

A Review on Lean Green Methodology for Pakistani Manufacturing SMEs Sustainability Performance

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ABSTRACT

Sustainability performance achievement using the operations (lean practice) and green (environmental) practices are frequently discussed topics in business literature. However, there have been minimal efforts at integrating the concepts of Lean and Green concerning sustainability performance in Pakistani SMEs. Hence, this paper evaluates the importance of the implementation of Lean, Green practices on Pakistani SMEs' sustainability performance. As these manufacturing practices are adopted, economic savings, environmental performance and increased social outcomes are achieved. Lean green practices help to produce products at lower costs, ensuring the highest quality, also according to the needs and demands of customers. Therefore, this study reviews Pakistani SMEs to understand the importance of Lean Green practices for the achievement of operational excellence, to mitigate environmental concerns and to pursue the path towards Sustainability.

Keywords: Lean, Green, Sustainability Performance, Pakistani SMEs

INTRODUCTION

In today's volatile business world, with serious constraints on resources, business companies are encouraged to apply methods that sustain their businesses while retaining a competitive advantage. As there is a significant increase in the world's population, expected to be 9 billion people by the year 2050, faced with exhaustible non-renewable natural resources, scarce, challenging and difficult to attain, hence, Sustainability should be treated as a top priority (Lee et al., 2017; Nawanir et al., 2020; Nor-Aishah et al., 2020)

Previous studies on environmental degradations such as water and air pollutions, waste productions, etc., point to SMEs as being responsible, to a greater extent (Cherrafi et al., 2019; Siegel et al., 2019; Thanki & Thakkar, 2019). Due to insufficient understanding and various operational issues related to manufacturing SMEs practices, along with failure to see sustainability benefits, the discussion related to Sustainability is still limited and needs attention (Nawanir et al., 2020; Siegel et al., 2019; Wassan et al., 2024). SMEs should undoubtedly focus their management approaches toward the advancement of environmental, social and economic performance without any large expenditure (Nor-Aishah et al., 2020).

The manufacturing sector is mostly resource-based industries, for instance, plastic products, chemicals, electrical and electronic products, food and beverages, non-metallic minerals, as well as metallic products. Existing literature outlined various SME challenges such as low productivity, access to credit, poor managerial capabilities insufficient use of technology, heavy regulatory burden (Alshuwaikhat & Abubakar, 2008; Wassan et al., 2024) Many authors stated that SMEs should concentrate on high-quality products and services, improvement of management skills and financial systems reform to confirm financial Sustainability (Amir et al., 2020; Wassan et al., 2024). These

challenges are not just limited to poor management skills; issues related to training and development, low information awareness, cultural barriers, and regulatory burden are also involved (Nor-Aishah et al., 2020). In this globalized era, SMEs need to be equipped with resolution, along with equipping their workers with knowledge, skills and competencies, which SMEs have failed to develop (Amir et al., 2020; Wassan et al., 2024).

SMEs in Pakistan

SMEs in Pakistan continuously deal with a host of challenges as well as structural deficiencies. This includes a lack of technology, unskilled human resources, non-value-added products, low infrastructure, as well as a low level of value chains integration (Amir et al., 2020; Wassan et al., 2024). Despite the main income source for the Majority, Pakistani SMEs are generally regarded as low-value-added manufacturing with inefficient labor, obsolete technology, and limited market reach (Wassan et al., 2024)

SMEs should upgrade their management approaches, comprising economic, environmental and social targets through utilizing their limited funds and assets (Wassan et al., 2022). As adoption of these practices, such as lean, green and Sustainability, could be the finest answer to these issues (Abualfarraa et al., 2020; Elemure et al., 2023; Vilaça et al., 2025; Wassan et al., 2022; Wassan et al., 2024)

LITERATURE REVIEW

This study literature review was conducted by using electronic library databases, which are Emerald, Science Direct, Taylor and Francis, and IEEEExplore from the perspective of lean green, its synergy and lean green manufacturing application in the manufacturing Industry.

The Concept of Sustainability Performance

Most empirical reviews agree that sustainability performance incorporates multiple dimensions (Carter & Rogers, 2008; Fauzi et al., 2010; Nor-Aishah et al., 2020). Companies should emphasize both the economic and social dimensions to enhance sustainability performance (Nor-Aishah et al., 2020). David J. Colbert and Michael J. Kurucz (2007), as well as Adrian Henriques and John Richardson (2013), argued that sustainability performance measures should address the interests of multiple stakeholder groups within society. Similarly, Abualfaraa et al. (2020), Furnish et al. (2013), and Nor-Aishah et al. (2020) viewed sustainability performance from a holistic perspective by integrating the social, environmental, and economic dimensions as key measures of organizational Sustainability.

