# Lean and its Impact on Sustainabilithy Performance in Service Companies: Results from a Pilot Study

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**Abstract**

The purpose of this empirical research is to understand the application of Lean practices (technical and social) and tools in the service sector, whose implementation is less studied, despite its economic relevance. The study aims to extend previous studies that focused on the relationship between Lean and operational and financial performance, and analyzing the impact on sustainability, encompassing economic, social and environmental perspectives. Further the study analyzes Lean as a set of social and technical practices to better represent the system, as suggested by previous studies. The results of the study showed that there are several motivating factors for the implementation of Lean, the highlights being improving customer satisfaction, efficiency, delivery and reducing them and costs. The most frequently used Lean tools are related to the identification of improvement opportunities and causes of problems. The pilot survey

also made it possible to identify the greater use of technical practices than social practices. The sustainability performance analysis showed that the better performance of service companies is in the economic dimension.

**Keywords:** Lean, Services, Empirical Research, Sustainability

## 1. Introduction

Womack et al. (1990) established the term "Lean" in the 1980s as a powerful strategy for increasing efficiency through minimizing non-value added activities while retaining the customer-perceived value. Although various Lean applications have received much-deserved attention in manufacturing over the last three decades, research on Lean in service settings is still at its infancy (Malmbrandt and Ahlstrom, 2012; Gupta et al., 2016; Julião and Gaspar, 2021). One of the early applications of Lean in services was explicitly shown in the work of Bowen and Youngdahl (1989). Moreover, several Lean applications within the service domain are in the healthcare sector, according to existing literature (Lodge and Bamford, 2008; Proudlove et al., 2008). There is still a lack of studies on the application of Lean in the service organization as a whole, focusing on different service industries (Gupta et al., 2016).

The service sector contributes significantly more than manufacturing to the gross domestic product in most developed economies (Piercy and Rich, 2009; Suarez-Barraza et al., 2012; Malmbrandt and Åhlström, 2013). Services are the major employer and source of income for developed economies (Piercy and Rich, 2009). However, the level of productivity in this sector still needs improvement (Suarez-Barraza et al., 2012) and Lean practices has a positive effect on service outcomes (Hadid et al., 2016; Suarez-Barraza et al., 2012). Lean is applicable in services, although transfer of Lean manufacturing principles to services has challenges because of the characteristics of services (Gupta et al., 2016).

There are limitations in studies focusing on Lean service, in terms of the narrow focus on the independent effect of isolated Lean practices while ignoring their potential (Suarez Barraza et al., 2012; Hadid et al., 2016; Tortorella et al., 2021). Very little attention is given to the level of adoption of social Lean practices such as employee involvement or engagement, empowerment, and cultural transformation (Suárez-Barraza et a., 2012; Gupta et al., 2016). To overcome these limitations, several authors have seen Lean as a socio-technical system (STS) (Hadid et al., 2016; Abdallah et al., 2019; 2021) composed of social and technical practices that interact with each other (Bortolotti et al., 2015; Sahoo, 2020). Another limitation is that empirical studies on Lean service, focus on operational and financial performance, which are often used to assess the success of process improvement initiatives (e.g., Alsmadi et al., 2012; Malmbrandt and Åhlström, 2013; Hadid et al., 2016), using hard measures such as cycle time and lead time reduction and productivity improvement. The impact of Lean implementation can enhance the financial, social and environmental performance (Yadav et al., 2019). Sustainability is an important factor for service companies to remain competitive and meet the needs of various stakeholders (Moisescu, 2018; Ali et al., 2020). However, there are few studies on sustainability in services, especially considering the impact of Lean in this context.

This study, therefore, has the following objectives and aims to fill gaps in the literature through the development of a questionnaire and pilot survey on a sample of European service organizations. First, this study aims to understand the application of Lean practices (technical and social) and tools in the service sector, whose implementation is less studied, despite its economic relevance (Hadid and Mansouri, 2014; Hadid et al., 2016) and services have unique characteristics which can change the level of practices and tools use and implementation (Alsmadi et al., 2012; Gupta et al., 2016). Second, this study aims to extend previous studies that focused on the relationship between Lean and

operational and financial performance (e.g., Alsmadi et al., 2012; Hadid et al., 2016; Vanichchinchai, 2021), aiming at analyzing the impact on sustainability, encompassing economic, social and environmental perspectives. Third, this study analyzes Lean as a set of social and technical practices to better represent the system, as suggested by previous studies (e.g., Hadid and Mansouri, 2014; Hadid et al., 2016). This provides an opportunity for further understanding of the topic and empirical refinement.

The paper is structured as follows. Section 2 presents the literature review on Lean service and sustainability performance. This is followed by the research method (Section 3) showing the development of the survey questionnaire, and data collection for the pilot survey. Section 4 presents the main pilot survey results and Section 5, the discussions. The last section is focused on conclusions, major limitations of the research and suggestions for further work.

## 2. Literature Review

### 2.1 *Lean service*

Now it is widely accepted that Lean is equally relevant to service organizations as manufacturing, as these organizations use a process perspective to reduce costs, improve quality and satisfy customers (Alsmadi et al., 2012; Suarez-Barraza et al., 2012). Reinforcing the interest of academics and practitioners (Hadid and Mansouri, 2014. Hadid et al., 2016).

Malmbrandt and Åhlström (2013) see Lean service as a set of principles, for improving service delivery. While Hadid and Mansouri (2014) considers that Lean service is designed to improve processes by focusing on and eliminating non-added value activities. Lean service refers to the deployment and adaptation of the Lean philosophy in the service sector (Ahlstrom, 2004). Lean is increasingly applied to a wide range of service operations over the past years (Alsmadi et al., 2012; Tortorella et al., 2021). Different

types of service industries have implemented Lean, such as financial, health care, education, airline, telecommunications, and hotels and restaurants (Suarez Barraza et al., 2012; Gupta et al., 2016; Ali et al., 2020).

Service companies have been encouraged to use Lean to improve their performance and reduce waste, culture change to focus on customers' needs, continuous improvement and search for better service quality (Alsmadi et al., 2012; Suarez-Barraza et al., 2012; Hadid and Mansouri, 2014; Tortorella et al., 2021). The service sector has been adapting and implementing this philosophy to obtain positive results to their flows and processes (Julião and Gaspar, 2021).

### 2.2 *Lean as a Socio-Technical System*

Hadid et al. (2016) affirm that service firms achieve the best potential benefits from Lean implementation; Lean must be seen as a socio-technical system (STS), consisting of two interconnected and correlated components: social (soft) and technical (hard) skills (Hadid et al., 2016; Abdallah et al., 2019; 2021). Shah and Ward (2007) reinforce the view of Lean as an STS and propose a conceptual definition of Lean based on a set of social and technical practices.

