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Eco-Design for Sustainability: A Mediating Role in Achieving Sustainable Manufacturing through Lean Production

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Abstract

The increasing awareness of environmental issues and sustainability has driven the manufacturing industry to adopt a more holistic approach. Sustainable Manufacturing (SM) has emerged as a comprehensive concept that integrates environmental, social, and economic aspects into the production process. This study aims to examine the role of Eco-Design for Sustainability as a mediating factor in achieving SM through the implementation of Lean Production Practices in the Fast-Moving Consumer Goods (FMCG) industry, specially investigating the rarely explored interplay between these tree elements within the FMCG context. The research uses a quantitative approach, with data collected through questionnaires and analyzed using Structural Equation Modeling (SEM). The results show that Eco-Design for Sustainability acts as a significant mediating variable in the relationship between Lean Production Practices and SM. This implies that the implementation of Lean Production Practices, although contributing to efficiency, does not necessarily guarantee the achievement of SM without being integrated with Eco-Design. The study also found that Eco-Design, with its focus on minimizing environmental impacts throughout the product life cycle, strengthens and directs the Lean production system to be more effective in achieving SM goals. Based on these findings, the study proposes strategies to drive FMCG companies towards SM practices, including optimizing the effectiveness of Total Productive Maintenance (TPM) to improve efficiency and reduce waste, developing an Operational Excellence program, Life Cycle Optimization, digital transformation, improving employee capabilities, and developing environmentally friendly product designs. This research positions Eco-Design for Sustainability as crucial for Sustainable Manufacturing in the FMCG industry. Integrating Lean Production Practices optimizes eco-conscious designs, minimizes waste, and improves resource efficiency, enhancing brand reputation and competitiveness.

Keywords: *Eco-Design, Lean Production Practices, Sustainable Manufacturing.*

Introduction

Driven by growing environmental concerns and the imperative for responsible production, Sustainable Manufacturing (SM) has become a focal point of industrial discourse [1]. Sustainable manufacturing takes a comprehensive approach by incorporating environmental, social, and economic factors into production processes. This holistic strategy aims to reduce environmental impact, conserve resources, and enhance social well-being while maintaining economic viability [2]. This research investigates the intricate interplay between Lean Production practices, Eco-Design for Sustainability, and SM, exploring their combined contribution to achieving sustainable practices within the manufacturing sector.

Lean Production, with origins in the Toyota Production System, is a management approach that prioritizes customer value maximization while minimizing waste through continuous improvement and the elimination of non-value-added activities [3]. By streamlining operations and optimizing resource use, Lean Production contributes to environmental sustainability by reducing waste, energy consumption, and emissions [4]. However, to truly achieve comprehensive sustainability, Lean Production must be integrated with a holistic approach that considers the environmental impact throughout the entire product lifecycle, including design, material selection, and end-of-life management [5].

Environmental factors are actively included into the product design process through eco-design, often known as design for the environment [6]. It aims to minimize the environmental impacts of products throughout their entire life cycle, from raw material extraction and manufacturing to use and end-of-life disposal [7]. Incorporating eco-design principles throughout product development enables manufacturers

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to substantially decrease their environmental impact and progress towards sustainable manufacturing objectives [8]. However, eco-design should not be considered in isolation. To maximize its effectiveness, it needs to be integrated with other sustainable practices, such as lean production, to optimize resource utilization and minimize waste across the entire value chain [9].

This study specifically investigates the mediating role of Eco-Design in the relationship between Lean Production and SM. It posits that Lean Production practices, while enhancing efficiency and reducing waste, do not inherently guarantee the achievement of SM without being coupled with Eco-Design considerations. The research aims to provide empirical evidence for the mediating effect of Eco-Design, demonstrating how it strengthens and directs Lean production systems towards SM goals.

This research offers valuable, applicable insights for the FMCG industry seeking to enhance operational efficiency and market competitiveness. By demonstrating the pivotal role of Eco-Design as a mediator between Lean Production and Sustainable Manufacturing, this study provides a practical framework of FMCG companies. For instance, the study findings on how PT. A successfully integrated Eco-Design principles into their Lean Production system to achieve SM objective- such as reducing waste, optimizing resources use, and developing eco-friendly packaging – can serve as a replicable model for other companies in the industry. This not only leads to cost savings and improved environmental performance but also strengthens brand image and market positioning in an increasingly eco-conscious consumer landscape.

