eco-efficiency refers to the ability to deliver value and satisfy human needs while simultaneously reducing the environmental impact and the resource intensity of processes. Eco-efficiency principle solves the traditional trade-off that provides that initiatives undertaken by manufacturing companies with the goal of relieving some burden on the environment coincides with a deterioration of its financial performance.

1.2. Lean Management and Soft Practices

Eco-efficiency overlaps and, in some sense, also includes the concept of Lean, whose aim is to improve the efficiency and to minimize wastes through process and product re-design. Lean Management is a powerful managerial approach widely recognized as improving the overall operational performance of a company (Shah and Ward, 2003; Liker, 2004). The successful implementation of this methodology consists of lower process variability, scrap rate and rework time. These factors lead to a decrease in production costs and to shorter lead times, therefore directly impacting the competitiveness of the firm.

This methodology's notoriety spread thanks to Womack et al. (1990) work "The Machine that Changed the World", a study on the Toyota Production Systems, which managed to have better performances with respect to the American competitors in the automotive sector despite the fewer resources available. Lean Management is considered a philosophy whose aim is to eliminate all sources of waste from the production processes (Womack and Jones, 1996).

Lean management is considered as an interrelated system of soft and hard practices (Shah and Ward, 2007). Hard practices refer to the technical and analytical tools of Lean, while the soft ones concern people and relations. As defined by Bortolotti et al. (2015), hard practices refer to "technical and analytical tools introduced to improve production systems", whereas soft practices are related to principles, managerial concepts, people, and relations. They include, among the others, human-related elements such as the involvement of employees in the company's Lean initiatives and the top management commitment.

Soft practices are considered crucial for achieving a superior performance through Lean Manufacturing (Matsui, 2007) and for sustaining the performance over time. Many companies in different economic sectors have adopted Lean Management over the last decades, often leading to better results and competitiveness. However, many of them have not achieved the results that they expected. A common element between unsuccessful companies was the inability to sustain their results over the medium and long-term (Lucey

et al., 2005). Lean is very difficult to be implemented and has a rate of adoption failure of almost 90 percent (Bhasin, 2012).

One of the explanations is that companies sometimes focus more on the hard tools on Lean than on soft ones, and the latter are the key to a successful Lean transformation over time. According to Bortolotti (2015), the implementation of hard practices is a strong predictor of Lean contribution to operational performance improvements, but soft practices are essential for obtaining better outcomes. Indeed, a successful Lean implementation is based on the soft side of Lean. Thus, it is possible to say that the efficacy of hard practices is higher when soft practices are systematically and simultaneously applied. From the work of Costa et al. (2019), we know that the implementation of Lean Manufacturing requires an elaborate integration of both hard and soft practices, described as the critical success factors of Lean.

1.3. Lean and Eco-efficiency

Several studies found a positive relationship between the improvements that Lean Management brings to resource efficiency and the reductions in materials and energy consumptions, resulting in a reduced environmental impact and consequently in a better eco-efficiency performance (King and Lenox, 2001; Larson and Greenwood, 2004). Lean implementation represents an opportunity for companies to gain in terms of eco-efficiency performance, therefore not giving up anything on the financial and operational sides. Overall, the positive impact that Lean practices have on the eco-efficiency performance is due to the promoting of an efficient use of resources. More in general, Lean principles and practices have been found to be facilitators of improvements in environmental goals and results.

The simultaneous adoption of Lean and environmental sustainability practices is considered to be the most effective in improving the eco-efficiency performance. However, integrated approaches' success is hindered by several barriers, identified with factors that

overlap with the previously mentioned soft practices of Lean, for example the lack of involvement by employees or by the top management.

There is already a fair amount of literature that deals the relationship between Lean Manufacturing, and its hard tools in particular, and eco-efficiency performance in the manufacturing sector. Instead, the role of soft practices in the achievement of a certain company performance has not been covered by a wide amount of research yet. For this reason, the aim of this study is to dig deeper into this topic, ultimately clarifying the relation between the soft practices of the Lean Culture and the achievement of better results in terms of environmental sustainability and eco-efficiency performance.

2.   Literature Review

2.1.   Environmental Sustainability

The industrial expansion that happened in the last few decades has been the engine for economic development; however, it also had an important negative effect on the environment. The manufacturing sector is the main player in the game of a country's economic and social growth, but at the same time, it is also one of the main causes of the damages that we observe on the environment these days. Organizations are considered the main responsible of climate change (Trudeau & Canada West Foundation, 2007). According to the WWF (2012) the world is currently consuming resources as the planet was 1.5 times bigger than it is. Hence, environmental sustainability of any human activity becomes an urgency.

2.1.1.   Environmental Sustainability definitions

The World Commission on Environment and Development has defined "sustainability" as "economic development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs". According to the theory, there are three aspects to achieve sustainability: social, environmental, and financial. While the social dimension relates with the people within the company and the financial one deals with the profits, the environmental dimension of sustainability deals with how and how much the companies' activities impact on the natural resources and, more in general, on the environment (Parkinson, 2003). These three aspects are also known together as the Triple Bottom Line (TBL), which takes its name by the approach developed by Elkington (1994) to measure the sustainability in all its three dimensions. Dyllick and

Hockerts in 2002 defined sustainability as meeting the needs of a firm's direct and indirect stakeholders without compromising its ability to meet the needs of its future stakeholders. Similarly, EU MDG7 report (2005) has defined environmental sustainability as "meeting current human needs without undermining the capacity of the environment to provide for those needs over the long term". As a response to the demands of external stakeholders such as customers and the regulators, manufacturing companies have begun adopting environmental sustainability practices to partially reduce or even completely avoid the negative impacts on the environment that are due to their operations. Environmental sustainability practices are defined by Alhaddi (2015) as those actions or methods which have a positive impact on the external environment. These actions include for example an appropriate consumption of the natural resources in the production process, the minimization of emissions or the re-usage of materials (Gallego-Alvarez, 2014).

2.1.2. Drivers for Environmental Sustainability

Is it possible to be simultaneously profitable and not harmful to the environment or the society? At first, many skeptics thought that Corporate Social Responsibility in general was a too vague concept and only brought a burden of increased costs to companies trying to align to it; also, they stated that the pros of adopting practices attentive to the environment could not overcome the cons in terms of expense. Walley and Whitehead (1994) stated that the costs that a company must bear to adhere to ethical standards will result in higher prices, competitive disadvantage with respect to rivals and a reduced profitability. The traditional view regarding the relation between environmental and economic performance of a company states that there is a trade-off among the two (Porter, 1991).

In contrast with this idea were, among the others, Porter and Van Der Linde (1995). According to them, initiatives that were implemented taking in consideration also Corporate Social Responsibility were perceived positively by the markets because of an improved reputation and a more efficient resources' usage. They stated that pollution is inherently an economic waste since it involves resources that have not been used in their

totality. This means that by reducing pollution, productivity is improved and consequently costs are lower. Also, findings from Bower et al. (2011) confute the skeptics position about CSR.

King and Lenox (2001) studied whether firms with higher environmental performance are also the profitable ones, finding a positive relation between the two attributes. Anyway, they could not prove the direction of the causality.

Carvalho et al. (2017) emphasized that the drivers for companies to become environmental concerned are a rigorous environmental regulation, the changed customer requirements, the opportunity to take an ethical stand and – obviously – the possibility of increasing profits. According to Gordon (2001), the main driver for developing environmental sustainability practices are the new laws and regulations, thus the pressure by the government, followed by the pressure from other external stakeholders like customers. Also Routray (2021) emphasizes as the most important environmental sustainability enablers for a company the role of the government alongside the top management involvement.

Jooh Lee and He-Bong Kwon (2019) researched on the effect that environmental sustainability has on corporate reputation and the market value of a firm, getting a positive response. They found that nowadays, in a time where the pressure of the public opinion, and therefore of customers, for practices that are not harmful to the environment is high, a firm establishing as a leader in the field of environmental sustainability is able to avoid criticism from consumers and rivals' competition. In this study, the firm's effort for the environment does not directly contribute to the firm economic performance, but this latter is instead influenced by an enhanced corporate reputation.

Environmental sustainability practices help an organization getting competitive advantage through an improved financial performance, employee motivation and brand reputation and makes it more effective in retaining customers (Sendowola et al., 2020).

A structured review by Centobelli et al. (2018) on the topic of environmental sustainability highlighted some drivers, hence factors influencing in a positive way environmental sustainability practices adopted by organizations. The implementation of these kind of initiatives is due to relational drivers like customer pressure and regulatory ones as the

government support. Customers, nowadays, require also issues regarding environmental sustainability alongside the traditional factors of choice when purchasing a product (Dornfield, 2013).

Research by Bunga Bangsa (2020) also shows that attributes related to environmental sustainability are relevant in the purchasing decision and influence the customer, which is more involved with ethical products. Also, they are willing to pay a premium for sustainability.

Regarding the cost side of an organization implementing environmental sustainability practices, for example aimed at the reduction of waste, including energy, seems to make sound economic sense (Burke et al., 2007). Many huge manufacturers across the globe are now developing actions to reduce the environmental impact and the energy consumption, not only due to responsibility reasons but to control energy and material costs, whose price has raised lately.

2.1.3. Eco-efficiency

According to the World Business Council for Sustainable Development, eco-efficiency is the delivery of goods that are competitively priced and able to fulfill the needs of their customers, while simultaneously reducing the resource intensity and the environmental impact all over the life cycle to a level which is acceptable considering the estimated earth's carrying capacity. According to Velloni and Ribeiro (2009), eco-efficiency is about integrating the economic and environmental performances together. In simple terms, ecoefficiency is the economic value a company can deliver in relation to the waste and the negative impact it generates (Derwall, 2005). Eco-efficiency is generally measured through the ratio between the product value over its environmental impact; the indicator generated is of the "bigger the better" type (Ehrenfeld, 2005). This ratio can be understandingly called also environmental productivity. Indeed, eco-efficiency is about producing more while using less resources and minimizing the negative influence the production activity has on the environment (May et al., 2003). The main objective of this concept, which is aligned to

that of the broad definition of sustainability, includes both dimensions of economic and environmental sustainability. Organizations have three different ways to improve their ecoefficiency: through the reduction of resources' consumption, the lowering of the environmental impact by taking proper actions or the improvement the product value as it is perceived by the final customers (Schmidheiny, 2000; Barba-Gutierrez et al., 2007). WBSCD, in 1996, defined some ways to achieve eco-efficiency as guidelines for organizations. These are, among others, reducing material and energy intensity, reducing the toxic dispersion, improving the possibilities for recyclability, using renewable resources as much as possible and extending the product life cycle. What eco-efficiency claims is that it is possible to both reduce the costs by improving the productivity of an organizations while improving the environmental performance (Lehman, 2002). This goes against the previously mentioned traditional view that saw a trade-off among the two performances. Eco-efficiency is seen as the win-win paradigm of the trade-off. Managers adopting creative methodologies to improve or keeping the same level of productivity while reducing cost, resource consumption and emissions are showing an eco-efficient behavior (WBCSD, 2000). Porter and Van der Linde (1995) hypothesized that this eco-efficient behavior has to be stimulated by regulatory interventions and will not occur otherwise (*guided* eco-efficiency). On this topic, Al-Tuwaijiri et al. (2004) studied a sample of firms from S&P's 500, finding a positive relation between a toxic-waste indicator (inversely proportional to the amount of waste generated) and market returns. This is consistent with *voluntary* eco-efficiency because there was no regulatory act mandating a reduction for toxic waste for these firms. Therefore, rational managers seem to have all the interest to adopt this kind of behavior. Moreover, if managers believe that a good environmental performance is related with a better economic result, this is well viewed by investors (Al-Tuwaijiri, 2004), as it is a signal that investing in companies engaged in environmental sustainability makes sense. Feldman (1997) stated that environmental improvements may be seen by the financial markets as a reduction in the overall risk of the company, resulting for example in a lower cost of capital or a rise in stock price. Evidence by Derwall et al. (2005) shows that the shares of the most

eco-efficient companies were initially undervalued; the price received later an upward correction with respect to the least eco-efficient ones.

Eco-efficiency concept is based on the safeguarding of the environment through the reduction on material and energy intensity; the reduction of toxic waste, both in the level and quantity; the promotion of longer and closed life cycles for the goods produced; promotion of renewables and abundant resources (Florentina Abreu et al., 2017).

Through the adoption of eco-efficient practices, organizations can optimize their processes in terms of resource usage, for example materials, water, or energy, which is an input for any process irrespective of the industry the company is working in. Also, emissions (like those of Greenhouse Gasses, which have a direct impact on global warming) can be taken into account as a measure of the impact; these values can be taken in consideration separately, as air, water and soil waste.

Eco-efficiency should go hand in hand with the adoption of a management philosophy aimed at both environmental improvements and profitability, for example with the application Lean techniques (Carvalho et al., 2017).

2.2. Lean Management

Providing more value with less environmental impact requires innovation capabilities, both in the product and the production process. Moreover, many scholars, including King and Lenox (2002), emphasized that companies can show environmental commitment through end-of-the-pipe pollution control, so by cleaning up when the damage has already been done; however, proactive pollution prevention methods are the ones that will more likely help improving the efficiency and profitability within a company. Lean Management can be the mean to deal with these opportunities.

2.2.1. Lean Management definitions

Lean Management is a managerial approach recognized as having the capability to improve the operational performance of a company (Shah and Ward, 2003). It was first developed by the Toyota Production System, then exported worldwide under the term "Lean". This name is attributed to John Krafcik, one of the MIT undergraduates that were working in the Womack's team who discovered the peculiar practices put in place by Toyota, bringing their performance to excellent levels if compared with western automotive manufacturers with way more resources available. As Krafcik stated, "*Lean production is Lean because it uses less of everything compared with mass production*", which was the previous management common principle in the United States in the second half of the 20th century. Liker (1998) proposed that Lean is "*a philosophy that reduces the time from customer order to delivery through the elimination of wastes all along the production flow*". However, the most complete definition is considered to be the one by NIST (2003) which suggested that Lean is a "*systematic approach aimed at identifying and eliminating waste through continuous improvement; flowing the product at the pull of the customer in pursuit of perfection*".

One stream of literature defines Lean as a philosophy following five principles - Value, Value Stream, Flow, Pull production, Pursuit of perfection – with the final aim to eliminate all wastes or *Muda* from the production process (Womack and Jones, 1996). Another perspective considers Lean in a more pragmatic way as the integration of specific techniques to reduce the internal and external process variability, or *Mura* (Shah and Ward, 2007). These techniques can be divided in internal-related practices – like Kanban, continuous flow, setup time reduction, Total Productive Maintenance, statistical process control, employee involvement – and in practices related to the external relations with supplier and customers, like Just in Time deliveries, for example.

Organizations that can implement Lean Management principles in an effective way are also able to improve continuously their operations by removing non-value added or waste activities (from the perspective of the end-customer) through the personnel's initiatives (Rother, 2010). It is often labeled as "common sense" approach since it appears simple to be

adopted and also the practices cannot be blindly implemented but have to be specifically adapted to a context.

The "wastes" that Lean Management wants to tackle are the following:

(i) **Overproduction**, which occurs when what is produced is more than what is required.

(ii) **Inventory**, hence, the finished goods stocked.

(iii) **Defects**, therefore, scraps that must be reworked.

(iv) **Waiting**, meaning wasted time in any of the stages of the production process, implying that the flow is not perfectly continuous.

(v) **Transportation**, which is the unnecessary movement of information, items, materials, parts and finished good from one place to another.

(vi) **Motion**, related to operators doing unnecessary movements in their work area.

(vii) **Over-processing,** thus all the unnecessary steps in the production process.

(viii) **Incorrect use of staff and their abilities**, meaning the loss of opportunity of not exploiting at maximum the capabilities and ideas of the personnel.

To sum it all up, Lean wants to create more value for the end customers whilst consuming the less resources possible. According to Suzuki (2004), the main distance among Toyota and other companies trying to adopt Lean Management principles is the eight waste afore mentioned: efficiency must be sought not only in the use of resources, but also within workers in the organization, by fully exploiting their potential and abilities.

2.2.2. Lean adoption: drivers and barriers

A huge amount of literature already deals with the benefits brought by Lean adoption within companies. There is empirical evidence that a successful Lean Management implementation has a positive influence over the company's operational performance (Moyano-Fuentes and Sacristàn-Diaz, 2012), over process variability, scrap rate and rework time, resulting therefore in a lower cost of production, above everything else, but also in an

improved process flexibility and quality. All the benefits provided by this philosophy to organizations are enough to justify companies trying to go through a Lean transformation. A wide amount of research also deals with the enablers for a Lean transformation, and therefore with the Critical Success Factors of Lean Management and the barriers that hinder its adoption. Indeed, even though many companies have successfully implemented Lean, others have failed, since they were not able to sustain their results over time (Lucey, 2005). Eaton's results (2010) show that 75 percent of Lean programs ultimately fail.

Worley and Doolen (2014) stated that a flat organizational structure within a company may be a problem while trying to implement Lean. Indeed, where there was no dedicated personnel, the flatter organization was detrimental to the process of Lean implementation. On the contrary, a hierarchical organizational structure is positively associated with Lean Culture (Paro and Girolamo, 2017). This is consistent with the research by Shah and Ward (2003), that showed how large plants are more successful in implementing Lean practices since they possess more resources than smaller ones. Another finding by these authors, stating that the synergistic effect of all Lean practices leads to a superior performance with respect to just few of them adopted, show how Lean is more a philosophy that must be embraced in its totality by the organization than a collection of tools.

Wincel and Kull (2013) pointed out that over time, as Lean tools are adopted and refined, the Lean culture will spread within the organization. Powell and Coughlan (2020), in their case study, identified two stages of Lean implementation: in the first one, the practices of Lean are implemented and mastered by employees; in the second one, the cultural shift occurs. Lean Culture acts therefore as an indicator of the level of maturity reached by an organization in the Lean transformation.