Environmental Performance

Environmental performance can be seen from two perspectives, namely performance in terms of the reduction of pollution and resource minimization. Resources used in production should be recoverable with the lowest CO₂ emissions(Quarshie et al., 2016). CO₂ emissions cause weather pattern changes, global warming, air pollution, and acid rain formation, which disturb human health and upset the ecosystem's natural balance(Harisekar, 2021; Nawanir et al., 2020). Substances based on chemicals, physical agents, and conditions that are injurious to human health as well as the environment should be reduced, and the usage level of hazardous substances can be used as an indicator for environmental performance. The manufacturing process must utilize energy; however, emphasis should be put on minimizing the use of resources. In addition, minimizing resource use, such as energy consumption, will directly benefit manufacturing in terms of cost savings. From the literature review, environmental

performance here measures three important items, namely pollution reduction, reduction of hazardous substances, and minimization of production resources(Quarshie et al., 2016). The table below shows a summary of environmental performance items proposed by prior scholars.

Measurement items	Researchers
Air pollution reduction	(Quarshie et al., 2016)
Liquid waste reduction	(Quarshie et al., 2016; Sachs, 2006; Sarkis, 2001)
Solid waste reduction	(Quarshie et al., 2016)
Energy consumption/material usage reduction	(Jeswiet & Kara, 2008; Quarshie et al., 2016)

Economic Performance

Prior research suggested that measurement of economic performance should be based on economic growth, environmental protection, and quality of life improvement. Wagner (2005) highlighted that companies should focus on environmental performance. Additionally, economic outcomes are related to increasing market share, enhancing the company's position and market image(Quarshie et al., 2016). Some researchers identified a number of indicators for economic performance measurement, such as cost and fee reduction measurement. In contrast, other researchers used the traditional economic indicators like profit, sales, and growth margins(Quarshie et al., 2016). Maxwell, Sheate, and Van der Vorst (2006), examined economic performance through manifest variables such as increased market share, productivity, competitive advantage, as well as cost benefit from eco-efficiencies. Christensen, Germain, and Birou (2005) looked into economic performance constructs over a period of three years. Rao and Holt (2005) stated that economic measures are a new market opportunity, increased efficiency, as well as cost savings(Quarshie et al., 2016). The table below shows the common economic performance items proposed by prior scholars.

Measurement Items	Researchers
Improved market share	(Quarshie et al., 2016; Qureshi et al., 2020; Rao & Holt, 2005)

Increase in profitability	(Quarshie et al., 2016; Qureshi et al., 2020; Wagner, 2005)
Cost savings	(Quarshie et al., 2016; Qureshi et al., 2020)

Social performance

Harisekar (2021), suggested that social performance is related to people as people form part of manufacturing processes, fundamental to production and converting raw material into finished products. In making a sustainability assessment, social impact needs to be considered. Quarshie et al. (2016), suggested that social performance consists of an increase in terms of employees' health and safety programs at the workplace, extra incentives for workers, engagement for local employment, implementation of programs for organizational health and safety, activities that help a country's economy and development, and reduction of impacts of services and products on the local community. This study measures social performance based on the important items scale given (Quarshie et al., 2016). The table below shows a summary of social performance items proposed by prior scholars.

Measurement Items	Researchers
Employees' health and safety/programs organizational health and safety	(Quarshie et al., 2016)
Local employment incentives Health and safety of the local community Services and products impact reduction on the local community	(Quarshie et al., 2016)

Lean Manufacturing

In the 1950s, Lean manufacturing was first developed and introduced by the Toyota Production System. Lean means less, less in cost, defects, lead time, space, non-value added activities, inventory, number of suppliers, number of employees (Nawanir et al., 2020). Narasimhan et al. (2006) suggested lean manufacturing as a

strategy that emphasized efficient use of resources through waste minimization. Lean manufacturing aims at reducing non-value-added activities and waste.

Lean Definitions

The following are different definitions of lean by prior scholars. As the table presented below shows, Lean manufacturing is seen as a program that aims to increase operational efficiency and focuses on waste elimination (Shah & Ward, 2007).

Author(year)	Definitions
(Shah & Ward, 2007)	Lean as a management philosophy focuses on waste elimination throughout a product value stream, not only within an organization but also its entire supply chain.
(Bergmiller & McCright, 2009)	Lean manufacturing aims to increase operational efficiency

Green Manufacturing

Green Manufacturing is considered to be an environmental and economic-focused approach for waste minimization through process design, products and material consumption (Leong et al., 2019). Green Manufacturing approach aids in achieving better economic value, meaningfully, without damaging the environment. Energy cost as well as resources are increasing due to growing demand and limited supply. Therefore, manufacturing industries are discovering ways to improve production capabilities while gaining healthy environmental performance (Thanki & Thakkar, 2019).

