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A comparative review of the complementary and conflicting nature of lean production and green manufacturing implementation

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Abstract

Purpose – Buoyed by the increasing demand for improved productivity and environmentally conscious manufacturing, research in the area of lean production and green manufacturing has experienced significant growth since Dües *et al.* (2013). Taking the latter as the point of reference, a review of recent developments in the complementary and conflicting areas between lean production and green manufacturing that has been missing is presented.

Design/methodology/approach – A systematic search was done to identify articles on lean production and green manufacturing from Scopus, Web of Science, and Google Scholar. The population-intervention-outcome format was used to develop and answer the research questions. ATLAS.ti 22 was used to analyse 141 qualifying papers and identify the research themes.

Findings – Lean production and green manufacturing have strong synergy, and when integrated, they tend to deliver superior organisational performance than their individual implementations. This is consistent with the pre-2013 results, and other areas of synergy and divergence were also identified.

Research limitations – The study considers only papers published in the manufacturing sector after Dües *et al.* (2013). A review of lean production and green manufacturing in integrated product-service systems may also be relevant, especially due to the continuing trend since its introduction.

Practical implications - Any new adopter of lean production should consider implementing it simultaneously with green manufacturing.

Originality –This study establishes the persistence of the pre-2013 patterns of synergy and divergence between lean production and green manufacturing, and identifies new considerations for their joint implementation.

Keywords: Green manufacturing, lean production, synergy, divergence

Paper type Literature review

1. Introduction

Many organisations have implemented approaches such as Lean Production (LP) and Green Manufacturing (GM) to improve their performance. The Toyota production system (now popularly known as LP) aims to add value by removing waste, thereby improving operational performance (Ohno, 1988, p. 4). Hallam and Contreras (2016, p. 2177) in their review of published articles noted that LP improvements include reduced lead time, improved product quality, and reduced product costs. Also, increasing concern for social and environmental issues by regulators, shareholders, customers, and governments requires organisations to be environmentally friendly, and organisations may implement GM to be more compliant. GM aims to manufacture products that do not harm the environment, hence, as organisations strive to increase their profitability while meeting their environmental obligations, they may integrate LP and GM to meet both objectives. Lean-Green Manufacturing (LGM) integrates LP and GM to reduce waste, increase value, and improve environmental sustainability and organisational performance. The integration is motivated by the fact that both approaches focus on minimising resource consumption (Marco-ferreira *et al.*, 2020). Lartey *et al.* (2020) stated that organisations that implement LGM create a good image before customers, pressure groups, and stakeholders, thereby improving product acceptance and the firm's growth. Organisations need to know the possible complementary and conflicting natures of LP and GM so that their synergy can be exploited to attain maximum benefits and trade-offs can be made where the two show divergence.

A study that articulated the complementary and conflicting natures of LP and GM was done by Dües *et al.* (2013). It reviewed LP and GM publications and outlined LGM integration and overlap. Many articles have since been written to further this research, with Leong *et al.* (2019) highlighting the need for further studies on LGM. Our study was conducted because we firmly believe that publications on LGM are due for another review, and we seek to discern patterns and themes post-2013. The study by Dües *et al.* (2013) was chosen because it extensively articulated the synergy and divergence between LP and GM, and furthering this work can equip organisations with the pertinent knowledge for a successful implementation of LGM. A systematic Literature Review (SLR) was conducted to answer the following questions:

RQ1: Is the pattern observed pre-2013 by Dües *et al.* (2013) similar to, or different from that obtained post-2013?

RQ2. What further complementary or conflicting themes are reported when implementing LP and GM in manufacturing organisations?

These research questions were answered in this study, which consists of six sections. Section two presents the analytical framework, and section three details the design of the review methodologies. Section four outlines the findings, while section 5 discusses these findings. Lastly, section six presents the conclusion.

2. Analytical framework

2.1 Lean production

LP originated from the Toyota Production System and aims to reduce waste, thereby maximising efficiency and inculcating a continuous improvement culture (Kurdve and Bellgran, 2021). LP suggests that the activities of organisations can be categorised into value-adding or non-value-adding. Value-adding activities seek to transform services and products to what the customers are willing to pay for, while non-value-adding activities are activities that customers are not interested in, and hence, waste (Hallam and Contreras, 2016).

2.2 Green manufacturing

GM is an approach meant to reduce environmental waste (Mohanty and Deshmukh, 1999) and the negative environmental impacts. In addition, it seeks to reduce the consumption of raw materials, thereby reducing costs. Queiroz *et al.* (2015) stated that every waste that is produced has a cost because it was purchased as a raw material, and other inputs like water and electricity were used. When environmental waste is produced, it costs money to treat and store it; pay fines for non-compliance; or manage the firms' losses due to their reputational damage.

2.3 *Summary for pre-2013 studies: the road to* Dües *et al.* (2013)

This section presents a summary of the findings by Dües *et al.* (2013) and the supporting references. Bashkite and Karaulova (2012) highlighted the synergy and divergence between LP and GM. Synergy represents features of LP and GM that reinforce each other, while divergence attenuates each other's results. For example, LP aims to reduce waste and create value, while GM aims to reduce resource exploitation and environmental waste (Duarte *et al.*, 2011), hence, synergistic. LP utilises Just in Time (JIT) delivery and prefers small lot sizes, thereby increasing replenishment frequency (Mollenkopf *et al.*, 2010), leading to increased greenhouse gas emissions (Rothenberg *et al.*, 2001). GM prefers large lot sizes, minimises the replenishment frequency, thereby reducing greenhouse gas emissions (Venkat and Wakeland, 2006). Hence, there is a need for trade-offs between JIT and emissions' considerations.

Dües *et al.* (2013) also wrote about the similarities and differences between LP and GM. Similarities are issues that both LP and GM aim to address even if there is no synergy, while differences are issues they handle differently even if they do not negatively affect each other. For example, both LP and GM are concerned about waste reduction (Pampanelli *et al.*, 2011), hence, they apply various tools such as Value Stream Mapping (VSM) and Life Cycle Assessment (LCA) (Johansson and Winroth, 2009). Furthermore, both espouse people involvement (Bashkite and Karaulova, 2012), organisational and supply chain relationships (Johansson and Winroth, 2009), and focus on lead time reduction (Parveen *et al.*, 2011).

LP and GM show differences in various areas. Although both approaches consider waste reduction, they target different types of waste (Carvalho *et al.*, 2010). They apply different tools; the LP tools aim to add value, while GM tools target pollution reduction. Unlike GM, LP is not concerned with product end-of-life and environmental performance (Bashkite and Karaulova, 2012). GM is concerned about product end-of-life issues (Florida, 1996; Bashkite and Karaulova, 2012); hence, it employs tools such as LCA to minimise environmental damage (Hall, 2009). Also, LP focuses on cost and flexibility, while GM is concerned with improving environmental performance. While not mutually exclusive, some customers are more concerned about the cost of the product and lead time reduction, which are attained through LP (Bashkite and Karaulova, 2012). Hence in LP, the products are designed to improve performance (Winroth and Johansson, 2009) and reduce costs (Taubitz, 2010), making cost a Key Performance Indicator (KPI). Other customers are more interested in environmentally friendly processes and products (Bergmiller and McCright, 2009) achieved through GM implementation. Therefore, LCA is deployed to monitor the environmental impact of the products in their entire lifetime (Torielli *et al.*, 2010). Customers interested in the cost of products do not mind incorporating GM tools as long as it does not increase the cost. Also, customers interested in environmental performance do not mind paying less as long as the products are made in an environmentally friendly manner. Thus, when LP and GM are combined where possible, the customers are more pleased, as some are both environmentally and cost-conscious. The dominant cost in LP is physical cost, and VSM is the principal tool, while in GM, the dominant cost-equivalence is the implication on future generations, and LCA is the principal tool used (Johansson and Winroth, 2009). Figure 1 illustrates these synergy and divergence between LM and GM.

[Insert Figure 1 here]

3. Design of review methodology

A systematic search was done to identify LP and GM articles from Scopus, Web of Science, and Google Scholar. To enhance the quality of this review, the Population-Intervention-Comparison-Outcome (PICO) format was used. In evidence-based research, the PICO format is used to formulate and answer questions (Dekkers *et al.*, 2022, pp. 122-126). In this case, the population is the organisations; the intervention is the implementation of LGM; and the outcome is the organisational performance. Comparison is not relevant in this case, hence, PIO was adopted. Organisational performance includes operational performance measures such as quality, lead time, cost and flexibility (Jabbour *et al.*, 2013), as well as other broader nonoperational measures, including environmental, economic and social performance measures (Hallam and Contreras, 2016).

For the search protocol, we listed the synonyms of each term using the PIO logic grid, as shown in Table 1. No synonyms were used for LP as suggested by Kelendar *et al.* (2020), while synonyms for green manufacturing were adopted from Vrchota *et al.* (2020). 'AND' and 'OR' Boolean operators were used to constrain the search to the relevant keywords, as shown in Table 2. We also used the wild cards, * and ? to retrieve different renditions and combinations.

[Insert Table 1 here]

[Insert Table 2 here]

The Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines outlined in the PRISMA 2020 statement by Page *et al.* (2021) were used to screen and identify the relevant articles. A total of 2921 articles were identified through database search. 2382 were removed being duplicates. 97 were removed because they had no authors' names, while 73 were removed because they were not written in English. The 369 remaining articles were screened using their titles and abstracts, further eliminating 53 articles. 101 articles could not be retrieved, because they were available only through institutional access (dissertations, theses, and subscriptions); thus, full-text analysis was done on the remaining 215 articles, as shown in Table 3. 39 articles focusing only on LP and 21 only on GM implementations were excluded. 14 articles were ineligible as they focused on non-manufacturing industries. The remaining 141 articles matched the selection criteria and were used. Journal articles, conference publications, and accessible theses published between 2014 and 2021 were considered (Figure 2). The researchers conducted the search process in stages and stopped when the search yielded a few number of articles, which demonstrated a reasonable degree of saturation Irvine *et al.* (2022, pp. 178–179).

[Insert Table 3 here]

[Insert Figure 2 here]

The selected articles were analysed using ATLAS.ti 22, which provides quick access to articles based on keywords, relationships, subjects, and themes. Open coding and in-vivo coding were used. The first-order coding was accomplished by identifying all relevant words and phrases associated with LP and GM like JIT, Reduce, Recycle and Reuse (3R), cost reduction, top management support, and financial barrier amongst others. 137 first-order codes were identified, and they were aggregated into 8 groups through higher-level coding, namely: operational performance, environmental performance, barriers, CSFs, drivers, integration with other approaches, synergy, and divergence. These first-order and second-order codes were presented in the form of Gioia diagrams (see the supplementary file). The thematic areas were reduced from eight to six by combining some of the second-order themes into aggregate themes. Operational performance and environmental performance were combined into organisational performance, while synergy and divergence themes were aggregated into a theme. The supplementary file also contains other information extracted from the articles, including the research type, industry size, year of publication, and the relationship between study themes.

4. Results of the review

The identified LGM tools are presented in section 4.1, while in section 4.2, an outline of our findings is presented in alignment with the thematic classifications from Dües *et al*. (2013). The other thematic findings from text coding are presented in section 4.3.

4.1 Identified LGM tools

Figure 3 shows the LP and GM tools identified from the reviewed papers. According to Maware and Adetunji (2019), the words "techniques", "tools", and "practices" are all used interchangeably, but all tend to describe the same concept. Hence, in this study, we have adopted the term "tools" for consistency purposes. Although Bevilacqua *et al.* (2017) and Luis *et al.* (2020) identified human resource management as a LP tool, organisations that do not implement LP also apply it, hence, it was excluded.

[Insert Figure 3 here]

4.2 Synergy and divergence post-2013

This section discusses the synergy and divergence between LP and GM post-2013. Three different overlap diagrams were used to simplify the presentation.

Results from most researchers indicated that the pattern obtained by Dües *et al.* (2013) is still valid (Baumer-cardoso *et al.*, 2020; Rodrigues *et al.*, 2020; Cherrafi *et al.*, 2021), hence, we have used a similar classification scheme to present the post-2013 analysis, while referencing the recent authors supporting these findings. However, we also found areas that Dües *et al.* (2013) did not mention explicitly and added these to Table 4 (items 14-20). The information in Table 4 was used to develop the general overlap in Figure 4, extending Dües *et al.* (2013). The extended thematic areas are: philosophical focus; product and/or process focus; sustainability contribution; value; improvement process; profitability and competitiveness; and the most common tools. Table 4 summarises the comparison between LP and GM, where items 1-13 are similar findings pre- and post-2013.

[Insert Table 4 here]

The general overlap shows a lot of agreement with Dües *et al.* (2013), for example, on waste reduction (Hallam and Contreras, 2016), which is the main point of the similarity (Lerher *et al.*, 2016; Leme *et al.*, 2018) and customer satisfaction. Although LP and GM have different definitions for waste, they both consider waste to be non-value-adding activities. Prasetyawan (2016) noted that although LP and GM define value differently, they both seek to add value, mainly from operations and the environmental perspectives respectively; hence, both improve sustainable performance (Pampanelli *et al.*, 2016). Although the study agrees in some areas with Dües *et al.* (2013), other areas are also mentioned.

Further evidence shows that there are other complementary areas that Dües *et al.* (2013) did not extensively cover. For instance, LP focuses more on the economic and social impacts, while GM focuses more on the environmental impact. Thus, LP increases profits, while GM increases competitiveness (Kaswan *et al.*, 2020) by meeting the demands of environmentally-conscious customers (Huo *et al.*, 2019). Our general overlap also indicated that both LP and GM focus on continuous improvement (Farias *et al.*, 2019) and long-term thinking, as they both have long-term effects. Additionally, Dües *et al.* (2013) identified seven common types of manufacturing waste; however, most researchers have noted that the manufacturing waste can be extended to eight. For instance, Tiwari and Tiwari (2016); Verrier *et al.* (2016); Logesh *et al.* (2017); da Silva *et al.* (2021) identified loss of creativity as the eighth waste, while Fercoq *et al.* (2016); and Zekhnini *et al.* (2021) identified environmental waste as the eighth waste. In addition, the results from this study showed that the most common LP tool is VSM, while 3R is the most common GM tool. In summary, the study identified some areas that Dües *et al.* (2013)might have overlooked.

[Insert Figure 4 here]

4.2.1 Overlap of the relationship between LP and GM towards environmental and operational performance

LP and GM improve environmental and operational performance of manufacturing organisations. To explore these impacts, environmental and operational performance measures were identified from literature as classified by Farias *et al.* (2019). The performance measures were linked to LP and GM tools through a matrix, where each author was represented by a number inserted into a specific cell to indicate which author applied which LP and/or GM tools, and what performance improvements were attained. Nine performance criteria were identified, namely: profitability, productivity, inventory reduction, delivery improvement, quality improvement, cost reduction, waste management, environmental impacts, and energy utilisation. These nine performance criteria were divided into sub-criteria. However, the profitability criteria and other sub-criteria like return on sales, return on assets, return on investments, capacity utilisation, equipment reliability and processing time were excluded from the matrix as no author reported on their use towards environmental and operational performance. Furthermore, LP and GM tools such as 5 why's, andon and green packaging were excluded from the matrix as no article reported on the application of these tools in improving specific environmental or operational sub-criteria. The selected GM tools are LCA, DFE, 3R, Green Purchasing (GP), EEC and ISO 14001, while the LP tools are TQM, kaizen, 5S, VSM, JIT, jidoka, TPM, CM, kanban, and SMED. The matrix is shown in Table 5.

[Insert Table 5 here]

Figure 5 shows how the selected LP and GM tools influence the 8 groups of performance criteria. LGM has a greater impact on waste management, environmental impacts, productivity, and energy utilisation than on inventory reduction and delivery improvement. Kaizen and 3R were the most common tools, while EEC and GP were the least used tools. Overall, some performance criteria are enhanced by both LP and GM.

[Insert Figure 5 here]

Further synergy and divergence between LP and GM were outlined by studying the overlap based on environmental and operational performance. This is not combined with the overlap in Figure 4 to manage the diagram's size, hence splitting Figure 6 (performance) from Figure 7 (tools). Figure 6 shows that both LP and GM impact operational and environmental performance. LP tools are much more focused on improving operational performance, hence, sub-criteria such as productivity improvement, inventory reduction, delivery improvement, and cycle time reduction are affected by LP tools only. A framework proposed by Farias *et al.* (2019) also indicated that GM tools do not affect inventory reduction and productivity. Additionally, the overlap agrees with Dües *et al.* (2013), showing similarities in lead time reduction and waste reduction. It also shows that LP and GM complement each other in setup time reduction, percentage of value-added time, customer satisfaction, quality improvement, cost reduction, material usage, environmental performance, and energy consumption. Thus, implementing GM supports LP by reducing costs through decreasing energy consumption, material usage and waste. This agrees with Fercoq *et al.* (2016), who noted that integrating LP and GM results in cost reduction. Therefore, the simultaneous implementation of LP and GM impacts organisational performance more than their individual implementation. The overlap shows divergence in productivity improvement, inventory reduction, delivery improvement, and cycle time reduction sub-criteria. Although there is some divergence between LP and GM, they are still compatible.

[Insert Figure 6 here]

4.2.2 Overlap between LP and GM tools

LP and GM tools deployed for process improvement demonstrate some synergy or divergence. The LGM matrix in Table 5 was used to determine if the LP and GM tools have synergy or divergence. This extends the work by Dües *et al.* (2013) that did not explicitly consider these tools, although they identified the principal tools. The results showed that most tools are complementary. This agrees with Salvador *et al*. (2021), who noted that LCA and VSM show common attributes. It was noted that VSM could be extended to Green VSM by incorporating GM aspect into traditional VSM (Hartini *et al*., 2021). However, LP and GM showed divergence in emission reduction, which is the major area of concern, as also reported in section 3.2. Figure 7 outlines the synergy or divergence between LP and GM tools.

[Insert Figure 7 here]

4.3 Identified study themes

Figure 8 shows the six additional thematic areas identified. These are explained in the following sections, excluding performance improvement, and synergy and divergence, which were explained earlier.

4.3.1 Integration with other approaches

LP and GM can be integrated with other manufacturing approaches to improve performance. In order to improve organisational performance, LGM can be integrated with Six Sigma (Garza-reyes *et al.*, 2014) or Resilient Manufacturing (Ruiz-Benitez *et al.*, 2017). Sustainability can be improved by including Agile Manufacturing (Udokporo *et al.*, 2020a) or Industry 4.0 elements into LGM (Leong *et al.*, 2020); for example, logistic 4.0 (Edirisuriya *et al.*, 2019). Big data analytics can be integrated into LGM to improve environmental performance (Belhadi *et al.*, 2020). Other advanced technologies that support the integration of LP and GM supply chains are the internet of things, radio frequency identification and cloud computing (Carvalho *et al.*, 2019). LGM can be integrated with Additive Manufacturing (Torres *et al.*, 2020) or both Agile and Resilient Manufacturing to improve supply chain performances (Rachid and Ayyad, 2017).

4.3.2 Implementation barriers

These are factors that prevent the successful implementation of LGM, such as lack of top management commitment (Mittal *et al.*, 2016), fear of change, and lack of employee training (Siegel *et al.*, 2019). Harikannan *et al.* (2018) indicated a lack of research and development, poor organisational structure, and a lack of design and testing. Additional barriers include a lack of government assistance (Bharadwaj and Sundar, 2016), lack of finance (Hussain *et al.*, 2019), lack of expertise (Pampanelli *et al.*, 2016), and a lack of knowledge (Kaswan *et al.*, 2020). They also include an unstable political environment, lack of customer involvement (Hussain *et al.*, 2019), technology adoption resistance, and supplier reluctance to change (Kumar *et al.*, 2015). Others are lack of LGM thinking, lack of Kaizen environment, poor project implementation, time and resource mismanagement (Zhu and Zhang, 2020), lack of proper data collection and performance measures (Singh *et al.*, 2019), fear of failure, lack of visual and statistical control, and lack of communication (Cherrafi *et al.*, 2017b).

4.3.3 Critical success factors (CSFs):

These are factors that make the integration of LP and GM successful. Their identification and communication help organisations to prioritise important issues and avoid wasting resources (Mishra, 2018). Although CSFs look like the flip side of barriers, various authors have separated them from barriers, hence, they are reported separately in this study. They include management commitment, training and education, culture change, government support, motivation of employees and rewards, financial capabilities (Siegel *et al.*, 2019), project management skills, quality management practices, and successful use of statistical practices (Rahman and Ogunleye, 2019). Mishra (2018) highlighted the readiness of the organisation, resource selection, and project priority.

4.3.4 Implementation drivers

These are factors that push companies to integrate LP and GM. They include cost reduction and profitability, satisfaction of employees, shareholders' complaints, need for process improvement, corporate image improvement, regulations, consumer requirement, government policies (Cherrafi *et al.*, 2017a), public pressure, and competitor pressure (Gandhi *et al.*, 2018).