#### 2.2.1 Social Lean Practices

Social Lean practices are related to behavioral and human aspects, and people and its relationships, encompassing involvement and commitment of management and employees with Lean system, customer and supplier involvement, continuous improvement, and training (Bosrtolotti et al., 2015; Abdallah et al., 2019, 2021). The social interactions contribute to a lean organizational environment that has a dominant effect on the lean practices of employee, supplier and customer involvement (Malik and Abdallah, 2020). Social Lean practices help create a suitable environment for implementing technical Lean practices by showing managers, employees, customers, and

suppliers the importance of changing the production system according to a Lean perspective (Bortolotti 2015; Sahoo, 2020).

In services, important aspects of Lean social practices are employee skills, training, motivation, empowerment, leadership and employee engagement (Gupta et al., 2016; Vadivel, 2021). Empirical results affirm that service firms are interested in the soft practices of Lean such as people and customer involvement, as services are based on labor-intensive, since people manage and deliver the service in question (Suárez-Barraza et a., 2012), and is critical to exploit their ideas, enhance problem-solving skills, and keeping them open to change and flexibility (Alsmadi et al., 2012).

For the current study, the Lean social practices have been selected considering the context of Lean service, and they encompass continuous improvement culture, leadership, training and people development, multifunctional employees, employee involvement, and reward and recognition (Alsmadi et al., 2012; Malmbrandt and Ahlstrom, 2013; Hadid and Mansouri, 2014; Hadid et al., 2016; Kundo and Manohar, 2016).

2.2.2 Technical Lean Practices

The technical practices consider technologies, processes, equipment, tools, and techniques, (Hadid et al., 2016; Abdallah et al., 2021). Technical aspects of Lean are represented by technical and analytical tools that aim to improve production processes (Bortolotti et al., 2015; Abdallah et al., 2019; 2021). In line with previous studies, Bortolotti et al. (2015) point out technical practices such as, statistical process control and kanban (Bortolotti et al., 2015). The technical Lean practices focus on identifying customer value and eliminating non-added activities (Hadid and Mansouri, 2014). Some scholars argued that implementing Lean technical practices could lead to several benefits for both customers and the adopting service firms (Hadid et al., 2016).

Abdallah et al. (2021) affirm that the most-cited technical Lean practices in the literature include: set-up time reduction, JIT purchasing, statistical process control (SPC), total productive maintenance (TPM). While, for example, Hadid and Mansouri (2014) identified by a systematic literature review, JIT, Kanban, pull system, total preventive maintenance, and workload balancing. For the current study, the Lean technical practices have been selected considering the context of Lean service, and they encompass supplier feedback, customer involvement, pull, continuous flow, work standardization, visual control, and TPM (Alsmadi et al., 2012; Malmbrandt and Ahlstrom, 2013; Hadid and Mansouri, 2014; Hadid et al., 2016; Kundo and Manohar, 2016;).

2.3 *Lean Service Motivators*

The motivational factors for implementing Lean in services are decisive for the greater adoption and embedding of the approach by all employees in day-to-day operations (Lameijer et al., 2020). There is a strong relationship between motivation and benefits, in Lean implementation (Vashishth et al., 2017). Understanding the motivating factors in the context of Lean services can be considered a research gap (Thornton et al., 2017; Vashishth et al., 2017). The motivators for Lean implementation are diverse, but they are often directly or indirectly associated with eliminating waste (Costa et al., 2017; Thornton et al., 2017), cost-effectiveness and improved efficiency and productivity (Thornton et al., 2017). Table 1 presents the main motivational factors for the implementation of Lean service.

Table 1 – Main Lean Service Motivating Factors

| **Motivating Factors** | **Authors** |
|---|---|
| Eliminate waste | Vashishth, Chakraborty, Antony (2017); Costa et al. (2017); Thornton et al. (2019) |
| Eliminate non-value-adding tasks | Vashishth, Chakraborty, Antony (2017); Lameijer et al. (2020) |
| Reduce costs | Costa et al. (2017); Thornton et al. (2019); Lameijer et al. (2020) |
| Improve operational efficiency | Vashishth, Chakraborty, Antony (2017); Thornton et al. (2019) |

| | |
|---|---|
| Reduce errors | Costa et al. (2017) |
| Improve the service process | Thornton et al. (2019); Robinson et al. (2012); Costa et al. (2017) |
| Improve service quality | Vashishth, Chakraborty, Antony (2017); Lameijer et al. (2020) |
| Enhance customer satisfaction | Vashishth, Chakraborty, Antony (2017); Lameijer et al. (2020) |
| Introduce new services | Lameijer et al. (2020) |
| Create new innovative processes | Lameijer et al. (2020) |
| Improve service delivery | Robinson et al. (2017) |
| Reduce delays, waiting times and operational time | Vashishth, Chakraborty, Antony (2017); Costa et al. (2017) |
| Transform organisational culture | Vashishth, Chakraborty, Antony (2017) |

*2.4 Lean Service Tools*

Lean is rooted in key principles and supported by simple tools designed to help teams and individuals to achieve process improvement, value addition, and customer satisfaction goals (Emiliani, 2004; Pokinska, 2010). Furthermore, it is necessary to identify if Lean service applies the same tools as manufacturing or developed its own characteristics (Pedersen, 2010; Bortolotti and Romano, 2012). The suitable applications of Lean tools, by understanding each tool's purpose and characteristics, are crucial to implementing Lean in the service environment (Song et al., 2009; Sum et al., 2020). The definition of the tools used can help to understand what is being called by Lean Service (Suárez-Barraza et al., 2012). Although the Lean system should not be seen as a toolbox, the use of tools allows the incorporation of Lean principles and culture (Pokinska, 2010) and fit the specific needs of the services (Vashishth et al., 2017). Table 2 shows Lean tools with application in the context of services.

