Management Studies and Business Journal (PRODUCTIVITY)
Vol 1 (6) 2024 : 902-910

Lean Six Sigma in Service Industries: Application, Challenges, and Best Practices

Lean Six Sigma dalam Industri Jasa: Aplikasi, Tantangan, dan Praktik Terbaik

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ABSTRACT
Lean Manufacturing with Six Sigma tools to improve efficiency and quality in various business processes. In the service industry, Lean Six Sigma has great potential for reducing waste, managing process variability, and increasing customer satisfaction. However, its implementation in the service sector faces unique challenges compared to manufacturing, due to the complexity of human interactions and high variability in service delivery. This research uses the PRISMA systematic approach to analyze and synthesize existing literature from various international databases. By identifying successful Lean Six Sigma best practices adaptation strategies, this research aims to provide insight into effective implementation strategies adapted to diverse service contexts, thereby increasing operational efficiency and overall service quality.
Keywords: Lean Six Sigma, service industry, best practices, adaptation, operational efficiency, customer satisfaction

ABSTRAK
Lean Manufacturing dengan alat-alat Six Sigma untuk meningkatkan efisiensi dan kualitas di berbagai proses bisnis. Di industri jasa, Lean Six Sigma memiliki potensi besar untuk mengurangi pemborosan, mengelola variabilitas proses, dan meningkatkan kepuasan pelanggan. Namun, penerapannya dalam sektor jasa menghadapi tantangan unik dibandingkan dengan manufaktur, karena kompleksitas interaksi manusia dan variabilitas tinggi dalam pengiriman layanan. Penelitian ini menggunakan pendekatan sistematis PRISMA untuk menganalisis dan mensintesis literatur yang ada dari berbagai database internasional. Dengan mengidentifikasi strategi adaptasi best practices Lean Six Sigma Yang berhasil, penelitian ini bertujuan untuk memberikan wawasan tentang strategi implementasi yang efektif yang disesuaikan dengan konteks layanan yang beragam, sehingga meningkatkan efisiensi operasional dan kualitas layanan secara keseluruhan.
Kata Kunci: Lean Six Sigma, industri jasa, best practices, adaptasi, efisiensi operasional, kepuasan pelanggan

1. Introduction

Lean Six Sigma is a methodology that has gained significant attention across a variety of industries for its ability to drive process improvements and cost savings. Originally implemented in manufacturing settings such as General Electric and Toyota, Lean Six Sigma has now found applications in service industries, including healthcare, pharmaceuticals, transportation, and public services (Downen & Jaeger, 2020; Patel & Patel, 2021; "Implementation of Lean Six Sigma in Public Road Transportation", 2019). This approach aims to improve service quality, reduce process variation, eliminate waste, and prevent defects, ultimately increasing customer satisfaction and operational efficiency (Talapatra & Gaine, 2019; Sharikh et al., 2019; Olanrewaju et al., 2019).

Lean Six Sigma adoption is particularly prominent in sectors such as health, higher education, and public services, where organizations seek to improve service quality, increase customer satisfaction, lower operational costs, and improve overall performance (Patel & Patel,

2021; Francescatto et al., 2022). By integrating Lean principles with Six Sigma tools, organizations can achieve continuous improvement and excellence in service delivery (Silva, 2023; Abbes et al., 2021). This methodology focuses on metrics and uses statistical tools such as DMAIC to analyze, measure, improve and control process variability, which corresponds to critical aspects of meeting customer requirements (Lamine, 2020).

In addition, Lean Six Sigma is recognized for its role in increasing supply chain resilience, especially during difficult times such as the COVID-19 pandemic, by identifying and addressing inefficiencies in internal business processes (Praharsi et al., 2021). The methodology's emphasis on eliminating waste, reducing costs, and creating value for consumers is in line with the overall goal of achieving world-class quality and operational excellence (Linde & Philippov, 2020). In conclusion, Lean Six Sigma has emerged as a valuable approach to drive continuous improvement and improve service quality in various industries. By leveraging its principles and tools, organizations in the service sector can streamline processes, reduce inefficiencies, and ultimately deliver superior value to customers.

