FRAMEWORK OF LEAN MANUFACTURING IMPLEMENTATION FOR WOOD AND FURNITURE INDUSTRY IN MALAYSIA

FALAH BIN ABU

A thesis submitted in fulfilment of the
requirements for the award of the degree of
Doctor of Philosophy

School of Mechanical Engineering
Faculty of Engineering
Universiti Teknologi Malaysia

SEPTEMBER 2020

DEDICATION

To my parents, Abu Not and Rohani Harun,
They give birth to me, raised me, supported me, taught me and loved me.
I could not have done this without their support.
To them I dedicate this book.

ACKNOWLEDGEMENT

In the name of Allah the Most Gracious, the most Merciful.

This journey of mine has been enriched by many. First of all, I would like to give my sincerest thanks to my supervisors Prof. Dr. Muhamad Zameri Mat Saman and Assoc. Prof. Dr. Norhayati Zakuan for their enthusiasm, patience, encouragement and support that have kept me on the right track with high spirits.

I would like to express my deepest appreciation to Dr. Hamed Gholami. I have learned so much from you over the years about how to review and write high impact articles, and how to go about my PhD journey. You have provided so much support that I could never have imagined from a student-mentor relationship. Special thanks to Ainul Basirah Othman for always being there whenever I needed you.

I am specifically indebted to the organization that had provided access to its production line as well as limited access to its confidential databases and successfully validated the proposed models. My special thanks go out to Muhammad Wafiq Khairul Anuar of Ruang Idea Kreatif Sdn Bhd who had made this facility available for me.

I want to thank all lean consultants and experts who had shared their time and knowledge throughout the lean initiative programs that I had carried out during the early stages of my work: Muhar Murad, executive director and principal consultant of Lean Management Academy Sdn Bhd; Loke Yoon Foo @ Eric Foo, 2017 GMP-5S lean consultant; Ch'ng Chin Leng and Lee Soo Lee, 2018 LMP lean consultants.

To all experts and practitioners namely Prof. Dr. Sulaiman Hasan, UTHM; Assoc. Prof. Dr. Mohd Nizam Ab Rahman, UKM; Assoc. Prof. Dr. Mohd Ariff Jamaludin, UiTM; Assoc. Prof. Dr. Zamalia Mahmud, UiTM; Dr. Noor Zuraida Jusoh, Certified Timber & Credible Suppliers Sdn Bhd, and Suhaimi Saad, CEO Furniture Industry Technology Centre (FITEC) Sdn Bhd. Thanks for the wealth of knowledge and experience that you have shared with me.

Without the generous financial assistance provided by Universiti Teknologi MARA (UiTM) Shah Alam and the financial support from the Ministry of Higher Education under the Latihan Akademik Bumiputra (SLAB), I would not have been able to undertake this postgraduate research. Appreciation also goes out to the Research Management Centre (RMC) at Universiti Teknologi Malaysia (UTM) for the support and funding of this research under the Fundamental Research Grant Scheme (FRGS), Vot No. R.J.130000.7809.4F935.

Finally, I must express my gratitude to several of my family members who in different and most honourable ways have contributed to this effort. Mom and Dad for always being so solid and supportive of everything I have ever attempted. My mother and father-in-law for caring and giving so much love to my children throughout the first eighteen months. To my beloved children Hana, Hud, Zara and Zulfa; I love you all so much. Most importantly, I would like to thank my wonderful wife, my companion, the love of my life, Norzariza Idrais, who has been patient, supportive, and very understanding throughout the course of me completing this research. Thanks for vigorously encouraging this venture despite the additional burden that my absence from home has put on your shoulders.

Without the help of many family members, colleagues, friends, UiTM faculty members, and UTM staff members, this monumental task would not have been possible.