Furthermore, the quantitative approach employed, using Structural Equation Modeling (SEM) to analyze data, ensures the robustness and generalizability of the findings, allowing other FMCG companies to adopt and implement similar strategies based on their specific needs and context. Ultimately, this research empowers FMCG companies to embrace sustainable practices as a pathway to enhanced operational efficiency and competitive advantages.

Literature Review

This section provides a comprehensive review of the relevant literature on Lean Production, Eco-Design, and Sustainable Manufacturing, establishing the theoretical foundation for the research.

1.1 Lean Production

Lean Production, originating from the Toyota Production System, focuses on maximizing value for customers while minimizing waste [10]. It emphasizes continuous improvement and efficiency across all aspects of the production process.

Lean thinking is a business approach aimed at enhancing customer value by optimizing resource utilization for long-term financial sustainability [11]. The core of Lean management lies in waste reduction, quality maintenance, and production acceleration [12]. Lean methodologies utilize various tools, such as process mapping, Value Stream Mapping (VSM), Six Sigma, and 5S, to drive improvements and enhance efficiency [13].

Evaluating Lean Production success involves assessing its impact across three key areas: financial health, operational efficiency, and resource management. Strong financial performance is essential for Lean implementation. Operational improvements, such as reduced waiting times and shorter cycle times, are crucial for enhancing efficiency and overall performance [14]. Additionally, successful Lean implementation necessitates a focus on fostering a positive work culture and prioritizing the human element in the production process [15].

1.2 Eco-Design

Eco-Design takes a forward-thinking approach by incorporating environmental factors directly into the product design process [16]. To achieve sustainable manufacturing, eco-design is essential for minimizing the environmental impact of products and processes throughout their entire existence [6]. Eco-design is

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crucial for realizing sustainable manufacturing by mitigating the environmental footprint of products and processes across their entire lifecycle [8]. From the extraction of raw materials to the ultimate disposal, environmental effects are taken into account in an all-encompassing approach to eco-design. A holistic eco-design approach considers the environmental impacts across the entire lifecycle of a product, from raw material extraction to its final disposal [17]. Beyond minimizing environmental impact, eco-design can stimulate innovation and lead to the creation of new, more sustainable products. However, successful implementation requires effective cross-functional collaboration, encompassing planning, design, engineering, and production departments [8]. By reducing environmental pollution, eco-design significantly contributes to the sustainability of an organization's business [18].

1.3 Sustainable Manufacturing

Sustainable Manufacturing is a holistic concept that balances economic, social, and environmental objectives in manufacturing processes [19]. Sustainable production aligns with the core principles of sustainable development, striving to satisfy current needs without compromising the ability of future generations to meet their own [20]. For long-term organizational performance, this calls for a balanced triple bottom line strategy that takes into account social, economic, and environmental aspects [21]. While the concept of sustainability has various interpretations, its application in manufacturing requires a refined definition. Companies have adopted different methods, such as planetary profit, ecological sustainability, and the triple bottom line, to integrate sustainability into their operations [1].

Sustainable Manufacturing (SM) prioritizes environmental concerns through control, prevention, and product stewardship. This involves addressing emissions with end-of-pipe treatment, preventing pollution, and engaging stakeholders in environmental improvement. SM focuses on minimizing the environmental impact of production activities throughout the product's life cycle. The concept is evolving to encompass strategies that prevent, reduce, and eliminate negative environmental impacts [22].

Sustainable manufacturing relies on a framework of interconnected sustainability indicators spanning five key dimensions: environmental management, economic growth, social welfare, technological advancement, and performance management [23]. Environmental management evaluates the environmental footprint of manufacturing processes and products, including resource consumption, emissions, and potential ecological damage. Economic growth focuses on the financial implications of investments, encompassing costs, profits, and overall economic benefits. Social well-being assesses the impact on stakeholders such as employees, customers, and communities, considering factors like health and safety, satisfaction, and opportunities for growth and development. Lastly, technological advancement is gauged by research and development efforts that lead to technologically advanced products [24]. Lastly, performance management involves the implementation of sustainable programs and policies, ensuring compliance with environmental regulations [25].