When there is a mismatch between the cultural principles and the practices and methods implemented within a company, the chances of achieving a higher performance are decreased (Lozeau et al., 2002). Similarly, Galbraith (1997) emphasized the fact that not all the organizations should adopt the same practices; indeed, the management approach is successful depending on the organizational characteristics.

The extensive literature review by Bhamu and Sangwan (2014) highlights that the effectiveness of Lean implementation is mainly due to the culture of the organization. There is evidence that Lean implementation fails when little attention is given to the human-side (Chakravarty, 2009). Mostafa et al. (2015) define a Lean implementation effective when a company can develop a Lean Culture thanks to the adoption of soft Lean practices and of some hard practices (techniques and tools).

2.2.3. Soft Lean practices

Lean Management is considered as an integrated system of soft and hard practices (Shah and Ward, 2007). While hard practices refer to the afore mentioned "technical" tools of Lean, the soft practices deal with people within the organizations, and the relations among them. On the one hand, hard tools are the ones in charge to improve the operational performance directly by acting on the company's processes; instead, soft practices include principles, managerial concepts, people, and relations (Bortolotti et al., 2015). Soft Lean practices involve the human side of the system, promoting the involvement of employees and the commitment of management.

According to Matsui (2007), soft practices are necessary for an organization to get the superior performance expected through the implementation of Lean Management; the effect of hard practices is magnified when these are backed by soft practices. These latter also have the role to sustain the superior performance in the long term (Hines et al., 2004; Costa et al., 2019). Liker and Rother (2011) showed that companies usually focus more on the technical practices only; managers fully understand the benefits that hard Lean tools can bring to organizations, but do not fully understand and therefore implement soft practices. Also Shah and Ward (2007) emphasized the effectiveness of implementing hard and soft Lean practices jointly. According to Powell and Coughlan (2020), hard Lean tools are accelerators for Lean Culture to pervade the organization.

What really differentiate companies that have adopted Lean Management in an effective way are the soft practices and not the hard ones implemented (Bortolotti et al., 2015). We

can consider hard tools as essential, a necessary condition for Lean but not a sufficient one; indeed, this study emphasizes that the success of a Lean implementation is based on the soft side of Lean, for example on a trend and a habit for Continuous Improvement that pervades the whole organizations, on training or leveraging teamwork to solve problems, etc.

The work by Costa et al. (2019) identified a set of soft practices from a systematic literature review. In their framework, these practices (called Critical Success Factors since they were studied as the reason why a Lean implementation can eventually be successful over time) converge to the following 14:

(i)   Employee engagement – the motivation of employees and their commitment towards Lean implementation within the organization, and their participation in the redefinition of the processes.

(ii)   Top management commitment – the degree of engagement and motivation that the top management can transmit to the rest of the organization through participation in the initiatives, etc.

(iii)   Leadership – How the leader can understand, motivate and help employees adapting to the new way of work and favor the cultural shift.

(iv)   Teamwork – the ability to exploit work in teams for continuous improvement initiatives.

(v)   Consultants – the use of experts coming from outside the company to share methodologies and specialized knowledge to set the path for the Lean adoption within the organization.

(vi)   Unionized workforce – the presence of workers adhering to labor unions.

(vii)   Kaizen events – focused projects that have specific objectives, a limited time span and use of financial resources.

(viii) Bottom-up approach

(ix)   Top-Down approach

(x)   Working conditions/environment – how the employee's perception about their work has changed since the implementation of Lean.

(xi) Training and job empowerment – training for employees and management, aimed at sharing and consolidating Lean principles across the organization; job empowerment is instead about the increased responsibility and decision-making power that employees should be recognized if Lean is well implemented in the organization.

(xii) Non-financial rewards – the recognition that is given to employees achieving a good performance through the application of Continuous Improvement and Lean techniques.

(xiii) Financial rewards – bonuses related to improvements actively suggested by employees.

(xiv) Communication – how the information about Lean implementation is shared across the organization, including the needs for managerial shift, the new goals set by the company, etc.

From their study on the cause-effect relations among Lean practices, employee engagement resulted to be the main effect, therefore it is always visible in a successful Lean plant over time; on the other hand, top management commitment and leadership are the root causes of all the other soft practices. These two must create the ground for Lean implementation to be successful. Recent studies found that the main reasons for the failure of a Lean implementation project within a company are the lack in top management commitment, an ineffective communication and training (Mclean and Antony, 2013). Pearce (2018) states that the commitment of management in the process of Lean implementation is more relevant for the success of the adoption than the Lean methods proposed and put in place.

Another framework by Che Mamat et al. (2015) tries to include all soft Lean practices. These do not differ from the ones defined of Costa, except for "supplier relationship" and "customer involvement"; these are included because indeed an effective Lean company must be well coordinated with both upstream and downstream to continuously flow. Also, they include "continuous improvement" as a soft practice, while Costa's framework considers it as a result of the adoption of these tools.

Coherent with the results of Costa et al. are also the 10 factors that compose the integrated system of Lean according to Shah and Ward (2007). Indeed, among the hard tools previously mentioned, one of the elements that constitute Lean is employee involvement.

According to Alves et al. (2012) employees in Lean companies become thinkers, and their involvement is crucial for the Continuous Improvement philosophy. Lean is indeed very concerned with people: therefore, the achievement of a superior performance is possible only if workers are deeply involved and share the values of this philosophy. According to Alavi (2003) companies with a high level of maturity of Lean implementation show a flatter structure, because of the more empowered position of employees.

A model by Pienkowski (2019) wants to assess the degree of maturity of Lean implementation within organizations. It is based on four categories, among which we find leadership and people. For what concerns leadership, the criteria to assess the maturity revolve mainly around how in depth the top and middle management have understood and internalized Lean principles, and how much they are engaged in this approach. Instead, focusing on people, what makes an organization mature is mainly the level of employee engagement in continuous improvement activities, alongside their training and the use of teams that are cross-functional or interdisciplinary. These are all soft practices; and the more these practices are observable in an organization, the more the maturity of Lean implementation, and, therefore, also the spread of the Lean culture across the company.

2.3. Lean and Eco-efficiency performance

Burke et al. (2007) emphasize the convenience to work on the 'low apples first' when beginning the process of improving a company eco-efficiency performance. This means to work on those factors that will give the best payback possible in the shortest time horizon. In this paper, low apples are considered, among the others, waste reduction, energy consumption, the redesign of packaging and transportation… Clearly, Lean Management

represents an opportunity for companies to try and gain on the environmental performance side in a short time while not giving up anything on the operational and financial side.

2.3.1. Shared ground

According to Martinez-Jurado et al. (2014), Lean and eco-efficiency are two complementary concepts since they share some principles. The main one is that of *waste reduction*, respectively of non-value-added activities in Lean Manufacturing and resources usage and pollution in eco-efficient practices. Eco-efficient practices are simply defined as those practices enhancing the eco-efficiency performance of the company. According to King and Lenox (2002), the Lean goal to reduce wastes brings to the continuous reduction of the use of materials and energy, and this is automatically aligned with the objective to reduce impact on the environment. Indeed, it seems that Lean practices affect positively the company's environmental performances (Azevedo, 2012), since they imply a more responsible consume of resource. Then, another commonality among the two concepts is that both Lean Management and eco-efficiency overlook the process in its entirety trying to prevent problems from occurring in the future. Moreover, one of the milestones of Lean approach, that is the participation and involvement of people in the organization, is also crucial for the implementation of eco-efficient practices. According to Rothenberg et al. (2001) people involvement is vital in environmental initiatives since ideas are more likely to be effectively adopted.

Many scholars found that there is a positive relation between the implementation of Lean Management within a company and its ability to improve the eco-efficiency performance; in addition to that, these companies reach the goal through prevention mainly. Companies that implemented Lean practices were able to prevent the waste at its generation (Florida 1996), since the pursuit of waste reduction generates spillovers benefits to the environment; also, it creates a more fertile context in which innovative solutions increasing the eco-efficiency performance are more likely to be proposed and implemented. Indeed, Alves

(2012) states that Lean Management is mainly about a continuous collective learning of the whole organization rather than on a particular implementation or techniques.

According to Leon and Calvo-Amodio (2017), Lean is a facilitator for the adoption of eco-efficient practices because it improves the capacity of employees to autonomously solve problems. Also Piercy and Rich (2015) found that companies that already implemented effectively Lean have less trouble implementing also eco-efficient practices with respect to non-Lean companies. Also, companies committed to environmental sustainability find it easier to implement Lean Management. This clearly means that there are synergies among the two approaches (Dues et al., 2013).

Bocken et al. (2014) categorized different "sustainable business model archetypes". Among the others, they defined as sustainable a system that promotes the minimization of consumption and the maximization of the material productivity. This archetype includes concepts like Lean and Eco-efficiency, whose aim is the improvement of resource efficiency and environmental performance through the redefinition of the production process.

According to Garza-Reyes (2014), Lean and Eco-efficiency's own goals have an impact over the goals of the other concept, in terms for example of waste or lead time reduction. In this sense, there is a complementarity among the two.

2.3.2. The impact of Lean on the Eco-efficiency performance

As previously mentioned, most of the studies state that the implementation of Lean Manufacturing has a positive impact on the eco-efficiency performance of a company. Indeed, there is a measurable reduction in materials and energy consumptions that results in a lower environmental pollution (Larson and Greenwood, 2004). Moreira (2010) states that Lean Management is positively related to the reduction of toxic waste dispersion in the environment thanks to a lower raw material consumption, for example. However, a smaller number of researchers show that there can be negative links between Lean and Environmental Sustainability. The two concepts may conflict: some solutions brought by Lean, despite being cost efficient, may have a greater environmental impact (Rothenberg,

2001). According to Bandehnezhad (2012), some of the practices that result from Just In Time, for example more frequent setups and deliveries, can be associated with a higher environmental damage. The relationship is not straightforward also in the opposite direction: indeed, some of the environmental sustainability practices put in place by companies can be a too big constraint for Lean practices (Dues et al., 2013; Azevedo et al., 2012). The study by Yang et al. (2011), found that Lean Manufacturing alone cannot be sufficient to improve eco-efficiency performance: indeed, practices strictly targeted to the improvement of the environmental side of the eco-efficiency ratio still must be put in place, and therefore resources must be specifically assigned to implement them. Also Torielli (2011) emphasized that Lean alone does not reduce in any case the environmental impact. This is consistent with the findings of the literature review by Garza-Reyes (2015): some point out that there are synergies and complementarities between Lean and practices aimed at the improvement of the eco-efficiency performance, while others state that the two concepts are inherently different, have different goals and therefore impact different performances (Kleindorfer et al., 2005). According to some scholars, the impact on eco-efficiency performance given by the implementation of Lean practices is a side effect and unintended; therefore, it is not automatically replicable (Corbett and Klassen, 2006; Florida, 1996). Findings from a case study by Baumer-Cardoso et al. (2020) show that, despite having a generally positive relationship with the eco-efficiency performance, sometimes the adoption of Lean can result in an increased negative impact because of the contingent situation of the process it is being applied on. Lean is not completely aligned with eco-efficiency performance, but it could be after specific changes in the production process. Also in the paper by Raj et al. (2017), the fact that some of the Lean Manufacturing practices should be redefined also including elements of environmental sustainability to be effective in reducing the external impact of the company's activities. For this reason, Vinodh et al. (2011) proposed to include the environmental waste as the 9th waste among those that Lean Management aims to tackle. In this way, the environmental impact should be continuously reduced. Galeazzo (2014) suggests that the best possible outcome in terms of improvement of operational and eco-efficiency performances will be achieved if Lean and Environmental

Sustainability practices are implemented together, simultaneously, or sequentially; or, according to Pampanelli (2014), it could be useful to integrate the two strategies in a unique approach to fully exploit synergies and shared efforts. The simultaneous adoption of Lean and Environmental Sustainability practices improves both the financial and environmental performances of the company, hence the eco-efficiency one, according to Gaikwood (2020). Resta (2016) emphasized that Lean cannot be considered only as a bunch of practices, but has to be analyzed as a philosophy that permeates the whole organizations: this may explain the contrasting results in literature about the impact of Lean on the eco-efficiency performance of a company, while still most of the scholars think that an effective Lean implementation sets a perfect ground for a company to become more environmental sustainable.

2.3.3. Barriers and Success Factors

Given these premises, it is obvious that a handful of different integrated approaches have been proposed; however, they are all made of Lean and environmental sustainability practices combined. There is quite a literature on these methods, and besides focusing on the positive impact that these methodologies have on the eco-efficiency performance of companies, what is interesting is to understand the barriers to their implementation. According to Singh (2020), the most prominent barriers to the simultaneous implementation are the resistance of the system to change, the lack of training for employees, the lack of environmental knowledge and, above all, the lack of top management commitment. Also according to Yadov (2022), the barriers to the execution of an integrated approach are, above others, the lack of top management support and employee engagement.

According to Kuo-Chen (2020), in a Lean company, employee involvement is the moderator among the implementation of practices to reduce the environmental impact and the final eco-efficiency performance: this means that any project could fail to achieve the expected results if there is lack of participation by operators. Rothi et al. (2021) state that in general,

top management support is always necessary for the successful implementation of any project or strategy; the lack of this support is seen as one of the main barriers, which are all human-related ones.

2.4.   Gaps in Literature

In the first section of the narrative literature review, a brief definition and overview over the problem of environmental sustainability was provided, in particular related to the manufacturing sector. Then, the drivers and barriers for companies to become more environmentally sustainable were listed. According to the literature, companies mainly develop a sustainability program because of the pressure of external stakeholders, whether they are customers claiming for products that generate less damage to the environment or government imposing new standards and restrictions on production activities; however, there can be a significant improvement in the economic performance through the adoption of environmental sustainability practices. Hence, the eco-efficiency concept was quickly treated. Eco-efficiency, by solving and overcoming the traditional trade-off between economic performance and sustainable activity, gives company the opportunity to create value while impacting less on the external environment.

This is when it comes Lean Management into play. Since Lean is recognized as the most popular paradigm for companies that want to create more value through a more efficient and conscious use of the available resources, it becomes an opportunity for companies to achieve eco-efficiency. This second part of literature review is dedicated to Lean Management, in particular to the problem in its implementation and, as a result, the so-called soft Lean practices, also known as human-related practices. Indeed, there is a wide amount of literature on the reasons why so many Lean adoption projects in the end fail, and companies go back to their previous way of work. What emerges is that the main reason for failure has not to be researched in how the techniques and methods of Lean (*the hard side*) are implemented, but in the lack of Lean Culture among the people constituting the organization, which is ultimately expressed by the absence of soft Lean practices.

The last part of the literature review focuses on the papers that treat the two topics of Lean and Environmental Sustainability together. Indeed, despite Lean being almost fully aligned with eco-efficiency (deliver more value whilst consuming less resources), to achieve a complete victory both the sides of the eco-efficiency ratio must be improved (value generated and environmental impact). Even if there are contrasting results regarding the impact that Lean has on the environmental performance of a company, and the improvements achieved are mostly considered as side-effects and non-replicable; there is still evidence of a synergy among the two concepts. Indeed, a Lean company turns out to be more ready than a non-Lean one when it comes to implementing environmental sustainability practices. In particular, the case that is considered to bring the best possible outcome is the one in which the two principles are adopted simultaneously within a company. Hence, the development of a handful of integrated approaches. The very last part of the literature shows some of the barriers that do not allow the effective implementation of these approaches, and these barriers turn out to be quite similar to the ones already hindering a successful Lean implementation: the absence of soft practices.

In literature, soft practices are always considered as a critical success factor or a barrier to the achievement of a successful Lean implementation. There is no study that directly tries to link soft Lean practices to the achievement of a certain performance, in this case, the environmental one.

Also, top management commitment, leadership and employee engagement are the two soft practices that are mentioned the most in the literature analyzed. However, it is not entirely clear about which figures within an organization we are talking about. Indeed, Lean is known to be more successfully implemented in larger organizations with a hierarchical and well formalized structure (Shah and Ward, 2003); in this kind of organizations, there are many levels between the top management and the operators working on the production line. There is no study that tries to distinguish how soft practices are differently "used" for each different level of the organization.

2.4.1. Purpose and Research Question

The purpose of this work is to discover what are the soft practices, hence, the critical success factors of Lean Culture, that have a role and thus help the organization in the achievement of better results in terms of environmental sustainability performance. Moreover, the second topic of interest is to understand how the soft practices that will result as relevant from the first part of the study are perceived and adopted by more hierarchical levels in the organization, to understand and highlight the peculiarity of each figure, and ultimately to deepen the knowledge about the human-related side of the Lean Culture.

RQ1: How can the soft practices of the Lean Culture allow a company to achieve better results in terms of eco-efficiency performance?

RFQ2: How are the soft Lean practices implemented to achieve a better eco-efficiency performance perceived by different hierarchical levels?

3.   Methodology

3.1.   Research Methodology

This paragraph aims to explain how the research was performed. In the following figure, the entire process is shown.
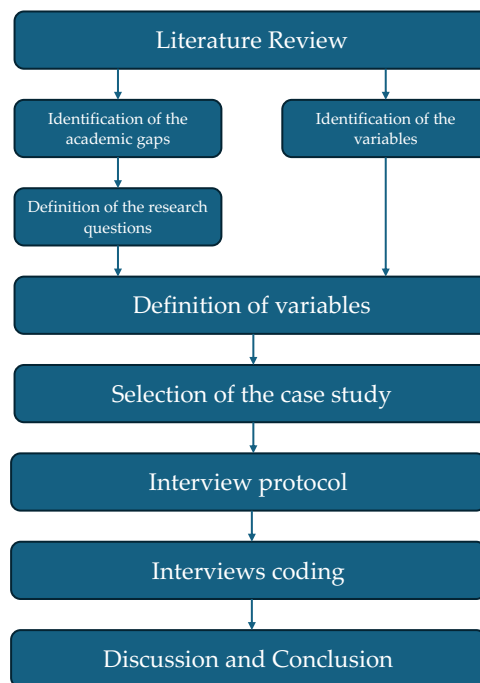
Figure 1: research methodology

The analysis of the existing literature on the selected topics of Soft Lean practices and Eco-Efficiency was the first step of the research. The two topics were first approached separately to be understood more in depth. Then, articles that addressed the intersection between these two subjects were analyzed, to assess how far advanced was the academic research in this realm. This preliminary step is necessary to highlight the gaps in literature and to build the needed theoretical knowledge to approach the study that will follow. Through the literature review, academic gaps and consequently research questions have been identified. The research framework was built through the variables identified during the phase of literature

review: indeed, it consisted of the list of soft practices that had to be assessed lately when analyzing the interviews.

