



Impact of Operational Excellence Frameworks on Sustainable Performance in Services: A Qualitative Study

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Abstract:	

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Abstract

Purpose - This study investigates the adoption and effects of operational excellence methodologies on sustainable performance within the sector, drawing insights from 18 global quality management experts.

Design/methodology/approach - Utilizing a phenomenological approach alongside constant comparison, classical content, and taxonomy analysis, qualitative data from semi-structured interviews are rigorously examined. The study examines the challenges and outcomes of implementing Lean, Six Sigma, and Lean Six Sigma, particularly in the financial, social, and environmental realms. By integrating academic research with real-world applications, this research identifies challenges and opportunities across diverse service industries, with the aim of informing best practices for practitioners.

Findings - The findings highlight a significant impact on financial outcomes, with Lean Six Sigma implementations predominantly enhancing financial performance. However, perceptions differ regarding sustainability and the acknowledgment of such impact. In terms of social performance, opinions vary from consistently positive impact to a dual effect—both positive and negative. Regarding environmental impact, perspectives range from limited to significant positive outcomes. Additionally, quantitative analysis of operational measures underscores a noteworthy emphasis on financial performance, with a grand average of 4.23. Social performance marginally surpasses environmental performance, with averages of 3.01 and 2.95, respectively.

Originality/value - The critical role of the service sector in modern economies highlights the imperative for enhancing operational efficiency and sustainability. The findings highlight the importance of proactively integrating Lean Six Sigma principles into the operational frameworks of service organizations to optimize both operational and sustainable performance.

Keywords: Operational excellence, Frameworks, Sustainability, Qualitative study

1. Introduction

The service sector plays a crucial role in developed economies, contributing significantly to the gross domestic product (GDP), surpassing the manufacturing sector (Piercy and Rich, 2009; Suárez-Barraza *et al.*, 2012). A study conducted by the World Bank Group, (2021) has shown that the service sector contributes to approximately 61.7% of the GDP worldwide. Moreover, as service operations experience exponential growth globally, it becomes imperative to address the unique challenges in this sector. Additionally, nonvalue-added (NVA) costs often constitute 50% of total service costs, impacting the economy as a whole (George, 2003). Therefore, it is crucial to address these challenges to improve overall operations and services within the sector.

Beyond operational performance, the dynamic and competitive marketplace pressures customers, stakeholders, and the government to adopt sustainable practices (Caiado *et al.*, 2017, 2019). Given the substantial contribution of service industries to the economy, it is essential to improve operational performance and consider the impact of these operations on sustainable performance dimensions: (financial, social, and environmental) (Cherrafi *et al.*, 2016).

Operational excellence methodologies, such as Lean, Six Sigma, and Lean Six Sigma, initially introduced in the manufacturing sector, have gained significant adoption in the service sector due to the need for timely services, cost reduction, and overall improvement in service quality, leading to enhanced customer satisfaction (George, M.L. and George, 2003). The growing importance of these methodologies in service operations is reflected in the doubling of academic articles focusing on Lean Six Sigma in recent years, underscoring their substantial contribution to the service sector (Tjahjono *et al.*, 2010). Although numerous studies have explored the adoption of methodologies such as Lean, Six Sigma, and Lean Six Sigma in various service industries, there is a scarcity of research that comprehensively addresses the entire service sector, particularly investigating the overall impact on the three dimensions of sustainable performance. Furthermore, only a few studies have examined the disparity between scholarly articles and real-world applications within these industries.

This research aims to bridge these gaps by comprehensively analyzing the adoption of Lean, Six Sigma, and Lean Six Sigma in the service sector. It seeks to provide insights into their overall impact on sustainable performance dimensions and address the disparity between academic studies and practical applications within various industries. In doing so, this study attempts to contribute to a more holistic understanding of the challenges and opportunities associated with implementing these methodologies in the service sector and their contribution to the economy, society, and the environment. This study aims to answer the following research questions:

- RQ1: What are the key aspects of Lean, Six Sigma, and Lean Six Sigma implementation in the service sector, including their adaptation, tools used, and challenges faced?
- RQ2: What are the outcomes of the implementation of Lean, Six Sigma, and Lean Six Sigma in the service sector, and how can those outcomes be classified into sustainable performance on the financial, social, and environmental dimensions?
- RQ3: What is the impact of operational measures on sustainable performance in the service sector?

This paper is structured to address the above-mentioned questions. The first section of the analysis discusses the main findings regarding the implementation of operational excellence methodologies in the service sector, including the preferred methodology, commonly used tools, and the challenges encountered during implementation. Subsequently, the next section delves into the examination of the impact on the three dimensions of sustainable performance: financial, social, and environmental. Finally, the last section explores the indirect impact of operational excellence methodologies on sustainable performance through operational measures.

2. Literature Review

2.1 Theoretical background

2.1.1 Lean Six Sigma

Lean is an operational excellence methodology that was first introduced in the 1980s to enhance efficiency through waste reduction and elimination of non-value-added activities (Womack *et al.*, 1980). According to (Schonberger, 1986), Lean focuses on eliminating seven types of waste (transportation, inventory, motion, waiting, overproduction, overprocessing, and defects) and creating value for customers, employees, and suppliers. The elimination of waste is tied to the

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3 creation of low-cost improvements and doing more with less (Barraza *et al.*, 2009; Comm and
4 Mathaisel, 2005; Dahlgard and Dahlgard-Park, 2006).

7 Additionally, Six Sigma is an operational excellence methodology introduced by Bill Smith at
8 Motorola in 1988 to improve the quality of manufactured goods (Snee, 2003). Six Sigma aims to
9 systematically identify and eliminate causes of errors to reduce defects to 3.4 parts per million
10 opportunities, thus improving customer satisfaction (Mikel, 1998; Snee, 2000).

14 The integration of Lean and Six Sigma gained significance in the early 2000s to address the
15 inherent limitations of each standalone methodology (Antony *et al.*, 2017; George, 2002; Salah *et*
16 *al.*, 2010; Snee, 2010). Although both Lean and Six Sigma have exhibited remarkable results in
17 the manufacturing and service sectors independently, their integration becomes crucial to
18 overcoming specific challenges. Lean's limitation in statistical analysis for capturing process
19 variation, a critical aspect for process quality improvement, and its inability to solve complex
20 problems requiring intensive data analysis can be addressed by incorporating Six Sigma (Antony
21 *et al.*, 2021; Drohomerski *et al.*, 2014; Salah *et al.*, 2010). Similarly, Six Sigma's challenge in
22 capturing interactions between processes can benefit from Lean's emphasis on the overall value
23 stream (Antony *et al.*, 2021). Consequently, Lean Six Sigma aims to simultaneously minimize
24 waste between processes through Lean practices and reduce variation within processes through
25 Six Sigma (George, 2002). The integration of Lean and Six Sigma tools enables organizations to
26 improve the overall quality of products and services, ultimately leading to improved customer
27 satisfaction (Mader, 2008).

39 40 2.2.2 Lean Six Sigma in the Service Sector

41 While organizations across various sectors share commonalities, the service sector is characterized
42 by unique attributes that distinguish it from manufacturing. These distinctive features encompass
43 intangibility, heterogeneity, inseparability, simultaneity, and perishability (Lovelock C. and E.,
44 2004).

48 Despite Lean's initial introduction and predominant use in manufacturing, it has gained widespread
49 application in various service industries (Hasle *et al.*, 2012; Staats *et al.*, 2011). As a result,
50 numerous contributions have aimed to modify Lean methodologies to better suit the unique
51 characteristics of service organizations (Åhlström, 2004). However, it is now widely accepted that
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3 Lean is equally relevant to service organizations as it is to manufacturing, serving the same purpose
4 in both sectors (Alsmadi *et al.*, 2012; Sharma *et al.*, 2016; Suárez-Barraza *et al.*, 2012). Although
5 some service organizations face some challenges in implementing Lean due to the nature of their
6 organizations, it has shown a significant positive impact on overall service outcomes (Hadid *et al.*,
7 2016; Narayanan *et al.*, 2022; Rundall *et al.*, 2021; Sharma *et al.*, 2016; Suárez-Barraza *et al.*,
8 2012). This recognition marks a shift from the initial hesitations in the service sector towards
9 embracing Lean principles, highlighting its adaptability to improve operational efficiency and
10 quality of services.
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18 Similarly, Six Sigma was originally introduced and implemented in the manufacturing sector.
19 However, it was argued that service operations operated below a 3.5-sigma quality level, resulting
20 in a notable defect rate (Yilmaz and Chatterjee, 2000). The adoption of Six Sigma emerged as a
21 viable solution to improve these aspects, promising financial savings and improved customer
22 satisfaction (Antony, 2006; Yilmaz and Chatterjee, 2000). Consequently, Six Sigma quickly
23 garnered recognition in the service sector (Antony, 2006; Antony *et al.*, 2007). Antony (2006) has
24 illustrated that implementing Six Sigma in the service sector can foster effective management
25 decisions and enhance understanding of customer needs and expectations. Today, the methodology
26 contributes to efficient internal operations, accelerates service delivery, and reduces variability,
27 resulting in an improved and more predictable service level (Antony, Palsuk, *et al.*, 2018; Niñerola
28 *et al.*, 2020).
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37 2.2.3 Sustainable Performance

38 Sustainable performance is the capacity of an organization to meet its objectives while ensuring
39 long-term viability across environmental, social, and economic dimensions. Known as the "triple
40 bottom line," this framework assesses and manages sustainable performance by emphasizing the
41 importance of balancing these three essential pillars (Elkington, 1998; Hansmann, 2010).
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46 To evaluate the impact on sustainable performance, various indicators can be used, often tailored
47 to specific industries. Commonly addressed indicators include energy efficiency, waste generation,
48 emissions, and compliance with legal requirements as part of environmental performance (Rahdari
49 and Anvary Rostamy, 2015). In terms of social performance, organizations generally consider
50 professional ethics, social impact, and customer and employee satisfaction (Amjad *et al.*, 2022;
51 Hansmann, 2010; Souza and Alves, 2018). Finally, for financial performance, indicators such as
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3 cost savings, profitability, and productivity are often examined (Amjad *et al.*, 2022; Hansmann,
4 2010). Together, these indicators provide a comprehensive view of sustainable performance of an
5 organization in all three dimensions.
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9 In addition, the Balanced Scorecard (BSC) is a strategic planning and management tool that
10 translates organizational strategies into actionable objectives in four key perspectives: financial,
11 customer, internal processes, and learning and growth. This structured framework allows
12 organizations to align their activities with their strategic goals, ensuring a comprehensive approach
13 to performance measurement (Heavey and Murphy, 2012; Journeault, 2016).
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18 Furthermore, the BSC can incorporate sustainability as a critical dimension of organizational
19 performance. The sustainability-focused Balanced Scorecard (SBSC) integrates environmental
20 and social considerations into the traditional BSC framework, allowing organizations to align their
21 sustainability goals with overall strategic objectives (Dağıdır and Özkan, 2024; Jassem *et al.*,
22 2018). This integration ensures that sustainability is not treated as an isolated initiative but is
23 embedded within the overall performance of the organization, addressing both financial and non-
24 financial aspects (Hsu *et al.*, 2011; Journeault, 2016).
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31 Moreover, several studies have recently shown the synergistic effect of integrating operational
32 excellence methodologies and BSC (Heavey and Murphy, 2012; Trakulsunti *et al.*, 2023). By
33 employing data-driven methodologies, operational excellence methodologies help organizations
34 identify inefficiencies and optimize processes, which directly contributes to achieving the strategic
35 objectives outlined in the BSC (Trakulsunti *et al.*, 2023; Yüksel and Dağdeviren, 2010; Al Zaabi
36 *et al.*, 2024). This integration not only improves operational efficiency but also improves customer
37 satisfaction by providing higher quality services. When combined with sustainability initiatives,
38 this approach allows organizations to effectively manage their environmental and social
39 responsibilities alongside operational excellence, leading to a more holistic and competitive
40 business model (Hansen and Schaltegger, 2016; Moktadir *et al.*, 2020).
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52 2.2.4 The Impact of Lean Six Sigma on Sustainable Performance in the Service Sector

53 Although improving operational performance is a key motivator for implementing Lean, Six
54 Sigma, and Lean Six Sigma, their contribution to sustainable performance in the service sector is
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3 crucial (Caiado *et al.*, 2018). Considering this aspect is essential to foster competitive advantage
4 and align with the needs of customers, stakeholders, and government agencies (Moisescu, 2018).
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6 Cherrafi *et al.*, (2016) demonstrated that integrating Lean, Six Sigma, and sustainable performance
7 strategically aims to improve organizational performance. Sustainable performance goes beyond
8 immediate gains by achieving long-term success while also considering economic, environmental,
9 and social factors (Elkington, 1998). Although several studies have addressed the impact of Lean,
10 Six Sigma, and Lean Six Sigma on one or two dimensions of sustainable performance, a limited
11 number of empirical studies address the comprehensive impact of operational excellence
12 methodologies on the three dimensions of sustainable performance in the service sector.
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20 The impact of Lean on the three dimensions of sustainable performance in some industries within
21 the service sector was empirically explored. In higher education, for example, Klein *et al.*, (2022)
22 indicated that Lean significantly impacts economic, environmental, and social performance, with
23 economic performance being the most affected among the three dimensions. Similarly, in the
24 hospitality industry, it was found that lean tools and practices impacted the sustainable
25 performance of hotel supply chains. The findings indicate that Lean practices significantly
26 influence economic performance while exerting the least influence on environmental performance
27 (Hussain *et al.*, 2019). The impact of Lean on the service sector was recently explored by Lizarelli
28 *et al.*, (2023) using a survey. The findings indicate a significant relationship between improved
29 performance in the service sector and the economic dimension of sustainability.
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38 In addition, several studies have investigated the influence of Six Sigma and Lean Six Sigma on
39 some dimensions of sustainable performance within specific industries in the service sector. In the
40 healthcare sector, Niñerola *et al.*, (2020) reported that 17% of Six Sigma articles focused on
41 financial measures, specifically addressing issues contributing to higher expenses and achieving
42 cost reduction. Bhat *et al.*, (2023) found that Six Sigma positively impacted return on investment,
43 savings, and profits in hospitality, transportation, and logistics organizations in the UAE. Antony
44 *et al.*, (2018) have also demonstrated the potential impact of Six Sigma on certain financial and
45 social measures. Furthermore, a review conducted by Antony *et al.*, (2007) indicates that Six
46 Sigma significantly influences financial performance by reducing costs and social performance
47 measures, such as increased customer and employee satisfaction and enhanced employee morale.
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3 Numerous empirical investigations have highlighted the positive impact of Lean Six Sigma on
4 financial performance measures, including cost reductions, savings, and increased profits. This
5 impact has been observed across various industries, such as Healthcare (Antony *et al.*, 2021;
6 Honda *et al.*, 2018; Trakulsunti *et al.*, 2020) Financial Services (Vashishth *et al.*, 2019), Higher
7 education (Hess and Benjamin, 2015), and the service sector as a whole (Zhang *et al.*, 2016).
8 Furthermore, Lean Six Sigma has demonstrated positive effects on social performance measures,
9 such as creating a positive work environment, improving employee happiness, and fostering
10 trusting relationships, particularly in Healthcare (De Koeijer *et al.*, 2022). It has also shown an
11 impact on patient satisfaction and well-being (Honda *et al.*, 2018).
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19 Despite the findings, a significant emphasis on operational outcomes associated with Lean, Six
20 Sigma, and Lean Six Sigma raises important concerns about the broader impact of these
21 methodologies on sustainable performance. While the operational efficiencies achieved are
22 valuable and often lead to immediate improvements, this focus can overshadow critical social and
23 environmental outcomes. Prioritizing short-term operational gains can result in organizations
24 neglecting the long-term implications of their practices on employee well-being and environmental
25 sustainability. This operational bias is likely influenced by the tangible nature of operational
26 metrics, which are easier to measure and report, making them more appealing to management.
27 Furthermore, while some studies have addressed the impact of Lean on sustainable performance
28 in specific service industries, there remains a notable gap in exploring the effects of Six Sigma and
29 Lean Six Sigma on all three dimensions of sustainable performance across various sectors within
30 the service industry.
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41 Thus, the current study aims to address this gap by empirically examining the direct impact of
42 Lean, Six Sigma, and Lean Six Sigma on the three dimensions of sustainable performance in the
43 service sector. Additionally, it seeks to identify indirect effects through the most commonly
44 reported operational performance measures, ensuring a comprehensive understanding of this area
45 (as illustrated in Figure 1). Qualitative research and interviews with industry experts will help
46 uncover indirect benefits and provide a more holistic understanding of the impacts that are often
47 overlooked in academia.
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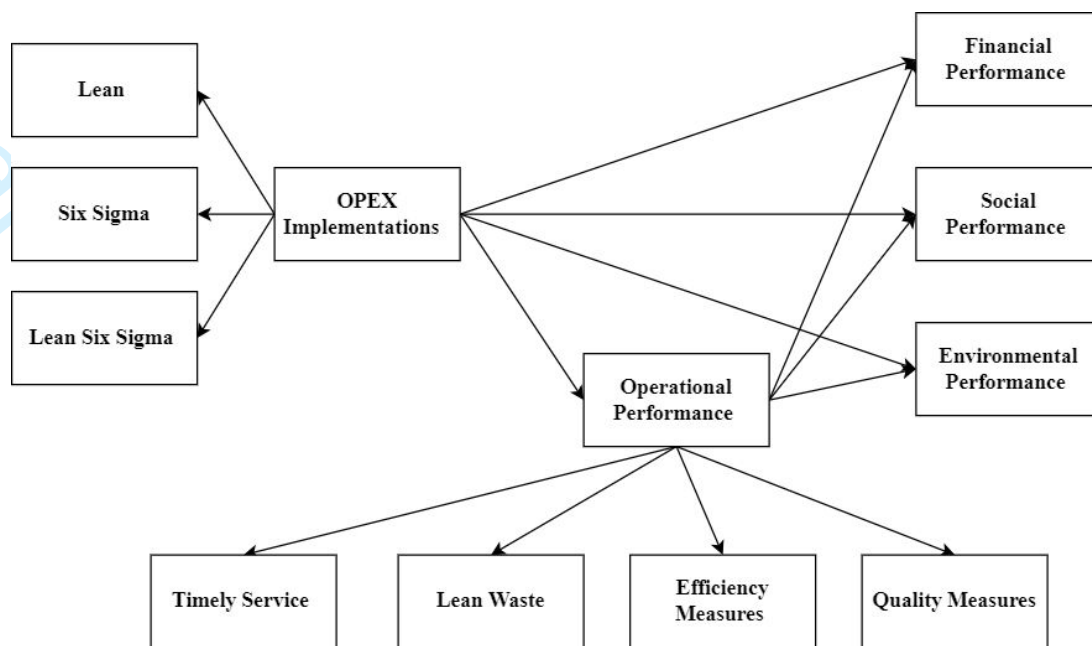


Figure 1. Conceptual Framework

3. Method

3.1 Research Design

This study adopts a qualitative research design to explore the impact of operational excellence methodologies on sustainable performance within the service sector. Qualitative research is chosen for its ability to provide in-depth insights into complex phenomena, allowing for a thorough examination of the experiences, perceptions, and perspectives of quality management experts within the service sector. Additionally, qualitative methods play a crucial role in documenting and understanding the adaptations required when applying interventions in real-life contexts. This documentation is essential because real-world situations often involve complexities that may not be fully captured by quantitative methods alone (Nastasi and Schensul, 2005).