However, implementing Lean Six Sigma in the service industry often faces various challenges. In contrast to the manufacturing sector which has a more structured and measurable production process, the service sector often involves complex human interactions and high variability. This makes implementing Lean Six Sigma in the service sector more difficult because of the difficulty of identifying and measuring relevant variables and establishing consistent quality standards. In addition, resistance to change and limited resources are also major obstacles in the adoption of this methodology in various service sectors.

Based on this problem phenomenon, the research question that arises is: how can best practices in implementing Lean Six Sigma in the service industry be adapted for different service sectors? Answering this question is critical to identifying effective strategies for addressing the unique challenges faced by the service sector. By analyzing best practices that have been successfully implemented, it is hoped that a more flexible and adaptive approach can be found that can be applied in various service contexts, thereby improving overall operational quality and efficiency.

Although Lean Six Sigma has been implemented successfully in various manufacturing industries, there is still a significant research gap regarding the adaptation of best practices of this methodology in various service sectors. Previous research has tended to focus on specific sectors without considering the variation and complexity that exists across the service industry spectrum. This creates a void in the literature regarding how Lean Six Sigma best practices can be adapted and implemented effectively in different contexts in the service sector.

The urgency of this research lies in the importance of understanding how to adapt Lean Six Sigma best practices to improve efficiency and service quality in diverse service sectors. Given the dynamic and complex nature of the service industry, a one-size-fits-all approach is not always effective. Therefore, this research aims to fill this gap by providing insights into adaptation strategies that can be implemented to meet the specific needs of various service sub-sectors.

The novelty of this research lies in the new approach in adapting Lean Six Sigma to different service sectors. By identifying and analyzing best practices that have been successfully applied in various contexts, this research offers a more holistic and flexible perspective. This allows the development of implementation strategies that better suit the unique characteristics of each service sector, thereby optimizing desired outcomes.

The contribution of this research is very significant, especially in providing practical guidance for the service industry in implementing Lean Six Sigma effectively in various sectors. By providing recommendations based on comprehensive analysis, this research is expected to help service organizations reduce waste, increase efficiency, and achieve higher levels of customer satisfaction. This practical guide can also be a valuable reference for practitioners and

academics interested in further exploring the application of Lean Six Sigma in the service sector.

2. Research Methods

This research method uses the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach to collect and analyze relevant articles from reputable international databases. The article collection process began with a literature search using several main keywords, namely "Lean Six Sigma", "service industries", "best practices", "adaptation", "application", and "challenges". Searches were conducted on various databases including Scopus and Web of Science.

From the initial search results, a number of articles were obtained that met the initial criteria. To ensure the relevance and quality of the articles analyzed, inclusion and exclusion techniques were applied based on several criteria. Inclusion criteria include articles discussing Lean Six Sigma in the context of the service industry, case studies regarding best practices, articles written in English, and articles published in reputable journals. Meanwhile, exclusion criteria include articles that are not relevant to the research topic, articles that only discuss Lean and Six Sigma separately, and articles that do not have empirical data to support their findings.

The number of articles obtained from various databases reached 115 articles. After going through a screening process based on inclusion and exclusion criteria, 28 articles were obtained which will be analyzed further. This process ensures that only the most relevant and high-quality articles are used in the research, so that the analysis results can provide comprehensive and reliable insights regarding the adaptation of Lean Six Sigma best practices in the service sector.

3. Results and Discussions

3.1. Application of Lean Six Sigma in the Service Industry

Lean Six Sigma is a methodology that integrates Lean manufacturing principles with Six Sigma methodology to drive continuous improvement in organizations (Francescatto et al., 2022). The main goal of this methodology is to increase operational uniformity, quality, and efficiency while reducing variation and waste (Chiarini & Bracci, 2013). By focusing on improving quality, eliminating waste, and increasing customer satisfaction, Lean Six Sigma helps organizations maintain a competitive advantage in the marketplace (Francescatto et al., 2022). This approach involves the use of statistical tools such as DMAIC to define, analyze, measure, improve, and control process variability (Lamine, 2020).