Green definitions

The following are the different definitions of green manufacturing by prior scholars. In Table 2.6 presented below, Green Manufacturing is seen as

"a manufacturing practice which does not damage the environment during any of its journey stages". It contains environmentally friendly raw material usage, green product design, environmentally friendly packaging, distribution, and after-product end-of-life reuse. Green manufacturing focuses on the improvement of design, raw materials and clean energy utilization, advanced processes implementation, technologies and equipment (Foster, 2001; Srivastava, 2007)

Author(year)	Definitions
(Foster, 2001)	Green Manufacturing is "a manufacturing practice that does not damage the environment during any of its journey phases.
(Jawahir et al., 2006)	Green manufacturing stresses reducing parts, material rationalizing, and component reuse.
(Rehman & Shrivastava, 2013)	Green manufacturing focuses on the improvement of design, raw materials and clean energy utilization, advanced processes implementation, technologies and equipment.

Lean and Green Manufacturing Integration Process

Both Lean and Green approaches have the same objectives related to non-value-added products minimization, and in operations, they form a synergy when incorporated simultaneously (Leong et al., 2019). LM and GM have been proven effective in competition globally (Abualfaraa et al., 2020). Lean manufacturing and green manufacturing may act as tools to improve production efficiency and make firms competitive (Abualfaraa et al., 2020; Farias et al., 2019; Siegel et al., 2019). Previous studies suggested that both lean management and green management are similar with strong commitment to efficiency-driven practices as well as zero waste (Siegel et al., 2019). Lean manufacturing's extensive application helps organizations to rethink processes by reducing waste and achieving this via GM. In operational and

environmental performance terms, Lean Green manufacturing has similar positive effects (Abualfaraa et al., 2020; Leong et al., 2019) Dues, Tan, and Lim (2013) stated that in manufacturing, green implementation in lean can be a catalyst and green also helps to maintain lean best practices (Abualfaraa et al., 2020). Lean and Green approaches balance each other and improve operational outcomes compared to a single approach (Abualfaraa et al., 2020). Hallam and Contreras (2016) indicated that Lean Green manufacturing consists of the same objectives in performance improvement, product quality, reducing operational costs and creating value (Farias et al., 2019; Harisekar, 2021). In manufacturing systems, Lean Green is interconnected. Lean focuses on profit maximization through cost reduction, whereas green focuses on lessening environmental risk while improving the organization's ecological efficiency. Lean practices ensure a great resource utilization rate through frequently replenishing required elements, whereas Green practices reduce environmental pollution (Harisekar, 2021).

Previous Studies Related to Lean Green Practices Implementation in SMEs.

In recent years, the concepts of lean green have increasingly achieved popularity (Chiet, 2019). For organizations, Lean Green can be a new opportunity to improve on sustainability performance (Abualfaraa et al., 2020). Cherrafi et al. (2017), stated that organizations using Lean Green practices simultaneously attained improved results, as compared to those which only focused on one of the initiatives. Siegel et al. (2019), emphasized a structured framework for Lean and Green and suggested their implementation in SMEs. Studies highlighted the need for improvement tools like Lean Green and their practices related to management support and

responsibility, integration strategy and employee involvement (Kurdve et al., 2014; Siegel et al., 2019; Thanki & Thakkar, 2019).

The table below shows literature showing a research gap related to Lean Green practices and sustainability performance.

Researchers	Dimensions	Findings
(Vilaça et al., 2025)	Lean, green, and Sustainability	This study suggested further research in the lean green and sustainability context.
(Elemure et al., 2023)	Lean, green, and Sustainability	This study highlighted the importance of the combined effect of lean green for the achievement of Sustainability.
(Harisekar, 2021)	Lean Green	This study suggests that sustainability performance can be achieved and enhanced through the use of Lean and Green tools in SMEs.
(Abualfaraa et al., 2020)	Lean Green and Sustainability	This study advised the integration of Lean and Green practices.
(Siegel et al., 2019)	Lean Green practices	This study mainly provides a summary of Lean Green practices in the SME context.
(Chiet, 2019)	Lean Green practices	This study suggested integrated Lean-Green practices model for daily operations.