[Insert Figure 8 here]

5. Discussion of findings

Our findings agree with Dües *et al.* (2013) that LP and GM are complementary in areas such as supply chain management, application of waste reduction tools, and employee involvement, amongst others. This reinforces the imperativeness of the joint implementation of LP and GM post-2013 as already observed. Our study and Dües *et al.* (2013) also agree that there are dichotomies between LP and GM, for example, their focus, principal tools, and product end-of-life programmes. It can, therefore, be concluded that the patterns of synergy and divergence observed in the joint implementation of LP and GM pre-2013 persists, and the implications for their joint implementation are still relevant. This differs from the conclusion of Hallam and Contreras (2016) that the synergy between LP and GM is at best weak and that there is a low operating model. They believe most studies are rather opprtimistic when integrating LP and GM, but our review suggests that there are actually synergistic in most instances although there might be contrary areas requiring trade-offs.

This study also highlights other similarities and differences between LP and GM in addition to those mentioned by Dües *et al.* (2013). For instance, both approaches have long-term thinking, focus on continuous improvement, aim to add value, and improve sustainable performances (triple bottom line). Noted differences include how they define value, their contribution to sustainability, product and/or process focus and their approach toward competitiveness and profit. This provides the new implementers of LP and GM further areas that may require careful consideration when being jointly implemented to derive further benefits and minimise conflicts. In particular, Green *et al.* (2018) noted that even the individual benefits of LP and GM are amplified when they are jointly implemented correctly, and Cherrafi *et al.* (2018) observed that improved GM results are attained through reducing manufacturing waste and adopting LP tools. Thus, there could be opportunities to explore even more areas of synergies post-2013 compared to pre-2013.

In addition, not only do the post-2013 studies also confirm that the greatest divergence is between JIT delivery and increased greenhouse gas emissions, they also detailed ongoing strategies for resolving this divergence, like selecting suppliers who are geographically close together to share trucks during deliveries. Venkat and Wakeland (2006) advocated reducing emissions by sharing trucks between products and companies, and using heavy-duty trucks. Also, optimisation of the vehicle routing system can be beneficial as the shortest routes and routes with less traffic congestion can be utilised, and proximal customers can be clustered together to minimise cost and emissions (Kim *et al.*, 2009). Also, if suppliers and customers are in the same geographical area, emissions can be reduced due to the shorter distance travelled; however, as the travel distance increases, the divergence also increases due to increased delivery complexity from possible diseconomy of scale. In addition, Lindblom and Stenqvist (2007) pointed out that using either sea transportation or a combination of sea and road transportation can reduce CO_2 emissions. Hence, it can be seen that while JIT delivery divergence persists between LP and GM, mitigation strategies are also evolving.

6. Conclusion

The review of 141 studies shows that lean production and green manufacturing are both synergistic and divergent. LP and GM are synergistic as both aim to eliminate waste, satisfy customers, reduce lead time, and improve the supply chain by applying various waste reduction tools and the involvement of employees. However, LP and GM differ in how they define waste and the tools adopted. It was highlighted that LP aims to improve operational performance while GM is interested in environmental performance.

This study shows that patterns observed pre-2013 persist, and it extends the work by Dües *et al.* (2013) on several areas including sustainable performance. Additional themes of implementation barriers, drivers, CSFs, synergy and divergence, impact on performance, and integration with other approaches were identified. Thus, knowledge of themes does not only benefit manufacturing industries, but it is useful in other industries such as services. This research extends to extant knowledge in understanding complementary and conflicting areas between LP and GM, particularly post-2013.

6.1 Implications

While synergy and divergence between LP and GM were noted, divergence in CO_2 emissions is concerning; hence, organisations seeking to integrate LP and GM should devise ways to tackle it. This study will help organisations willing to adopt LGM on what to expect and encourage new adopters to consider their joint implementation, particularly as the positive impacts of their integration outweigh the trade-offs. Managers should understand that some performance criteria like delivery performance, inventory reduction and cycle time are improved by LP only whilst others, such as solid waste reduction, are only improved through GM. Therefore, while the joint implementation of LP and GM is encouraged, a holistic performance evaluation system should be properly designed to find the sweet spots due to the possible trade-offs.

6.2 Research limitations

The study is based on a literature review and summarises results obtained by researchers within the manufacturing industry. The socio-economic and political environments differ across countries; thus, it may be helpful to understand how different regulatory requirements may influence the integration of LP and GM across countries. The study focused on papers from developing and developed countries that have different economic environments; hence, impact levels may differ according to the type of country. However, this was necessary so that a comprehensive SLR is conducted, and important papers are not excluded.

Three databases, Web of Science, Scopus and Google Scholar, were utilised during the search process. We took care to remove all duplicate entries that could have resulted from the overlap of these databases. While there might be other databases that could be searched, we believe that it had minimum effects as most journals are indexed in these databases. Also, this review made use of the Boolean operators and the wild cards to improve the level of recall of relevant articles. However, we could have used complimentary strategies that would combine other search strategies with the Boolean approach to further improve the level of recall which could have led to some other findings and possible deductions.

6.3 Future research opportunities

In the future, this study may be extended to other industries such as services, agriculture and construction as articles from these industries were excluded. As seen from the matrix, some performance criteria are improved by LP only, some by GM only, and some by both; hence, it is useful to investigate the design of holistic measures of the joint impacts of LP and GM on organisational performance. Also, research can investigate conditions under which optimal results are achieved, and which combination of tools achieves the best results. Additionally, organisations can investigate if some tools are more applicable to them due to the size of the business and the nature of the order penetration point as described in Dekkers (2006). It is also important to investigate how LP and GM impact those criteria excluded from the matrix, such as return on sales, return on assets, and return on investments. Also, the effect of the excluded LP and GM tools, such as andon and green packaging needs further exploration. Such investigations can make readers understand the impacts of LP and GM even better.

References

Abdullah, M., Chew, B., Hamid, S., Management, F. and Teknikal, U. (2014) "Transformation from Lean Service to Green Service", in *International Symposium on Research in Innovation and Sustainability (iSORIS)*. Malacca, pp. 1–4.

Afum, E., Agyabeng-mensah, Y. and Sun, Z. (2020) "Exploring the link between green manufacturing , operational competitiveness , firm reputation and sustainable performance dimensions : a mediated approach", *Journal of Manufacturing Technology Management*, Vol. 31 No.7, pp. 1417–1438.

Agyabeng-mensah, Y., Afum, E. and Ahenkorah, E. (2020) "Exploring the mediating influences of total quality management and just in time between green supply chain practices and performance", *Journal of Manufacturing Technology Management*, Vol. 32 No.1, pp. 156–175.

Ahmad, S., Abdullah, A. and Talib, F. (2020) "Lean-green performance management in Indian SMEs: a novel perspective using the best-worst method approach", *Benchmarking: An International Journal*, Vol. 28 No.2, pp. 737–765.

Basha, A. M. M., Rajaiah, M., Vijayakumar, O., Haranath, Y. and Srinivasulu, T. (2020) "Green and Lean Industrial Engineering Practices in Selected Manufacturing Units in Andhra Pradesh : Statistical Analysis", *International Journal of Emerging Trends in Engineering Research*, Vol. 8 No.5, pp. 1768–1775.

Bashkite, V. and Karaulova, T., 2012. Integration of Green thinking into Lean fundamentals by Theory of Inventive Problems-Solving tools. *DAAAM International, Vienna, Austria, EU*, pp.345-350.

Baumer-cardoso, M. I., Campos, L. M. S., Santos, P. P. P. and Frazzon, M. E. (2020) "Simulation-based analysis of catalyzers and trade-offs in Lean & Green manufacturing", *Journal of Cleaner Production*, Vol. 242, p. 118411.

Belhadi, A., Kamble, S. S., Zkik, K., Cherrafi, A., Touriki, F. E. and El, S. (2020) "The integrated effect of big data analytics, lean six sigma and green manufacturing on the environmental performance of manufacturing companies: the case of North Africa", *Journal of Cleaner Production*, Vol. 252, pp. 1–14.

Belhadi, A., Touriki, F. E. and El Fezazi, S. (2018) "Benefits of adopting lean production on green performance of SMEs: a case study", *Production Planning and Control*, Vol. 29 No.11, pp. 873–894.

Bergmiller, G. G. and McCright, P. R. (2009) "Are lean and green programs synergistic?", in *Proceedings of the 2009 Industrial Engineering Research Conference*, Citeseer, pp. 1155–1160.

Bevilacqua, M., Ciarapica, F. E. and De Sanctis, I. (2017) "Lean practices implementation and their relationships with operational responsiveness and company performance: an Italian study", *International Journal of Production Research*, Vol. 55 No.3, pp. 769–794.

Bharadwaj, S. and Sundar, S. (2016) "Analysis of significant issues in green lean system in small and medium scale enterprises", *International Journal of Research in Mechanical, Mechatronics and Automobile Engineering*, Vol. 1 No.4, pp. 154–158.

Bhattacharya, A., Nand, A. and Castka, P. (2019) "Lean-green integration and its impact on sustainability performance: a critical review", *Journal of Cleaner Production*, Vol. 236, p. 117697.

Campos, L. M. S. and Vazquez-Brust, D. A. (2016) "Lean and green synergies in supply chain management", *Supply Chain Management: An International Journal*, Vol. 21 No.5, pp. 627–641.

Carvalho, H., Pimentel, C., Azevedo, S. and Gento, A. M. (2019) "Advanced technologies supporting the implementation of lean/green supply chain management practices and its influence on the performance", in *Proceedings of the 6th European Lean Educator Conference: ELEC 2019 6*, Springer International Publishing, pp. 149–157.

Carvalho, H., Azevedo, S. G. and Cruz-Machado, V. (2010) "Supply chain performance management : lean and green paradigms", *international Journal of Business Performance and Supply Chain Modelling*, Vol. 2 No.3/4, pp. 304–333.

Cherrafi, A., Elfezazi, S., Govindan, K., Garza-reyes, J. A., Benhida, K. and Mokhlis, A. (2017a) "A framework for the integration of green and lean six sigma for superior sustainability performance", *International Journal of Production Research*, Vol. 55 No.15, pp. 4481–4515.

Cherrafi, A., Elfezazi, S., Garza-Reyes, J. A., Benhida, K. and Mokhlis, A. (2017b) "Barriers in green lean implementation: A combined systematic literature review and interpretive structural modelling approach", *Production Planning and Control*, Vol. 28 No.10, pp. 829–842.

Cherrafi, A., Garza-reyes, J. A., Kumar, V., Mishra, N. and Ghobadian, A. (2018) "Lean , green practices and process innovation: a model for green supply chain performance", *International Journal of Production Economics*, Vol. 206, pp. 79–92.

Cherrafi, A., Elfezazi, S., Hurley, B., Garza-Reyes, J. A., Kumar, V., Anosike, A. and Batista, L. (2019) "Green and lean: a gemba–kaizen model for sustainability enhancement", *Production Planning and Control*, Vol. 30 No.5/6, pp. 385–399.

Cherrafi, A., Garza-reyes, J. A., Belhadi, A., Kamble, S. S. and Elbaz, J. (2021) "A readiness self-assessment model for implementing green lean initiatives", *Journal of Cleaner Production*, Vol. 309, pp. 1–10.

Chiarini, A. (2014) "Sustainable manufacturing-greening processes using specific lean production tools: an empirical observation from European motorcycle component manufacturers", *Journal of Cleaner Production*, Vol. 85, pp. 226–233.

da Silva, A. F., Marins, F. A. S., Dias, E. X. and Ushizima, C. A. (2021) "Improving manufacturing cycle efficiency through new multiple criteria data envelopment analysis models: an application in green and lean manufacturing processes", *Production Planning and Control*, Vol. 32 No.2, pp. 104–120.

Dawood, L. M., Division, I. E. and Abdullah, Z. H. (2018) "Managing waste throughout lean-green perspective", *Journal of University of Babylon, Engineering Sciences*, Vol. 26 No.1, pp. 192–204.

Dekkers, R. (2006). Engineering management and the order entry point, *International Journal of Production Research*, Vol. *44* No.18/19, pp.4011-4025.

Dekkers, R., Carey, L., & Langhorne, P. (2022). *Making Literature Reviews Work: A Multidisciplinary Guide to Systematic Approaches*. Cham: Springer.

Dhingra, R., Kress, R. and Upreti, G. (2014) "Does lean mean green?", *Journal of Cleaner Production*, Vol. 85, pp. 1–7.

Dieste, M. and Panizzolo, R. (2019) "The effect of lean practices on environmental performance : an empirical study", in *Lean Engineering for Global Development*. Springer International Publishing, pp. 225–258.

Duarte, S., Cabrita, R. and Machado, V. (2011) "Exploring lean and green supply chain performance using balanced scorecard perspective", in *Proceedings of the 2011 International Conference on Industrial Engineering and Operations Management*. IEOM Research Solutions Pty Ltd, pp. 520–525.

Duarte, S. and Cruz-Machado, V. (2018) "Exploring linkages between lean and green supply and the industry 4.0", in *Proceedings of the Eleventh International Conference on Management Science and Engineering Management*. Springer, Cham, pp. 1242-1252.

Dües, C. M., Tan, K. H. and 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*, Vol. 40, pp. 93–100.

Edirisuriya, A., Weerabahu, S. and Wickramarachchi, R. (2019) "Applicability of lean and green concepts in logistics 4.0: a systematic review of literature", in *2018 International Conference on Production and Operations Management Society,* IEEE, pp. 1–8.

Farias, L. M. S., Santos, L. C., Gohr, C. F., de Oliveira, L. C. and da Silva Amorim, M. H. (2019) "Criteria and practices for lean and green performance assessment:systematic review and conceptual framework", *Journal of Cleaner Production journal*, Vol. 218, pp. 746–762.

Fercoq, A., Lamouri, S. and Carbone, V. (2016) "Lean/Green integration focused on waste reduction techniques", *Journal of Cleaner Production*, Vol. 137, pp. 567–578.

Florescu, A. and Barabaş, B. (2018) "Integrating the lean concept in sustainable manufacturing development", in *IOP Conference Series: Materials Science and Engineering*. IOP Publishing, pp. 1–8.

Florida, R. (1996) "Lean and green: The move to environmentally conscious manufacturing", *California Management Review*, No.1, pp. 80–105.

Gandhi, N. S., Thanki, S. J. and Thakkar, J. J. (2018) "Ranking of drivers for integrated lean-green manufacturing for Indian manufacturing SMEs", *Journal of Cleaner Production*, Vol. 171, pp. 675–689.

Garza-Reyes, J. A. (2015) "Lean and green-a systematic review of the state of the art literature", *Journal of Cleaner Production*, Vol. 102, pp. 18–29.

Garza-reyes, J. A., Jacques, G. W. and Lim, M. K. (2014) "Lean and green – synergies, differences, limitations, and the need for six sigma", in *IFIP International Federation for Information Processing*. Berlin, Heidelberg: Springer, pp. 71–81.

Green, K. W., Inman, R. A., Sower, V. E. and Zelbst, P. J. (2018) "Impact of JIT, TQM and green supply chain practices on environmental sustainability", *Journal of Manufacturing Technology Management*, Vol. 30 No.1, pp. 26–47.

Hall, R. W. (2009) *Compression: Meeting the challenges of sustainability through vigorous learning enterprises*, *CRC press*.

Hallam, C. and Contreras, C. (2016) "Integrating lean and green management", *Management Decision*, Vol. 54 No.9, pp. 2157–2187.

Harikannan, N., Palpandi, M. and Rajasuthan, K. (2018) "Enablers and barriers for integrated lean-green-agile manufacturing systems", *International Journal of Mechanical Engineering and Technology*, Vol. 9 No.11, pp. 320–324.

Harisekar, V. (2021) "*Increasing sustainability performance in a SME: focusing on lean and* *green",* working paper, Jönköping University, Jönköping, 1 June.

Hartini, S., Wicaksono, P. A., Rizal, A. M. . and Hamdi, M. (2021) "Integration lean manufacturing and 6R to reduce wood waste in furniture company toward circular economy", in *IOP Conference Series: Materials Science and Engineering*. IOP Publishing, p. 012067.

Huo, B., Gu, M. and Wang, Z. (2019) "Green or lean? A supply chain approach to sustainable performance", *Journal of Cleaner Production*, Vol. 216, pp. 152–166.

Ikatrinasari, Z. F., Hasibuan, S. and Kosasih, K. (2018) "The implementation lean and green manufacturing through sustainable value stream mapping", in *IOP Conference Series: Materials Science and Engineering*. IOP Publishing, p. 012004.

Inman, R. A. and Green, K. W. (2018) "Lean and green combine to impact environmental and operational performance", *International Journal of Production Research*, Vol. 56 No.14, pp. 4802–4818.

Irvine, L., Dekkers, R., Carey, L. and Langhorne, P. (2022). Search Strategies for [Systematic] Literature Reviews. In R. Dekkers, L. Carey, and P. Langhorne (Eds.), *Making Literature Reviews Work: A Multidisciplinary Guide to Systematic Approaches* Cham: Springer, pp. 145–200.

Jabbour, C. J. C., De Sousa Jabbour, A. B. L., Govindan, K., Teixeira, A. A. and De Souza Freitas, W. R. (2013) "Environmental management and operational performance in automotive companies in Brazil: the role of human resource management and lean manufacturing", *Journal of Cleaner Production*, Vol. 47, pp. 129–140.

Johansson, G. and Winroth, M. (2009) "Lean vs green manufacturing : similarities and differences", in *Proceedings of the 16th International Annual EurOMA Conference, Implementation Realizing Operations Management Knowledge*. Göteborg, Sweden, pp. 1–10.

Kaswan, M. S., Rathi, R., Garza-Reyes, J. A. and Antony, J. (2020) "Exploration and investigation of green lean six sigma adoption barriers for manufacturing sustainability exploration and investigation of green lean six sigma adoption", *IEEE Transactions on Engineering Management,* pp. 1–15.

Kelendar, H., Faisal, M., McIntosh, B., Mohammed and A, M. (2020) "The use of lean methodology in healthcare settings in developing countries: a narrative review", *British Journal of Healthcare Management*, Vol. 26 No.6, pp. 1–13.

Kim, N. S., Janic, M. and Wee, B. Van (2009) "Trade-off between carbon dioxide emissions and logistics costs based on multiobjective optimization", *Transportation Research Record*, Vol. 2139 No.1, pp. 107–116.

Kumar, S., Kumar, N. and Haleem, A. (2015) "Conceptualisation of sustainable green lean six sigma: an empirical analysis", *International Journal of Business Excellence*, Vol. 8 No.2, pp. 210–250.

Kurdve, M. and Bellgran, M. (2021) "Green lean operationalisation of the circular economy concept on production shop floor level", *Journal of Cleaner Production*, Vol. 278, p. 123223.

Lartey, T., Yirenkyi, D. O., Adomako, S., Danso, A., Amankwah-Amoah, J. and Alam, A. (2020) "Going green, going clean: lean-green sustainability strategy and firm growth", *Business Strategy and the Environment*, Vol. 29 No.1, pp. 118–139.

Leme, R. D., Nunes, A. O., Message Costa, L. B. and Silva, D. A. L. (2018) "Creating value with less impact: lean, green and eco-efficiency in a metalworking industry towards a cleaner production", *Journal of Cleaner Production*, Vol. 196, pp. 517–534.

Leong, W. D., Teng, S. Y., How, B. S., Ngan, S. L., Lam, H. L., Tan, C. P. and Ponnambalam, S. G. (2019) "Adaptive analytical approach to lean and green operations", *Journal of Cleaner Production*, Vol. 235, pp. 190–209.

Leong, W. D., Teng, S. Y., How, B. S., Ngan, S. L., Rahman, A. A., Tan, C. P., Ponnambalam, S. G. and Lam, H. L. (2020) "Enhancing the adaptability: lean and green strategy towards the industry revolution 4.0", *Journal of Cleaner Production*, Vol. 273, p. 122870.

Lerher, T., Pejić, V., Jereb, B., Kramberger, T. and Rosi, B. (2016) "Lean and green logistics: a theorethical framework approach", in *13th International Conference on Industrial Logistics, ICIL 2016 - Conference Proceedings*, pp. 136–143.

Lindblom, H. and Stenqvist, C. (2007) *SKF freight transports and CO2 emissions a study in environmental management*. Chalmers University of Technology.

Logesh, B., Nagaraj, P., Sankaran, P. S. and Raj, N. A. (2017) "A review on implementation of lean manufacturing techniques in manufacturing industry to deploy green manufacturing through reduction of hazardous waste", *International Research Journal of Engineering and Technology*, Vol. 4 No.11, pp. 2395–56.

Logesh, M. and Balaji, B. (2020) "Experimental investigations to deploy green manufacturing through reduction of waste using lean tools in electrical components manufacturing company", *International Journal of Precision Engineering and Manufacturing-Green Technology*, Vol. 8 No.2, pp. 365–374.

Luis, L., Negrão, L., Beatriz, A., Sousa, L. De, Filho, M. G., José, C., Jabbour, C. and Miller, G. (2020) "The management of operations lean manufacturing and business performance: testing the S-curve theory", *Production Planning & Control*, Vol. 31 No.10, pp. 771–785.

Marco-ferreira, A., Stefanelli, N. O., Seles, B. M. R. P. and Fidelis, R. (2020) "Lean and green: practices , paradigms and future prospects", *Benchmarking: An International Journal*, Vol. 27 No.7, pp. 2077–2107.

Maware, C. and Adetunji, O. (2019) "Lean manufacturing implementation in Zimbabwean industries: Impact on operational performance", *International Journal of Engineering Business Management*, Vol. 11, pp. 1–12.