The Six Sigma component in Lean Six Sigma is a structured methodology that focuses on reducing variation, measuring defects, and improving the quality of products, processes and services (Lee & Wei, 2009). On the other hand, Lean principles which are also part of Lean Six Sigma emphasize eliminating waste throughout the process to increase efficiency, quality and profitability (Kulkarni, n.d.). The integration of Lean's focus on value and speed with Six Sigma's emphasis on consistency results in an effective Lean Six Sigma methodology ("Takt Time Analysis in Lean Six Sigma: From Conventional to Integration", 2019).

Leadership plays an important role in the successful implementation of Lean Six Sigma, with management involvement and leadership style being key factors for effective implementation (Alnadi & McLaughlin, 2020). Organizations that have successfully integrated Lean Six Sigma into their operations, such as Toyota and GE, have seen this methodology evolve from a cost reduction initiative to an integral part of their business strategy (Laureani & Antony, 2017).

Thus, Lean Six Sigma is a powerful methodology that combines Lean manufacturing principles with Six Sigma methodology to drive continuous improvement, improve quality, reduce waste, and increase customer satisfaction in organizations. This methodology requires

strong leadership, effective use of statistical tools, and a focus on value creation and process consistency to achieve its goals.

3.2. Benefits of Lean Six Sigma in the Service Industry

Lean Six Sigma has gained significant attention in various industries, including the service sector, because of its ability to drive operational excellence and quality improvement (Kumar, 2021; Azalanzazllay & Lim, 2019; Silva, 2023). In the service industry specifically, the implementation of Lean Six Sigma has been associated with several key benefits. First, this methodology improves operational efficiency by streamlining processes, reducing waste, and increasing productivity (Rojas-Suárez et al., 2019; Abbes et al., 2021). This increase in efficiency is very important for service organizations to provide services quickly and effectively.

In addition, Lean Six Sigma contributes to cost reduction by identifying and eliminating activities that do not add value, thereby optimizing resource utilization and minimizing expenses (Jacob & Kothandaraman, 2020; Modupe, 2021). Cost reduction is a vital aspect for service providers to maintain competitiveness and profitability in the market.

Furthermore, Lean Six Sigma plays an important role in increasing customer satisfaction (Ferreira et al., 2021; Ofosu-Boateng & Acquaye, 2020). By focusing on improving quality and optimizing processes, service organizations can meet customer expectations more consistently, which in turn increases satisfaction levels. Customer satisfaction is a critical success factor in the service industry, influencing loyalty, retention and overall business performance.

Thus, Lean Six Sigma offers real benefits to the service industry by increasing operational efficiency, reducing costs, and ultimately increasing customer satisfaction. By leveraging the Lean Six Sigma methodology, service organizations can optimize their processes, deliver high-quality service, and drive overall business success.

3.3. Best Practices in Implementing Lean Six Sigma in the Service Industry

Lean Six Sigma, a methodology that combines Lean principles and Six Sigma tools, has gained significant attention in various sectors including manufacturing, healthcare, and transportation. Research shows the importance of factors such as strong leadership, management commitment, skilled workforce, and customer satisfaction for the successful implementation of Lean Six Sigma (Alkunsol et al., 2019). This methodology aims to improve overall production, reduce waste, and increase customer satisfaction (Kumar et al., 2019). Additionally, the adoption of Lean Six Sigma has proven effective in sectors such as healthcare and higher education, emphasizing its role in continuous improvement (Patel & Patel, 2021).