(Farias et al., 2019)	Lean Green and Sustainability	This study proposes that the Lean and Green relationship can be extended towards Sustainability, in three dimensions: environmental, economic and social.
(Leong et al., 2019)	Lean Green practices	This study identifies research gaps related to Lean and Green practices implementation.
(Thanki & Thakkar, 2019)	Lean Green practices	This study proposes Lean Green practices in the manufacturing SMEs context which is less developed and deserves attention.
(Gandhi et al., 2018)	Lean Green and sustainability performance	This study highlighted that the simultaneous implementation of Lean Green practices can achieve excellent results.
(Zhan et al., 2018)	Lean Green	This research demonstrates how Lean Green practices affect organizational performance in a positive way.
(Yusoff et al., 2018)	Lean Green	This study suggested future research for development of an integrated model based on LeanGreen for the

		sustainable growth of SMEs.
(Garza-Reyes, 2015)	Lean Green practices	This study highlighted the importance of Lean Green practices and suggested further research to formulate more effective strategies.
(Abreu et al., 2017)	Lean Green	This study highlights the initiative of Lean Green Integration carries a valuable approach towards Sustainability as well as greener industrial activities.

Greenwood, 2004; Rothenberg et al., 2001; Zhan et al., 2018). In a Lean Green environment, developing strategy, organizational goals, and values, this aspect of leadership and management is essential. Third, employee involvement has been widely recognized as a critical factor in Lean Manufacturing. Numerous studies have highlighted that the human element—including employees' attitudes, skills, prior experience, expertise, and commitment—is essential for achieving organizational Sustainability (Diaz-Elsayed et al., 2013; Florida, 1996; Foo et al., 2021; Mason et al., 2008; Pampanelli et al., 2014; Zhu et al., 2005). Fourth, the adoption of integrated Lean and Green operating systems has been identified as an effective approach to enhancing both operational efficiency and sustainability performance (Carvalho et al., 2011; Chiet, 2019; Drew et al., 2004; Gandhi et al., 2018; Garza-Reyes, 2015; Zhan et al., 2018; Zhu & Sarkis, 2004). The effectiveness of these operating systems depends on adopting an integrated approach. Fifth, Lean and Green tools and techniques emphasize the effective management of manufacturing processes to ensure that operations function as intended, without breakdowns, shortages of materials, equipment, or tools (Banawi & Bilec, 2014; Foo et al., 2021; Harisekar, 2021; Hines et al., 2004; Salleh et al., 2012; Sertyesilisik, 2014; Siegel et al., 2019; Srivastava, 2007; Zhan et al., 2018). The table below shows the five common Lean Green practices based on previous literature.

Lean Green practices

In recent years, literature has highlighted the five common lean green practices. The first practice is, namely, mindset and attitude, according to several researchers. All these researchers highlighted that a positive mindset, comprised of a can-do approach to work, contributes towards the successful implementation of Lean Green initiatives, thus achieving sustainability performance. Second, prior studies on leadership and management emphasized involvement, support and dedication from top management as essential to solving and taking actions on sustainability issues (Bergmiller & McCright, 2009; Gandhi et al., 2018; Larson &

Lean Green practices	Researchers
Mindset and attitude	(Azevedo et al., 2012; Zhan et al., 2018)
Leadership and management	(Bergmiller & McCright, 2009; Zhan et al., 2018)

Employee Involvement	(Foo et al., 2021; Pampanelli et al., 2014; Zhan et al., 2018)
Integrated approach	(Garza-Reyes, 2015; Zhan et al., 2018)
Tools and techniques	(Foo et al., 2021; Srivastava, 2007)

Mindset and Attitude

If people change how they think, then they may be inspired to do things differently and only then can the organization hope to achieve different results. Previous studies point to failures in implementing Lean Green practices, starting with a misunderstanding of concepts (Gandhi et al., 2018; Zhan et al., 2018). Therefore, the key concepts of cognitive dimension and tools must be learned (Harisekar, 2021; Siegel et al., 2019). Many organizations have invested considerably in lean and green training programmes without ever seeing sustainable shop floor benefits. This study identifies mindset and attitude as several key aspects for the successful implementation of lean green practices.

Leadership and Management

In driving the organization towards success, leadership plays an important role. Larsson and Vinberg (2010), stated that organizational success depends on leadership behaviour. Visionary leaders lead by setting examples as well as inspiring and encouraging people, being influential and a positive factor in the overall performance of organizations (Al-Najem et al., 2012; Larsson & Vinberg, 2010; Zhan et al., 2018). Most experts in quality management for lean and quality management opined that leadership is considered to be a key success factor and cannot be ignored

(Gandhi et al., 2018; Zhan et al., 2018). Leaders' ten crucial traits that need to be considered while dealing with colleagues and subordinates. These key traits include being a good commander, good planner, strong-minded, having high-level integrity, good organizer, team player, good controller, good listener, having a good personality (Zhan et al., 2018). Regardless of their size and organizational activities, all want to achieve desirable results, ensuring a healthy organizational culture through adopting the triangle model in the organizational setup, which comprises senior management, leadership and its people. Dahlgard-Park and Dahlgard (2006) asserted that organizations need strong leadership to foster the right culture in the case of lean adoption that starts from senior to middle management and eventually to the shop floor (Al-Najem et al., 2012; Zhan et al., 2018).