Mishra, M. N. (2018) "Identify critical success factors to implement integrated green and lean six sigma", *International Journal of Lean Six Sigma*, Vol. 13 No.4, pp. 765–777.

Mittal, V. K., Sindhwani, R. and Kapur, P. K. (2016) "Two-way assessment of barriers to lean–green manufacturing system: insights from India", *International Journal of Systems Assurance Engineering and Management*, Vol. 7 No.4, pp. 400–407.

Mohanty, R. P. and Deshmukh, S. G. (1999) "Managing green productivity: a case study", *Work Study*, Vol. 48 No.5, pp. 165–169.

Mollenkopf, D., Stolze, H., Tate, W. L. and Ueltschy, M. (2010) "Green, lean, and global supply chains", *International Journal of Physical Distribution and Logistics Management*, Vol. 40 No.1/2, pp. 14–41.

Ohno, T. (1988) *Toyota production systems: beyond large scale production*, *Productivity Press*. Cambridge.

Page, M. J., Mckenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-wilson, E., Mcdonald, S., Mcguinness, L.A., Stewart, L.A., Thomas, J., Tricco, A.C., Welch, V.A., Whiting, P., Moher, D. (2021) "The PRISMA 2020 statement : an updated guideline for reporting systematic reviews", Vol. 88 p. 105906.

Pampanelli, A. B., Found, P. and Bernardes, A. M. (2011) "A lean and green kaizen model", in *POMS annual conference, Reno, Nevada, USA*, pp. 1–23.

Pampanelli, A. B., Found, P. and Bernardes, A. M. (2014) "A lean and green model for a production cell", *Journal of Cleaner Production*, Vol. 85, pp. 19–30.

Pampanelli, A. B., Found, P. and Bernardes, A. M. (2015) "Sustainable manufacturing : the lean and green business model", *Sustainable operations management*, Vol. 44, pp. 131–161.

Pampanelli, A., Trivedi, N. and Found, P. (2016) *The green factory creating lean and sustainable manufacturing*. CRC Press.

Parveen, C. M., Kumar, A. R. P. and Narasimha Rao, T. V. V. L. (2011) "Integration of lean and green supply chain - Impact on manufacturing firms in improving environmental efficiencies", in *Proceedings of the International Conference on Green Technology and Environmental Conservation, GTEC-2011*. IEEE, pp. 143–147.

Prasetyawan, Y. (2016) "Defining technology strategy for small to medium enterprise within lean and green manufacturing framework", in *Proceeding of 9th International Seminar on Industrial Engineering and Management*, pp. 1–7.

Queiroz, G., Cobra, R. L. R. ., Guardia, M Oliveira, J. A., Ometto, A. R. and Esposto, K. F. (2015) "The use of lean manufacturing practices in cleaner production: a systematic review", in *5th International Workshop Advances in Cleaner Production*, pp. 1–11.

Rachid, B. and Ayyad, C. (2017) "Supply chain improvement in LARG (lean, agile, resilient, green) context: a risk management approach", in *6th IEEE International Conference on Advanced Logistics and Transport,* IEEE, pp. 212–220.

Rad, A. P. and Azizi, A. (2021) "History will repeat: industry 4.0 brought lean, agile, resilience and green", *Research Journal of Nanoscience and Engineering*, Vol. 5 No.1, pp. 9–14.

Rahman, M. and Ogunleye, J. (2019) "A lean, green and six sigma (LG6σ) for SMEs in the leather industry in Bangladesh", *International Journal of Entrepreneurship and Innovation*, Vol. 7 No.2, pp. 42–66.

Rodrigues, H. S., Alves, W. and Silva, Â. (2020) "The impact of lean and green practices on logistics performance: a structural equation modelling", *Production*, Vol. 30, pp. 1–14.

Rothenberg, S., Pil, F. K. and Maxwell, J. (2001) "Lean, green, and the quest for superior environmental performance", *Production and Operations Management*, Vol. 10 No.3, pp. 228–243.

Ruiz-Benitez, R., López, C. and Real, J. C. (2017) "Environmental benefits of lean, green and resilient supply chain management: the case of the aerospace sector", *Journal of Cleaner Production*, Vol. 167, pp. 850–862.

Sabadka, D. (2014) "Innovation lean principles in automotive green manufacturing", *Acta logistica*, Vol. 1 No.4, pp. 23–27.

Sajan, M. P., Shalij, P. R., Ramesh, A. and Biju, A. P. (2017) "Lean manufacturing practices in Indian manufacturing SMEs and their effect on sustainability performance", *Journal of Manufacturing Technology Management*, Vol. 28 No.6, pp. 772–793.

Salvador, R., Vetroni, M., Elias, G., Godoi, K., Mierlo, V., Moro, C., Carlos, A. and Francisco, D. (2021) "Towards a green and fast production system: integrating life cycle assessment and value stream mapping for decision making", *Environmental Impact Assessment Review*, Vol. 87, p. 106519.

Sharma, V., Raut, R. D., Mangla, S. K., Narkhede, B. E., Luthra, S. and Gokhale, R. (2021) "A systematic literature review to integrate lean, agile, resilient, green and sustainable paradigms in the supply chain management", *Business Process Management Journal*, Vol. 30 No.2, pp. 1191–1212.

Siegel, R., Antony, J., Garza-Reyes, J. A., Cherrafi, A. and Lameijer, B. (2019) "Integrated green lean approach and sustainability for SMEs: from literature review to a conceptual framework", *Journal of Cleaner Production*, Vol. 240, p. 118205.

Silva, S., Sá, J.C., Silva, F.J., Ferreira, L.P. and Santos, G., 2019, November. Lean green-the importance of integrating environment into lean philosophy-a case study, In *European Lean Educator Conference*. Springer, Cham, pp. 211-219.

Singh, P. L., Sindhwani, R., Dua, N. K., Jamwal, A., Aggarwal, A., Iqbal, A. and Gautam, N. (2019) "Evaluation of common barriers to the combined lean-green-agile manufacturing system by two-way assessment method", in *Advances in Industrial and Production Engineering*. Springer Singapore, pp. 653–683.

Suhardini, P. N. and Hadiwidjojo, S. D. (2021) "Lean and green supply chain management in improving operational performance in sugar industry", *Journal of Applied Management*, Vol. 19 No.1, pp. 198–205.

Szymanska-Bralkowska, M. and Malinowska, E. (2017) "The improvement of the company's environmental performance through the application of green lean/ lean and green approach", *Ekonomia i Prawo. Economics and Law*, Vol. 17 No.4, pp. 433–442.

Taubitz, M. (2010) "Lean, green and safe: integrating safety into the lean, green and sustainability movement", *Professional Safety*, Vol. 55 No.5, pp. 39–46.

Thanki, S., Govindan, K. and Thakkar, J. (2016) "An investigation on lean-green implementation practices in Indian SMEs using analytical hierarchy process (AHP) approach", *Journal of Cleaner Production*, Vol. 135, pp. 284–298.

Tiwari, R. K. and Tiwari, J. K. (2016) "Green lean manufacturing: way to sustainable productivity improvement", *International Journal of Engineering Research and General Science*, Vol. 4 No.6, pp. 243–262.

Torielli, R. M., Abrahams, R. A., Smillie, R. W. and Voigt, R. C. (2010) "Using lean methodologies for economically and environmentally sustainable foundries", *China Foundry*, Vol. 8 No.1, pp. 74–88.

Udokporo, C. K., Anosike, A., Lim, M., Nadeem, S. P., Garza-Reyes, J. A. and Ogbuka, C. P. (2020) "Impact of lean, agile and green (LAG) on business competitiveness: an empirical study of fast moving consumer goods businesses", *Resources, Conservation & Recycling*, Vol. 156, p. 104714.

Venkat, K. and Wakeland, W. (2006) "Is lean necessarily green?", in *50th Annual Meeting of* *the International Society for the Systems Sciences 2006, ISSS 2006*. Sonoma, CA, USA, pp. 347–362.

Verrier, B., Rose, B. and Caillaud, E. (2016) "Lean and green strategy: the lean and green house and maturity deployment model", *Journal of Cleaner Production*, Vol. 116, pp. 150–156.

Vinayagasundaram, R., Ramkumar, V., Arasu, K. K. A. and Anax, S. (2020) "Implementation of business process re-engineering using lean and green strategy in manufacturing industry", in *AIP Conference Proceedings*. AIP Publishing, p. 020010.

Vrchota, J., Pech, M., Rolínek, L. and Bednar, J. (2020) "Sustainability outcomes of green processes in relation to industry 4.0 in manufacturing : systematic review", *Sustainability*, Vol. 12 No.15, p. 5968.

Whyle, A. and Bland, R. (2017) "Application of green and lean production at Ricoh", *International Journal of Automation Technology*, Vol. 11 No.4, pp. 615–622.

Wiese, A., Luke, R., Heyns, G. J. and Pisa, N. M. (2015) "The integration of lean, green and best practice business principles", *Journal of Transport and Supply Chain Management*, Vol. 9 No.1, pp. 1–10.

Winroth, M. and Johansson, G. (2009) "A manufacturing strategy perspective on lean and green manufacturing", in *Proceedings of the Swedish Production Symposium*. Goteborg, Sweden, pp. 2–3.

Zekhnini, K., Cherrafi, A., Bouhaddou, I., Chaouni Benabdellah, A. and Bag, S. (2021) "A model integrating lean and green practices for viable, sustainable, and digital supply chain performance", *International Journal of Production Research*, Vol. 60 No.21 pp. 6529–6555.

Zhu, X. Y. and Zhang, H. (2020) "Construction of lean-green coordinated development model from the perspective of personnel integration in manufacturing companies", *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, Vol. 234 No.11, pp. 1460–1470.

Zhu, X. Y., Zhang, H. and Jiang, Z. G. (2020) "Application of green-modified value stream mapping to integrate and implement lean and green practices: a case study", *International Journal of Computer Integrated Manufacturing*, Vol. 33 No.7, pp. 716–731.

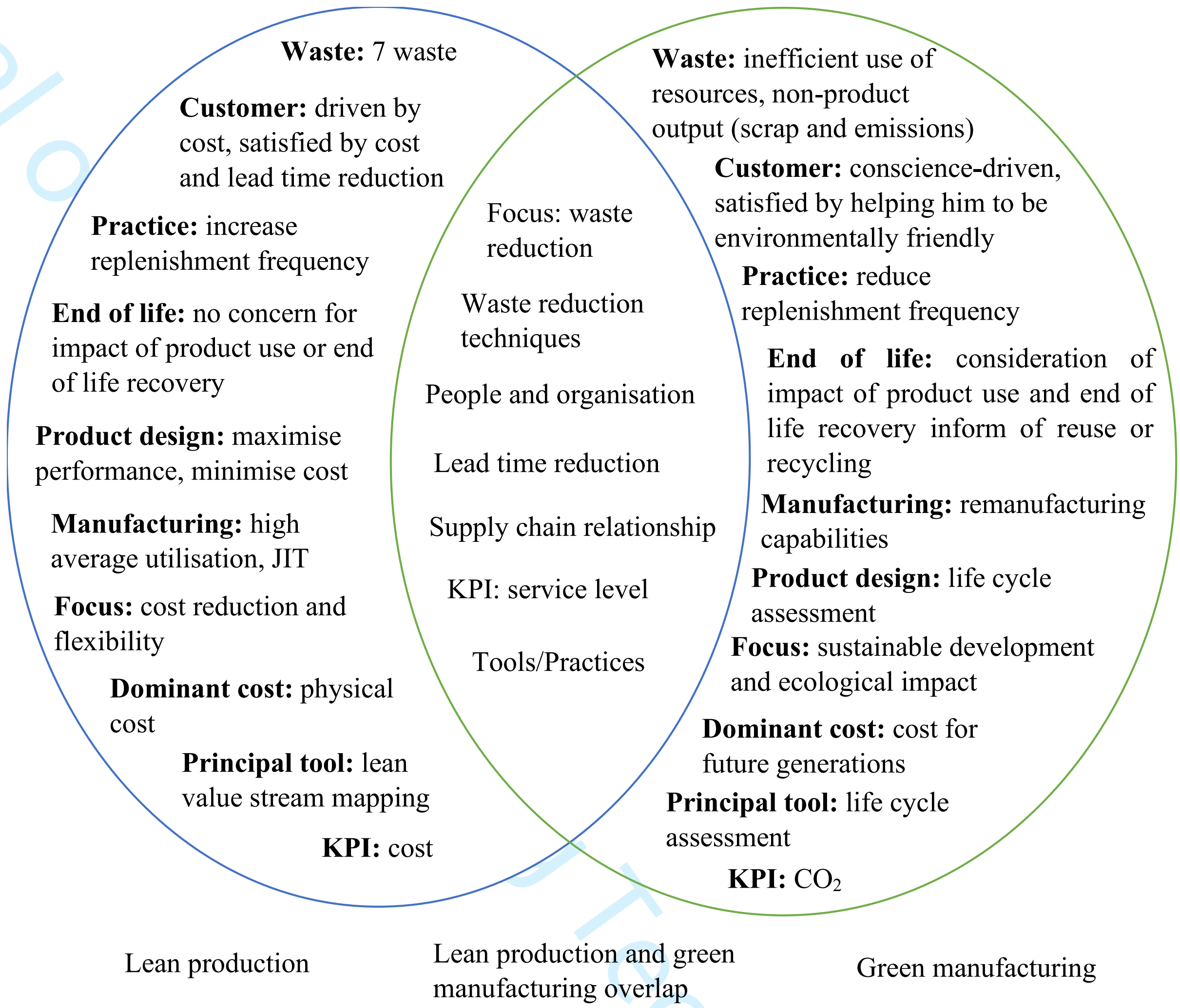

Figure 1: Overlap of LP and GM (source: Dües *et al*., 2013)

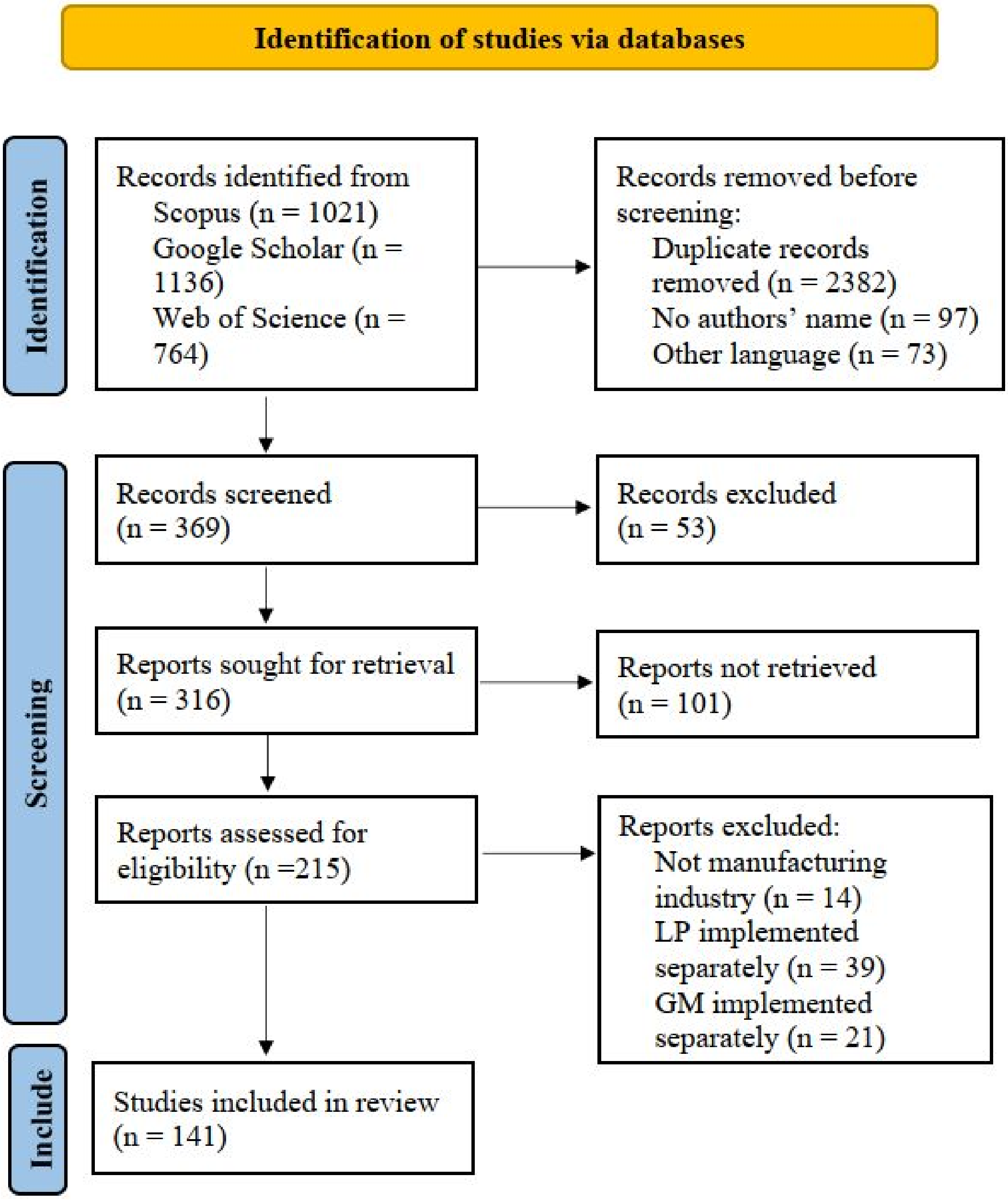

Figure 1: PRISMA reporting

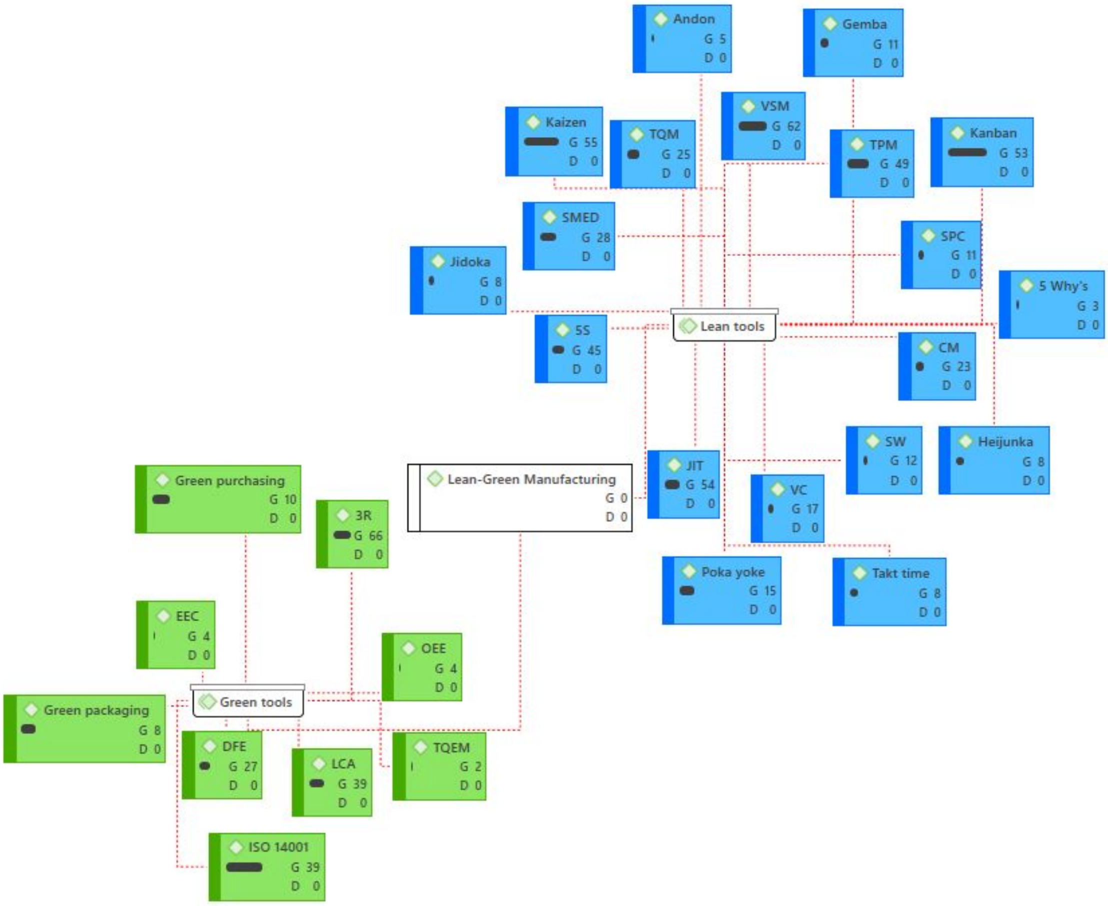

Figure 1: Lean production and green manufacturing tools

Legend: G is the groundedness, which shows how many quotations are linked to a code.
D is the density, which shows the number of linkages formed with other codes.
DFE - Design For Environment, 3R – Reduce, Recycle and Reuse, TQEM – Total Quality Environmental Management, OEE – Overall Equipment Effectiveness, LCA – Life Cycle Assessment, EEC – Environmental Emission Control, VC – Visual Control, JIT – Just in Time, SMED – Single Minute Exchange of Dies, SPC – Statistical Process Control, SW – Standardised Work, CM – Cellular Manufacturing, TPM – Total Preventive Maintenance, VSM – Value Stream Mapping, TQM – Total Quality Management, 5S – Housekeeping