In the healthcare sector, Lean Six Sigma has been recognized for its potential to reduce waste and variation, ultimately increasing organizational efficiency (Rathi et al., 2022). In addition, the implementation of Lean Six Sigma in the transportation sector has been linked to efforts to improve process quality and efficiency (Saad, 2023). In the banking sector, this methodology can contribute to streamlining operations and improving service delivery, while in the hospitality sector, Lean Six Sigma can improve customer experience and operational efficiency.

Overall, successful implementation of Lean Six Sigma requires a strategic approach, emphasizing the importance of factors such as leadership involvement, data-based decision making, and positive company culture (Huang et al., 2023; Alnadi & McLaughlin, 2020). By integrating Lean's focus on value and speed with Six Sigma's emphasis on consistency, organizations can achieve continuous improvement and sustainable practices across a variety of sectors ("Takt Time Analysis in Lean Six Sigma: From Conventional to Integration", 2019).

3.4. Elemen Best Practices

To determine best practices regarding Lean Six Sigma in the service industry, several key elements need to be considered based on the available literature. Top management commitment is critical because it sets the tone for the organization's dedication to continuous improvement (Alkunsol et al., 2019). Employee training and development plays a vital role in ensuring that staff are equipped with the necessary skills to implement the Lean Six Sigma methodology effectively (Ahmed, 2020). The use of Lean Six Sigma tools and techniques is essential to drive process improvements and cost savings in the service industry (Saad, 2023). Finally, building a culture of continuous improvement is fundamental to sustaining Lean Six Sigma practices and achieving long-term success in service organizations (Sharikh et al., 2019).

Top management commitment is a key element because top management is committed to providing the support and resources necessary for the implementation of Lean Six Sigma, which will ultimately create an environment conducive to positive change. Furthermore, employee training and development ensures that the entire team has a deep understanding of Lean Six Sigma principles and tools, enabling them to contribute effectively to improvement projects.

The use of Lean Six Sigma tools and techniques, such as DMAIC (Define, Measure, Analyze, Improve, Control), is important for analyzing and improving processes, reducing variation, and eliminating waste. Implementation of these tools helps in achieving significant operational efficiencies and cost savings. Additionally, building a culture of continuous improvement within the organization is key to maintaining the sustainability of Lean Six Sigma practices. This involves establishing an environment where employees are encouraged to continually look for ways to improve processes and services. A culture like this ensures that Lean Six Sigma becomes an integral part of the organization's daily operations, rather than just a stopgap initiative. Overall, by paying attention to key elements such as top management commitment, employee training and development, use of Lean Six Sigma tools and techniques, and a culture of continuous improvement, service organizations can implement Lean Six Sigma effectively and achieve long-term success.

3.5. Adaptation of Best Practices for Different Service Sectors

Adapting Lean Six Sigma best practices in various service sectors requires in-depth analysis of the different characteristics of each sector. Service complexity is an important aspect that influences the implementation of Lean Six Sigma. Each service sector has a different level of complexity, which influences how Lean Six Sigma methods and tools can be applied effectively. For example, the healthcare sector is highly complex with multiple clinical processes that require specialized approaches to ensure quality and patient safety (Rathi et al., 2022).

Additionally, interaction with customers is another key factor to consider. The level and nature of interaction with customers varies between service sectors. The hospitality sector, for example, relies heavily on direct interaction with customers to provide a satisfying experience. Therefore, implementing Lean Six Sigma in this sector must focus on improving service quality and customer experience (Ofosu-Boateng & Acquaye, 2020). In contrast, the financial sector may have more limited interactions and be more focused on internal process efficiency (Saad, 2023).

Regulation and compliance are also critical aspects influencing the adaptation of Lean Six Sigma. Every service sector is governed by various regulations and compliance standards that must be adhered to. For example, the healthcare sector is governed by strict patient safety standards and medical regulations, which require a Lean Six Sigma approach that pays close attention to these aspects of compliance (Rathi et al., 2022). In the financial sector, regulations regarding data privacy and information security also require special attention in implementing Lean Six Sigma (Saad, 2023). By understanding these differences, organizations can effectively

adapt Lean Six Sigma best practices to the specific needs of each service sector. This adaptation allows the application of a more targeted and effective methodology, so as to achieve optimal results in improving quality, efficiency and customer satisfaction in various service sectors.