Table 2 – Main Lean Tools

| **Tools** | **Definition** | **Authors** |
|---|---|---|
| 5S | Sorting, simplifying, standardising, sweeping and sustaining | Emiliani (2004), Pokinska (2010), Suárez-Barraza et al. (2012), Song et al. (2009), Robinson et al. (2012); Costa et al. (2017); Hadid and Mansouri (2016); Hadid et al. (2016) |

| | | |
|---|---|---|
| Mistake proofing/Poka-Yoke | Device or procedure that prevents the propagation of errors | Pokinska (2010); Vashishth et al. (2017); Hadid and Mansouri (2016); Hadid et al. (2016) |
| Policy deployment/ Hoshin Kanri | Deployment of corporate strategy to key objectives determining resources, daily activities and deadlines | Emiliani (2004), Pokinska (2010); Hadid and Mansouri (2016); Hadid et al. (2016) |
| Quality function deployment | A process used to incorporate the wants and desires of intermediate and end-use customers in the design of goods and services | Emiliani (2004), Pokinska (2010), Song et al. (2009), Vashishth et al. (2017); Hadid and Mansouri (2016); Hadid et al. (2016) |
| Value stream mapping | A visual representation of detailed operation sequence and process flow. Easy to look for the opportunities and wastes. | Emmiliani (2004), Pokinska (2010); Pedersen (2010); Bortolotti and Romano (2012), Song et al. (2009), Costa et al., (2020), Sum et al. (2020); Hadid and Mansouri (2016); Hadid et al. (2016) |
| Takt time | The rate of customer demand and workplace activities | Emiliani (2004), Bortolotti and Romano (2012); Hadid and Mansouri (2016); Hadid et al. (2016) |
| Root cause analysis | Methods used to determine the root cause of a problem and identify countermeasures to prevent reoccurrence. The main tools are "5 whys" and fishbone or cause and effect diagram | Emiliani (2004), Pokinska (2010); Hadid and Mansouri (2016); Hadid et al. (2016) |
| A3 Report | Structured form for conducting improvement projects | Song et al. (2009); Costa et al. (2017); Hadid and Mansouri (2016); Hadid et al. (2016) |

2.5 *Lean Service and Sustainability performance*

Corporate sustainability is understood as a synergistic achievement of three dimensions, environmental, social, and economic performance (Elkington, 1998). These dimensions combined into the Triple Bottom Line (TBL) perspective (Carter and Rogers, 2008). Environmental Performance is related to firms' wastes management, energy consumption, emissions, and environmental management practices (Moldan et al., 2012; Garza-Reyes, 2015). Social Performance encompasses human well-being, employees' health, morale, satisfaction, and the firm's impact on community and overall society (Souza and Alves, 2018). Finally, Economic Performance includes firms' operational

improvements, financial sustainability, and market growth (Carter and Rogers, 2008; Henao et al., 2019). Sustainability is an important decision factor for service companies (Moisescu, 2018; Ali et al., 2020).

Several studies highlight the positive impact of Lean service on operational and financial performance (e.g., Alsmadi et al., 2012; Hadid et al., 2016; Hadid, 2019; Tortorella et al., 2021). These results are achieved because Lean practices implementation can eliminate wastes, time, costs, and inefficiencies in service operational processes leading to an increase in the firm's performance (Alsmadi et al., 2012; Ali et al., 2020). They enable more flexible and effective operations oriented to customers' needs (Tortorella et al., 2021). Empirical results in UK service organizations indicated that the Lean social practices had an independent positive impact on operational and financial performance, while the technical practices had effect on only operational performance (Hadid et al., 2016).

Literature suggests that Lean can promote green performance (Sajan et al., 2017, Dey et al., 2020), benefits that can be extended to service operations. Service and manufacturing companies that implement Lean have shown concern for the environment, such as with decrease in water consumption (Sarango-Lalangui et al., 2018). Choudhary et al. (2019) mentioned that kanban reduces warehousing fuel consumption in the logistics sector. Romero and Rossi (2017) analyzed that, in product-service integration, lean can promote the efficient use of resources, which improves overall green performance. Connor et al. (2010) indicated that lean thinking can eliminate duplicates and rework throughout the patient's journey in a clinic, reducing environmental wastes and increasing operational performance.

Recent studies have discussed the positive outcomes on social performance through lean adoption (Sajan et al., 2017, Nawanir et al., 2020). Lean service can be driven to achieve

social performance in hospitals (Al-Mailam, 2005). Hwang et al. (2014) identified that the adoption of some lean tools in a hospital, such as standardized procedures and visual management, enhanced employee motivation and reduced turnover. This evidence shows the importance of studying the role of Lean for the sustainability of service companies.

## 3. Research Method

The objective of this pilot study is to explore how service organizations can achieve sustainability performance from Lean implementation based on Lean tools and practices. This study intends to address the following Research Questions (RQs):

*RQ1: What are the main motivating factors of service companies for the implementation of Lean?*

*RQ2: What are the main Lean tools used by service companies?*

*RQ3: What are the main Lean (soft and hard) practices used by service companies?*

*RQ4: What are the sustainability performances in service companies?*

*RQ5: What are the relationships between Lean practices and sustainability performance?*

A questionnaire-based survey was sent to service organizations to help answer the RQs. The pilot survey was exploratory as the objective was to gain fundamental insights into Lean in service organizations. This kind of surveys helps to uncover or provide preliminary evidence of associations among concepts, in this case, between technical and social Lean practices and the sustainability performance. Further, it can help to explore the valid boundary of a theory (Forza, 2002).

### 3.1. Research instrument and data collection

The questionnaire response format is a significant design consideration. This will determine the type and wording of the question and focus on the kind of analysis that the researcher wants to perform (Antony et. al., 2007). The research instrument used for data

collection was an online questionnaire developed using Google Forms. The steps used to create the questionnaire followed those proposed by Hair et al. (2020), Forza (2002) and Malhotra and Grover (1998): including the development of the RQs, the definition of the target population, selecting variables/indicators to represent the concepts and measurement scale, determining question types and format, and pretesting the questionnaire. The constructs and variables used to answer the five RQs were identified in the literature and are presented in Table 3.

The questionnaire was divided into three sections; the first encompasses the characterization of the company and the respondent, which includes the position of the respondent, number of full-time employees, the service industry, and finally, whether they have implemented Lean and for how long. The second section presented questions about the Lean implementation motivation factors, the use of tools and Lean social and technical practices. Followed by the questions on sustainability performance related to environmental, economic, and social performance in the third section.

As they are complex concepts and difficult to be measured directly, Lean practices and sustainability performance were designed as a multi-item scale. Statements relating to technical Lean practices were grouped in seven constructs and the social Lean practices were grouped in six constructs. Each sustainability dimension, social, environmental, and economic was grouped in one construct. The statements in the second and third sections were evaluated using the 7-point Likert scale (1-Strongly disagree; 7-Strongly agree) as recommended by Hair et al. (2020). The Likert scale used provide a more precise measure than binary options such as by yes/no or true/false items and so, it is fast and easy to complete (Neuman, 2006) and allows the respondents to indicate the relative importance of choices (Antony et al., 2007). Further, closed-ended questions render the questionnaire

easy to complete, enables automated data entry, and facilitates data analysis and summarization (Antony et al., 2007). The research steps are illustrated in Figure 1.