Employee Involvement

Zhu et al. (2005), stated that lean successful implementation can only be achieved in organizations with employees' involvement. Additionally, improvements in pollution control can also be made through employee involvement (Zhan et al., 2018). For instance, Dow Chemicals encouraged its employees to reduce pollution and waste (Denton, 1999). Organizations' business and environmental performance can be improved through employees in three ways. Firstly, as a long-term approach, it needs permanent employee commitment. Therefore, to change employees' thinking and way of doing things, discipline and continuous learning also require employee commitment. If people are resistant to changing their work method, then the chance of success for Lean Green is very little (Zhan et al., 2018). Employees must have a deeper understanding of the concept underpinning Lean Green practices, not only related to its tools and techniques, but also in overall Lean Green transformation processes

and employee development.

Integrated Approach

A successful integrated approach involves integration of both Lean and Green (Vachon & Klassen, 2006; Zhan et al., 2018). Many studies highlighted that a Lean Green integrated approach is a helpful development and change strategy to improve organizational business performance through eliminating waste, customer value and continuous improvement through sustainable integration practices (Cherrafi et al., 2019; Farias et al., 2019; Siegel et al., 2019). This also involves structural and systems alignment, affecting behaviours as well as infrastructures to support Lean Green practices. Lean Green can be integrated with technology, with other programs and systems aligned accordingly. Moreover, it can improve organizational environmental performance through reducing environmental degradation and pollution through Lean Green tools and techniques (Alshuwaikhat & Abubakar, 2008; Gandhi et al., 2018; Harisekar, 2021; Zhan et al., 2018).

Tools and Techniques

Lean Green tools and techniques are considered those principles and concepts which aim to identify and remove waste with optimized resource utilization. Every organization uses different sets of Lean Green tools according to their needs, preferences and company size (Harisekar, 2021). Siegel et al. (2019), specified that there is a total of 26 Lean Green tools. These tools function differently from one another and are designed for SMEs, do not require huge investments and help to increase sustainability performance (Harisekar, 2021). Kaizen, 5S (Sort, Set in Order, Shine, Standardize, and Sustain), Value Stream Mapping, Visual Workplace, Total Productive Maintenance, Supplier Network Management, and Total Quality Management are among the most important Lean tools (Garcia et al., 2021). In addition, Green Value

Stream Mapping has been recognized as an effective tool for integrating Lean and Green practices (Chiarini, 2014; Piercy & Rich, 2015). Furthermore, Eco-design, Life Cycle Assessment (LCA), ISO 14001, and the 3R principles (Reduce, Reuse, and Recycle) are considered essential Green tools for improving environmental Sustainability (Thanki et al., 2016).

DISCUSSION

This research on SMEs sustainability performance (Foo et al., 2021) adds knowledge towards sustaining SMEs business and performance. This study throws light on how previous research has looked into Lean Green combined practices and their contribution towards Sustainability. This study highlights the current understanding of performance determinants, and this new information will be beneficial for academics and specialists who are interested in theory development. This study also provides some practical implications. Firstly, this comprehensive study helps to understand manufacturing practices which are sustainable as well as in the use of resources to lessen risk failure and to increase the chances of success. Secondly, this study tries to promote consciousness and understanding of the role of Pakistani SMEs in the manufacturing industry and their economic contribution. Thirdly, this study is beneficial to the Pakistani government sector as it provides them with information on the issues faced by SMEs.

In summary, the current study findings add to the existing academic and practical knowledge of Pakistani SMEs. This research may stimulate new research by other research students and researchers. This research's findings are useful for governments as well as economic, environmental and social planners.

CONCLUSION AND DIRECTIONS FOR FUTURE

RESEARCH

Hence, SMEs should embark on understanding these manufacturing practices, which can ensure their product quality, safety and meet their customers' demands efficiently. In future, researchers may extend this study to different organizations for the generalizability of results, and also explore possible moderators and mediators.

Conflict of Interest

There was no conflict of interest while conducting this research.