1.4 Previous Studies

Environmental science research explores Sustainable Manufacturing through the triple bottom line approach to minimize environmental damage. These studies analyze the interrelationship between economic, social, and environmental aspects, with the economic aspect focusing on profit maximization and loss minimization, the social aspect on organizational responsibility for employee and community well-being, and the environmental aspect on energy efficiency and emission reduction. Organizations implement Lean Manufacturing to minimize waste, and research integrates Lean Production into sustainability indicators. Studies indicate Lean benefits Sustainable Manufacturing from environmental and economic perspectives. Adding eco-design to this framework further strengthens the environmental aspect, contributing to a more comprehensive approach to sustainability.

[26] integrated sustainability indicators into Value Stream Mapping (VSM) to assess manufacturing processes, considering economic, social, and environmental factors. Key performance indicators (KPIs) like Takt Time and Overall Equipment Effectiveness (OEE) were used to assess economic sustainability, while absenteeism and turnover rates were used for the social dimension. The study suggested developing

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benchmarks for sustainability indicators and improving them towards workplace motivation, community development, and product life cycle assessment.

Another research was explored the alignment of Lean Manufacturing (LM) with sustainability, focusing on its potential to enhance efficiency while minimizing negative environmental and social impacts. Their research highlighted the positive contributions of LM to economic sustainability through cost reduction and improved performance, while also acknowledging the importance of Human Resources Management for long-term social impact. The study emphasized that LM's focus on waste reduction provides value to employees and promotes well-being. Furthermore, it illustrated the link between LM and economic sustainability through Just-in-Time (JIT) practices, which reduce production costs and enhance flexibility. The study also recognized the positive relationship between LM and environmental sustainability due to its focus on waste reduction and equipment performance improvement. Additionally, it highlighted the connection between LM and social sustainability, emphasizing the positive effects on worker attitudes, motivation, and health and safety through ergonomic workplace design [27].

[28] integrated Lean Production into a sustainability framework and used a SWOT analysis to improve performance in a pharmaceutical plant. They employed the best-worst method to calculate the significance of sub-indicators, collected data through questionnaires, and utilized Data Envelopment Analysis (DEA) to assess production performance. Sensitivity analysis was conducted to understand the impact of each sub-indicator on production line performance, leading to the development of improvement measures. The study identified weaknesses in areas like investment, cost reduction, training, and customer orientation, while recognizing the pull system as a strength. The researchers proposed strategies based on the SWOT analysis and suggested using fuzzy models and neural networks in future research for performance evaluation.

[29] investigated the impact of Lean Production tools on environmental sustainability in manufacturing. The study found that Value Stream Mapping (VSM) can identify environmental impacts, 5S can reduce oil leaks and improve waste processing, and cellular manufacturing can decrease electricity consumption. Total Productive Maintenance (TPM) was found to help reduce machine impacts like oil leaks and emissions, while Single-Minute Exchange of Die (SMED) did not show significant environmental improvement. The study also revealed positive effects on electricity consumption and standardization of worker activities. However, it did not explore a specific Lean Production model for achieving Sustainable Manufacturing.

[18] underscored the crucial role of eco-design in achieving sustainable manufacturing, noting that waste reduction not only lowers costs but also improves product quality and productivity. The study acknowledged the challenge of meeting customer demands for affordable, high-quality, and environmentally friendly products. It also noted the growing implementation of Life Cycle Assessment (LCA) and sustainability practices as crucial for remaining competitive in today's market.

Methodology

This quantitative study utilized a purposive sample of 361 employees from PT. A, an Indonesian FMCG company, with data collected via questionnaires. The purpose of sampling using purposive sampling is so that the selected sample is a sample that is in accordance with the research objectives. The sample selected is employees who are directly involved in lean production practices of 159 people consisting of management and operation levels and are employees who are directly involved in the implementation of lean principles, and have knowledge of production systems and lean concepts, so that this sample accurately represents the characteristics of the population. To investigate the complex interplay between Lean Production practices, Eco-Design for Sustainability, and Sustainable Manufacturing, researchers utilized structural equation modeling (SEM) as an analytical tool.