ABSTRACT

Although research on the adoption of lean manufacturing (LM) in the furniture industry in emerging economies is slowly progressing, its urgent implementation has been emphasized by researchers and practitioners. Research on this aspect is therefore limited, particularly when compared to the vast amount of scholarly studies on the successful implementation of lean in developed countries. To support the narrow body of knowledge for this under-researched scope, this study presents the current shortfalls of implementing LM in terms of motives, barriers, challenges, and applications. More significantly, this research develops a framework to facilitate LM implementation in the Malaysian wood and furniture industry. In doing so, a methodological approach was implemented in four tiers. Firstly, a comprehensive review of contemporary literature was performed to assess the issues. Due to lack of information regarding lean tools adopted by the wood and furniture industry, the selection of LM practices was made based on research on the wood industry and validated by two responsible lean consultants appointed by the Malaysian Timber Industry Board (MTIB) for the Good Manufacturing Practice (GMP-5S) and Lean Management Program (LMP). Secondly, a pilot study on 148 wood and furniture SME companies in Kuala Lumpur and Selangor was carried out to improve the survey instrument. Thirdly, an actual survey to test the questionnaire was also conducted after the initial reliability and validity of the measurement scales had been determined. Focusing on investigations into 599 wood and furniture companies in Malaysia, the status of LM implementation (i.e. awareness, level and duration of lean implementation) was examined and the two context factors (i.e. company size and ownership) that influence the implementation of lean practices were investigated. Then, the barriers for implementing lean and the challenges while implementing lean on knowledge (KNW), resources (RES) and culture and human attitudinal issues (CUL) were verified using the partial least squares-structural equation modelling (PLS-SEM). The findings found that there is a notable lack of research and publications on LM in the wood and furniture industry. Based on the current situation, the status of lean implementation is not promising and can be considered as earlier implementation (started phase) based on three main reasons. Firstly, the 5S is the only lean tool implemented massively by companies; secondly, over half of the lean companies had only practiced lean for less than 2 years; and thirdly, more than half of the companies with some implementation agreed with the lean expertise constraint hinders companies from implementing lean practices extensively. The findings found that there is no relationship between LM practices with plant size and company ownership. Both lean and non-lean companies have different viewpoints on the issue of culture reluctance and financial constraints. Furthermore, the findings indicate that CUL, KNW and RES are positively and significantly related to the barriers and challenges in implementing lean. Thus, the aims are to strengthen the KNW, CUL and RES factors by providing educational support in the form of training sessions, site visits, workshops, and counselling. Finally, valid empirical evidence for the under-studied context of the Malaysian wood and furniture industry was provided and a novel 'LM implementation framework' to guide SMEs to successfully adopt LM practices was presented.

