

# **The Barriers and Critical Success Factors that Affect the Implementation of Lean Supply Chain Management in Medical Devices Companies**

**Hamizah Pardi, Mohd Nizam Ab Rahman, Nizaroyani Saibani  
and Rosdin Abdul Kahar**

Department of Mechanical and Manufacturing Engineering  
Faculty of Engineering & Built Environment,  
Universiti Kebangsaan Malaysia,  
Malaysia

[hamizahpardi@gmail.com](mailto:hamizahpardi@gmail.com), [mnizam@ukm.edu.my](mailto:mnizam@ukm.edu.my),  
[nizar@ukm.edu.my](mailto:nizar@ukm.edu.my), [rosdinkahar@gmail.com](mailto:rosdinkahar@gmail.com)

## **Abstract**

The objective of this study is to conduct a systematic literature review (SLR) to identify the barriers and critical success factors that influence in the implementation of Lean Supply Chain Management (LSCM) practices in the industry. Through the analysis systematic literature review, it is hoped to identify the main gaps related to LSCM implementation in literature and industry and also discusses the relevance of research in this topic for indicating the future research direction. A SLR method was used, developed and determined. It is about 48 research articles were analyzed. The content of the present literature was reviewed, critically analyzed and synthesized from the perspective of barrier and critical success factors that influence the implementation of LSCM. Based on the extensive systematic review of the literature, we discovered the consistency data between Barriers and Critical Success Factors. This study strengthens the body of knowledge on the issue and consolidates the key LSCM activities, extending previous studies on LSCM barriers and critical success factors associated with its implementation. The clear identification of these topics can allow researchers and practitioners to predict occasional problems and to set the right standards for the implementation of the LSCM.

## **Keywords**

Lean; Supply Chain Management; Lean supply chain management; Barriers; Critical Success Factor; Systematic literature review

## **1. Introduction**

A supply chain is a dynamic structure that consists of technology, people, organization, information, activities and resources. The supply chain does not only apply to manufacturing firms only; it also applies to service firms, which are increasingly focusing on supply chain management to ensure that their customers receive prompt service (Alomari 2021). Activities in the supply chain turn natural commodities, raw materials and components into semi-finished and finished goods that are then delivered to end customer and distributors (Zhou & Ji 2015).

The growing emphasis on sustainability in supply chain management (SCM) has contributed to the growth of a distinct area of interest for over the last three decades: sustainable supply chain management SSCM (Pagell and Shevchenko, 2014). International business strategy has shifted in recent years. The entire distribution of raw materials to consumers is known as an integrated whole in lean supply chain. Therefore, interfaces between phases i.e. between companies-suppliers and customers) are seen as artificial, created not as normal stages of transition in the development of value, but as a result of the economic arrangement of properties controlled by many variable. The variables are convenient configurations of technology, labor skills and geographical location of raw materials (Lamming 1996). The supply chain management requires operational and supply chain alignment, scheduling and cooperation of functions such as planning of distribution, market analysis, ordering, production planning, warehousing, material handling, inventory, packing, order processing and shipping. In today's business worlds, all of these functions are used as building blocks in the supply chain management (Agus 2012).

The Toyota Production System (TPS) is the benchmark utilized all through the world as the establishment for "lean" thinking. At Toyota, the TPS practices and standards expand well past the manufacturing plant dividers to incorporate the all-inclusive production network and require some urgent decisions to guarantee supply chain effectiveness (Lander and Liker 2007).

The objective of this study is to perform a systematic literature review to identify the barrier and critical success factor in implementation of lean supply chain management and contextual factor that influence it. Through this literature review, it is expected to identify the main gap related to lean supply chain implementation and discuss the relevance of the research in this topic, so can lead to future research directions.

### **1.1 Objectives**

The objective of this study is to conduct a systematic literature review to identify the barriers and critical success factor that influence in implementation of Lean Supply Chain Management (LSCM) practices in industry.

## **2. Literature Review**

There are two types of literature review ; traditional literature review and systematic review (Jesson et al. 2011). The literature review is a written product is a literature review; the style may varies depending on the review 's intent. The review will be the part of dissertation and study project and it's also can be stand-alone review (Jesson et al. 2011).The systematic review's approach and presentation of are methodical and repeatable. They entail a thorough search for all relevant published and unpublished work on a topic, a systematic integration of search results, and a critical assessment of the scope, nature, and quality of evidence in connection to a specific research issue (Siddaway et al. 2018). Reason for implement lean is to reduce cost, fullfill management decision and to develop the organization (Albjorn 2011). The stage of lean implementation in a factory influences which factors are perceived as more effective than others to a small extent (Netland 2015).

## **3. Methods**

Jesson et al. 2011 define a systematic review as a review with a clear stated purpose, a question, a defined search approach, stating inclusion and exclusion criteria, producing a qualitative appraisal of articles. Systematic literature review (SLR) is a method that systematically explores current research literature to “produce a structured overview of the field” (Pickering & Byrne 2013). Systematic reviews address the issue about how primary study is carried out, how various techniques and methods suit the task, the impact of what needs to be clarified and to how primary research will fill the gaps (Gough et al. 2012). Systematic reviews search, evaluate and collate all relevant empirical evidence in order to provide a complete interpretation result of research. Although conventional SRs are typically used in social sciences and clinical research, they have found application in many subject areas for example in basic science research, engineering, environmental science, advertising, education, international development, public policy and ecology (O’Hagan et al. 2018, Gilbody 2005, Pullin & Stewart 2006 & Petticrew 2001). The importance of the guideline of systematic review of a literature base is to avoid bias and reliable assessment was carried out (Tranfield 2003).