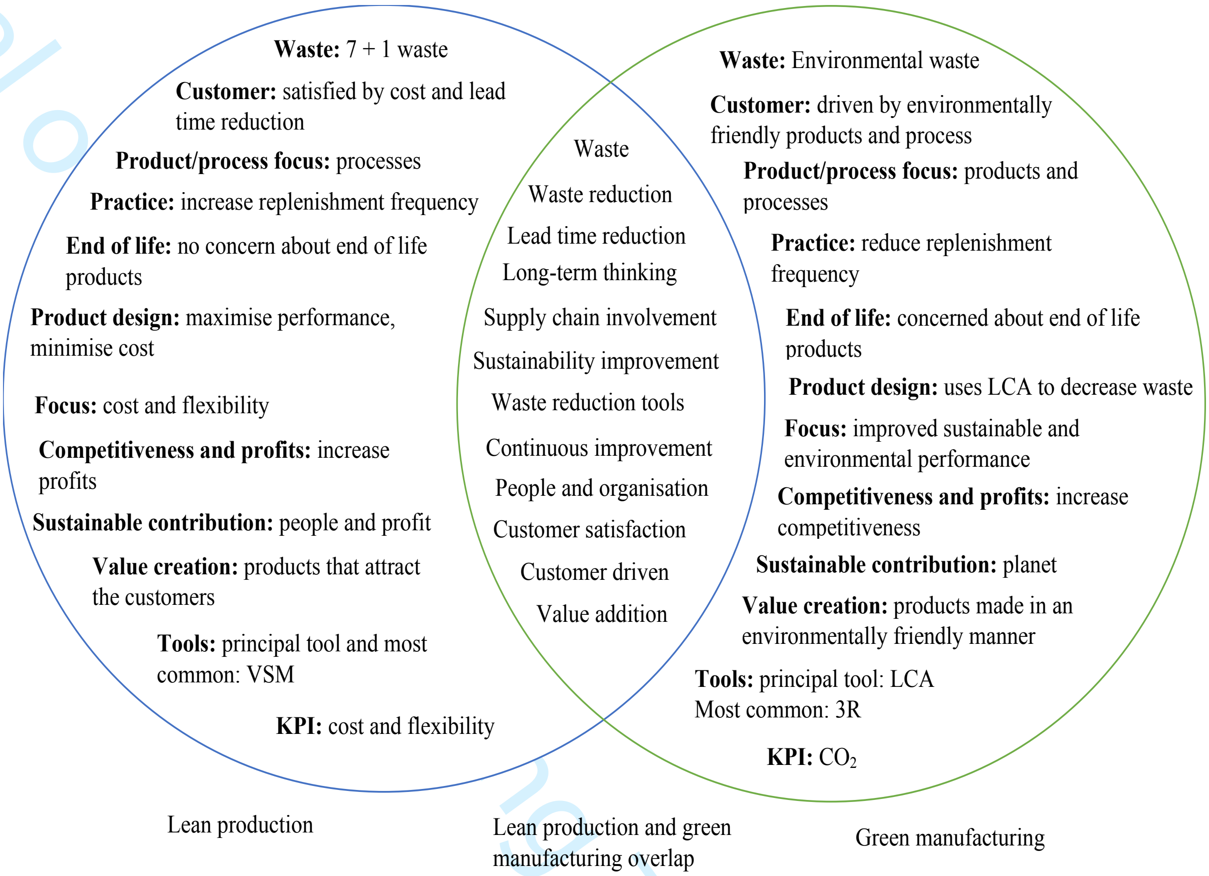

Figure 1: Extended overlap between LP and GM post-2013

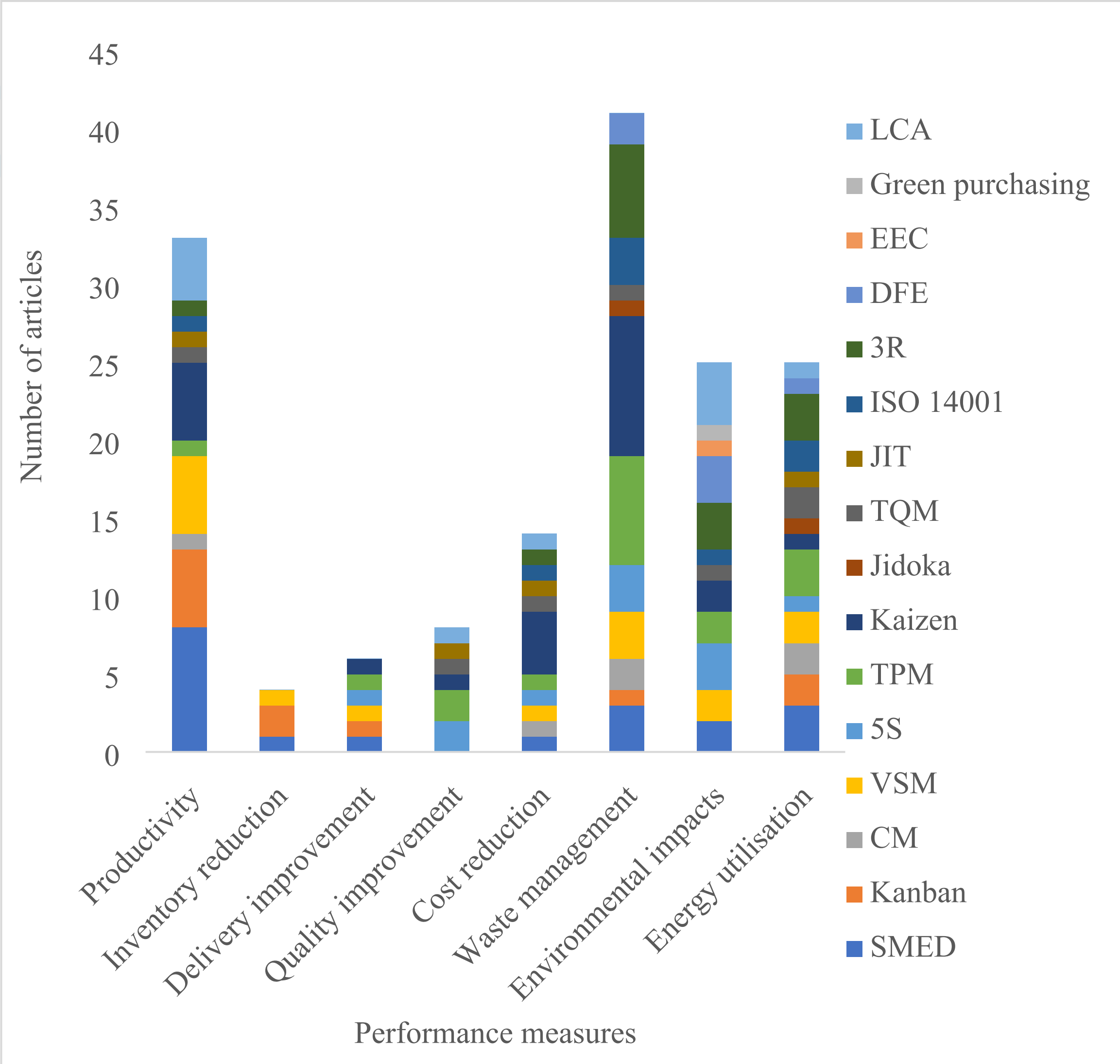

Figure 1: Relationships between performance criteria and LGM tools

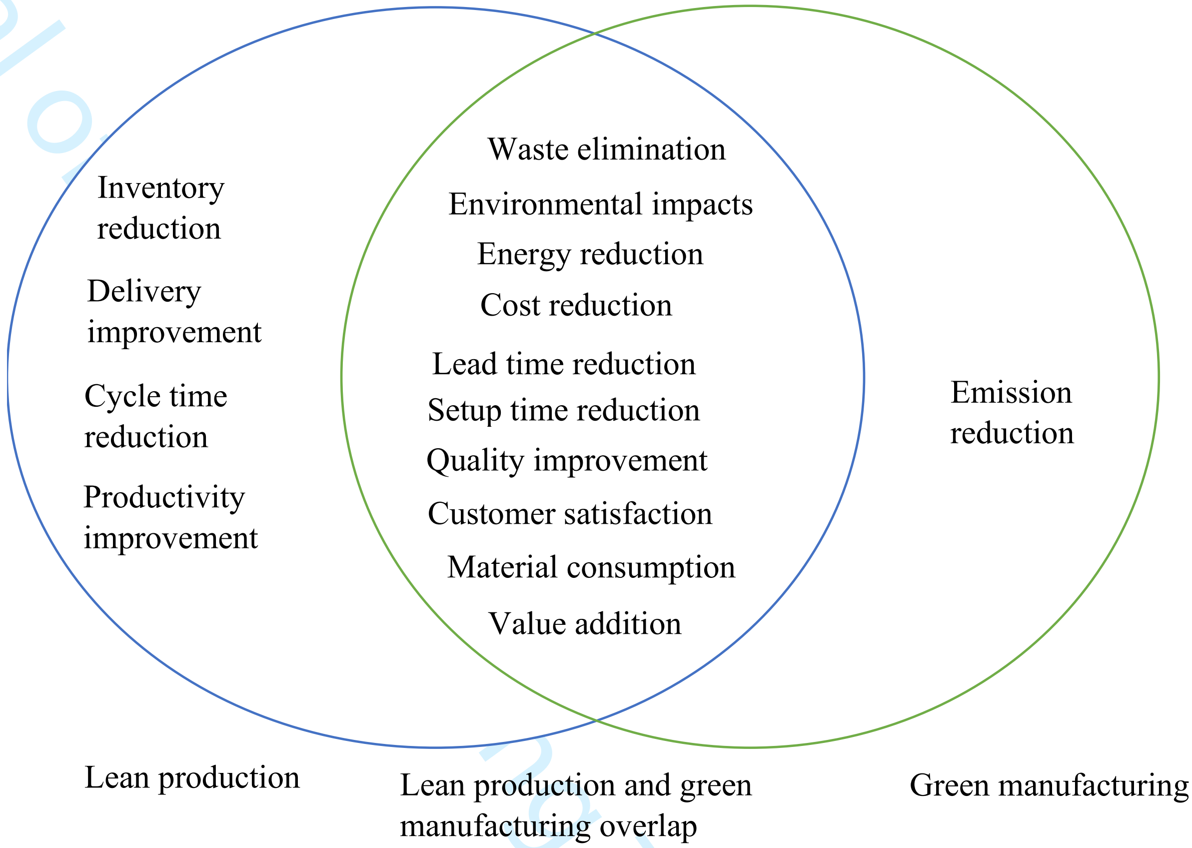

Figure 1: Overlap between LP and GM for operational and environmental performance

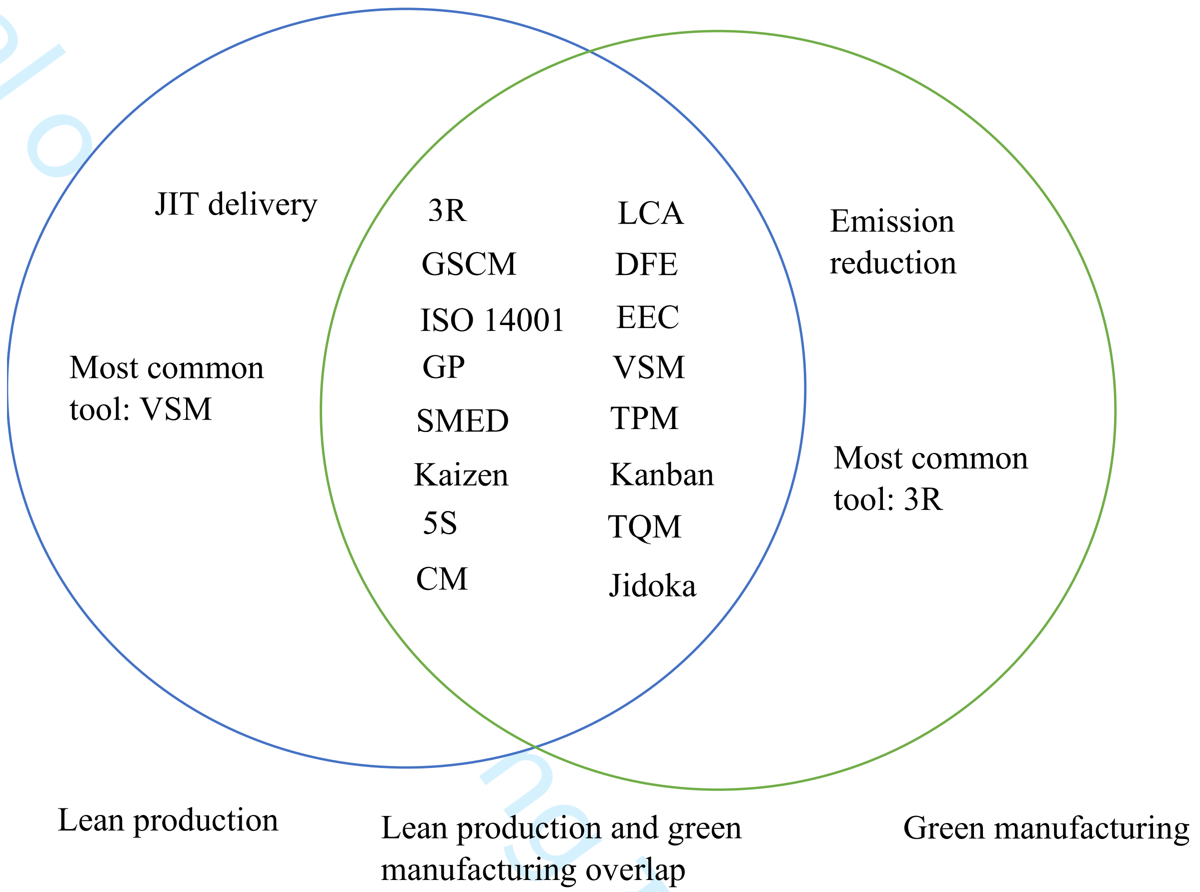

Figure 1: Overlap between lean production and green manufacturing tools

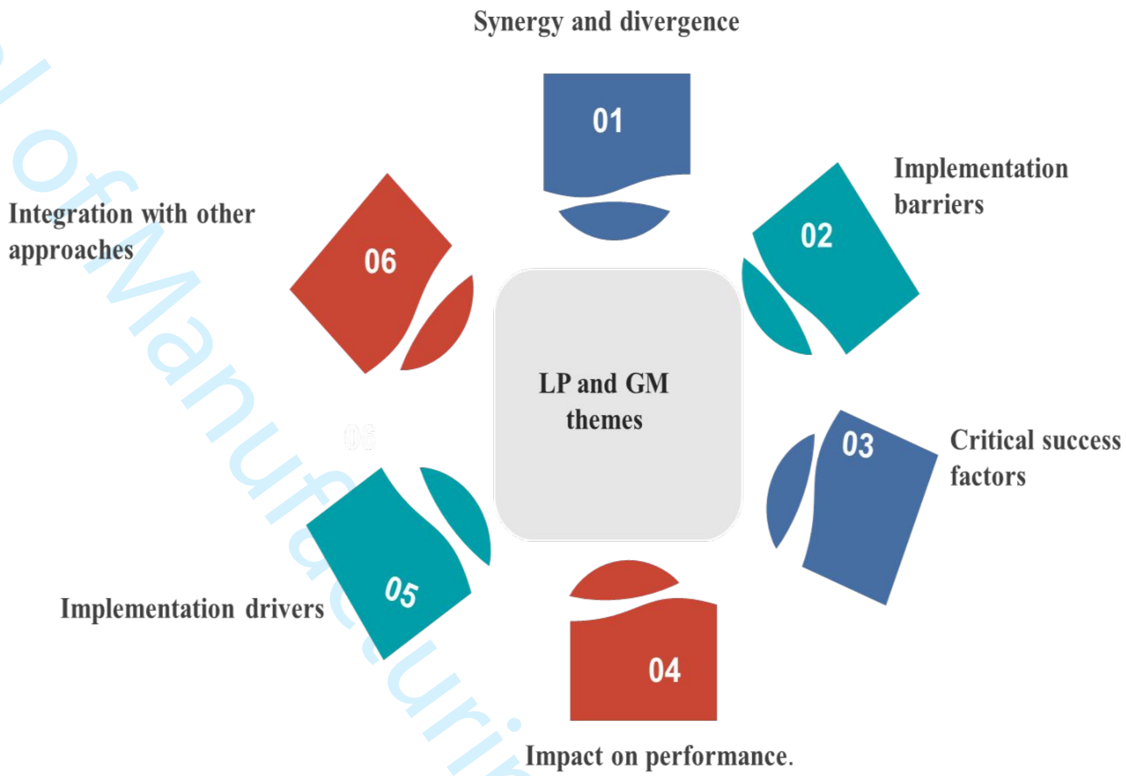

Figure 1: Other LGM themes

Table 1: The PIO logic grid

	Population	Intervention	Outcome
Synonyms	Organisations Companies Firms	Green manufacturing Environmental manufacturing Eco/ecological manufacturing Clean manufacturing Low carbon manufacturing	Organisational performance Operational performance Sustainability Environmental performance Ecological performance

Table 1: Search strategy

	PIO tool	Search terms
1.	P	"organi?ation*" OR "compan*" OR "firm*"
2.	I	("manufacturing" OR "process*" OR "operation*" OR "production*" OR "technolog*" AND ("Green" OR "Clean*" OR "Environmental" OR "low carbon" OR "Eco" OR "Ecological") AND ("Lean")
3.	O	("performance*") AND ("organi?ation*" OR "operation*" OR "environment*" OR "ecological" OR "sustainab*"
	Query	1 AND 2 AND 3

Table 1: PIO inclusion and exclusion criteria

PIO	Included	Excluded
Population	Papers focusing on LGM in the manufacturing industry	Papers focusing on LGM in other sectors that are not manufacturing
Intervention	Implementation of LGM	Implementation of LP and GM separately
Outcome	Impact of LGM on organisational performance	-

Table 1: Further comparison of LP and GM: distinctive attributes

LP and GM attributes	LP	GM
1. Waste perception	7 + 1 manufacturing waste (Tiwari and Tiwari, 2016; Verrier *et al.*, 2016; Logesh *et al.*, 2017; da Silva *et al.*, 2021)	Environmental waste (Abdullah *et al.*, 2014; Pampanelli *et al.*, 2014; Inman and Green, 2018)
2. Customer attention	Customers are satisfied with cost and lead time (Pampanelli *et al.*, 2014)	Customers are satisfied with the environmental management (Sharma *et al.*, 2021)
3. End-of-life approach	No concern about end-of-life of products (Harisekar, 2021)	Concerned about products end-of-life (Harisekar, 2021)
4. Product design focus	Maximise performance, minimise cost (Dhingra *et al.*, 2014)	Uses LCA to minimise waste and environmental impacts (Duarte and Cruz-Machado, 2018)
5. Focus of the concept	Diminishing cost (Kaswan *et al.*, 2020)	Improving environmental performance (Rad and Azizi, 2021)
6. Practice strategy	Increase the replenishment frequencies by decreasing lot sizes (Campos and Vazquez-Brust, 2016)	Decrease the replenishment frequencies (Campos and Vazquez-Brust, 2016)
7. Supply chain management	Customers are involved, and there is a close relationship with suppliers (Sabadka, 2014)	Suppliers are involved in improving environmental performance (Sabadka, 2014)
8. Lead time approach	Seeks to reduce lead time (Basha *et al.*, 2020)	Seeks to improve lead time (Garza-Reyes, 2015)
9. Waste reduction tools	Applies various tools (Sabadka, 2014). The principal tool is VSM (Florescu and Barabaş, 2018)	Applies various tools (Sabadka, 2014). LCA is the principal tool (Florescu and Barabaş, 2018)
10. Employee involvement	Employees are involved in continuous improvement (Duarte and Cruz-Machado, 2018)	Employees are involved in implementing GM for enhanced environmental performance (Duarte and Cruz-Machado, 2018)
11. Leadership and strategic planning (organisation)	Management should be involved and show commitment and provide resources, set clear strategies required for successful implementation (Szymanska-Bralkowska and Malinowska, 2017)	The successful implementation of GM requires the support, involvement and commitment of the top management in setting clear strategies (Szymanska-Bralkowska and Malinowska, 2017)
12. Gas emissions	Increases the emissions due to increased transportation necessitated by JIT (Campos and Vazquez-Brust, 2016)	Aims to reduce all forms of emissions (Campos and Vazquez-Brust, 2016)
13. KPI(s)	Cost and flexibility (Florescu and Barabaş, 2018)	CO_2 (Florescu and Barabaş, 2018)
14. Philosophy focus	Long-term thinking (Duarte and Cruz-Machado, 2018)	Long-term thinking (Duarte and Cruz-Machado, 2018)
15. Product and/or process focus	Focuses mainly on processes (Sabadka, 2014)	Focuses on products and processes (Sabadka, 2014)

16. Sustainability contribution	Affects people and profit (Pampanelli *et al.*, 2016)	Affects the planet (Pampanelli *et al.*, 2016)
17. Value	Value is created by the elimination of waste which is considered as anything that the customer is not willing to pay for (Fercoq *et al.*, 2016)	Value is associated with satisfying customers by creating products in an environmentally friendly manner (Pampanelli *et al.*, 2015)
18. Improvement process	Focus on continuous improvement through the elimination of manufacturing waste (Fercoq *et al.*, 2016; Bhattacharya *et al.*, 2019)	Focus on continuous improvement through the elimination of environmental waste (Fercoq *et al.*, 2016; Bhattacharya *et al.*, 2019)
19. Profitability and competitiveness	Reduction of waste makes the companies more profitable (Kaswan *et al.*, 2020)	Competitiveness is attained through the decrease in environmental damage (Kaswan *et al.*, 2020)
20. Most common tool	VSM	3R

Table 1: Matrix for the relation between performance criteria and LGM tools

Performance criteria	Sub-criteria	LGM tools															
		Kanban	SMED	CM	VSM	5S	TPM	Kaizen	TQM	JIT	Jidoka	ISO 14001	3R	DFE	LCA	EEC	GP
Productivity	Productivity improvement	71	23					5									
	Lead time reduction	71	29 71	55	15 69		15	15 54 55							69		
	Set up time reduction	71	4 32 71		69										69		
	Cycle time reduction	15	15					54									
	Value-added time	71	23		59 69										69		
	Customer satisfaction								46	46					46		
Inventory reduction	Inventory reduction	23 71	23		69												
Delivery improve	Delivery performance	15	15		15	15	15	15									
Quality improvement	Product quality					15 48	15 48	15	46	46					46		
Cost reduction	Cost reduction		71	55	15	15	15	5 15 55 11	46	46		45	9		46		
Waste management	Waste reduction		71	55		71	15 4 54	53 55 11			54		10				
	Material usage	71	21 23 71	23	21 23 54	21 23	4 21 23 54	5 38 54 11	23		54	53	53				
	Waste water reduction							11				15	15 70	15			
	Solid waste reduction											15	15 70	15			

Environmental impacts	Environmental performance				69			5	25				48	24 48	49 69 48	48	48
	Emission reduction		32			4 59	4 71					15	15 70	15			
Energy utilisation	Energy consumption	23 71	4 23 71	23 4	23	23	23 71 54		23 46	46	54	9 15	9 15 22	15	15		

Note: the numbers in Table 5 correspond to the following authors.