Result And Discussion

This study explores how lean production and eco-design contribute to the advancement of sustainable manufacturing practices within the fast-moving consumer goods (FMCG) sector. Lean implementation

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entails a management strategy centered on waste reduction and quality assurance to enhance company competitiveness. Through the reduction of waste, the company will be more efficient and more responsive to market needs [2]. Figure1 shows the SEM model tested in this study which is a model of the relationship between lean production and eco design to promote sustainable manufacturing.

The results of the indicator reliability test in a variable can be seen from the composite reliability results in Table 1 which shows the Composite reliability and Cronbach's Alpha values for all constructs exceed 0.7, indicating high consistency in respondents' answers. Thus, it can be concluded that all constructs in this study have good reliability or it can be concluded that respondents respond to the questions in the questionnaire consistently.

Table 1. Composite Reliability and Cronbach's Alpha

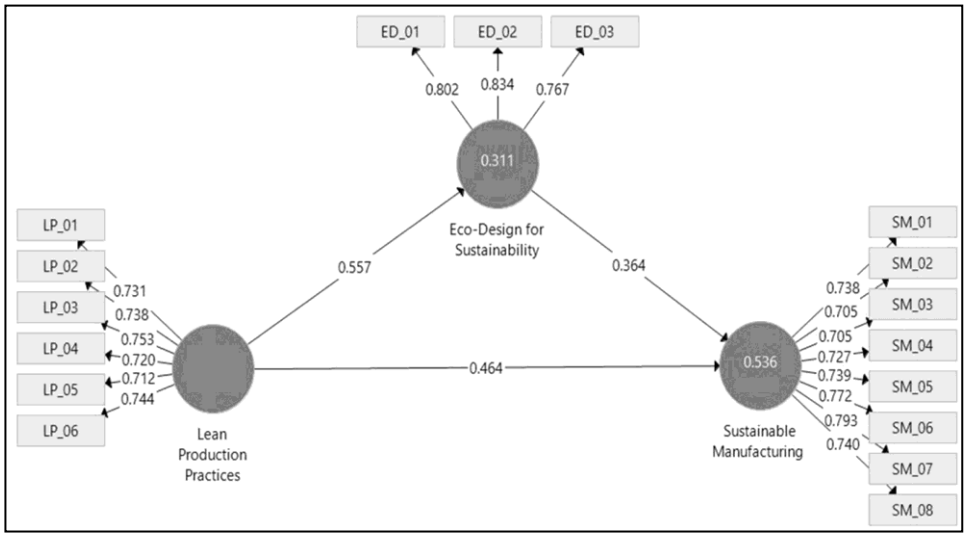

Figure 1. Structural Equation Modelling with SMART PLS

	Cronbach's Alpha	Composite Reliability
Lean Production Practices	0.828	0.874
Eco-Design for Sustainability	0.721	0.843
Sustainable Manufacturing	0.882	0.907

Analysis of the Average Variance Extracted (AVE) values, presented in Table 2, indicates that the indicators used for Lean Production Practices, Eco-Design for Sustainability, and Sustainable Manufacturing effectively represent their respective constructs. All three variables demonstrate AVE values ≥ 0.5, confirming their suitability for inclusion in the Sustainable Manufacturing model. However, while AVE provides a measure of convergent validity, it is crucial to also assess discriminant validity to ensure that the constructs are distinct and not merely measuring the same underlying concept. Further analysis, such as examining the correlation between constructs, is needed to establish discriminant validity and strengthen the robustness of the model.

Table 2. Average Variance Extracted (AVE)

	Average Variance Extracted (AVE)	Note

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Lean Production Practices	0.537	Valid
Eco-Design for Sustainability	0.642	Valid
Sustainable Manufacturing	0.548	Valid

Table 3 shows that the indicators have high outer loading (>0.7) which indicates a strong relationship with their respective latent variables. This confirms that the indicators are effective in measuring the intended concept. Specifically, it shows that VSM, JIT, TPM, TQM, HRM and 5S are proven to contribute significantly to the implementation of lean production.