The search for articles is can be search in targeted webite (Godin et al. 2015). The search of article mainly conducted using the online journal databases:

- Sciencedirect
- PubMed
- Wiley Online Library
- Emerald

The keyword for search the online journal has been selected from Berger et al. 2018 , Alkhoraif et al. 2018 , Martinez-Jurado & Moyano-Fuentes 2014, Parmar & Shah 2016 , Tebaldi et al. 2018, Hugo & Cabrita 2015 and Tortorella 2017. The search dimension is restricted to the keywords:

- Lean
- Lean management
- Lean supply chain
- Lean supply chain management
- Supply Chain
- Critical success factor
- Critical success factor in lean
- Critical success factor in lean management
- Systematic literature review
- Barrier

This study adopts the classification system proposed by Durach et al. 2017 and such system involves the following six steps:

- Step 1: Defining the research question;
- Step 2: Determining the required characteristics of primary studies;
- Step 3: Locating a representative sample of potentially relevant literature;
- Step 4: Selecting the relevant literature;
- Step 5: Synthesizing the literature;
- Step 6: Reporting the outcome;

The screening and the selection process was figured out by Tawfik et al. 2019 which the process is called Prisma flow diagram. The figure has shown the screening of 7449 papers to 48 papers. Centobelli et al. (2017) applied three selection criteria to direct the focus of the research papers closer to the desired topic. Firstly, the abstracts describe about the critical success factor and/or barrier in lean supply chain management. Secondly, the content is related to the topic. Finally, it is necessary to search for related references cited in the literature but not in Scopus.

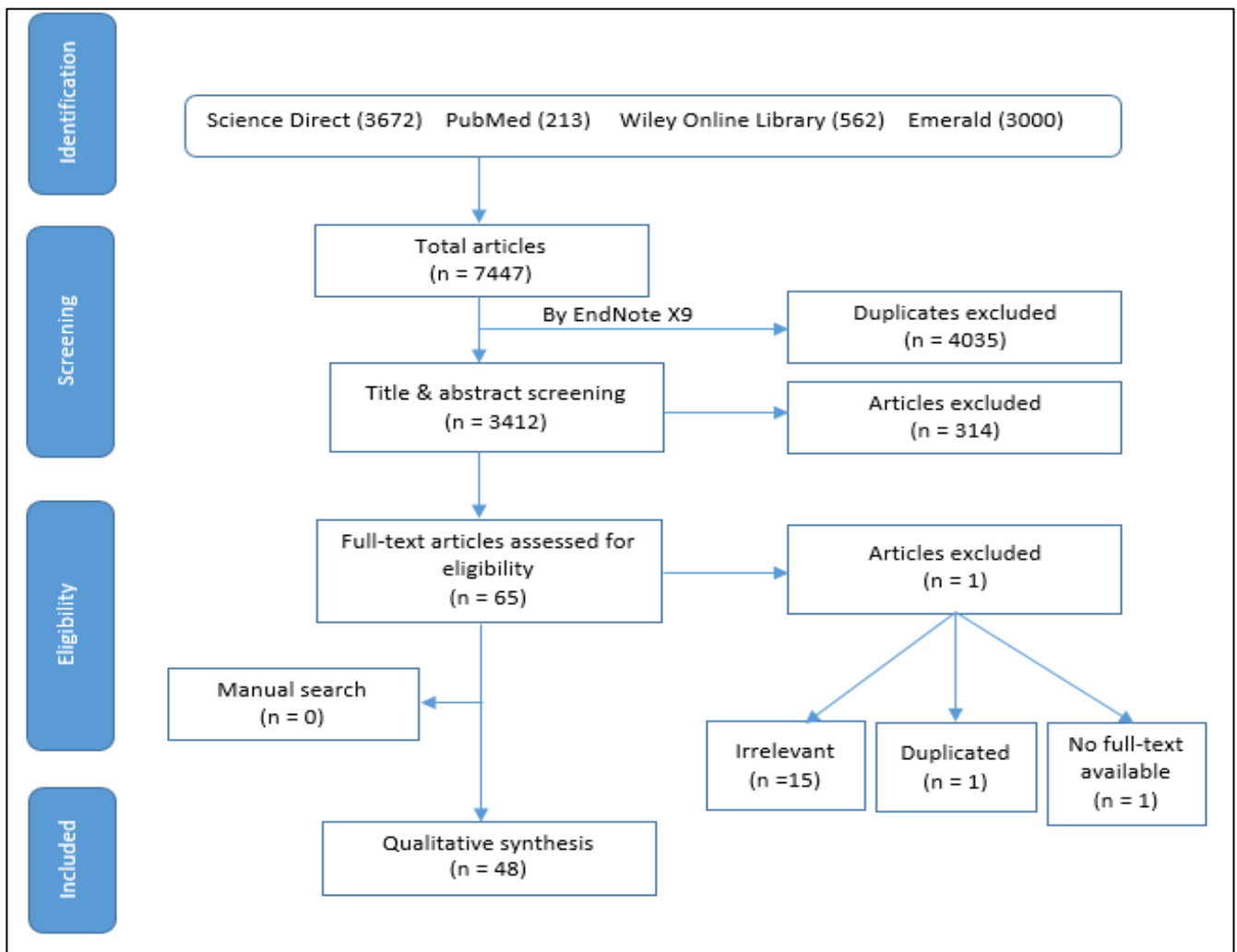


Figure 1. PRISMA flow diagram of studies' screening and selection (Tawfik et al. 2019).

#### 4. Data Collection

There are 48 of selected articles were selected for the systematic literature review. The papers were analyzed for the Research Field, the Barriers and Critical Success Factors in lean supply chain implementation.

## 5. Results and Discussion

### 5.1 Graphical Results

#### 5.1.1 The research field by sector

The Figure 2 was present the research field by sector from the 48 selected papers. According to the findings of this review article, the manufacturing sector had the highest rank with 52%. The second rank was fall to healthcare sector with rank 15% then followed by pharmaceutical and automotive with rank 4% respectively. Furthermore, it was discovered that the manufacturing sector ranked highest among all other sectors, with results reported in the majority of published papers (Mardani 2019).

