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Abstract

Purpose – This research aims to establish the applicability of the ISO 18404 standard to the service sector, identify any required amendments, and identify the critical success factors and barriers to deploying the standard within the service sector.

Design/methodology/approach – The study used a qualitative approach by interviewing operational excellence (OPEX) professionals who work in the service sector.

Findings – The findings indicate a significant lack of knowledge about the existence of the standard and a general scepticism regarding the applicability of the current ISO 18404 standard to the service sector.

Research limitations/implications – Limited examples of the application of ISO 18404 in organisations exist, as only a few organisations have adopted the standard. Therefore, the research focused on the challenges and obstacles that experienced OPEX professionals perceived could be an issue.

Originality/value – The study will aid service sector organisations in understanding the standard and, subsequently, determine whether to pursue it as part of an OPEX program. This research is the first study on the application of ISO 18404 to the service sector.

Keywords: Service Sector, Lean Six Sigma, ISO Standards, ISO 18404

Introduction

Many organisations strive to improve market competitiveness and deliver an enhanced customer experience. Organisations have embraced OPEX methodologies to improve their productivity and quality of products and services (Antony *et al.*, 2017). In particular, organisations have continuously improved the quality and delivery of products and services at an affordable cost through Lean and Six Sigma (Snee and Hoerl, 2018). In recent years, the integration of Lean and Six Sigma became Lean Six Sigma (LSS) to optimise the reduction of variation achieved by Six Sigma with the decrease in waste achieved through Lean (George, 2002). Organisations have embraced a tiered certification or belt system to train personnel in LSS as an OPEX methodology

and ensure certain competency levels. These belt levels can start with a basic level (yellow or white) to more advanced levels of competency and training, including Green Belts (GB), Black Belts (BB), and Master Black Belts (MBB) (Antony and Snee, 2010). Employees may be certified by their company as part of an internal training program or engage an external training body to certify them. Alternatively, they may sign up for an external certification body training course and exam (Antony *et al.*, 2021). Therefore, there has been a proliferation of certification bodies and training consultants offering certifications for purchase in recent years with little or no governance of these awards or the quality of training provided (Louzada *et al.*, 2022).

In many cases, the curricula of these belt courses may differ. They may not follow a body of knowledge as offered by, for example, the American Society of Quality (ASQ) belt certification system (Oudrhiri *et al.*, 2022). International Management Information Systems such as those offered by the International Standards Organisation (ISO) have provided methods of ensuring that organisations set up and are audited and certified to a level of competence in, for example, quality management (ISO 9001), environmental management (ISO 14001), and other technical areas (Tarí *et al.*, 2012). The importance of integrating a continuous improvement programme with organisational management systems and within an ISO 9001 certified Quality Management System has been documented (Sá *et al.*, 2020). The ISO 18404 standard defines the competencies for the attainment of specific levels of competency with regards to Six Sigma, Lean, and LSS in individuals (e.g., MBB, BB, GB, and Lean practitioners) and their organisations (ISO 18404, 2015) to resolve the issue around a lack of standardisation within LSS training bodies and consultants. However, this standard has not been widely embraced according to studies (Antony et al., 2021; Antony et al., 2022a; Antony et al., 2022b; McDermott et al., 2023). Specific criticisms of the standard included that Lean cannot be standardised as the approach in one organisation to Lean may not suit another organisation (Antony et al., 2021). There have also been concerns about the suitability of the standard for small and medium enterprises (SMEs). Antony et al. (2022) published a study about the unsuitability of the standard to SMEs. Further, Kazakova (2019) researched the difficulties of applying the standard to SMEs in Russia. Equally, using the standard to service type organisations has been a concern (Antony, McDermott, Sony, Cudney *et al.*, 2021). This research aims to follow previous studies on applying ISO 18404 to manufacturing sectors and SMEs and establish how applicable the ISO 18404 standard is to services. The research questions (RQs) are as follows:

RQ1: To what extent does the current version meet the requirements and challenges of the service industry?

RQ2: What amendments should be made further to the current version?

RQ3: What are the critical success factors and barriers to using this standard in the service sector?

The following section outlines the literature review. The next section describes the methodology for the study. The results are then presented and discussed, while the study concludes in the final section.

Literature Review

Background to ISO 18404:2015

The Royal Statistical Society (RSS) developed the standard in association with the British Standards Institute (BSI) and Professor Tony Bendell, a prolific advocate of the standard. Professor Bendell was chair of the committee in BSI that had oversight for that standard development. He also chairs the RSI quality improvement section (Oudrhiri *et al.*, 2022). The standard was reviewed and confirmed in 2021 as part of the ISO systematic review process, which involves a close review of the standard and any requests to upgrade it or edit it every five years (ISO, 2019). During the systematic review process, members of the ISO Technical Committee (TC) 69/SC 7 for "Applications of statistical and related techniques for the implementation of Six Sigma" highlighted several concerns with the standard and referenced a study by Antony et al. (2021) as evidence of a need for revision of the standard (Antony *et al.*, 2022; McDermott *et al.*, 2023). However, the TC decided to confirm the standard and work on a revision separately. The TC placed this initial revision on hold. A new work order to revise the standard has been put to the ISO TC involved, citing a lack of resources to work on the revision of the standard, and an expected ISO 18404: 2023 revision will now not take place until at least 2026 based on timelines put forward by the project leads (ISO TC 69, 2023).