Table 3. Outer Loadings

	Lean Production Practices	Eco-Design for Sustainability	Sustainable Manufacturing
LP_01	0.731		
LP_02	0.738		
LP_03	0.753		
LP_04	0.720		
LP_05	0.712		
LP_06	0.744		
ED_01		0.802	
ED_02		0.834	
ED_03		0.767	
SM_01			0.738
SM_02			0.705
SM_03			0.705
SM_04			0.727
SM_05			0.739
SM_06			0.772
SM_07			0.793
SM_08			0.740

The path coefficient values presented in Table 4 serve as indicators of both the magnitude and direction of the relationships between the variables under investigation. The relationship between the Lean production variable to Eco-Design for Sustainability is positive at 0.557 which indicates that efforts to eliminate waste and improve efficiency in the production process contribute to the development of more environmentally friendly products. Similarly, the correlation between Eco-Design for Sustainability to Sustainable Manufacturing is 0.364 which has a positive correlation explaining that designing products that consider their environmental impact inherently supports sustainable manufacturing practices. Furthermore, the positive relationship between Lean Production Practices and Sustainable Manufacturing also has a positive effect of 0.464 reinforcing the opinion that by increasing value for customers through the elimination of waste directly contributes to the achievement of sustainable goals in the manufacturing process. This finding is consistent with the basic principle of Lean Production which emphasizes on creating maximum value with minimum resources [30] and is aligned with the principles of Sustainable Manufacturing that seeks to balance economic, social, and environmental goals [9].

Table 4. Path Coefficient

	Lean Production Practices	Eco-Design for Sustainability	Sustainable Manufacturing

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Lean Production Practices	0.557	0.464
Eco-Design for Sustainability		0.364
Sustainable Manufacturing		

Table 2 is used to calculate the Goodness of Fit (GoF) value. Based on the above calculations, the GoF value is 0.4934 which is in the interval 0.36-1 as a requirement for a good instrument. The GoF value of 0.4934 indicates that the data sample taken is in accordance with the model under study. The bootstrapping value in Table 5 also shows lean production practices on Eco-Design for Sustainability due to P Values <0.05 which indicates that the application of Lean principles, such as waste reduction and efficiency improvement, can encourage the integration of environmental considerations into the product design process. Similarly, there is a significant effect of Eco-Design for Sustainability on Sustainable Manufacturing with P values <0.05 which illustrates the important role of environmentally friendly product planning in realizing sustainable manufacturing practices. These results reinforce evidence from previous studies that Eco-design is a strategic approach to realizing Sustainable Manufacturing by reducing environmental impacts at every stage of the product life cycle [16].

Table 5. Bootstrapping

	Original Sample (O)	Sample Mean (M)	P Values
Lean Production Practices -> Eco-Design for Sustainability	0.557	0.569	0.000
Eco-Design for Sustainability -> Sustainable Manufacturing	0.364	0.365	0.000
Lean Production Practices -> Sustainable Manufacturing	0.464	0.466	0.000

Analysis reveals that eco-design plays a crucial mediating role in the relationship between lean production practices and sustainable manufacturing. Specifically, eco-design strengthens the link between these two by channeling the efficiency gains of lean production towards achieving sustainability goals. Statistical analysis (Table 6) confirms this significant partial mediation effect, with a path coefficient of 0.203 ($p = 0.002 < 0.05$). This indicates that while lean production practices positively influence sustainable manufacturing, this impact is significantly enhanced by integrating environmentally friendly design principles. In essence, eco-design acts as a critical bridge, translating the operational efficiencies of lean production into tangible environmental benefits and contributing to a more holistic approach to sustainable manufacturing [31].

Table 6. Specific Indirect Effects

	Original Sample (O)	Sample Mean (M)	P Values
Lean Production Practices -> Eco-Design for Sustainability -> Sustainable Manufacturing	0.203	0.207	0.002

While this study demonstrates the significant mediating role of eco-design in linking lean production practices to sustainable manufacturing, it also acknowledges that other factors contribute to this relationship. Eco-design, although crucial, is not the sole determinant of achieving sustainability through lean practices. Further research is necessary to explore these additional pathways, which might include factors such as organizational culture, supply chain integration, technological innovation, and external pressures like regulatory frameworks and consumer demand. Investigating these interconnected elements will provide a more comprehensive understanding of how organizations can effectively leverage lean production to achieve holistic sustainability goals.