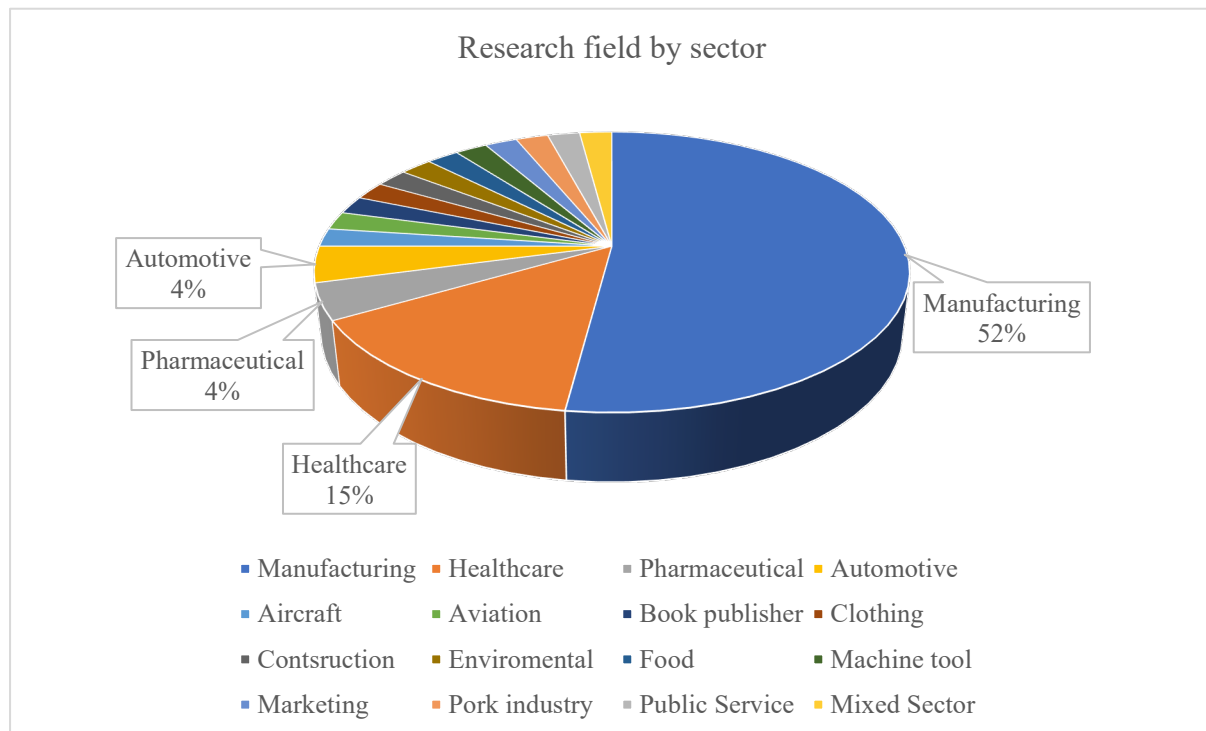


Figure 2. The research field by sector from the 48 selected papers.

#### 5.1.2 The barriers that affects the implementation of lean supply chain

This section contains all the factors that may affect the organization to successfully implement lean supply chain management practices are assess. It is important to realize that many distinctive factors mentioned above here substantial impact on any organization attempting to implement lean supply chain management. However, understanding how these elements play a role in lean implementation in the context of lean supply chain management. Table 1 presents an overview of the barrier that affect the implementation of lean supply chain management.

Table 1. The barriers in lean supply chain management implementation.

No	Barrier	Abideen and Mohamad (2019)	Aronsson et al. (2011)	Borges et al. (2019)	Campos and Varquez-Brust (2016)	Das (2017)	Gligor et al. (2015)	Guimarães et al. (2013)	Frazzon et al. (2017)	Jasti and Kurra (2017)	Singh et al. (2016)	Manzouri et al. (2013)	Marodin et al. (2017)	Martínez-Jurado and Moyano-Arif-Uz-Zaman and Ahsan (2014)	Perez et al. (2010)	Sharma et al. (2015)	Baliga et al. (2020)	Piercy and Rich (2015)	Dixit et al. (2019)	Moyano-Fuentes et al. (2020)	Almutairi et al. (2019)	Qrunfleh and Tarafdar (2013)	Kolawole et al. (2021)	Zhao et al. (2021)	Mohaghegh et al. (2021)	
1	Managerial and technical barrier	Commitment from the management.	•	•						•	•				•	•								•		
2		Employee lack of training and skills.										•					•		•					•		
3		Lack of system view or strategy.		•		•																	•			
4		Lack of flexibility.		•					•																	
5		Unsmooth information transfer.											•									•		•	•	
6		Lack of planning.							•						•											
7		Low attitude.																		•						
8	Economic barriers	Cost for implementation.		•								•												•		
9		Lack of financial.					•												•							
10		Lack of organizational incentive.				•	•																			
11	Social barriers	Employee resistance to change in lean implementation.									•					•		•								
12		Low awareness of lean in lean implementation.									•	•													•	
13		Organizational culture of the company.										•														
14		Lean customer relationship negatively moderates the effect.													•											
15		Lack of communication.																				•				

### 5.1.3 The critical success factor that affects the implementation of lean supply chain

Table 2 is an overview of the critical success factor that affect the implementation of lean supply chain management.

Table 2. The Critical Success Factor in lean supply chain management implementation.

No.	Critical Success Factor	Sharma et al. (2015)	Agus and Hajinoor (2012)	Al-Shboul et al. (2017)	Çankaya (2020)	Carvalho et al. (2011)	Das (2017)	Arlbjørn et al. (2011)	Gligor et al. (2015)	Govindan et al. (2014)	Frazzon et al. (2017)	Marodin et al. (2017)	Perez et al. (2010)	Qrunfleh and Tarafdar (2013)	Piercy and Rich (2015)	Moyano-Fuentes et al. (2020)	Almutairi et al. (2019)	Saxby et al. (2020)	Stavroulaki and Davis (2010)	Hofer et al. (2021)	
1	Relationship with supplier		•																		
2	Top management gives commitment and support in lean implementation.					•	•	•					•		•						
3	Effort in lean implementation						•	•													
4	Training and education for the employee for lean implementation.	•											•								
5	Management leadership in lean implementation.									•	•										
6	Financial capability of company in lean implementation.			•					•												
7	Performance measurement in lean implementation.					•															
8	Lean awareness	•																			
9	Continuous improvement		•																		
10	Adequate support from middle level managers						•														
11	Supply chain strategies				•																
12	Contribution of managers				•																
13	Strategic plan in lean implementation														•						
14	Flexibility with partners			•																	
15	Customer relationship			•																	

After reviewing the Critical Success Factor (CSF) to implementing lean supply chain management in the organization and the Barrier for its success, we observe that there is a consistency among them, which confirms the validity of what we have achieved in our research. The consistency data of 5 main data was compiled in Table 3. The consistency data gives the organization a clear view of what to do and what to avoid during adopt lean methodology (Ayoub et al. 2019).