REFERENCES

- Abreu, M. F., Alves, A. C., & Moreira, F. (2017). Lean-Green models for eco-efficient and sustainable production. *Energy*, *137*, 846-853.
- Abualfaraa, W., Saloniitis, K., Al-Ashaab, A., & Ala'raj, M. (2020). Lean-Green Manufacturing Practices and Their Link with Sustainability: A Critical Review. *Sustainability*, *12*(3), 981.
- Al-Najem, M., Dhakal, H., & Bennett, N. (2012). The role of culture and leadership in lean transformation: a review and assessment model. *International Journal of Lean Thinking*, *3*(1), 119-138.
- Alshuwaikhat, H. M., & Abubakar, I. (2008). An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices. *Journal of cleaner production*, *16*(16), 1777-1785.
- Amir, S., Ali, M., & Ahmad, F. (2020). Evolution of SMEs in Pakistan and key challenges that hampers their expansion. *International Journal of Social Sciences & Humanities (IJSSH)*, *5*(2), 23-40.
- Azevedo, S. G., Carvalho, H., Duarte, S., & Cruz-Machado, V. (2012). Influence of green and lean upstream supply chain management practices on business sustainability. *IEEE Transactions on Engineering Management*, *59*(4), 753-765.
- Banawi, A., & Bilec, M. M. (2014). A framework to improve construction processes: Integrating Lean, Green and Six Sigma. *International Journal of Construction Management*, *14*(1), 45-55.
- Bergmiller, G. G., & McCright, P. R. (2009). *Parallel models for lean and green operations*. Paper presented at the Proceedings of the 2009 industrial engineering research conference.
- Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: moving toward new theory. *International Journal of Physical Distribution & Logistics Management*.
- Carvalho, H., Duarte, S., & Cruz Machado, V. (2011). Lean, agile, resilient and green: divergencies and synergies. *International Journal of Lean Six Sigma*, *2*(2), 151-179.
- Cherrafi, A., Elfezazi, S., Govindan, K., Garza-Reyes, J. A., Benhida, K., & Mokhlis, A. (2017). A framework for the integration of Green and Lean Six Sigma for superior sustainability performance. *International Journal of Production Research*, *55*(15), 4481-4515.
- Cherrafi, A., Elfezazi, S., Hurley, B., Garza-Reyes, J. A., Kumar, V., Anosike, A., & Batista, L. (2019). Green and Lean: a Gemba-Kaizen model for sustainability enhancement. *Production Planning & Control*, *30*(5-6), 385-399.

- Chiarini, A. (2014). Sustainable manufacturing-greening processes using specific Lean Production tools: an empirical observation from European motorcycle component manufacturers. *Journal of Cleaner Production*, *85*, 226-233.
- Chiet, C. W., Ching, N. T., Huat, S. L., Fathi, M., & Tzuo, T. J. . (2019). The Integration of Lean and Green Manufacturing for Malaysian Manufacturers: A Literature Review to Explore the Synergies between Lean and Green Model. *IOP Conference Series: Earth and Environmental Science*, Vol. 268, No. 1, p. 012066). IOP Publishing.
- Christensen, W. J., Germain, R., & Birou, L. (2005). Build-to-order and just-in-time as predictors of applied supply chain knowledge and market performance. *Journal of operations management*, *23*(5), 470-481.
- Colbert, B. A., & Kurucz, E. C. (2007). Three conceptions of triple bottom line business sustainability and the role for HRM. *People and Strategy*, *30*(1), 21.
- Dahlgaard-Park, S. M., & Dahlgaard, J. J. (2006). In search of excellence-past, present and future. *Kreativ und konsequent*, *2*(3), 57-84.
- Diaz-Elsayed, N., Jondral, A., Greinacher, S., Dornfeld, D., & Lanza, G. (2013). Assessment of lean and green strategies by simulation of manufacturing systems in discrete production environments. *CIRP Annals*, *62*(1), 475-478.
- Drew, J., Mc Callum, B., & Roggenhofer, S. (2004). Journey to lean: Making Operational Change Stick. Palgrave MacMillan. *New York*.
- Dües, C. M., Tan, K. H., & Lim, M. (2013). Green as the new Lean: how to use Lean practices as a catalyst to greening your supply chain. *Journal of Cleaner Production*, *40*, 93-100.
- Elemure, I., Dhakal, H. N., Leseure, M., & Radulovic, J. (2023). Integration of lean green and Sustainability in manufacturing: a review on current state and future perspectives. *Sustainability*, *15*(13), 10261.
- Farias, L. M. S., Santos, L. C., Gohr, C. F., de Oliveira, L. C., & da Silva Amorim, M. H. (2019). Criteria and practices for lean and green performance assessment: Systematic review and conceptual framework. *Journal of Cleaner Production*.
- Fauzi, H., Svensson, G., & Rahman, A. A. (2010). "Triple bottom line" as "Sustainable corporate performance": A proposition for the future. *Sustainability*, *2*(5), 1345-1360.
- Florida, R. (1996). Lean and green: the move to environmentally conscious manufacturing. *California management review*, *39*(1), 80-105.
- Foo, P. Y., Lee, V. H., Ooi, K. B., Tan, G. W. H., & Sohal, A. (2021). Unfolding the impact of leadership and management on sustainability performance: Green and lean practices and guanxi as the dual mediators. *Business Strategy and the Environment*.
- Foster, S. T. (2001). *Managing quality: An integrative approach*. Prentice Hall.
- Furnish, A., Kay, A., & Xia, S. (2013). Evaluation of Triple Bottom Line Impacts of Resourceful Communities' Creating New Economies Fund.
- Gandhi, N. S., Thanki, S. J., & Thakkar, J. J. (2018). Ranking of drivers for integrated lean-green manufacturing for Indian manufacturing SMEs. *Journal of Cleaner Production*, *171*, 675-689.