ABSTRAK

Walaupun penyelidikan mengenai pembuatan *lean* (LM) dalam industri perabot di negara-negara membangun sedang berkembang dengan perlahan, pelaksanaan segeranya telah ditekankan oleh para penyelidik dan pengamal. Oleh itu, kajian ke atas aspek ini adalah sangat terhad terutamanya jika dibandingkan dengan kajian akademik mengenai kejayaan pelaksanaan *lean* di negara-negara maju. Bagi menyokong badan pengetahuan yang terhad bagi aspek yang kurang diselidiki, kajian ini membentangkan kekurangan pelaksanaan LM dari segi motif, halangan, cabaran, dan aplikasi. Lebih penting, penyelidikan ini membangunkan satu rangka kerja yang memudahkan pelaksanaan LM di dalam industri perkayuan dan perabot di Malaysia. Justeru, satu pendekatan metodologikal telah dilaksanakan dalam empat peringkat. Pertama, satu kajian literatur kontemporari yang komprehensif dijalankan bagi menilai isu-isu berkaitan. Berikutan kekurangan maklumat mengenai alat-alat *lean* yang digunapakai oleh industri perkayuan dan perabot, pemilihan amalan-amalan LM dilakukan berdasarkan penyelidikan ke atas industri perkayuan dan disahkan oleh dua perunding *lean* yang dilantik oleh Lembaga Perindustrian Kayu Malaysia (MTIB) untuk Amalan Pembuatan Terbaik (GMP-5S) dan Program Pengurusan *Lean* (LMP). Kedua, satu kajian pandu ke atas 148 syarikat SME perkayuan dan perabot di sekitar Kuala Lumpur dan Selangor dijalankan bagi memperbaiki instrumen kaji selidik. Ketiga, satu kaji selidik sebenar bagi menguji borang kaji selidik turut dijalankan selepas kebolehharapan dan kesahan awal skala pengukuran ditentukan. Menerusi kajian ke atas 599 syarikat perkayuan dan perabot di Malaysia, status pelaksanaan LM (iaitu kesedaran, tahap dan tempoh pelaksanaan *lean*) dikaji dan dua faktor konteks (saiz syarikat dan pemilikan) yang mempengaruhi pelaksanaan amalan-amalan *lean* dikaji. Seterusnya, halangan dalam melaksanakan *lean* dan cabaran semasa melaksanakan *lean* ke atas pengetahuan (KNW), sumber (RES) serta isu budaya dan sikap manusia (CUL) disahkan menggunakan pemodelan persamaan struktur kuasa dua terkecil separa (PLS-SEM). Didapati terdapat kekurangan penyelidikan dan penerbitan tentang LM di dalam industri kayu dan perabot. Berdasarkan keadaan semasa, status pelaksanaan *lean* adalah tidak memuaskan dan boleh di katakan masih di dalam pelaksanaan awal (fasa permulaaan) berdasarkan tiga sebab utama. Pertama, 5S merupakan alat yang digunapakai secara meluas oleh syarikat; kedua, lebih separuh daripada syarikat telah mengamalkan *lean* untuk kurang dari 2 tahun; dan ketiga, lebih dari separuh daripada syarikat yang mengamalkan *lean* secara tidak menyeluruh bersetuju bahawa kekurangan pakar di dalam bidang lean merupakan faktor yang menghalang syarikat daripada melaksanakannya secara lebih meluas. Penemuan mendapati tiada hubungan antara amalan LM dengan saiz kilang dan pemilikan syarikat. Syarikat yang mengamalkan dan tidak mengamalkan *lean* mempunyai pandangan yang berbeza mengenai isu kekangan budaya dan kewangan. Tambahan lagi, penemuan menunjukkan bahawa CUL, KNW dan RES adalah berkaitan secara positif dan signifikan dengan halangan dan cabaran dalam melaksanakan *lean*. Oleh itu, tujuan penyelidikan ini adalah untuk mengukuhkan faktor KNW, CUL dan RES dengan menyediakan sokongan pendidikan dalam bentuk sesi latihan, lawatan tapak, bengkel dan kaunseling. Akhir sekali, bukti empirikal yang sah untuk konteks kurangnya kajian di industri perkayuan dan perabot telah disediakan dan satu rangka kerja pelaksanaan LM yang novel untuk membimbing SME dalam menggunapakai amalan-amalan LM dengan jayanya telah dibentangkan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ANOVA	-	Analysis of variances
AVE	-	Average variance extracted
BCUL	-	Barriers to lean implementation related to culture and human attitudinal issues
BKNW	-	Barriers related to knowledge issues
BRES	-	Barriers related to resource issues
BSC	-	Balanced scorecard
CCUL	-	Challenges in implementing lean related to culture and human attitudinal issues
CIP	-	Continuous improvement process
CKNW	-	Challenges related to knowledge issues
COO	-	Chief of Operating Officer
CR	-	Composite reliability
CRES	-	Challenges related to resource issues
CTCS	-	Certified Timber and Credible Suppliers Global Sdn. Bhd
CUL	-	Culture and human attitudinal issues
CV	-	Convergent validity
DMAIC	-	Six Sigma design, measure, analyse, improve, control
DV	-	Discriminant validity
GMP	-	Good manufacturing practices
HOC	-	Higher-order component
HRM	-	Human resource management
HTMT	-	Heterotrait-monotrait ratio of correlations
IF	-	Impact factor
JIT	-	Just in time
JITF	-	Just-in-time flow
KDN	-	Ministry of Home Affairs
KL	-	Kuala Lumpur
KLSFIA	-	Kuala Lumpur and Selangor Furniture Industry Association
KNW	-	Knowledge issues

KPIs	-	Key performance indicators
LCCA	-	Life cycle cost analysis
LM	-	Lean manufacturing
LMP	-	Lean management program
LOCs	-	Lower-order components
LP	-	Lean practices
LSS	-	Lean Six Sigma
MARB	-	Mean absolute relative bias
MCDM	-	Multiple criteria decision-making
MF3	-	Malaysian Furniture and Furnishing Fair
MFC	-	Malaysian Furniture Council
MFPC	-	Malaysian Furniture Promotion Council
MPIC	-	Ministry of Plantation Industries and Commodities
MTIB	-	Malaysian Timber Industry Board
OEE	-	Overall equipment effectiveness;
PDCA	-	Plan-do-check-act cycle
PEKA	-	Association of Bumiputera Timber and Furniture Entrepreneur Malaysia
PLS	-	Partial least squares
QFD	-	Quality function deployment
QM	-	Quality management
R&D	-	Research and development
RES	-	Resource issues
RI	-	Ruang Idea Sdn. Bhd.
RMSE	-	Root mean squared error
SCP	-	Single-country publication
SEM	-	Structural equation modelling
SMED	-	Single minute exchange of dies
SMEs	-	Small and medium enterprises
SOPs	-	Standard operation procedure
SPSS	-	Statistical Package for Social Sciences
TLDM	-	Royal Malaysian Navy
TPM	-	Total productive maintenance