ISO Standard

There are sparse mentions of ISO 18404:2015 in peer-reviewed studies, conference papers, or on general internet or blog searches for the standard (Antony *et al.*, 2022; Antony, McDermott, Sony, Cudney *et al.*, 2021; Antony, McDermott, Sony, Powell, *et al.*, 2021). Ward and Caklais (2019)

discussed the advantage of having an LSS standard in theory. They discussed the ISO 18404 standard, referencing its first in-the-world implementation in a UK construction company in 2018. There are practically no case studies of the practical deployment of the standard (Ward and Caklais, 2019; Herrera and Van Hillegersberg, 2019; Antony *et al.,* 2021). There are some references to organisations with ISO 18404 on internet searches via Google, but still no evidence of implementing the standard as a case study publication in refereed journals. For example, the Dubai Electricity and Water Authority (DEWA) in Saudi Arabia became the first government authority to gain ISO 18404 certification in 2019 (Alqahtani *et al.*, 2015; BSI, 2019). Sobhra Facades, a construction company in the Gulf, obtained ISO 18404 certification in 2022 (Illankoon, 2022), and the University of Pittsburgh Medical Centre hospital group are certified to the standard (UPMC Whitfield, 2021). Many have referenced the standard (Herrera and van Hillegersberg, 2019; Kikuchi and Suzuki, 2018; Artamonova *et al.*, 2022), but very few authors have discussed the standard in more detail. Table 1 summarises the published studies related to the standard and their main findings. Limited studies specifically discuss ISO 18404 and its application; therefore, it is possible to summarise the studies most applicable to the standard here.

Table 1. Literature related to ISO 18404 - the requirement for a standard and its pros and cons

Studies	**Findings**
A study into the pros and cons of ISO 18404: viewpoints from leading academics and practitioners (Antony, McDermott, Sony, Cudney, *et al.*, 2021)	The qualitative study identified mixed opinions about the standard's necessity but generally agreed on the need for its enhancement, offering suggestions for improving the standard.
A global study on the applicability of ISO 18404: 2015 for SMEs: An exploratory qualitative study (Antony *et al.*, 2022)	This study shows that the ISO 18404:2015 standard is unsuitable for SMEs using LSS. It has shortcomings that need fixing or a tailored LSS standard for SMEs.

The place of ISO 18404:2015 in organisational improvement (Oudhriri et al., 2022)	This paper was a rebuttal of a study on ISO 18404 by Antony et al. (2021) and cited the standard's many benefits.
The misplacement of ISO 18404:2015 in organisational improvement: A point-counterpoint article (McDermott *et al.*, 2023)	This point-counterpoint paper refuted the Oudhriri et al. (2022) work, defended the study by Antony et al. (2021), and cited the standard's shortcomings as written.
A global study into the pros and cons of ISO 18404: A convergent mixed method study and recommendations for further research (Antony, McDermott, Sony, Powell, *et al.*, 2021)	This study revealed conflicting OPEX professional views on ISO 18404. Qualitative findings showed support for Lean Sigma but concerns about audibility and suitability, suggesting a need for revisions. In the quantitative survey, 42% had not heard of it, and 90% of those who had read it. Only 10% planned to apply it. Less than 50% found it fit for purpose, hinting at potential future refinements.
Piloting the deployment of ISO 18404 in the construction sector, an approach to organisational transformation (Ward and Caklais, 2019)	The authors discussed the importance of the standard and its benefits while providing an example of its application to the construction sector.
Problems of implementation of ISO 18404: 2015 in the enterprise in Russia (Kazakova, 2019)	This study discussed the difficulties of implementing the standard in SMEs in Russia.
Kaizen and Standardization (Kikuchi and Suzuki, 2018)	The authors discussed the background of the ISO 18404 standard and concluded that

	African organisations, particularly SMEs, would not embrace such a standard due to resource issues and costs involved.

Benefits of a Lean Six Sigma Standard and ISO 18404

Many studies related to ISO 18404 have mixed viewpoints on the benefits of the requirement for a Lean and Six Sigma standard (Antony, McDermott, Sony, Cudney, *et al.*, 2021). Industry practitioners and academics in qualitative studies by Antony et al. (2021, 2022a, 2022b) cited that having a standard could eliminate some "rogue" trainers and consultants who certify individuals as BBs with little training required, in turn, in exchange for a fee, a faster certification time, and a framed certificate. The value of a certification attached to the ISO was deemed valuable. The importance of having competencies that an individual could be certified to is also an advantage of ISO 18404, as the certification could move from one employer to another with the individual (Antony, McDermott, Sony, Powell *et al.*, 2021; McDermott *et al.*, 2023).

Critique of a Lean Six Sigma standard and ISO 18404

Many of the studies on ISO 18404 available spoke of the "lack of fitness for use" as currently written (Antony *et al.*, 2021). Qualitative studies conducted by Antony *et al.* (2022) and practitioners in LSS discussed that Lean could not be standardised or measured and that the standard itself has several shortcomings. For example, the standard refers to Lean and Six Sigma but not LSS. The standard does not include the YB level and Design for Six Sigma or Design for LSS. Many commentators have stated that a continuous improvement program without inclusivity of an operator or basic level belt makes the program more exclusive and goes against an ethos of involving everyone, employee respect, and total engagement of the workforce for an OPEX journey (Antony, McDermott, Sony, Cudney, *et al.*, 2021; Kikuchi and Suzuki, 2018; Roser, 2016). Others stated that ISO 9001 certification is sufficient as a base standard for continuous improvement and that another standard is not required (Antony., 2021). In their 2021 study, Antony et al. put forward a series of recommendations for improving the standard. The participants overwhelmingly repeated these recommendations in subsequent qualitative and quantitative

analyses by Antony's research team. The Oudhriri et al. (2022) study also reflected that the standard needed to be updated to reflect the shortcomings.