4 – Chiarini (2014)
5 - Pampanelli *et al.* (2014)
9 - Wiese *et al.* (2015)
10 - Fercoq *et al.* (2016)
11 - Pampanelli *et al.* (2016)
15 - Thanki *et al.* (2016)
21 – Cherrafi *et al.* (2017a)
22 - Whyle and Bland (2017)
23 - Belhadi *et al.* (2018)
24 - Dawood and Abdullah (2018)
25 - Green *et al.* (2018)
29 - Ikatrinasari *et al.* (2018)
32 - Leme *et al.* (2018)
38 - Cherrafi *et al.* (2019)
45 - Dieste and Panizzolo (2019)
46 - Agyabeng-mensah *et al.* (2020)
48 - Ahmad *et al.* (2020)
49 - Belhadi *et al.* (2020)
53 - Logesh and Balaji (2020)
54 - Silva *et al.* (2020)
55 - Udokporoa *et al.* (2020b)
59 - Zhu *et al.* (2020)
69 - Salvador *et al.* (2021)
70 - Suhardini and Hadiwidjojo (2021)
71 - Vinayagasundaram *et al.* (2020)

Supplementery file

1. Post-2013 studies

Table 1 shows the 141 post-2013 articles that were used in this study. The authors in the Table were arranged according to the year of publication. For the articles published in the same year, the authors were arranged in alphabetical order.

Table 1: Lean-Green studies post-2013

No.	Author(s) and year	Title	Journal/ conference/ thesis
1.	Abdullah *et al.* (2014)	Transformation from Lean service to Green service	International symposium on research in innovation and sustainability 2014 (ISoRIS '14)
2.	Chiarini (2014)	Sustainable manufacturing-greening processes using specific Lean production tools: an empirical observation from European motorcycle component manufacturers	Journal of cleaner production
3.	Dhingra *et al.* (2014)	Does Lean mean Green?	Journal of cleaner production
4.	Galeazzo *et al.* (2014)	Lean and green in action: interdependencies and performance of pollution prevention projects	Journal of cleaner production
5.	Gandhi and Sharma (2014)	Lean manufacturing technology: a way to green business practice and sustainable environmental development	Journal of economic and social development
6.	Garza-reyes *et al.* (2014)	Lean and Green – synergies, differences, limitations, and the need for six sigma	IFIP international conference on advances in production management systems
7.	Johansson and Sundin (2014)	Lean and green product development: two sides of the same coin?	Journal of cleaner production
8.	Pampanelli *et al.* (2014)	A Lean and Green model for a production cell	Journal of cleaner production
9.	Prasad and Sharma (2014)	Lean and Green manufacturing: concept and its implementation in operations management	International Journal of advanced mechanical engineering
10.	Sabadka (2014)	Innovation Lean principles in automotive green manufacturing	Acta Logistica
11.	Wadhwa (2014)	Synergizing Lean and Green for continuous improvement	IFIP international federation for information processing 2014
12.	Engin *et al.* (2015)	Lean and Green supply chain management: a comprehensive review	Lean and Green supply chain management, international series in operations research and management science
13.	Garza-Reyes (2015)	Lean and Green – a systematic review of the state of the art literature	Journal of cleaner production

14.	Kumar *et al.* (2015)	Conceptualisation of sustainable Green Lean Six Sigma: an empirical analysis	International Journal of. business excellence
15.	Nallusamy *et al.* (2015)	Sustainable Green Lean manufacturing practices in small scale industries - a case study	International Journal of applied engineering research
16.	Pampanelli *et al.* (2015)	Sustainable manufacturing: the Lean and Green business model	Sustainable operations management
17.	Queiroz *et al.* (2015)	The use of Lean manufacturing practices in cleaner production: a systematic review	5th international workshop advances in cleaner production
18.	Wiese *et al.* (2015)	The integration of lean, green and best practice business principles	Journal of transport and supply chain management
19.	Bharadwaj and Sundar (2016)	Analysis of significant issues in Green Lean system in small and medium scale enterprises	International Journal of research in mechanical, mechatronics and automobile engineering
20.	Bortolini *et al.* (2016)	A reference framework integrating lean and green principles within supply chain management	International Journal of social, behavioral, educational, economic, business and industrial engineering
21.	Campos and Vazquez-Brust (2016)	Lean and green practices: are they synergic?	2016 POMS annual conference
22.	David and Found (2016)	An implementation model for Lean and Green	Understanding the Lean enterprise
23.	Fercoq *et al.* (2016)	Lean/Green integration focused on waste reduction techniques	Journal of cleaner production
24.	Hallam and Contreras (2016a)	Integrating lean and green management	Management Decision
25.	Hallam and Contreras (2016b)	The interrelation of Lean and Green manufacturing practices: a case of push or pull in implementation	2016 Proceedings of PICMET '16: technology management for social innovation
26.	Lerher *et al.* (2016)	Lean and Green logistics: a theorethical framework approach	International conference on industrial icil 2016 logistics
27.	Mittal *et al.* (2016)	Two-way assessment of barriers to Lean–Green manufacturing system: insights from India	International Journal of systems assurance engineering and management
28.	Pampanelli *et al.* (2016)	The Green factory: creating Lean and sustainable manufacturing	CRC press
29.	Prasad *et al.* (2016)	An empirical study on applicability of lean and green practices in the foundry industry	Journal of manufacturing technology management
30.	Prasetyawan (2016)	Defining technology strategy for small to medium Enterprise within lean and green manufacturing framework	Proceeding of 9th international seminar on industrial engineering and management
31.	Verrier *et al.* (2016)	Lean and Green strategy: the Lean and Green house and maturity deployment model	Journal of cleaner production

32.	Thanki and Thakkar (2016)	Value–value load diagram: a graphical tool for lean–green performance assessment	Production planning and control
33.	Thanki *et al*. (2016)	An investigation on Lean-Green implementation practices in Indian SMEs using analytical hierarchy process (AHP) approach	Journal of cleaner production
34.	Tiwari and Tiwari (2016)	Green Lean manufacturing: way to sustainable productivity improvement	International Journal of engineering research and general science
35.	Abreu *et al*. (2017)	Lean-Green models for eco-efficient and sustainable production	Energy
36.	Cherrafi, *et al*. (2017a)	A framework for the integration of Green and Lean Six Sigma for superior sustainability performance	International Journal of production research
37.	Cherrafi *et al*. (2017b)	Barriers in Green Lean implementation: a combined systematic literature review and interpretive structural modelling approach	Production planning and control
38.	Chugani *et al*. (2017)	Investigating the Green Impact of Lean, Six Sigma, and Lean Six Sigma: a systematic literature review	International Journal of Lean Six Sigma
39.	Dawood and Abdullah (2017)	Effect of manufacturing activities on Lean -Green management integration	Proceedings of the international conference on industrial engineering and operations management
40.	Haddach *et al*. (2017)	Alliance of Lean and Green in company: a literature review and future research	International Journal of engineering science invention
41.	Kuppusamy *et al*. (2017)	Evaluation and identification of Lean-Green resourced person (LGRP) for integrating and implementing lean and green practices in a manufacturing industry	Proceedings of the ASME 2016 international mechanical engineering congress and exposition
42.	Logesh *et al*. (2017)	A review on implementation of lean manufacturing techniques in manufacturing industry to deploy green manufacturing through reduction of hazardous waste	International research journal of engineering and technology (IRJET)
43.	Malhotra and Kumar (2017)	The literature review of Lean and Green manufacturing system	International Journal of theoretical and applied mechanics
44.	Rachid and Ayyad (2017)	Supply chain improvement in LARG (Lean, Agile, Resilient, Green) context: a risk management approach	2017 6th IEEE international conference on advanced logistics and transport (ICALT)
45.	Reis *et al*. (2017)	Online platform for measuring the lean/green maturity level based on the slg method	Proceedings of the international conference on industrial engineering and operations management
46.	Ruiz-Benitez *et al*. (2017)	Environmental benefits of lean, green and resilient supply chain management: the case of the aerospace sector	Journal of cleaner production

47.	Sartal *et al.* (2017)	How much does Lean Manufacturing need environmental and information technologies?	Journal of manufacturing systems
48.	Szymanska-Bralkowska and Malinowska (2017)	The improvement of the company's environmental performance through the application of Green Lean/ Lean and Green approach	Institute of economic research working papers
49.	Whyle and Bland (2017)	Application of Green and Lean production at Ricoh	International Journal of automation technology
50.	Belhadi *et al.* (2018)	Benefits of adopting lean production on green performance of SMEs: a case study	Production planning and control
51.	Cherrafi *et al.* (2018)	Lean, green practices and process innovation: a model for green supply chain performance	International journal of production economics
52.	Dawood *et al.* (2018)	Managing waste throughout Lean-Green perspective	Journal of University of Babylon, engineering sciences
53.	Duarte and Cruz-Machado (2018)	Exploring linkages between Lean and Green supply chain and the Industry 4.0	International conference of management science and engineering management
54.	Florescu and Barabaş (2018)	Integrating the Lean concept in sustainable manufacturing development	3rd China-Romania science and technology seminar (CRSTS 2018)
55.	Gandhi *et al.* (2018)	Ranking of drivers for integrated Lean-Green manufacturing for Indian manufacturing SMEs	Journal of cleaner production
56.	Ghobakhloo *et al.* (2018)	Lean-Green manufacturing: the enabling role of information technology resource	Kybernetes
57.	Hammadi and Herrou (2018)	Lean maintenance logistics management: the key to green and sustainable performance	2018 4th International conference on logistics operations management (GOL)
58.	Harikannan *et al.* (2018)	Enablers and barriers for integrated Lean-Green-Agile manufacturing systems	International Journal of mechanical engineering and technology (IJMET)
59.	Ikatrinasari et al. (2018)	The implementation Lean and Green manufacturing sustainable value stream mapping	International conference on design, engineering and computer sciences 2018
60.	Inman and Green (2018)	Lean and Green combine to impact environmental and operational performance	International Journal of production research
61.	Kipper et al. (2018)	Lean and Green indicators: an application in the coffee sector	Agriculture research and technology
62.	Leme *et al.* (2018)	Creating value with less impact: Lean, green and eco-efficiency in a metalworking industry towards a cleaner production	Journal of cleaner production
63.	Mishra (2018)	Identify critical success factors to implement integrated green and Lean Six Sigma	International Journal of Lean Six Sigma

64.	Oliveira *et al.* (2018)	Lean and Green approach: an evaluation tool for new product development focused on small and medium enterprises	International Journal of production economics
65.	Ramos *et al.* (2018)	A lean and cleaner production benchmarking method for sustainability assessment: a study of manufacturing companies in Brazil	Journal of cleaner production
66.	Sumant and Negi (2018)	Review of Lean-Green manufacturing practices in SMEs for sustainable framework	International journal of business innovation and research
67.	Thanki and Thakkar (2018a)	A quantitative framework for lean and green assessment of supply chain performance	International Journal of productivity and Performance Management
68.	Thanki and Thakkar (2018b)	Interdependence analysis of Lean-Green implementation	Journal of manufacturing technology management
69.	Abreu *et al.* (2019)	The Lean-Green BOPSE indicator to assess efficiency and sustainability	Lean engineering for global development
70.	Avancini *et al.* (2019)	Lean and Green manufacturing practices: a multiple case study about synergy	Proceedings of the international conference on industrial engineering and operations Management
71.	Bhattacharya *et al.* (2019)	Lean-green integration and its impact on sustainability performance: a critical review	Journal of cleaner production
72.	Caldera *et al.* (2019)	Transforming manufacturing to be good for planet and people, through enabling Lean and Green thinking in small and medium-sized enterprises	Sustainable earth
73.	Carvalho *et al.* (2019a)	Using Lean and Green indexes to measure companies' performance	Lean Engineering for Global Development
74.	Carvalho *et al.* (2019b)	Advanced technologies supporting the implementation of Lean/Green supply chain management practices and its influence on the performance	European Lean educator conference
75.	Cherrafi *et al.* (2019)	Green and Lean: a Gemba–Kaizen model for sustainability enhancement	Production planning and control
76.	Chiet *et al.* (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
77.	Choudhary *et al.* (2019)	An integrated lean and green approach for improving sustainability performance: a case study of a packaging manufacturing SME in the U.K.	Production planning and control

78.	Coutinho *et al.*, (2019)	A critical review on lean green product development: state of art and proposed conceptual framework	Environmental engineering and management journal
79.	Edirisuriya *et al.* (2019)	Applicability of Lean and Green concepts in logistics 4.0: a systematic review of literature	2018 Internatonal conference on production and operations management society (POMS)
80.	Dieste and Panizzolo (2019)	The effect of Lean practices on environmental performance: an empirical study	Lean engineering for global development
81.	Farias *et al.* (2019)	Criteria and practices for lean and green performance assessment: systematic review and conceptual framework	Journal of cleaner production
82.	Farias *et al.* (2019)	An ANP-based approach for lean and green performance assessment	Resources, conservation and recycling
83.	Green *et al.* (2019)	Impact of JIT, TQM and green supply chain practices on environmental sustainability	Journal of manufacturing technology management
84.	Huo *et al.* (2019)	Green or lean? A supply chain approach to sustainable performance	Journal of cleaner production
85.	Kaswan and Rathi (2019)	Analysis and modeling the enablers of Green Lean Six Sigma implementation using Interpretive structural modeling	Journal of cleaner production
86.	Leong *et al.* (2019a)	Adaptive analytical approach to lean and green operations	Journal of cleaner production
87.	Leong *et al.* (2019b)	Lean and Green manufacturing—a review on its applications and impacts	Process integration and optimization for sustainability
88.	Marco-ferreira *et al.* (2019)	Lean and Green: practices, paradigms and future prospects	Benchmarking: an international journal
89.	Moro *et al.* (2019)	Product-service systems towards eco-effective production patterns: a Lean-Green design approach from a literature review	Total quality management and business excellence
90.	Muñoz-Villamizar *et al.* (2019)	Trends and gaps for integrating Lean and Green management in the agri-food sector	British food journal
91.	Rahman and Ogunleye (2019)	A Lean, Green and Six Sigma (LG6σ) for SMEs in the leather industry in Bangladesh	International Journal of knowledge, innovation and entrepreneurship
92.	Sindhwani *et al.* (2019)	Modelling and analysis of barriers affecting the implementation of Lean Green Agile manufacturing system (LGAMS)	Benchmarking: an international Journal
93.	Singh *et al.* (2019)	Evaluation of common barriers to the combined Lean-Green-Agile manufacturing system by two-way assessment method	Advances in industrial and production engineering
94.	Siegel *et al.* (2019)	Integrated Green Lean approach and sustainability for SMEs: from literature review to a conceptual framework	Journal of cleaner production

95.	Tayyab and Sarkar (2019)	Sustainable lot size in a multistage Lean-Green manufacturing process under uncertainty	Mathematics
96.	Abualfaraa *et al.* (2020)	Lean-Green manufacturing practices and their link with sustainability: a critical review	Sustainability
97.	Ahmad *et al.* (2020)	Lean-Green performance management in Indian SMEs: a novel perspective using the best-worst method approach	Benchmarking: an international journal
98.	Basha *et al.* (2020)	Green and Lean industrial engineering practices in selected manufacturing units in Andhra Pradesh: statistical analysis	International Journal of emerging trends in engineering research
99.	Baumer-cardoso *et al*. (2020)	Simulation-based analysis of catalyzers and trade-offs in Lean and Green manufacturing	Journal of cleaner production
100.	Belhadi *et al.* (2020)	The integrated effect of big data analytics, lean six sigma, and green manufacturing on the environmental performance of manufacturing companies: the case of North Africa.	Journal of cleaner production
101.	Gaikwad and Sunnapwar (2020)	An integrated Lean, Green and Six Sigma strategies a systematic literature review and directions for future research	The TQM Journal
102.	Jbira *et al.* (2020)	Integration of Lean management for the growth of Green manufacturing	IOP conference series: materials science and engineering
103.	Kaswan and Rathi (2020)	Investigating the enablers associated with implementation of Green Lean Six Sigma in manufacturing sector using Best Worst method	Clean technologies and environmental policy
104.	Khan *et al.* (2020)	The development of a sustainability framework via Lean Green Six Sigma practices in SMEs based upon RBV theory	International Journal of innovation, creativity and change
105.	Kovilage (2020b)	Influence of lean–green practices on organizational sustainable performance	Journal of Asian business and economic studies
106.	Kumar and Rodrigues (2020)	Synergetic effect of Lean and Green on innovation: a resource-based perspective	International Journal of production economics
107.	Lartey *et al.* (2020)	Going Green, going clean: Lean-Green sustainability strategy and firm growth	Business strategy and environment
108.	Leong *et al.* (2020)	Enhancing the adaptability: Lean and Green strategy towards the Industry revolution 4.0	Journal of cleaner production
109.	Logesh and Balaji (2020)	Experimental investigations to deploy Green manufacturing through reduction of waste using lean tools in electrical components manufacturing company	International Journal of precision engineering and manufacturing-green technology

110.	Rodrigues *et al.* (2020)	The impact of Lean and Green practices on logistics performance: a structural equation modelling	Production
111.	Silva *et al.* (2020)	Lean Green—the importance of integrating environment into Lean philosophy—a case study	Proceedings of the 6th European Lean educator conference
112.	Sindhwani, *et al.* 2020	Analysis of barriers to Lean–Green manufacturing system (LGMS): a multi-criteria decision-making approach	Advances in intelligent manufacturing
113.	Singh *et al.* (2020a)	Analyzing barriers of Green Lean practices in manufacturing industries by DEMATEL approach	Journal of manufacturing technology management
114.	Singh et al. (2020b)	Understanding the key performance parameters of Green Lean performance in manufacturing industries	Materials today: proceedings
115.	Thanki and Thakkar (2020)	An investigation on Lean–Green performance of Indian manufacturing SMEs	International Journal of productivity and performance management
116.	Udokporo *et al.* (2020)	Impact of Lean, Agile and Green (LAG) on business competitiveness: an empirical study of fast moving consumer goods businesses	Resources, conservation and recycling
117.	Vinayagasundaram *et al.* (2020)	Implementation of business process reengineering using Lean and Green strategy in manufacturing industry	AIP conference proceedings
118.	Zhu and Zhang (2020)	Construction of lean-green coordinated development model from the perspective of personnel integration in manufacturing companies	Journal of engineering manufacture
119.	Zhu *et al.* (2020)	Application of green-modified value stream mapping to integrate and implement lean and green practices: a case study	International Journal of computer integrated manufacturing
120.	Aisyah *et al.* (2021)	identification of implementation Lean, Agile, Resilient and Green (LARG) approach in Indonesia automotive industry	Journal Européen des systèmes automatisés
121.	Amrina and Shiami (2021)	Selection of sustainable performance strategies in cosmetics SMIs using Lean and Green balance scorecards methods	International Journal of scientific advances
122.	Amrina *et al.* (2021)	Mapping challenges in developing sustainable small and medium industries: integrating Lean and Green principles	Journal of industrial engineering and management
123.	Bouhannana (2021)	Integrating Lean, Green and Agile concepts in supply chain management - a systematic literature review	Journal of Tianjin University science and technology