- Garcia, V. M. B., Martens, C. D. P., Carvalho, R. B., & Martens, M. L. (2021). Contributions of entrepreneurial orientation in the use of agile methods in project management. *Innovation & Management Review*.
- Garza-Reyes, J. A. (2015). Lean and green—a systematic review of the state of the art literature. *Journal of Cleaner Production*, *102*, 18-29.
- Hallam, C., & Contreras, C. (2016). Integrating lean and green management. *Management Decision*, *54*(9), 2157-2187. doi:10.1108/md-04-2016-0259
- Harisekar, V. (2021). Increasing sustainability performance in a SME: Focusing on lean and green. In.
- Henriques, A., & Richardson, J. (2013). *Triple Bottom Line*: Routledge.
- Hines, P., Holweg, M., & Rich, N. (2004). Learning to evolve: a review of contemporary lean thinking. *International journal of operations & production management*, *24*(10), 994-1011.
- Jawahir, I., Wanigarathne, P., & Wang, X. (2006). Product design and manufacturing processes for Sustainability. *Chapter 12 Mechanical Engineers' Handbook*, 414-443.
- Jeswiet, J., & Kara, S. (2008). Carbon emissions and CES™ in manufacturing. *CIRP annals*, *57*(1), 17-20.
- Jeyaraman, K., & Kee Teo, L. (2010). A conceptual framework for critical success factors of lean Six Sigma: Implementation on the performance of electronic manufacturing service industry. *International Journal of Lean Six Sigma*, *1*(3), 191-215.
- Kurdve, M., Zackrisson, M., Wiktorsson, M., & Harlin, U. (2014). Lean and green integration into production system models—experiences from Swedish industry. *Journal of Cleaner Production*, *85*, 180-190.
- Larson, T., & Greenwood, R. (2004). Perfect complements: synergies between lean production and eco-sustainability initiatives. *Environmental Quality Management*, *13*(4), 27-36.
- Larsson, J., & Vinberg, S. (2010). Leadership behaviour in successful organizations: Universal or situation-dependent? *Total quality management*, *21*(3), 317-334.
- Lee, M. D., Djubair, R. A., & Ngu, H. J. (2017). Sustainability Paradigm for Malaysian Manufacturing SMEs: An Operations Research Approach. *International Journal of Business and Technopreneurship*, *7*(3), 355-368.
- Leong, W. D., Lam, H. L., Ng, W. P. Q., Lim, C. H., Tan, C. P., & Ponnambalam, S. G. (2019). Lean and green manufacturing—a review on its applications and impacts. *Process integration and optimization for Sustainability*, *3*(1), 5-23.
- Mason, R., Nieuwenhuis, P., & Simons, D. (2008). Lean and green supply chain mapping: adapting a lean management tool to the needs of industrial ecology. *Progress in Industrial Ecology, An International Journal*, *5*(4), 302-324.
- Maxwell, D., Sheate, W., & Van der Vorst, R. (2006). Functional and systems aspects of the sustainable product and service development approach for industry. *Journal of Cleaner Production*, *14*(17), 1466-1479.