ISO 18404 and Services

Traditionally, LSS has proliferated more in manufacturing than in service sectors (Sunder M. *et al.*, 2018). However, in recent years, continuous improvement methods have been embraced increasingly in the financial, healthcare, and retail sectors. Some of the criticisms of employing LSS in services are that, for example, many are customer or public-facing and subject to surges in capacity. For instance, in healthcare and other public sector organisations, surges occur during pandemics and other capacity challenges (McDermott *et al.*, 2022a). Quality improvement can take longer to implement in such sectors, particularly in public organisations with administrative processes and cultural issues causing constraints (Bhat *et al.*, 2019). The ever-changing nature of the services environment and variability in services required can restrict the process of improvement initiatives (McDermott *et al.*, 2022b). Therefore, the complexity and diversity of the service sector can lead to different approaches and practices in the deployment of LSS, which does not fit with a standard (Antony *et al.*, 2021). Many service sector organisations have many support personnel (e.g., retail employees, call centre support employees) who need to be involved in continuous improvement to improve processes; having no YB or white belt (WB) level in the ISO 18404 standard restricts their access to a continuous improvement program.

Research Methodology

The research questions set out in this study were exploratory. Therefore, the study used a qualitative research methodology. Qualitative studies are appropriate when researchers seek a deeper, contextual, and more nuanced understanding of a phenomenon, particularly when exploring subjective experiences, social processes, or poorly understood areas (Cresswell et al., 2016). In this case, the research intends to assess the suitability of the current version of the ISO 18404 standard for the service industry and identify any necessary amendments. In addition, the research seeks to examine critical success factors and barriers to applying this standard in the service sector. Therefore, the research employed a qualitative study to understand the perspectives of senior professionals working in the service sector about this standard. This approach enabled the capture of diverse viewpoints about this standard through a heterogeneous purposive sampling

technique or maximum variation purposive sampling technique (Saunders et al., 2009). The study targeted individuals who are BBs or MBBs with a minimum of five to ten years of experience in the service industry, specifically those engaged in Six Sigma or LSS projects.

The research team developed an open-ended semi-structured interview protocol to gather insights on various aspects of the ISO 18404 standard. The first part of the interview protocol captured the demographic information about the participants. The second part consisted of various aspects of ISO 18404 regarding its applicability in the service sector. The protocol underwent a piloting phase involving four participants.

Two of them, with over a decade of experience, were industry professionals in the service sector and MBBs. The other two were academicians, each having published a minimum of 10 research papers on LSS. The piloting exercise proved instrumental in refining the interview questions for enhanced clarity and understanding. First, the researchers used Linkedin (Prodromou, 2015), a professional social networking site, to identify participants from four continents: North America, Europe, Asia, and Australia. The qualifying criteria for the participants were those working in the service sector with a minimum of five years of experience with LSS BB or MBBs. The researchers sent a personalised invite to each participant via e-mail outlining the study's objectives. The researchers provided the requested information to participants who needed further information. Once the consent form was signed, the researchers conducted one-on-one semi-structured online interviews. The average time of the interview was 71 minutes, with a standard deviation of 13. The researchers ensured participant anonymity as we will not reveal any identifying information. Assurance of anonymity avoids socially desirable responses (Paulhus,1994). The interviews were stopped at 15 participants, as the same themes recurred without providing new insights, indicating theoretical saturation (Guest *et al.*, 2006). Further, Creswell et al. (2016) suggest a sample size of 10 to 15 is sufficient in most cases as data would be saturated. Thus, the sample size was adequate for this study. Table 2 presents the participants' backgrounds and demographic information.

The researchers conducted, recorded, and transcribed the interviews via Zoom. Two researchers ensured accuracy by cross-referencing the transcriptions with the original voice recordings. After obtaining the transcribed data for each interview, the researchers anonymised the participants' identities using pseudo-names (P1 to P15). The transcribed content was shared with

respective participants, allowing them to cross-check and provide feedback (Cresswell et al., 2016) to enhance the validity of the collected data and ensure its reliability and validity.

Three researchers' data from the 15 interviews underwent independent analysis, leading to thematic categorisation into themes and meta-themes. The interrater percentage agreement reached 89%. In cases of disagreement, all researchers conducted collaborative discussions to achieve amicable resolutions.

Table 2. Participants' profiles

Code	Qualification Level	Job Title	Sector	Years of Experience in the Service Sector	Company Headquarters	Company Size	Business Unit Size
P1	MBB	Program Manager of Customer Service Team	E-commerce	20 years	United States	1,500,000	130,000
P2	MBB	Program Manager of Customer Excellence Team	E-commerce	17 years	United States	1,500,000	50,000
P3	BB	Senior Process Engineer	Finance	Five years	United States	220,000	50,000
P4	MBB	Director Process Operations	Information Technology	24 years	United States	200,000	40
P5	MBB	Head of Continuous Improvement	Probation	30 years	England and Wales	85,000	18,000
P6	BB	Senior Product Owner	Finance	35 years	United States	50,000	20
P7	BB	Associate Director	Business Consulting	16 years	India	21,000	-

P8	MBB	Senior Consultant	Finance	Ten years	Netherlands	20,000	3,000
P9	MBB	Director of Operational Excellence Team	Business Consulting	20 years	United States	20,000	-
P10	MBB	Senior Associate Director	Shared Services	18 years	India	20,000	-
P11	MBB	Senior Performance Improvement Consultant	Healthcare	Six years	United States	14,000	13
P12	BB	Transformation Program Manager	Telecom	18 years	Australia	5000	-
P13	MBB	Quality Improvement Lead	Healthcare	30 years	Ireland	3500	-
P14	MBB	Quality Assurance Compliance Lead	Construction	20 years	Ireland	1500	-
P15	BB	Associate Professor	Higher Education	13 years	Australia	1280	-

Findings

Figure 1 showcases a word cloud derived from the interviews, visually summarising the key themes. This graphical representation effectively highlights the authors' and interviewees' most frequently used keywords, emphasising their relative importance (Lohmann et al., 2015; Munoz Lopez, 2010). Prominent terms included service, belt, organisations, sectors, Lean, ISO, Six Sigma, 18404, process, improvement, competency, and LSS. Figure 2 presents a more detailed analysis plan.