After the definition of the research framework, the practical phase started. A company operating in the food industry was selected as case study for the thesis because of a specific project that was carried out in the recent past. This project perfectly reflected the aim to improve the eco-efficiency performance through the implementation of Lean Manufacturing that the study wanted to investigate in depth.

Interviews were chosen as a method to carry on the research given the anthropological nature of the variables object of the study. Semi-structured interviews were performed: variables were addressed by prepared questions in the interview protocol; however, the author did not want to lose the opportunity to spot other variables in an inductive way by letting the interviewee speak more freely.

After a preliminary understanding of how the company under analysis worked, specific roles were chosen to be the ones to be interviewed, specifically the top manager, the shift supervisor and two lines supervisors. They were asked about the role that soft Lean practices held during the implementation of the project. Then, interviews were analyzed, and results discussed to get to the final conclusions of the thesis.

3.2. Literature Review

A narrative literature review was performed to get a general understanding of the topics under analysis and to verify whether the subject had already been treated in the past. The literature review was narrative given the enormous number of articles and papers on the topics of lean management and environmental sustainability or eco-efficiency. Given instead the relatively low number of papers written on the intersection of the two topics, in particular regarding the soft practices of lean management, two separate literature reviews were carried out for each of the macro-topics under analysis. Only at a later stage articles and studies performed directly on both topics were analyzed.

The material search was performed on archives such as Scopus, using different combinations of query and then manually filtering to narrow the review only to paper and articles of interest for the thesis. Indeed, the topics of lean management, environmental sustainability and eco-efficiency have many different sectors of application nowadays; however, the idea was to focus on a production reality since the beginning. For what concerns Lean Management, key words like "Lean Culture", "Lean Approach" and "Soft Lean practices" were used, given the width of the topic and the necessity to focus mainly on the philosophical side of the subject instead than the technical one, mostly oriented to the lean tools and whose literature was clearly more comprehensive. Regarding the eco-efficiency side, after a brief overview of the topic of environmental sustainability through keywords like "Environmental sustainability" linked with "Manufacturing Companies", words like "eco-efficiency" and "eco-efficiency performances" were searched with the aim to be narrower in the review. Finally, the two sets of words were combined to find the literature covering the two topics together. Overall, more than 50 articles were analyzed.

3.3. Definition of Variables

A research framework was developed to be able to answer to the research questions. This framework aims to comprehend the Soft Lean Practices found in literature. In particular, the main reference was the paper by Costa et al. (2019), which developed a framework comprehensive of all the relevant soft practices related to Lean thanks to a systematic literature review. Starting from 24 practices, the study rationalized them in 14 macro-categories that are here reported. The definitions are taken by the paper just mentioned and then integrated with literature regarding each one of the topics.

(i)   Employee engagement – the motivation of employees and their commitment towards Lean implementation within the organization, and their participation in the redefinition of the processes, decision-making and performance monitoring. Also,

the emotional and physical involvement they show towards the Lean initiatives. According to Robinson and Schroeder (2009), Lean initiatives fail when work force is poorly engaged in the Lean culture of continuous improvement.

    a. This macro-category also included "employee resistances": these are considered to be the barriers, endogenous or exogenous, to be overcome to engage employees in Lean initiatives. According to Eswaramoorthi et al. (2011), anxiety and difficulties in changing the employees' mindset are two factors that hinder Lean adoption. Cultural and language barriers are challenges in the Lean implementation (Cudney and Elrod, 2010).

(ii)   Top management commitment – the degree of engagement and motivation that the top management can transmit to the rest of the organization through its active participation and the time dedicated to the continuous improvement initiatives. Also, the physical presence of the top management in the shop-floor to further motivate employees (Tracy, 2007). The lack of commitment by the top management may result in ineffective communication (Scherrer-Rathje et al., 2009).

(iii)   Leadership – How the leader can understand, motivate, and help employees adapting to the new way of work and favor the cultural shift. It is also the ability of the leader to guide the employees in evolving by overcoming their personal difficulties, to inspire them and to define a clear vision for the lean initiatives' outcome. Leadership is considered as a huge success factor for Lean implementation also according to Hines et al. (2008), that identify it as a reason for the change sustainability in the long term.

A variable composing this macro-category is the mutual trust between employees and management: this is crucial too for Lean implementation as it creates the environment for delegation to occur (Staudacher and Tantardini, 2007).

(iv)   Teamwork – the ability to exploit work in teams for continuous improvement initiatives. Teamwork requires each member is able and motivated to co-operate, to favor a honest communication, to share opinions, ideas and proposals and to give feedbacks.

(v)   Consultants – the use of experts coming from outside the company to share methodologies and specialized knowledge to set the path for the Lean adoption within the organization. Also, to have a structured process for the Lean implementation. According to Tracy (2007), companies often find the transformation brought by Lean adoption so significant to make the presence of external experts necessary for the adoption success. Also, according to Cudney and Elrod (2010), Lean transformation may be incomplete in absence of a rigorous methodology. Also, external validation is a major boost in the involvement of the internal stakeholders in the Lean initiative (Scherrer-Rathje, 2009).

(vi)   Unionized workforce – the presence of workers adhering to labor unions.

(vii) Kaizen events – focused project that through lean teams aims to bring quick and radical improvements over a specific dimension, in a limited time window and with contained investments.

(viii) Bottom-up approach – active participation of employees in problems detection and solution proposal.

(ix)   Top-Down approach – application of solutions set by few experts and/or the top management.

(x)   Working conditions/environment – how the employee's perception about their work has changed since the implementation of Lean; specifically, it regards the stress and the physical fatigue caused by how the process is performed.

(xi)   Training and job empowerment – training for employees and management, aimed at sharing and consolidating Lean principles across the organization and at motivating people within the company to sustain continuous improvement. Regarding workers, to implement Lean it is necessary to have knowledgeable human resources (Hurd, 2004). Training also makes operators aware of Lean concepts and formalizes these latter in their minds (Eswaramoorthi, 2011). Job empowerment is instead about the increased responsibility, decision-making power, flexibility that employees should be recognized if Lean is well implemented in the organization. In some sense, it relates to their gained autonomy towards the traditional hierarchical structure of the company.

(xii)   Non-financial rewards – the recognition that is given to employees achieving a good performance through the application of Continuous Improvement and Lean techniques. Under this practice is included, for example, the public celebration of those employees that are considered to have achieved a remarkable performance in the Lean implementation.

(xiii)   Financial rewards – financial bonuses related to improvements actively suggested by employees.

(xiv)   Communication – how the information about Lean implementation is shared across the organization, including the needs for a managerial shift (Lean adoption), the new goals set by the company, the knowledge spillovers between different jobs or hierarchical levels, etc. According to Cudney and Elrod (2010), it is crucial to inform employees about the changes that are coming within the Lean implementation.

Communication also refers to the degree of the discussion among the different stakeholders and whether employees are listened or not; to the implementation of ways to improve the communication across the organization and to spread the results, like, for example, a performance measurement system and the data sharing. On this subject, Scherrer-Rathje (2009) stated how a lack of awareness about the success of the Lean initiatives among employees brought to a low degree of support from them.

3.4. Case Study

The focus of the study is on a specific plant belonging to an Italian multinational company that operates in the food industry; in particular, this company deals with both the processing of food and its packaging for the final destination. In this last stage of the production, plastic finds wide employment; hence, one of the company's strategic goals is that of becoming more environmentally sustainable through the improvement of its eco-efficiency performance. Indeed, the plant under analysis had the target to reduce the overall consumption of plastic in the packaging stage of the production process. To do this, the company has undertaken continuous improvement initiatives: the "Lean project" that will be the subject of this thesis.

The project started with the arrival of consultants within the plant; their role at the beginning was to perform a preliminary analysis to have a more detailed overview of the process. This analysis brought up the fact that there was a huge consumption of plastic during the packaging stage of the production, and a low but still relevant percentage of it was not finished product, as evidenced by the amount of plastic waste thrown out by employees. This was clearly bad news for the environment; however, it also meant higher operating costs for the company. Most plastic wastes came from those packages of finished products that were considered not suitable for sale. There were two categories of packages unfit for sale, those that presented label printing errors and those that remained empty because of process errors. The company decided to act on those two inefficiencies; therefore, the AS-IS

situation analysis started, consisting in the collection of data directly on the packaging line. The data collected was then monitored to assess the exact impact that the units considered unsuitable for the final destination had in terms of plastic waste in the department. This latter consists of three different lines; summing the different types of waste categories before the launch of the Lean project, the percentages of unsaleable products were 10 on Line 1, 7 on Line 3 and 8.6 on Line 4. More in detail, the majority of these wastes were due to the empty packages category.

After the AS-IS analysis, the following step was to understand the determinants of the inefficiencies occurring throughout the process. Having identified the root causes responsible for the huge amount of plastic wasted, it was possible to develop specific countermeasures for each one of them. In particular, standard procedures for some of the process stages that were considered decisive for the waste generation (like setting up the start of shift or the finished product changeover) were formalized. These new procedures were implemented gradually; meanwhile, the data measurement continued to understand whether the countermeasures were effective and to estimate for each one of them a quantitative saving. Over a limited amount of time of almost two months, the percentages of waste for the three lines went down to almost 4%, 3% and 3% respectively for Line 1, Line 3 and Line 4; the project was indeed successful over different dimensions, with a decrease in the usage of plastic equal to almost 11.5 tons (which was more than expected and targeted by the company before the project launch). First, obviously, the implementation of the project had as an effect the reduction of the overall burden the plant entailed on the external environment through the waste of plastic; then, at the same time, there were many benefits for the production, like the cost reduction, also for what concerns the disposal, and the decrease in the complexity of the process.

This project was implemented using the A3 tool for problem solving. A3 is a methodology that applies concepts of Lean to problem-solving (Flinchbaugh, 2012) and it is considered to be very useful in the first stages of Lean adoption within a company or a particular plant. It emerged at Toyota in the 1960s and it is based on the Shewhart cycle (PDCA – Plan, do, check, act), which is a Lean technique supporting the identification of opportunities for

waste reduction and efficiency increase (Rosa, Silva and Ferreira, 2017). The A3 methodology requires a limited amount of resources, money and time with respect to setting up a whole lean production system. For these reasons, the case study is suitable for this study. Also, obviously, because of the multidimensional type of improvement stated before: the company, through the implementation of this project, aims at enhancing the financial and the operational side of the company, with an eye to environmental sustainability; or, from another perspective, the company wants to upgrade its environmental performance without having to bear any additional cost, but rather saving money and resources. The two dimensions are not considered antithetical, but instead making each other better, as it is when considering the eco-efficiency principle. Finally, the simultaneous implementation of Lean and Environmental Sustainability practices was found in literature to be the most effective in the improvement of eco-efficiency performance.

This case study is interesting also for the second research question, since it involved many different stakeholders and at a different hierarchical level. Indeed, line operators were helpful in detecting many of the issues that emerged through the project. Therefore, the author can collect information regarding different hierarchical levels to be compared afterwards.

3.5. Interview protocol

The first step in defining the interview protocol was the decision on how to interview within the plant under analysis. The department in which the project was carried out had the following hierarchical structure.

1. A top manager, who is in charge of two department within the plant under analysis (department manager); these departments are positioned one after the other in the value chain and while the first one deals with food processing, the following one is about packaging and is the one.

2. Three shift supervisors. The three lines previously mentioned are divided in two macro-stages. Two of them are assigned to stage 1 and the other is assigned to stage 2. The shift supervisor role consists in managing closely what occurs in each station of one stage of the lines over the duration of a shift. The shift supervisor has a partial autonomies in the machinery management and therefore has discretion over the decision of some of their parameters; also, he is responsible for incomplete work in progress at the end of the shift, for unforeseen events and problems occurring, etc.

3. Four Line supervisors; two of them are assigned to stage 1 and the others to stage 2. They manage a stage of the line and in particular the workers assigned to that stage, by verifying that every procedure is performed correctly, that the necessary material is available on the line, etc.

4. Line operators, that are almost 50 in the whole department.

All levels except the line operators were interviewed. Indeed, from the case study it was known that also employees participated in the project. In particular, the team in charge of the project was made by the top manager together with line supervisors. This is because, according to the top manager, it was more useful to directly involve those workers that were the most impacted by the changes that the project would have brought. Therefore, to answer to the Research Question 1, and thus to understand the role of the soft lean practices in the achievement of a better eco-efficiency performance, the people involved in the project was interviewed. This is reasonable given the presence of variables such as "top management commitment" and "employee engagement", which make both the testimonials interesting. Then, to answer to Research Question 2, also the shift supervisor, although not directly involved in the dedicated team, was interviewed, to have a third perspective on how the project was carried out and therefore to have another point of view over the soft practices used to implement it.

Once defined the interviewees, a semi-structured interview protocol was developed to be able to lead the interview towards the topics under analysis. However, this protocol allows the respondents to digress from the specific question's subject, in order to get information

not accessible otherwise. To prepare for the interviews, the author investigated about the company and the plant under analysis, and in particular about the Lean project that had been carried out in the month preceding this research. Questions are reported in table 1. These were structured as general as possible in order to avoid possible biases invalidating the whole research. Therefore, they were written mainly in the structure of "was there…" to assess the presence of a given soft practice, and then letting the interviewee tell how the practices were implemented.

Topic	Top manager	Shift supervisor	Line supervisor
Top management commitment	Which role did you have in the project implementation?	Which was the top manager role in the definition and implementation of the project?	Which was the top manager role in the definition and implementation of the project?
Employee engagement	Which was the role held by employees in the project implementation?	Which was your role in the project implementation?	Which was your role in the project implementation?
Training	Were there moments dedicated to training for manager/employees?	Were there moments dedicated to training?	Were there moments dedicated to training?
Working Conditions	How did the employees' job change during and after the project implementation?	How did your job change during and after the project implementation? What about line operators?	How did your job change during and after the project implementation? What about line operators?
Communication	How were employees informed about the project?	How were you informed about the project?	How were you informed about the project?
Communication Top-down/Bottom-up approach	How did the exchange of ideas and information occur during the project?	How did the exchange of ideas and information occur during the project?	How did the exchange of ideas and information occur during the project?
Teamwork	Was a team formed for the project? Who were the members?	Was a team formed for the project? Who were the members?	Was a team formed for the project? Who were the members?
Consultants	How did you interact with external consultants? What was	How did you interact with external consultants? What was	How did you interact with external consultants? What was

	their role in the project implementation?	their role in the project implementation?	their role in the project implementation?
Rewards	Were rewards assigned during the project?	Were rewards assigned during the project?	Were rewards assigned during the project?
Communication	How were the performance measured and shared?	How were the performance measured and shared?	How were the performance measured and shared?
Personal commitment to the project	What was your motivation to commit to the project? And what about employees?	What was your motivation to commit to the project?	What was your motivation to commit to the project?
Leadership	How did you interact with line operators or supervisors during the project?	How did you interact with line operators or managers during the project?	How did you interact with line operators or managers during the project?
Kaizen Event	Talk about the project, what was it about, how was it implemented… etc.	Talk about the project, what was it about, how was it implemented… etc.	Talk about the project, what was it about, how was it implemented… etc.

Table 1: Interview protocol

After a brief presentation asked to each respondent, almost each topic was covered by at least one question. Despite one main variable of interest being attached to each question, the semi-structured interview protocol allows the interviewee to move the discussion also to other topics. This may be useful in getting a deeper understanding of the project's dynamics, and to get an idea of what practices the interviewee considers to have been more relevant. To be able to answer to the Research Question 2, which is about the different perception the different hierarchical levels have of the soft lean practices adopted in the project implementation, almost the exact same questions have been proposed to each interviewee. Interview with the top manager lasted for almost an hour; then, one shift supervisor and two line supervisors were interviewed, for a duration of almost 30-45 minutes each.

3.6. Interview coding

Coding consists in labelling a paragraph or a part of the text to synthetize what is written and to extract information from a piece of data. It enables to synthetize the unstructured data coming from the interviews' transcription into more structured information useful for the analysis.

For this study, a hybrid approach to coding was applied. Indeed, the first step in coding the interviews was to assess whether the variables previously defined from literature were present: in this stage, the coding was deductive. However, the author left room for new possible variables to be extracted from interviews in an inductive way. This was due to the flexibility given by the semi-structured interview protocol chosen for the research, offering the interviewee the possibility to talk freely about topics others than the one that were mainly addressed by each question.

Excerpts from interviews were categorized into first-order concepts. This was done to find recurrent themes or patterns; indeed, many first-order concepts were present more than once and even in different interviews.

In the deductive part of the coding, first-order concepts were extracted from the transcriptions, and consequently linked to one or more variables obtained from literature.
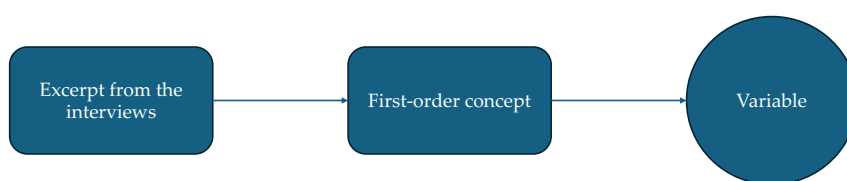

Figure 2: Deductive coding process

In the following tables, the first-order concepts found through the deductive coding are reported, with the corresponding variable they were attached to. Each first-order concept is also labelled with the hierarchical level from whose interview it was extracted. Hierarchical levels are identified with L1 in case of the top manager, L2 for the shift supervisor, L3 for the line supervisors. The first-order concepts were numbered to allow the recall during the discussion of the research questions.