3.6. Best Practices Adaptation Strategy

To effectively implement Lean Six Sigma in the service industry, it is critical to adapt the use of Lean Six Sigma tools and techniques to address the specific needs and challenges of the service sector (Saad, 2023). This customization involves designing a methodology that fits the process and service-related requirements. Additionally, providing tailored training and development programs for employees is essential so that they have the skills and knowledge necessary to successfully implement Lean Six Sigma in the service industry (Sharikh et al., 2019).

Adopting a context-based approach when implementing Lean Six Sigma in the service sector is critical to successful implementation. This involves understanding the unique characteristics and demands of the service industry and aligning Lean Six Sigma initiatives accordingly (Talapatra & Gaine, 2019). With a focus on eliminating waste, reducing process variation, and improving overall performance, Lean Six Sigma can be effectively integrated into service processes to drive efficiency and improve quality.

Additionally, measuring and evaluating success is an important component of implementing Lean Six Sigma in the service industry. Companies must establish clear metrics and performance indicators to monitor the progress and impact of Lean Six Sigma initiatives on service delivery and customer satisfaction (Lamine, 2020). Regular evaluation of the results and effectiveness of Lean Six Sigma projects allows organizations to identify areas for improvement and ensure continuous improvement in service quality.

Overall, by adapting Lean Six Sigma tools and techniques, providing tailored training, implementing a context-based approach, and implementing robust measurement and evaluation mechanisms, the service industry can effectively leverage Lean Six Sigma principles to drive process improvements, improve quality , and achieve operational excellence.

4. Conclusions

Lean Six Sigma is a powerful methodology that integrates Lean manufacturing principles with Six Sigma tools to achieve continuous improvement in organizations (Francescatto et al., 2022). Its focus on eliminating waste, reducing variation, and improving quality allows companies to maintain competitive advantages and increase customer satisfaction (Chiarini & Bracci, 2013). Implementing Lean Six Sigma requires strong management commitment, effective use of statistical tools, and a focus on process consistency to achieve established improvement goals.

4.1. Implications

Implementing Lean Six Sigma in the service industry has significant implications. By increasing operational efficiency, reducing costs, and increasing customer satisfaction, this methodology can help service organizations achieve their business goals more effectively (Kumar, 2021; Azalanzazllay & Lim, 2019). Active management involvement and employee empowerment through training are the keys to success in implementing Lean Six Sigma in various service sectors (Sharikh et al., 2019).

4.2. Limitations

However, there are several limitations that need to be considered in implementing Lean Six Sigma in the service industry. High service complexity and stringent regulations can hinder the comprehensive adaptation of this methodology across organizations (Rathi et al., 2022; Saad, 2023). In addition, the challenge of changing the organizational culture to accept

continuous improvement can also be a significant barrier to effectively adopting Lean Six Sigma (Alnadi & McLaughlin, 2020).

4.3. Future Research

For future research, it is important to further explore the adaptation of Lean Six Sigma in specific service sectors such as education, tourism, and health services. Further studies could explore the best strategies to address unique service complexities and better understand the impact of regulations and compliance in Lean Six Sigma implementation (Ofosu-Boateng & Acquaye, 2020; Rathi et al., 2022). Additionally, future research could also focus on developing more sophisticated evaluation methods to measure the long-term impact of Lean Six Sigma on business performance and customer satisfaction in the service industry (Lamine, 2020).

By continuing to develop our understanding of Lean Six Sigma implementation in various service industry contexts, we can optimize the benefits of this methodology to create more efficient, responsive, and competitive organizations in dynamic global markets.