Figure 1. Word cloud

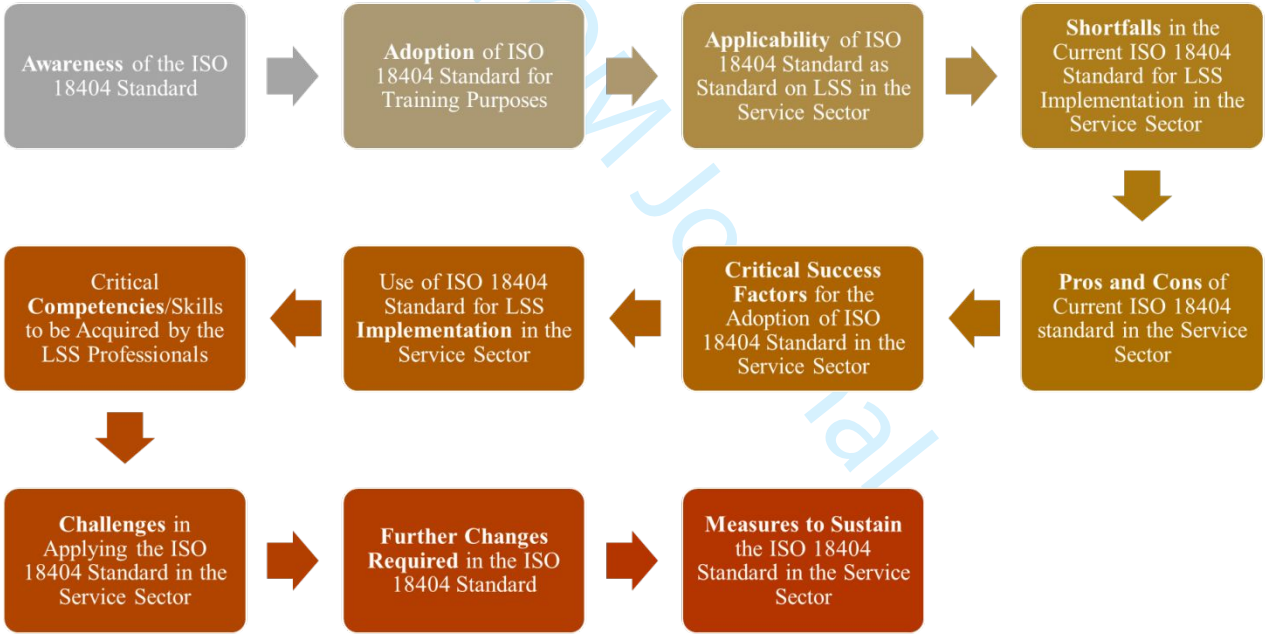

Figure 2. Detailed analysis plan

Awareness of the ISO 18404 Standard

Overall, many participants were unaware of the standard, with seven out of fifteen participants having no prior knowledge of it before this study. Table 3 showed that only two participants, P2 and P5, claimed to understand the standard fully. P2 had successfully applied it in past

employment, sharing comprehensive knowledge, while P5 was close to implementing it at their organisation but faced resistance from leaders. Six participants had some awareness, with three stating that they learned about the standard from Antony et al. (2022). The results further indicate that 80% of BBs were unaware of the standard before this study, indicating a significant knowledge gap.

Table 3. Participants' awareness levels of the ISO 18404 standard

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
Fully aware	-	Yes	-	-	Yes	-	-	-	-	-	-	-	-	-	-
Somewhat Aware	Yes	-	-	Yes	-	-	-	Yes	-	Yes	-	-	Yes	-	Yes
Fully unaware	-	-	Yes	-	-	Yes	Yes	-	Yes	-	Yes	Yes	-	Yes	-

Adoption of ISO 18404 Standard for Training Purposes

The study also found that none of the participants currently use ISO 18404 for training personnel in Lean or Six Sigma. Instead, their organisations preferred using internal standards, ASQ LSS certification or tailored certifications provided by consulting firms, implying these certifications aligned better with their organisational needs.

Applicability of ISO 18404 Standard as Standard on LSS in the Service Sector

The researchers had participants who agreed to assess the applicability of ISO 18404 in the service sector. As highlighted in Table 4, only four individuals (P1, P3, P6, and P10) endorsed ISO 18404's applicability to the service sector. They believe that its comprehensive nature suits the diverse service sector and effectively addresses the sectors' needs, emphasises process alignment, is applicable across the entire service sector without exception, and emphasises the importance of having uniform competencies.

However, eight participants expressed scepticism about the competencies within the standard, suggesting inflexibility related to different business scenarios and problem severity. They also deemed the standard too rigid and proposed it as a guiding framework. While some found it more

suited to manufacturing, others acknowledged its adaptability but noted that specific aspects might require modification to suit service organisations.

Three participants strongly disapproved of ISO 18404 for LSS in the service sector due to its technical nature. They raised concerns about data collection issues, the service sector's diverse nature, and the need for sector-specific tools. The participants collectively questioned its value, citing existing standards such as ISO 13053-1:2011 and ISO 21500:2021.

In summary, 73% of the participants expressed doubts about the standard's applicability in the service sector, indicating a significant level of scepticism. These findings indicate that modifications may be necessary to ensure the standard's adoption and suitability in the service sector.

Table 4. Participants' viewpoint on the applicability of the ISO 18404 standard as an LSS standard for the service sector

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
Fully Applicable	Yes	-	Yes	-	-	Yes	-	-	-	Yes	-	-	-	-	-
Somewhat Applicable	-	Yes	-	-	Yes	-	Yes	Yes	Yes	-	Yes	Yes	-	Yes	-
Inapplicable	-	-	-	Yes	-	-	-	-	-	-	-	-	Yes	-	Yes

Shortfalls in the Current ISO 18404 Standard for LSS Implementation in the Service Sector

Although some participants recognised ISO 18404's relevance in the service sector, discussions highlighted notable shortcomings. Table 5 ranks these shortfalls themes by the number of participants expressing each concern.