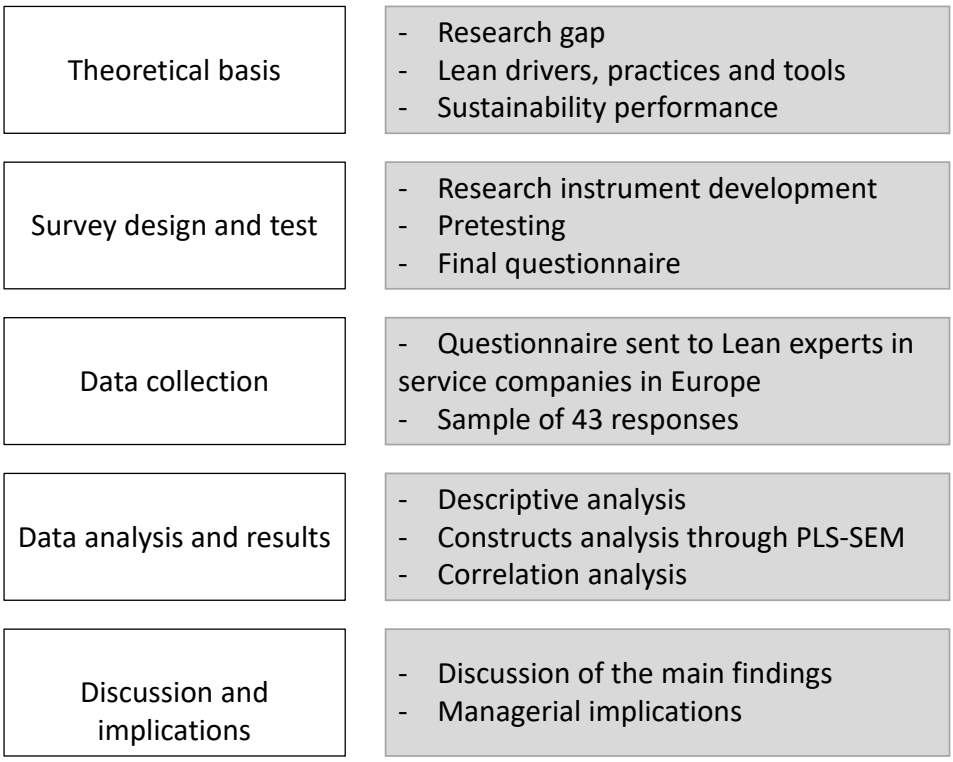


**Figure 1:** Research methodology steps

The target population was Lean experts working in European service companies or as consultants for European service companies. Respondents were selected by identifying corporate social media of professionals with experience in Lean and service companies, following other studies in the area (e.g., Potter, 2021, Secchi and Camuffo, 2019). The pretesting of the survey questionnaire was developed with four academic professionals with experience, research, and peer-reviewed papers on the Lean subject, and seven practitioners with extensive experience in leading and participating in Lean projects. The pretesting ensures that no constructs have been omitted, allowing some refinement in vocabulary and writing, helping eliminate measurement errors (Forza, 2002; Hair et al., 2020). The final web survey link was sent to 200 experts and after eliminating

uncompleted questionnaires, a sample of 43 respondents was obtained (21.5% response rate), which is quite satisfactory for pilot surveys (Antony et al., 2019; Antony, 2004).

3.2 Sample characterization

The sample is characterized by most respondents (56%) dedicated full-time to Lean responsibilities (Table 3). The sample is composed of senior managers (37%), associate or middle manager, (23%) with a background and role of LSS Master Black Belt or LSS Black Belt (23%). The sample also contained Continuous Improvement Managers (16%) and Lean Managers (12%) (Table 3). The position and involvement of respondents with Lean activities show that they have knowledge and experience and are able to answer the questionnaire.

**Table 3:** Respondent characteristics

| **Respondent Position*** | **Number** | **Percentage** |
|---|---|---|
| Senior Manager | 16 | 37% |
| Associate or middle manager | 10 | 23% |
| LSS Master Black Belt or LSS Black Belt | 10 | 23% |
| Continuous Improvement or Operational Excellence Manager | 7 | 16% |
| Lean Manager or Lean Champion | 5 | 12% |
| Executive Manager (C-position) | 3 | 7% |
| Nonmanager-level employee | 2 | 5% |
| Operational Excellence Director | 2 | 5% |

| **Lean responsibility** | **Number** | **Percentage** |
|---|---|---|
| Full-time Involvement | 24 | 56% |
| Part-time Involvement | 19 | 44% |

*The respondent could mark more than one option

Table 4 presents the companies location, industry, size, and Lean implementation. The sample of companies is distributed over several countries in Europe, focusing mainly on Ireland (35%), Netherlands (19%), United Kingdom (14%) and Romania (14%). Some companies (9%) were characterized as global, operating in different countries. The sample comprises large companies, with 59% having more than 500 employees. The sample's composition shows a diversity of countries and company sizes, which is

reinforced by service industry. The sector with the highest number of companies in Banking/Finance (16%) followed by Healthcare (14%), Consultancy, Information Technology and Transport (each corresponding to 12% of the sample).

Most organizations have been using the Lean approach for more than 2 years and less than 10 (56% of the sample). Still, a considerable portion (19%) have applied it for over 10 years, showing the diffusion of the Lean approach in the services sector. Most companies (72%) have applied Lean in some functions, indicating that Lean is still being developed and consolidated, while others (14%) already have applications company-wide. Thus, the sample of companies shows a compilation of different Lean applications in the service sector.

**Table 4:** Companies characteristics

| **Company location** | **Number** | **Percentage** |
|---|---|---|
| Ireland | 15 | 35% |
| Netherlands | 8 | 19% |
| United Kingdom | 6 | 14% |
| Romania | 6 | 14% |
| Poland | 1 | 2% |
| Italy | 1 | 2% |
| Scotland | 1 | 2% |
| Bulgaria | 1 | 2% |
| Global | 4 | 9% |
| **Company size** | **Number** | **Percentage** |
| 1 to 49 | 10 | 23% |
| 50 to 249 | 5 | 12% |
| 250 to 500 | 3 | 7% |
| 501 to 5.000 | 14 | 33% |
| >5.000 | 11 | 26% |
| **Service industry** | **Number** | **Percentage** |
| Banking/Finance | 7 | 16% |
| Healthcare | 6 | 14% |
| Consultancy | 5 | 12% |
| Information Technology | 5 | 12% |
| Transport | 5 | 12% |
| Insurance | 3 | 7% |
| Telecommunication | 2 | 5% |
| Utilities | 2 | 5% |
| Other* | 8 | 19% |

| How long Lean has been used (years) | Number | Percentage |
|---|---|---|
| Between 0-1 | 9 | 21% |
| Between 2-5 | 11 | 26% |
| Between 5-10 | 11 | 26% |
| More than10 | 8 | 19% |
| No answer | 4 | 9% |
| **The extent that Lean has been deployed** | **Number** | **Percentage** |
| None | 6 | 14% |
| In some functions | 31 | 72% |
| Company-wide | 6 | 14% |