Table 3. The consistency among Barriers and Critical Success Factor for implementation lean supply chain management in organization.

Critical Success Factor	Barrier
Commitment and support from top management	Commitment from the management
Lean awareness	Low awareness
Strategic plan	Lack of planning
Training and education for the employee	Employee lack of training and skills
Financial capability of company	Lack of financial

## 6. Conclusion

In this study, we highlighted the main organizational and managerial features of the organization and the need to adopt a lean methodology in the management of these organization, as well as the main obstacles to the application of this methodology and the critical success factors of its implementation.

The objective of this study is to conduct a systematic literature review to identify the barriers and critical success factor that influence in implementation of Lean Supply Chain Management (LSCM) practices in industry.

Through this systematic literature review, it is expected to identify the main gaps related to LSCM implementation in industry and discuss the relevance of research in this topic for indicating the future research direction.

The results reveals that “relationship with supplier” was the top critical success factor. Then following by “commitment and support by top management”, “effort in lean implementation”, “training and education” and “management leadership” as the key of critical success factor in lean implementation in any organization.

Furthermore, the results showed that “lack of management commitment and leadership”, “lack of training and skills”, “lack of system view or strategy” “lack of flexibility” and “reluctant to exchange information” are the most critical barriers hence these should be considered as the foundation of any lean implementation project in any organization. The study also suggested that employees should have a basic understanding of lean and its benefits from the start in order for them to participate actively. Furthermore, commitment from the top management was found to be a dominating factor in organization. Greater management needed together with increasing costs and high complexity to improve efficiency (Borges et al. 2019).

## References

- Ab Rahman, M.N., Wasilan, H., Deros, B.M. and Ghani, J.A., Barriers of SCM in SMEs. *Applied Mechanics and Materials*, 44-47, pp. 3997-400, 2011.
- Abideen, A. Z. and Mohamad, F.B., Supply chain lead time reduction in a pharmaceutical production warehouse – a case study, *International Journal of Pharmaceutical and Healthcare Marketing*, vol. 14, no. 1, pp. 61–88, 2019.
- Adler, S., The relation between long-term seating comfort and driver movement, Dipl.-Sportwiss, Friedrich-Schiller-Universität Jena, 2007.
- Agarwal, A. and Sharma, M. K., Lean management – a step towards sustainable green supply chain, *Competitiveness Review*, vol. 26, no.3, pp. 311–331, 2016.
- Agus, A., and Hajinoor, M.S., Lean production supply chain management as driver towards enhancing product quality and business performance, *International Journal of Quality & Reliability Management*, vol.29, no.1, pp. 92–121, 2012.
- Alkhorraif, A., Rashid, H. and McLaughlina, P., Lean Implementation in small and medium enterprises: Literature review, *Operations Research Perspectives*, pp.2214-7160, 2018.
- Alomari, K. M., Identifying critical success factors in designing effective and efficient supply chain structures: A literature review, *Uncertain Supply Chain Management* 447–456, 2021.
- Almutairi, A. M., Salonitis, K. and Al-Ashaab, A., A framework for implementing lean principles in the supply chain management at health-care organizations, *International Journal of Lean Six Sigma*, 11(3), 463–492, 2019.
- AlManei, M., Salonitis, K. and Xu, Y., Lean Implementation Frameworks: The Challenges for SMEs, *Procedia CIRP* 63, pp. 750–755, 2017.
- Al-Shboul, M. A., Garza-Reyes, J. A. and Kumar, V., Best Supply Chain Management Practices and High-Performance Firms: The Case of Gulf Manufacturing Firms, *International Journal of Productivity and Performance Management*, 2018.
- Al-Shboul, M. A. R., Barber, K. D., Garza-Reyes, J. A., Kumar, V. and Abdi, M. R., The effect of supply chain management practices on supply chain and manufacturing firms’ performance, *Journal of Manufacturing Technology Management*, vol.28, no.5, pp.577–609, 2017.
- Ansari, Z.N., Kant, R. and Shankar, R., Prioritizing the Performance Outcomes due to adoption of Critical Success Factors of Supply Chain Remanufacturing, *Journal of Cleaner Production*, 2018.
- Antonson, H., Ahlström, C., Mårdh, S., Blomqvist, G. and Wiklund, M., Landscape heritage objects’ effect on driving: a combined driving simulator and questionnaire study, *Accident Analysis and Prevention*, vol.62, no.1, pp.168-177, 2014.
- Arif-Uz-Zaman, K. and Nazmul Ahsan, A.M.M., Lean supply chain performance measurement, *International Journal of Productivity and Performance Management*, vol.63, no.5, pp. 588–612, 2014.
- Arlbjørn, J.S, Freytag, V. P. and de Haas, H. Service supply chain management, *International Journal of Physical Distribution & Logistics Management*, vol.41, no.3, pp.277–295, 2011.
- Aronsson, H., Abrahamsson, M. and Spens, K., Developing lean and agile health care supply chains, *Supply Chain Management: An International Journal*, vol.16, no.3, pp.176–183, 2011.