TQC	-	Total quality control
TQM	-	Total quality management
UK	-	United Kingdom
US	-	United States
VIF	-	Variation inflation factor
VSM	-	Value Stream Mapping
WIP	-	Work-in-process inventory
WPC	-	Wood plastic composite

LIST OF SYMBOLS

$\tilde{\mu}$	-	Population median
f^2	-	Effect size
Q^2	-	Blindfolding-based cross validated redundancy measure
R^2	-	Coefficient of determination
A	-	Level of confidence
B	-	Significance of path coefficients

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background of research

After the publication of the ground-breaking work "The Machine that Changed the World" (Womack et al., 1990), lean underwent a significant and unprecedented evolution over the years, subsequently being unanimously accepted as a highly beneficial practice (Bhamu and Singh Sangwan, 2014). Over the course of time, a number of prominent researchers have explored the various range of tools for lean manufacturing (LM), since it has been successfully proved in a large variety of industries with many successful cases recorded in the literature (Pearce et al., 2018a).

An increasing number of literature studies have found that LM has significantly contributed to the success of companies in developed countries (e.g. Japan, the US, the UK, Germany, and Italy). Until now, this methodology has only been applied to developed countries, and there is little effort taken to investigate LM implementation in developing countries because of the awareness constraints (Amoako-Gyampah and Gargeya, 2001; Nawanir et al., 2013). The Malaysian Timber Industry Board (MTIB) has taken the initiative to increase the productivity and promote the quality of the factory environment through Good Manufacturing Practices (GMP-5S) and Lean Management Programme (LMP) for the Malaysian wood and furniture companies (MTIB, 2017c). The first initiative of lean implementation program was initiated in 2014 with the participation of 40 timber based product companies. The program aimed to encourage furniture manufacturers to implement lean practices (LP) for better business performance. The economic importance of this industry is evident: it contributes 33.7% out of the total of RM11.5 billion Malaysia's total timber and timber products export in January 2017 until June 2017 (MTIB, 2017a).

A large number of studies found that while many companies are adhering to LM practices, they are also faced by various barriers in adopting any new lean production system (Oliveira et al., 2019). LM practices implementation is not easy and can take a long time to reach maturity (Filho et al., 2016). For example, the forest based (Finnish SMEs) companies were at a very early stage of development and may not have matured sufficiently within company thinking (D'Amato et al., 2018). Almost half of all small and medium enterprises (SMEs) fail in their first year of implementing LM due to their inability to address the accompanying issues and challenges (Ali et al., 2019). In order to guide LM implementation, Spagnol et al. (2013) examined the challenges faced during lean practices application.

Although researchers and practitioners have shown significant interest in studying lean manufacturing (LM) (Filho et al., 2016; Oliveira et al., 2019; Taddeo et al., 2019), LM implementation in less-automated sectors such as the wood industry is still showing sluggish progress (Rosienkiewicz et al., 2018). Moreover, the influences of lean manufacturing in the furniture industry is not promising because of the resources and expertise constraints (Pirraglia et al. 2009). An evidence indicates no respondents from wood and furniture company has implemented lean practices in China (Huo et al., 2019). The problem faced by wood processing factories is their incapability to implement LM in a continuous manner (Soetara et al., 2018). Yet, Suhardi et al. (2019) believe that the furniture industry has great potentials considering the successful implementation of Kaizen in an Indonesian furniture company.

Therefore, this study presents the current shortfalls of implementing LM in terms of motives, barriers, challenges, and applications to provides a framework used to facilitate LM implementation in the Malaysian wood and furniture industry.

1.2 Problem statements

A key problem with much of the literature is that the application of lean implementation in the furniture industry are limited; majority are predominantly practiced in the automotive industry. This is starkly evident in the investigation by

Henao et al. (2019) out of the 679 articles, 3% of the literature indicated being related to the furniture, machinery, foundry, and logistic industry. The lack of – a need for in-depth research on the practices in the wood and furniture industries.

Despite the numerous anecdotal and empirical evidences about the benefits of LM for the manufacturing industry, not many theoretical and methodological studies have been carried out about this matter in the context of wood and furniture companies particularly in emerging economies. The lack of research on the recognition of barriers and challenges in SMEs, particularly, in the wood and furniture companies, is indeed apparent, due to the fact research on the abovementioned matter still be considered limited. To complement and support the narrow body of knowledge on the under-researched scope, this study contributes to the prevailing lean implementation literature by revealing the current shortfalls of lean implementation in terms of motives, barriers, challenges, and applications. More specifically, this study is undertaken to clarify the aforementioned questions, which were fundamentally formulated to propagate the research purpose.