*Education, retail, medical device, law enforcement, construction, employment agency, product service and technical support

3.3 Data analysis

Aiming to reduce measurement error, ensure a more accurate measurement, to represent the theoretical conceptual aspects and guarantee reliability, the Lean practice and sustainability performance constructs were based on an indirect multi-item scale (Forza, 2002; Hair et al., 2017). The measurement scales used were based on previous studies (Table 3), in this case, all constructs are reflective.

To carry out the analysis, the observable variables (items) were used to compose the score factor of each construct. For the measurement of the factor score, the Partial Least Square – Structural Equation Modeling (PLS-SEM) was chosen, since the scores are calculated by exact linear combinations of the values of all the items associated with a construct and it results in more precise estimates (Hair et al., 2011; 2017). Other positive aspects are that the method is suitable for small samples and data that do not follow the normal distribution (Hair et al., 2011; 2017). The values compiled from the scores allow researchers to prioritize factors and identify differences between them, ensuring accurate data analysis (Hair et al., 2011).

Lean social and technical practices comprise sub-constructs representing specific activities and indicators. A measurement analysis of reflective models was performed to ensure that the observable variables reflected and presented the minimum criteria to compose each construct. The measurement model of each construct was assessed by the

internal consistency (Composite Reliability or Cronbach's alpha >0.7), convergent validity (outer loadings > 0.7 and Average Variance Extracted - AVE >0.5) and discriminant validity (Heterotrait-Monotrait – HTMT<0.85) (Hair et al., 2017; Ringle et al., 2012). The measurement step helps in validating the questionnaire for future research. To carry out the analyses, the SMARTPLS 3.3.3 software program was used. The main validation information is presented in Table 5.

**Table 5:** Internal consistence and convergent validity

| Construct | Authors | Cronbach's Alpha* | Composite Reliability* | (AVE)** |
|---|---|---|---|---|
| **Technical Practices** | | | | |
| Customer Involvement | Shah and Ward (2007); Alsmadi et al. (2012); Malmbrandt and Ahlstrom (2013); Hadid et al. (2016); Kundo and Manohar (2016) | 0.867 | 0.905 | 0.659 |
| Continuous Flow | | 0.842 | 0.895 | 0.681 |
| Pull | | 0.939 | 0.956 | 0.845 |
| Supplier Feedback | | 0.908 | 0.935 | 0.783 |
| TPM | | 0.880 | 0.917 | 0.734 |
| Visual Control | | 0.895 | 0.928 | 0.762 |
| Work Standardization | | 0.897 | 0.928 | 0.763 |
| **Social Practices** | | | | |
| Continuous Improvement Culture | Shah and Ward (2007); Liker and Convis (2011); Alsmadi et al. (2012); Malmbrandt and Ahlstrom (2013); Albliwi et al. (2014); Hadid et al. (2016); Kundo and Manohar (2016) | 0.896 | 0.935 | 0.828 |
| Employee Involvement | | 0.892 | 0.925 | 0.756 |
| Leadership | | 0.811 | 0.878 | 0.646 |
| Multifunctional Employees | | 0.888 | 0.931 | 0.817 |
| Training and People Development | | 0.862 | 0.916 | 0.785 |
| Reward and Recognition | | 0.963 | 0.976 | 0.931 |
| **Sustainability Performance** | | | | |
| Economic Sustainability | Maletič et al. (2020); Fernando et al. (2019) | 0.920 | 0.937 | 0.680 |
| Environmental Sustainability | | 0.947 | 0.956 | 0.759 |
| Social Sustainability | | 0.924 | 0.940 | 0.694 |

*All values are > 0.7 threshold value
**All values are > 0.5 threshold value

To identify the association between the constructs, a correlation analysis was performed using the Spearman coefficient, which measures the degree of correspondence between rankings, and it is a measure of association between two variables (Gibbons and Chakraborty, 2003). The analysis involved the scores of Lean practices and sustainability performance constructs and was performed using Minitab 17 software.

## 4. Pilot survey results

### 4.1 Main drivers for Lean implementation

When asked about the motivation factors for Lean implementation in the service organization (Figure 2), the highest level of agreement (proportion of respondents declaring agree or strongly agree) was enhances customer satisfaction, in which 72% of the sample agreed. The other reasons (70% of the sample with a high level of agreement) include reduce costs, improve operational performance, improving service delivery and reducing delays, waiting and operational time. In organizations, the motivation factors less present are associated with innovation, "create new innovative processes" and "introduce new services". Therefore, deploying Lean in service organizations is related to operational improvements.