Table 5. Shortfalls in the current ISO 18404 standard for LSS implementation in the service sector

Shortfalls	**Participant Code**	**Count**
Inadequate consideration of the unique characteristics and challenges of the service sector	P1, P2, P7, P9, P11, P14, P15	7
Lack of additional value for the standard	P4, P6, P7, P8, P9	5
Inapplicability of tools in the service sector	P8, P10, P13, P14	4

Measurement and evaluation obstacles	P4, P5, P11, P12	4
Generalizability of the standard	P4, P12, P15	3

Inadequate Consideration of the Unique Characteristics and Challenges of the Service Sector

Participants identified the standard's primary drawback as insufficient recognition of the distinct traits and complexities within the service sector. They believe the standard's limitations include its inability to encompass the sector's diversity, intricacies, ever-changing dynamics, diverse scenarios, criticality, and data availability issues. They also emphasise the standard's lack of oversight of customer interactions and stress integrating customer viewpoints.

Lack of Additional Value

Five participants raised concerns regarding ISO 18404's perceived value. These respondents believe existing Six Sigma and project management standards may confuse ISO 18404's unique benefits. Additionally, organisations already proficient in Lean and Six Sigma may perceive limited advantages in the current standard.

Inapplicability of Tools in the Service Sector

Four participants noted that specific tools, including control charts, gauge repeatability and reproducibility, design of experiments, and process capability analysis, were seen as inapplicable or less applicable in the service sector. For instance, Participant 14 highlighted challenges with process visualisation and tools such as value stream mapping in this context.

Measurement and Evaluation Obstacles

Four participants identified measurement and evaluation challenges in ISO 18404, focusing on skill assessment in the service sector. The participants noted challenges measuring competencies such as auditing, motivation, customer focus, and leadership development. They highlighted the added complexity of quantification and assessment due to the inherent intangibility of services in this sector.

Generalizability of the Standard

Three participants highlighted the standard's generalizability issues, pointing out its generic, inflexible, prescriptive, and theoretical nature. Participant 15 explained, "the standard is overly prescriptive, which may not suit the service sector's practical needs. In my experience, data availability can be limited."

Pros and Cons of Current ISO 18404 Standard in the Service Sector

Participants compiled a list of the pros and cons of the ISO 18404 standards in the service industry. Eight key pros emerged during the interviews. The most common one (P1, P3, P6, P8, P13, P14) is its emphasis on competencies and performance. It offers a "prescriptive model for understanding knowledge, skills, and expertise" and "helps measure and verify competence levels". Additionally, it grants accreditation and recognition, confirming competence (P4, P13, P14, P15). P15 highlighted the absence of a global certification for Lean practitioners, making ISO 18404 recognition valuable. Further, the ISO 18404 standard ensures consistency and standardisation (P13, P14, P15), serves as a guiding principle (P1, P6, P8, P13), and fosters sustainability and continuous improvement (P2, P13, P11). Notably, it enhances efficiency and operational excellence (P11, P14), customer satisfaction (P11, P14), employee engagement (P14), and competitive advantage (P11).

Thirteen key cons emerged from the interviews. The most prevalent challenge is its rigidity and lack of flexibility (P7, P9, P10, P11, P12, P14, P15). P11 emphasised that excessive standardisation in the service industry can stifle creativity and hinder customisation. Similarly, P14 noted that service sector work is often project-based and unique, making it challenging to tailor the standard to specific organisational needs. The second most common con (P2, P3, P9, P11, P15) is the absence of service-specific knowledge. Interviewees believe that the standard requires adjustments to accommodate service sector characteristics, such as intangibility, variability, customer interactions, challenges associated with data availability, and the absence of anecdotal evidence.

The third most common con is the separation between Lean and Six Sigma (P4, P8, P10, P13, P15). P4 pointed out that although the standard's title mentions LSS, the content treats them as distinct entities. P13 and P10 mentioned that the industry no longer distinguishes Lean and Six Sigma separately but focuses on LSS. P8 and P15 believe it focuses more towards Six Sigma. Other challenges mentioned include vagueness and a theoretical nature (P4, P10, P15), difficulties

in measuring competencies and success (P4, P15, P11), lack of a unified body of knowledge (P1, P6), limited coverage of YB (P1, P4), and the standard being costly and time-consuming (P14, P11).

Critical Success Factors for the Adoption of ISO 18404 Standard in the Service Sector

Participant input revealed recurring critical success factors themes, as illustrated in Table 6.

Table 6. Critical success factors for adopting ISO 18404 in the service sectors

Success Factors	Participant Code	Count
Leadership buy-in/ Management support	P2, P5, P9, P11, P12, P13, P14, P15	8
Amendment of standard structure	P1, P3, P4, P7, P8, P10, P12	7
Training and education	P1, P2, P10, P11, P13, P14, P15	7
Employee engagement and cross-functional collaboration	P2, P6, P8, P11, P14	5
Fostering a continuous improvement culture	P7, P11, P12, P14, P15	5
Effective performance measurement systems	P5, P6, P11, P12	4
Sustainment plan	P6, P13	2

Leadership buy-in

Nearly half of the participants stressed the importance of strong leadership commitment to LSS success. Participant 8 specifically noted that top management must actively promote the LSS culture, allocate resources, and demonstrate unwavering commitment to process improvement to foster a culture of continuous improvement and ensure LSS's effective implementation throughout the organisation.

Amendment of Standard Structure

Seven participants highlighted the importance of aligning the existing structure with sector-specific needs for successful ISO 18404 implementation. The participants preferred a flexible, guideline-based approach over a strict standard to prevent employee resistance. Participant 10

added, “Real benefits emerge when the standard prescribes Lean and Six Sigma processes, project timelines, and roles, not just competencies.”

Training and Education

Seven participants emphasised the importance of LSS training, certification, and education in applying the standard effectively in the service sector to equip employees with the necessary skills. Participant 13 highlighted the value of online training for sustainability, advocating for accessible, continuous learning opportunities to ensure long-term adherence and understanding of the standard.