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This research seeks to enrich the theory of Sustainable Manufacturing by integrating Eco-Design for Sustainability and Lean Production Practices. Lean production and eco-design have mutually supportive and reinforcing roles in driving the creation of sustainable manufacturing, they do so through different yet complementary mechanisms. Lean production focuses on eliminating waste and improving efficiency so that it can directly contribute to the sustainability of manufacturing [3]. By minimizing resource consumption and streamline operations, lean principles contribute to environmental preservation [32]. Conversely, eco-design takes a proactive approach by embedding environmental considerations into the earliest stages of product development. This involves prioritizing sustainable material selection, minimizing the use of hazardous material, and designing products with end-of-life recyclability in mind [8]. Thus, eco-design contributes to sustainable manufacturing by reducing the environmental impact of a product throughout its entire lifecycle, from raw material extraction to disposal [16].

Conversely, eco-design proactively incorporates environmental factors into the product design phase [33]. This includes sustainable material selection, reduction of hazardous materials, and product design that facilitates recycling [9]. Therefore, eco-design supports the goal of sustainable manufacturing by minimizing environmental impacts throughout its life [19]. By integrating lean production and eco design, companies can create a more holistic and effective sustainable manufacturing strategy, resulting in products that are both environmentally responsible and economically competitive [34]. This holistic strategy not only reduces environmental impact but also optimizes resource use, lowers costs, and enhances product quality, ultimately bolstering the company's market competitiveness.

Moreover, the strategic integration of advanced technologies like IoT, AI, and blockchain can significantly enhance the effectiveness of Lean Production and Eco-Design initiatives, acting as a powerful catalyst for achieving sustainable manufacturing goals. These technologies can optimize processes, enhance resource efficiency, and support data-driven decision-making, hence enhancing the benefits of eco-design techniques and lean concepts. IoT sensors, by providing real-time data on resource consumption, enable dynamic adjustments to production processes, facilitating predictive maintenance and minimizing waste generation [35]. AI algorithms, through the analysis of complex datasets, can optimize designs for minimal environmental impact while maximizing material utilization and circularity [36]. Blockchain technology can enhance supply chain transparency and traceability, ensuring the ethical sourcing of sustainable materials and fostering accountability across all stages of the product lifecycle [37]. This synergistic convergence of sustainable practices and advanced technologies represents a compelling opportunity for FMCG companies to unlock unprecedented levels of operational efficiency, cost reduction, and competitive advantage in a rapidly evolving market.

Conclusions

Lean production practices that have been implemented at PT. A, one of the FMCG industries, aim to reduce waste so as to increase efficiency. The results show a positive synergy between lean production and eco design in driving sustainable manufacturing. Lean Production Practices directly contribute to Sustainable Manufacturing. On the other hand, Eco-Design for Sustainability emerges as a key strategy in achieving Sustainable Manufacturing in Fast Moving Consumer Goods (FMCG) companies. The integration of Lean Production principles with Eco-Design practices enables companies to significantly improve their sustainability performance. This research validates that implementing both Lean Production and Eco-Design are essential, interconnected strategies for achieving Sustainable Manufacturing. Although this study was conducted at PT. A, an FMCG company, the findings and recommendations can be generalized and applied to various types of industries. The principles of Lean Production and Eco-Design are universal and can be adapted by any manufacturing company committed to achieving Sustainable Manufacturing. In addition, Eco-Design is only one of the factors that together with Lean Production contribute to Sustainable Manufacturing. While eco-design plays a key role in linking lean production to sustainable manufacturing, other contributing factors exist. Future research should explore these additional pathways and identify further indicators that promote Sustainable Manufacturing.

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References

Sartal A, Bellas R, Mejías AM, García-Collado A. The sustainable manufacturing concept, evolution and opportunities within Industry 4.0: A literature review. Adv Mech Eng 2020;12. https://doi.org/10.1177/1687814020925232.