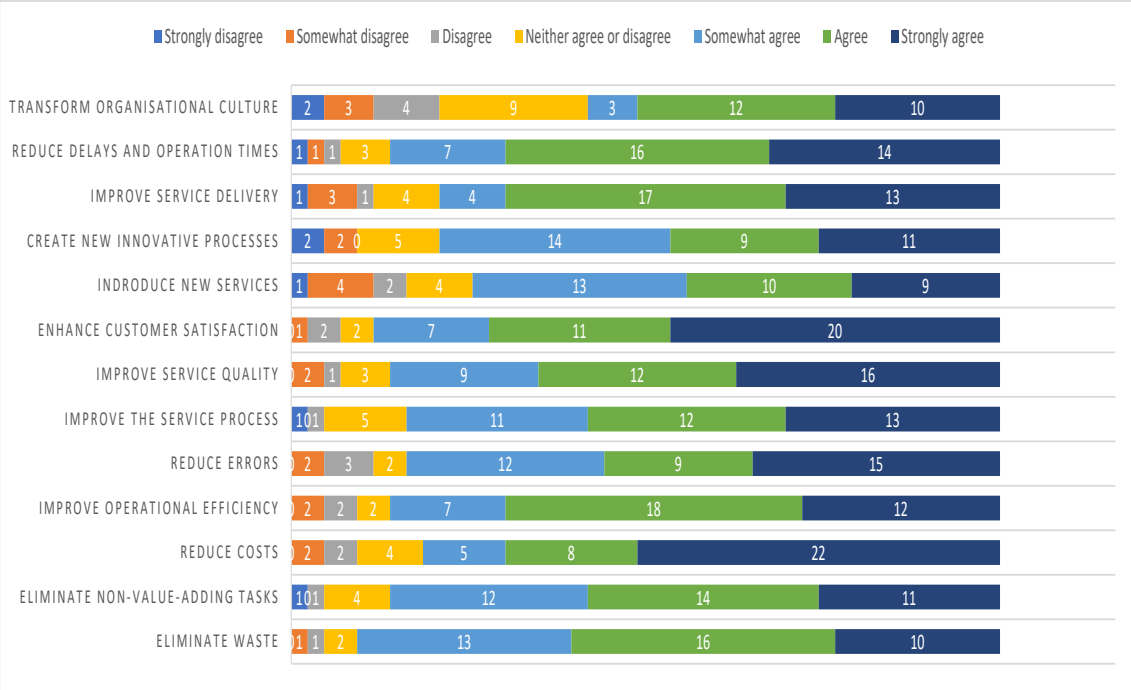


**Figure 2:** Main motivations for Lean implementation

### 4.2 Lean tools

The surveyed sample of service companies still has low adoption of Lean tools (Figure 3). Hoshin Kanri, used in strategic planning and used for policy deployment, is the one

with the lowest adhesion, which is a tool for unfolding objectives and policies, showing that Lean can be little incorporated into more strategic actions by companies. Low adherence is followed by the Spaghetti Diagram, which is a widely used Lean tool in flows and may not suit all service environments. The highest levels of usage agreement are present in the 5-Whys and in the Value Stream Map, tools for identifying problems, their causes, and opportunities for improvement.

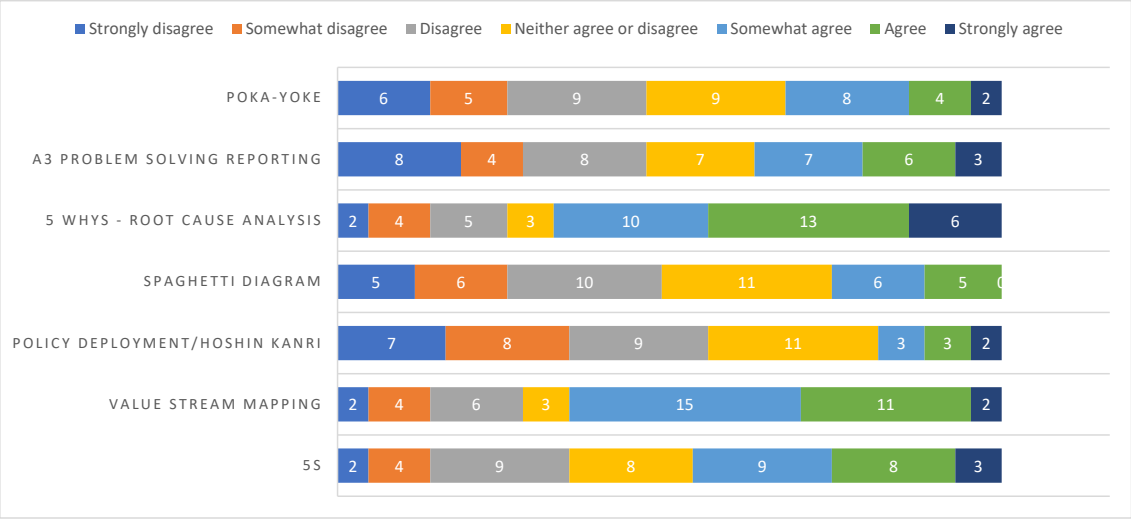


**Figure 3:** The adoption of Lean tools

4.3 Lean practices

The service companies sampled show high adoption of practices related to "Supplier Feedback" and "Customer Involvement", with high use of actions such as treating the supplier with respect, close contact with customers and customers' feedback (Table 6). "Work Standardization" it was also identified as a practice with high adoption, showing that service companies have standardized work activities and normalization of work standards. Followed by the practice of "Continuous Flow", emphasizing the adoption of pace of operation linked with the rate of customer demand. "Visual Control" practices were the fifth most adopted technical practice, emphasizing information availability activities and presentation in the correct place. The lesser-used technical practices are related to "TPM" and "Pull", with little emphasis on sharing information about equipment

maintenance, daily planning of maintenance activities, and use of Kanban or similar signals for operations control.

**Table 6:** Use of technical Lean practices

| Practice | Score | Observable variables | Mean |
|---|---|---|---|
| Supplier Feedback | 5.34 | Close contact with our suppliers | 5.16 |
| | | Suppliers feedback on quality and delivery | 4.81 |
| | | Establish long-term relationship with suppliers | 5.42 |
| | | Treat suppliers with respect | 5.74 |
| Customer Involvement | 5.34 | Close contact with customers | 6.00 |
| | | Customers feedback in quality and delivery performance | 5.53 |
| | | Customers are actively involved in current and future offerings | 4.91 |
| | | Customers frequently share current and future demand information | 4.60 |
| | | Regularly conduct customer satisfaction surveys | 5.21 |
| Work Standardization | 4.78 | Standardized work activities | 5.02 |
| | | Formalization of work standards | 4.88 |
| | | Stable and predictable tasks | 4.74 |
| | | Value stream and waste identification | 4.40 |
| Continuous Flow (CF) | 4.57 | Use workplace and information system design to produce a continuous flow | 4.23 |
| | | Use information and resources located based on when and where they are needed | 4.49 |
| | | Pace of operation is linked with the rate of customer demand | 4.84 |
| | | The areas work together to connect the process cross-functionally | 4.77 |
| Visual Control | 4.25 | Uses visual control for making problems transparent | 4.21 |
| | | Uses visual indicators for detecting problems/deviation | 4.14 |
| | | Has the information needed in the right place | 4.28 |
| | | Makes improvement information available in central locations | 4.40 |
| TPM | 4.19 | Dedicate a portion of everyday to planned equipment maintenance | 3.95 |
| | | Maintain all equipment regularly | 4.58 |
| | | Maintain records of all equipment maintenance related activities | 4.35 |
| | | Provide a visual equipment maintenance for active sharing | 3.81 |
| Pull | 4.08 | Uses “pull” concepts in their operations | 4.28 |
| | | Operation is ‘pulled’ by the current demand of the next process step | 4.09 |
| | | Use a ‘pull’ operations system | 4.16 |
| | | Use Kanban or similar signals for operations control | 3.77 |

The sample's adoption of Lean social practices shows (Table 7) that the main practice is the “Continuous Improvement Culture”, emphasizing supporting management to improve processes and sustaining improvements. “Employee Involvement” and “Training and People Development” were the subsequent practices with the highest level of adoption. Employees are seen as key to the problem-solving teams and to lead improvement initiatives, while training for skill building is adopted.