- Aslam, S. and Emmanuel, P. Formulating a researchable question: A critical step for facilitating good clinical research, *Indian Journal of Sexually Transmitted Diseases and AIDS*, vol.31, no.1, 2010.
- Auberlet, J.M., Rosey, F., Anceaux, F., Aubin, S., Briand, P., Pacaux, M.P. and Plainchault, P., The impact of perceptual treatments on driver's behavior: from driving simulator studies to field tests-first results. *Accident Analysis and Prevention*, vol.45, no.2, pp.91-98, 2012.
- Ayoub, E., Faycal, F., Alami and El., A.S., Barriers and Critical Success Factors for Implementing Lean Manufacturing in SMEs, *IFAC-PapersOnLine*. vol.52, no.13, pp.565–570, 2019.
- Azyan, Z.H.A., Pulakanam.V. and Pons. D., Success factors and barriers to implementing lean in the printing industry: A case study and theoretical framework, *Journal of Manufacturing Technology Management*, vol. 28, no.4, pp.458-484, 2017.
- Baliga, R., Raut, R. and Kamble, S., The effect of motivators, supply, and lean management on sustainable supply chain management practices and performance, *Benchmarking: An International Journal*, vol.27, no.1, 347–381, 2019.
- Berger, S.L.T, Tortorella, G.L. and Rodriguez, C.M.T., Lean Supply Chain Management: A Systematic Literature Review of Practices, Barriers and Contextual Factors Inherent to Its Implementation, *Progress in Lean Manufacturing, Management and Industrial Engineering*, Chapter 2, pp.39-68.
- Bhasin, S., Prominent obstacles to lean, *International Journal of Productivity and Performance Management* vol.61, no.4, pp.403 – 425, 2012.
- Borges, G. A., Tortorella, G., Rossini, M. and Portioli-Staudacher, A., Lean implementation in healthcare supply chain: a scoping review, *Journal of Health Organization and Management*, 2019.
- Bougard, C., Moussay, S. and Davenne, D., An assessment of the relevance of laboratory and motorcycling tests for investigating time of day and sleep deprivation influences on motorcycling performance, *Accident Analysis and Prevention*, vol.40, no.2, pp.635-643, 2008.
- Campos, L. M. S. and Vazquez-Brust, D. A., Lean and green synergies in supply chain management, *Supply Chain Management: An International Journal*, vol.21, no.5, pp.627–641, 2016.
- Çankaya, S. Y., The effects of strategic sourcing on supply chain strategies, *Journal of Global Operations and Strategic Sourcing*, vol.13, no.2, pp. 129-148, 2020.
- Carvalho, H., Duarte, S. and Cruz Machado, V., Lean, agile, resilient and green: divergencies and synergies. *International Journal of Lean Six Sigma*, vol.2, no.2, pp.151–179, 2011.
- Centobelli, P., Cerchione, R. and Esposito, E., Knowledge management in startups: systematic literature review and future research agenda., *Sustainability*, vol.9, no.3, pp.361, 2017.
- Costanzo, A., Graziani, G. and Orsi, G., Driving ergonomics: New methodology for the assessment of stresses on upper limbs, *Safety Science Monitor*, vol.3, no.2, pp.1-11, 1999.
- Das, D., Development and validation of a scale for measuring Sustainable Supply Chain Management practices and performance, *Journal of Cleaner Production*, vol.164, pp.1344-1362, 2017.
- Das, D., The impact of Sustainable Supply Chain Management practices on firm performance: Lessons from Indian organizations, *Journal of Cleaner Production*, 2018.
- Dauber, D., Fink, G. and Yolles, M., A configuration model of organizational culture, *SAGE Open*, vol.2, no.1, pp.1-16, 2012.
- Dixit, A., Routroy, S. and Dubey, S. K., A systematic literature review of healthcare supply chain and implications of future research, *International Journal of Pharmaceutical and Healthcare Marketing*, vol.13, no.4, pp.405-435, 2019.
- Dora, M., Kumar, M. and Gellynck, X., Determinants and barriers to lean implementation in food-processing SMEs – a multiple case analysis, *Production Planning & Control*, vol.27, no.1, pp.1-23, 2015.
- Döring, T., Kern, D., Marshall, P., Pfeiffer, M., Schöning, J., Gruhn, V. and Schmidt, A., Gestural interaction on the steering wheel: reducing the visual demand, *Proceedings of the 2011 Annual Conference on Human Factors in Computing Systems*, 2011, pp.483-492.
- Duarte, S. and Cruz Machado, V., Green and lean implementation: an assessment in the automotive industry. *International Journal of Lean Six Sigma*, vo.8, no.1, pp.65–88, 2017.
- Dües, C. M., Tan, K. H. and Lim, M., 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, 2013.
- Durach, C.F., Kembro, J. and Wieland, A.A new paradigm for systematic literature reviews in supply chain management, *Journal of Supply Chain Management* , vol.53, no.4, 2017.
- Fatollahzadeh, K., A laboratory vehicle mock-up research work on truck driver's selected seat position and posture: A mathematical model approach with respect to anthropometry, body landmark locations and discomfort, Doctoral Thesis, Royal Institute of Technology, 2006.
- Florimond, V., *Basics of surface electromyography applied to physical rehabilitation and biomechanics*, Volume 1, Montreal, Canada: Thought Technology Ltd, 2009.
- Frazzon, E., Tortorella, G. L., Dávalos, R., Holtz, T. and Coelho, L., Simulation-based analysis of a supplier-manufacturer relationship in lean supply chains, *International Journal of Lean Six Sigma*, vol.8, no.3, 262–