1.3 Research questions

The research questions are as follows:

i. What are the motives, barriers, challenges, and applications of lean that are practiced by the Malaysian wood and furniture industry?

ii. What is the status of awareness, level and duration of lean implementation in the Malaysian wood and furniture industry?

iii. To what extent is the use of lean practices within the Malaysian wood and furniture industry related to company size and ownership?

iv. How can lean be implemented in the Malaysian wood and furniture industry?

1.4 Research objectives

The main objectives of this study is developed the lean implementation framework exclusively for Malaysian wood and furniture industry. The objective of this study are guided by the following aims:

i. To identify the motives, barriers, challenges and applications of lean practices in the Malaysian wood and furniture industry.

ii. To investigate the status of lean practices in terms of awareness, level, and duration of its implementation in Malaysian furniture industry.

iii. To examine the influence of the contextual factors related to company size and ownership on the lean status quo of that industry.

iv. To propose a strategic framework for the implementation of lean.

1.5 Research scope

The scope of the research covers lean implementation in terms of motives, barriers, challenges and applications. This study emphasizes on the lean issues through the scenarios performed in developing countries, particularly in the context of Malaysian companies. The focus of this study is mainly on lean initiative programs conducted by MTIB to increase the productivity and promote the quality of factory environment through the Good Manufacturing Practice (GMP-5S) and Lean Management Programme (LMP). In order to guide LM implementation, the barriers for non-lean companies and challenges faced by lean companies were covered from three different perspectives: knowledge, culture and human attitudinal and resources issues.

1.6 Significance of research

This study discusses the barriers for non-lean companies and challenges faced by lean companies from a different perspective. Currently, researchers have studied the reasons why firms refuse to implement lean and the challenges in implementing lean individually. Furthermore, the models for investigating the barriers and challenges in implementing lean manufacturing (LM) in SMEs are not available. Therefore, this study developed a model using PLS-SEM which focuses on the barriers that prevent lean implementation as well as the challenges while implementing it in terms of knowledge issues (KNW), culture and human attitudinal issues (CUL), and resources issues (RES) among Malaysian wood and furniture companies.

The theoretical and practical contributions of this study are, firstly, it provides an intensive exploration on the current shortfalls of implementing LM in the Malaysian wood and furniture industry. Secondly, it presents a structured analysis framework that provides answers to the four research questions to facilitate LM implementation in the Malaysian wood and furniture industry. Thirdly, it reveals the effects of knowledge, culture and human attitude on the success of lean implementation especially in companies that have limited resources. In addition, this study also provides a framework for LM implementation that will bring competitive advantage not only in business improvement but also in improving working conditions and education for employees even with very limited resources.

1.7 Organization of the thesis

This thesis is organized into six chapters. Chapter 1 presents the background of the research, problem statements, research questions, research objectives, research scopes and significance of the research.

Chapter 2 provides insight into the specified domains through a literature review. In the first section, a bibliometric and classification method was performed to analyse the scientific literature. The next section presents the theoretical framework

and hypothetical framework based on the reviewed literature. This is followed by the introduction of the structural equation modelling (SEM) method used to validate the proposed model.

Chapter 3 addresses the research methodology. It provides the overall structure of the research methodology, systematic literature review analysis, data collection activities, data analysis, and framework development.

Chapter 4 presents the comprehensive results and discussion on the data analysis. This chapter consists of a findings of the pilot study to assess and improve the survey instrument, findings of the actual survey on the wood and furniture industries in Malaysia and findings of the refinement process from the lean initiative program conducted by MTIB to validate the challenges. Lastly is the validation of the proposed model.

Chapter 5 provides the whole view of the research with its ultimate result. This chapter outlines the integrative discussion from the pilot study, actual survey and refinement process for the development of the lean implementation framework. Additionally, the theoretical and practical implications are also presented.

Finally, Chapter 6 outlines the conclusions, limitations of the research and recommendations for future research.

REFERENCES

Abdul-Halim, H., Ahmad, N. H., Geare, A., & Thurasamy, R. 2018. Innovation Culture in SMEs: The Importance of Organizational Culture, Organizational Learning and Market Orientation. Entrepreneurship Research Journal, 1-14.