5. References

Abbes, N., Sejri, N., Boubaker, J., & Cheikhrouhou, M. (2021). An integrated lean six sigma approach to modeling and simulation: a case study from clothing sme. Autex Research Journal, 22(3), 305-311. https://doi.org/10.2478/aut-2021-0028

Ahmed, E. (2020). Developing readiness index for critical success factors for lean six sigma in service organization.. https://doi.org/10.31220/osf.io/87k3q

Alkunsol, W., Sharabati, A., Al-Salhi, N., & El-Tamimi, H. (2019). Lean six sigma effect on jordanian pharmaceutical industry's performance. International Journal of Lean Six Sigma, 10(1), 23-43. https://doi.org/10.1108/ijlss-01-2017-0003

Alnadi, M. and McLaughlin, P. (2020). Leadership that facilitates the successful implementation of lean six sigma.. https://doi.org/10.1145/3416028.3416045

Azalanzazllay, N. and Lim, S. (2019). A systematic review of lean six sigma implementation in food industry. International Journal of Engineering & Technology, 7(4.14), 319. https://doi.org/10.14419/ijet.v7i4.14.27664

Chiarini, A. and Bracci, E. (2013). Implementing lean six sigma in healthcare: issues from italy. Public Money & Management, 33(5), 361-368. https://doi.org/10.1080/09540962.2013.817126

Downen, J. and Jaeger, C. (2020). Quality improvement of intravenous to oral medication conversion using lean six sigma methodologies. BMJ Open Quality, 9(1), e000804. https://doi.org/10.1136/bmjoq-2019-000804

Ferreira, C., Djo, M., Freitas, J., & Abi, M. (2021). The impact of service quality on customer satisfaction: a study on higher education students in timor-leste. Timor Leste Journal of Business and Management, 3, 47-53. https://doi.org/10.51703/bm.v3i2.35

Firmansyah, M. A., & Maemunah, S. (2021). Lean management and green supply chain management implementation on the manufacturing and logistics industry at an Indonesia. Business and Entrepreneurial Review, 21(1), 11-22.

Francescatto, M., Paris, S., Kubota, F., Guimarães, G., & Oliveira, B. (2022). Lean six sigma case studies literature overview: critical success factors and difficulties. International Journal of Productivity and Performance Management, 72(1), 1-23. https://doi.org/10.1108/ijppm-12-2021-0681

Francescatto, M., Paris, S., Kubota, F., Guimarães, G., & Oliveira, B. (2022). Lean six sigma case studies literature overview: critical success factors and difficulties. International Journal of Productivity and Performance Management, 72(1), 1-23. https://doi.org/10.1108/ijppm-12-2021-0681

Jacob, S. and Kothandaraman, K. (2020). Services six sigma: knowing the debates and failure modes to drive better.. https://doi.org/10.5772/intechopen.86870

Kulkarni, S. Application of lean-six sigma to improve quality in health care industry.. https://doi.org/10.18260/1-2-620-39080

Kumar, S. (2021). Lean six sigma implementation in engineering institutions.. https://doi.org/10.31224/osf.io/r937d

Lamine, K. (2020). Lean six sigma and performance metrics.. https://doi.org/10.5772/intechopen.85815

Laureani, A. and Antony, J. (2017). Leadership and lean six sigma: a systematic literature review. Total Quality Management & Business Excellence, 30(1-2), 53-81. https://doi.org/10.1080/14783363.2017.1288565

Lee, K. and Wei, C. (2009). Reducing mold changing time by implementing lean six sigma. Quality and Reliability Engineering International, 26(4), 387-395. https://doi.org/10.1002/qre.1069

Linde, I. and Philippov, D. (2020). Applying lean six sigma in construction. world practice experience.. Access Access to Science Business Innovation in Digital Economy, 1(2), 103-111. https://doi.org/10.46656/access.2020.1.2(2)

Maemunah, S., & Cuaca, H. (2021). Influence of epidemic COVID–19 on business strategy, information technology and supply chain agility to firm performance in medical device industry. Linguistics and Culture Review, 5(S1), 661-669. https://doi.org/10.21744/lingcure.v5nS1.1452

Maemunah, S., & Susanto, P. H. (2019). The effect of attitude and purchasing of millennials consumers towards brand love in sports wear brands. International Journal of Advanced Science and Technology, 29(5), 515-523.