The research aims to uncover the ways in which operational excellence methodologies, tools, and practices impact sustainable performance dimensions, including economic, environmental, and social aspects. Drawing on a phenomenological approach, this study seeks to understand the lived experiences and subjective interpretations of participants regarding the effects of Lean Six Sigma on sustainable performance. A purposive sampling strategy is used to select participants who

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3 possess significant knowledge and experience in implementing Lean Six Sigma within service
4 organizations. Ethical considerations, including informed consent and confidentiality, will be
5 rigorously adhered to throughout the research process. In general, this research design is designed
6 to provide a comprehensive understanding of the impact of operational excellence methodologies
7 on sustainable performance in the service sector, offering valuable insights for both academia and
8 industry.
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14 3.2 Data Collection

17 This study employs one-to-one semi-structured interviews with experts in operational excellence
18 methodologies within the service sector. Semi-structured interviews, a widely used approach,
19 involve providing interviewees with a predefined set of open-ended questions while allowing for
20 the introduction of emergent questions that naturally arise during the discussion (DiCicco-Bloom
21 and Crabtree, 2006; Johnson and Christensen, 2014; Kallio *et al.*, 2016). Semi-structured
22 interviews were chosen due to their ability to generate open and in-depth data while maintaining
23 consistency (Ng, and Coakes, 2013; Yin, 1994). The interviews range between 30-60 minutes in
24 duration and are structured around 15 questions aimed at capturing the following aspects
25 (Appendix A):
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- 28 • Respondent's profile
- 29 • Insights into the implementation of Lean, Six Sigma, and Lean Six Sigma in service
30 organizations, covering the adoption of methodologies, tools used, and challenges
31 faced.
- 32 • The impact of Lean, Six Sigma, and Lean Six Sigma on the three dimensions of
33 sustainable performance.
- 34 • The indirect impact of operational performance measures on sustainable performance.

35 The same set of fundamental questions was posed to all participants to ensure uniformity and
36 consistency in data collection. Before the main interviews, a pilot test with experts was conducted
37 to refine and clarify the interview questions. Consequently, a personalized invitation was sent to
38 each participant by email. The interviews were conducted using Microsoft Teams and recorded for
39 transcription purposes.
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3.2 Participants

This study used a purposive sampling approach to selectively choose participants based on specific criteria relevant to the research objectives (Etikan, 2016). The targeted participants were experts in operational excellence methodologies, specifically Black Belts (BB) and Master Black Belts (MBB) with extensive experience in various industries within the service sector. Participants were identified through professional online platforms, and their consent was obtained by email, along with the distribution of individual signed consent forms. In this empirical study, a total of 18 participants were included. These participants originated from various parts of the world, held various positions, and had experience in different industries within the service sector. To maintain anonymity, each interviewee was assigned a unique code that will be used consistently throughout the study. Table 1 summarizes the codes, positions, years of experience, and participants' countries.

Conducting a global study with participants from diverse regions facilitates a comprehensive understanding of the adaptation of methodologies and enhances our ability to generalize the findings. It ensures a broader perspective, allowing us to identify cultural differences, regional variations, and unique contextual factors that may influence the results of our research, thus strengthening the overall quality and relevance of the study. Regarding the geographical distribution of the participants, Europe constitutes the largest segment with nine participants, comprising 50% of the total. Following closely, Asia accounts for four participants, representing 22.2%. Australia is the third most represented continent, with three participants making up 16.7% of the sample. South America and North America each had one participant, constituting 5.6% each.

Table 1. Participants' Profile

Codes	Position	Experience (Yrs.)	Country
P1	Director of Process Improvement	24	UAE
P2	Continuous Improvement & LSS Manager	13	UAE
P3	Corporate Change and Continuous Improvement Manager	20	Oman
P4	Professor & Head of Department at a Higher Education Institution /The Head of Internal Quality Assurance	12	India
P5	Assistant Professor at a Higher Education Institution / Director of the Training Institute for LSS	7	Netherlands
P6	Professor & Program Coordinator at a Higher Education Institution	26	US

P7	Senior Manager at a Telecommunication Organization	20	Australia
P8	Business Analyst / Quality Manager	10	Germany
P9	Quality Leader	17	US
P10	Head of Industrial Engineering, Digitalization & Transformation	10	Germany
P11	Lead Consultant	25	Netherlands
P12	Associate Professor in Project Management.	14	Australia
P13	Associate Professor in Industrial Engineering	8	Brazil & Australia
P14	Chairman of the International LSS Institute & Director of LSS Training Company	20	UK
P15	Managing Partner in a Service Organization	25	UK
P16	A Consultant in a Consultancy Firm	23	Italy
P17	Runs an Institute of Six Sigma professionals and a Lean Six Sigma consultancy business	28	UK
P18	Senior Lecturer in Operations Management	15	UK

Furthermore, since the service sector encompasses various industries, participants from various industries were specifically chosen to represent the service sector more accurately. This ensures a holistic representation, allowing for a comprehensive exploration of potential variations and commonalities. Figure 3 shows the distribution of experiences of the participants in various industries. The data reveals that participants have experience in a total of eight industries, and it considers cases where individuals have experience in more than one industry.

The industry with the highest participant count is Healthcare, with seven participants. Financial Services closely follows with six participants. Education, Transportation & Logistics, and other back-end services each have five, four, and four participants, respectively. Telecom, IT Services, and CallCenters have two participants each. Furthermore, our study included representatives from each of the eight industries in Europe. Australia closely followed, representing four of the eight industries, North America and Asia each having representation from three of the eight industries, and South America only represented the healthcare industry.

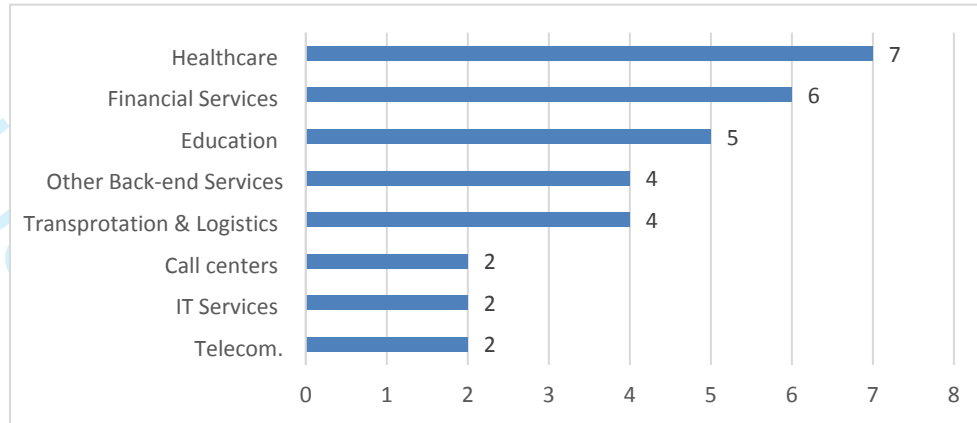


Figure 2. Industry Distribution of Participants

3.3 Data Analysis

In the data analysis process, the recorded interviews underwent transcription in the data analysis process, and the interview transcripts were analyzed using Dedoose software for Constant Comparison Analysis. The analysis involved open coding to categorize the scripts into main categories corresponding to the primary research questions by two coders. Subsequently, subcategories of themes were identified within each main category. To analyze the transcripts, the following steps of Constant comparison analysis as explained by Leech and Onwuegbuzie (2007) were followed:

- Thoroughly review the transcribed interviews.
- Divide the data into smaller, meaningful parts or "chunks."
- Label each chunk with a descriptive title or code.
- Compare each new chunk to previously coded chunks to ensure consistency.
- Group similar codes together based on their similarity.
- Identify and document themes based on these groupings, providing a structured framework for understanding and analyzing the data.

Subsequently, Classical Content Analysis helped identify the frequency and utilization of the identified themes and codes (Leech and Onwuegbuzie, 2007). It can identify which codes are used most and which might be the most important concepts for the interviewee. Finally, Taxonomic analysis was used to summarize the primary findings and offer an overarching perspective (Leech and Onwuegbuzie, 2007). This approach of combining different qualitative

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3 data analysis methods aligns with the concept of data analysis triangulation, emphasizing the
4 importance of employing various analysis tools to holistically comprehend the research
5 phenomenon (Leech and Onwuegbuzie, 2007; Lincoln *et al.*, 1985).
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8 9 4. Study Findings

10 11 4.1 Lean Six Sigma in the Service Sector

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14 The first section of the interview aimed to explore the implementation of operational excellence
15 methodologies in the service sector. This involved investigating themes such as the methodologies
16 employed, commonly used tools, and challenges specific to the service sector. This provides
17 valuable insight into the adaptation of such methods within the service sector and serves as a
18 baseline understanding for the subsequent sections of the interviews.
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21 22 The methodology used and why?

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24 When asked about the preferred methodology within the service sector, some participants
25 expressed a preference for adopting the integrated Lean and Six Sigma approach. The main reason
26 behind the integration is the recognition that Lean alone may not effectively address certain
27 complex problems that Six Sigma is capable of resolving. Simultaneously, the beneficial tools of
28 Lean are considered crucial and necessary within the framework of Six Sigma:
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33 *"Some of the problems which we have seen were so complicated, so we could not solve using lean*
34 *methodology." -P4.*

35 *" We usually integrate them; we believe they work well together and that they're complementary." -*
36 *P15.*
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39 Other reasons mentioned by P1, a director of continuous improvement in a logistics company, and
40 P8, a quality manager in an IT services company, include that the integrated approach is now part
41 of the evolution and is widely accepted:
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44 *"It's part of the evolution that it is well accepted." - P1*

45 *"It's what is used now." - P8*
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48 However, other participants indicated that their choice depends on the nature of the project. Three
49 participants emphasized a preference for Lean in situations that require "daily improvements",
50 "incremental changes", or "quick changes" and highlighted Six Sigma as the preferred
51 methodology when addressing complex problems that demand extensive data and statistical
52 analysis.
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3 *"If I'm trying to help other people improve their processes daily, more incremental, then we focus*
4 *more on lean instruments. But If the project requires more data collection and analysis, we go for*
5 *Six Sigma." – P5*
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8 Furthermore, P11 specified that Lean is used if there is “a lot of waste” in the process, whereas Six
9 Sigma is chosen to resolve “variation issues”. While P12 indicates that the decision depends on
10 the investment required.
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14 Moreover, some participants expressed a preference for Lean over Six Sigma. They noted that
15 Lean is favored in the service sector because it does not require extensive statistical tools and
16 analysis as in manufacturing, and it is more difficult to obtain sufficient data."
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19 *" There is a less need for statistical tools." - P2*

20 *" We use Lean because Six Sigma requires data, and in the service industries, they don't collect*
21 *data."- P16*
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24 The corporate change and continuous improvement manager at an oil and gas company (P3)
25 emphasized that “Lean fits the nature of our industry,” describing it as a “rich methodology of
26 tools, easy to learn and implement, with minimal costs and substantial benefits.” Moreover, P17,
27 who operates an LSS consultancy business, expressed his preference for Lean by noting that “there
28 is a belief, rightly or wrongly, that Six Sigma was overkill for their culture.” Furthermore, P14
29 raised doubts about the applicability of Six Sigma in the service sector, indicating that 'Six Sigma
30 is more applicable in the manufacturing and automotive industry.'
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38 Overall, based on the insights gathered from the participants, Lean Six Sigma emerges as the most
39 commonly employed methodology in service organizations. However, when integration is
40 unnecessary, Lean is preferred. Conversely, Six Sigma is not favored and is selectively used,
41 primarily in situations necessitating statistical analysis, which is uncommon in the service sector.
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46 Tools

47 When questioned about the most frequently utilized tools within these methodologies, most
48 participants highlighted the importance of process mapping tools such as Value Stream Mapping,
49 swim lane, Flowcharts, etc. Several participants emphasized the benefits of process mapping tools
50 with the following statements:
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"It displays all the different interactions and steps needed, so it's beneficial for mapping lengthy processes." – P3

"It really helps in understanding value-added and non-value-added activities." – P4

"The beauty of the value stream map is it enables us to look at cross-functionally how different functions operate together. It is an eye-opener for the different teams." – P1

"It suits the service industry." – P1

"In the service sector, there has to be a lot of process mapping." – P2

"There has to be some sort of process mapping." – P6

In general, process mapping tools are considered crucial for the service industry. This is because individuals in the service sector typically do not think in process terms. In contrast to the manufacturing sector, where processes are clear and known by everyone, in the service industry, employees may not perceive their work as a defined process. Furthermore, the DMAIC methodology, 5S, and statistical analysis were frequently cited (5 times each), followed by the Cause-Effect Diagram and SIPOC, mentioned four times. DOE, Pareto Charts, and FMEA were mentioned three times. Control Charts, Kaizen events, PDCA, Project Charter, and Gemba Walks were each referenced twice. Figure 3 summarizes the most commonly used tools along with the number of times they were mentioned throughout the interviews.

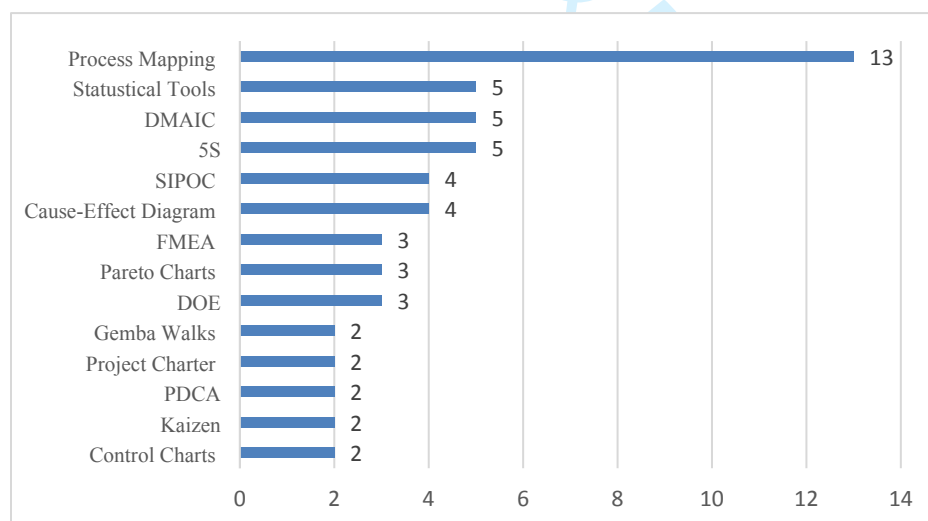


Figure 3. Most commonly used tools

Challenges

There is a consensus among most participants on the distinct characteristics of the service sector that differentiate it from the manufacturing sector, where Lean Six Sigma methodologies were initially introduced. This disparity creates some unique challenges for this sector, summarized in Figure 6 and Appendix A, Table A1.

Theme 1: Human Resources Challenges

A key point of contention, emphasized by the majority of participants, is centered around Human Resources Challenges. This includes resistance to change, mindset and culture, motivation and buy-in, lack of knowledge about methodologies, and difficulties in understanding processes, among other challenges in managing people within service organizations. According to several participants, employees in the service sector often lack awareness and knowledge of operational excellence methodologies, which presents significant challenges:

"It's a bit difficult, because managers in the service industries have just a little bit of knowledge about Lean." - P16

"People are not aware of such methodologies in the healthcare industry." - (P4 & P6)

"The type of people that we tend to work with in the service industries are normally very low-level people, so they find it difficult to grasp the more statistical technical tools and applying them, particularly the Six Sigma type tools." - P15

This contributes to their resistance to change and the introduction of such methods. Furthermore, skepticism arises as these methodologies are traditionally associated with the manufacturing sector, making people question their relevance to service organizations:

"There were a lot of hesitations at the start, whether or not such methodologies that were introduced in automotive will work in the oil and gas industry." -P3

"The first challenge is people would say, well, we're not a factory, we deal with people not with widgets, and you can't treat a person like a widget. This doesn't apply to us, so thanks, but no, it doesn't apply here. It's just a form of resistance that says we're different." - P9

In addition, the prevailing mindset in service operations often does not prioritize continuous improvement, creating cultural barriers that require awareness-raising, training, and a shift toward transparency. This prevailing culture and mindset present obstacles to effectively improving service processes:

1
2
3 *"Service industries are really behind in terms of efficiency and quality, the service problems are*
4 *easier to fix than the manufacturing problems, and yet people still do not take the effort to fix service*
5 *processes, because they don't have the mindset to improve and change." - P14*
6

7 *"I'd say in most service operations people do not think of continuous improvement. That's not what*
8 *they're thinking about when they come in the morning." - P9*
9

10 *"There is a challenge in terms of the culture, you need to raise awareness and conduct a lot of*
11 *training." - P16*
12

13 Furthermore, this culture gives rise to challenges such as a lack of understanding of processes or
14 the ability to think in process terms. Individuals in the service sector often struggle to comprehend
15 their processes and fail to adopt a process-oriented mindset:
16
17

18
19 *"Individuals are very interested in people but not necessarily interested in processes." - P17*
20

21 *"A lot of these organizations don't understand their processes. So, we often start with them to say*
22 *look, just map out your process and even that can be quite challenging." - P15*
23

24 *"One of the big issues with service is that people don't generally understand the process. In*
25 *manufacturing, it's easier to see the processes. But in the service sector they say we don't have a*
26 *process, and they could not articulate it to me." - P9*
27

28 Even after raising awareness, motivating individuals with such mindsets and level of knowledge
29 remains a challenge, as it is difficult to keep them engaged and dedicated to these initiatives:
30
31

32
33 *"It's a challenge to engage front line employees." - P1*
34

35 *"It's a challenge to convince people to work on the project and collect the data." - P2*
36

37 *"The buy-in and commitment of employees and their willingness to participate in projects is a*
38 *challenge." - P5*
39

40 Furthermore, dealing with human interactions rather than products, which is much more complex,
41 adds a layer of complexity, as highlighted by the participants:
42
43

44 *"Because you are dealing with people, it's not as clear." - P6*
45

46 *"The most challenging part is to identify the standard and then try to improve the standard and get*
47 *everyone along in this process of improving standards. Since it's driven by humans and not settings*
48 *in a machine. The level of details cannot be captured for human behaviors unlike in machines." -*
49 *P5*
50

51 *"It's more complicated in terms dealing with people, there are more stakeholders involved in*
52 *services." - P11*
53

54 **Theme 2: Data-related Challenges**

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Another critical point of contention revolves around the challenge of data. The participants describe the service sector as not being “data-heavy” or having “too fine-grained data” as compared to manufacturing. The challenges outlined by the participants revolve around the limited availability of data in the service industries. The issues include the lack of data collection practices, concerns about security, confidentiality and difficulties in obtaining enough numbers for statistical tools. In general, participants noted a general lack of awareness about the importance of data, resulting in insufficient and often unavailable data to utilize statistical tools effectively.