Abdul-Rashid, S. H., Sakundarini, N., Ghazilla, R. A. R., & Thursamy, R. 2017. The impact of sustainable manufacturing practices on sustainability performance: empirical evidence from Malaysia. International Journal of Operations & Production Management, 37(2), 1-27.

Abdulmalek, F. A., & Rajgopal, J. 2007. Analyzing the benefits of lean manufacturing and value stream mapping via simulation: A process sector case study. International Journal of Production Economics, 107(1), 223-236.

Abolhassani, A., Layfield, K., & Gopalakrishnan, B. 2016. Lean and US manufacturing industry: Popularity of practices and implementation barriers. International Journal of Productivity and Performance Management, 65(7), 875-897.

Aguado, S., Alvarez, R., & Domingo, R. 2013. Model of efficient and sustainable improvements in a lean production system through processes of environmental innovation. Journal of Cleaner Production, 47, 141-148.

Al-Aomar, R., & Hussain, M. 2018. An assessment of adopting lean techniques in the construct of hotel supply chain. Tourism Management, 69, 553 - 565.

Alhuraish, I., Robledo, C., & Kobi, A. 2017. A comparative exploration of lean manufacturing and six sigma in terms of their critical success factors. Journal of Cleaner Production, 164, 325-337.

Ali, M. M., Haron, N. H., Abdullah, N. A. I. N., & Hamid, N. A. 2019. Loan applications amongst small medium enterprises: challenges, risk and sustainability. Communications on Stochastic Analysis, 13(5), 211-221.

Ali, R. M., & Deif, A. M. 2014. Dynamic lean assessment for takt time implementation. Proceedings of the 47th CIRP Conference on Manufacturing Systems, Procedia CIRP, 17, 577-581.

Alkhoraif, A., Rashid, H., & McLaughlin, P. 2019. Lean implementation in small and medium enterprises: Literature review. Operations Research Perspectives, 6(100089), 1-19.

AlManei, M., Salonitis, K., & Tsinopoulos, C. 2018. A conceptual lean implementation framework based on change management theory. 51st CIRP Conference on Manufacturing Systems, 72, 1160 -1165.

AlManei, M., Salonitis, K., & Xu, Y. 2017. Lean implementation frameworks: The challenges for SMEs. Paper presented at the Procedia CIRP Conference on Manufacturing Systems.

Alsyouf, I., Al-Aomar, R., Al-Hamed, H., & Qiu, X. 2011. A framework for assessing the cost effectiveness of lean tools. European Journal of Industrial Engineering, 5(2), 170-197.

Amin, M., Thurasamy, R., Aldakhil, A. M., & Kaswuri, A. H. B. 2016. The effect of market orientation as a mediating variable in the relationship between entrepreneurial orientation and SMEs performance. Nankai Business Review International, 7(1), 39-59.

Amoako-Gyampah, K., & Gargeya, V. B. 2001. Just-in-time manufacturing in Ghana. Industrial Management & Data Systems, 101(3), 106-113.

Anand, G., & Kodali, R. 2009. Selection of lean manufacturing systems using the analytic network process - a case study. Journal of Manufacturing Technology Management, 20(2), 258-289.

Anholon, R., & Sano, A. T. 2016. Analysis of critical processes in the implementation of lean manufacturing projects using project management guidelines. The International Journal of Advanced Manufacturing Technology, 84(9), 2247-2256.

Antony, J., Krishan, N., Cullen, D., & Kumar, M. 2012. Lean Six Sigma for higher education institutions (HEIs): Challenges, barriers, success factors, tools/techniques. International Journal of Productivity and Performance Management, 61(8), 940-948.

Antony, J., Rodgers, B., & Gijo, E. V. 2016. Can lean six sigma make UK public sector organisations more efficient and effective? International Journal of Productivity and Performance Management, 65(7), 995-1002.

Arana-Solares, I. A., Ortega-Jiménez, C. H., Rafaela Alfalla-Luque, & Ríos, J. L. P.-D. d. l. 2019. Contextual factors intervening in the manufacturing strategy and

technology management-performance relationship. International Journal of Production Economics, 207, 81–95.

Ayeni, P., Ball, P., & Baines, T. 2016. Towards the strategic adoption of lean in aviation Maintenance Repair and Overhaul (MRO) industry: An empirical study into the industry's lean status. Journal of Manufacturing Technology Management, 27(1), 38-61.