Employee Engagement and Cross-functional Collaboration

Five participants highlighted the significance of engaging people in the design and implementation of the standard. They emphasised open communication and employee involvement to secure commitment to process improvements, emphasising cross-functional collaboration, improved information flow, and streamlined organisational decision-making.

Fostering a Continuous Improvement Culture

Five participants emphasised the importance of fostering a culture of continuous improvement in organisations. They believed that instilling a culture of proactive mindset, continuous process improvement, and adaptability to changing customer needs urges employees to pursue growth, innovation, and efficiency, fostering an agile and responsive organisational environment.

Effective Performance Measurement Systems

Four participants emphasised the need for performance measurement systems through KPIs to gauge LSS initiative success, track progress, pinpoint improvement areas, and evaluate intangible aspects while validating outcomes and ensuring corporate goals align with LSS goals.

Sustainment Plan

Two participants stressed the importance of sustainment plans for ISO 18404 adoption success. Participant 6 highlighted the need to sustain and reinforce understanding regarding “what,” “why,”

and "who." This finding underscores the importance of clear, comprehensive plans for ongoing adherence.

Use of ISO 18404 standard for LSS implementation in the Service Sector

Five participants (P6, P10, P11, P14, P15) stressed their role in providing crucial structure, clarity, and a shared language. One participant, with an operational background, lauded its "systematic approach, making life easier." Another noted how this structure "ensures consistent and effective LSS application in service organisations." Additionally, three participants (P11, P13, P15) emphasised the significance of performance measurement in LSS implementation. They highlighted the challenge of quantifying initiative success, a common hurdle in the service sector. Additional insights included cross-functional collaboration, awareness of necessary skills, benchmarking, training checklists, guided process enhancement, knowledge sharing, nurturing a culture of continuous improvement, promoting a customer-centric approach to quality enhancement, obtaining personnel buy-in, and organisational accreditation.

Conversely, three participants (P1, P4, P10) viewed ISO 18404 as overly generic and not tailored to the service industry, resulting in limited adoption. Similarly, two participants (P7, P15) believed that using the ISO 18404 standard only applies to highly structured, transaction-based, or novel services.

Critical competencies or skills to be acquired by the LSS professionals

After reviewing ISO 18404, the researchers asked participants to detail critical competencies for GBs, BBs, and MBBs. Three participants (P1, P6, P7) found the standard to adequately cover essential competencies, with P6 stating, "I don't think there was anything that shouldn't have been there." For others, Tables 7, 8, and 9 summarise MBB, BB, and GB critical competencies, including some mentioning YB competencies such as basic improvements (P1, P2) and following BBs' guidance (P1).

In a broader context, certain participants noted additional competencies without specifying a belt level, such as a growth mindset, commitment to learning (P9, P12, P14), and critical thinking (P9, P13, P14). Understanding the steps, tools, and requirements (P2, P13) was also highlighted. Moreover, individual competencies surfaced during interviews, including hands-on experience and grasping ground realities (P9), emphasising long-term sustainability in solution

implementation (P9), challenging the status quo (P9), fostering a culture across business teams (P7), and possessing an analytical mindset with attention to detail (P14).

Table 7. MBB critical competencies

Critical Competency	Participant Code
Leadership and coaching for BBs and GBs	P1, P2, P3, P7, P11, P14
Strategic alignment with organisational goals	P3, P10, P11, P14
Communication with top management and stakeholders	P2, P13, P14,
Problem-solving, Change Management, and Leading Organizational-Level Improvement Initiatives	P7, P11, P13, P14
Statistical Analysis, Data Modelling, and Knowledge of LSS Principles and Tools	P11, P13, P14
Shaping LSS Culture, Continuous Improvement, and Project Management for Complex Projects	P2, P11, P13, P14
Training program design and implementation	P11
Effective presentation to stakeholders	P11

Table 8. BB Critical competencies

Critical Competency	Participant Code
Advanced statistical analysis and new data techniques	P7, P8, P11, P13, P14
Process improvement expertise and change implementation	P1, P3, P7, P13, P14
Effective communication and stakeholder influence	P2, P7, P11, P14

Leadership and mentoring for teams	P1, P2, P11, P14
Project management skills for improvement projects	P1, P3, P11, P14
Driving organisational and cultural change	P10, P11, P13, P14
In-depth LSS principles, methodologies, and tools knowledge	P7, P11, P14
Problem-solving mastery, including root cause analysis	P7, P11, P14
Cross-department project leadership	P2
Understanding of the organisation's strategy	P2
Industry 4.0 expertise	P8

Table 9 GB critical competencies

Critical Competency	**Participant Code**
Basic understanding of LSS principles, tools, and methodologies	P3, P7, P10, P11, P14
Statistical knowledge and data analysis	P7, P11, P13, P14
Communication, teamwork, presentation skills	P2, P7, P11, P14
Process mapping and improvement	P7, P8, P14
Problem-solving and root-cause analysis	P7, P10, P11, P14
Project management	P11, P114
Customer focus and satisfaction	P14
Ability to apply LSS in real-world scenarios	P1
Process specialisation	P10

Challenges in Applying the ISO 18404 Standard in the Service Sector

Since none of the participants currently adhere to ISO 18404, we prompted them to evaluate potential challenges faced by service sector companies adopting this standard, collectively outlined in Table 10.