“Statistical tools need more numbers, and in the service organizations we have difficulties in getting those numbers.” - P12

“It is hard to get data and conduct experiments on patients, we cannot wait for the same set of people to come again. It is hard to do many levels for the DOE like in manufacturing because we are dealing with human resources not physical entity.” - P4

“People don’t keep track of data. The IT person came in and said, we didn't know it was important to know the cycle time.” - P9

“When we refer to service industries, they don't collect data.” - P16

“Security and confidentiality of data because of the legal and health reasons” - P4

Furthermore, during data collection, specific characteristics may pose challenges, necessitating a more detailed examination of variability. P4, an expert in healthcare, pointed out that data in service sectors often exhibit abnormal patterns due to ecosystem variations. Additionally, P9, a quality leader with experience in financial services and healthcare, highlighted that identifying Critical to Quality (CTQ) factors in services differs from manufacturing, with fewer CTQs typically being nominal. This shift in measurement requirements demands the utilization of tools suited for discrete data rather than those designed for continuous data.

Theme 3: Process-related Challenges

Additionally, the participants underscore the inherent challenges of service operations, highlighting the complexity arising from frequent communication with customers. This interaction introduces the potential for missed, incorrect, misunderstood, or delayed information. In addition, the service sector is considered to exhibit greater variability due to the intangible nature of services and the variable customer requirements. Understanding and implementing Lean Six Sigma in services is hindered by the complexity of processes, making it challenging to capture the exact

value stream. Furthermore, unlike manufacturing, service processes are characterized by sudden emergencies and numerous influencing factors, making them more difficult to navigate:

"Service operation involves a lot of communication with customers, so there is always a chance for missed, incorrect, misunderstood or delayed information." - P1

"It is hard to capture the exact value stream, like in manufacturing, due to Sudden emergencies and such situations. So, there are some modifications that need to be done." - P4

"In manufacturing, the number of factors that are influencing the outcome is known and the factors have more of a direct relationship than in services. In services you need to deal with more factors and it's more complex." - P11

"It's more complex, it's hard to decide what input parameters influence your outcome and goal." - P8

Theme 4: Time-related Challenges

Moreover, time was also a challenge that was raised by the participants, where the projects in the discussed context experienced extended durations. The prolonged period of time is attributed to the additional time required for team training and ensuring a thorough understanding of the principles. Challenges also arise in finding time and availability for the team, as employees engaged in such projects in service organizations often need to balance these responsibilities with their regular day-to-day jobs. The need for additional time is echoed in training efforts, explaining project tasks, and using statistical analysis, particularly when waiting for sufficient data:

"Lean projects took long time (20% of the project took 2 years instead of 3-6 months)" -P3

"Takes more time to train them to make sure they understand." - P15

"It's a challenge to find the time and availability for the team." - P2

" Most of those employees are doing their day-to-day job and they are also doing six Sigma or lean projects. So, for them it is like outside their working hours. Sometimes they must devote time to really work on those projects." - P12

Theme 5: Bureaucratic Challenges

Finally, some participants have encountered bureaucratic challenges related to data approvals, confidentiality, and security:

"It's sometimes hard to get approvals." - P1

"Long process to obtain approvals and getting the support from top management. In healthcare, there is also a challenge in terms of the Security and confidentiality of data because of the legal and health reasons " - P4

Overall, the predominant challenge identified by most participants was related to Human Resources, accounting for the highest total count of challenges (27) and mentioned by 17 participants as shown in Figure 5. This reflects a consistent theme where issues related to human resources. Within this category, as shown in Figure 6, the "Lack of Knowledge" has the most occurrences, followed by challenges related to the "Culture and Mindset", "Motivation and Buy-in", "Complexities in dealing with people", "Lack of understanding the process" and "Resistance to Change". The "Data" is the second highest total count of challenges (14) and mentioned by 10 participants. Within this category, Moreover, the "Process-related challenges" occurred seven times by five participants, followed by "Time-related challenges" which occurred six times by six participants, and lastly, the "Bureaucratic challenges" mentioned three times by two participants. The different categories of challenges, along with their corresponding sub-challenges, are summarized in Figure 4.

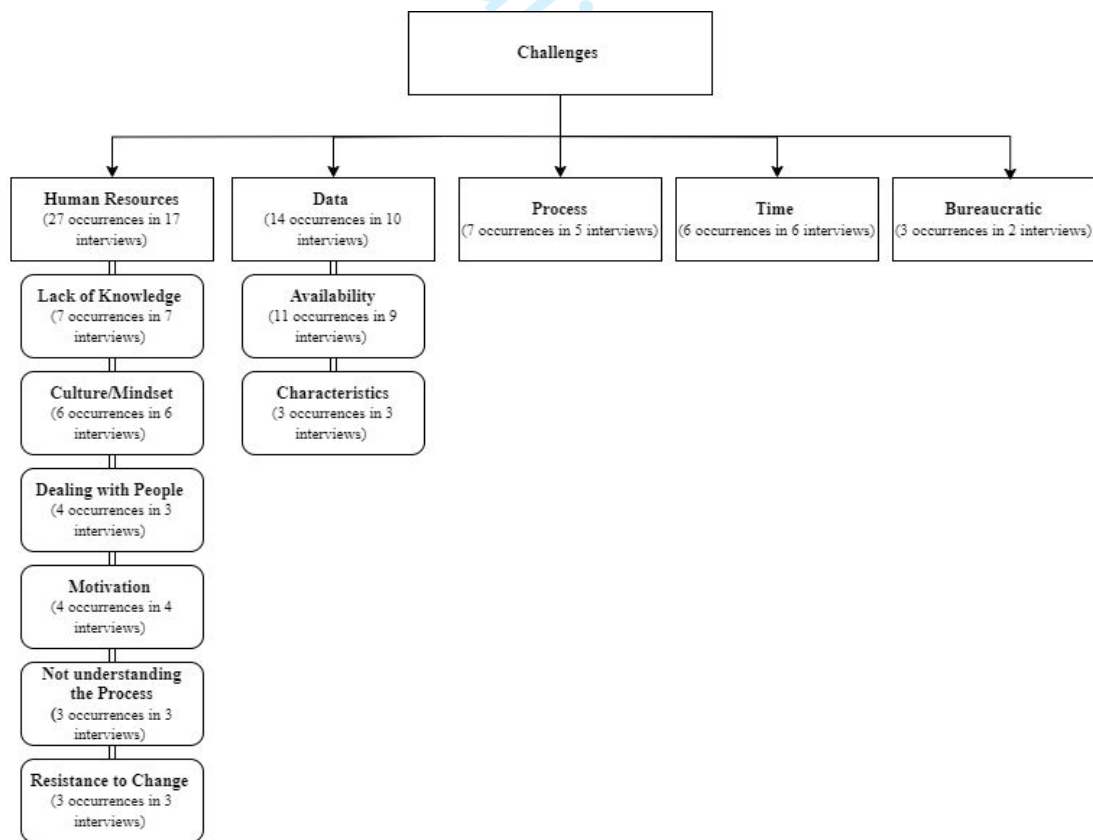


Figure 4. Challenges

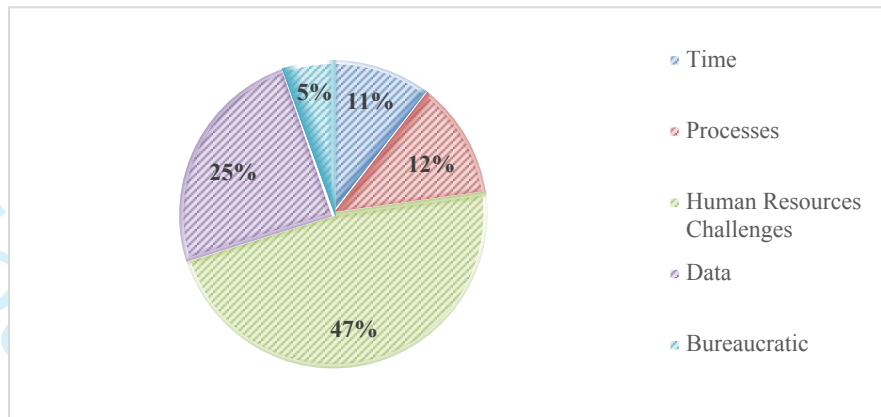


Figure 6. Challenges Categories

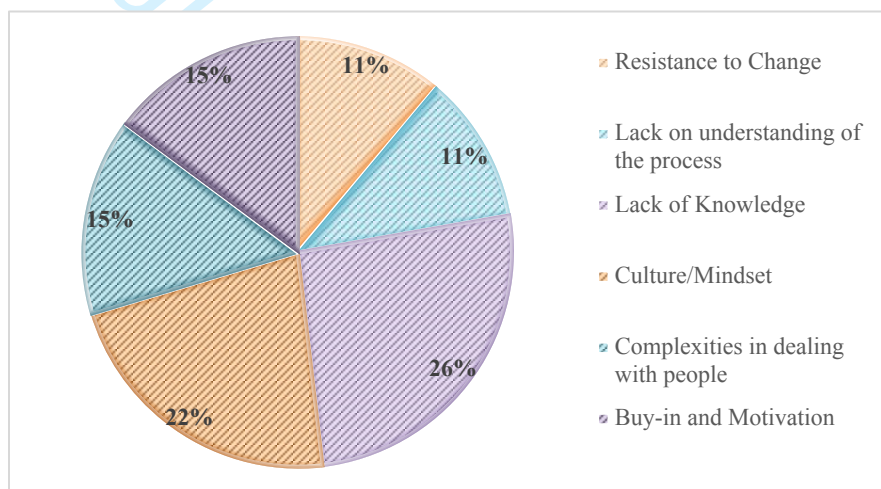


Figure 6. Human Resources Challenges

Additionally, Figure 7 illustrates the distribution of various challenges across different industries. It is evident that "Human Resources" challenges rank highest in all industries except for IT services, where "Data" poses a greater challenge, and in call centers where challenges related to "Data," "Processes," and "Human Resources" hold the same rank. Moreover, the healthcare industry stands out as the only industry expressing all five challenge categories. Furthermore, "Data" challenges are prevalent across all industries except for Transportation and Logistics. "Processes" challenges are mentioned in all industries except for telecom and back-end services. Similarly, "Time" challenges are mentioned across industries except for call centers and telecom

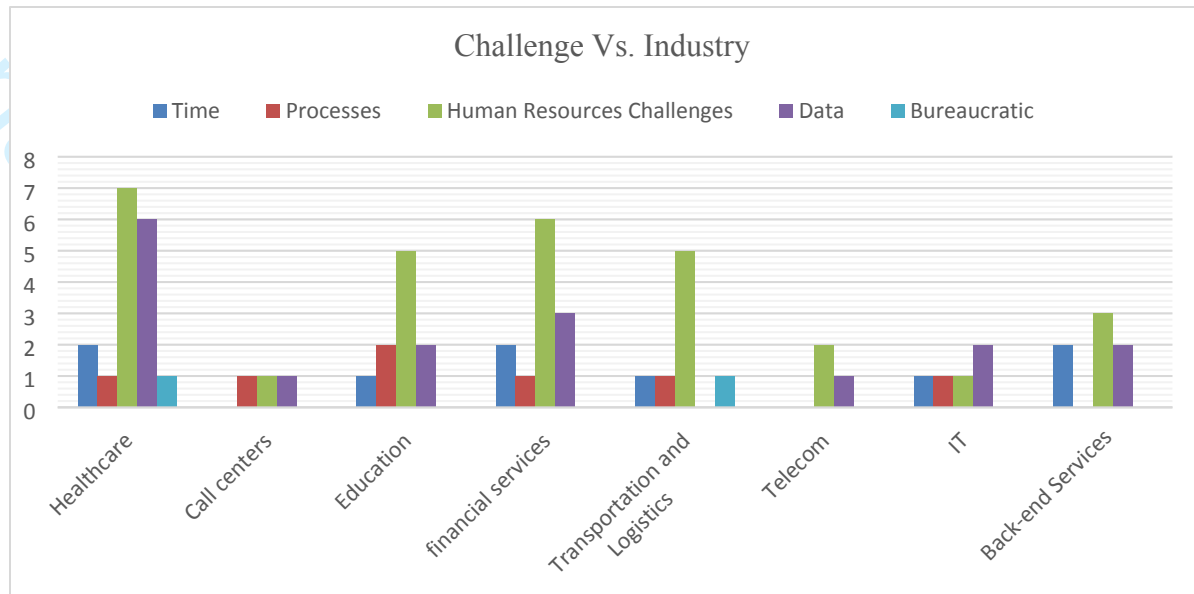


Figure 7. Challenges Vs. Industry

4.2 The Impact of OPEX Methodologies on Sustainable Performance

The second section of the interview aimed to explore the impact of operational excellence methodologies on the financial, social, and environmental performance dimensions across the various industries within the service sector. This includes a discussion on participants' perceptions of this impact, allowing them to identify examples from their real-world case studies and projects, along with specific measures related to each performance dimension.

Financial Performance

Generally, all participants recognize the significant impact of Lean, Six Sigma, and Lean Six Sigma on financial performance. However, some participants have demonstrated a more direct and profound impact on specific financial measures, while others have indicated that there is less emphasis on this performance dimension, and that the impacts are rather indirect or less realized. When questioned about the impact of operational excellence methodologies on financial performance the majority of participants affirmed that such methodologies exert a direct and robust influence on financial performance. They articulated statements such as “Huge impact,” “Absolutely”, “Financial impact is predominant,” “One of the key things that we can see as the outcome of our LSS Projects,” “Results in millions of savings,” “Absolutely high impact”, “There is a good impact,” “There is definitely a financial aspect”, “Financial measures are probably the easiest ones”. These participants highlighted tangible and measurable metrics related to financial

1
2
3 performance, including return on investment, cost reduction, increased income, revenues, profits,
4 savings, reduction in the cost of poor quality, reduction in labor cost, and operational expenditure.

6 *Theme 1: Financial Impact is recognized and measured*

8 Several participants underscored the significance of measuring the financial impact as a crucial
9 step in every project. P1, who is a director of process improvement in a logistics company,
10 indicates that financial measures are highly emphasized in their organization:
11
12

13
14 *"Financial measures are one of the key things that we can see as an outcome of our LSS projects.*
15 *We established a committee at the level of the whole organization where we've got representatives*
16 *from each business unit and then we assign targets based on benchmarks known globally. For*
17 *example, you need to achieve at least 1,000,000 of hard savings."*
18

19 Similarly, experts in industries such as financial services (P8) and oil and gas services (P3) have
20 indicated that they track financial measures in terms of concrete and tangible savings, relating
21 operational measures to the increase of sales and revenues. This includes measures such as the
22 billing amount in financial services, as discussed by P8, and the number of employees needed, as
23 indicated by P3, along with other operational measures that translate into financial benefits.
24
25

26 *Sub-theme 1: Long-term and Sustainable Impact*

27
28 Additionally, some participants have demonstrated a long-term and sustainable impact that extends
29 beyond the financial performance of individual organizations to influence the economy as a whole.
30 P3, P7, and P9 indicate that financial performance is an essential aspect considered due to the
31 significant contribution of their industries (oil and gas, financial services, and healthcare,
32 respectively) to the countries in which they operate. They illustrate that operational excellence
33 methodologies generate substantial savings not only for the organizations themselves but also
34 contribute to the overall income and economic development of the country.
35
36

37
38 *"We have savings of 120M\$ per year, it is a huge organization, and it contributes to 80% of the*
39 *income of the country." -P3*
40

41
42 *"Looking at the bigger picture, it is a big bank, so it definitely funded billions of dollars for*
43 *mortgages and providing loans and credit cards. They created a lot of jobs and supported a lot of*
44 *people." - P7*
45

46
47 *"For economic stability, I would say that's the one I have the most experience in because I'm trying*
48 *to make entities, whether they're for profit or even a nonprofit hospital, more efficient, which*
49 *impacts the economic performance." - P9*
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Sub-theme 2: Short-term Impact

On the other hand, some participants have indicated that while financial benefits are realized, organizations usually focus on short-term or quick gains rather than looking at the bigger picture and economic sustainability. P14 indicates:

“There is absolutely a financial impact, but it is looked at as short terms of quarterly based savings, but not looking at the bigger picture.”