- 274, 2017.
- Fouladi, M. H., Inayatullah, O. and Ariffin, A. K., Evaluation of seat vibration sources in driving condition using spectral analysis, *Journal of Engineering Science and Technology*, vol.6, no.3, pp. 339-356, 2011.
- Found, P. and Harrison, R., Understanding the lean voice of the customer, *International Journal of Lean Six Sigma*, vol.3, no.3, pp. 251–267, 2012.
- Garfield, E., The history and meaning of the journal impact factor, *JAMA*, vol.295, no.1, pp.90-93, 2006.
- Gilbody, S., Benefits and harms of direct to consumer advertising: a systematic review, *Quality and Safety in Health Care*, vol.14, no.4, pp. 246–250, 2005.
- Giunipero, L.C., Hooker, R.E. and Denslow, D., Purchasing and supply management sustainability : Drivers and barriers, *Journal of Purchasing Supply Management*, vol.18, pp.258-269, 2012.
- Gligor, D. M., Esmark, C. L., and Holcomb, M. C., Performance outcomes of supply chain agility: When should you be agile? *Journal of Operations Management*, pp.33-34, pp.71-82, 2015.
- Gyi, D.E., Porter, J.M. and Robertson, N.K., Seat pressure measurement technologies: considerations for their evaluation. *Applied Ergonomics*, vol.29, no.2, pp. 85-91, 1998.
- Godin, K., Stapleton, J., Kirkpatrick, S. I., Hanning, R. M. and Leatherdale, S. T., Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Systematic Reviews*, vol.4, no.1, 2015.
- Gough, D., Oliver, S. and Thomas, J., *An Introduction to Systematic Reviews*, Sage Publications, London, pp.289, 2012.
- Govindan, K., Azevedo, S. G., Carvalho, H. and Cruz-Machado, V., Impact of supply chain management practices on sustainability, *Journal of Cleaner Production*, vol.85, pp. 212–225, 2014.
- Grove, A.L, Meredith, J.O., MacIntyre, J., Angelis, M. and Neailey, K., UK health visiting: challenges faced during lean implementation, *Leadership in Health Services*, vol.23, no.3, pp. 204-218, 2010.
- Gupta, U. and Ramesh, A., The Barriers of Health Care Supply Chain in India: The Contribution and Interaction of Factors, *Procedia - Social and Behavioral Sciences*, vol.189, pp.217-228, 2015.
- Haffar, M., Al-Karaghoul, W. and Ghoneim, A., An analysis of the influence of organizational culture on TQM implementation in an era of global marketing: the case of Syrian manufacturing organizations, *International Journal of Productivity and Quality Management*, vol.11, no.1, 96-115, 2013.
- Hartono, Y., Astanti, R. D. and Ai, T. J. Enabler to Successful Implementation of Lean Supply Chain in a Book Publisher, *Procedia Manufacturing*, vol. 4, pp.192–199, 2015.
- Hirao, K., Kitazaki, S. and Yamazaki, N., Development of new driving posture focused on biomechanical loads, *SAE International Journal*, vol.100, no.3, pp. 5-10, 2006.
- Hofer, C., Barker, J. and Eroglu, C., Interorganizational imitation in supply chain relationships: The case of inventory leanness, *International Journal of Production Economics*, 2021.
- Hugo, A. and Cabrita, M.R., Developing a Lean Supply Chain Performance Framework in a SME: A Perspective Based on the Balanced Scorecard, *Procedia Engineering*, vol.131, pp.270–279, 2015.
- Jabbour, B.L.S A., Junior, C.O J. and Jabbour, J.C., Extending lean manufacturing in supply chains: a successful case in Brazil, *Benchmarking: An International Journal*, vol.21, no.6, 1070–1083, 2014.
- Jasti, N. V. K. and Kurra, S., An empirical investigation on lean supply chain management frameworks in Indian manufacturing industry, *International Journal of Productivity and Performance Management*, vol.66, no.6, pp. 699–723, 2017.
- Jayaram, J., Choon Tan, K. and Laosirihongthong, T., The contingency role of business strategy on the relationship between operations practices and performance, *Benchmarking: An International Journal*, vol.21, no. 5, pp.690–712, 2014.
- Jorgensen, L.M., Hauser, F., Cazzamali, G., Williamson, M. and Grimmelikhuijzen, C.J.P., Molecular identification of the first SIFamide receptor, *Biochem. Biophys. Res. Commun*, vol.340, no.2, pp.696-701, 2006.
- Kamp, I., The influence of car-seat design on its character experience, *Applied Ergonomics*, vol.43, no.2, pp.329-335, 2012.
- Keene, D., Guide for assessing ankle range of movement for the AIM trial, *Oxford, UK: Ankle Injury Management (AIM)*, 2010.
- Khorasani, S. T., Cross, J. and Maghazei. O., Lean supply chain management in healthcare: a systematic review and meta-study, *International Journal of Lean Six Sigma*, 2019.
- Kolawole, O.A., Mishra, J.L. and Hussain, Z., Addressing food waste and loss in the Nigerian food supply chain: Use of Lean Six Sigma and Double-Loop Learning, *Industrial Marketing Management*, 2021.
- Lamming, R., Squaring lean supply with supply chain management, *International journal of operations & production management*, vol.16, no.2, pp.183-196, 1996.
- Lande, M., Shrivastava. R.L. and Seth, D., Critical success factors for Lean Six Sigma in SMEs (small and medium enterprises), *The TQM Journal*, vol.28, no.4, pp.613-635, 2016.
- Lander, E. and Liker, J.K., 2007. The Toyota Production System and art: making highly customized and creative