Table 10 Challenges facing companies in applying ISO 18404 in the service sectors

Challenge	Participant Code	Count
Inapplicability in the service sector	P2, P3, P4, P5, P8, P9, P10, P11, P13, P14, P15	11
Lack of management support in using the standard	P1, P2, P3, P5, P6, P9, P12, P14	8
Resistance to change	P1, P5, P7, P8, P11, P12, P14	7
Immeasurability of Competencies	P4, P5, P10, P11, P12	5
Competing standards	P1, P4, P6, P8, P15	5
Absence of YB competencies	P1, P4, P5, P7	4
High cost of accreditation	P3, P5, P11, P13	4
Absence of merged LSS competencies	P4, P10, P13	3

Inapplicability in the Service Sector

Participants identified ISO 18404's inapplicability for the service sector as a significant challenge. 73% echoed this concern, citing issues with its alignment with service-oriented organisations. They argued that the standard fails to adequately address the unique needs of the service sector, describing it as overly theoretical, rigid, and tailored primarily for manufacturing. Participant 11 encapsulated this sentiment concisely, stating, "Adapting the standard to align with service organisations, characterised by intangibility, variability, and customer interactions, can be daunting."

Lack of Management Support

53% of the participants identified the second most significant challenge as the lack of management support, emphasising the importance of educating leaders about the standard's reasons, benefits, expected outcomes, and its continuous value to the organisation to facilitate effective application

within their business domains. Participant 5 stressed the need to persuade leaders, "Without convincing leaders, momentum is hard to gain."

Resistance to Change

Resistance to change, identified by seven participants, emerged as the third most influential challenge, underscoring the potential reluctance from employees and stakeholders when adopting new practices. Participant 8 stated, "In my country, people don't readily embrace standards; it feels imposed, and they are entrepreneurial and prefer autonomy." Likewise, participant 7 expressed concerns about the perception of the standard as an extra burden for team members.

Immeasurability of Competencies

Five participants highlighted the challenge of competencies' immeasurability, underlining the difficulty in accurately assessing and quantifying necessary skills. Participant 11 succinctly captures this by saying, "In the service sector, services are often intangible, making performance measurement more difficult." Participant 5 echoes this sentiment by posing questions like, "How can you audit motivating others? How can you audit customer focus? How can you audit leadership development?"

Competing Standards/Bodies of Knowledge

As highlighted by five participants, numerous competing standards or bodies of knowledge pose a significant challenge. This challenge arises from companies' difficulty when selecting a standard and determining its suitability. The respondents questioned the effectiveness of introducing the ISO 18404 standard separately, suggesting that integrating it into the existing LSS standard provided by ASQ might have been more efficient. Similarly, Participant 8 questioned the authority behind the ISO standard and its alignment with their company's specific needs, asking, 'Who created this ISO standard, and how do they know what is best for our company?'

Absence of YB Competencies

Four participants noted the standard's absence of YB competencies. One participant emphasised, "The standard overlooks YB competencies, which are often the starting point for many individuals

in organisations." Likewise, Participant 1 echoed this concern: "The standard lacks YB considerations, yet the importance of LSS YBs is prevalent globally."

High Cost of Accreditation and Implementation

Four participants identified high accreditation and implementation costs as a significant obstacle, potentially hindering widespread ISO 18404 adoption due to financial constraints. Participant 3 highlighted leadership's view on continuous improvement initiatives: "The continuous improvement team is seen as a cost center by the top executives, which is frustrating, but we consistently save the company money. Selling the value of improvement initiatives, like this standard, to leadership is something that I have been struggling with for five years."

Absence of Merged LSS Competencies

Three participants raised concerns about the absence of integrated LSS competencies, arguing that the separation of Lean and Six Sigma could diminish the standard's effectiveness. Participant 4 highlighted the issue: "The standard's title mentions LSS, but it lists separate competencies for Lean and Six Sigma. This distinction overlooks that Lean and Six Sigma are intrinsically part of LSS."

Further Changes Required in the ISO 18404 Standard

Participants offered diverse opinions and recommendations to improve ISO 18404 standards. The most common suggestions, mentioned by six participants, revolved around the need for greater people orientation (P9, P2, P15, P8, P11) and increased service-specific focus (P2, P15, P8, P14, P15).

Participant 8 emphasised the importance of considering service industry characteristics, focusing less on data and specifications and more on people's opinions and feelings. Participant 9 advocated for introducing "feed-forward" to involve customers in the loop, while P15 highlighted the inclusivity of "people" in the service sector, encompassing both employees and customers.

Regarding service-specific recommendations, P11 suggested providing specific guidance for adapting LSS methodologies, tools, and performance indicators to the unique features of the service sector, such as intangibility and variability. Four participants (P8, P11, P10, P7) proposed making the standard less rigid, emphasising that it should serve as a guideline, allowing

organisations to balance efficiency and customisation, as noted by P11. P8 stressed that ownership by those involved is crucial for success.

Integration with existing standards was also a recurrent recommendation (P4, P14, P13, P6). P14 proposed incorporating ISO 18404 into the high-level structure of ISO 9001:2015 (Quality Management System), ISO 45001 (Health and Safety Management System), ISO 14001 (Environmental Management System), and ISO 27001 (Information Security System) for streamlined implementation of continuous improvement of these systems.

Several participants suggested focusing on improving the body of knowledge (P4, P1, P10), measuring competencies (P4, P15), emphasising emerging trends and future focus (P9, P11, P15), and providing greater depth (P4, P6, P15). Additional recommendations included incorporating YBs (P1, P15), enhancing guidance on change management (P11, P8), integrating leadership and culture (P15), emphasising sustainability (P11, P13), reducing statistical tools (P2, P13), addressing technical skills (P4), providing the required information in the appendix (P13), considering workforce diversity (P11), accommodating different maturity levels (P15), promoting creative thinking (P15), integrating Design For Six Sigma methods (P15), incorporating advanced statistics and analytical tools (P8), offering practical cases and real-world examples (P14), and linking competencies with organisational competency matrices and LSS frameworks with human resources frameworks (P2). However, P3 believed that ISO 18404 requires no changes or enhancements.

Measures to Sustain the ISO 18404 Standard in the Service Sector

The interview's last part discussed ISO 18404's sustainability in the service sector. Some were concerned, finding it challenging due to its competency-based nature (P10, P12, P13). They believed the dynamic service sector posed obstacles (P8, P11, P14). On the contrary, some argue that maintaining it is straightforward due to its broad applicability (P4, P7). Table 11 outlines participants' steps for long-term sustainability and adherence to the standard.