“They look at a very narrow set of metrics, they are not looking at throughput, and sales growth.”

Similarly, P17, who has expertise in logistics and healthcare industries, described his frustration with the mindset of people who prioritize short-term benefits over considering the bigger picture:

“Most of the people I work with are worrying about today, they’re not worrying about tomorrow, and that’s a bit frustrating. So, they tend to focus on short term measures as in a year or less, to meet challenges that they’re currently facing.”

Additionally, P12 and P18 indicate that while there are some financial benefits, they are not yet connected to financial sustainability. P18 notes:

“In the service sector, lean Six Sigma may not have much of a drastic impact at a macro level, but rather at a functional level.”

Theme 2: Financial Impact is recognized but not measured

While the previously mentioned participants indicated an emphasis on financial performance, whether it was a long- or short-term impact, some participants assert that it is typically not emphasized or directly realized. It is highlighted that, especially in healthcare, financial performance is not a primary emphasis. Instead, they stress operational performance measures such as reducing waste, utilizing doctors' time more efficiently, spending more time with patients, improving patients' satisfaction ratings, increasing the number of patients seen, reducing queue length, and minimizing the length of stay and cycle time. While acknowledging that these measures do influence financial performance, they emphasize that the financial aspect is not prominently highlighted. P6 explained this lack of emphasis by the following statement:

“Healthcare they don’t want the perception that they are doing things for money, so although they track such measures, but in the reports and meeting they don’t highlight it as much.” - P6

1
2
3 Similarly, P2 and P10, who are involved with other back-end services, indicate that the primary focus
4 is usually on operational measures, and while there is a connection to financial measures, it is not
5 consistently emphasized.
6
7

8
9 Overall, all participants agree that there is a significant impact on financial performance. However,
10 there is a divergence of opinions on whether this impact is long-term, leading to financial and
11 economic sustainability, and whether it is recognized and emphasized. Figure 8 and Appendix A,
12 Table A2, summarize the main themes and sub-themes along with the number of participants under
13 each theme.
14
15

16
17 Additionally, Figure 9 shows the comparison of perceptions regarding the impact of financial
18 performance across various industries. Each bar represents the total number of statements made
19 by participants within a specific industry and under a particular theme related to financial
20 performance impact. Upon examining the first-level themes related to financial performance
21 impact, notable differences emerge among industries. Healthcare, Telecom, Call Centers, and IT
22 Services, despite acknowledging the significant impact of operational excellence methodologies,
23 exhibit a higher number of statements indicating a lack of emphasis or measurement of such
24 performance. Particularly in Healthcare, the number of statements indicating a lack of emphasis
25 surpasses that of all other industries (n=12). Conversely, Transportation & Logistics and Financial
26 Services demonstrate a consensus that the impact is highly emphasized and measured (n=11), with
27 zero statements indicating otherwise. The Education industry similarly shows results where the
28 number of statements indicating emphasis exceeds those that don't. Moreover, in Back-end
29 Services, the distribution between the two themes is evenly balanced.
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43 Concerning the second-level themes, as illustrated in Figure 10, it is observed that when emphasis
44 is placed on financial performance, only IT-services, Telecom, and back-end services suggest that
45 the impact is predominantly long-term and sustainable. In contrast, for Financial Services,
46 Education, Healthcare, Transportation and Logistics, and Call Centers, it was determined that the
47 impact is typically short-term, with a notably higher number of statements under this sub-theme
48 compared to the alternative sub-theme.
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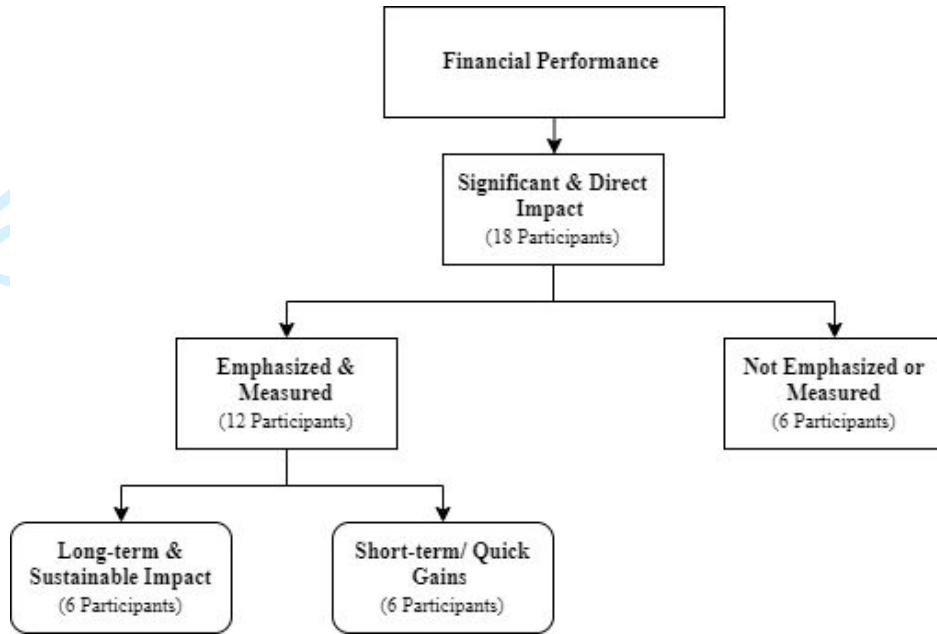


Figure 8. Financial Performance Impact

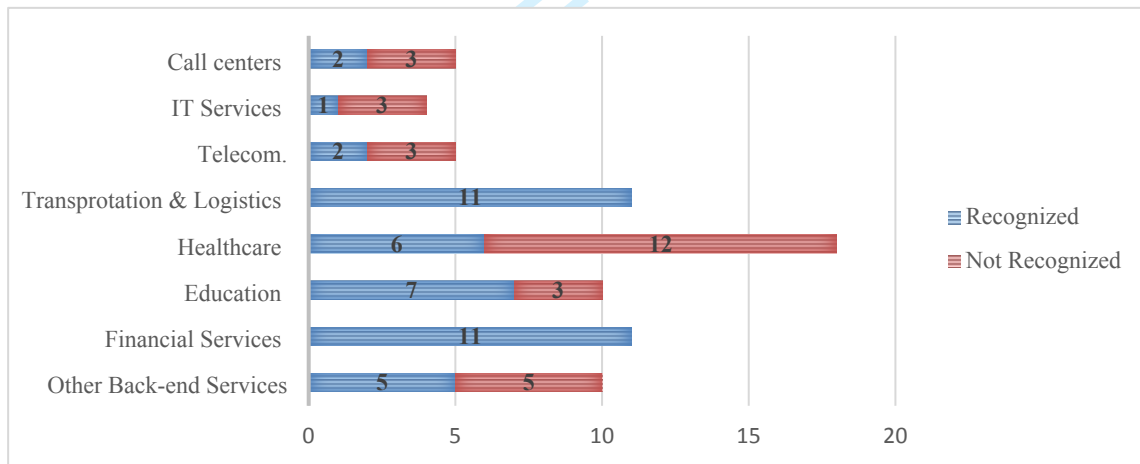


Figure 9. Financial Performance- Industry Comparison

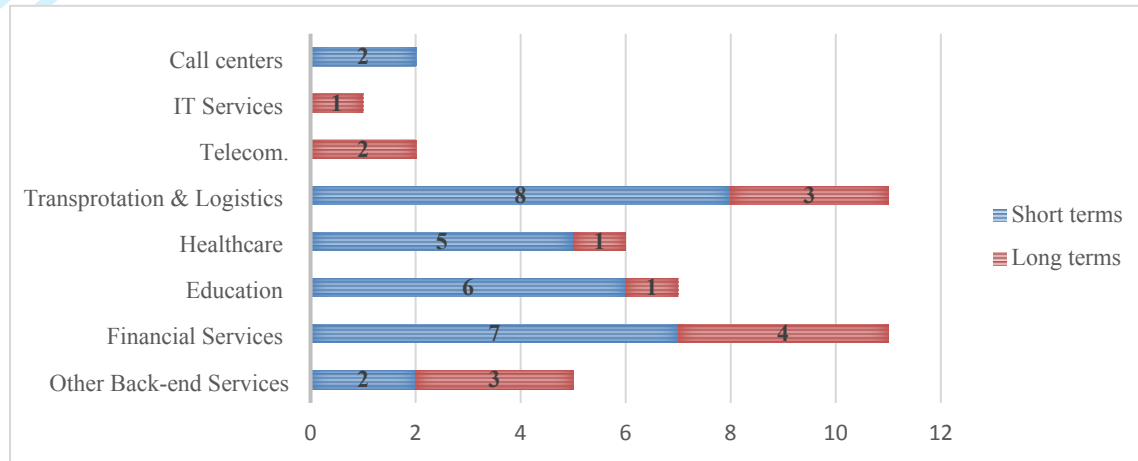


Figure 10. Financial Performance - Industry Comparison II

Social Performance

When questioned about the influence of operational excellence methodologies on social performance, participants found it challenging to provide direct answers. The impact on social performance was not perceived as significantly as it was on the financial dimension. While the majority of participants did mention some positive social measures resulting from their projects, the focus was primarily on specific and narrow indicators. Additionally, some participants expressed a lack of impact, and in certain instances, highlighted negative impacts.

Theme 1: Positive Social Impact

Subtheme 1: Satisfaction

The implementation of Lean Six Sigma (LSS) methodologies has yielded significant improvements in satisfaction across various stakeholders within organizations. Participants highlighted the multifaceted impact of LSS, with P1 emphasizing how it extends to shareholder

satisfaction through measured return on investment (ROI) from LSS projects in transportation and logistics. Additionally, feedback from P6, from her expertise in healthcare, indicates that LSS initiatives have led to increased employee satisfaction, particularly noted by nurses.

“There are a lot of benefits for the customers, employees, and the whole society”- P1

“We measure employee satisfaction and turnover. It increased employee satisfaction, the nurses loved it” – P6

Moreover, in healthcare, P13 also observed that project improvements facilitated staff members' work, contributing to their satisfaction. This was echoed by P2 who emphasized the direct correlation between LSS and employee satisfaction, attributing it to increased efficiency and reduced workload. Furthermore, both P8 and P10 emphasized the dual benefit of LSS in improving both customer and employee satisfaction, where customer positive feedback as a result of LSS projects contributes to the satisfaction of employees. In financial services, P5 highlighted how individuals thrive and even transition into different roles due to their positive experiences with LSS.

“People frequently mention that they enjoy seeing the outcome of their work from customer positive customer feedback on the projects.” - P10

“Employee satisfaction increases because employees should have less tasks and work more efficiently, so they don't have to work overtime and so on.” - P2

“Some people actually really liked it, and they flourish, and they move, sometimes even into different job roles where they do more of this.” - P5

Subtheme 2: Employee Engagement and Motivation

The integration of employees into project processes and ensuring their satisfaction are pivotal aspects of successful Lean Six Sigma (LSS) implementations, as highlighted by participants in the interviews. Specifically, in Healthcare, P6 emphasized the importance of engaging employees throughout projects, fostering their satisfaction. This was echoed by P13, who emphasized the continuous involvement of staff in designing processes and ensuring their engagement, emphasizing their active role and voice in decision-making:

“We involve employees all way along, we engage the employees, and they have a voice.”- P13.

Moreover, a lead consultant with expertise in both call centers and higher education (P11)

underscored the significance of measuring social impact, particularly employee engagement and dedication, as key indicators of project success. Furthermore, P5 highlighted how LSS enhances employee involvement by providing them with tools and instruments to evaluate, assess, and improve their own tasks and activities, thereby fostering a sense of ownership and empowerment.

"We always measure it in terms of social impact such as, employee engagement and dedication." -

P11

"It enhances the level of employee involvement because you're giving them tools and instruments that also evaluate, assess and analyze and improve their own working tasks, their own activities."

- P5

Additionally, the motivation of employees and other stakeholders were emphasized by several participants, both P1 and P13 highlighted how LSS fosters teamwork and enhances both employee morale and motivation. Similarly, P7 noted that stakeholders were motivated and became advocates of LSS methodologies.

Subtheme 3: Learning and Development

The training of employees in Lean Six Sigma (LSS) methodologies resulted in both individual development and broader cultural transformation within organizations, as emphasized by participants in the interviews. P1 highlighted how LSS training not only offers career development opportunities but also fosters a positive culture that extends beyond the organization, impacting the broader community.

"Employee training in LSS not only provides career development opportunities but also instills a positive culture that extends beyond the organization to impact the broader community."

Similarly, participants with expertise in different industries including IT services, financial services, higher education, healthcare, and transportation and logistics (P8, P12, and P14) emphasized the positive impact of Lean Six Sigma training on employee development and skill enhancement, noting its contribution to personal growth, upskilling, and the acquisition of new knowledge. This training was seen as instrumental in fostering meaningful progression and professional growth among employees.

"All employees got some training which helped their development and learning." - P8

"Positive impact in terms of training and upscaling, because that's where the people feel that, yes, it's making sense to them." - P12

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2
3 *It's a positive impact because employees learn something new" - P14*
4
5

6 Subtheme 4: Work-Life Balance

7 Moreover, participants highlighted how Lean Six Sigma implementations contribute to a better
8 work-life balance for employees by improving efficiency, reducing working hours, and freeing up
9 capacity for more meaningful tasks. This led to employees feeling that their work and life were
10 facilitated, ultimately enhancing their overall well-being and satisfaction.
11
12
13
14

15 *"From reducing working hours, they have more work-life balance." - P2*
16

17 *"Employees should have less tasks and work more efficiently, so they don't have to work overtime*
18 *and so on." - P2*
19

20
21 *"Staff felt that it facilitated their work and life." - P13*
22
23

24 Furthermore, participants highlighted other positive social measures, including enhancing the
25 safety and well-being of employees, reducing accidents, and promoting transparency while
26 breaking down bureaucratic barriers.
27
28

29
30 *"Lean was used to improve road safety and reduce the number of accidents and deaths." -P3*
31

32 *"If you look at accident rate, it comes down" - P18*
33

34 *"It promotes transparency, breaks down bureaucratic barriers." - P1*
35
36

37 Theme 2: Negative Social Impact

38 Subtheme 1: Dissatisfaction

39 While the majority of participants indicated that LSS projects have the potential to enhance
40 employee satisfaction, some instances revealed negative impacts or dissatisfaction among
41 employees due to various reasons. The reasons include the perception of employees that changes
42 require more effort without clear benefits, leading to discontent, as explained by a director of LSS
43 training company (P14). This was also echoed by P2 and P10, where they expressed that the
44 resistance to change was also evident among employees who preferred the status quo and were
45 resistant to continuous improvement efforts which results in a dip of the satisfaction rate.
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53 *"Sometimes the employees are not happy if you change, it can seem like they work harder." - P14*
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55 *"Some people would say this is extra work, we are not paid to do this." - P9*
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4 *"The employees may be dissatisfied with having to deal with more customers." - P2*
5

6 *"At the beginning people weren't that happy about the LSS program, so I think we had a dip in our*
7 *employee satisfaction." - P10*
8

9 Moreover, P17, who runs an Institute of Six Sigma professionals and a Lean Six Sigma
10 consultancy business, highlighted the challenge of ensuring employee satisfaction, particularly in
11 the service sector where individuals are highly involved in process improvements:
12
13

14
15 *"But in the world of service, you have a new thing you're delivering, you throw people at it, those*
16 *people become established, the process has become day to day, we improve those processes at the*
17 *cost of those bodies that go in, so people are not happy it's a very a very difficult situation."*
18
19

20 21 Subtheme 2: Fear of job loss and Stress

22 Additionally, participants highlighted psychological adverse effects such as fear and stress as
23 significant factors affecting employees due to Lean Six Sigma implementations. Fear of job loss
24 and job insecurity resulting from LSS projects were demonstrated by experts in financial services
25 and transportation and logistics companies (P14 and P15):
26
27
28
29

30
31 *"Sometimes organizations if they are making some good improvements, they might want to reduce*
32 *head counts. Now that does cause a problem because that sends the wrong message, then people*
33 *are thinking, well, if we make these improvements, I'm likely to lose my job." - P15*
34
35

36 *"If your goal is to reduce people through improving processes, we will have negative impact on*
37 *employees and society." - P14*
38
39

40 Furthermore, P5 suggests that fear can also stem from increased transparency, which is typically
41 positive but may occasionally lead to negative consequences. Additionally, participants
42 highlighted the correlation between Lean Six Sigma implementations and increased stress among
43 employees especially when they feel the need to do more work. P12 noted that employees
44 experience stress when they are not assigned full-time projects. Additionally, P18 emphasized that
45 when the strategy solely focuses on cost reduction, as often seen in projects, employees experience
46 increased stress levels:
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53 *"We have seen that employees are already very stressed and because when employees are not*
54 *getting a full-time project, there is definitely a stress factor." - P12*
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3 *“If your strategy is to reduce costs only, lean Six Sigma is more concentrating on reducing the cost,*
4 *at that time employees under stress.” – P18*
5

6
7 Moreover, the negative impact on social measures includes the limited potential for Lean Six
8 Sigma initiatives to significantly affect employee motivation (P4), and the observation that
9 employees may not always be motivated or interested in such projects (P2). Additionally, concerns
10 were raised about the potential negative impacts of LSS on employee engagement, particularly
11 when they concentrate solely on efficiency instead of growth, leading to boredom (P18).
12 Furthermore, participants highlighted challenges in effectively measuring social performance
13 metrics, noting that data related to social measures is often utilized for reporting purposes rather
14 than for driving improvement initiatives (P9):
15

16
17 *“But it can also add to the boredom, there is the dark side of lean Six Sigma where managers get*
18 *bored because they are doing the same things, and are only concentrating on efficiency, but not the*
19 *growth.” - P18*
20

21
22 *“Either that companies don't make the effort to measure it, or they do it in a superficial way that*
23 *basically ensures they get biased information that everybody's happy.” - P9*
24

25
26 *“So, safety data is being collected and most companies again they collect it for reporting purposes.*
27 *They don't collect it for improvement purposes.” - P9*
28