Employee engagement	
First-order concept	Hierarchical level
1. **Employee involvement was crucial for the project success**	L1; L2
2. **Operators are highly considered**	L1
3. **Novelty effect**	L1
4. **Absence of judgement**	L1
5. **Employees are requested to be creative**	L1
6. **Mixed top-down and bottom-up approaches for improvement proposals**	L1; L3
7. **Operators' resistance to additional work**	L1; L2; L3
8. **Operators are afraid of performance measurement**	L1; L3
9. **Shift in mentality towards improvement**	L1; L2; L3
10. **Employees were involved since the beginning**	L1; L3
11. **Opinions from operators are listened and implemented**	L1; L3
12. **External consultants involve operators**	L1
13. **A dedicated team was set up for the project duration**	L1
14. **Engagement is given by the opportunity of bringing benefits to the company**	L2
15. **The shift supervisor has been involved marginally**	L1; L3
16. **Operators' knowledge is relevant for the process improvement**	L1; L2; L3
17. **Frequent communication between top manager and Team members**	L1; L3
18. **Employees faced obstacles in the first phase**	L2; L3
19. **Operators struggle feeling the project as theirs**	L2
20. **The focus of the project is people**	L2
21. **Need to involve someone working directly on the line**	L3
22. **Operators understand the benefits they get from the project**	L3

23. It takes time to digest new instructions	L3
24. A tangible target involves operators	L1; L3
25. Cultural shift from personal evaluation to process evaluation	L1; L3
26. Some operators struggled more adapting to the project	L3
27. Over time, line supervisors gained confidence	L3
28. Operators feel responsible for the project success	L3
29. Every proposal must undergo a feasibility check by line supervisors	L1; L3
30. The old procedures of the company are questioned	L3
31. Top management commitment is crucial for the involvement of others	L3
32. Reduced distance between hierarchical levels during the project	L1; L3

Table 2: first-order concepts for employee engagement

Top management commitment	
First-order concept	Hierarchical level
33. Active participation of the top manager	L1; L2; L3
34. Weekly alignment between top manager and team members	L1; L2; L3
35. The top manager is the project's main advocate and promoter	L2; L3
36. The project was given a high priority	L1; L2; L3
37. Top manager keeps himself constantly updated about the project	L1; L3
38. Operators feel the commitment of the top manager	L2; L3
39. The top manager physically showed in the department during the project	L1; L2; L3

Table 3: first-order concepts for top management commitment

Leadership	
First-order concept	Hierarchical level
40. Top manager has a practical knowledge of the process	L1
41. There is mutual trust between top managers and operators	L1; L3
42. The manager does not rush employees to adapt to the project	L1; L2; L3
43. The top manager actively participates to the project	L1; L2; L3
44. The top manager communicates effectively	L2; L3
45. The top manager has a clear vision for the project	L1
46. Leadership style of the top manager is successful among employees	L2; L3
47. Trust in top manager's choices	L2; L3

First-order concept	Hierarchical level
48. **The top manager is recognized charisma and leadership by workers**	L2; L3
49. **The top manager is the advocate of the project**	L2; L3
50. **The top manager is determined to complete the project**	L2
51. **The shift supervisor acts as an example for operators**	L2
52. **Operators need to be reassured by supervisors**	L2; L3
53. **Top management followed closely over the whole project duration**	L1; L2; L3
54. **Top managers delegates supervisors to directly help employees**	L3
55. **Line supervisor use dialogue with operators as mean to help them**	L3
56. **Operators are more comfortable talking about their challenges with line supervisors**	L3

Table 4: first-order concepts for leadership

Communication	
First-order concept	Hierarchical level
57. **Reduced distance between hierarchical levels during the project**	L1
58. **Waterfall communication between the different hierarchical levels**	L2
59. **Employees were informed since the beginning about the project**	L1; L3
60. **Weekly alignment between the Lean team members**	L1; L2; L3
61. **Continuous information flow**	L1; L3
62. **Performance measurement system**	L1; L2; L3
63. **Visual communication of results**	L1
64. **Consultants help the communication**	L1; L3
65. **Operators struggle in communication**	L2
66. **Difficulties in making the operators understand the new instructions**	L2; L3
67. **Usage of visual methods to facilitate the memorization of new procedures**	L2
68. **Communication by the top manager is effective**	L1; L2; L3
69. **Effective promotion of the project (communication of benefits for stakeholders)**	L3

Table 5: first-order concepts for communication

Teamwork	
First-order concept	Hierarchical level
70. **It's necessary to involve people at different hierarchical levels**	L1
71. **The team is made of expert and ambidextrous employees**	L1
72. **Continuous information flow between team members**	L1; L3
73. **Performance discussed within the team**	L1; L3
74. **Discussion is promoted within the team**	L1; L3
75. **Top manager is closer to employees during the project**	L1; L3
76. **Mixed top-down and bottom-up approaches for improvement proposals**	L1; L3
77. **The team brings together different perspectives**	L1; L3
78. **The team is used as a means of communication to the rest of employees**	L1; L3

Table 6: first-order concepts for teamwork

Consultants	
First-order concept	Hierarchical level
79. **Consultants help focusing on certain dimensions**	L1
80. **Consultants involve operators**	L1
81. **Consultants' point of view helps questioning the old process**	L1; L3
82. **Consultants have a deep knowledge about Lean Management**	L1
83. **Consultants have experience of other similar projects**	L1; L3
84. **Consultants had a role in setting up the performance measurement system**	L1
85. **Consultants were a link between top manager and line supervisors**	L1; L3
86. **Consultants directly proposed solutions**	L1; L3
87. **The top manager thinks consultants were crucial for the project success**	L1
88. **Consultants have a direct relation with line supervisors**	L1; L3
89. **Consultants have a role in explaining the project to employees and in training**	L1; L3

Table 7: first-order concepts for consultants

Working conditions	
First-order concept	Hierarchical level
90. Operators are made more responsible	L1; L2; L3
91. Operators' resistance to the additional work	L2; L3
92. The improvement of operators' tasks is a focus of the project	L1; L3
93. Supervisors must manage more situations and unforeseen events	L2; L3

Table 8: first-order concepts for working conditions

Training	
First-order concept	Hierarchical level
94. Training for manager was not formalized	L1
95. The shift supervisor did not receive any training	L2
96. Line supervisors received a formalized training well-narrowed on the project	L1; L3
97. Consultants performed training for line supervisors in the Lean Team	L1, L3
98. Consultants have a deep knowledge about Lean Management	L1
99. Consultants have experience of other similar projects	L1

Table 9: first-order concepts for training

Top-Down and Bottom-Up Approach	
First-order concept	Hierarchical level
100. Requests from operators are listened and implemented	L1; L2; L3
101. Mixed top-down and bottom-up approaches for proposals of improvement	L1; L3
102. Decisions and directives come from the top manager	L2

Table 10: first-order concepts for top-down and bottom-up approach

Kaizen event	
First-order concept	Hierarchical level
103. The waste perception was the input for the project launch	L1; L2; L3
104. Kaizen event is a boost to focus on certain dimensions/problems	L2; L3
105. Kaizen event is an extraordinary situation for the company	L1; L3
106. Performance must be maintained in the future	L2; L3

Table 11: first-order concepts for kaizen event

Rewards	
First-order concept	Hierarchical level
107. No rewards of any kind were assigned during the project duration	L1

Table 12: first-order concepts for rewards

After having performed the deductive coding, there were still a few first-order concepts that remain unattached to any variable. Indeed, a part of the discussion referred to the main target of the project, which was the improvement of eco-efficiency performance. As previously explained, this performance includes the improvement of parameter which measure an impact on the external environment (in this case, the plastic material used in the whole process). Therefore, a new variable was defined in an inductive way: the "Environmental Commitment". According to Gavronski et al. (2011), environmental commitment refers to the ability of a business to improve its operations to improve its environmental performance. More in detail, referring to the single individual, a manager that is environmental committed is more aware of the necessity to undertake initiatives to reduce environmental impact of the company because of the financial and non-financial benefits that follow (Tilleman, 2012). Generalizing, an individual shows environmental commitment if he is involved in the initiatives that have as a target the improvement of environmental performances.

Environmental Commitment	
First-order concept	Hierarchical level
108. Sensitivity to the environmental topic	L1; L3
109. Environmental sustainability is a motivation for employees	L1; L3
110. Alignment of the environmental goals with financial goals	L1
111. The strategic direction set by the company is to be more environmentally sustainable	L1

Table 13: first-order concepts for environmental commitment

Since the project implemented provided for the adoption of Lean principles within the department, this was also a topic of discussion of the interviews. In particular, the top manager spoke about this theme in a formal way; however, also the shift supervisor and the line supervisors expressed non explicitly many concepts that can be ascribed to Lean culture. Therefore, another variable was defined: "Continuous Improvement culture". This variable contained all those first-order concepts that refer to general principles of Lean without being specifically linked to any of the previous mentioned soft practices. We can consider this variable as an umbrella one, including all those first-order concepts whose main underlying theme was the Lean philosophy in general and its comprehension within the department; it gives a good proxy of the maturity level of the Lean adoption within the department; it tells about the understanding and trust that the three hierarchical levels have in general of the Lean Approach.

Continuous Improvement Culture	
First-order concept	Hierarchical level
112. The top manager understands Lean Culture	L1
113. Top manager believes in Lean approach	L1
114. The company direction is adopting Lean in every plant	L1
115. Root causes' research	L1; L3
116. Benefits of lean adoption are multidimensional within the company	L1
117. Visual communication	L1; L2; L3
118. Continuous improvement	L1; L3

119.Kaizen event	L1
120.Hierarchy is flattened for the project duration	L1
121.Shift in mentality towards continuous improvement	L1; L2; L3
122.The project implementation changed the operators' mindset	L2
123.Lean Culture comprehension by employees	L2
124.Confident and proactive attitude by operators better suited the project	L3
125.More responsibility is given to line supervisors (job empowerment)	L1; L3
126.The focus of the project is the people	L2

Table 14: first-order concepts for continuous improvement culture

All the first-order concepts above alternatively regard the high-level adoption of Lean within the plant under analysis or methods of approaching the project that are aligned with Lean philosophy. For example, root causes' research is one of the phases of the A3 methodology, that refers to Lean approach. Also, the centrality of people in Lean transformation is recognized in literature by Chakravarty (2009). Powell and Coughlan (2020) identify two stages of the Lean implementation in a company, and after a first one in which the "technical" tools of Lean are adopted, the second stage shows an initial change in the operators' mindset as stated in first-order concepts [121], [122], [123]. Paro and Girolamo (2017) affirm that a defined hierarchical structure, as in the department under analysis, increases the chances of a long-lasting Lean transformation. However, results by Alavi (2003) shows that a flattening of the organization because of the reduced perceived distance from the top manager and the empowerment of employees' job is normal during the implementation of a Lean initiative and hence as the level of maturity of the Lean Culture increases, confirming the first-order concepts [120] and [125].

Given the nature of the information regarding training for managers and employees, very well defined, the variable "Training" was detached from "Job empowerment" for the sake of clarity, and this latter was indeed included in the "Continuous improvement culture" as it was just explained. Financial and non-financial rewards were joint together for the very little information regarding this topic and the absence of these soft practices in the project; the same was done for "Top-Down" and "Bottom-Up approach", that were joint together to

highlight mainly the differential effects with respect to traditional situation in which the project is top-down. The author considered "Non-Financial Rewards" as "explicit" ways to glorify the work of someone; indeed, it is obvious that there is a sense of pride that the individual feels when performing well a new or challenging task. However, this was not considered of interest for the study. Finally, the variable "Unionized Workforce" was not taken in consideration for the same reason.

Finally, after the coding, the variables object of the analysis were the following.

1. Employee engagement
2. Top management commitment
3. Leadership
4. Communication
5. Teamwork
6. Consultants
7. Working conditions
8. Training
9. Top-down and Bottom-up approach
10. Kaizen event
11. Rewards
12. Environmental Commitment
13. Continuous Improvement Culture

4. Results and Discussion

The two research questions, despite having sharply distinct objectives, slightly overlap in the discussion. Indeed, they both use the first-order concepts extracted from the interviews to get to a conclusion. To answer to the first research question, the author delved into each single soft lean practice listed before. For the sake of validity, first-order concepts are reported for each practice and in the text to justify the author's statements. On the other hand, the second research question's answer was categorized according to hierarchical levels. For each hierarchical level, the author referred more deeply to the interviews to show, beyond the facts regarding how the project was implemented, and therefore qualitative information about the soft practices implemented, also the individual perception of the interviewee regarding the practices. Also, the differences in the practices' implementation among the different hierarchical levels. For both answers, quotes from the interviews were used to highlight even more the validity of a statement.

4.1. Research Question 1

RQ1: How can the critical success factors of the Lean Culture allow a company to achieve better results in terms of environmental sustainability performance?

4.1.1. Employee engagement

Employee engagement
1. Employee involvement was crucial for the project success
2. Operators are highly considered
3. Novelty effect
4. Absence of judgement
5. Employees are requested to be creative

6.	**Mixed top-down and bottom-up approaches for improvement proposals**
7.	**Operators' resistance to additional work**
8.	**Operators are afraid of performance measurement**
9.	**Shift in mentality towards improvement**
10.	**Employees were involved since the beginning**
11.	**Opinions from operators are listened and implemented**
12.	**External consultants involve operators**
13.	**A dedicated team was set up for the project duration**
14.	**Engagement is given by the opportunity of bringing benefits to the company**
15.	**The shift supervisor has been involved marginally**
16.	**Operators' knowledge is relevant for the process improvement**
17.	**Frequent communication between top manager and Team members**
18.	**Employees faced obstacles in the first phase**
19.	**Operators struggle feeling the project as theirs**
20.	**The focus of the project is people**
21.	**Need to involve someone working directly on the line**
22.	**Operators understand the benefits they get from the project**
23.	**It takes time to digest new instructions**
24.	**A tangible target involves operators**
25.	**Cultural shift from personal evaluation to process evaluation**
26.	**Some operators struggled more adapting to the project**
27.	**Over time, line supervisors gained confidence**
28.	**Operators feel responsible for the project success**
29.	**Every proposal must undergo a feasibility check by line supervisors**
30.	**The old procedures of the company are questioned**
31.	**Top management commitment is crucial for the involvement of others**
32.	**Reduced distance between hierarchical levels during the project**

Given their role of proximity with respect to the process, since they are the ones actually working on the line, operators were crucial to the project and their involvement was one of the keys of its success [1] [2] [21]. Indeed, they were in charge of collecting data and justify them, hence offering the input for the root cause analysis and the development of

countermeasures. Also, they presented a great degree of knowledge about the procedures [16]. Each proposal had to undergo their feasibility check, in the sense that they were able to tell whether a new procedure could fit and be useful if introduced within the process or not [29]. Moreover, according to the interviews, operators were involved since the beginning, the launch phase of the project, which helped make them feel relevant for its success [10].

Motivation played a crucial role in the workers' involvement. According to the interviews, employees were motivated by the fact that the project success would have meant an improvement in the working conditions of them and their colleagues [22], because of a simplified process to deal with and other targets like the number of plastic bags that had to be thrown away at the end of the shift. An additional motivation was the sensitivity to environmental issue; finally, the fact that the way of work promoted by the project brought to less wastes, which is something that benefits the environment but in particular the company [14]. Therefore, they were given more responsibility for their work.

Then there is the novelty effect [3]: from the interviews, the fact that the project was new and broke the usual routine emerged as a reason for a higher feeling of involvement of employees. Those belonging to the Lean Team were asked to meet at least weekly the top manager in another place (the conference room) when communicating and discussing the data about the project [3] [13] [17] [17]: this resulted in them feeling more important, and consequently responsible about the project outcome [28]. It also had an impact on those employees who were not asked to attend the meetings with top manager, that felt the "extraordinary" nature of the project.

Workers were asked to be creative during the project [5]. Creativity in this case meant that they had to find ways to improve the process and, therefore, to ultimately reduce the waste generated. This could be possible only if employees were actually involved; and the more they had the opportunity to be creative, the more they felt motivated about the project. Indeed, the possibility to challenge the status quo, represented by the traditional way of working in the company, through their own insights, made them more responsible, more engaged within the project itself and the company in general.

Strictly linked with the concept of creativity, a mixed top-down and bottom-up approach to propose new solutions came up from the interviews [6]: the usually unquestionable ideas of the top manager, or in general coming from the above, could be not only discussed, but also adjusted with counterproposals from the employees [11] [32]. The solutions that were ultimately implemented were the outcome of a team discussion, and not decided by the top manager autonomously without being questioned. In addition to that, some of the process improvements came directly from the opinions and ideas of operators, meaning that they were listened, and their point of view was taken in consideration. The possibility of seeing their proposals realized, and more widely bringing benefits to the whole company built commitment and responsibility within the employees [30].

External consultants also had a role in engaging employees [12]. Indeed, at the beginning of the project they were a massive stakeholder. They presented the project to employees and communicated with them quite frequently; even their presence in the department was a way to keep the project goals on top of the priority list in the minds of employees. Since the top manager could not be dedicated to the project for all his time, in his absence consultants acted in his place and kept employees engaged and their attention high towards the project.

There were also some resistances that hindered the engagement of employees to the project. For example, a first order concept that came up from interviews was the absence of judgement towards employees, that deals with the freedom to express their own opinion [4]. This is both a matter of engagement and resistance: to be able to give a positive contribution to the project, line supervisors had to be free and feel comfortable enough within their environment in order to express their opinions and ideas on how to improve the procedures. It was difficult for them to align to this mindset, since they were afraid of the top manager judgement and were not used to share their opinions on how they worked; in the end, however, they were able to contribute with their own proposals to the project [27]. The absence of judgement was crucial also in overcoming the employees' resistances when discussing the reasons for the out-of-range values [8][4]. Indeed, the data about the wastes collected on the line were discussed with the top manager; and each data whose

value was out of the range established as the "acceptable variation" had to be justified and discussed. In this situation, employees had a hard time understanding that the discussion was about the process and not about themselves. They felt they were being evaluated as workers, and therefore, their justifications, at least in the beginning, were given with the goal not to be held responsible for a mistake instead of making a process's problem emerge [25]. In general, we may say that the majority of employees were to some degree insecure and were afraid to make mistakes.