Bajjou, M. S., & Chafi, A. 2018. Lean construction implementation in the Moroccan construction industry: Awareness, benefits and barriers. Journal of Engineering, Design and Technology, 16(4), 533 - 556.

Ball, P. 2015. Low energy production impact on lean flow. Journal of Manufacturing Technology Management, 26(3), 412-428.

Bamana, F., Lehoux, N., & Cloutier, C. 2019. Simulation of a Construction Project: Assessing Impact of Just-in-Time and Lean Principles. Journal of Construction Engineering and Management, 145(5).

Bamford, D., Forrester, P., Dehe, B., & Leese, R. G. 2015. Partial and iterative lean implementation: Two case studies. International Journal of Operations & Production Management, 35(5), 702-727.

Barth, H., & Melin, M. 2018. A Green Lean approach to global competition and climate change in the agricultural sector - A Swedish case study. Journal of Cleaner Production, 204, 183-192.

Basu, R. 2011. *Fit sigma: A lean approach to building sustainable quality beyond six sigma*. Ltd West Sussex, United Kingdom: John Wiley & Sons.

Baysan, S., Kabadurmus, O., Cevikcan, E., Satoglu, S. I., & Durmusoglu, M. B. 2019. A simulation-based methodology for the analysis of the effect of lean tools on energy efficiency: An application in power distribution industry. Journal of Cleaner Production, 211, 895-908.

Becker, J.-M., Klein, K., & Wetzels, M. 2012. Hierarchical Latent Variable Models in PLS-SEM: Guidelines for Using Reflective-Formative Type Models. Long Range Planning, 45, 359-394.

Belayutham, S., González, V. A., & Yiu, T. W. 2016. Clean–lean administrative processes: a case study on sediment pollution during construction. Journal of Cleaner Production, 126, 134-147.

Berman, H. 2019.Binomial Probability Calculator. https://stattrek.com/online-calculator/binomial.aspx#. (Date Accessed, 18 January 2019)

Bhamu, J., & Singh Sangwan, K. 2014. Lean manufacturing: Literature review and research issues. International Journal of Operations & Production Management, 34(7), 876-940.

Bhat, S., Gijo, E. V., & Jnanesh, N. A. 2016. Productivity and performance improvement in the medical records department of a hospital. International Journal of Productivity and Performance Management, 65(1), 98-125.

Birkie, S. E. 2016. Operational resilience and lean: In search of synergies and trade-offs. Journal of Manufacturing Technology Management, 27(2), 185-207.

Bonatto, F., de Resende, L. M. M., de Andrade, P. P., Jr., Pontes, J., & Betim, L. M. 2014. Value stream mapping: A case study in a furniture industry. Espacios, 35(7).

Booth, R. 1996. Agile manufacturing. Engineering Management Journal, 6(2), 105-112.

Bortolotti, T., Boscari, S., & Danese, P. 2015. Successful lean implementation: Organizational culture and soft lean practices. Int. J. Production Economics, 160, 182–201.

Boscari, S., Danese, P., & Romano, P. 2016. Implementation of lean production in multinational corporations: A case study of the transfer process from headquarters to subsidiaries. International Journal of Production Economics, 176, 53-68.

Brenes-Angulo, O., Bond, B., Kline, E., & Quesada-Pineda, H. 2015. The impact of vacuum-drying on efficiency of hardwood products manufacturing. BioResources, 10(3), 4588-4598.

Browning, T. R., & Heath, R. D. 2009. Reconceptualizing the effects of lean on production costs with evidence from the F-22 program. Journal of Operations Management, 27(1), 23-44.

Caldera, H. T. S., Desha, C., & Dawes, L. 2017. Exploring the role of lean thinking in sustainable business practice: A systematic literature review. Journal of Cleaner Production, 167 1546-1565.

Caldera, H. T. S., Desha, C., & Dawes, L. 2019. Evaluating the enablers and barriers for successful implementation of sustainable business practice in 'lean' SMEs. Journal of Cleaner Production, 218, 575-590.

Campos, L. M. S., & Vazquez-Brust, D. A. 2016. Lean and green synergies in supply chain management. Supply Chain Management, 21(5), 627-641.

Chaple, A. P., Narkhede, B. E., Akarte, M. M., & Raut, R. 2018. Modeling the lean barriers for successful lean implementation: TISM approach. International Journal of Lean Six Sigma.

Chaplin, L., Heap, J., & O'Rourke, S. T. J. 2016. Could "lean lite" be the cost effective solution to applying lean manufacturing in developing economies? International Journal of Productivity and Performance Management, 65(1), 126-136.