29
30
31
32 Overall, the participants have been divided into two categories as illustrated in Figure 11. Some
33 indicate that the impact is positive, while others agree on the positive impact but have also
34 observed some negative consequences (Appendix A, Table A3).
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39 As for the different perceptions across the various industries, Figure 12 indicates that in
40 Healthcare, Education, Financial Services, and Transportation & Logistics, a significant number
41 of statements underscore the positive impact of operational excellence methodologies on social
42 performance. Healthcare leads with 11 statements, closely followed by Education with 10
43 statements, both surpassing the number of statements indicating negative impact. However,
44 Financial Services stands out as the only industry where negative impact is more prevalent.
45 Meanwhile, Telecom and Call Centers exhibit an equal distribution between the two themes.
46 Notably, industries with the highest numbers of positive impacts also record the highest number
47 of negative impacts, indicating the complex nature of social performance.
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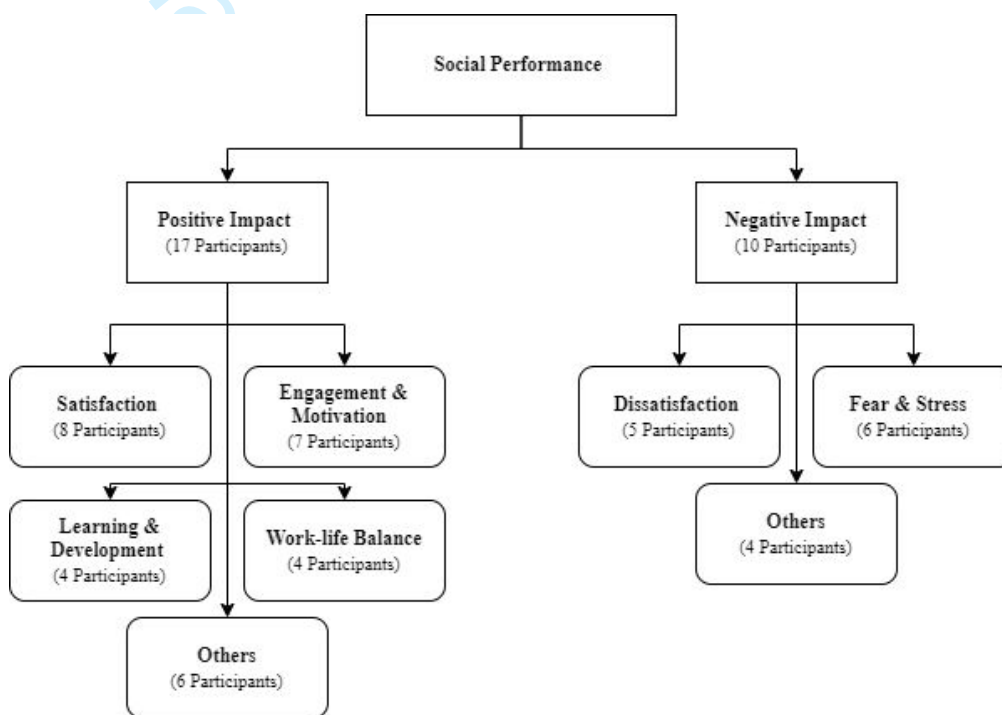


Figure 11. Social Performance Impact

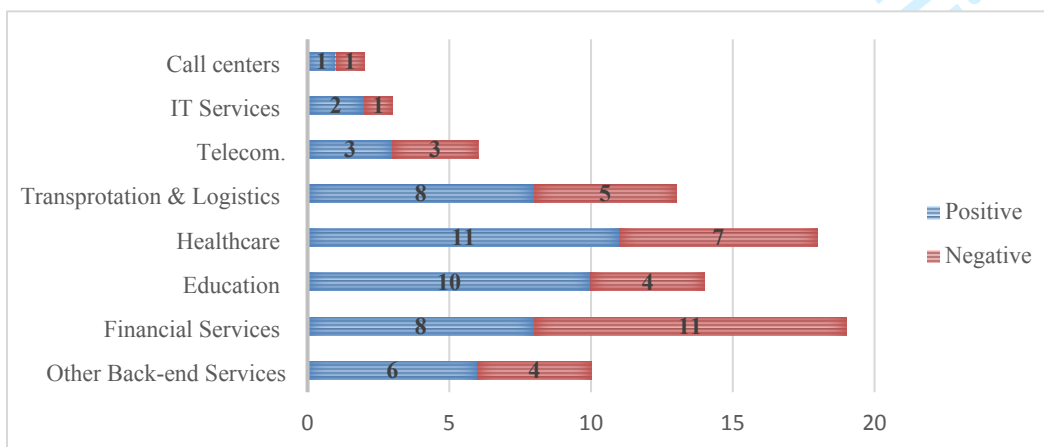


Figure 12. Social Impact - Industry Comparison

Environmental Performance

When questioned about the impact of operational excellence methodologies on environmental performance, participants were categorized into two groups. Some expressed that the impact is significant and positive, while others suggest that it is very limited and not accounted for (Appendix A, Table A4).

Theme 1: Positive Environmental Impact

Subtheme 1: Energy Consumption

Participants discussed various initiatives aimed at reducing energy consumption and promoting sustainability through Lean Six Sigma projects. Participants with experience in different industries including financial services (P5, P7, and P12), education and healthcare (P12), as well as other bank end services (P10) have demonstrated the emphasis on energy consumptions, such as efforts to set up Environmental, Social, and Governance (ESG) monitoring to track individual employee energy consumption (P5 and P18), implementing strategies like adjusting blinds and air conditioning usage to reduce electricity consumption (P7), establishing specific key performance indicators such as labor hours and energy usage to track progress in reducing consumption (P10), and transparently monitoring and minimizing energy and water usage as discussed (P12):

"We have projects that are about, for instance, setting up ESG monitoring so that it becomes clear what the per employee Energyconsumption is." - P5

"Reduce consumption of electricity, using LSS in the office space. Using the AC with the blinds down vs having them up, the electricity consumption was less." - P7

"We established a KPI like the number of labor hours and the energy we use, and we're trying to get this down. So, it's we're justconsidering it as the as part of the deployment." - P10

"We keep track of measures like water waste, energy consumption and type of material used." - P12

Moreover, P6 discussed a common project in healthcare that focuses on reducing material waste, leading to decreased electricity usage and CO2 emissions from transportation. The impact of waste reduction on energy consumption was also emphasized by P14:

"Common projects in healthcare help reduce the usage of sheets and towels, which results in less washing, less electricity, and less waste" - P6

"If we are reducing waste, we are using less the amount of energy, so it has to be good for sustainability, the planet and working conditions." - P14

Subtheme 2: CO2 Emissions

Additionally, the reduction of CO2 emissions was expressed by several participants across different industries. P3, who is a Corporate Change and Continuous Improvement Manager in an oil and gas organization emphasized the focus on CO2 emissions within his organization even if it entails higher costs. He mentioned that they conduct a lot of LSS projects that specifically target CO2 emission reduction and improve carbon competitiveness. As well as using innovative approaches such as utilizing gravity for transportation to further reduce CO2 emissions and oil usage.

"The organization is focusing more on CO2 reduction even if it sometimes costs more." -P3

"5-8 LSS projects this year were focused on CO2 emission reduction and carbon competitiveness in terms of machines and truck movements." -P3

"Using gravity to transport items reduced CO2 emissions and oil used." -P3

Such measures were also evident in other industries, specifically from reducing the transportation for outsourcing specific services in healthcare (P6), telecommunications (P7), and transportation and logistics (P1):

"We were able to reduce carbon emissions by reducing the number of trucks riding to customers' houses to solve some issues." - P7

"Common projects in healthcare help reduce the usage of sheets and towels, which results in less washing, less electricity, and less waste. A lot of those services such as washing and so are not done in-house, so less trucks are used to deliver those, so less CO2 emissions from the trucks." - P6

"Minimizing transportations: combining some routes together for delivery, so less carbon emissions." - P1

Subtheme 3: Physical Waste Reduction

Furthermore, participants discussed how Lean Six Sigma projects target reducing physical waste,

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3 which subsequently impacts the environment. Paper waste emerged as a significant focus,
4 particularly among participants in education, telecommunications, financial services, and
5 transportation and logistics industries. Several projects were highlighted for their efforts to reduce
6 paper usage, with some integrating digitalization to achieve this objective. P16, a consultant
7 working with various service organizations, emphasized the substantial environmental impact of
8 such initiatives, given the widespread use of paper within the service sector:
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13 *" We Reduce the number of printings papers." - P7*

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16 *"A lot of projects were targeted to going paperless and using automation, so that impacted the waste
17 reduction as well as resourceconsumption and peoples' time." - P6*

18
19 *"Reduce the number of papers used and reduce them with tablets." - P1*

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21 *"We measured the kg of paper saved, we had that as a KPI, the service industries use a lot of
22 papers." - P16*

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26 Especially within a transportation and logistics company, there was a notable emphasis on
27 reducing physical waste. The director of process improvement (P1) in this company elaborated on
28 how the elimination of physical waste is prioritized and often achieved through Lean Six Sigma
29 projects. He cited examples of waste reduction initiatives, including minimizing scrap, extending
30 the lifecycle of ship vessels, adopting environmentally friendly materials, and mitigating damage
31 to marine life:
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36 *" Instead of using the ship vessels for three years, we found after testing that we can use it for at
37 least 5 more years without risks, prolonging the life cycle, which positively impacts the environment.
38 - P1*

39 *"We Select material that is environmentally friendly, and renewable sources of energy." - P1*

40 *"We focused on protecting the marine life and minimize the damage." - P1*

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44 Additionally, P5 and P18 have also demonstrated the environmental impact of LSS projects by
45 reducing physical waste. They achieved this through waste recycling initiatives and by decreasing
46 graphite and dust pollution:
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49 *"We've had projects in the waste processing industry where they've looked into how, how you can
50 increase the yields of recycling, and waste that comes in the processing facility." - P5*

51 *"We reduced the graphite and dust pollution." - P18*

Theme 2: Limited Environmental Impact

Despite the positive impact highlighted previously, some participants expressed a consensus that the impact of operational excellence methodologies on environmental performance is still quite limited. P2 and P11 observed that while the environmental impact is evident in manufacturing, it is generally not as pronounced in the service sector. P4, P8, P7 and P17 concurred, suggesting that any impact in service organizations is often indirect and tied to specific operational measures.

"Manufacturing really impacts the environment, but for the service it really depends on the industry, so there might be some impact but not as strong as in manufacturing. It might not be directly related to the projects though." - P2

"In manufacturing it's simpler to realize these impacts, like zero waste, but in the service sector it's more indirect." - P11

"In service environment it tends to be in that it's difficult to have a massive impact on CO2 emissions if you're just in an office." - P17

"Not as much impact on environment. But in general streamlining processes indirectly impacts the environment, because u are usesresources more efficiently." - P7

Similarly, in financial services, P5 noted that although some projects may target specific environmental improvements, the focus is typically restricted. He argued that unless there is a deliberate decision to prioritize environmental impact, organizations tend to naturally emphasize more direct impacts, particularly those with financial implications.

"It should be very deliberate, because there's a natural tendency for people in organizations to focus on more direct impacts which are typically financial impacts"- P5

Furthermore, P15 indicates that in the aviation services, there is a potential for environmental impact, but nobody knows what and how to measure it, so it receives less emphasis. P9 echoed this sentiment, pointing out that while there is potential for methodologies to affect the environment, such efforts are often driven by a need for legal compliance rather than a continuous improvement mindset. He emphasized that the projects he was involved in were deliberately aimed at meeting legal requirements rather than focusing on continuous improvements:

" We did not keep track of environmental measures, because nobody knows what the measure, and how to measure, there must besome standards." - P15

"So, in environmental, I think we it can be very suitable to continuous improvement, but we have to have a continuous improvement mindset rather than a legal compliance mindset that has to come from see senior management." - P9

Overall, some participants demonstrated a positive impact on environmental performance measures such as Energy Consumption, CO₂ Emissions, Waste Reduction. While other participants indicated that there is limited or no impact on environmental performance, some of which had demonstrated positive effects but still view this effect as insignificant. The themes and sub-themes are summarized in Figure 13. Additionally, Figure 14 illustrates the differences between the various service industries. It is shown that all industries have demonstrated a positive impact on environmental performance, whether significant or not.

Transportation and Logistics, Financial Services, and Education show particularly strong performance in this area, with nine, nine, and eight statements respectively. They are closely followed by Healthcare and Other Back-end Services, each with seven statements. However, while Financial Services and Healthcare rank among the top five industries in terms of positive impact, they also rank the highest in terms of limited impact, with six statements each. Nevertheless, all industries except Call Centers and IT Services have showcased a higher number of positive impacts. Call Centers and IT Services exhibit a balanced distribution between the two themes.

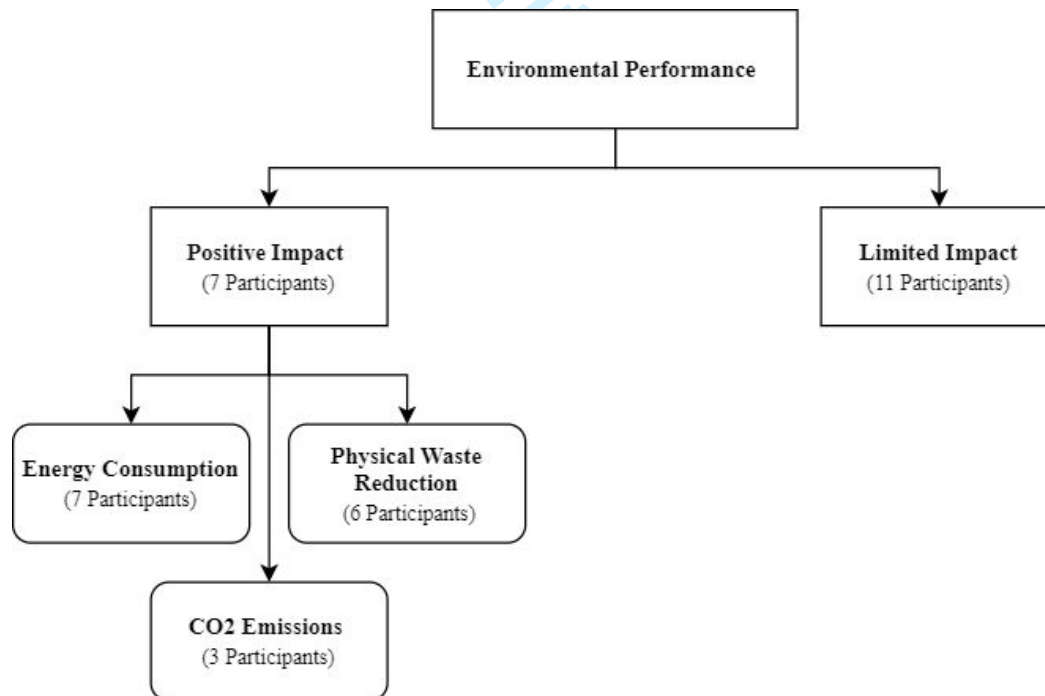


Figure 13. Environmental Performance Impact

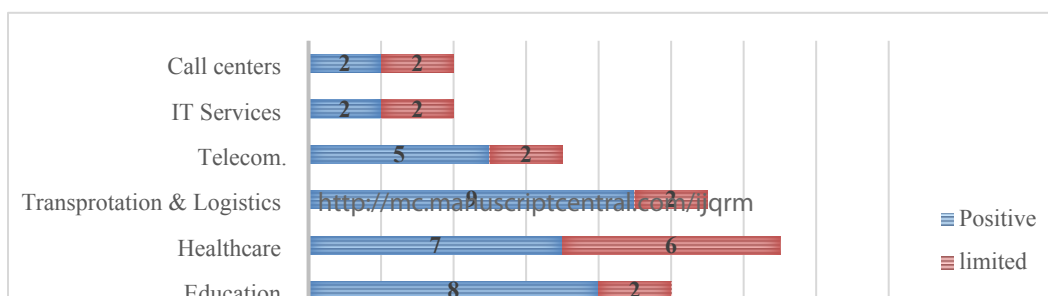


Figure 14. Environmental Impact- Industry Comparison

4.3 The impact of operational measures on Sustainable Performance

The third section of the interview aimed to explore the impact of a set of predefined and commonly reported operational measures on the financial, social, and environmental performance dimensions across the various industries within the service sector. This section included verifying the preset operational measures categories with the participants and questions were designed for quantitative analysis.

Quantitative Analysis

In a prior phase of the systematic literature review, it was observed that Lean Six Sigma applications within the service sector are primarily associated with operational performance measures rather than measures related to the broader dimensions of sustainable performance. This tendency is attributed to the study focusing on reporting operational benefits, which are more tangible and easier to measure compared to the multifaceted nature of sustainable performance measures. Furthermore, as operational benefits have a direct impact on organizations' bottom-line performance, they tend to receive more attention from management and stakeholders. Consequently, the initial findings indicate that 79% of reported benefits in published papers over the past decade are related to operational measures. Four operational measure categories were identified and are summarized in Table 2.

Table 2. Operational Performance Measures Categories

Performance	Category	Description
	Timely Service	This category focuses on enhancing service efficiency by reducing various time-related factors in service delivery.

Operational	Efficiency	This category encompasses various aspects of service efficiency, including customer volume, resource utilization, equipment effectiveness, queue management, performance efficiency, capacity, service levels, overtime, the handling of processes, etc.
	Reduction of Lean waste	This category targets the reduction of eight types of lean waste - transportation, inventory, motion, waiting, overproduction, over processing, defects, and underutilized skills.
	Quality	This category concentrates on improving the quality and statistical aspects of process performance, including Sigma level, standard deviation, process stability, repeatability, reproducibility, accuracy, process yield, first-time fix rate, process performance index (PPK), part per million (PPM), and process capability (CpK), etc.

This section aims to explore the impact of commonly reported operational performance measures in the service sector on the three dimensions of sustainable performance. While specific questions were posed during interviews to capture this aspect, participants consistently highlighted the mediating influence of operational performance measures when discussing financial, social, or environmental performance. During the interview process, participants were asked to rate the impact of top-reported operational measure categories across the three dimensions of sustainable performance on a scale from 1 to 5 (1: Low/no Impact, 5: Very High Impact). This assessment allows for a comprehensive understanding of how these methodologies influence sustainable performance across various dimensions through such operational measures.