Workers showed a different resistance to the additional work also depending on their own degree of ambidexterity [7]. Indeed, some had a better attitude than others in performing new tasks or adapting to the changes in the ones they were already performing [26]. During the project, employees were asked to collect data, which was a totally new task to be performed alongside the usual ones. Then, as solutions were proposed, their implementation caused changes to the traditional procedures: this was a problem for those who respond worse to changes and had difficulties in remembering the new instructions or performing them. From the interviews, it emerged that some employees are simply slower than others in digesting the new information. It may be a matter of personality or language spoken. The time that employees take to really make the change effective differs for each one of them. Moreover, they find it difficult to introduce the new instructions in their routine [23].

Finally, employees did not immediately understand the need for the project and had difficulties in feeling the project as their own [18]. Some of them lived the project as forced, they could not feel responsible for it and therefore were not motivated to commit to it. However, over time they adapted to the new way of work, also thanks to the lead of the top manager, who followed as close as possible the implementation, and of the supervisors that were daily supports for struggling operators [22] [31].

4.1.2. Top management commitment

Top manager commitment
33. Active participation of the top manager
34. Weekly alignment between top manager and team members
35. The top manager is the project's main advocate and promoter
36. The project was given a high priority
37. Top manager keeps himself constantly updated about the project
38. Operators feel the commitment of the top manager
39. The top manager physically showed in the department during the project

The top manager was clearly the first advocate and promoter of the project [35]. He organized every activity to launch it and gave it a high priority which was perceived and therefore shared by employees [36]. He set the direction, decided who was part of the dedicated Lean team and how the communication occurred within it; then involved external consultants to help with the implementation. He was unanimously considered by employees the reason why the project ended up being successful.

What arose from the interviews was the active and direct participation of the top manager [33]. He shows a deep knowledge and familiarity with the line and the process. Therefore, he was able to propose improvements that were contingent to the specific stage of the line and to assess the feasibility of others' proposals directly. Moreover, he was able and credible in guiding the employees in their work, and this was also one of the reasons why employees did not feel distant to him. His closeness to employees and the fact of working next to them, expressed by frequently also showing up in the shop-floor, sometimes more as a "colleague" than a boss, was a way to involve them and make them understand the importance of the project [38] [39]. To generalize, we may say that the top management commitment was crucial to engage employees in the project activities.

The top manager kept himself constantly informed about the project, although he had different priorities and other aspects of the department to manage [37]. Hence the weekly

alignment with the Lean Team: each week, some hours were allocated to meet with the employees of the Lean Team and discuss the data collected in the previous week [34].

Also, the top manager trusts the Lean Approach. The top manager truly believed that Lean approach could bring benefits to the company; this belief was perceived by employees and helped their involvement [35] [38].

4.1.3. Leadership

First-order concept
40. Top manager has a practical knowledge of the process
41. There is mutual trust between top managers and operators
42. The manager does not rush employees to adapt to the project
43. The top manager actively participates to the project
44. The top manager communicates effectively
45. The top manager has a clear vision for the project
46. Leadership style of the top manager is successful among employees
47. Trust in top manager's choices
48. The top manager is recognized charisma and leadership by workers
49. The top manager is the advocate of the project
50. The top manager is determined to complete the project
51. The shift supervisor acts as an example for operators
52. Operators need to be reassured by supervisors
53. Top management followed closely over the whole project duration
54. Top managers delegates supervisors to directly help employees
55. Line supervisor use dialogue with operators as mean to help them
56. Operators are more comfortable talking about their challenges with line supervisors

"Respect for people" is one of the Lean management philosophy pillars. This implies respect for people's opinions, for their limits and for the challenges they face in their work.

We may say that the project implementation temporarily flattened the company hierarchical structure, since within the Lean Team, the top manager worked very closely to employees,

adopting a leadership style that can be defined as participative, in the sense that the opinions and ideas of employees are not only respected and listened, but requested in order to add value to the project [43] [46].

As for the respect of the limits of some employees, the top manager, and as a consequence all the supervisors, was patient in giving them time to digest the instructions received and to adapt to the new procedures [42] [44]: this proved to be a successful method in overcoming the resistances of the employees, and also in building trust in the top manager [41] [47]. The knowledge the top manager had about the process, as previously mentioned, made him gain respect among operators [40].

In general, the top manager is recognized his charisma and his talent by employees [48]. He has a clear vision on the target to reach with the project implementation, and according to the words of employees "the project was in the end successful because the top manager was determined to overcome difficulties in order to complete it" [45] [49] [50].

Supervisors show attachment, admiration towards the manager and above all they trust his choice to launch the project [47]. They are his trusted workers and for this reason the top manager delegates them a part of the leadership. One reason could be that Lean Leadership provides for making themselves superfluous in the process; and the fact that Lean Leaders should works at the Gemba with a low leader-to employee ratio (Dombrowski, Mielke, 2014). Supervisors have the time to work directly with line operators, by talking to them and reassuring. Line supervisors explain that their way of dealing with a worker facing a challenge was "talking to them, staying close and reassuring them". On the other hand, also operators feel more comfortable discussing their struggles with the supervisors [51] [52] [55] [56]. Therefore, this leadership delegation was crucial in overcoming some employees' resistances.

4.1.4. Communication

Communication
57. **Reduced distance between hierarchical levels during the project**
58. **Waterfall communication between the different hierarchical levels**
59. **Employees were informed since the beginning about the project**
60. **Weekly alignment between the Lean team members**
61. **Continuous information flow**
62. **Performance measurement system**
63. **Visual communication of results**
64. **Consultants help the communication**
65. **Operators struggle in communication**
66. **Difficulties in making the operators understand the new instructions**
67. **Usage of visual methods to facilitate the memorization of new procedures**
68. **Communication by the top manager is effective**
69. **Effective promotion of the project (communication of benefits for stakeholders)**

Thanks to the interviews, it was possible to draw a map of the interaction between the stakeholders of the project (communication map). In light blue are highlighted those stakeholders that belong to the Lean Team. The maintenance manager was in frequent touch with the top manager of the department given the fact that each process change had a reflection on the machinery in charge of that process. Therefore, the design had to be done cooperatively. This is an example of the soft practice that in the framework by Che Mamat et al. (2017) is called "supplier involvement".
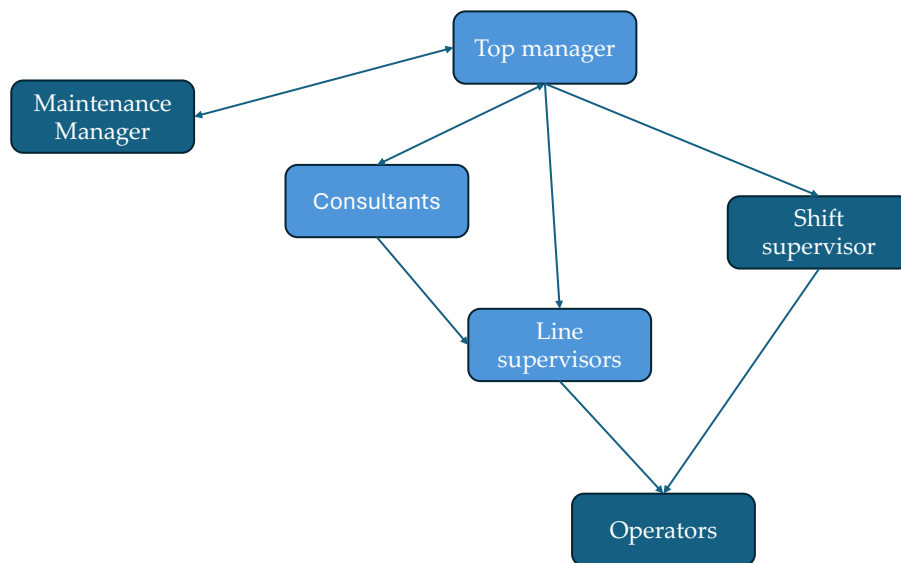
Figure 3: Communication Map of the department. In light blue, the members of the Lean Team

As it Is shown in the picture, the communication scheme was a waterfall [58]: the top manager communicated directly with the line supervisor belonging to the Lean Team; through them, the instructions and information were shared among all the other operators on the line. The team was therefore an effective vehicle of information beyond being the "engine" where solutions and ideas were generated. The top manager makes it very clear by saying that "the communication expands like a spot of oil", in an efficient way that is very similar to the delegation explained for the "leadership" variable.

In the launch phase, the reasons behind the project were clearly explained by the top manager, also thanks to the consultants which facilitated the communication channel [59] [64] [68].

The promotion of the project was good among employees since it focused on finding that one benchmark that directly affected the work of employees and that was tangible to them; hence, a pain for their job to be solved [69]. In this case, it was the number of garbage bags that had to be thrown away by employees at the end of the shift. Reducing this number was a goal that would have been more popular among all the employees with respect to the lower costs that the project may bring, or the environmental impact of plastic waste [63] [68].

The communication among the top manager and the employees belonging to the Team was frequent, as previously mentioned [60] [61]: this was effective in keeping the employees engaged and to clarify and keep in mind the goals of the project. The meetings were also the place where the knowledge transferred between the two hierarchical levels, since working together and discussing the process so frequently allowed everybody to learn from each other in a way that is usually not possible [57]. The communication had to be transparent: indeed, as explained before, there was the need to justify exactly every out-of-range data to identify its root cause and propose a solution; anyway, employees showed some kind of resistance in justifying errors, since they were afraid to be blamed for them [65]. They are indeed used to the tendency to protect themselves and their colleagues. In the end, however, they learnt to focus on the process only, considering the problems that emerged as an opportunity of improvement more than a judgement on their individual performance.

For what concerns the performance measurement system, as it was already briefly mentioned before, the data collected on the line each week regarding the number of wastes that occurred was the input of the project [62]. Indeed, before the measurement began, in the company there was only the perception of the waste; only later the perception could be verified. Data measurement and sharing was crucial to the communication of project goals among the team members. Indeed, the weekly meeting consisted mainly of observation and discussion about the values that were not aligned with the target of the company. Data were visualized in an easy way to be clear at a glance, as it is common in the Lean Culture, through excel files and graphs shown on a maxi-screen [63]. Each out-of-range value had attached the justification for it, that had to be written by hand by the employees since there was yet no computerized system to collect them. Every data had to be discussed also because of the frequent errors in the measurement and the unclearness of justifications.

The centrality of the performance measurement system to share the goals among all the members of the Lean Team and subsequently to all the employees is understood better considering that when the data stopped being collected, few months after the project started and there were already signs of improvement, the performances targeted by the project

clearly got worse again. Therefore, the data collection was restarted not to be stopped again. Also, the visualization of actual performances compared to the project goals each week was an effective way to boost the focus of employees towards the project.

Relevant to the memorizing of the new procedures by line operators were the formalization of the new standardized procedures that were output of the project, and the usage of visual methods like boards and signs [66] [67].

4.1.5. Teamwork

Teamwork
70. It's necessary to involve people at different hierarchical levels
71. The team is made of expert and ambidextrous employees
72. Continuous information flow between team members
73. Performance discussed within the team
74. Discussion is promoted within the team
75. Top manager is closer to employees during the project
76. Mixed top-down and bottom-up approaches for improvement proposals
77. The team brings together different perspectives
78. The team is used as a means of communication to the rest of employees

The Lean and Sustainability project needed to involve people at different hierarchical levels [70]: indeed, it involved the observation of the process, which could be better performed by involving employees; then, after the weekly performance assessment, the discussion, proposal and implementation of new solutions, which in the end have to be checked and endorsed by the top management [72] [73] [77]. Obviously, the top manager was the one in charge of setting the direction and devoting resources to the project; employees needed to be involved to inform the top manager about the problems that they spotted on the line; then to receive the instructions when a new procedure was introduced and to make the changes effective [76]. Anyway, the goal of the teamwork is also the one to favor creativity and the generation of solutions that couldn't be achieved individually: in this sense, the

team was successful, because, as we previously said, a lot of the implemented proposals came from the mixed ideas of the team members, irrespective of their job [75] [77]. Moreover, it was also a way to engage as much as possible the members of the team in the project. In fact, the team was a way for the employees to be more in contact with the top manager, therefore a vehicle to transmit enthusiasm, the feeling of importance of the project and the direction set by the top manager to the other employees that were not included in the team. The top manager chose four line supervisors to make the Lean Team; these supervisors were chosen because they were from the two different stages of the line – in this perspective we may say the team is cross-functional, even if they all belong to the same department. The chosen employees were expert and showed a good degree of ambidexterity, meaning that they got comfortable faster with the new tasks given, like the data collection, or showed less resistances to the changes in the process that occurred over the project implementation [71]. For this reason, they were able to bear the fact of being in the Team, confronting with consultants and the top manager and at the same time guiding the other employees struggling with the new instructions and tasks. The line supervisors chosen for the Team showed a better degree of self-confidence, which allowed them to be proactive in the discussion with the top manager but also to exert their leadership with employees [74] [78].

4.1.6. Consultants

Consultants
79. **Consultants help focusing on certain dimensions**
80. **Consultants involve operators**
81. **Consultants' point of view helps questioning the old process**
82. **Consultants have a deep knowledge about Lean Management**
83. **Consultants have experience of other similar projects**
84. **Consultants had a role in setting up the performance measurement system**
85. **Consultants were a link between top manager and line supervisors**
86. **Consultants directly proposed solutions**
87. **The top manager thinks consultants were crucial for the project success**

88.	**Consultants have a direct relation with line supervisors**
89.	**Consultants have a role in explaining the project to employees and in training**

Having consultants with a given goal and a specific knowledge, in this case the Lean approach, available within the company was a way to boost the focus on the topic of reducing wastes for the time that these consultants were hired [79] [82]. They were, in some sense, a catalyst to the project and to the shift in mindset towards a more continuous improvement one. So, we may say that consultants helped focusing more on certain dimension.

They also helped the engagement of employees [80]. Consultants worked side by side with the line supervisors in the Lean Team and therefore they were an additional interface for employees; their presence in the department and on the line was a way to involve employees, to guide them and communicate, and also, indirectly, to force them not to drop the new procedures inherent to the project, at least in the beginning where there could be resistances to win.

Consultants were also used as a means of communication [85]. Given that they were totally aligned with the top manager and communicated with him very frequently, they acted as an additional vehicle of information between top manager and employees. They had a role in setting the training program and explaining the project at the beginning [89].

Consultants had an active participation in the project, in the sense that they proposed countermeasures to the problems found on the line [86]. What emerged the most from interviews, was that the external point of view that consultants brought to the discussion helped seeing wastes and inefficiencies of the project that could be neglected by employees or the top manager because of the so-called organizational myopia – the inability to see that something must be changed because the company is too used to it to even notice [81]. They saw procedures for the first time, and therefore their perspective is "fresh" and more capable to see the contradictions and the wastes of the process. People within the company may not see the possible improvements they see, because they never questioned their way of work over the years and may not see that something is unnecessary or avoidable. Moreover, the consultants have experience in other companies, and therefore bring to the project proposals

that have already been tested in other environments, best practices whose value has already been proved [83]. Also, their experience and methodology were important in setting up the mechanism to collect and synthetize data, since there was no one in the department with knowledge or expertise in this realm [84].

Finally, the fact that they were Lean experts has helped the whole company in shifting to the mentality of making problems emerge to be solved instead of hiding them towards layers of inefficiencies [82].

4.1.7. Working conditions

Working conditions
90. Operators are made more responsible
91. Operators' resistance to the additional work
92. The improvement of operators' tasks is a focus of the project
93.   Supervisors must manage more situations and unforeseen events

Change of the working conditions were due to the additional responsibilities assigned to the supervisors and to workers on the line [90]. In the beginning, employees faced the stress of the new tasks to be performed; also, their traditional procedures and routines were questioned and then changed as the project carried on [91]. However, employees were given the needed time to overcome this stress. According to the interviews, some of them faced the challenge with enthusiasm while others had a really hard time understanding the reasons for the project and digesting the new instructions.

Before the launch of the project, some of the procedures were overrated to make it easier not to make mistakes. For example, many plastic bowls were left empty as a sign for the employees on the next stage of the line to change the set up as the product was about to change. Since the project aims to eliminate inefficiencies, this may result in an additional stress for the employees; in fact, in dealing with a faster process they must be more careful and have less breaks over the passage of the product on the line.

However, the improvement of the working conditions of employees is one of the goals of the Lean project, and indeed the biggest motivation for employees to commit to its implementation [92].

In the end, one of the improvements was the reduction of the garbage bags, which was a physical tough task for employees, in particular considering that most of them are women. Also, some components were located in places where it is way faster and less painful for employees to take them; and we must keep in mind that many of the cases in which the line stops working may result in parts of the plastic film that are wasted.

More generally, a lot of changes resulted in simplified procedures for the worker, requiring less physical fatigue or movement or time to be performed. According to the words of the top manager, "when this happens, the operator is satisfied about it and increases its trust towards the project and more in general towards the top manager; in the next improvement opportunity, he is willing to collaborate more".

Regarding the situation of the line supervisors, they had to face the stress of managing the operators in facing the challenge of the project and the anxiety of change. This resulted in more tasks; it was however well handled by them, since gratification was higher than the stress provoked by the project [93].

4.1.8. Training

Training
94. **Training for manager was not formalized**
95. **The shift supervisor did not receive any training**
96. **Line supervisors received a formalized training well-narrowed on the project**
97. **Consultants performed training for line supervisors in the Lean Team**
98. **Consultants have a deep knowledge about Lean Management**
99. **Consultants have experience of other similar projects**

A form of training was performed at the beginning for both the top manager and employees, although not always formalized (for managers), and very much focused on the project [94] [96]. As it is obvious, different levels received different forms of training (less formalized for

the top manager). Consultants had a role in this stage, given their solid background with Lean; also, their presence throughout the project implementation made up for the fact that the whole department was completely new to the Lean approach [97] [98] [99].