Maemunah, S., & Syakbani, B. (2021). Strategic Logistics on Halal Products. Valid: Jurnal Ilmiah, 18(2), 128–135. https://doi.org/10.53512/valid.v18i2.177

Maemunah, S. (2017). The Effect Of Information And Communication Technology (Ict) And Business Strategy On Business Performance In Small And Medium Businesses. Business and Entrepreneurial Review, 17(1), 53-66.

Maemunah, S. (2018). The effect of corporate reputation and sustainable innovation strategy on business performance in automotive companies. Business and Entrepreneurial Review, 18(1), 65-74.

Maemunah, S. (2021). The Implementation of Lean Manufacturing And Industrial Technology 4.0 On Business Performance. Jurnal Indonesia Sosial Teknologi, 2(08), 1432–1437. https://doi.org/10.59141/jist.v2i08.214

Modupe, A. (2021). Perspectives on service quality dimensions and customer satisfaction in the nigerian banking industry. Journal of Economics Management and Trade, 12-19. https://doi.org/10.9734/jemt/2021/v27i1230379

Ofosu-Boateng, I. and Acquaye, P. (2020). Effects of service quality and customer satisfaction on customers' loyalty in the hospitality industry of ghana. European Journal of Business Management and Research, 5(5). https://doi.org/10.24018/ejbmr.2020.5.5.538

Olanrewaju, F., Uzorh, A., & Nnanna, I. (2019). Lean six sigma methodology and its application in the manufacturing industry – a review. American Journal of Mechanical and Industrial Engineering, 4(3), 40. https://doi.org/10.11648/j.ajmie.20190403.11

Patel, A. and Patel, K. (2021). Critical review of literature on lean six sigma methodology. International Journal of Lean Six Sigma, 12(3), 627-674. https://doi.org/10.1108/ijlss-04-2020-0043

Praharsi, Y., Jami'in, M., Suhardjito, G., & Wee, H. (2021). The application of lean six sigma and supply chain resilience in maritime industry during the era of covid-19. International Journal of Lean Six Sigma, 12(4), 800-834. https://doi.org/10.1108/ijlss-11-2020-0196

Rojas-Suárez, J., Gómez-Colmenares, C., & Ortega, M. (2019). Lean six sigmas in academic processes. Journal of Physics Conference Series, 1414(1), 012006. https://doi.org/10.1088/1742-6596/1414/1/012006

Saad, N. (2023). Deployment of lean six sigma in transportation sector. IJERM, 1(2), 74-80. https://doi.org/10.59762/ijerm205275791220231205140246

Sharikh, N., Farra, M., Abuzerr, S., & Madi, K. (2019). The impact of lean six sigma practices on physiotherapy services quality at unrwa healthcare centers, gaza strip, palestine. Journal of Biosciences and Medicines, 07(12), 79-94. https://doi.org/10.4236/jbm.2019.712008
Sharikh, N., Farra, M., Abuzerr, S., & Madi, K. (2019). The impact of lean six sigma practices on physiotherapy services quality at unrwa healthcare centers, gaza strip, palestine. Journal of Biosciences and Medicines, 07(12), 79-94. https://doi.org/10.4236/jbm.2019.712008
Silva, B. (2023). Analysis of lean six sigma use in pharmaceutical production. Brazilian Journal of Pharmaceutical Sciences, 59. https://doi.org/10.1590/s2175-97902023e22949

Talapatra, S. and Gaine, A. (2019). Putting green lean six sigma framework into practice in a jute industry of bangladesh: a case study. American Journal of Industrial and Business Management, 09(12), 2168-2189. https://doi.org/10.4236/ajibm.2019.912144