For the financial performance, the mean scores ranged from approximately 4.05 to 4.50 across the four operational measures categories. This indicates a generally high perception of impact on financial performance among the respondents. Specifically, "Improved efficiency" and "Reduction of Lean Waste" have the highest mean scores (4.5 and 4.28, respectively), indicating that respondents perceive them to have the most significant impact on financial performance. "Timely Services" has a slightly lower mean score (4.08). Moreover, "Improved Quality Measures" has the lowest mean score (4.06), but it is still relatively high.

For the social performance, the mean scores ranged from approximately 2.89 to 3.11 across the four operational measure categories. This suggests a moderate perception of impact on social performance among the respondents. Specifically, "Timely Service" and "Reduction of Lean Waste" have the highest mean scores (both at 3.11), indicating that respondents perceive them to have the most significant impact on social performance, yet this impact is deemed moderate.

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3 "Efficiency" and "Quality Measures" have slightly lower mean scores (2.94 and 2.89,
4 respectively), but they still suggest a considerable impact on social performance.
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7 For the environmental performance, the mean scores ranged from approximately 2.39 to 3.64
8 across the four operational measure categories. This suggests a low to moderate perception of the
9 impact on environmental performance. "Reduction of Lean Waste" has the highest mean score
10 (3.64), indicating that respondents perceive it to have the most significant impact on environmental
11 performance. While, "Efficiency" and "Improved Quality Measures" also show a relatively lower
12 mean score (2.89), suggesting a moderate impact on environmental performance. "Timely Service"
13 has slightly lower mean scores (2.38) which indicates that its impact on environmental
14 performance is somewhat low.
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22 Overall, financial performance stands out with a grand average of 4.23, indicating the significant
23 impact of commonly reported operational measures on financial outcomes. While social and
24 environmental measures are moderately influenced by these operational measures, social
25 performance slightly surpasses environmental performance, with a grand average of 3.01
26 compared to 2.95, respectively.
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31 Furthermore, analyzing the standard deviation for each operational measure category across
32 responses from the 18 participants reveals insightful patterns. Financial performance exhibits the
33 smallest standard deviation at 0.58, implying a higher level of agreement among participants
34 regarding the impact of operational measures on financial outcomes. Following closely, social
35 performance presents a standard deviation of 0.65, indicating a moderate level of agreement.
36 Conversely, environmental performance displays the largest standard deviation of 0.74, suggesting
37 greater variability in responses and less consensus among participants regarding the influence of
38 operational measures on environmental outcomes. Nevertheless, it is notable that all standard
39 deviations are considered low, suggesting a high level of consensus among participants from
40 diverse backgrounds, spanning different parts of the world and various industries. Figure 15
41 summarizes the quantitative data obtained in this section. While this data is derived from the 18
42 participants to support the qualitative findings, it is worth noting that these findings support the
43 qualitative findings in previous sections but cannot be generalized due to the insufficient sample
44 size for quantitative analysis.
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Discussion

While operational excellence methodologies were initially introduced and predominantly utilized in the manufacturing sector, their adoption has been on the rise across various industries within the service sector (Chakrabarty and Chuan Tan, 2007). This trend underscores the importance of gaining a deeper understanding of how these methodologies are adapted and implemented in the service sector, as well as identifying the most commonly utilized methodologies and tools, along with the challenges encountered during their implementation. Furthermore, the association between operational excellence methodologies and the three dimensions of sustainable performance is increasingly emphasized, particularly in response to growing pressure for the provision of sustainable services (Caiado *et al.*, 2017, 2019; Cherrafi *et al.*, 2016). Identifying the impact of operational excellence methodologies on sustainable performance in the service sector is multifaceted and complex. Authors often prioritize the reporting of direct and tangible operational measures, making it challenging to fully assess the holistic impact on the financial, social, and environmental aspects.

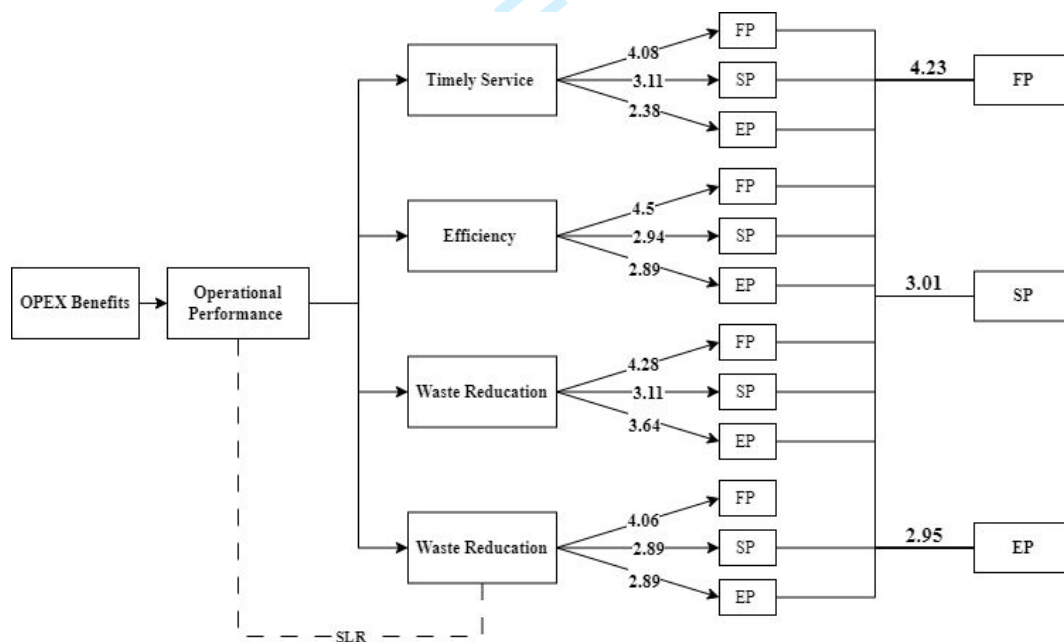


Figure 15. Impact of Operational Measures on Sustainable Performance

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3 This qualitative study highlights the adaptation of operational excellence methodologies across
4 various industries within the service sector through one-to-one interviews with experts in this field
5 with extensive experience across various industries in service sector. In terms of the most
6 commonly used operational excellence methodologies, Lean Six Sigma stood out to be the
7 predominant, benefiting from its synergy. This was also supported by Antony *et al.*, (2023) who
8 highlighted the advantages of integrating Lean and Six Sigma, revealing that this integration yields
9 a higher number of benefits compared to Lean or Six Sigma individually. However, in instances
10 where the integration is not necessary, Lean was preferred over Six Sigma, and this was explained
11 by the simplicity of Lean and how it fits the nature of service processes. Moreover, participants
12 strongly emphasized the importance of process mapping tools within the service sector. They
13 indicated that these tools are both simple and highly informative, serving as eye-openers,
14 especially when dealing with individuals who may not inherently think in terms of processes or
15 understand their complexities. While the service sector was noted to offer many inefficiencies
16 facilitating the implementation of such methodologies, several challenges were identified,
17 particularly concerning human resources and personnel within these industries. Additionally, data
18 was highlighted as a significant challenge for implementing such methodologies, alongside various
19 other challenges that may hinder the successful implementation of such initiatives.
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33 Regarding the impact of operational excellence methodologies on sustainable performance in the
34 service sector, the authors identified several emergent themes within each performance dimension.
35 For financial performance, there is a consensus about the significant influence of operational
36 excellence methodologies on financial performance. Consistently, all 18 participants concur on the
37 direct and significant impact of these methodologies on financial outcomes. These findings are in
38 line with other studies in the literature, in different industries within the service sector, where
39 OPEX methodologies improved productivity (D'Andreanmatteo *et al.*, 2015; Narayanan *et al.*,
40 2022), cost savings (Rundall *et al.*, 2021; Zhang *et al.*, 2016), and other financial benefits (Antony,
41 Ghadge, *et al.*, 2018; Bhat *et al.*, 2023; Hadid, 2019; Vashishth *et al.*, 2019). However, opinions
42 diverge concerning the sustainability of this impact and its recognition. Some of participants note
43 the emphasis on financial performance within Lean Six Sigma implementations in their
44 organizations, with 50% of these indicating a focus on long-term sustainability, while the other
45 50% perceive it as more short-term and quick gains. While others acknowledged the substantial
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3 impact but highlight a lack of emphasis or measurement on financial performance, with operational
4 measures taking precedence in their organizations.
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8 Understanding the impact on social performance presented a nuanced challenge, as participants
9 did not have a clear answer to give. This is in line with a study conducted by McFadden *et al.*,
10 (2014) where the impact on social measures is still not clear or is indirect. This can be explained
11 by the argument put forth by Vadivel *et al.*, (2022) that Lean Social Practices have been shown to
12 be the least influential on operational performance, which can be a reason why practitioners do not
13 emphasize such aspects. However, the participants' responses were categorized into two themes,
14 some reported consistent positive impacts, while others suggested a dual impact—both positive
15 and negative—dependent on several factors. The negative impact was only realized in social
16 performance, which is supported by Fournier *et al.*, (2023), who explained that the focus on
17 efficiency and cost reduction can lead to employee resistance to such initiatives, thereby affecting
18 their overall satisfaction. Despite this divergence, both groups consistently emphasized positive
19 outcomes, with a notable focus on highlighting positive impacts over negative ones. For positive
20 impacts, approximately 80% of the perceived positive impact is attributed to 20% of social
21 measures, specifically those related to Satisfaction, Engagement, Work-life Balance, and Learning
22 & Development as shown in Figure 16. This is in line with other studies in the service sector,
23 where Lean has improved job satisfaction and productivity (Crema and Verbano, 2016; McFadden
24 *et al.*, 2015; Rees and Gauld, 2017). While the negative impacts are mainly related to
25 Dissatisfaction (33%), Fear (27%), and 13% for each of Stress, Lack of Motivation, and other
26 negative impacts.
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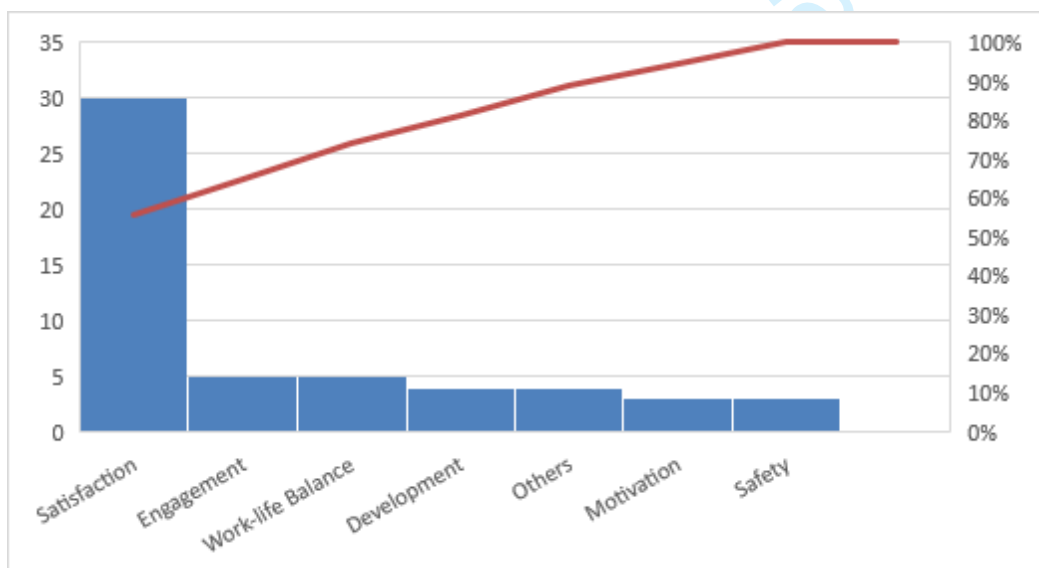


Figure 16. Positive Social Measures

As for the environmental impact, there was a greater variability with participants indicating that the impact on environmental performance is limited. This is also evident in literature where there is a lack of emphasis on environmental performance. Morell-Santandreu *et al.*, (2020), and de Freitas *et al.*, (2017) indicated the trade-off between environmental sustainability and financial performance, which can be the reason behind the limited impact on such performance. However, some of the participants in our study highlighted positive impacts. Approximately 80% of the perceived positive impact on environmental performance is explained by 20% of environmental measures related to Energy Consumption, CO2 Emissions, and Waste Reduction as shown in Figure 17.

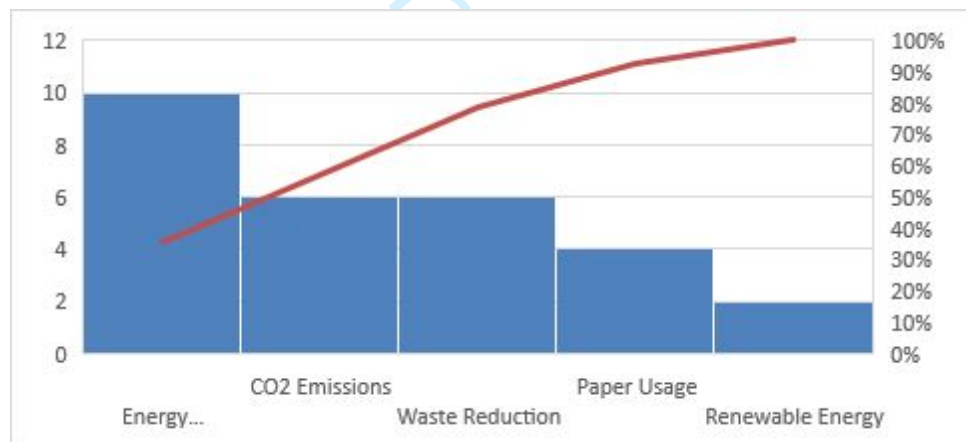


Figure 17. Positive Environmental Measures

Studies that have addressed similar research questions in the literature have utilized quantitative methods (surveys) to identify the impact of lean on sustainable performance dimensions, either in a unique industry within the service sector or across the service sector as a whole (Hussain *et al.*, 2019; Klein *et al.*, 2022; Lizarelli *et al.*, 2023). To our knowledge, Six Sigma and the integrated approach of Lean Six Sigma have not been studied. Furthermore, these studies employed predefined indicators for each performance dimension and measured the impact of lean on each indicator, as summarized in Table 1.

In our study, we allowed themes to emerge from discussions with participants, placing a greater emphasis on the qualitative insights provided by them and exploring different themes within each performance dimension, as discussed in previous sections. Similar to our findings, economic performance is the most influenced dimension as a result of OPEX implementation, except in one study focused on green initiatives, which showed a greater influence on environmental performance. Similar indicators were also observed from our participants and the predefined indicators in the survey analyses of previous studies. Some differences in indicators emerged when focusing on specific industries, as seen in Studies 2 and 3, compared to the more general indicators used in Study 1, which addressed the service sector as a whole. Overall, the findings of our study align with the main themes identified in the existing literature, despite some differences arising from the nature of our study and the questions involved in the data-gathering method.

Our research helps identify new insights and classify findings, leading to conclusions about the impact of OPEX methodologies on sustainable performance, whereas previous studies primarily focused on quantitatively assessing the strength of OPEX's impact, specifically Lean on sustainable performance dimensions.

Given that we included some quantitative analysis, Figure 1 displays a comparison of the strength of impact on each performance dimension between our study and other studies in the literature. Nevertheless, the qualitative nature of our study and the small number of participants limit the potential for generalization and sufficient numerical analysis.

Overall, studies indicate that economic performance is the primary influence resulting from the implementation of OPEX methodologies. Unless specific initiatives are employed to target certain dimensions. While social performance ranks next and can sometimes be nearly as strong as environmental performance.

Table 3. Previous studies results

Results of previous studies on the impact of OPEX methodologies on sustainable performance in the service sector			
Study 1 Lizarelli et al., 2023	Description	A quantitative study with Lean experts in 43 European service companies to identify the impact of lean on sustainability performance in service companies.	
	Results		
	Performance	Coefficient	Indicators
	Economic	0.554	<ul style="list-style-type: none"> - Reduction in operational costs. - Improve competitiveness of business.

			<ul style="list-style-type: none"> - Improve productivity. - Increase in ROI above the industry average. - Increase in sales growth above industry average. - Increase in profit growth above industry average. - Increase in market share
	Social	0.495	<ul style="list-style-type: none"> - Improve social wellbeing across employees and community. - Improve the Health and safety standard of the organization. - Reduction in employee turnover. - Increase in employee education and training. - Increase in employees' satisfaction and motivation. - Increase in employees' quality of life has increased. <p>Improve community engagement.</p>
	Environmental	0.504	<ul style="list-style-type: none"> - Reduction in energy consumption. - Reduction in overall CO₂ emissions. - Reduction in waste across processes. - Increase in resource efficiency. - Reduced resource consumption. - Increase in recycling initiatives which has improved waste recycling.
Study 2 Hussain et al., 2019	Description	A quantitative study with 239 hotel experts to assess lean and green practices and their impact on the sustainable performance of hotel supply chains	
	Economic	0.373	<ul style="list-style-type: none"> - Improve sales and market share. - Reduce operating expenditure. - Improve resource management efficiency.
	Social	0.399	<ul style="list-style-type: none"> - Improve the company image. - Improve the relationship with stakeholders and the community. - Increase compliance with social laws and regulations.
	Environmental	0.424	<ul style="list-style-type: none"> - Improve organizational compliance with environmental standards. - Reduce energy consumption. - Reduce consumption of hazardous/toxic materials.
Study 3 Klein et al., 2022	Description	A quantitative study with 966 academic staff of HEI in Brazil and Portugal to study Lean management and sustainable practices in Higher Education Institutions.	
	Economic	0.888	<ul style="list-style-type: none"> - Increase process management and improve daily activities. - Increase the provision of community services. - Continuously improve cost reduction in all activities. - Increase the offering of residence and student assistance services. - Improve policies that encourage equality, diversity, and social inclusion. - Increase support for professional and personal development and improve employee recognition. - Promote initiatives to increase a healthy lifestyle
	Social	0.708	<ul style="list-style-type: none"> - Health services available for the academic community (e.g., psychological, medical, dental). - Promotion of sustainable education events for the university community. - Provision of student support services (e.g., pedagogical, psychological, integration). - Cultural and scientific initiatives for the broader community (e.g., events, lectures). - Accessibility features for individuals with special needs.