4.1.9. Top-Down/Bottom-Up Approach

Top-Down/Bottom-Up Approach
100.Requests from operators are listened and implemented
101.Mixed top-down and bottom-up approaches for proposals of improvement
102.Decisions and directives come from the top manager

The approach was unanimously defined by all the interviewee a hybrid one, mixed between a top-down and a bottom-up approach [101]. Indeed, opinions by the line supervisors involved in the Lean Team are not only listened and implemented, but also warmly requested by the top manager [100]. Indeed, the whole point of the project is to spot every possible source of inefficiency in the process, and this is possible only if workers are involved at a higher level. Decisions and directives obviously come from the top manager; he has the final word on every improvement to be implemented [102]. No decision-making power was observed in the lower hierarchical levels over the research.

4.1.10. Kaizen events

Kaizen events
103.The waste perception was the input for the project launch
104.Kaizen event is a boost to focus on certain dimensions/problems
105.Kaizen event is an extraordinary situation for the company
106. Performance must be maintained in the future

The whole Lean and Sustainability project carried on by the company can be considered a Kaizen event – it was indeed a focused project aimed at bringing quick improvements in the realm of plastic bowls wastes, and with a limited number of additional resources invested. For a certain period, the company allocated a lot of time and resources to the improvement of the plastic bowls wastes performances; and it was successful. In general, the main goal of a Kaizen event is to shift the focus on something specific [104].

The input for the project was the perception of a huge waste in the department, which had to be verified through data collection. One of the reasons of the perception was the high number of plastic bags already mentioned that were thrown away at the end of each shift [103].

The Lean project was the way the company had to really assess whether the perception on the waste was true or not. The Kaizen event, in this case, was the breakthrough, thanks to the analytical approach adopted: data collection, evaluation, proposals and implementation of new solutions and then a new data collection ex post to assess whether an improvement had occurred [104]. In this perspective, it is evident that consultants were crucial for the kaizen event to happen given their knowledge and methodological approach that could not have been adopted otherwise.

The interviews showed how the Kaizen event (Lean project) was considered important, as otherwise the company would have remained in the position of having a perception of a waste without being able to tackle it.

The Lean project was a way to engage more employees because it was extraordinary: indeed, it brought the presence of external consultants in the company, and moreover, it gave employees to be closer to the top manager [105].

However, Kaizen is the philosophy of continuous improvement. The project should be the beginning of a process of continuous improvement. What we know for sure is that, after a few months where positive results were registered on the side of plastic bowls wastes, the data collection stopped, and this is considered one of the reasons why shortly thereafter the performances dropped. Indeed, the measurement restarted immediately. Moreover, from the interviews, it emerged the fact that, although the period of maximum focus on these

performances came to an end, everyone thinks that the search for possible improvements aimed at reducing plastic wastes should continue also in the future [106].

4.1.11. Rewards

Rewards
107. No rewards of any kind were assigned during the project duration

No financial nor formal non-financial rewards were assigned to employees over the project implementation [107]. The only rewards that were mentioned through the interviews were those benefits brought to all the stakeholders by a successful project implementation; these cannot be considered rewards because of how the variable were defined in the methodology; instead, they refer more to job empowerment, motivations to commit to the project or gratification that brings to improved working conditions.

4.1.12. Environmental commitment

Environmental Commitment
108. Sensitivity to the environmental topic
109. Environmental sustainability is a motivation for employees
110. Alignment of the environmental goals with financial goals
111. The strategic direction set by the company is to be more environmentally sustainable

The environmental commitment comes from the holding management, setting the direction for all the plants belonging to the group. They want to make all their plants more sustainable, also because of the high brand recognizability and the specific industry in which the company operates in (food sector). To do this, they spotted Lean as the paradigm which can bring steps forward from an environmental point of view while also improving the financial dimension of the company [110] [111]. So, they started to implement this

approach in some of their plants and finally got to the one that is object of the case study. Therefore, there was already a clear understanding of the benefits that the implementation of Lean could bring to the environmental sustainability of the plant. Hence, it is possible to assert that environmental commitment was one of the root determinants that led to the adoption of Lean Management.

Then, the sensitivity to the environmental topic was used to motivate and involve the people within the project, and it was more effective on the lower hierarchical levels given their reduced sensitivity to the finances of the company [108] [109]. However, the environmental sustainability was not necessarily the main motivation for the people involved in the project; instead, it was a mostly a further reason for them to commit to it given the fact that there were already issues addressed that were considered closer to their daily activity. It is important to remember though that each stakeholder had clear the idea that the success of the project was tightly linked with the improvement of the plastic wastes' performance.

4.1.13. Continuous Improvement Culture

Continuous Improvement Culture
112. The top manager understands Lean Culture
113. Top manager believes in Lean approach
114. The company direction is adopting Lean in every plant
115. Root causes' research
116. Benefits of Lean adoption are multidimensional within the company
117. Visual communication
118. Continuous improvement
119. Kaizen event
120. Hierarchy is flattened for the project duration
121. Shift in mentality towards continuous improvement
122. The project implementation changed the operators' mindset
123. Lean Culture comprehension by employees
124. Confident and proactive attitude by operators better suited the project
125. More responsibility is given to line supervisors (job empowerment)

Many concepts expressed during the interviews are clues of the fact that after the project the Lean Culture is starting to breach the traditional mindset of people within the company [118]. First, it is a shared thought that the project is just the beginning of a journey of continuous adjustment of processes to constantly improve the company's performances. There was a shift in mentality towards improvement: indeed the constant challenging of how the processes are traditionally performed was assimilated by the people in the department; and given the satisfaction that the easing and speeding of procedures brought, workers will be more available in the future to accept a change, and also to help and be proactive with the search for a new solution [121] [122] [125].

Also, the flattening of the organizational structure during the project is typical of Lean, as reported in literature by Alavi (2003): indeed, the line supervisors reported directly to the top manager, while the shift supervisor remained in a marginal position during the implementation [120]. The usage of visual methods to share data and results within the Lean Team is another characteristic of the Lean approach [117].

Above all, the biggest legacy of the Lean project is the centrality of operators [126]: in an ideal Lean plant, employees should be empowered, more autonomous and responsible of their work, being able to detect problems and propose solutions to solve them. This is the transformation that began to happen in the company with the line supervisors that were the most engaged by the project [125].

4.1.14. Relations between Soft Lean practices

To answer comprehensively to the research question and therefore to understand which was the impact that each of these variables had on the environmental sustainability performances of the company, we use the following tables.

For each variable previously analyzed, its main impact on the final performance improvement is summarized. Given the nature of our variables, it is easier to compare the

Lean project with a non-Lean one (base case), that is simplistic assumed to be a project in which initiatives and decisions are taken top-down and passively accepted by employees. The variables were divided in four layers, according to how they are affected by or impact the other variables. This is possible only assuming that by using the information extracted by the interviews, it is possible to deduce a cause-effect relation between the variables studied. For example, the first-order concept 31, "Top manager commitment is crucial for the involvement of others", defines a clear causality relation between the commitment of the top manager and the involvement of employees.
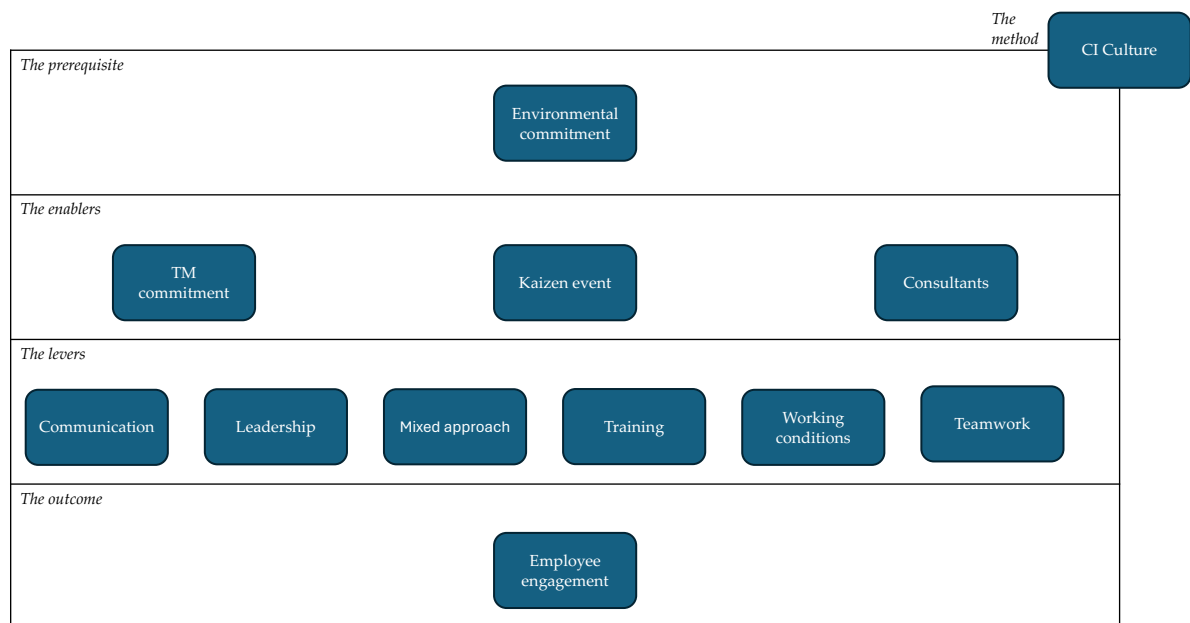

Figure 4: the map of the four layers of variables. CI culture is considered in parallel with all the other variables

In the first layer (the "outcome"), we find the "employee engagement", a variable that is mostly affected by other variables and whose impact is mainly on the final target of the project, which is the improvement of the environmental performance.

Variable	Impact
Employee engagement	Employee engagement clearly defines the separation of the Lean project from a non-Lean one. In this case, employees are given the chance to have a positive contribution to the project, by directly proposing solutions or by improving those coming from the top management, for example. Therefore, it is possible to say that the involvement of employees has a positive and direct impact on the performances of eco-efficiency since there were improvements that wouldn't have been implemented in a base case. This is true particularly for the line supervisors. On the other hand, there were resistances that hindered or sloweddown the project implementation. Indeed, regardless of who was that proposed the solution, in the end, the new procedures must be performed by line operators: results cannot be achieved if instructions are not digested and therefore are not followed correctly

Table 15: first layer

Figure 5: the impact of the first layer on the environmental performance

In the second layer (the "levers") we find those variables that mainly positively affect the employee engagement or help in overcoming the employees' resistances hindering the involvement of workers. These variables are still impacted by those defined as the third level variables. For these two reasons combined, they can be considered as levers to be exploited in a Lean project to make it successful.

Variable	Impact
Training	Although not being discussed in depth by the interviewees, a sort of training was performed for the top manager and for line supervisors. It was important to overcome resistances, by explaining how the project would have been implemented and therefore reducing the anxiety and uncertainty brought by the new method of work, and to engage employees.
Teamwork	The Dedicated Lean Team was probably the highlight of the whole project and had a major role in facilitating the communication between the stakeholders and in involving employees.
Communication	Communication had an impact both in involving employees, through the project promotion and the performance measurement system, and in overcoming the employee resistances, thanks to its clearness, frequency, and its visual nature.
Leadership	Leadership, very similarly to communication, had the effect of involving employees and overcoming their resistances. This latter was achieved at every level with patience, by letting workers get used to the project methods and digest the new instructions. The launch of the project made the adoption of this practice more necessary, to overcome the challenges arising with it.
Working conditions	The launch of the project initially brought stress in the employees working on the line, given the changes it brought to their traditional procedures and the unusual request to collect data. Therefore, in the beginning at least, working conditions generated resistances among employees. As the project implementation went on, however, it is possible to observe that there were definitely improvements of the procedures, and this brought satisfaction among workers. Therefore, working conditions' improvement clearly helped the engagement of employees in the process.

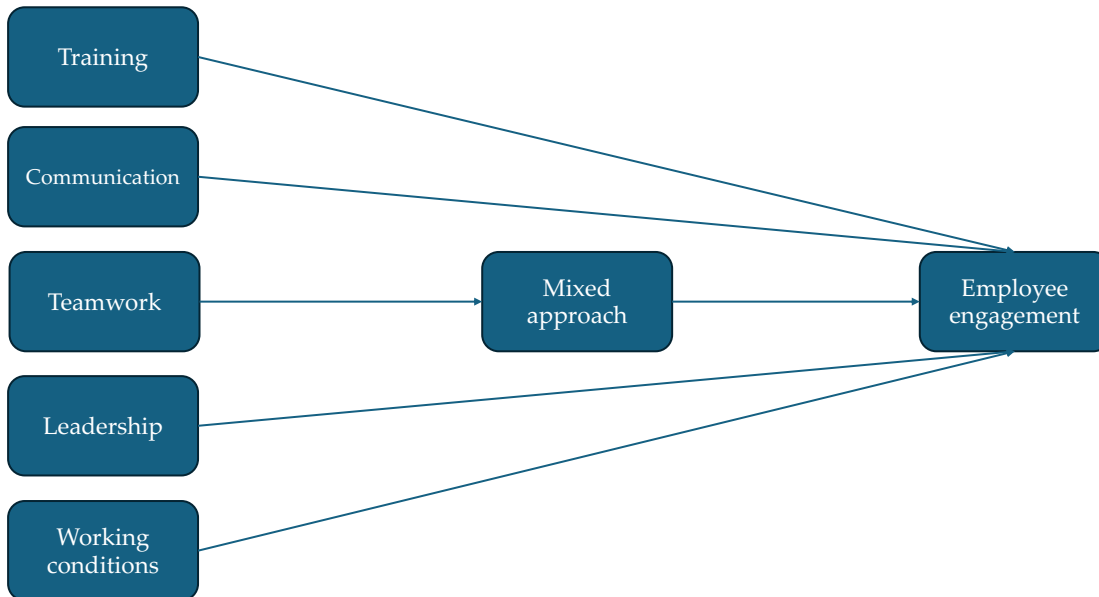| Mixed Approach	The mixed top-down and bottom up-approach had the main role to involve employees in the definition of the new procedures.

Table 16: second layer

Figure 6: the second layer's impact on the first layer of variables. The mixed approach is enabled by the teamwork and acts directly on the employee engagement

In the third layer (the "enablers"), we find the following variables. These are considered necessary for the presence of the variables contained in the second layer.

Variable	Impact
Top management commitment	The commitment of the top manager turned out to be one of the reasons why the employees were so involved in the project. In particular, it has made the communication more frequent and effective possible. Moreover, the fact that the top manager was committed increased the effectiveness of the Dedicated Lean Team formed for the project, given the fact that he was a "member".

|	
Consultants	First, consultants had a role in directly proposing possible improvements on the line; they facilitated the communication, also thanks to the data collection they were able to set up. Also, their presence helped employees' commitment towards the project, and was crucial to the deployment of the kaizen event. Finally, they were important in the deployment of the necessary knowledge at the beginning (training).
Kaizen event	The kaizen event, intended as the narrowed project with the aim to give a twist over the wastes on the line, was the determinant for the arrival of consultants within the company and for the high level of involvement of the top management and of employees.

Table 17: third layer
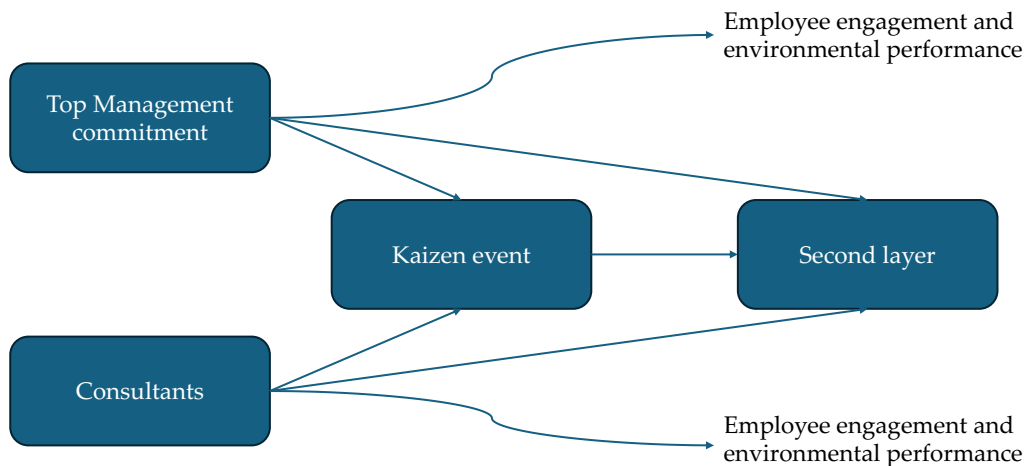
Figure 7: The third layer's impact on the second layer of variables. It is highlighted the fact that both consultants and top management commitment have a direct impact on the first layer and the environmental performance through solutions' proposal

The last layer (the "prerequisite") entails the reason why the project was implemented in the first place, and thus, in this case, it only includes the "Environmental commitment".

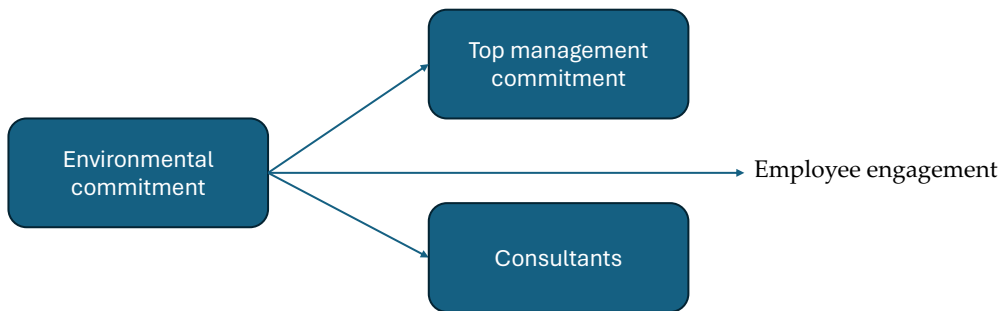| Variables	Impact
Environmental commitment	Environmental commitment can be seen as the main engine of the project, the motivation behind the decision to implement it. Also, it is one of the reasons why consultants were involved, given their research on this topic. Finally, it was an additional reason for both manager and employees to be committed and responsible for its success.