Dombrowski U, Mielke T, Schulze S. Sustainable Manufacturing. Sustain Manuf 2012:17–8. https://doi.org/10.1007/978-3-642-27290-5.

Shah S, Naghi Ganji E, Coutroubis A. Lean Production Practices to Enhance Organisational Performance. MATEC Web Conf 2017;125:1–7. https://doi.org/10.1051/matecconf/201712502003.

Wickramasinghe GLD, Wickramasinghe V. Implementation of lean production practices and manufacturing performance: The role of lean duration. J Manuf Technol Manag 2017;28:531–50. https://doi.org/10.1108/JMTM-08-2016-0112.

Nawanir G, Lim KT, Othman SN. Lean manufacturing practices in Indonesian manufacturing firms: Are there business performance effects? Int J Lean Six Sigma 2016;7:149–70. https://doi.org/10.1108/IJLSS-06-2014-0013.

Millicer H, Collins R, Fennessy L, Richardson M, Rajaratnam T, Hill A, et al. Associate Professor Simon Lockrey ECO-DESIGN PRINCIPLES 2022.

König DU. Guide to resource efficiency in manufacturing. Eur INNOVA 2012:32.

Cimatti B, Campana G, Carluccio L. Eco Design and Sustainable Manufacturing in Fashion: A Case Study in the Luxury Personal Accessories Industry. Procedia Manuf 2017;8:393–400. https://doi.org/10.1016/j.promfg.2017.02.050.

Kuo YC, Wu YM, Liu YX. Identifying Key Factors for Sustainable Manufacturing and Development. Rev Integr Bus Econ Res 2022;11:30–50.

Womack JP, Jones DT. Lean Thinking—Banish Waste and Create Wealth in your Corporation. J Oper Res Soc 1997;48:1148–1148. https://doi.org/10.1038/sj.jors.2600967.

Florescu A, Barabaş B. Integrating the Lean concept in sustainable manufacturing development. IOP Conf Ser Mater Sci Eng 2018;399. https://doi.org/10.1088/1757-899X/399/1/012018.

Samant S, Prakash R. Achieving Lean and Improving Sustainability through Value Stream Mapping for Complex Manufacturing. IOP Conf Ser Mater Sci Eng 2020;748. https://doi.org/10.1088/1757-899X/748/1/012022.

Palange A, Dhatrak P. Lean manufacturing a vital tool to enhance productivity in manufacturing. Mater Today Proc 2021;46:729–36. https://doi.org/10.1016/j.matpr.2020.12.193.

Naeem M, Ahmad N, Hussain S, Nafees B, Hamid A. Impact of Lean Manufacturing on the Operational Performance: Evidence From Textile Industry. Humanit Soc Sci Rev 2021;9:951–61. https://doi.org/10.18510/hssr.2021.9393.

Adlin N, Nylund H, Lanz M, Lehtonen T, Juuti T. Lean indicators for small batch size manufacturers in high cost countries. Procedia Manuf 2020;51:1371–8. https://doi.org/10.1016/j.promfg.2020.10.191.

Singhal TS, Jain JK, Ramacharyulu DA, Jain A, Abdul-Zahra DS, Manjunatha, et al. Eco-Design of Products and Processes: A Review on Principles and Tools for Sustainable Manufacturing. E3S Web Conf 2024;505. https://doi.org/10.1051/e3sconf/202450501033.

Dhingra R, Kress R, Upreti G. Does lean mean green? J Clean Prod 2014;85:1–7. https://doi.org/10.1016/j.jclepro.2014.10.032.

Subharaj C, Jerin Leno I, Shivashankara, Vivek S, Joe Patrick Gnanaraj S, Appadurai M. Sustainable manufacturing system applying on eco-design products. Mater Today Proc 2022;68:1528–35. https://doi.org/10.1016/j.matpr.2022.07.169.

Lu T, Gupta A, Jayal AD, Badurdeen F, Feng SC, Dillon OW, et al. Advances in Sustainable Manufacturing. Adv Sustain Manuf 2011. https://doi.org/10.1007/978-3-642-20183-7.