124.	Dahmani and Belhadi (2021)	Integrating Lean design and eco-design to improve product design: from literature review to an operational framework	Energy and Environment
125.	Dias (2021)	Combine Lean with Green paradigm as an enabler for an environmentally sustainable supply chain	Doctoral dissertation
126.	da Silva *et al.* (2021)	Improving manufacturing cycle efficiency through new multiple criteria data envelopment analysis models: an application in Green and Lean manufacturing processes	Production planning and control
127.	Farrukh *et al.* (2021)	A natural resource and institutional theory-based view of green-lean-six sigma drivers for environmental management	Business strategy and the environment
128.	Firmansyah and Maemunah (2021)	Lean management and Green supply chain management implementation on the manufacturing and logistics industry at an Indonesia	Business and entrepreneurial review
129.	Harisekar (2021)	Focusing on Lean and Green increasing sustainability performance in a SME	Production systems
130.	Hartini *et al.* (2021)	Integration Lean manufacturing and 6R to reduce wood waste in furniture company toward circular economy	IOP conference series: materials science and engineering
131.	Kurdve and Bellgran (2021)	Green Lean operationalisation of the circular economy concept on production shop floor level	Journal of cleaner production
132.	Leong *et al.* (2021)	The performance of adaptive approach in Lean and Green operations	MATEC web of conferences
133.	Rad and Azizi (2021)	History will repeat: Industry 4.0 brought Lean, Agile, Resilience and Green	Research Journal of nanoscience and engineering
134.	(Raut et al., 2021)	Big data analytics as a mediator in Lean, Agile, Resilient, and Green (LARG) practices effects on sustainable supply chains	Transportation research part E
135.	Shokri *et al.* (2021)	A readiness self-assessment model for implementing Green Lean Six Sigma initiatives in manufacturing	Journal of Cleaner Production
136.	Suhardini and Hadiwidjojo (2021)	Lean and Green supply chain management in improving operational performance in sugar industry	Journal of applied management
137.	Suhendrianto *et al.* (2021)	The integrated Lean and Green manufacturing system: a case study at the peeled loaf production	IOP conference series: materials science and engineering
138.	Thorne (2021)	Towards Lean and Green production management in the pharmaceutical industry: a framework for E-VSM and	KTH royal institute of technology school of industrial engineering and management

		Kaizen event prioritization through a systematic literature review and case study at AstraZeneca	
139.	Verma (2021)	Sustainability synergy with Lean Green and Six Sigma	International Journal of research and analysis in science and engineering
140.	Viles *et al.* (2021)	Lean–Green improvement opportunities for sustainable manufacturing using water telemetry in agri-food industry	Sustainability
141.	Yadav *et al.* (2021)	Integral measures and framework for Green Lean Six Sigma implementation in manufacturing environment	International Journal of sustainable engineering

2. Pre-2013 studies

Table 2 shows the articles from pre-2013 articles that supported the results obtained by Dües *et al.* (2013). The authors in the Table were arranged according to the year of publication and in alphabetical order as done in Table 1.

Table 2: Lean-Green studies pre-2013

No.	Author	Title	Journal
1.	Florida (1996)	Lean and Green: the move to environmentally conscious manufacturing	California management review
2.	King and Lenox (2001)	Lean and Green? An empirical examination of the relationship between lean production and environmental performance	Production and operations management
3.	Rothzenberg*et al.* (2001)	Lean, Green, and the quest for superior environmental performance	Production and operations management
4.	Zhu and Sarkis (2004)	Relationships between operational practices and performance among early adopters of Green supply chain management practices in Chinese manufacturing enterprises	Journal of operations management
5.	Simpson and Power (2005)	Use the supply relationship to develop Lean and Green suppliers	Supply chain management: an international journal
6.	Venkat and Wakeland (2006)	Is lean necessarily green?	50th Annual Meeting of the International Society for the Systems Sciences 2006, ISSS 2006
7.	Sawhney *et al.* (2007)	En-Lean: a framework to align lean and green manufacturing in the metal cutting supply chain	International journal of enterprise network management
8.	Bergmiller and Mccright, (2009a)	Lean manufacturers' transcendence to Green manufacturing	Proceedings of the 2009 industrial engineering research conference

9.	Bergmiller and McCright (2009b)	Are Lean and Green programs synergistic?	Proceedings of the 2009 industrial engineering research conference
10.	Hall (2009)	Compression: meeting the challenges of sustainability through vigorous learning enterprises	CRC press
11.	Johansson and Winroth (2009)	A manufacturing strategy perspective on lean and green manufacturing	Proceedings of the Swedish production symposium
12.	Winroth and Johansson (2009)	Lean vs. Green manufacturing: similarities and differences	Proceedings of the 16th international annual EurOMA conference, implementation realizing operations management knowledge
13.	Carvalho *et al.* (2010)	Supply chain performance management: Lean and Green paradigms	International Journal of business performance and supply chain modelling
14.	Mollenkopf *et al.* (2010)	Green, lean, and global supply chains	International Journal of physical distribution and logistics management
15.	Taubitz (2010)	Lean, Green and safe integrating safety into the Lean, Green and sustainability movement	Professional safety
16.	Torielli *et al.* (2010)	Using Lean methodologies for economically and environmentally sustainable foundries	China foundry
17.	Duarte (2011)	Exploring Lean and Green supply chain performance using balanced scorecard perspective	Proceedings of the 2011 international conference on industrial engineering and operations management
18.	Pampanelli *et al.* (2011)	A Lean and Green Kaizen model	2011 POMS annual conference
19.	Parveen *et al.* (2011)	Integration of Lean And Green supply chain -impact on manufacturing firms in improving environmental efficiencies	International conference on green technology and environmental conservation (GTEC-2011)
20.	Bashkite and Karaulova (2012)	Integration of Green thinking into Lean fundamentals by theory of inventive problems-solving tools	Annals of DAAAM for 2012 and proceedings of the 23rd international DAAAM symposium
21.	Cabral, *et al.* (2012)	A decision-making model for Lean, Agile, Resilient and Green supply chain management	International Journal of production research
22.	Chahal (2012)	An advance Lean production system in industry to improve flexibility and quality in manufacturing by implementation of FMS and Green manufacturing	International Journal of emerging technology and advanced engineering

3. Descriptive summary of review

According to Figure 1, 39% of the papers followed the case study method, while 34% are based on literature review and 27% were conducted through surveys.

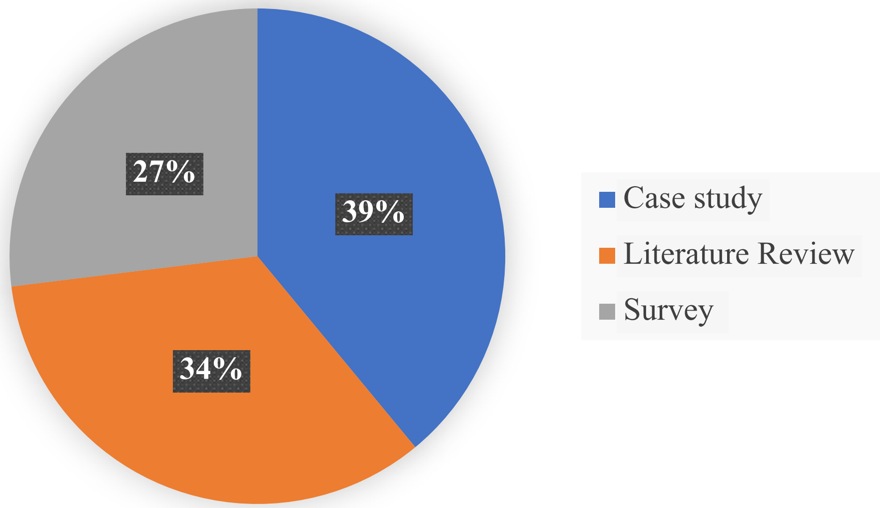

Figure 1: Type of research

Figure 2 presents the size of the organisation in which the research was conducted. Most of the papers (62%) did not state the size of the organisation where their study was done. 18% of the papers were conducted in large enterprises, while 15% were conducted in SMEs.

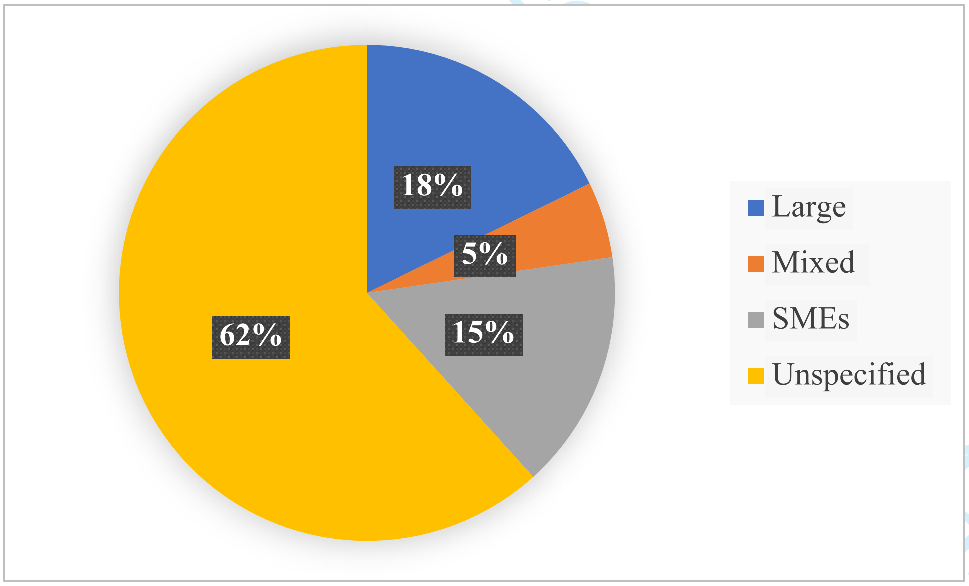

Figure 2: Size of the industry

From Figure 3, it can be noted that from 2014 to 2021, there has been an increase in research on Lean-Green Manufacturing.

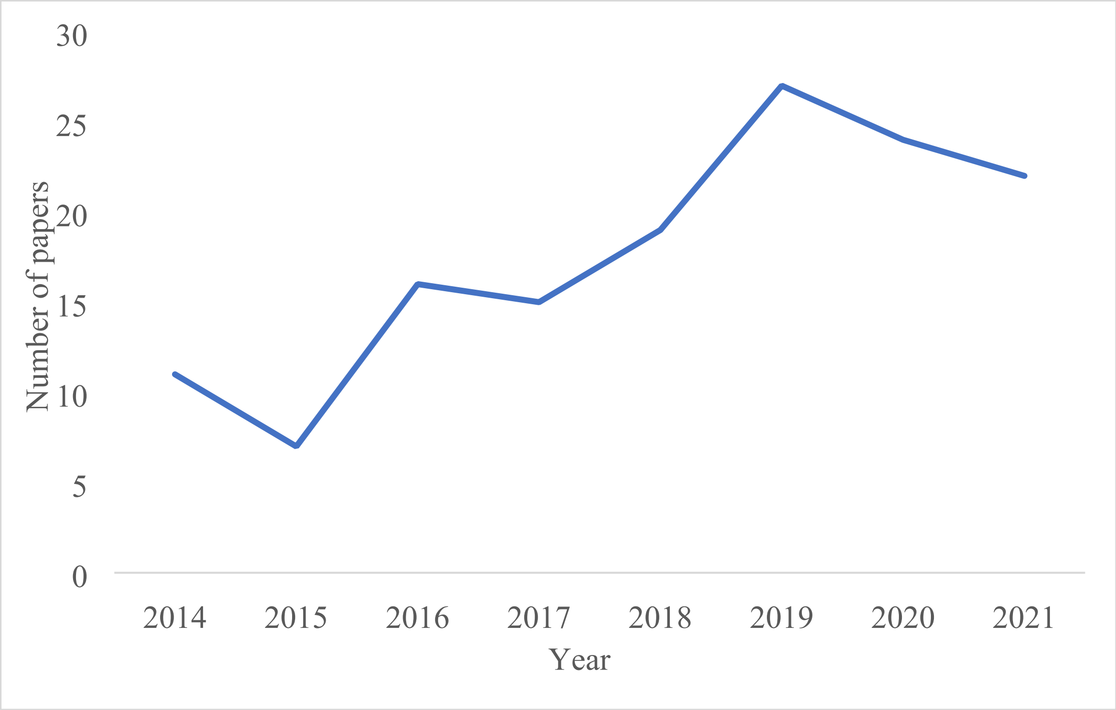

Figure 3: Number of papers and year of publication

4. Gioia diagram and thematic relationships

Figures 4-6 illustrate the Gioia diagram which presents the research themes that were identified through Atlas.ti coding.

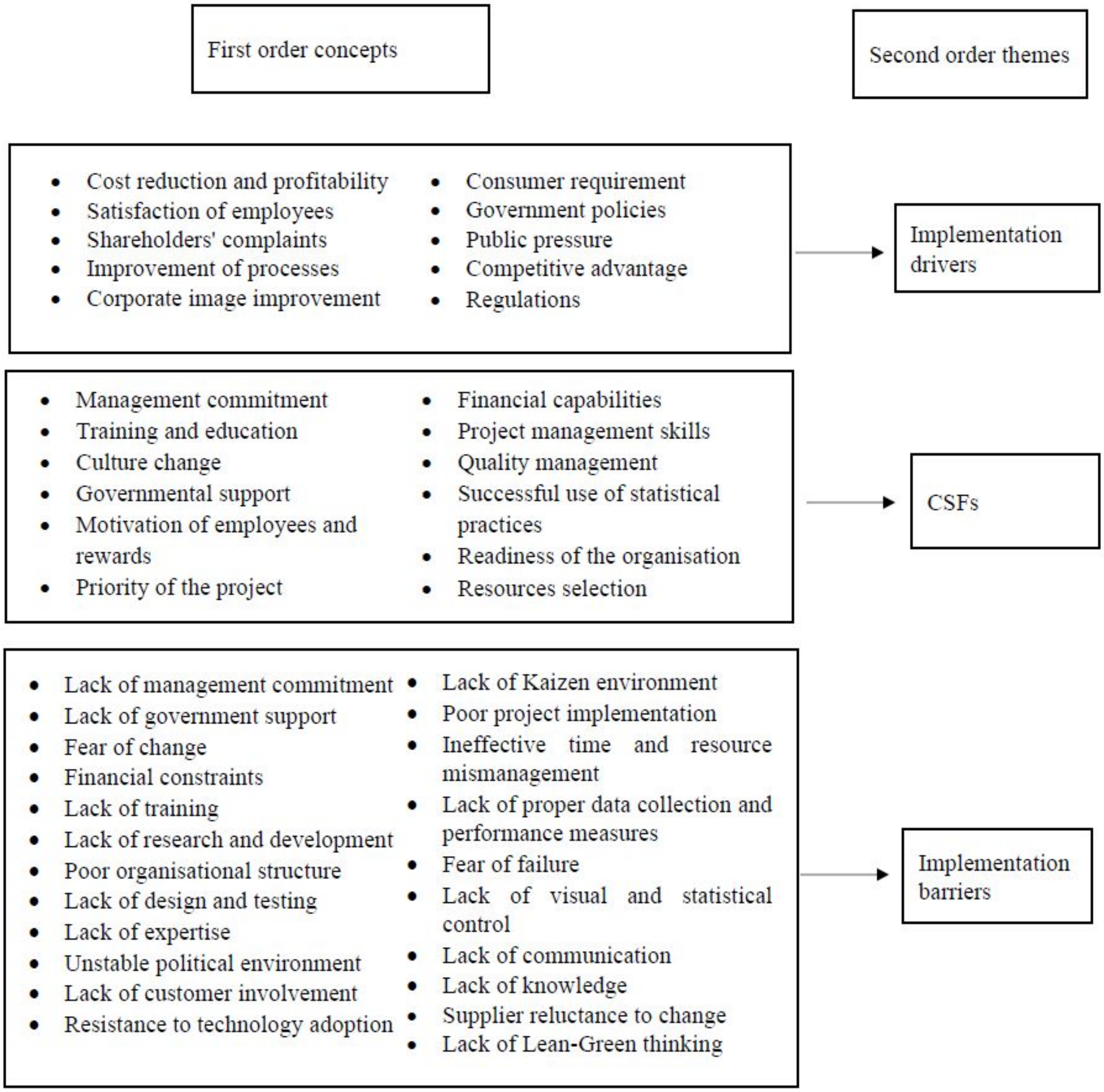

Figure 4: Gioia diagram for drivers, barriers, and CSFs

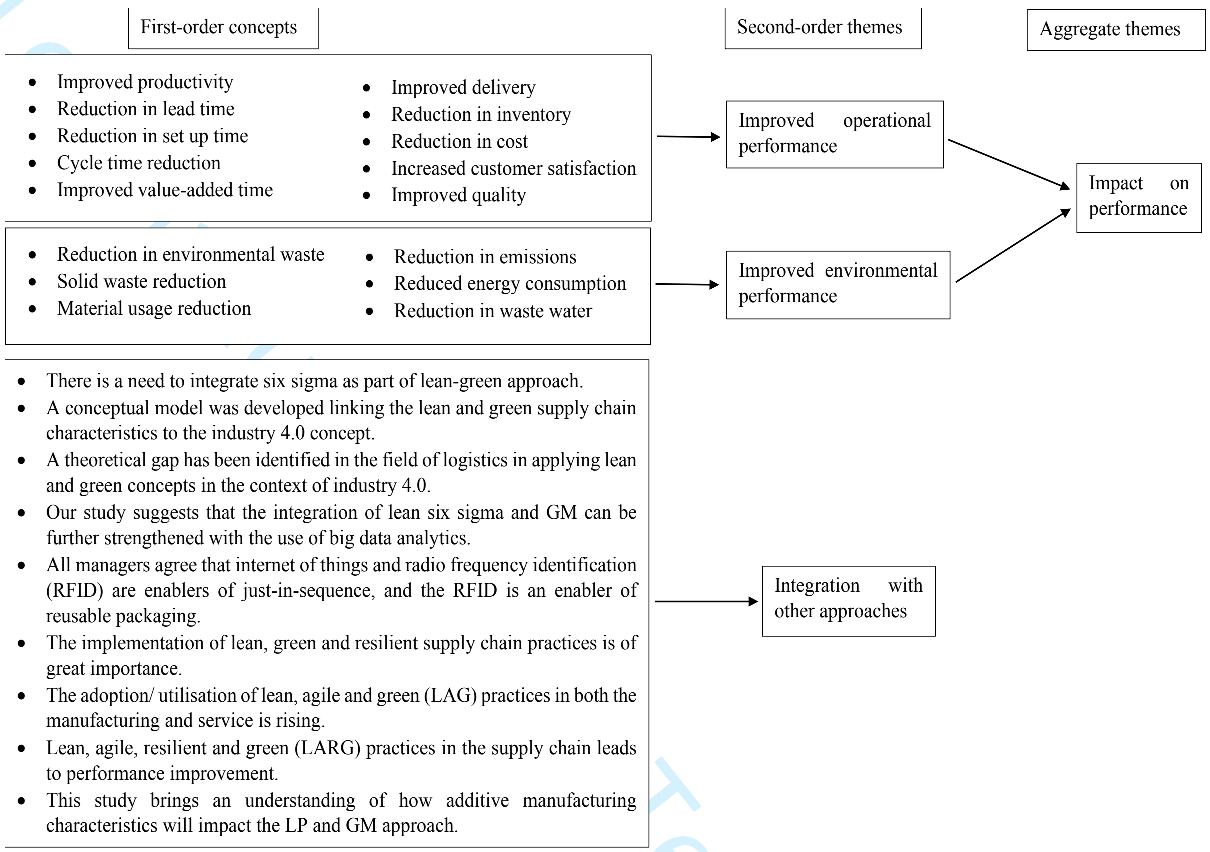

Figure 5: Gioia diagram for synergy and divergence

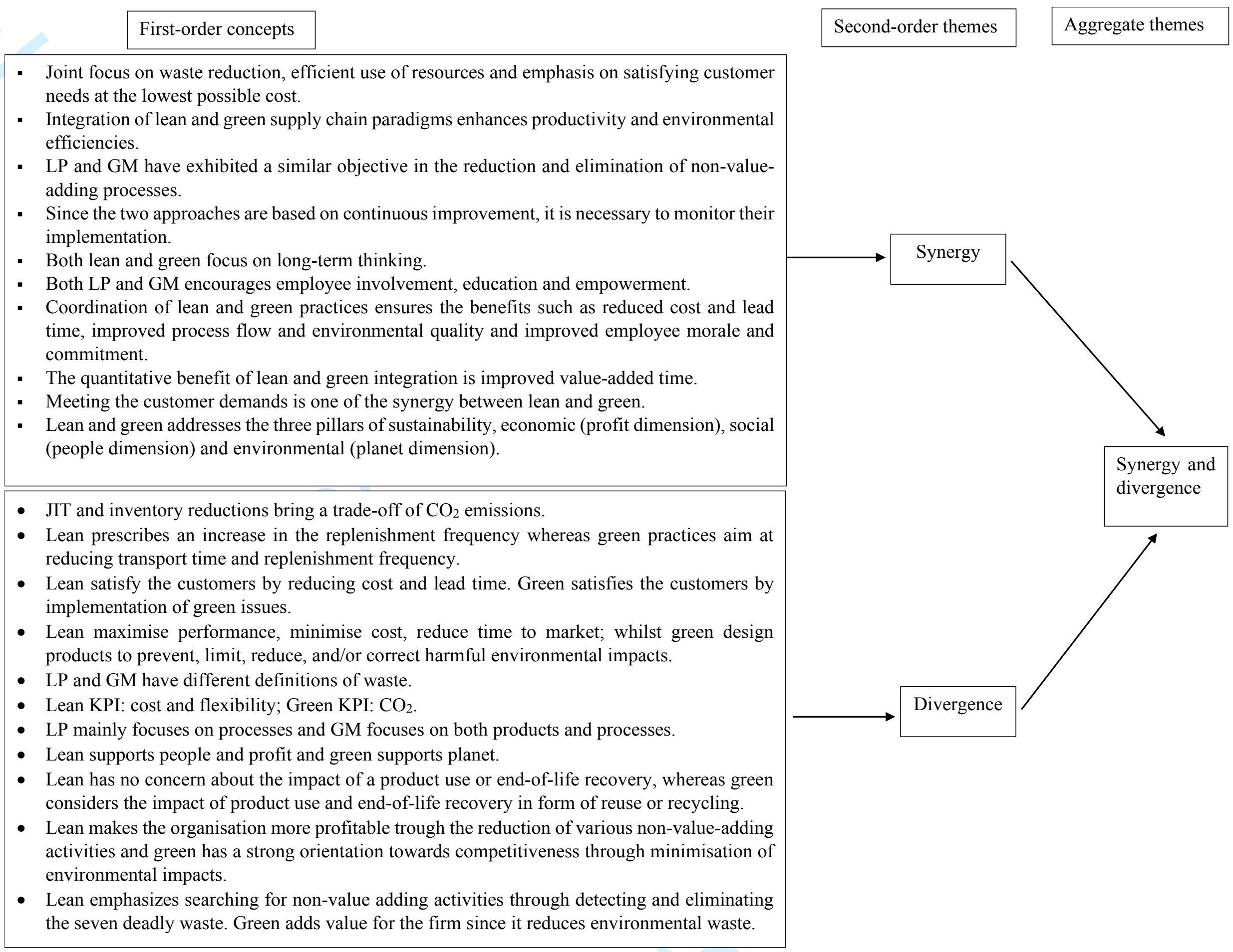

Figure 6: Gioia diagram for impact on performance and integration with other methodologies

The relationships between the study themes are shown in Figure 7.