- products the Toyota way, *International Journal of Production Research*, vol.45, no.16, pp.3681-3698, 2007.
- Li, J., Fang, H. and Song, W., Sustainable supplier selection based on SSCM practices: A rough cloud TOPSIS Approach, *Journal of Cleaner Production*, 2019.
- Guimarães, M. C., Carvalho, J.C. and Maia, A. Vendor managed inventory (VMI): evidences from lean deployment in healthcare, *Strategic Outsourcing: An International Journal*, vol.6, no.1, pp.8–24, 2013.
- Hajmohammad, S., Vachon, S., Klassen, R. D. and Gavronski, I., Reprint of Lean management and supply management: their role in green practices and performance, *Journal of Cleaner Production*, vol.56, pp.86–93, 2013.
- Maël, A., Etienne, P. and Vincent, R., Multimodal approach to automobile driving comfort: The influence of visual setting on assessments of vibro-acoustic comfort in simulators, *Applied Acoustics*, vol.74, no.12, pp.1378-1387, 2013.
- Mardani, A., Kannan, D., Hooker, R. E., Ozkul, S., Alrasheedi, M. and Tirkolaee, E. B., Evaluating of Green and Sustainable Supply Chain Management Using Application of Structural Equation Modelling: A systematic review of the state of the art literature and recommendations for future research, *Journal of Cleaner Production*, 119383, 2019.
- Marodin, G.A., Tortorella, G.L., Frank, A.G. and Filho, M.G., The moderating effect of Lean supply chain management on the impact of Lean shop floor practices on quality and inventory, *Supply Chain Management: An International Journal*, 2017.
- Martínez-Jurado, P. J. and Moyano-Fuentes, J., Lean Management, Supply Chain Management and Sustainability: A Literature Review, *Journal of Cleaner Production*, vol.85, pp.134–150, 2014.
- Mansfield, N. J., Sammonds, G., Darwazeh, N., Massoud, S., Mocio, A., Patel, T. and Sehdev, A., Movement analysis to indicate discomfort in vehicle seats, *1st International Comfort Congress*, pp.7-8, 2017.
- Manzouri, M., Ab Rahman, M.N., Saibani, N. and Zain, R.C.M., Lean supply chain practices in the Halal Food, *International Journal of Lean Six Sigma*, vol.4, no. 4, 389-408, 2013.
- Miranda, R. and Garcia-Carpintero, E., Overcitation and overrepresentation of review papers in the most cited papers, *Journal of Informetrics*, vol.12, no. 4, pp.1015-1030, 2018.
- Mohaghegh, M., Blasi, S. and Gröbler, A., Dynamic capabilities linking lean practices and sustainable business performance, *Journal of Cleaner Production*, pp.322, 2021.
- Mossey, M. E., Xi, Y., McConomy, S.K., Brooks, J.O., Rosopa, P.J. and Venhovens, P.J., Evaluation of four steering wheels to determine driver hand placement in a static environment, *Applied Ergonomics*, vol.45, no.4, pp.1187-1195, 2014.
- Netland, T.H., Critical success factors for implementing lean production: the effect of contingencies, *International Journal of Production Research*, 2015.
- O'Hagan, E.C., Matalon, S. and Riesenber, L.A., Systematic reviews of the literature: a better way of addressing basic science controversies, *American Journal of Physiology-Lung Cellular and Molecular Physiology*, vol.314, no.3, pp.439 - 442, 2018.
- Parmar, V. and Shah, H.G., A literature review on supply chain management barriers in manufacturing organization, *International Journal of Engineering Development and Research*, vol.4, no.1, 2014.
- Perez, C., de Castro, R., Simons, D. and Gimenez, G., Development of lean supply chains: a case study of the Catalan pork sector, *Supply Chain Management: An International Journal*, vol.15, no.1, pp.55-68, 2010.
- Petticrew, M., Systematic reviews from astronomy to zoology: myths and misconceptions, *BMJ*, vol.322, no.7278, pp.98–101, 2001.
- Piercy, N. and Rich, N., The relationship between lean operations and sustainable operations. *International Journal of Operations & Production Management*, vol.35, no.2, pp.282–315, 2015.
- Pickering, C. and Jason, B., The benefits of publishing systematic quantitative literature reviews for PhD candidates and other early-career researchers. *Higher education research & development*, vol.33, no.3, pp.534–548, 2014.
- Porter, J.M. and Gyi, D.E., Low back trouble and driving. *Proceedings of the 2nd International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS'95)*, 1995, pp.117-119.
- Pullin, A.S. and Stewart, G.B., Guidelines for systematic review in conservation and environmental management, *Conservation Biology*, vol.20, no.6, pp.1647-56, 2006.
- Qrunfleh, S. and Tarafdar, M., Lean and agile supply chain strategies and supply chain responsiveness: the role of strategic supplier partnership and postponement, *Supply Chain Management: An International Journal*, vol.18, no.6, pp.571–582, 2013.
- Rajeev, A., Pati, R.K., Padhi, S.S. and Govindan K., Evolution of sustainability in supply chain management: A literature review, *Journal of Cleaner Production*, 2017.
- Regattieri, A., Bartolini, A., Cima, M., Fanti, M. G. and Lauritano, D., An innovative procedure for introducing the lean concept into the internal drug supply chain of a hospital. *The TQM Journal*, 2018.
- Rudin-Brown, C. M., Edquist, J. and Lenné, M. G. Effects of driving experience and sensation-seeking on drivers'