Table 18: fourth layer

Figure 8: the fourth layer's impact on the third layer's variables. Also in this case, it is highlighted the direct relationship between environmental commitment and employee engagement

The last variable remaining, which is the Continuous Improvement Culture, can be seen as resulting from the adoption of all the previously mentioned variables.

Variables	Impact
Continuous improvement culture	This variable can be seen as the level of maturity of Lean achieved by the company implementing this paradigm. The application of each soft practice previously mentioned nurtures the development of a CI culture

within workers of the company, and clearly makes the way for the improvements to be gradual and never stop over time. In particular, it is possible to say that a more mature level of CI culture has the effect of improving and making more responsible and autonomous the human resources already available within the company (development of the human capital).

Table 19: continuous improvement culture

From these maps, it is highlighted the centrality of the employees' involvement, which has a clear direct effect on the performance of environmental sustainability. Indeed, employees are the ones in charge of those processes that are wasteful; also, they give their perspective and ideas for improvement, coming directly from their experience on the line.

This is consistent with literature in general, and specifically with the results by Costa et al. (2019). This study, using the methodology of DEMATEL analysis, provides insights on cause-effect relationships between soft practices; the methodology used in the Costa's study, that was the main reference of this research, makes its results more reliable. However, the author wants to highlight the similar position found for some of the variables with respect to his study.

"Employee Engagement" is considered by Costa to be the main effect of the other variables, in the sense that it is affected by the other variables directly or indirectly; this is also what resulted from the qualitative insights of the interviews analyzed by this research.

The variables "Training" and "Communication" are, in the model by Costa, found to be in the middle among root causes and the main effects, similarly to what is found in this case study.

An interesting similarity to be highlighted concerns the "Working Conditions". Indeed, Costa states that this variable is a "self-engagement element" for employees: an improvement in the working conditions of employees is an engaging element for them because they are in charge for it. This is the same dynamic that is explained by the top manager of the company under analysis in this study. In particular, he says that "*if a change*

is for the better, operators will be satisfied; this will engage them even more, because in the next opportunity they will be proactive seeking for a further improvement".

"Top Management Commitment" is the root cause variable in the Costa's research, as it is in this one, where each interviewee emphasized how the project could not be sustained without the full involvement of the top manager.

Both studies show the low relevance of "Rewards", whether financial or non-financial.

There is a slight mismatch on the variable "Consultants". Costa states how the role of consultants is not so relevant for the long-term sustainability of Lean initiatives; therefore, it refers to a long-term period. This study highlights instead the relevance of consultants in the kaizen event, which takes place in a short time window, thus in the first stage of the Lean implementation. It is more aligned with the view by Cudney and Elrod (2010), stating that Lean implementation can be hindered by the lack of inappropriate methodology. Also, consultants had a direct impact on the final performance thanks to their own proposals and the best practices put at stake. Their role was overall found to be more relevant in this case study with respect to the one attributed by the literature.

To sum up, employee engagement was found to be the variable that is mostly affected by the others. Indeed, each other practice has a direct or indirect effect on it. At the same time, it is considered to be the main variable having a direct positive relation on the eco-efficiency performance of the company. Indeed, as it was previously mentioned, employee engagement implies proactivity by line supervisors in proposing solutions and ideas. This was defined as a differential effect to the situation of a non-Lean project in which the approach is not mixed; also, the successful integration of new procedures in the process performed by line operators. The process is ultimately what generates the plastic waste, therefore, if new procedures struggle to be included, the eco-efficiency performance cannot be affected by the project.

The variables in the second layer have the main purpose of engaging employees or overcoming their resistances. Variables belonging to the third layer, instead, are impacted only by the decision of implementing the project, while being the main enablers for all the

following practices. Very explicative is the example of consultants, playing a role in communication and training; or the one of the top manager linked positively with all the variables of the second layer.

The variable "Environmental Commitment" is a prerequisite. It is indeed the engine behind the whole project implementation from the beginning and affected the choice of the Lean approach as a paradigm for change. The top management commitment and the presence of consultants whose field of research is exactly the sustainability of the manufacturing sectors both emerge from this variable.

For what concerns "Continuous Improvement Culture", this variable is considered external to all this chain. Indeed, Continuous Improvement Culture is the paradigm chosen to implement the project; also, each variable present in the project implementation has an impact on the Culture, by enhancing it. This is evincible in the answers by supervisors, that have a rough but clear understanding of the concept of Lean without having this knowledge formalized.

4.2. Research Question 2

RFQ2: How are the Soft lean practices implemented to achieve better environmental performance perceived by different hierarchical levels?

Given the nature of the questions asked during the interview phase, the table 20 shows for each hierarchical level studied if, according to the interviewees, the given soft practice was present (P) or absent (A) in his personal experience of the project implementation. This information was taken by the first-order concepts: a certain variable was considered present for a hierarchical level if this latter compared at least once in the specific column.

TOPIC	Top manager	Shift supervisor	Line supervisor
Employee engagement	P	P	P
Top manager commitment	P	P	P
Leadership	P	P	P
Communication	P	P	P
Teamwork	P	A	P
Consultants	P	A	P
Working conditions	P	P	P
Training	P	A	P
Mixed Approach	P	P	P
Kaizen events	P	P	P
Rewards	A	A	A
Environmental Commitment	P	A	P
CI culture	P	P	P

Table 20: presence of the soft practices for each hierarchical level

We observe that for the top manager and the line supervisors, therefore the two hierarchical levels that were the most engaged in the Lean project, all the soft practices studied were used except for the "Rewards" that, as we previously mentioned, were not assigned over the implementation. Instead, the shift supervisor, only marginally involved in the project, did not mention "Training", "Rewards", "Teamwork", "Consultants", "Mixed Top-Down and Bottom-Up Approach" and "Environmental Commitment" during his interview.

In this table, instead, it is reported the hierarchical level to whom the interviewee refers when mentioning a specific soft practice. We use L1 for the top manager, L2 for the shift supervisor, and L3 for the line supervisors; C is used if the interviewee refers to the soft practice irrespective of a specific hierarchy level.

TOPIC	Top Manager	Shift Supervisor	Line Supervisor
Employee engagement	L3	L2; L3	L3
Top manager commitment	L1	L1	L1
Leadership	L3	L1; L2; L3	L1
Communication	L1; L3	L1; L3	L1; L3
Teamwork	L1; L3	/	L1; L3
Consultants	L1	/	L1; L3
Working conditions	L3	L2; L3	L3
Training	L1; L3	/	L3
Mixed Approach	L3	L3	L1
Kaizen events	L1	C	C
Rewards	/	/	/
Environmental commitment	L1	C	L3
CI culture	C	C	C

Table 21: the hierarchical level each interviewee is referring to for each soft practice

4.2.1. Top manager

First, the top manager thinks that the employees were committed to the project, and this is one of the reasons why the project was successful [1]. The most involved according to him were the line supervisors; for what concerns the shift supervisor, he was involved in the project only marginally.

The top manager showed to be motivated to the project [35]. Its main reason to commit to project was the fact that a Lean improvement, if successful, would have brought a saving in terms of time (throughput time) and of money (fewer material wastes, more units produced at the same time… etc.); considering that at the time of the project, the cost for materials had skyrocketed. Despite the absence of rewards for any stakeholder involved, he says to be *"motivated for the resources that could be freed by a successful implementation"* and therefore bring a direct benefit to the company; this is obvious, however, considering that, because of his job, he feels way more responsible and engaged in the company goals than the other stakeholders. Moreover, it is also a matter of environmental commitment: according to him, transforming the processes to reduce their impact on the environment is *"an ethical issue that should be in the interest of everybody"* [108] [109]. Finally, he states that *"a successful Lean project brings satisfaction among employees that see their procedures simplified or improved, and therefore improves their working conditions and availability to potential improvements that will occur in the future"* [93] [2]. He showed up in the department in order to understand better the solutions that the employees proposed and to keep the degree of involvement to the project high [39] [43] [31]; more in general, his participation to the project was direct, he didn't limit himself to coordinating it from a distance; he frequently discussed indeed both with consultants and employees the data collected and the potential improvements on the process [17] [60] [61] [64]. According to him, the fact of seeing the top manager so close and so available to listen and understand the point of view of employees was in some way crucial to their engagement to the project [32]. He said that *"the fact of seeing colleagues moving in another room for the weekly alignments had the consequence to involve line operators even more"* [3] [38] [105].

Regarding leadership, the top manager is patient and isn't demanding to get immediately the results of the project [42]. He understands that there may be difficulties for employees in the impact with the project and in dealing with the additional work and the procedures that will be changed over the project duration. To overcome the employee resistances, he relies very much on the leadership of the line supervisors which belong to the lean team and of the shift supervisor [54]. Within the team, which is the place in which he mostly exerts his leadership, he is participative, meaning that he promotes the discussion and the participation of the line supervisors, and patient [74] [78]. He said that he trusted his employees, in the sense that he knew they could do well in this project and for this reason he gave them more responsibility [41].

He defines his communication scheme as a waterfall, in the sense that he communicates mostly with the line supervisors, that have been chosen because of their strong character and experience and expect them to mutually explain and instructs the other employees, since, according to him, it would be ineffective to try and involve directly the 50 workers in the departments [58]. Within the team, the communication was frequent: at least one meeting per week, but sometimes they spoke also daily. He informed immediately the employees about the launch of the project [10], and about the fact that some external consultants would have come to visit and analyze the line: indeed, in this way, according to him, the beginning was as smooth as possible. The only request that he made to workers was to be available and active, to take part in the discussion since the project would have mainly concerned their own work. His communication was very successful with the line supervisor, that, according to him had the "right attitude towards the process" [44] [124]. Despite not being directly involved in the project, the shift supervisor, who is the one with the most experience in the company, was not neglected by the top manager; instead, he was always involved also in some of the team meetings to be informed about the results [48].

The top manager believes that *"the involvement of the line supervisors in the project was crucial because of the knowledge of the procedures that they brought to the discussion, that me and the consultant would not have had otherwise"* and also because *"since they are the ones in charge of performing these tasks, they have to be involved also in the redefinition the process"* [16] [21].

Indeed, they were the only one that really knew if an idea, a proposed solution was feasible with the actual process [29].

The data collected on the line were shared by the top manager to the line supervisors and the employees that could be immediately aware if the percentage of wastes was better or worse than the previous week [71] [73]. This was an employees' request, and it was crucial in keeping them focused on the project and on performing well the new procedures added. The template used by employees to count the plastic bowls that were thrown away was directly set up by the top manager.

In the team, as previously said, the top manager took part directly: he was a part of it as anyone else [75]; moreover, he chose the members, explaining that he preferred the line supervisors to be a part of it instead of the shift supervisor, because the former are more directly working on the line [70] [71]. In the team the discussion was carried on like a brainstorming, therefore starting from a problem that occurred on the line reported by the supervisors, there was a free discussion about possible ways to solve that problems, in which each point of view was listened and respected [74] [76]. Most of the solutions came from ideas of the top manager and from consultants; however, some of them also came from employees. We may say that their point of view was always taken in consideration even if the proposal came from the top manager. In the end, although the approach in the "creativity" phase was not always a top-down one, and we may say that indeed the approach was a mixed top-down and bottom-up one; the decision had to be made by the top manager alone, and in this sense the decision-making within the department is completely centralized.

Regarding consultants, the top manager thinks they were crucial to the project success and were very active in its implementation and not a simple support [87] [86]. Indeed, the data collection was set up by the top manager together with them [84]; and they also helped the analysis of the values measured over the project implementation. In general, consultants brought on the table a rigorous methodology and a knowledge that the company alone did not have. Alongside this analysis, consultants discussed with the top management about possible improvements on the line. According to the top manager, *"the consultants had a*

different perspective in observing the process and therefore were able to spot problems and inefficiencies that I could not see, since I was used to that way of doing things" [81].

He also mentioned that the presence of consultants and their interactions with employees were one of the reasons why these latter were more involved in the project, in particular the fact of having another person of expertise giving them instructions beyond their boss. Literally, *"consultants' presence within the company was another element of novelty that pushed employees to give something more to the project"* [80].

The top manager claims to be a neophyte of Lean Management and did not receive a traditional training for Lean. Anyway, in the other plants of the group, Lean projects had already been implemented [114]. In other plants, there are functions that are directly dedicated to Lean Management. The training for the manager mostly occurred on the field, in the sense that he was able to see the approach and the methods behind the projects implemented by his colleagues in the other plants of the group and therefore to learn directly from them [94]. Then, of course, he benefitted of the presence of the consultants that were experts in Lean management [97] [98].

The top manager is happy about his autonomy, in the sense that in the other plants of the group, the fact that there are functions dedicated to Lean and simultaneously managers responsible for entire stages of the production like him create a situation less easy to be coordinated; instead, he is in charge of both the project and the production, therefore he is fully responsible for the process and consequently for the changes on the procedures that will occur. In this sense, we may say that the decision-making is decentralized.

The kaizen event, considered as the whole project which, using the temporary Lean team, was aimed at bringing improvements in the realm of the plastic waste, was the key to transform the vague perception of waste in the methodical analysis and tackling of it, according to the top manager. Regarding the continuous improvement culture, instead, he defines the company not so mature yet in terms of Lean transformation. However, he has a clear understanding of what Lean is, mentioning that *"Lean is about addressing wastes, tackling them and improving processes"*. This is emblematic of his personal approach to Lean Culture, which is closer to the concept of eliminating all wastes, to the soft side, and not about the

techniques and tools belonging the perspective by Shah and Ward (2007). Also, his management style is not at all antithetic to Lean, in the sense that he was able to successfully empower employees to some degree and give them the opportunity to create value in the project. He frequently visited the line, the Gemba, to make sure that his ideas and improvement proposals were not far from the reality, and to reduce the distance that employees felt towards him. Finally, he knows that to make the change consistent, the shift in the company's mentality towards continuous improvement must be maintained and nurtured.

4.2.2. Shift supervisor

The shift supervisor thinks that employees were committed to the project, and that this was an unavoidable determinant of its success [1] [21]: indeed, he states that *"operators are those who directly work on the line and whose observation can highlight something to keep monitored and that may represent a possible opportunity for improvement"*. However, he insists on the employee resistances in particular [18]. According to him, workers had difficulties in bearing the additional work at the beginning because it was not perfectly standardized. Involving employees in the project was the most complicated thing to do because at the beginning they did not feel responsible for it [19]; instead, they live it as forced and superficially. There is a huge difference in the employees' personalities, in the sense that some of them are quicker than others in understanding the new instructions and in adapting to changes. After a while, however, the mentality of workers started to shift. According to the interviewee, *"in the first stages of the project I had to closely follow and supervise line operators, but now the new culture of working smart is making inroads into them"* [23] [52] [51].

The shift supervisor gives a lot of credit for the project success to the top manager, that in his opinion was definitely committed. According to his words, *"all that the project was, how it was prepared, communicated and performed came from the top manager"*, that clearly set the direction and never left it aside, in spite of the different priorities that he had given his role, and also in spite of the difficulties that came up during the implementation [33] [35] [45] [50]. He confirms that the top manager always discussed with everyone about the

improvements or the problems that came up weekly [53] [44] [37]. Also, even if he recognizes that some suggestions and even some improvements came from the ideas of the employees (and therefore the approach was a mixed top-down and bottom-up one), all the decisions, evaluations… were responsibility of the top manager – however, he did not take part of the team discussion [102].

Although he was not directly involved in the project, the shift supervisor was quite engaged in the project anyway, and from the beginning: he took part to some of the meetings (even if he was not a part of the team) and was always kept informed about it. In particular, he shows a certain degree of responsibility towards the company, given his experience, and his motivations were aligned to those of the top manager: he wishes to eliminate the wastes that occur in the department, because "*this is the way you would work if the business was your own one*" [122]. Moreover, his involvement was evident in the leadership he had to exert over employees to win some of their resistances. From the interview, it emerges that he was very supportive towards workers; he tried to patiently guide them into the new procedures: given the fact that he works in the department and "*can work with his hands*", he was able to show them how to perform instructions directly and this was a very effective method of going beyond the operator's resistances [54]. In particular, he did not want to leave anyone behind the others. In his opinion, this was the most important part of the project; "*the main focus of the project is the people, we had to follow and help in overcoming challenges*" and "*the main challenge for us (supervisors) is to involve people in the project and to make them responsible for its success*" [19]. He acted as an example for them, showing directly how to do the procedures. He declared that he was very persistent, also because the communication was very tough [65]. Indeed, he insists on the fact that it is very difficult to make them understand some instructions, and that they do not usually communicate with each other. For example, he had to write on a paper some of the indications that were mostly forgotten, to make them more visual and to consolidate them among operators: a sort of formalization and easy visualization of the new instructions had to be done to be sure that everyone followed them [63].

The shift supervisor also signaled some difficulties in the performance measurement system, given the fact that in the beginning the task was not assigned specifically to some employees, but all of them did it on certain days. This led to incongruences and errors in the data collected, to the point that he directly had to take the record of the plastic bowls wasted and of the attached motives. These problems were solved when the procedures of measuring values were brought up to scratch, but it took some time [18] [62].

According to him, he didn't have relevant interactions with consultants; he only communicated with the top manager; moreover, since he was not directly involved, he didn't receive any sort of training. When speaking generally about the project (kaizen event) he said that this way of analyzing the process in detail is the way of "making the right adjustments"; also, according to him, the performances were improved, and therefore the project was successful.