Service companies have adopted employees and cross-functional teams, followed by the practice of leadership. Still, companies find it difficult for leaders to support daily kaizen, which may not be appropriate for service companies. The least adopted social practice is “Reward and Recognition”, in which the Lean program is not yet related to human resources and there are no rewards for Lean project members.

**Table 7:** Use of social Lean practices

| Practice | Score | Observable variables | Mean |
|---|---|---|---|
| Continuous Improvement Culture | 4.93 | Use a structured problem-solving approach for improvement | 4.60 |
| | | Work to sustain improvements | 4.95 |
| | | Have management support to improve processes | 5.19 |
| Employee Involvement | 4.84 | Employees are key to problem-solving teams | 5.28 |
| | | Employees drive suggestion programmes | 4.72 |
| | | Employees lead service/process improvement efforts | 4.84 |
| | | Employees are empowered to make changes | 4.49 |
| Training and People Development | 4.84 | Adopt training for skill building | 5.26 |
| | | Adopt training for team building | 4.72 |
| | | Adopt training for cross-functional skills | 4.44 |
| Multifunctional Employees | 4.81 | Adopt multifunctional teams | 5.00 |
| | | Employees have multiple functions | 4.77 |
| | | Adopt cross-functional teams | 4.60 |
| Leadership | 4.77 | Leaders have a coaching role and develop others | 4.98 |
| | | Leaders support daily kaizen | 4.02 |
| | | Leaders create the vision and align goals | 4.79 |
| | | Leaders have thorough understanding of work | 5.02 |
| Reward and Recognition | 3.88 | Lean program is connected to human resources reward | 3.81 |
| | | There are policies to recognize the team success in lean projects | 4.02 |
| | | There are appropriate rewards provided to lean project members | 3.81 |

4.4 Sustainability performance

The service organizations sampled demonstrate a more advanced sustainability performance in the economic dimension than environmental and social ones (Table 8). The economic performance is positively reflected in operational issues such as increased productivity and cost reduction. The indicator with the lowest degree of agreement in this category is that ROI increased above the market average.

In the opinion of the interviewees, the environmental indicator with the greatest positive impact was reduced energy consumption in facilities, followed by the company achieving higher resource efficiency. This shows an effect on efficiency. However, there is still little impact on resource consumption in processes. The social performance had the most negligible impact, with little perception about the increase in employees' satisfaction and motivation and a little more impact on the wellbeing across employees and community.

**Table 8:** Sustainability performance

| Practice | Score | Observable variables | Mean |
|---|---|---|---|
| Economic Performance | 4.80 | Reduction in operational cost | 4.93 |
| | | Improved competitiveness of business | 4.86 |
| | | Productivity has gone up | 5.07 |
| | | ROI has increased above the industry average | 4.47 |
| | | Sales growth has increased above industry average | 4.88 |
| | | Profit growth rate has increased above industry average | 4.65 |
| | | Market share has increased in the last three years | 4.72 |
| Environmental Performance | 4.40 | Have substantially reduced energy consumption in facilities | 4.67 |
| | | Have substantially reduced overall CO2 emission | 4.30 |
| | | Have substantially reduced waste across processes | 4.44 |
| | | Have achieved higher resource efficiency | 4.47 |
| | | Have decreased resource consumption in processes | 4.07 |
| | | Have substantially improved recycle of waste | 4.42 |
| | | Have substantially improved reuse of resources | 4.42 |
| Social Performance | | Social wellbeing across employees and community have improved | 4.47 |
| | | Health and safety standard of our organisation has improved | 4.86 |
| | | Employee turnover has decreased | 4.23 |
| | | Employee education and training have increased | 4.23 |
| | | The employees' satisfaction and motivation have increased | 4.21 |
| | | The employees' quality of life has increased | 4.28 |

4.5 Relationships between Lean practices and sustainability performance

Table 9 presents the Spearman correlation for the scores of the latent variables. The leading associations with all sustainability performance dimensions occur with “Continuous Improvement Culture” practice. Data show that continuous improvement is moderately and positively correlated with economic, environmental, and social aspects. The second practice with the highest correlation with the three sustainability dimensions is also a social practice, it is Leadership.

The economic dimension is moderately correlated with technical practices such as "Continuous Flow" and "Pull". Therefore, technical issues make it possible to improve productivity and reduce costs, impacting financial and market results. It should be noted that the "Pull" practice was the one with the lowest adherence by service organizations. The environmental and social dimensions of sustainability are more correlated with Lean social rules, including, in addition to "Continuous Improvement Culture" and "Leadership", also "Employee Involvement", which are the practices that make people commit and be aligned with the increase in the efficiency of resources and in the wellbeing, health and safety of employees.

**Table 9:** Spearman correlation between Lean practices and sustainability performance

| | | | **Sustainability** | | | |
|---|---|---|---|---|---|---|
| **Practices** | **Economic** | **p-value** | **Environmental** | **p-value** | **Social** | **p-value** |
| **Technical** | | | | | | |
| Continuous Flow | **0,603** | <0,001 | 0,432 | 0,004 | 0,485 | 0,001 |
| Customer Involvement | **0,557** | <0,001 | 0,461 | 0,002 | 0,440 | 0,003 |
| Pull | **0,599** | <0,001 | 0,502 | <0,001 | 0,521 | <0,001 |
| Supplier Feedback | 0,496 | 0,001 | 0,368 | 0,015 | **0,560** | <0,001 |
| TPM | 0,373 | 0,014 | **0,511** | <0,001 | **0,555** | <0,001 |
| Visual Control | 0,542 | <0,001 | **0,519** | <0,001 | 0,543 | <0,001 |
| Work Standardization | **0,592** | <0,001 | **0,536** | <0,001 | **0,601** | <0,001 |
| **Social** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Continuous Improvement Culture | **0,664** | <0,001 | **0,619** | <0,001 | **0,663** | <0,001 |
| Employee Involvement | **0,515** | <0,001 | **0,575** | <0,001 | **0,632** | <0,001 |
| Leadership | **0,627** | <0,001 | **0,604** | <0,001 | **0,652** | <0,001 |
| Multifunctional employees | 0,343 | 0,024 | 0,299 | 0,052 | 0,387 | 0,01 |
| Reward and Recognition | 0,372 | 0,014 | 0,449 | 0,003 | 0,464 | 0,002 |
| Training and People Development | 0,398 | 0,008 | 0,464 | 0,002 | 0,541 | <0,001 |

In bold the main correlations

The research gaps, research questions, and how they were met through this research are shown in Table 10.