			<ul style="list-style-type: none"> - Availability of gardens or nature spaces for relaxation and recreation.
	Environmental	0.667	<ul style="list-style-type: none"> - Promotion of biodiversity conservation around the campus. - Support for waste separation and recycling (paper, plastic, metals, etc.). - Implementation of mechanisms to reduce water consumption and waste. - Use of energy-saving measures (e.g., presence sensors, hibernation modes). - Encouragement of practices to reduce energy consumption (e.g., turning off lights). - Promotion of sustainable transportation options for commuting to campus. - Awareness initiatives for sustainable water use and energy conservation. - Actions to encourage waste separation and recycling practices.

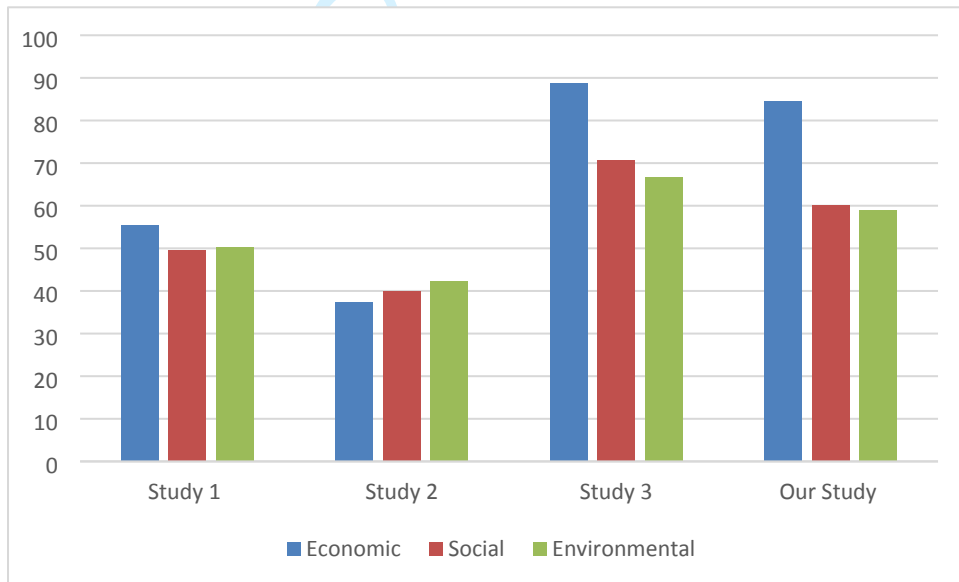


Figure 18. Studies Comparison

Conclusion

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3 In conclusion, this paper studied the adaptation and implementation of operational excellence
4 methodologies across various industries within the service sector, shedding light on their impact
5 on the three dimensions of sustainable performance. The rising adoption of these methodologies
6 underscores the need for a deeper understanding of their utilization, commonly used tools, and
7 encountered challenges. Particularly, as pressure is exerted for sustainable service provision,
8 identifying the influence of operational excellence methodologies on sustainable performance
9 becomes imperative. Through qualitative research methods, 18 interviews with experts spanning
10 different service industries and across all six continents were conducted. This study revealed Lean
11 Six Sigma as the predominant methodology, resulting in substantial benefits. However, challenges,
12 especially related to human resources and data, were identified as significant hurdles in the
13 implementation. The impact of these methodologies on the financial, social, and environmental
14 performance dimensions were also identified. The financial performance stood out significantly,
15 followed by social performance which exhibited a slightly stronger impact than environmental
16 performance. This comprehensive exploration offers valuable insights on the association between
17 operational excellence methodologies and sustainable performance, laying a foundation for further
18 research and practical application in diverse service industries.
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35 Implications

36 The findings of this study have several implications for both practitioners and researchers in the
37 field of operational excellence within the service sector. Firstly, insights into the adaptation of
38 these methodologies, along with the identification of commonly used tools and techniques, serve
39 as valuable guidance for practitioners, particularly those with limited experience in the service
40 sector. By showcasing successful examples of adaptation and implementation, this information
41 provides a roadmap for practitioners, offering practical strategies and approaches that have proven
42 effective in similar contexts. The findings of this paper help facilitate informed decision-making
43 and enhance the likelihood of successful implementation by providing tangible examples of what
44 works best and how successful adaptations can be achieved. Additionally, the identification of
45 challenges that are faced in the service sector highlights areas for intervention and improvement
46 in implementing operational excellence initiatives. Organizations can use this information to
47 proactively address these challenges and enhance the success of their initiatives.
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Moreover, the impact of operational excellence methodologies on financial, social, and environmental performance underscores the need for a holistic approach to sustainable performance management. Practitioners should consider the multidimensional nature of performance when designing and implementing operational improvement strategies. This holistic perspective can help organizations maximize their positive impact while minimizing potential negative consequences across all dimensions of sustainability. This in turn can serve as motivation for practitioners to adopt methodologies that have been demonstrated to influence more than just operational measures.

Limitations & Future Research Agenda

Despite the valuable insights gained from this study, several limitations should be acknowledged. Firstly, the sample size of participants may limit the generalizability of the findings to a broader population within the service sector. Additionally, the qualitative nature of the study may limit the depth of analysis compared to quantitative approaches. Future studies could employ a mixed methods approach to provide a more comprehensive understanding of the relationships between operational excellence methodologies and sustainable performance. Furthermore, the reliance on self-reported data from participants may introduce some biases and subjectivity into the findings. Future research could employ objective measures or triangulation methods to validate participant responses and enhance the reliability of the findings. Finally, the study focused on a selective set of industries within the service sector, which may limit the generalizability of the findings to other industries or contexts. Future research could explore additional industries and contexts to provide a more comprehensive understanding of the impact of operational excellence methodologies on sustainable performance.

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Appendix A

Interview Questions

Section 1 - Respondent Profile

- Please indicate the sector in which you operate.
- What is your current position in the organization?
- In which country is the company located?
- What is your experience in years with Lean, Six Sigma, and Lean Six Sigma in the Service Sector? Any certifications?

Section 2 - Implementation of Lean, Six Sigma, Lean Six Sigma in the Service Sector

Q1: Have you worked on any Lean/Six Sigma/Lean Six Sigma projects in the service sector? What industry? What were the primary objectives?

Q2: Which Specific tools, practices, principles of Lean/Six Sigma/Lean Six Sigma were used, and why?

Q3: How were those tools and practices adapted to address the unique characteristics of the service sector?

Q4: What challenges unique to the service sector did you encounter during the implementation, and how were these challenges overcome?

Q5: In your opinion, which Lean, Six Sigma, and Lean Six Sigma tools or practices can contribute to the different dimensions of sustainable performance?

Section 3 – The impact on Economic, Social, and Environmental performance.

Please provide your answers to the following questions, drawing upon your experience in projects within the service industry.

- **Economic Performance**

Q6: Could you please describe how the Lean, Six Sigma, and/or Lean Six Sigma contributes to economic sustainability?

(In what ways did the project influence financial performance metrics, such as cost reductions, productivity, return on investment (ROI), sales growth, profit growth, market share, etc.?)

Q7: What specific methods were employed to assess and evaluate the impact generated by this initiative, and what particular metrics or indicators were measured or reported?

(For instance, did you utilize methods like cost-benefit analysis, return on investment (ROI) calculations, financial performance metrics, profit margin improvements, efficiency gains, and competitive benchmarking to measure economic benefits and outcomes).

- **Social Performance**

Q8: Could you provide an explanation of how Lean, Six Sigma, and/or Lean Six Sigma contributes to social sustainability?

(How did the project influence social performance measures, including employee satisfaction, customer experience, social well-being, motivation, health and safety, community engagement, and other relevant aspects?)

Q9: What specific methods were employed to assess and evaluate the impact generated by this initiative, and what particular metrics or indicators were measured or reported?

(For instance, did you employ tools such as customer satisfaction surveys, track absenteeism, monitor a decrease in complaints, employee surveys, diversity and inclusion metrics, engagement scores, turnover rates, health and safety evaluations, community relations feedback, social responsibility reporting, work-life balance improvements, training and development assessments, and conflict resolution effectiveness.)

- **Environmental Performance**

Q10: Could you please describe how the Lean, Six Sigma, and/or Lean Six Sigma contributes to environmental sustainability?

(How did the project influence environmental performance metrics, such as energy consumption, resource consumption, CO2 emissions, waste reduction, and other relevant factors?)

Q11: What specific methods were employed to assess and evaluate the impact generated by this initiative, and what particular metrics or indicators were measured or reported?

(For instance. Did you consider methods such as conducting environmental audits, measuring energy consumption, tracking waste reduction, evaluating carbon emissions, analyzing resource efficiency, and utilizing life cycle assessments to quantify environmental improvements.)

- **Operational Performance**

Q12: What are the key operational benefits resulting from the implementation of Lean, Six Sigma, and Lean Six Sigma methodologies?

Q13: We have identified several operational measure categories that have prominently surfaced in studies related to Lean, Six Sigma, and Lean Six Sigma methodologies. These categories encompass factors such as ‘Timely Service,’ ‘Efficiency,’ ‘Reduction of Lean waste,’ ‘Quality’. In light of these operational measure categories, we would greatly appreciate your insight on how these measures could potentially have an indirect impact on various dimensions of sustainable performance, including economic, social, and environmental aspects? Kindly complete the following table by assigning numbers between 1 and 5, according to the following scale, and please briefly justify or provide a brief explanation for why you think that. (5: Very High Impact // 4: High impact // 3: Moderate Impact // 2: Low Impact // 1: Very Low Impact)

Interview Quotes

Table A1. Challenges Quotes

No.	Quote
1	"It's a bit difficult, because managers in the service industries have just a little bit of knowledge about Lean."
2	"People are not aware of such methodologies in the healthcare industry "
3	"You need to back off on the six sigma statistics a little bit, you need to reduce the emphasis on defect reduction, it just turns people off"
4	"In healthcare, they are not really aware of such methodologies"

C1	5	"They may not have good analytical skills and so will struggle. They might be good at dealing with people, but not necessarily very good at dealing with data."
	6	" They're not very much open towards statistical tools"
	7	"The type of people that we tend to work with in the service industries are normally very low-level people, so they find it difficult to grasp the more statistical technical tools and applying them, particularly the Six Sigma type tools."
	8	"There were a lot of hesitations at the start, whether or not such methodologies that were introduced in automotive will work in the oil and gas industry"
	9	"Employees resistance to change"
	10	"The first challenge is people would say," well, we're not a factory, we deal with people not with widgets, and you can't treat a person like a widget. This doesn't apply to us, so thanks very much, but no, it doesn't apply here." It's just a form of resistance that says we're different"
	11	"Service industries are really behind in terms of efficiency and quality, the service problems are easier to fix than the manufacturing problems, and yet people still do not take the effort to fix service processes, because they don't have the mindset to improve and change."
	12	"I'd say in most service operations people do not think of continuous improvement. That's not what they're thinking about when they come in the morning. While engineers are trained in the scientific method, engineers naturally think about how I can get another 1% improvement out of this process, but nurses and financial analyst accountants, they only think about following protocols"
	13	"There is a challenge in terms of the culture, you need to raise awareness and conduct a lot of training"
	14	"The need for more transparency and less sense of failure culture because you are working directly with external customers. You need to develop the capability to be very open and honest."
	15	"Individuals are very interested in people but not necessarily interested in processes."
	16	"Hospitals' culture is not the same as the manufacturing, doctors are not always welcoming and are not really receptive for these continuous improvement methodologies which raises a lot of barriers." "It's not easy to deal with medical doctors"
	17	"A lot of these organizations don't understand their processes. So, we often start with them to say look, just map out your process and even that can be quite challenging"
	18	"If you ask them to map the process, they don't understand, they will say what do you mean by map the process"?"
	19	"One of the big issues with service is that people don't generally understand the process. in manufacturing, it's easier to see the processes. But in the service sector they say we don't have a process, and they could not articulate it to me."
	20	"It's a challenge to engage front line employees"
	21	"It's a challenge to convince people to work on the project and collect the data."
	22	"The buy-in and commitment of employees and their willingness to participate in projects"
	23	"Because you are dealing with people, it's not as clear, you need to balance value, which could be perceived value. It's not like just about cutting the time and getting people through, values can be with the time spent with doctors."
	24	" The most challenging part is to identify the standard and then try to improve the standard and get everyone along in this process of improving standards. Since its driven by humans and not settings in a machine"
	25	"The level of details cannot be captured for human behaviors unlike in machines where you have specific settings"

	26	"It's more complicated in terms dealing with people, there are more stakeholders involved in services."
	27	"Statistical tools need more numbers, and in the service organizations we have difficulties in getting those numbers."
	28	"It is hard to get data and conduct experiments on patients, we cannot wait for the same set of people to come again. It is hard to do many levels for the DOE like in manufacturing because we are dealing with human resources not physical entity. "
	39	"People don't keep track of data, "The IT person came in and said, we didn't know it was important to know the cycle time""
C2	30	"They didn't have any data"
	31	"The service sector is different than other sectors that it is not as data- heavy."
	32	"There is no detailed data, or fine-grained data, so some data-based tools and practices such as DOE and PCA, are not much used.
	33	"It's hard to use some statistical tools due to the need for data which is not available."
	34	"It's hard to get sufficient data for using statistical tools"
	35	"Less availability of data"
	36	"When we refer to service industries, they don't collect data."
	37	"Security and confidentiality of data because of the legal and health reasons"
	38	"Variability is not looked at as much in the manufacturing sector, whereas in services variability is something which we look more detailed"
	39	" The data is always abnormal because of the variation in the ecosystem."
	40	"I found that in manufacturing there's multitudes of CTQs. In the service sector there's a couple of CTQs that almost always end up being critically important. So, it's no longer a continuous measurement like tensile strength. It's now nominal. It was either accurate or not. So, a lot of the tools based on say normal distribution and things like that are no longer the most appropriate. So, you end up using more tools that are appropriate for discrete data.
	41	"Service operation involves a lot of communication with customers, so there is always a chance for missed, incorrect, misunderstood or delayed information"
	42	"In the service sector there is higher variability. Services are intangible and you're focusing on customer requirements which could sometimes variable, more than in manufacturing to some extent."
	43	"It's hard to really understand the process, it is more complex. Although we are aware of Lean Six Sigma, we are not able to implement it because we don't know the process properly."
C3	44	"It is hard to capture the exact value stream, like in manufacturing, due to Sudden emergencies and such situations. So, there are some modifications that need to be done."
	45	"In manufacturing, the number of factors that are influencing the outcome is known and the factors have more of a direct relationship than in services. In services you need to deal with more factors and it's more complex."
	46	"There are so many sources of variance in a typical process in service operations because it's so much driven by, human beings"
	47	"It's more complex, it's hard to decide what input parameters influence your outcome and goal"
	49	"Lean projects took long time (20% of the project took 2 years instead of 3-6 months)"
C4	50	"Takes more time to train them to make sure they understand. "
	51	"It's a challenge to find the time and availability for the team"
	52	" More time was spent training them and explaining what they are doing.

	53	" Most of those employees are doing their day-to-day job and they are also doing six Sigma or lean projects. So, for them it is like outside their working hours. Sometimes they must devote time to really work on those projects"
	54	"You need more time to use statistical analysis until you get sufficient data."
C5	55	"It's sometimes hard to get approvals"
	56	"Long process to obtain approvals and getting the support from top management "
	57	"Security and confidentiality of data because of the legal and health reasons"

C1: Human Resources Challenges. C2: Data-related Challenges. C3: Process-related Challenges. C4: Time-related Challenges. C5: Bureaucratic Challenges.