Shukla GP, Adil GK. Exploring Sustainability Implications for Manufacturing Strategy Decision Areas-A New Model with a Case Study. Procedia Manuf 2020;43:352–9. https://doi.org/10.1016/j.promfg.2020.02.172.

Sembiring N, Tambunan MM, Ginting E. Sustainable Manufacturing that is Environmentally Friendly. J Phys Conf Ser 2020;1542. https://doi.org/10.1088/1742-6596/1542/1/012004.

Salvador R, Piekarski CM, Francisco AC de. Approach of the Two-way Influence Between Lean and Green Manufacturing and its Connection to Related Organisational Areas. Int J Prod Manag Eng 2017;5:73. https://doi.org/10.4995/ijpme.2017.7013.

Joung CB, Carrell J, Sarkar P, Feng SC. Categorization of indicators for sustainable manufacturing. Ecol Indic 2013;24:148–57. https://doi.org/10.1016/j.ecolind.2012.05.030.

Amrina E, Vilsi AL. Key performance indicators for sustainable manufacturing evaluation in cement industry. Procedia CIRP 2015;26:19–23. https://doi.org/10.1016/j.procir.2014.07.173.

Järvenpää E, Lanz M. Lean Manufacturing and Sustainable Development 2020:423–32. https://doi.org/10.1007/978-3-319-95726-5_7.

Helleno AL, de Moraes AJI, Simon AT. Integrating sustainability indicators and Lean Manufacturing to assess manufacturing processes: Application case studies in Brazilian industry. J Clean Prod 2017;153:405–16. https://doi.org/10.1016/j.jclepro.2016.12.072.

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Nääs I, Vendrametto O, Reis JM, Gonçalves RF, Silva MT, Cieminski G von, et al. Advances in Production Management Systems. Initiatives for a Sustainable World. IFIP Adv Inf Commun Technol 2016:659–66. https://doi.org/10.1007/978-3-319-51133-7.

Eskandari M, Hamid M, Masoudian M, Rabbani M. An integrated lean production-sustainability framework for evaluation and improvement of the performance of pharmaceutical factory. J Clean Prod 2022;376:134132. https://doi.org/10.1016/j.jclepro.2022.134132.

Chiarini A. Sustainable manufacturing-greening processes using specific Lean Production tools: An empirical observation from European motorcycle component manufacturers. J Clean Prod 2014;85:226–33. https://doi.org/10.1016/j.jclepro.2014.07.080.

Santos ACO, da Silva CES, Braga RA da S, Corrêa JÉ, de Almeida FA. Customer value in lean product development: Conceptual model for incremental innovations. Syst Eng 2020;23:281–93. https://doi.org/10.1002/sys.21514.

Mohamed A. Abobakr, Magdy G. Abdel-Kader, Ahmed F. Elbayoumi. The Impact of Lean Manufacturing Practices on Sustainability Performance: A Natural Resource-Based View. J Mod Account Audit 2022;18:115–30. https://doi.org/10.17265/1548-6583/2022.03.002.

Prosvirina N V., Tikhonov AI, Okagbue HI. Lean Production Principles in Production Management. Russ Eng Res 2021;41:1263–8. https://doi.org/10.3103/S1068798X21120352.

Schäfer M, Löwer M. Ecodesign-a review of reviews. Sustain 2021;13:1–33. https://doi.org/10.3390/su13010315.

Dahmani N, Belhadi A, Benhida K, Elfezazi S, Touriki FE, Azougagh Y. Integrating lean design and eco-design to improve product design: From literature review to an operational framework. Energy Environ 2022;33:189–219. https://doi.org/10.1177/0958305X21993481.

Nozari H, Fallah M, Kazemipoor H, Najafi SE. Big data analysis of IoT-based supply chain management considering FMCG industries. Bus Informatics 2021;15:78–96. https://doi.org/10.17323/2587-814X.2021.1.78.96.

Olufemi M. Artificial Intelligence and Supply Chain Management in the FMCG Sector : A Literature Review 2024;9:1594–601.

Prakash A. Blockchain Technology for Supply Chain Management: Enhancing Transparency and Efficiency. Int J Glob Acad Sci Res 2024;3:01–11. https://doi.org/10.55938/ijgasr.v3i2.73.