- adaptation to road environment complexity, *Safety Science*, vol.62, no.3, pp.121-129, 2014.
- Ruiz-Benitez, R., López, C. and Real, J. C., 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, 2017.
- Saxby, R., Cano-Kourouklis, M. and Viza, E. An initial assessment of Lean Management methods for Industry 4.0, *The TQM Journal*, vol.32, no. 4, pp.587–601, 2020.
- Sharma, V., Dixit, A. R. and Qadri, M. A., Impact of lean practices on performance measures in context to Indian machine tool industry, *Journal of Manufacturing Technology Management*, vol.26, no.8, pp. 1218–1242, 2015.
- Siddaway, A. P., Wood, A. M. and Hedges., L. V., How to Do a Systematic Review: A Best Practice Guide for Conducting and Reporting Narrative Reviews, Meta-Analyses, and Meta-Syntheses, *Annual Review of Psychology*, vol.70, no.1, 2018.
- Silva, W., Kimura, H. and Sobreiro, V.A., An analysis of the literature on systemic financial risk: a survey, *Journal of Financial Stability*, vol.28, pp.91-114, 2017.
- Singh, K.R., Kumar, R. and Kumar, P., Strategic issues in pharmaceutical supply chains: a review. *International Journal of Pharmaceutical and Healthcare Marketing*, vol.10, no.3, 2016.
- Stavrulaki, E. and Davis, M., Aligning products with supply chain processes and strategy. *The International Journal of Logistics Management*, vol.21, no.1, pp.127–151, 2010.
- Tanaka, Y., Kaneyuki, H., Tsuji, T., Miyazaki, T., Nishikawa, K. and Nouzawa, T., Mechanical and perceptual analyses of human foot movements in pedal operation. *Conference Proceedings - IEEE International Conference on Systems, Man and Cybernetics*, 2009, pp.1674-1679.
- Tawfik, G. M., Dila, Surya Dila, K.A, Mohamed, M.Y. F., Tam, D.N.H., Kien, N.D., Ahmed, A.M. and Huy, N.T., A step by step guide for conducting a systematic review and meta-analysis with simulation data, *Tropical Medicine and Health*, vol.47, no.1, pp.46, 2019.
- Tebaldi, L; Bigliardi, B, and Bottani, E., Sustainable Supply Chain and Innovation: A Review of the Recent Literature. *Sustainability*, vol.10, no.11, 2018.
- Tortorella, G. L., Miorando, R. and Tlapa, D., Implementation of lean supply chain: an empirical research on the effect of context, *The TQM Journal*, vol.29, no. 4, pp.610–623, 2017.
- Tortorella, G. L., Giglio, R. and Limon-Romero, J., Supply chain performance: how lean practices efficiently drive improvements, *Journal of Manufacturing Technology Management*, vol.29, no.5, pp.829–845, 2018.
- Tortorella, G.L., Miorando, R. and Marodin, G., Lean supply chain management: Empirical research on practices, contexts and performance. *International Journal of Production Economics*, vol.193, pp.98–112, 2017.
- Tranfield, D., Denyer, D. and Smart, P., How to carry out a literature search for a systematic review: a practical guide, *British Journal of Management*, vol.24, pp.74-82, 2018.
- Tseng, M.L., Chiu, (Anthony) Shun Fung, Tan, R. R. and Siriban-Manalang, A. B., Sustainable consumption and production for Asia: sustainability through green design and practice, *Journal of Cleaner Production*, vol.40, pp.1–5, 2013.
- Vanalle, R.M, Ganga, G.M.D., Filho, M.G. and Lucato, W.C., Green supply chain management: An investigation of pressures, practices, and performance within the Brazilian automotive supply chain, *Journal of Cleaner*, 2017.
- Vilimek, M., Horak, Z. and Petr, K., Optimization of shift lever position, *Journal of Chemical Information and Modeling*, vol.53, pp.1689-1699, 2011.
- Wang, X., Le Breton-Gadegbeku, B. and Bouzon, L., Biomechanical evaluation of the comfort of automobile clutch pedal operation, *International Journal of Industrial Ergonomics*, vol.34, no.3, pp. 209-221, 2004.
- Wong, Y.C. and Wong, K.Y., Approaches and practices of lean manufacturing: The case of electrical and electronics companies, *African Journal of Business Management*, vol.5, no.6, pp.2164-2174, 2010.
- Xiao, Y. and Watson, M., Guidance on Conducting a Systematic Literature Review, *Journal of Planning Education and Research* 0739456X1772397, 2017.
- Yadav, V., Jain, R., Mittal, M.L., Panwar, A. and Sharma, M.K. An appraisal on barriers to implement lean in SMEs, *Journal of Manufacturing Technology Management*, vol.30, no.1, pp. 195-212, 2019.
- Yusoff, A. R., Deros, B.M. and Daruis, D.D.I., Vibration transmissibility on foot during controlling and Operating Car Accelerator Pedal. *Proceedings of 4th International Conference on Noise, Vibration and Comfort (NVC 2012)*, 2012, pp.210-215.
- Zhang,L., Narkhede, B.E. and Chaple, A.P. 2017. Evaluating lean manufacturing barriers: an interpretive process. *Journal of Manufacturing Technology Management*, vol.28, no.8, pp.1086-1114, 2017.
- Zhang, J., Li, H., Golizadeh, H., Zhao, C., Lyu, S. and Jin, R., Reliability evaluation index for the integrated supply chain utilising BIM and lean approaches, *Engineering, Construction and Architectural Management*, vol.27, no.5, pp.997-1038, 2020.
- Zhao, P., Yin, S., Han, X. and Li, Z., Research on lean supply chain network model based on node removal, *Physica A: Statistical Mechanics and its Applications*, 2021.
- Zhou, B. Lean principles, practices, and impacts: a study on small and medium-sized enterprises (SMEs). *Annals*

*of Operations Research*, vol.241, no.1-2, pp.457-474, 2012.

Zhou, S.B and Ji, F.X., Impact of Lean Supply Chain Management on Operational Performance: A Study of Small Manufacturing Companies, *International Journal of Business Analytics*, vol.2, no.3, 2015.

## **Biographies**

**Hamizah Pardi** is a PhD student in Engineering Management in Faculty of Engineering and Built Environment, UKM. She graduated in the Master of Quality Management from Open University Malaysia in 2018. She has experienced in quality assurance and regulatory more than 10 years in medical devices industry. Her competency and expertise are in ISO 13485, GDPMD, EU MDR and MDA regulatory.

**Mohd Nizam Ab Rahman** is a Professor in Universiti Kebangsaan Malaysia. He is an expert in major in Quality Industry and Operations Management particularly Lean Manufacturing, SCM and Quality Assurance. He received his PhD in manufacturing engineering and operations management from the University of Nottingham, in 2004. He has published over 300 research papers in journals and conferences in the fields of quality tools and techniques, Lean manufacturing, SCM, ISO/TQM, Sustainability and SMEs.

**Nizaroyani Saibani** is a senior lecturer at the Department of Mechanical and Manufacturing Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia (UKM). She received her B.Eng in Manufacturing Engineering from University of Salford, UK in 1999 and PhD in Operations Management from University of Nottingham, UK in 2010. Her research interests include closed-loop supply chain management, performance management and sustainable supply chains.

**Rosdin Abdul Kahar** is a trained engineer who has worked in the manufacturing, mobile telecommunications, and wireless broadband industries. He has worked on projects involving wireless network solutions, broadband through power line communication, and telecommunications consulting. He is a certified trainer who provides training in entrepreneurship, human development, leadership, and quality improvement and productivity, particularly in the field of engineering management.