Table A2. Financial Performance Impact

Theme	Sub-theme	Codes	Quote
Significant and Direct Impact	Emphasized and measured	Long Term	<ul style="list-style-type: none"> • "Huge Impact" -P7 • "Looking at the bigger picture, it is a big bank, so it Definity funded billions of dollars for mortgages and providing loans and credit cards. They created a lot of jobs and supported a lot of people." -P7
			<ul style="list-style-type: none"> • "One of the key things that we can see is the outcome of our LSS Projects." -P1 • "Establishing a committee at the level of the whole organization where you've got representatives from each business unit and then you assign targets based on benchmarks known globally. and you need to achieve at least 1,000,000, let's say of hard savings. -P1 • "We translate these practices to tangible financial impact." -P1
			<ul style="list-style-type: none"> • "Savings of 120M \$ per year" -P3 • "Reduce the number of needed employees by 50%, and that is always translated to dollars." -P3 • "Contributes to 80% of the income of the country" -P3
			<ul style="list-style-type: none"> • "For economic stability, I would say that's the one I have the most experience in because I'm trying to make entities, whether they're for profit or even a nonprofit hospital, more efficient, which impacts the economic performance" -P9
			<ul style="list-style-type: none"> • "Financial impact is predominant. There are many examples of concrete tangible impacts in terms of finances." -P5
			<ul style="list-style-type: none"> • We focus on Increasing the billing amount by increasing the number of services and increasing the revenues." -P8
			<ul style="list-style-type: none"> • "Absolutely, but it is looked at as short terms of quarterly based savings, but not looking at the bigger picture." -P14 • "They look at a very narrow set of metrics, they are not looking at throughput, and sales growth" -P14
		Short Term	<ul style="list-style-type: none"> • "So financial measures are probably the easiest ones." -P15 • "So, the financial side of things are quite easy to measure, to track, to report against." -P15 • "I think the majority probably focused on the short term. Normally they want quick wins immediate, results." -P15
			<ul style="list-style-type: none"> • "It has a huge impact on financial performance, but we need to realize whether it is short term or long term." -P11 • "The less waste indicated that there is less cost and higher return on investment. But it is really about the short-term and long-term benefits." -P11
			<ul style="list-style-type: none"> • "So, they tend, they tend to be short term as in a year or less, so you are trying to meet this year's budget." -P17 • Most of the people I work with are worrying about today, they're not worrying about tomorrow, and that's and that's a bit frustrating." -P17 • "But most of the lean 6 Sigma projects tend to be short term, as in less than a year meeting challenges that they're recurrently facing." -P17

			<ul style="list-style-type: none"> • “I’ll say there is a financial aspect to it definitely.” -P12 • “There are some financial measures related to financial performance, but it is still not yet connected to financial sustainability, it’s just about how we benefited from the project and how cost is reduced.” -P12
			<ul style="list-style-type: none"> • “In the service sector, measures such as market share, ROI, and sales growth plays a major role.” -P18 • “In the service sector, lean Six Sigma may not have much of a drastic impact at a macro level, but rather at a functional level.” -P18
	Not emphasized or measured		<ul style="list-style-type: none"> • “They absolutely have financial outcomes, but they are not really emphasized or reported as much.” -P6 • “In healthcare, they focus more on patients’ satisfaction ratings; number of patients seen and then maybe translate that to revenue. But in general, I would say they focus more on operational and maybe social more than financial outcomes.” -P6 • “Healthcare they don’t want the perception that they are doing things for money, so although they track such measures, but in the reports and meeting they don’t highlight it as much.” -P6
			<ul style="list-style-type: none"> • “In healthcare, they are not measuring anything in terms of finances, they automatically know that it is getting improved.” -P4 • They’re focus on measures like workflow reduction, hospital, bed management, all those things are great for them because we they know they are able to accommodate more people, so their profit margin of course will be more.” - P4 • “I have never seen they measure it from the financial perspective.” -P4 • “They generally report the “cost have been reduced” but no focus on the overall economic aspect. They focus mainly on cycle time reduction and customer satisfaction.” -P4
			<ul style="list-style-type: none"> • “In terms of financial performance, we have a good impact.” -P16 • “Once you implement lean and improve the processes, you can find out that you can implement the processes with less people and this is the main savings that come from Lean, this is the biggest financial advantage.” - P16 • “In Healthcare, we never keep track of financial measures, but rather operational measures and measures related to quality” -P16
			<ul style="list-style-type: none"> • “We to focus in our projects on the operational performance indicators, but they definitely contribute to the financial performance.” -P10 • “But we rather using quality measures as the KPI's” -P10
			<ul style="list-style-type: none"> • “Every LSS have cost savings and they and be classified into soft and hard savings.” -P2 • “In the manufacturing sector it is usually both, in the service sector it would be more soft savings, unless there is a very big change.” -P2 • “In service sector its harder to assess the impact in the service sector” -P2
			<ul style="list-style-type: none"> • “We didn’t check financial performance, we checked operational measures, such as efficiency, idleness, length of stay for patients.” -P13 • “In hospitals is was more of a social need for improving operation rooms than a financial need.” -P13

Table A3. Social Performance Impact

Theme	Code	Quote
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Positive Impact	Satisfaction	<ul style="list-style-type: none"> • “The positive outcomes extend to shareholder satisfaction through measured return on investment (ROI) from LSS projects” -P1. • “Increase employee satisfaction, the nurses loved it.” -P6 • “We measure employee satisfaction and turnover.” -P6 • “The improvements of the projects satisfied the staff, they felt that it facilitated their work and life.” -P13 • “Improve customer and employee satisfaction.” -P8 • “When something is related to humans and their satisfaction, we run quickly, and we want to finish it quickly.” -P3 • “Employee satisfaction was increased in the medical department of the organization” - P3. • “Some people actually really liked it, and they flourish, and they move, sometimes even into different job roles where they do more of this.” -P5 • “People frequently mention that they enjoy seeing the outcome of their work from customer positive customer feedback on the projects.” -P10 • “Employee satisfaction increases because employees should have less tasks and work more efficiently, so they don’t have to work overtime and so on.” -P2
	Engagement	<ul style="list-style-type: none"> • “Engaging the employees and ensuring their satisfaction throughout the projects.” -P6 • “Involving the staff in designing the processes and ensuring their engagement.” -P6 • “We involve employees all way along, we engage the employees, and they have a voice.” -P13. • “We always measure it in terms of social impact such as, employee engagement and dedication.” -P11 • “Enhancing the level of involvement that employees feel because you’re giving them tools and instruments that also evaluate, assess and analyze and improve their own working tasks, their own activities.” -P5 • “LSS fosters teamwork, enhances employee morale and motivation.” -P1 • “Stakeholders were motivated and became advocates of such methodologies.” -P7 • “The staff are motivated” - P13 • “We look at the whole process from when we hire someone until they leave the so trying to incorporate metrics that matter.” -P7 • “We ensure that their voices are heard (students, staff, faculty) and we get them involved” -P6
	Learning & Development	<ul style="list-style-type: none"> • “Employee training in LSS not only provides career development opportunities but also instills a positive culture that extends beyond the organization to impact the broader community.” -P1 • “All employees got some training which helped their development and learning.” -P8 • “Positive impact in terms of training and upscaling, because that’s where the people feel that, yes, it’s making sense to them.” -P12 • It’s a positive impact because employees learn something new” -P14
	Work-life Balance	<ul style="list-style-type: none"> • “It contributes to a better work-life balance for employees.” -P1 • “They are normally making things better and freeing up capacity and time to do more. Once it’s done correctly, they find that they have more time and more capacity to do things better.” -P15 • “From reducing working hours, they have more work-life balance.” -P2 • “Employees should have less tasks and work more efficiently, so they don’t have to work overtime and so on.” -P2 • “Staff felt that it facilitated their work and life.” - P13
	Others	<ul style="list-style-type: none"> • “LSS prioritizes safety through improvement projects and training.” -P1 • “Lean was used to improve road safety and reduce the number of accidents and deaths.” -P3 • “It promotes transparency, breaks down bureaucratic barriers.” -P1 • “DMAIC was integrated with human centric design.” -P7
Negative Impact	Dissatisfaction	<ul style="list-style-type: none"> • “At the beginning people weren’t that happy about the LSS program, so I think we had a dip in our employee satisfaction.” -P10 • “Sometimes the employees are not happy if you change, it can seem like they work harder.” -P14 • “But you also have people that don’t really like that and who, let’s say Like to stick with the

		<p>standard, and I don't think too much about how everything should be changed or improved." – P5.</p> <ul style="list-style-type: none"> • "The employees may be dissatisfied with having to deal with more customers." -P2 • "But in the world of service, you have a new thing you're delivering, you throw bodies at it, you throw people at it, those people become established, the process has become day to day, we improve those processes at the cost of those bodies that go in, so people are not happy it's a very a very difficult situation" -P17
	Fear & Stress	<ul style="list-style-type: none"> • "There is negativity and speciesism about lean among certain level of personality or workers, because they see lean as a threat." -P14 • "Increasing transparency can also induce negative impact like fear. -P5 • "However, sometimes organizations if they are making some good improvements, might want to reduce head counts. Now that that does cause a problem because that sends the wrong message, then people are thinking, well, if we make these improvements, I'm likely to lose my job." -P15 • "If your goal is to reduce people through improving processes, we will have negative impact on employees and society." - P14 • "We have seen that employees are already very stressed and because when employees are not getting a full-time project, there is definitely a stress factor." -P12 • "If your strategy is to reduce costs only, lean Six Sigma is more concentrating on reducing the cost, at that time employees under stress." – P18
	Others	<ul style="list-style-type: none"> • "Employees motivation is not really changed." - P4 • "Employees are not always motivated or interested to work on such projects." -P2 • "But it can also add to the boredom, there is the dark side of lean Six Sigma where managers get bored because they are doing the same things, and are only concentrating on efficiency, but not the growth." -P18
	Others	<ul style="list-style-type: none"> • "Either that companies don't make the effort to measure it, or they do it in a superficial way that basically ensures they get biased information that everybody's happy." -P9 • "So, safety data is being collected and most companies again they collect it for reporting purposes. They don't collect it for improvement purposes." -P9 • "So, I would say in the social performance, there is a lot of opportunity, but I think most of it is untapped." -P9 • "I think there's some resistance in the social areas where people would say this is extra work, we are not paid to do this." - P9

Table A4. Environmental Impact

Theme	Code	Quotes
Positive Impact	Energy consumption	<ul style="list-style-type: none"> • "We have projects that are about, for instance, setting up ESG monitoring so that it becomes clear what the per employee Energyconsumption is." -P5 • "Reduce consumption of electricity, using LSS in the office space. Using the AC with the blinds down vs having them up, theelectricity consumption was less." -P7 • "We have quite a good transparency on our in-Energy consumption and water usage and stuff like that and we are trying to bringthem down." -P10 • "We established a KPI like the number of labor hours and the energy we use, and we're trying to get this down. So, it's we're justconsidering it as the as part of the deployment." -P10 • "Common projects in healthcare help reduce the usage of sheets and towels, which results in less washing, less electricity, and lesswaste. A lot of those services such as washing and so are not done in-house, so less trucks are used to deliver those, so less CO2 emissions from the trucks." -P6 • "We keep track of measures like water waste, energy consumption and type of material used." - P12 • " Lean Six Sigma is used to reduce the energy consumption." -P18 • "But we can look at energy consumption and we have in the past looked at reducing electricity consumption." -P17 • "If we are reducing waste, we are using less the amount of energy, so it has to be good for sustainability, the planet and workingconditions." -P14 • "Only in one project, we measured the kg of paper saved, we had that as a KPI, because we were asked by the manager to tracksuch indicator." -P16

	CO2 Emissions	<ul style="list-style-type: none"> " We were able to reduce carbon emissions by reducing the number of trucks riding to customers' houses to solve some issues and services." -P7 "Common projects in healthcare help reduce the usage of sheets and towels, which results in less washing, less electricity, and less waste. A lot of those services such as washing and so are not done in-house, so less trucks are used to deliver those, so less CO2 emissions from the trucks." -P6 "Minimizing transportations: combining some routes together for delivery, so less carbon emissions." -P1 "The organization is focusing more on CO2 reduction even if it sometimes costs more." -P3 "5-8 LSS projects this year were focused on CO2 emission reduction and carbon competitiveness in terms of machines and truck movements." -P3 "Using gravity to transport items reduced co2 emissions and oil used." -P3
	Physical Waste Reduction	<ul style="list-style-type: none"> "We've had projects in the waste processing industry where they've looked into how, how you can increase the yields of recycling, and waste that comes in the processing facility." -P5 "If we are reducing waste, we are using less the amount of energy, so it has to be good for sustainability, the planet and working conditions." -P14 " We Reduce the number of printings papers." -P7 "A lot of projects were targeted to going paperless and using automation, so that impacted the waste reduction as well as resource consumption and peoples' time." -P6 "Reduce the number of papers used and reduce them with tablets." -P1 "Only in one project, we measured the kg of paper saved, we had that as a KPI, because we were asked by the manager to track such indicator. You can save paper, for some reason, the service industries use a lot of papers." -P16 "The elimination of waste is emphasized in LSS, any type of waste you reduce, especially the physical waste (scrap) impacts the environmental performance." -P1 " Instead of using the ship vessels for three years, we found after testing that we can use it for at least 5 more years without risks, prolonging the life cycle, which improves the environment, which also saves money." -P1 "Protection of the marine life and minimize the damage." -P1 "We reduced the graphite and dust pollution." -P18 "We keep track of measures like water waste, energy consumption and type of material used." -P12 "We Select material that is environmentally friendly, and renewable sources of energy." -P1
Limited/No Impact		<ul style="list-style-type: none"> "So, in environmental, I think we it can be very suitable to continuous improvement, but we have to have a continuous improvement mindset rather than a legal compliance mindset that has to come from see senior management." -P9 "Our cases where we found that we were out of legal compliance in terms of CO2 emissions, and we had to quickly figure out how to get back into legal compliance." -P9 "For environmental impact the biggest impediment is a legalistic compliance mindset versus a continuous improvement mindset." -P9 "It should be very deliberate, because there's a natural tendency for people in organizations to focus on more direct impacts and more direct impacts are typically financial impacts, and environmental impacts has typically indirect impact on the financials because a lot of it is not factored in the price of producing or so." -P5 "Manufacturing really impacts the environment, but for the service it really depends on the industry, so there might be some impact but not as strong as in manufacturing. It might not be directly related to the projects though." -P2 "Less use of equipment have helped in terms of environmental performance but no direct impacts on the environmental aspect." -P4 "No impact on environmental performance." -P8 "Not as much impact on environment. But in general streamlining processes indirectly impacts the environment, because u are uses resources more efficiently." -P7 "In service environment it tends to be in that it's difficult to have a massive impact on CO2 emissions if you're just in an office." -P17 "In manufacturing it's simpler to realize these impacts, like zero waste, but in the service sector it's more indirect." -P11 "There were no measures related to environmental performance; it was not a priority in our projects." -P13 "No one measures the environmental impact of Lean in the service industry." -P16 " We did not keep track of environmental measures, because nobody knows what the measure, and

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	how to measure, there must besome standards." -P15
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Dear Dr., Elif Kongar

I hope this letter finds you well. I am writing to submit the revised version of our manuscript ID IJQRM-09-2024-0315 entitled "Impact of Operational Excellence Frameworks on Sustainable Performance in Services: A Qualitative Study", in response to the valuable feedback provided by you and the reviewers.

We have made several revisions to enhance the clarity and depth of our research. Key changes include:

1. **Integration of Sustainability and Balanced Scorecard:** We have added a new section discussing the integration of the Balanced Scorecard (BSC) with sustainability, highlighting the alignment of operational excellence, BSC, and sustainable performance.
2. **Addressing the gaps in the literature and motivation of the study:** A more in-depth critical discussion has been added to enhance understanding of the current literature, highlight existing gaps, and clarify the motivation for this study.
3. **Comparison with Existing Literature:** We have provided a comprehensive comparison of our findings with existing studies, including quantitative analysis to support our conclusions.
4. **A thorough revision of in-text citations and correction of any errors.**

We would like to extend our sincere thanks to the reviewers for their insightful comments and suggestions, which greatly improved the quality of our manuscript. Their feedback prompted us to have a better look into our research themes and articulate our findings more clearly.

We believe these revisions address the reviewers' concerns and enhance the overall contribution of our study. Thank you for considering our revised manuscript for publication. We look forward to your feedback.

Best Regards,

Shatha Siefan
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Our response to the comments:

Comments	Replies
<p>The literature review section is comprehensive. However, i wonder if it would be worth including brief mention of the Triple Bottom Line and the Balanced Scorecard as precursors for inclusion of sustainability dimensions in OPEX?</p>	<p>Thank you for the suggestion. A separate section has been added to the literature review to discuss the integration of the Balanced Scorecard (BSC) with sustainability, and the relationship between operational excellence, BSC, and sustainable performance, highlighting their alignment.</p> <p>In this section (section 2.23), we defined sustainable performance as the capacity of an organization to achieve its objectives while ensuring long-term viability across environmental, social, and economic dimensions, often referred to as the “triple bottom line”. We discussed how the Balanced Scorecard (BSC) can incorporate sustainability, transforming it into a sustainability-focused Balanced Scorecard (SBSC) that integrates environmental and social considerations into traditional performance measurement. This integration ensures sustainability is embedded within the overall performance strategy, addressing both financial and non-financial aspects.</p> <p>Furthermore, we highlight the synergistic effect of integrating operational excellence methodologies with the BSC, illustrating how data-driven approaches can optimize processes and enhance customer satisfaction while advancing sustainability goals. This holistic approach supports organizations in managing their operational, environmental, and social responsibilities effectively.</p>
<p>Section 2.23 would really be strengthened with a more in-depth critical discussion.</p>	<p>Thank you for the suggestion. A more in-depth critical discussion has been added to this section to enhance understanding of the current literature, highlight existing gaps, and clarify the motivation for this paper.</p> <p>In the newly added section, we acknowledge the significant emphasis on operational outcomes associated with Lean, Six Sigma, and Lean Six Sigma methodologies. While these approaches deliver valuable operational efficiencies and immediate improvements, we raise concerns about their broader impact on sustainable performance. Specifically, we note that a strong focus on short-term operational gains can overshadow essential social and environmental outcomes, potentially neglecting employee well-being and long-term sustainability.</p> <p>We also highlight the operational bias in management, influenced by the tangible nature of operational metrics, which are easier to measure and report. Additionally, we identify a notable gap in the literature regarding the effects of Six Sigma and Lean Six Sigma on all three dimensions of sustainable performance across various sectors within the service industry, despite some studies addressing Lean's impact in specific contexts.</p>

<p>The results are clearly presented and analysed. I would like to see how these results map out against the TBL or BSC in the literature - a brief comparative analysis here would perhaps help underscore that LSS is the most utilised means to address/achieve/pursue sustainable performance in organizations</p>	<p>Thank you for your suggestion. A separate section presenting the findings of previous studies and comparing them with our study has been added to the discussion section.</p> <p>In the newly added section, we discuss existing studies that have utilized quantitative methods, such as surveys, to explore the impact of Lean on sustainable performance dimensions within specific service industries or across the sector as a whole. Notably, to our knowledge, Six Sigma and Lean Six Sigma have not been similarly examined.</p> <p>Our research diverges by allowing themes to emerge from qualitative discussions with participants, emphasizing their insights and exploring various themes within each performance dimension. In previous studies, we found that economic performance is predominantly influenced by operational excellence (OPEX) implementation, mirroring trends in previous studies. However, some studies focusing on green initiatives indicated a greater impact on environmental performance.</p> <p>We also compared predefined indicators used in past research with those identified by our participants, noting variations based on industry focus. Our findings align with existing literature while providing new insights into the impact of OPEX methodologies on sustainable performance. We acknowledge that while our study includes some quantitative analysis, our qualitative approach and limited participant number may restrict generalizability and detailed numerical analysis.</p> <p>Overall, we confirm that economic performance is primarily enhanced through OPEX methodologies, with social performance often closely following, sometimes approaching the influence of environmental performance.</p>
<p>The paper could benefit from a thorough edit. In text citations are inconsistently formatted and there are a few typographical errors throughout.</p>	<p>Thank you for your comment. The paper went through a thorough edit to ensure the consistency of in-text citations and to correct any errors.</p>