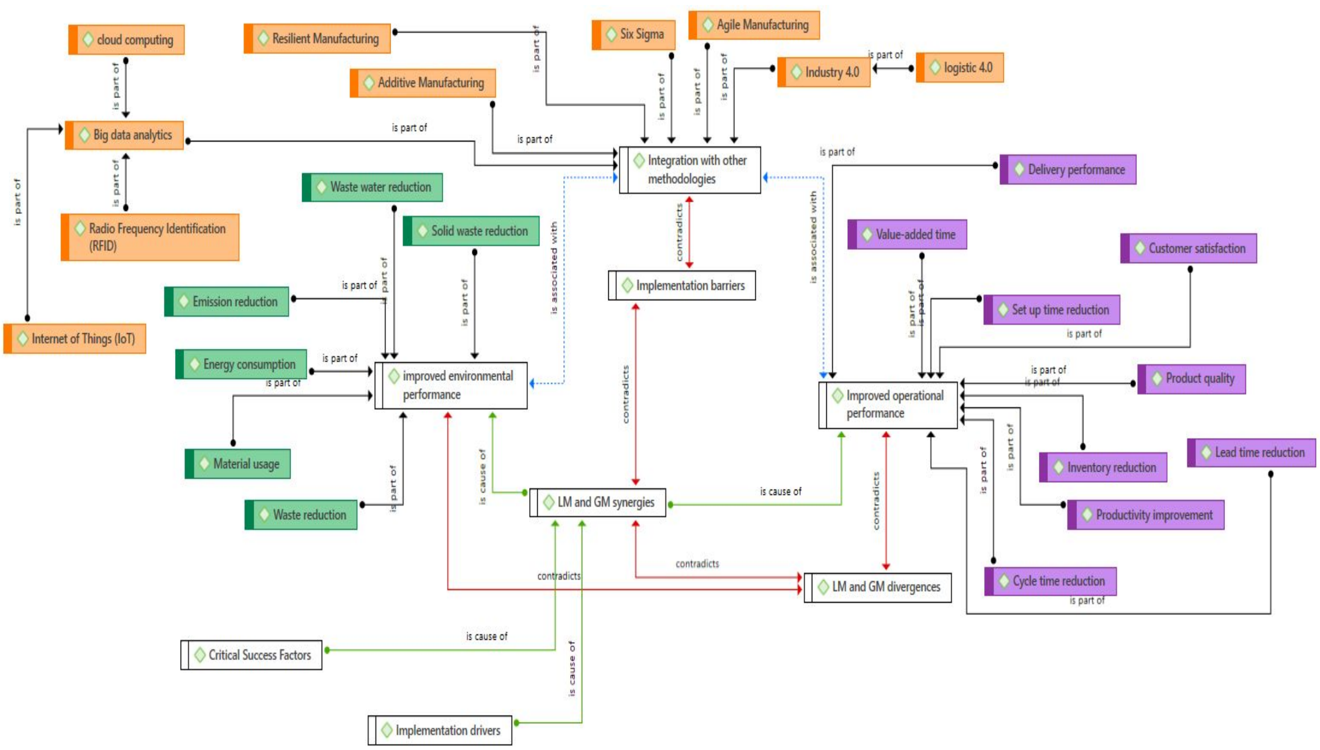

Figure 7: Relationship between study themes

References

Abdullah, M., Chew, B., Hamid, S., Management, F. and Teknikal, U. (2014) "Transformation from Lean Service to Green Service", in *International Symposium on Research in Innovation and Sustainability (iSORIS)*. Malacca, pp. 1–4.

Abreu, M. F., Alves, A. C. and Moreira, F. (2017) "Lean-Green models for eco-efficient and sustainable production", *Energy*, Vol. 137, pp. 846–853.

Abualfaraa, W., Salonitis, K., Al-Ashaab, A. and Ala'raj, M. (2020) "Lean-green manufacturing practices and their link with sustainability: A critical review", *Sustainability (Switzerland)*, Vol. 12 No.3, pp. 1–21.

Ahmad, S., Abdullah, A. and Talib, F. (2020) "Lean-green performance management in Indian SMEs: a novel perspective using the best-worst method approach", *Benchmarking: An International Journal*.

Aisyah, S., Purba, H. H., Jaqin, C., Amelia, Z. R., Adiyatna, H. and 1 (2021) "Identification of Implementation Lean , Agile , Resilient and Green (LARG) Approach in Indonesia Automotive Industry", *Journal Européen des Systèmes Automatisés*, Vol. 54 No.2, pp. 317–324.

Amrina, U., Hidayatno, A. and Zagloel, T. Y. M. (2021) "Mapping challenges in developing sustainable small and medium industries: integrating lean and green principles", *Journal of Industrial Engineering and Management*, Vol. 14 No.2, pp. 311–328.

Amrina, U. and Shiami, A. N. F. (2021) "Selection of Sustainable Performance Strategies in Cosmetics SMIs Using Lean and Green Balance Scorecards Methods", *International Journal of*

Scientific Advances, Vol. 2 No.3, pp. 316–321.

Avancini, P. R., Presbyterian, M., Paulo, S., Assumpção, J. J., Helleno, A. L. and Campos, L. M. S. (2019) "Lean and Green Manufacturing Practices: A multiple case study about synergy", in *Proceedings of the International Conference on Industrial Engineering and Operations Management*, pp. 698–709.

Basha, A. M. M., Rajaiah, M., Vijayakumar, O., Haranath, Y. and Srinivasulu, T. (2020) "Green and Lean Industrial Engineering Practices in Selected Manufacturing Units in Andhra Pradesh : Statistical Analysis", *International Journal of Emerging Trends in Engineering Research*, Vol. 8 No.5, pp. 1768–1775.

Bashkite, V. and Karaulova, T. (2012) "Integration of green thinking into lean fundamentals by theory of inventive problems-solving tools", in *23rd DAAAM International Symposium on Intelligent Manufacturing and Automation 2012*. Vienna, Austria, EU, pp. 345–350.

Baumer-cardoso, M. I., Campos, L. M. S., Santos, P. P. P. and Frazzon, M. E. (2020) "Simulation-based analysis of catalyzers and trade-offs in Lean & Green manufacturing", *Journal of Cleaner Production*, Vol. 242, p. 118411.

Belhadi, A., Kamble, S. S., Zkik, K., Cherrafi, A., Touriki, F. E. and El, S. (2020) "The integrated effect of big data analytics, lean six sigma and green manufacturing on the environmental performance of manufacturing companies: the case of North Africa", *Journal of Cleaner Production*, Vol. 252, pp. 1–14.

Belhadi, A., Touriki, F. E. and El Fezazi, S. (2018) "Benefits of adopting lean production on green performance of SMEs: a case study", *Production Planning and Control*, Vol. 29 No.11, pp. 873–894.

Bergmiller, G. G. and Mccright, P. R. (2009a) "Lean manufacturers' transcendence to green manufacturing", in *Proceedings of the 2009 Industrial Engineering Research Conference Lean*, pp. 1144–1149.

Bergmiller, G. G. and McCright, P. R. (2009b) "Are Lean and Green Programs Synergistic?", , in *Proceedings of the 2009 Industrial Engineering Research Conference*, pp. 1155–1160.

Bharadwaj, S. and Sundar, S. (2016) "Analysis of significant issues in green lean system in small and medium scale enterprises", *International Journal of Research in Mechanical, Mechatronics and Automobile Engineering*, Vol. 1 No.4, pp. 154–158.

Bhattacharya, A., Nand, A. and Castka, P. (2019) "Lean-green integration and its impact on sustainability performance: a critical review", *Journal of Cleaner Production*, Vol. 236, p. 117697.

Bortolini, M., Ferrari, E., Galizia, F. G. and Mora, C. (2016) "A reference framework integrating lean and green principles within supply chain management", *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, Vol. 10 No.3, pp. 844–849.

Bouhannana, F. (2021) "integrating lean , green and agile concepts in supply chain management - a systematic literature review", pp. 210–231.

Cabral, I., Grilo, A. and Cruz-Machado, V. (2012) "A decision-making model for lean, agile, resilient and green supply chain management", *International Journal of Production Research*, Vol. 50 No.17, pp. 4830–4845.

Caldera, H. T. S., Desha, C. and Dawes, L. (2019) "Transforming manufacturing to be ‘ good for planet and people, through enabling lean and green thinking in small and medium-sized enterprises", *Sustainable Earth*, Vol 2 No., pp. pp. 1–19.

Campos, L. M. S. and Vazquez-Brust, D. A. (2016) "Lean and green synergies in supply chain management", *Supply Chain Management: An International Journal*, Vol. 21 No.5, pp. 627–641.

Carvalho, H., Pimentel, C., Azevedo, S. and Gento, A. M. (2019) "Advanced technologies supporting the implementation of lean/green supply chain management practices and its influence on the performance", in *Lecture Notes in Networks and Systems 122 of the 6th European Lean Educator Conference*, pp. 149–157.

Carvalho, H., Machado, V. H., Barroso, A. P., Almeida, D. De and Cruz-machado, V. (2019) "Using lean and green indexes to measure companies' performance", in *Lean Engineering for Global Development*. Springer International Publishing, pp. 293–318.

Carvalho, H., Azevedo, S. G. and Cruz-Machado, V. (2010) "Supply chain performance management : lean and green paradigms", *international Journal of Business Performance and Supply Chain Modelling*, Vol. 2 No.3/4, pp. 304–333.

Chahal, V. (2012) "An advance lean production system in industry to improve flexibility and quality in manufacturing by implementation of FMS & green manufacturing", *International Journal of Emerging Technology and Advanced Engineering*, Vol. 2 No.12, pp. 405–408.

Cherrafi, A., Elfezazi, S., Govindan, K., Garza-reyes, J. A., Benhida, K. and Mokhlis, A. (2017a) "A framework for the integration of green and lean six sigma for superior sustainability performance", *International Journal of Production Research*, Vol. 55 No.15, pp. 4481–4515.

Cherrafi, A., Elfezazi, S., Garza-Reyes, J. A., Benhida, K. and Mokhlis, A. (2017b) "Barriers in green lean implementation: a combined systematic literature review and interpretive structural modelling approach", *Production Planning and Control*, Vol. 28 No.10, pp. 829–842.

Cherrafi, A., Garza-reyes, J. A., Kumar, V., Mishra, N. and Ghobadian, A. (2018) "Lean , green practices and process innovation: a model for green supply chain performance", *International Journal of Production Economics*, Vol. 206, pp. 79–92.

Cherrafi, A., Elfezazi, S., Hurley, B., Garza-Reyes, J. A., Kumar, V., Anosike, A. and Batista, L. (2019) "Green and lean: a gemba–kaizen model for sustainability enhancement", *Production Planning and Control*, Vol. 30 No.5/6, pp. 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*, Vol. 85, pp. 226–233.

Chiet, C. W., Ching, N. T., Huat, S. L., Fathi, M. and Tzuu, 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, pp. 1–7.

Choudhary, S., Nayak, R., Dora, M., Mishra, N. and Ghadge, A. (2019) "An integrated lean and green approach for improving sustainability performance: a case study of a packaging manufacturing SME in the U.K.", *Production Planning and Control*, Vol. 30 No. 5/6, pp. 353–368.

Chugani, N., Kumar, V., Garza-reyes, J. A., Rocha-lona, L. and Upadhyay, A. (2017) "Investigating the green impact of lean , six sigma , and lean six sigma: a systematic literature review", *International Journal of Lean Six Sigma*.

Coutinho, R. M., Ceryno, P. S., de Souza Campos, L. M. and Bouzon, M. (2019) "A critical review on lean green product development: State of art and proposed conceptual framework", *Environmental Engineering and Management Journal*, Vol. 18 No.11, pp. 2319–2333.

Dahmani, N. and Belhadi, A. (2021) "Integrating lean design and eco-design to improve product design: from literature review to an operational framework", *Energy & Environment*, Vol *33* No.1, pp.189-219.

David, S. M. C. and Found, P. (2016) "An implementation model for lean and green", in *Understanding the Lean Enterprise*, pp. 1–29.

Dawood, L. M. and Abdullah, Z. H. (2017) "Effect of manufacturing activities on lean - green management integration", in *Proceedings of the International Conference on Industrial Engineering and Operations Management*, pp. 491–502.

Dawood, L. M., Division, I. E. and Abdullah, Z. H. (2018) "Managing waste throughout lean-green perspective", *Journal of University of Babylon, Engineering Sciences*, Vol. 26 No.1, pp. 192–204.

Dhingra, R., Kress, R. and Upreti, G. (2014) "Does lean mean green?", *Journal of Cleaner Production*, Vol. 85, pp. 1–7.

Dias, B. F. (2021) *Combine Lean with Green Paradigm as an enabler for an environmentally sustainable supply chain*, Doctoral dissertation..

Dieste, M. and Panizzolo, R. (2019) "The effect of lean practices on environmental performance : an empirical study", in *Lean Engineering for Global Development*. Springer International Publishing, pp. 225–258.

Duarte, S., Cabrita, R. and Machado, V. (2011) "Exploring lean and green supply chain performance using balanced scorecard perspective", in *Proceedings of the 2011 International Conference on Industrial Engineering and Operations Management*. IEOM Research Solutions Pty Ltd, pp. 520–525.

Duarte, S. and Cruz-Machado, V. (2018) "Exploring linkages between lean and green supply and the industry 4.0", in *Proceedings of the Eleventh International Conference on Management Science and Engineering Management*. Springer, Cham, pp. 1242-1252.

Dües, C. M., Tan, K. H. and 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*, Vol. 40, pp. 93–100.

Edirisuriya, A., Weerabahu, S. and Wickramarachchi, R. (2019) "Applicability of lean and green concepts in logistics 4.0: a systematic review of literature", in *2018 International Conference on Production and Operations Management Society, POMS 2018*. IEEE, pp. 1–8.

Engin, B. E., Martens, M. and Paksoy, T. (2015) *lean and green supply chain management: a comprehensive review*, *Lean and green supply chain management*, pp.1-38

Farias, L. M. S., Santos, L. C., Gohr, Cláudia Fabiana and Rocha, L. O. (2019) "An ANP-based approach for lean and green performance assessment", *Resources, Conservation & Recycling*, Vol. 143, pp. 77–89.

Farias, L. M. S., Santos, L. C., Gohr, Claudia Fabiana, de Oliveira, L. C. and da Silva Amorim, M. H. (2019) "Criteria and practices for lean and green performance assessment:systematic review and conceptual framework", *Journal of Cleaner Production journal*, Vol. 218, pp. 746–762.

Farrukh, A., Mathrani, S. and Sajjad, A. (2021) "A natural resource and institutional theory-based view of green-lean-six sigma drivers for environmental management", *Business Strategy and the Environment*, *Vol. 31* No.3, pp.1074-1090..

Fercoq, A., Lamouri, S. and Carbone, V. (2016) "Lean/Green integration focused on waste reduction techniques", *Journal of Cleaner Production*, Vol. 137, pp. 567–578.

Firmansyah, M. A. and Maemunah, S. (2021) "Lean Management and Green Supply Chain Management Implementation on the Manufacturing and Logistics Industry at an Indonesia", *Business and Entrepreneurial Review*, Vol. 21 No.1, pp. 11–22.

Florescu, A. and Barabaş, B. (2018) "Integrating the lean concept in sustainable manufacturing development", in *IOP Conference Series: Materials Science and Engineering*. IOP Publishing, pp. 1–8.

Florida, R. (1996) "Lean and green: The move to environmentally conscious manufacturing", *California Management Review*, *California management review*, Vol. *39* No.1, pp. 80–105.

Gaikwad, L. and Sunnapwar, V. (2020) "An integrated lean, green and six sigma strategies: a systematic literature review and directions for future research", *TQM Journal*, Vol. 32 No.2, pp. 201–225.

Galeazzo, A., Furlan, A. and Vinelli, A. (2014) "Lean and green in action : interdependencies and performance of pollution prevention projects", *Journal of Cleaner Production*, Vol. 85, pp. 191–200.

Gandhi, N. S., Thanki, S. J. and Thakkar, J. J. (2018) "Ranking of drivers for integrated lean-green manufacturing for Indian manufacturing SMEs", *Journal of Cleaner Production*, Vol. 171, pp. 675–689.

Gandhi, S. and Sharma, N. (2014) "Lean manufacturing technology : a way to green business practice and sustainable", *Journal of Economic & Social Development,* Vol. 10 No.2, pp. 103–109.

Garza-Reyes, J. A. (2015) "Lean and green-a systematic review of the state of the art literature", *Journal of Cleaner Production*, Vol. 102, pp. 18–29.

Garza-reyes, J. A., Jacques, G. W. and Lim, M. K. (2014) "Lean and green – synergies, differences, limitations, and the need for six sigma", in *IFIP International Federation for Information Processing*. Berlin, Heidelberg: Springer, pp. 71–81.

Ghobakhloo, M., Azar, A., Fathi, M. and Authors, F. (2018) "Lean-green manufacturing: the enabling role of information technology resource", *Kybernetes*, Vol. 47 No.9, pp. 1752–1777.

Green, K. W., Inman, R. A., Sower, V. E. and Zelbst, P. J. (2019) "Impact of JIT, TQM and green supply chain practices on environmental sustainability", *Journal of Manufacturing Technology Management*, Vol. 30 No.1, pp. 26–47.

Haddach, A., Allal, L. Ben, Laglaoui, A. and Ammari, M. (2017) "Alliance of lean and green in company : a literature review and future research", *International Journal of Engineering Science Invention*, Vol. 6 No.7, pp. 26–31.

Hall, R. W. (2009) *Compression: Meeting the challenges of sustainability through vigorous learning enterprises*, *CRC press*.

Hallam, C. and Contreras, C. (2016a) "Integrating lean and green management", *Management Decision*, Vol. 54 No.9, pp. 2157–2187.

Hallam, C. R. . and Contreras, C. (2016b) "The interrelation of lean and green manufacturing practices: a case of push and pull in implementation", in *2016 Proceedings of PICMET '16: Technology Management for Social Innovation*, pp. 1815–1823.

Hammadi, S. and Herrou, B. (2018) "Lean maintenance logistics management: the key to green and sustainable performance", *Proceedings - GOL 2018: 4th IEEE International Conference on Logistics Operations Management*, pp. 1–6.

Harikannan, N., Palpandi, M. and Rajasuthan, K. (2018) "Enablers and barriers for integrated lean-green-agile manufacturing systems", *International Journal of Mechanical Engineering and Technology*, Vol. 9 No.11, pp. 320–324.