**Table 10**: Research gaps, questions and how they were met

| Research gap addressed | Research questions | How they were met |
|---|---|---|
| There is a strong relationship between motivation and benefits, in Lean implementation (Vashishth et al., 2017). Understanding the motivating factors in the context of Lean services can be considered a research gap. | *RQ1: What are the main motivating factors of service companies for the implementation of Lean?* | Identified main motivating factors, figure 2 |
| Lean tools should be encouraged to enable the implementation of Lean; managers must be aware of the technical and social practices of Lean, given that they are complementary and are related to different performances; managers should focus on social practices such as Continuous Improvement Culture and Leadership to strengthen all the dimensions of sustainability. | *RQ2: What are the main Lean tools used by service companies?* | Identified adoption of Lean tools, figure 3 |
| | *RQ3: What are the main Lean (soft and hard) practices used by service companies?* | Identified technical and social Lean practices, tables 4 and 5 |
| However, there are few studies on sustainability in services, especially considering the impact of Lean in this context. | *RQ4: What are the sustainability performances in service companies?* | Identified sustainability performance, table 6 |
| Advancing the knowledge of the relationship between Lean practices and sustainability performance in service organizations, filling a gap in the literature. | *RQ5: What are the relationships between Lean practices and sustainability performance?* | Developed statistics to validate relationships between Lean practices and sustainability performance, table 7 |

## 5. Discussion

The Lean approach has spread beyond manufacturing organizations, showing an interest from various service industries in its application (Gupta et al., 2016). However, knowledge about the application of Lean service is still scarce and little explored, especially in empirical studies (Malmbrandt and Ahlstrom, 2012; Gupta et al., 2016; Julião and Gaspar, 2021). This pilot study offers empirical validation on the adoption of Lean methodology and its impact on sustainability performance in service oriented industries. Service including banking, healthcare, utilities, and maintenance contribute significantly to the economy and development. Influenced by the popularity of Lean manufacturing, service oriented industries use the results to provision innovative services and optimize service design. Based on the analysis, the primary motivation for lean implementation in the service sector is to improve customer satisfaction, followed by cost reduction. This confirms the disconfirmation theory of service satisfaction which postulates comparison of service experience with standards previously experienced by customers. To achieve positive results root cause analysis and value stream mapping were the preferred tools for the service sector. Value stream mapping offers remarkable ways to redesign service processes and establish continuous flow, and reduces bottlenecks. The applicability of specific Lean tools may be different from non-service settings, this work provides specific guidance on the applicability of tools. It is fairly intuitive to note that customer involvement and supplier feedback were highly rated factors for adopting technical Lean practice in the service sector. In addition, continuous improvement culture, employee involvement, training and people development are highly rated for the Lean social practices. Continuous improvement is ubiquitous to a range of functions for service sector. In particular, this study addresses the integration of economic, environmental, and social Lean practices for the service industry. Continuous improvement culture positively correlates with all three aspects on positively with all three

aspects of established methodologies such as Lean and Six-Sigma. This requires a closer examination of how and why certain tools always are favored and work in the service sector and their differences with other sectors. Leadership is of paramount importance to the success of any Lean initiative. Goodridge et al. (2015) highlight the contribution of leadership change associated with Lean implementation in healthcare and how they positively affect the outcomes. Our present study reemphasizes the role of leadership and the results exhibit positive correlation with both environmental and social aspects of Lean implementation in the service sector. A Lean methodology is an extremely popular collection of tools and has proven benefits widely recognized in manufacturing and production-oriented industries. Lean can be referred to as a philosophy of identifying and reducing waste (non-value-added activities) leading to operational improvements and tangible savings in the service sector. From the theoretical perspective, most previous studies have focused on success associated with Lean implantation in the service industry. The association between adoption and sustainability of Lean has received little attention.

## 6. Conclusions

The results of the study showed that there are several motivating factors for the implementation of Lean, the highlights being improving customer satisfaction, efficiency, delivery and reducing them and costs. There are still restrictions on the adoption of Lean tools by service organizations, the most frequently used are related to the identification of improvement opportunities and causes of problems (5 Whys, Value Stream Map). The pilot survey also made it possible to identify the greater use of technical practices than social practices, the most used technical Lean practices are Supplier Feedback, Customer involvement and Work Standardization. The main soft practices identified were Continuous Improvement Culture, Employee Involvement and

Training and People Development. The sustainability performance analysis showed that the better performance of service companies is in an economic dimension. The relationships between Lean practices and sustainability performance showed that Lean social practices, as Leadership and Continuous Improvement Culture are positively associated with the three dimensions of sustainability, while Lean technical practices Continuous Flow and Pull are positively associated with the economic dimension.

### 6.1 Theoretical and practical implications

As theoretical implications, there was a contribution to the Lean service research field, since there is a lack of empirical studies on this topic (Hadid and Mansouri, 2014; Hadid et al., 2016). The study allowed an understanding of the motivational factors and tools for the service sector, which implies greater knowledge of what is being used in this sector, since it has its own characteristics and dynamics (Alsmadi et al., 2012; Gupta et al., 2016). The study advanced the analysis of the Lean practices used, observing social and technical practices, as indicated by several authors (e.g., Hadid and Mansouri, 2014; Hadid et al., 2016). The study advances the analysis of sustainability performance for the service sector, little observed empirically, but relevant for theory and practice (Moisescu, 2018; Ali et al., 2020). Finally, the study contributes to advancing the knowledge of the relationship between Lean practices and sustainability performance in service organizations, filling a gap in the literature.

Empirical results generate practical implications for service managers. These implications include: managers should pay attention to the implementation of Lean in their organizations, since it is a current trend that can help in different performance results; Lean tools should be encouraged to enable the implementation of Lean; managers must be aware of the technical and social practices of Lean, given that they are

complementary and are related to different performances; managers should focus on social practices such as a Continuous Improvement Culture and Leadership to strengthen all the dimensions of sustainability.

### 6.2 Limitations and future studies

In particular, very few studies have emphasized the interlink between sustainability and lean adoption in the service sector. A significant limitation of this research is the number of responses (n=43) (pilot study), and the focus on only the European context, a more detailed global study can generalize and provide comprehensive results. Other limitations are related to the survey being a cross-sectional one, whereas a longitudinal study could provide more information about how the practices are being implemented and how the impact on the dimensions of sustainability occurs. Future studies may encompass multi-methods, with a qualitative and quantitative perspective, allowing a greater level of generalization and deeper insights and conclusions.

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