Table 11. Measures to facilitate adherence and long-term sustainability of the standard

Measure	Participant Code	Count
Reviewal measurement systems	P2, P3, P4, P5, P6, P11, P12, P13	8

Training, education, and embedment of a culture of skill development	P6, P8, P11, P12, P13, P15	6
Tailoring of the standard	P5, P8, P11, P14	4
Digitalisation	P8, P14	2

Reviewal Measurement Systems

Most of the participants, 8 out of 15, identified the use of review and measurement systems as the critical factor in promoting adherence and ensuring the long-term success of the standard. Participant 2 believes that "without tracking outcomes and having control plans, there is no ownership of the process. We need to validate these outcomes over time to see if the standard is truly effective in the long run."

Training on the standard

Six participants stressed the significance of training, education, and nurturing a culture of continuous improvement. Participant 15 emphasised education, stating, "the first step is educating and training people, and education should start from the top down. In quality management, empowering, trusting, and educating people is vital."

Tailoring of the standard

Four participants stressed the importance of tailoring the standard to suit various service sectors. Participant 8 aptly coined this as "customising the standard to fit the company's context" to minimise team resistance. They mentioned that techniques like gauge R&R or design of experiments (DOE) might pose challenges in service settings, so the team should perceive the standard's relevance and feasibility.

Digitalisation

Participants P8 and P14 noted that using digitalisation and analytics is crucial. P14 stressed the advantages of digital transformation and adopting evolving digital technologies, especially in the construction sector. They argued that improved data management through digitalisation would support LSS standard implementation. P8 recommended including data mining, robotic process

automation (RPA), and big data analytics to gain valuable insights. The current standard version does not mention the importance of such skills, especially with the evolution of Industry 4.0 and 5.0.

Discussion and Implications

Many participants were not fully aware of the ISO 18404 standard, with almost half having no prior knowledge or exposure to the standard. This finding correlated with the literature, which indicated little or no mention of organisations embracing the standard (McDermott *et al.*, 2023). Due to the lack of familiarity with the standard, none of the participants currently use it as part of their LSS training programs. This finding indicates alternative approaches are available to organisations for training and certification in LSS that provide a better alignment with the organisation.

It is important to note that only four of the 15 participants (less than 30%) expressed some level of support for the standard. Further, over half of the participants expressed concerns regarding the competencies outlined in the standard aligning with previous studies on the standard (Antony, McDermott, Sony, Cudney, *et al.*, 2021; Antony, McDermott, Sony, Powell, *et al.*, 2021; McDermott *et al.*, 2023). This lack of support suggests that considerable effort must occur to bring the standard to where it must be to support the service sector. This lack of support is likely due to the perceived poor alignment to the specific challenges within the service sector, lack of additional value from the standard, and inapplicability of the tools to the service sector (Antony, McDermott, Sony, Cudney, *et al.*, 2021; McDermott *et al.*, 2023). Due to the diverse nature of the service sector, the ISO 18404 standard should consider the unique characteristics and challenges of the sector. One of the biggest hurdles rests with the lack of available data in the service industry. Therefore, the standard may need to be explicitly rewritten with the service sector in mind to address the sector's intricacies.

The findings of our study can be extremely beneficial to many key decision-makers in service organisations before they invest in ISO 18404. Initially, it aids decision-makers in comprehending the limitations and challenges associated with the existing standard, providing a nuanced understanding before any commitment is made. Moreover, the study sheds light on specific concerns, such as the incongruence between the outlined competencies and the unique characteristics and challenges prevalent in the service sector—factors like intangibility, variability,

customer interactions, and data availability issues. This scrutiny enables decision-makers to thoroughly assess the compatibility of the standard with their organization.

Furthermore, our research delivers essential insights into critical success factors, barriers, and challenges inherent in the application of this standard within the service sector. This knowledge empowers decision-makers to strategically plan and prepare for potential hurdles, facilitating informed decisions should they choose to adopt the standard. Additionally, the study offers guidance on necessary customizations and adaptations essential to align the standard with the specific needs of the service sector, addressing its intricacies. This equips decision-makers with a clear understanding of the efforts required for a successful implementation.

Importantly, the research serves as a cautionary guide by highlighting the lack of support for the standard in its current form, drawing on the perspectives of experienced professionals. This not only raises awareness but also emphasizes the risks associated with investing without essential modifications. The evidence-based assessment provided by our findings serves as a robust foundation for decision-making, going beyond promotional information about the standard. This approach is crucial in averting potential pitfalls and ensuring a more thorough consideration of the implications before committing to ISO 18404 in the context of the service industry.

Conclusion, limitations, and further research

This study revealed the challenges and opportunities to implementing the ISO 18404 standard in the service sector. Though the participants emphasised the standard's rigidity and limited compatibility with the dynamic nature of services, they also highlighted the importance of customisation and adaptation to align with service organisations' unique characteristics. The study expounds on critical success factors for deploying the standard, including leadership support, amendments to the standard structure, comprehensive training, employee engagement, a culture of continuous improvement, effective measurement systems, opportunity prioritisation, and sustainment plans. These findings contribute theoretically to the ISO 18404 standards and their suitability in the service sector. One of the limitations of this study is the sample size of 15 participants determined by data saturation. Therefore, we suggest future research to consider sub-sectors within service organisations. This study will help understand the sub-sector specifics characteristics of ISO 18404 to cite instances of how relevant ISO 18404 will be in the hospitality or education sector. An area of future research would be to study the applicability of ISO 18404 in the service sector by classifying the nature of services (tangible/intangible), service delivery

location (front office / back office), customer interaction (customer-facing / noncustomer facing), degree of customisation and service processes (core / peripheral services).

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