- Narasimhan, R., Swink, M., & Kim, S. W. (2006). Disentangling leanness and agility: an empirical investigation. *Journal of operations management*, 24(5), 440-457.
- Nawanir, G., Lim, K. T., Lee, K. L., Moshood, T. D., & Ahmad, A. N. A. (2020). Less for more: the structural effects of lean manufacturing practices on Sustainability of manufacturing SMEs in Malaysia. *International Journal of Supply Chain Management*, 2(2), 961-975.
- Nor-Aishah, H., Ahmad, N. H., & Thurasamy, R. (2020). Entrepreneurial leadership and sustainable performance of manufacturing SMEs in Malaysia: The contingent role of entrepreneurial bricolage. *Sustainability*, 12(8), 3100.
- Pampanelli, A. B., Found, P., & Bernardes, A. M. (2014). A Lean & Green Model for a production cell. *Journal of cleaner production*, 85, 19-30.
- Piercy, N., & Rich, N. (2015). The relationship between lean operations and sustainable operations. *International Journal of Operations & Production Management*.
- Quarshie, A. M., Salmi, A., & Leuschner, R. (2016). Sustainability and corporate social responsibility in supply chains: The state of research in supply chain management and business ethics journals. *Journal of Purchasing and Supply Management*, 22(2), 82-97.
- Qureshi, M. I., Khan, N., Qayyum, S., Malik, S., Hishan, S. S., & Ramayah, T. (2020). Classifications of sustainable manufacturing practices in ASEAN region: A systematic review and bibliometric analysis of the past decade of research. *Sustainability*, 12(21), 8950.
- Rao, P., & Holt, D. (2005). Do green supply chains lead to competitiveness and economic performance? *International journal of operations & production management*, 25(9), 898-916.
- Rehman, M. A., & Shrivastava, R. (2013). Green manufacturing (GM): past, present and future (a state of art review). *World Review of Science, Technology and Sustainable Development*, 10(1-2-3), 17-55.
- Rothenberg, S., Pil, F. K., & Maxwell, J. (2001). Lean, green, and the quest for superior environmental performance. *Production and operations management*, 10(3), 228-243.
- Sachs, W. (2006). Transcript of the lecture on: Can globalization become a driver for sustainable development. *Wuppertal Institute*.
- Salleh, N. A. M., Kasolang, S., & Jaffar, A. (2012). Green lean total quality information management in Malaysian automotive companies. *Procedia Engineering*, 41, 1708-1713.
- Sarkis, J. (2001). Manufacturing's role in corporate environmental sustainability-Concerns for the new millennium. *International journal of operations & production management*, 21(5-6), 666-686.
- Sertyesilisik, B. (2014). Lean and agile construction project management: As a way of reducing environmental footprint of the construction industry. In *Optimization and Control Methods in Industrial Engineering and Construction* (pp. 179-196): Springer.
- Shah, R., & Ward, P. T. (2007). Defining and developing measures of lean production.

- Journal of operations management*, 25(4), 785-805.
- Siegel, R., Antony, J., Garza-Reyes, J. A., Cherrafi, A., & Lameijer, B. (2019). Integrated green lean approach and Sustainability for SMEs: From literature review to a conceptual framework. *Journal of Cleaner Production*, 118205.
- Srivastava, S. K. (2007). Green supply-chain management: a state-of-the-art literature review. *International journal of management reviews*, 9(1), 53-80.
- Thanki, S., Govindan, K., & Thakkar, J. (2016). An investigation on lean-green implementation practices in Indian SMEs using analytical hierarchy process (AHP) approach. *Journal of Cleaner Production*, 135, 284-298.
- Thanki, S., & Thakkar, J. J. (2019). An investigation on lean-green performance of Indian manufacturing SMEs. *International Journal of Productivity and Performance Management*.
- Vachon, S., & Klassen, R. D. (2006). Extending green practices across the supply chain: the impact of upstream and downstream integration. *International Journal of Operations & Production Management*.
- Vilaça, D. M., de Sá, J. C., Antony, J., Sony, M., & McDermott, O. (2025). Lean, Green, and Sustainability 4.0—A systematic literature review. *Business Strategy and the Environment*.
- Wagner, M. (2005). How to reconcile environmental and economic performance to improve corporate Sustainability: corporate environmental strategies in the European paper industry. *Journal of environmental management*, 76(2), 105-118.
- Wassan, R. K., Shaikh, S. A., Marri, H. B., Memon, M. S., & Shah, S. F. (2024). Analyzing the impact of GLSS implementation over Sustainability in Pakistani SMEs. *Benchmarking: An International Journal*, 31(8), 2547-2564.
- Wassan, R. K., Shaikh, S. A., Shaikh, I. K., Memon, M. S., Rahman, A., & Shah, S. F. H. (2022). Initial screening of critical success factors for Green, Lean and Six Sigma implementation in Pakistani small and medium enterprises. *Journal of Applied Engineering Science*, 20(3), 946-956.
- Wiengarten, F., Fynes, B., & Onofrei, G. (2013). Exploring synergetic effects between investments in environmental and quality/lean practices in supply chains. *Supply Chain Management: An International Journal*, 18(2), 148-160.
- Yusoff, T., Wahab, S. A., Latiff, A. S., Osman, S. I., Zawawi, N. F., & Fazal, S. A. (2018). Sustainable Growth in SMEs: A Review from the Malaysian Perspective. *J. Mgmt. & Sustainability*, 8, 43.
- Zhan, Y., Tan, K. H., Ji, G., Chung, L., & Chiu, A. S. (2018). Green and lean sustainable development path in China: Guanxi, practices and performance. *Resources, Conservation and Recycling*, 128, 240-249.
- Zhu, Q., & Sarkis, J. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *Journal of operations management*, 22(3), 265-289.
- Zhu, Q., Sarkis, J., & Geng, Y. (2005). Green supply chain management in China: pressures,

practices and performance. *International Journal of Operations & Production Management*, 25(5), 449-468.