Harisekar, V. (2021) Increasing sustainability performance in a SME: focusing on lean and green, *Production systems*.

Hartini, S., Wicaksono, P. A., Rizal, A. M. . and Hamdi, M. (2021) "Integration lean manufacturing and 6R to reduce wood waste in furniture company toward circular economy", in *IOP Conference Series: Materials Science and Engineering*. IOP Publishing, p. 012067.

Huo, B., Gu, M. and Wang, Z. (2019) "Green or lean? A supply chain approach to sustainable performance", *Journal of Cleaner Production*, Vol. 216, pp. 152–166.

Ikatrinasari, Z. F., Hasibuan, S. and Kosasih, K. (2018) "The implementation lean and green manufacturing through sustainable value stream mapping", in *IOP Conference Series: Materials Science and Engineering*. IOP Publishing, p. 012004.

Inman, R. A. and Green, K. W. (2018) "Lean and green combine to impact environmental and operational performance", *International Journal of Production Research*, Vol. 56 No.14, pp. 4802–4818.

Jbira, K., Hlyal, M. and El Alami, J. (2020) "Integration of lean management for the growth of green manufacturing", in *IOP Conference Series: Materials Science and Engineering*, IOP Publishing, Vol. 827, No. 1, p. 012027.

Johansson, G. and Sundin, E. (2014) "Lean and green product development: two sides of the same coin?", *Journal of Cleaner Production*, Vol. *85*, pp.104-121..

Johansson, G. and Winroth, M. (2009) "Lean vs green manufacturing : similarities and differences", in *Proceedings of the 16th International Annual EurOMA Conference, Implementation Realizing Operations Management Knowledge*. Göteborg, Sweden, pp. 1–10.

Kaswan, M. S. and Rathi, R. (2019) "Analysis and modeling the enablers of green lean six sigma implementation using interpretive structural modeling", *Journal of Cleaner Production*, Vol. 231, pp. 1182–1191.

Kaswan, M. S. and Rathi, R. (2020) "Investigating the enablers associated with implementation of green lean six sigma in manufacturing sector using best worst method", *Clean Technologies and Environmental Policy*, Vol. 22 No.4, pp. 865–876.

Khan, M. P., Talib, N. A. and Kowang, T. O. (2020) "The development of a sustainability framework via lean green six sigma practices in SMEs based upon RBV theory", *International Journal of Innovation, Creativity and Change*, Vol. 12 No.5, pp. 135–156.

King, A. A. and Lenox, M. J. (2001) "Lean and green? An empirical examination of the relationship between lean production and environmental performance", *Production and Operations Management*, Vol. 10 No.3, pp. 244–256.

Kipper, L. M., Reis, L. V., Hoffmann, N., Forno, A. J. D. and Giraldo, F. D. (2018) "Lean and green indicators: an application in the coffee secto", *Agricultural Research & Technology: Open Access Journal*, Vol. 17 No.1, p. 556012.

Kovilage, M. P. (2020) "Influence of lean – green practices on organizational sustainable performance", *Journal of Asian Business and Economic Studies*.

Kumar, M. and Rodrigues, V. S. (2020) "Synergetic effect of lean and green on innovation: A resource-based perspective", *International Journal of Production Economics*, Vol. 219, pp. 469–479.

Kumar, S., Kumar, N. and Haleem, A. (2015) "Conceptualisation of sustainable green lean six sigma: an empirical analysi", *International Journal of Business Excellence*, Vol. 8 No.2, pp. 210–250.

Kuppusamy, B., Bangaru, M., Santhanam, S. and Viswanathan, D. (2017) "evaluation and identification of lean-green resourced person (LGRP) for integrating and implementing lean and green practices in a manufacturing industr", in *Proceedings of the ASME 2016 International Mechanical Engineering Congress and Exposition*, pp. 1–6.

Kurdve, M. and Bellgran, M. (2021) "Green lean operationalisation of the circular economy concept on production shop floor level", *Journal of Cleaner Production*, Vol. 278, p. 123223.

Lartey, T., Yirenkyi, D. O., Adomako, S., Danso, A., Amankwah-Amoah, J. and Alam, A. (2020) "Going green, going clean: lean-green sustainability strategy and firm growth", *Business Strategy and the Environment*, Vol. 29 No.1, pp. 118–139.

Leme, R. D., Nunes, A. O., Message Costa, L. B. and Silva, D. A. L. (2018) "Creating value with less impact: lean, green and eco-efficiency in a metalworking industry towards a cleaner production", *Journal of Cleaner Production*, Vol. 196, pp. 517–534.

Leong, W. D., Teng, S. Y., How, B. S., Ngan, S. L., Lam, H. L., Tan, C. P. and Ponnambalam, S. G. (2019) "Adaptive analytical approach to lean and green operations", *Journal of Cleaner*

Production, Vol. 235, pp. 190–209.

Leong, W. D., Lam, H. L., Ng, W. P. Q., Lim, C. H., Tan, C. P. and Ponnambalam, S. G. (2019) "Lean and green manufacturing—a review on its applications and impacts", *Process Integration and Optimization for Sustainability*, Vol. 3 No.1, pp. 5–23.

Leong, W. D., Teng, S. Y., How, B. S., Ngan, S. L., Rahman, A. A., Tan, C. P., Ponnambalam, S. G. and Lam, H. L. (2020) "Enhancing the adaptability: lean and green strategy towards the industry revolution 4.0", *Journal of Cleaner Production*, Vol. 273, p. 122870.

Leong, W. D., Lam, H. L., Tan, C. P. and Ponnambalam, S. G. (2021) "The Performance of Adaptive Approach in Lean and Green Operations", in *MATEC Web of Conferences*.. EDP Sciences, Vol. 333, p. 06006.

Lerher, T., Pejić, V., Jereb, B., Kramberger, T. and Rosi, B. (2016) "Lean and green logistics: a theorethical framework approach", in *13th International Conference on Industrial Logistics, ICIL 2016 - Conference Proceedings*, pp. 136–143.

Logesh, B., Nagaraj, P., Sankaran, P. S. and Raj, N. A. (2017) "A review on implementation of lean manufacturing techniques in manufacturing industry to deploy green manufacturing through reduction of hazardous waste", *International Research Journal of Engineering and Technology*, Vol. 4 No.11, pp. 2395–56.

Logesh, M. and Balaji, B. (2020) "Experimental investigations to deploy green manufacturing through reduction of waste using lean tools in electrical components manufacturing company", *International Journal of Precision Engineering and Manufacturing-Green Technology*, Vol. 8 No.2, pp. 365–374.

Malhotra, V. and Kumar, S. (2017) "The Literature Review of Lean and Green Manufacturing System", *International Journal of Theoretical and Applied Mechanics*, Vol. 12 No.3, pp. 389–393.

Marco-ferreira, A., Stefanelli, N. O., Seles, B. M. R. P., Fidelis, R., Michel, B. and Pais, R. (2019) "Lean and green: practices, paradigms and future prospects", *Benchmarking*, Vol. 27 No.7, pp. 2077–2107.

Mishra, M. N. (2018) "Identify critical success factors to implement integrated green and lean six sigma", *International Journal of Lean Six Sigma*.

Mittal, V. K., Sindhwani, R. and Kapur, P. K. (2016) "Two-way assessment of barriers to lean–green manufacturing system: insights from India", *International Journal of Systems Assurance Engineering and Management*, Vol. 7 No.4, pp. 400–407.

Mollenkopf, D., Stolze, H., Tate, W. L. and Ueltschy, M. (2010) "Green, lean, and global supply chains", *International Journal of Physical Distribution and Logistics Management*, Vol. 40 No.1/2, pp. 14–41.

Moro, S. R., Cauchick-miguel, P. A. and Campos, L. M. S. (2019) "Product-service systems towards eco-effective production patterns: a Lean-Green design approach from a literature review", *Total Quality Management*, Vol. 32 No. 9/10, pp.1046-1064.

Muñoz-Villamizar, A., Santos, J., Grau, P. and Viles, E. (2019) "Trends and gaps for integrating lean and green management in the agri-food sector", *British Food Journal*, Vol. 121 No.5, pp. 1140–1153.

Nallusamy, D. ., Dinagaraj, G. ., Balakannan, K. and Satheesh, S. (2015) "Manufacturing practices in small scale industries - a case study", *International Journal of Applied Engineering Research*, Vol. 10 No.62, pp. 143–146.

Oliveira, G. A., Tan, K. H. and Guedes, B. T. (2018) "Lean and green approach: an evaluation tool for new product development focused on small and medium enterprises", *International Journal of Production Economics*, Vol. 205, pp. 62–73.

Pampanelli, A. B., Found, P. and Bernardes, A. M. (2011) "A lean and green kaizen model", in *2011 POMS Annual Conference*, pp. 1–23.

Pampanelli, A. B., Found, P. and Bernardes, A. M. (2014) "A lean and green model for a production cell", *Journal of Cleaner Production*, Vol. 85, pp. 19–30.

Pampanelli, A. B., Found, P. and Bernardes, A. M. (2015) "Sustainable manufacturing : the lean and green business model", *Sustainable operations management*, Vol. 44, pp. 131–161.

Pampanelli, A., Trivedi, N. and Found, P. (2016) *The green factory creating lean and sustainable manufacturing*. CRC Press.

Parveen, C. M., Kumar, A. R. P. and Narasimha Rao, T. V. V. L. (2011) "Integration of lean and green supply chain - Impact on manufacturing firms in improving environmental efficiencies", in *Proceedings of the International Conference on Green Technology and Environmental Conservation, GTEC-2011*. IEEE, pp. 143–147.

Prasad, S., Khanduja, D. and Sharma, S. K. (2016) "An empirical study on applicability of lean and green practices in the foundry industry", *Journal of Manufacturing Technology Management*, Vol. 27 No.3, pp. 408–426.

Prasad, S. and Sharma, S. K. (2014) "Lean and green manufacturing: concept and its implementation in operations management", *International Journal of Advanced Mechanical Engineering*, Vol. 4 No.5, pp. 509–514.

Prasetyawan, Y. (2016) "Defining technology strategy for small to medium enterprise within lean and green manufacturing framework", in *Proceeding of 9th International Seminar on Industrial Engineering and Management*, pp. 1–7.

Queiroz, G., Cobra, R. L. R. ., Guardia, M Oliveira, J. A., Ometto, A. R. and Esposto, K. F. (2015) "The use of lean manufacturing practices in cleaner production: a systematic review", in *5th International Workshop Advances in Cleaner Production*, pp. 1–11.

Rachid, B. and Ayyad, C. (2017) "Supply chain improvement in LARG (lean, agile, resilient, green) context: a risk management approach", in *6th IEEE International Conference on Advanced Logistics and Transport (ICALT)*, pp. 212–220.

Rad, A. P. and Azizi, A. (2021) "History will repeat: industry 4.0 brought lean, agile, resilience and green", *Research Journal of Nanoscience and Engineering*, Vol. 5 No.1, pp. 9–14.

Rahman, M. and Ogunleye, J. (2019) "A lean, green and six sigma (LG6σ) for SMEs in the leather industry in Bangladesh", *International Journal of Entrepreneurship and Innovation*, Vol. 7 No.2, pp. 42–66.

Ramos, A. R., Ferreira, J. C. E., Kumar, V., Garza-Reyes, J. A. and Cherrafi, A. (2018) "A lean and cleaner production benchmarking method for sustainability assessment: A study of manufacturing companies in Brazil", *Journal of Cleaner Production*, Vol. 177, pp. 218–231.

Raut, R. D., Kumar, S., Narwane, V. S., Dora, M. and Liu, M. (2021) "Big data analytics as a mediator in lean, agile, resilient, and green (LARG) practices effects on sustainable supply chains", *Transportation Research Part E*, Vol. 145, p. 102170.

Reis, L. V., Giraldo, F. and Kipper, L. (2017) "Online platform for measuring the lean/green maturity level based on the SLG method", in *Proceedings of the International Conference on Industrial Engineering and Operations Management*, pp. 1001–1006.

Rodrigues, H. S., Alves, W. and Silva, Â. (2020) "The impact of lean and green practices on logistics performance: a structural equation modelling", *Production*, Vol. 30, pp. 1–14.

Rothenberg, S., Pil, F. K. and Maxwell, J. (2001) "Lean, green, and the quest for superior environmental performance", *Production and Operations Management*, Vol. 10 No.3, pp. 228–243.

Ruiz-Benitez, R., López, C. and Real, J. C. (2017) "Environmental benefits of lean, green and resilient supply chain management: the case of the aerospace sector", *Journal of Cleaner Production*, Vol. 167, pp. 850–862.

Sabadka, D. (2014) "Innovation lean principles in automotive green manufacturing", *Acta logistica*, Vol. 1 No.4, pp. 23–27.

Sartal, A., Llach, J., Vázquez, X. H. and de Castro, R. (2017) "How much does lean manufacturing need environmental and information technologies?", *Journal of Manufacturing Systems*, Vol. 45, pp. 260–272.

Sawhney, R., Teparakul, P., Bagchi, A. and Li, X. (2007) "En-Lean: a framework to align lean and green manufacturing in the metal cutting supply chain", *International Journal of Enterprise Network Management*, Vol. 1 No.3, pp. 238–260.

Shokri, A., Cherrafi, A. and Garza-reyes, J. A. (2021) "A readiness self-assessment model for implementing green lean initiatives", *Journal of Cleaner Production*, Vol. 309 No.April, pp. 1–10.

Siegel, R., Antony, J., Garza-Reyes, J. A., Cherrafi, A. and Lameijer, B. (2019) "Integrated green lean approach and sustainability for SMEs: from literature review to a conceptual framework", *Journal of Cleaner Production*, Vol. 240, p. 118205.

da Silva, A. F., Marins, F. A. S., Dias, E. X. and Ushizima, C. A. (2021) "Improving manufacturing cycle efficiency through new multiple criteria data envelopment analysis models: an application in green and lean manufacturing processes", *Production Planning and Control*, Vol. 32 No.2, pp. 104–120.

Simpson, D. F. and Power, D. J. (2005) "Use the supply relationship to develop lean and green suppliers", *Supply Chain Management*, Vol. 10 No.1, pp. 60–68.

Sindhwani, R., Mittal, V. K., Singh, P. L., Aggarwal, A. and Gautam, N. (2019) "Modelling and analysis of barriers affecting the implementation of lean green agile manufacturing system (LGAMS)", *Benchmarking*, Vol. 26 No.2, pp. 498–529.

Singh, C., Singh, D. and Khamba, J. S. (2020a) "Analyzing barriers of green lean practices in manufacturing industries by DEMATEL approach", *Journal of Manufacturing Technology Management*.

Singh, C., Singh, D. and Khamba, J S (2020b) "Understanding the key performance parameters of green lean performance in manufacturing industries", in *Materials Today: Proceedings*, Vol. 46, pp.111-115.

Singh, P. L., Sindhwani, R., Dua, N. K., Jamwal, A., Aggarwal, A., Iqbal, A. and Gautam, N. (2019) "Evaluation of common barriers to the combined lean-green-agile manufacturing system by two-way assessment method", in *Advances in Industrial and Production Engineering*. Springer Singapore, pp. 653–683.

Suhardini, P. N. and Hadiwidjojo, S. D. (2021) "Lean and green supply chain management in improving operational performance in sugar industry", *Journal of Applied Managemen*, Vol. 19 No.1, pp. 198–205.

Lufika, R.D. and Meutia, S., 2021, February. The integrated lean and green manufacturing system: a case study at the peeled loaf production. In *IOP Conference Series: Materials Science and Engineering*. IOP Publishing, Vol. 1082 No. 1, p. 012010.

Sumant, M. and Negi, A. (2018) "Review of lean-green manufacturing practices in SMEs for sustainable framework", *International Journal of Business Innovation and Research*, Vol. 17 No.1, pp. 38–64.

Szymanska-Bralkowska, M. and Malinowska, E. (2017) "The improvement of the company's environmental performance through the application of green lean/ lean and green approach", *Ekonomia i Prawo. Economics and Law*, Vol. 17 No.4, pp. 433–442.

Taubitz, M. (2010) "Lean, green and safe: integrating safety into the lean, green and sustainability movement", *Professional Safety*, Vol. 55 No.5, pp. 39–46.

Tayyab, M. and Sarkar, B. (2019) "Sustainable Lot Size in a Multistage Lean-Green Manufacturing Process under Uncertainty", *Mathematics*, Vol. *7* No.1 p.20..

Thanki, S., Govindan, K. and Thakkar, J. (2016) "An investigation on lean-green implementation practices in Indian SMEs using analytical hierarchy process (AHP) approach", *Journal of Cleaner Production*, Vol. 135, pp. 284–298.

Thanki, S. J. and Thakkar, J. (2018) "Interdependence analysis of lean-green implementation challenges: A case of Indian SMEs", *Journal of Manufacturing Technology Management*, Vol. 29 No.2, pp. 295–328.

Thanki, S. J. and Thakkar, J. J. (2016) "Value–value load diagram: a graphical tool for lean–green performance assessment", *Production Planning and Control*, Vol. 27 No.15, pp. 1280–1297.

Thanki, S. and Thakkar, J. (2018) "A quantitative framework for lean and green assessment of supply chain performance", *International Journal of Productivity and Performance Management*.

Thanki, S. and Thakkar, J. J. (2020) "An investigation on lean–green performance of Indian manufacturing SMEs", *International Journal of Productivity and Performance Management*, Vol. 69 No.3, pp. 489–517.

Thorne, N. (2021) *Towards Lean & Green production management in the pharmaceutical industry A framework for E-VSM and Kaizen event prioritization through a systematic literature review and case study at AstraZeneca*.

Tiwari, R. K. and Tiwari, J. K. (2016) "Green lean manufacturing: way to sustainable productivity improvement", *International Journal of Engineering Research and General Science*, Vol. 4 No.6, pp. 243–262.

Torielli, R. M., Abrahams, R. A., Smillie, R. W. and Voigt, R. C. (2010) "Using lean methodologies for economically and environmentally sustainable foundries", *China Foundry*, Vol. 8 No.1, pp. 74–88.

Udokporo, C. K., Anosike, A., Lim, M., Nadeem, S. P., Garza-Reyes, J. A. and Ogbuka, C. P. (2020) "Impact of lean, agile and green (LAG) on business competitiveness: an empirical study of fast moving consumer goods businesses", *Resources, Conservation & Recycling*, Vol. 156, p. 104714.

Venkat, K. and Wakeland, W. (2006) "Is lean necessarily green?", in *50th Annual Meeting of the International Society for the Systems Sciences 2006, ISSS 2006*. Sonoma, CA, USA, pp. 347–362.

Verma, N. and Sharma, V. (2021). Sustainability synergy with lean green and six sigma, *International Journal of Research and Analysis in Science and Engineering*, Vol 1 No.2, pp. 51–56.

Verrier, B., Rose, B. and Caillaud, E. (2016) "Lean and green strategy: the lean and green house and maturity deployment model", *Journal of Cleaner Production*, Vol. 116, pp. 150–156.

Viles, E., Santos, J., Muñoz-Villamizar, A., Grau, P. and Fernández-Arévalo, T. (2021) "Lean–green improvement opportunities for sustainable manufacturing using water telemetry in agri-food industry", *Sustainability (Switzerland)*, Vol. 13 No.4, pp. 1–12.

Vinayagasundaram, R., Ramkumar, V., Arasu, K. K. A. and Anax, S. (2020) "Implementation of business process re-engineering using lean and green strategy in manufacturing industry", in *AIP Conference Proceedings*. AIP Publishing, p. 020010.

Wadhwa, R. S. (2014) "Synergizing lean and green for continuous improvement", in *IFIP International Conference on Advances in Production Management Systems*, Springer, Berlin, Heidelberg, pp. 154–161.

Whyle, A. and Bland, R. (2017) "Application of green and lean production at Ricoh", *International Journal of Automation Technology*, Vol. 11 No.4, pp. 615–622.

Wiese, A., Luke, R., Heyns, G. J. and Pisa, N. M. (2015) "The integration of lean, green and best practice business principles", *Journal of Transport and Supply Chain Management*, Vol. 9 No.1, pp. 1–10.

Winroth, M. and Johansson, G. (2009) "A Manufacturing Strategy Perspective on Lean and Green Manufacturing A Manufacturing Strategy Perspective on Lean and Green Manufacturing", No.October 2018.

Yadav, V., Gahlot, P., Rathi, R., Yadav, G. and Kumar, A. (2021) "Integral measures and framework for green lean six sigma implementation in manufacturing environment", *International*

Journal of Sustainable Engineering, Vol. 14 No.6, pp. 1319–1331.

Zhu, Q. and 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*, Vol. *22* No. 3, pp. 265–289.

Zhu, X. Y. and Zhang, H. (2020) "Construction of lean-green coordinated development model from the perspective of personnel integration in manufacturing companies", *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, Vol. 234 No.11, pp. 1460–1470.

Zhu, X. Y., Zhang, H. and Jiang, Z. G. (2020) "Application of green-modified value stream mapping to integrate and implement lean and green practices: a case study", *International Journal of Computer Integrated Manufacturing*, Vol. 33 No.7, pp. 716–731.