In particular, he insisted on the fact that the project in his opinion should have changed the way of working and thinking of employees. On this realm, he showed to have a good understanding of the continuous improvement culture: indeed, he considers the kind of approach chosen by the top management "the right one", and he mentions the fact that the project has led to a "research for the problems" [115], which have to be hunted out through the analysis and the observation; he also showed a leadership style prone to the involvement of operators, that shares some characteristics with the Lean Leadership (Dombrowski, 2014), for example the fact that he focus on employees individually, learning is Gemba-based and also, he is trying to make himself superfluous in the process; and finally, his main worry is about the cultural mindset of employees, on what can be formalized as the soft side of Lean. He said that *the new way of working was difficult to be interiorized by employees because before their focus was mainly on themselves and on avoiding to make mistakes or to be blamed for them; but after a while the focus shifted outwards, towards the process and the workers started to be more mindful in their activities*": this is also the way to be less wasteful, not only with the aim of being more environmental friendly, but more generally to make a positive contribution for the company they are working in. In the end, the workers were more autonomous and did not need any more a constant supervision as in the beginning [122] [123] [121] [110] .

4.2.3. Line supervisors

The line supervisors were the most engaged in the project; their involvement was truly the core of the implementation, since they joined the discussion with the top management and the consultants about the possible improvements on the line and therefore, they gave an active and positive contribution to the project's success through their opinion, ideas, and observations [1] [2] [6] [8]. They were motivated mainly by the fact that better procedures would have improved the working conditions of themselves and all the colleagues [92]: indeed, this happened, since the improvements addressed some tasks that were physically demanding and made some other easier. Then, they were also motivated to reduce the impact of the department towards the environment, by reducing the plastic that was wasted [108]. Regarding the environment, one of the line supervisors said that *the environmental sustainability should be of everyone's interest, it is an ethical issue*", showing a real attachment to the matter. Finally, another main reason for their commitment was the top manager, who was defined as "*the brain of the project*" and "*since he was the most committed, he involved us too*" [31]. Indeed, he gave it a high priority, and everybody could perceive it, thanks to the meetings that he weekly organized with the supervisors belonging to the Lean team, and through the communication that was effective towards employees [34] [37] [44]. Indeed, he frequently spoke with them commenting about the data collected the week before, sticked signs on the line to help with the new instructions and used graphs to inform about the weekly performance of the plastic bowls wasted [63] [67]. More generally, he followed line supervisors through the whole project implementation [53]. From the interviews it also emerged how the formalization of the instructions was important to help the employees sticking to the new procedure; another problem that wasn't totally solved, however, is that not all the line operators have understood the reason behind the procedures' changes, and this hindered their learning process.

For what concerns the other employees on the line, according to the line supervisors they were committed to the project but showed however some resistances to the changes that the project brought. Even if they were immediately informed that an extraordinary activity

would have started, *"they were scared, afraid to be evaluated, judged, and to acknowledge the new procedures"* [4] [59] [25]. The leadership exerted by line supervisor helped overcoming these resistances [55] [54] [52]. They followed employees constantly, nearly, and patiently in understanding the instructions; in particular, in the interviews it emerged that the line supervisors' main "tool" to interact and guide the employees was frequent dialogue. One of the two stated that *"you have to repeat many times the new instructions to make operators remember".* Also, they consider their role in the project particularly that of *"following employees to check whether they were performing their new procedures in the right way"* (their job is "supervisors" indeed). Moreover, they also perceived themselves as important in this process, since their leadership style was different, complementary and in some ways even more effective on the employees than the one of the top management. Indeed, they were obviously less dreaded than the manager, and employees felt more comfortable sharing their mistakes or were less afraid of not understanding every instruction immediately. Indeed, one of the interviewees said that *"the only way I could help them was through dialogue; they were less afraid of talking to me than to the top manager"* [56].

Regarding the consultants, line supervisors had a direct relation with them: they discussed on the procedures and in this way, consultants got to know better the process and consequently the hitches causing wastes. Consultants were also the ones in charge of the training, that for the line supervisors consisted simply in talks, where they were explained how the project was going to be implemented, the reasons for it and how it impacted other realities in which something similar had already been done. Consultants were well accepted as line supervisors understood their expertise and their centrality in the project; however, it seems like their boundaries were never overcome, as they stated that their opinion was always requested and well accepted and that they had to confirm the feasibility of the consultants' proposals. In general, both the interviewees often mention the consultants, as a proof of their "starring" role in the project's dynamics, and of their frequent presence in the plant [85] [88] [89].

Overall, the project was well accepted by the workers at this level of the hierarchical structure. While mentioning that at the beginning there were higher stress levels because of

the change in the routine and because of the effort put in following and leading the employees below them, the line supervisors interviewed showed a certain degree of satisfaction and pride in the empowerment they had throughout the whole project and in the procedures that were improved through proposals coming directly from them. They understood their importance in the success of the initiative. They demonstrated to have understood the core of the project and therefore to have begun assimilating concepts of the continuous improvement culture [121] [122] [123]: indeed, they mentioned how the process before was calibrated in a way to be more wasteful because of their insecurity, never letting the inefficiencies emerge, contrary to the Lean philosophy; also, they noticed to have developed an eye for the opportunities to improve, in the sense that they got accustomed to question the way things are done and think and propose alternatives. We may say that the project made shift supervisors more creative; surely, their experience and knowledge is now a resource more at the service of the company.

4.2.4. Comparison among the different hierarchical levels

To compare how the different soft lean practices are perceived by the different hierarchical levels interviewed, the following code is attached to each one of them already present in the table X:

- N: necessary; the interviewee recognizes the Soft Practice under analysis as present and considers it necessary for his own role during the project implementation.
- U: unnecessary; the interviewee recognizes the Soft Practice under analysis as present but does not consider it necessary nor relevant for his own role during the project implementation.
- X: not mentioned; according to the interviewee's point of view, the variable under analysis was not present during the project implementation.

TOPIC	Top manager	Shift supervisor	Line supervisor
Employee engagement	N	N	N
Top manager commitment	N	N	N
Leadership	N	N	N
Communication	N	N	N
Teamwork	N	U	N
Consultants	N	U	N
Working conditions	N	N	N
Training	N	U	N
Mixed Approach	N	N	N
Kaizen events	N	N	N
Rewards	U	X	X
Environmental commitment	N	U	N
CI culture	N	N	N

Table 22: the individual perception of interviewees of each soft practice

Apart from the rewards, that were not considered directly unnecessary but were not used and therefore implicitly categorized as such by the top management, none of the soft lean practices were considered unnecessary by the top manager and the line supervisors. The shift supervisor did not consider "Training", "Consultants", "Teamwork" and "Environmental Commitment" as necessary for him to play his role within the project; however, this is considered aligned with how the project was implemented, since it formally involved more directly the top manager and the line supervisors.

The author suggests that some of the soft practices are considered more than necessary by the interviewees. This is obviously partially subjective. However, these crucial variables are defined as those variables that were stressed by the interviewees more than once during the interview, and in answering questions that initially addressed other soft practices.

The top manager considers the "Employee Engagement" literally as "the key for the project success", and a lot of the action he decided to undertake had, explicitly or not, the aim to involve them more in the project. Similarly, the shift supervisor stresses how the project, at least for him, revolved around overcoming the workers' resistances and therefore involving them in the implementation.

Both the shift and the line supervisors stress the fact that the top management was the main advocate and the reason for the project success; they define him "the brain" and praise his perseverance and determination in overcoming the difficulties and complete the project. Therefore, they consider "Top Management Commitment" to be a key practice in the project development. The same figures also place a special emphasis on the "Leadership", as it was exerted by themselves over the line operators: this leadership was complementary to the one more high-level and intrinsically detached of the top management and helped the workers in overcoming their resistances. The top manager also considers consultants as essential for the initiative success, for their role that was both active, in the sense that they give an organic contribution to the process improvement and set up the performance measurement system, but also an important link between the top manager and the line operators. Line supervisors consider both environmental commitment and the improvement in working conditions as the fundamental motivations for theirs and their colleagues' involvement in the project. Finally, the shift supervisor put an emphasis on the continuous improvement culture, stating that initially the main cause of the inefficiencies was the poor culture of workers, meaning a low responsibility with respect to the company and little awareness of their own job; as the project was implemented, the new mindset started to be assimilated by the line operators, and this shift coincided with the improvement in the performances.

Another comparison that is possible and makes sense is in the different interpretation that the three hierarchical levels have of the same practices. This is particularly evident for the leadership, that each level applies in a unique way. Although all the three figures show patience towards line operators and do not put an overwhelming pressure over them to

perform immediately, there are clear differences. Line supervisors, given the biggest degree of proximity towards operators, play the role of listeners: they try to be comprehensive and use dialogue as a means to win workers doubts, fears, and insecurities. They are the ones who know better each person working in the department and therefore explained how their approach was different with each one of them and tailored to their own personality. Similar was the role of the shift supervisors. He led by example too, but he was more detached from workers than the line supervisors. Also, he was not directly assigned to the project and therefore helped when needed, because he was physically around; this is mainly because he is used (and his job includes) to manage non-ordinary situations, problems and unforeseen events that occur on the line. The top manager, instead, while still showing traits of a participative leadership style, is more dedicated to the Lean Team or to the direct relations with his underlings, like the shift supervisor; he delegates the guidance of line operators mostly to the line supervisors and prefers his frequent visits to the department to be a boost of focus for workers. Besides, it would be quite impossible for him to have a direct relation with all of them.

Regarding the employee engagement, instead, the differences in how the interviewees talk about this practice is emblematic of their distinct jobs and of their different roles as leaders: indeed, the top managers deals more with the positive sides of it, the opportunities that came from the fact of having employees fully engaged in the project; instead, line and shift supervisors are more focused on the resistances shown by workers, that are hindering their involvement and therefore their contribution to the project. This is also connected with the just mentioned concept of leadership: the latter two are more operatively involved with operators, thus being more focused on the everyday challenges to be overcome; the top manager, however conscious of the daily problems faced by employees because of the problem implementation, has a wider overview of the project and of the organization and therefore is more focused with the outcome. It is relevant to mention that the top manager mentions some of the difficulties faced by line supervisors when working in team: at the beginning, they were not comfortable discussing their ideas freely. It is fair to say that since

the top management mainly exerts leadership within the team, he mainly sees the resistances of line supervisors; at the same time, the supervisors focus on the line operators. It is the same concept of waterfall already explained previously for the variable "Communication": this can be applied also to the delegation of leadership.

For what concerns the environmental commitment, line supervisors are the ones mentioning it as a bigger motivation for them to commit to the project. Instead, the top manager mentions it as one of more equivalent reasons behind the initiative; he also states that the ethical issue was used as a leverage to increase the employees' engagement in the project. The shift supervisor instead only briefly mentions it, in line with the indirect way in which he was engaged in the work. Overall, what emerges clearly from interviews at every level is the awareness that a successful project will have, among many benefits, a positive impact on the environment: this practice works as a backbone of the project, starting from the strategic direction set at the company level arriving to the operator committed to the line. Anyway, the interviews focused more on other aspects relating particularly to daily issues that had to be overcome to make the initiative successful.

As previously forecasted, there was a difference also in the interpretation of the continuous improvement culture and mindset among the different hierarchical levels. While the top manager has a formalized understanding of Lean, being also able to define the level of the adoption maturity in his plant as medium-low, the line and shift supervisors showed a good understanding of the Lean pillars even though they were not formally discussed during the interviews. In particular, the shift supervisor, given his experience and his job that allows him to take a wider look at his department, talks about a "culture" that is very similar to the Lean one. Indeed, he mentions how in the beginning operators lacked awareness, which led to more wastes; instead, by the end, they had begun to take more responsibility for their work and understood better how the tasks they were assigned fitted together within the whole process, making them more prone to avoid wastes.

5.   Conclusions

5.1. Findings

In this section, the author wants to summarize the main findings of this research. This work aims at understanding the role that those practices of Lean that are denominated "soft" have in improving the Eco-efficiency performance of a manufacturing company. Indeed, although the literature is wide on the concepts of Lean, Environmental Sustainability and Eco-Efficiency, the soft practices are mainly treated as a barrier hindering a sustainable implementation of Lean over time. Therefore, this study aims at considering soft practices through a new lens by exploring the role they have in a project targeting a specific company performance; and aims at highlighting differences in how these practices are perceived by different hierarchical levels.

The research was performed by focusing on a case study concerning a successful implementation of a Lean project to improve the eco-efficiency performance of a manufacturing company operating in the Italian food industry. Interviews were conducted to different stakeholders at different hierarchical levels in the company structure. The soft practices investigated were taken by the literature and two other variables, the "Environmental Commitment" and the "Continuous Improvement Culture" were instead obtained through the inductive coding of the interviews and defined by the author.

To explain the relation that soft practices have with the improvement of the eco-efficiency performance of the manufacturing company, variables were divided in four different layers, according to their links with the other practices. The "Employee engagement" resulted to be the variable that most directly affected the eco-efficiency performance of the company, thanks to the crucial role played by workers and line supervisors within the project implementation. Indeed, line supervisors directly proposed new solutions for the improvement of the process; line operators, instead, were in charge of performing the new

instructions, and therefore the success of the project was inevitably in their hands. "Employee engagement" was also the variable that was the most affected by others.

Indeed, in the second layer, it is possible to find the variables that were used as "levers" to increase the involvement of operators within the company, or the overcome their resistances, such as "Teamwork", "Communication", "Mixed top-down and bottom-up approach", "Training", "Leadership" and "Working conditions".

In the third layer, there are those variables that were considered the pillars of the project, necessary to the presence of all the other soft practices: the "Top Management Commitment", "Consultants" and the "Kaizen Event". Prominence is attributed to consultants, which bring the rigor and the methodology necessary to the project success and whose role was not so described in literature.

In the fourth and last layer, there is only the variable "Environmental commitment". This was considered a prerequisite for the project, the reason why it was planned in the first place and why the Lean paradigm was chosen to implement it.

The variable "Continuous Improvement Culture" can be considered in parallel with respect to the others: indeed, the more this philosophy makes its way in the organization and gets to a higher level of maturity, the more the soft practices previously mentioned are effective: indeed, in the end, operators started to become aware of their way of working and their mindset had shifted towards continuous improvement. On the other hand, the fact that soft practices are adopted and result to be effective in the project nurtures the CI culture development.

For what concerns the second research question regarding the different perception of soft practices by different hierarchical levels, different insights came up from the analysis. First, in the context of a successful Lean project for eco-efficiency performance, the two hierarchical levels that were involved the most, therefore the top manager and the line supervisors, find each soft practice present in the project as necessary for its implementation and success. So, it is possible to affirm that the soft practices of Lean are necessary in the

implementation of a successful Lean project for improving the eco-efficiency performance of a manufacturing company.

Furthermore, a figure like the shift supervisor, who was not directly involved in the project implementation but had to deal with it marginally, still considered more than half of the variables necessary for the project success ("Employee engagement", "TM commitment", "Leadership", "Communication", "Working Conditions", "Mixed Approach", "Kaizen Event" and "CI culture").

The author also dug deeper in the different interpretation that the three hierarchical levels gave to the same practices. The main difference highlighted was in "Leadership". Indeed, all the three interviewees had to exert their leadership over their subordinates. From the analysis, it emerged that they interpreted leadership in different and complementary ways. The top manager acted as a leader mainly in the Lean team, where he could have a more direct relation with the members; then, the supervisors were delegated the task to lead operators more closely to overcome their difficulties and integrate the new procedures successfully in the process. This is something that can be found also in the concept of Lean Leadership, that includes principles like a low ratio leader to employees, and that provides that the leader makes himself superfluous in the job.

This is also the reason why the top manager saw the variable "Employee Engagement" as the reason for the project success, while the supervisors were more focused on the resistances and the daily challenges workers had to overcome. Instead, the top manager is more interested in talking about the challenges faced by line supervisors in the teamwork. It is possible to say that each leader is focused on the difficulties and the resistances of their "followers".

Relevant differences were also found in the relation that the interviewees had with the variable "Environmental Commitment". Line supervisors mentioned that this was one of the main motivations for their commitment to the project; instead, the top manager, despite recognizing its relevance, equated it to other motivations, like the financial one. This is consistent with the idea that manufacturing companies have the most incentive in engaging in environmentally sustainable activities when these have also a positive impact on other

company dimensions. The variable emerged also to have a role in promoting and making the project popular among employees. However, it is important to state that the topic was not of high interest for the interviewees, in the sense that they did not elaborate it too much during the interviews. Indeed, they saw it mainly as a consequence of the project success, and therefore their focus was on this latter and on how to make it work.

The last remark regards the variable "Continuous Improvement Culture": all the three hierarchical levels showed to have developed a certain degree of comprehension and to have internalized elements of the Lean approach. Obviously, the top manager had a more formalized understanding on the topic, while the supervisors relied more on the "common sense" side of the concept. In particular, the shift supervisor mentioned the fact that workers had become more mindful and aware of their tasks and of the consequence of the way they performed them. For this reason, we may say that the project, beyond the success in the improvement of the eco-efficiency performance, made the way for a shift in the company's cultural mindset towards continuous improvement and waste reduction.

5.2. Limitations and Further Research

The last section of this chapter aims to underline the limitations of this study and the possible further research to be performed on this topic. First, it is important to underline the fact that the entire work is based only on one case study. A following research may focus on a wider test sample for a more generalizable and valid result. Furthermore, the research was performed through interviews. This methodology can be subject to biases in the answers and subjective assumptions made by the author over the answers collected. Employees are not expected to offer controversial insights about the top manager or how the project was implemented. For this reason, the questions asked were structured in the most general way possible. However, possible future research on this may include a different method of analysis, less subject to the individual perspectives of the interviewees and to the subjective deduction of the author. Finally, the topic of soft lean practice is a qualitative one, therefore it is a limitation of the study the fact of classifying a practice as "present" or "absent" over

the project implementation. It could be interesting for future research to find a way to measure the intensity of these practices, through an additional methodology of analysis, and to rigorously define differences or categories for each practice in the implementation.

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