Chaurasia, B., Garg, D., & Agarwal, A. 2016. Framework to improve performance through implementing lean six sigma strategies to oil exporting countries during recession or depression. International Journal of Productivity and Performance Management, 65(3), 422-432.

Chay, T., Xu, Y., Tiwari, A., & Chay, F. 2015. Towards lean transformation: The analysis of lean implementation frameworks. Journal of Manufacturing Technology Management, 26(7), 1031-1052.

Cherrafi, A., Elfezazi, S., Chiarini, A., Mokhlis, A., & Benhida, K. 2016. The integration of lean manufacturing, Six Sigma and sustainability: A literature review and future research directions for developing a specific model. Journal of Cleaner Production, 139 828-846.

Cherrafi, A., Garza-Reyes, J. A., Kumar, V., Mishra, N., Ghobadian, A., & Elfezazi, S. 2018. Lean, green practices and process innovation: A model for green supply chain performance. International Journal of Production Economics, 206 79–92.

Chiarini, A. 2014. Sustainable manufacturing-greening processes using specific lean production tools: An empirical observation from European motorcycle component manufacturers. Journal of Cleaner Production, 85, 226-233.

Chin, W. W. 1998. The partial least square approach to structural equation modeling. In G. A. Marcoulides (Ed.), Modern Methods for Business Research (pp. 295-336): Lawrence Erlbaum Associates.

Chin, W. W. 2010. Bootstrap cross-validation indices for PLS path model assessment. In V. Esposito Vinzi, W. Chin, J. Hensler, & H. Wold (Eds.), Handbook of Partial Least Squares (pp. 83-97). Heidelberg: Springer.

Chin, W. W., Marcolin, B. L., & Newsted, P. R. 2003. A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from

a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study. Information Systems Research, 14(2), 189-217.

Chin, Y. W., & Lim, E. S. 2018. SME policies and performance in Malaysia. Economics Working Paper, Yusof Ishak Institute, 1-40.

Ciccullo, F., Pero, M., Caridi, M., Gosling, J., & Purvis, L. 2018. Integrating the environmental and social sustainability pillars into the lean and agile supply chain management paradigms: A literature review and future research directions. Journal of Cleaner Production, 172, 2336-2350.

Coetzee, R., Dyk, L. v., & Merwe, K. R. v. d. 2018. Towards addressing respect for people during lean implementation. International Journal of Lean Six Sigma, 27(3), 79 - 91.

Cohen, J. 1988. *Statistical power analysis for the behavioral sciences* (2nd ed. ed.). US: Lawrence Earlbaum Associates.

Cohen, J. 1992. A power primer. Psychological Bulletin, 112(1), 155-159.

Colucci, F. 2007. Power plant. Vertiflite, 53(2), 18-21.

Cottyn, J. H., Landeghem, V., Stockman, K., & Derammelaere, S. 2011. A method to align a manufacturing execution system with lean objectives. International Journal of Production Research, 49(14), 4397-4413.

Crema, M., & Verbano, C. 2016. Safety improvements from health lean management implementation: Evidences from three cases. International Journal of Quality and Reliability Management, 33(8), 1150-1178.

Creswell, J. W. 2009. *Research design: Qualitative, quantitative and mixed method approaches* (3rd edition ed.). Thousand Oaks: Sage Publications.

Czabke, J., Hansen, E. N., & Doolen, T. L. 2008. A multisite field study of lean thinking in U.S. and German secondary wood products manufacturers. Forest Products Journal, 58(9), 77-85.

D'Amato, D., Veijonaho, S., & Toppinen, A. 2018. Towards sustainability? Forest-based circular bioeconomy business models in Finnish SMEs. Forest Policy and Economics, in press.

de Kogel, W., & Becker, J. M. J. 2016. Development of design support tool for new lean production systems. Procedia CIRP, 41, 596-601.

de Oliveira, R. P., Stefenon, S. F., Branco, N. W., De Oliveira, J. R., & Rohloff, R. C. 2017. Lean manufacturing in association to the industrial automation: Case study applied to furniture industry. Espacios, 38(17).

Delbridge, R., & Oliver, N. 1991. Narrowing the gap? Stock turns in the Japanese and Western car industries. International Journal of Production Research, 29(10), 2083-2095.

Delgado-Hernandez, D. J., & Aspinwall, E. 2010. A framework for building quality into construction projects - Part II. Total Quality Management & Business Excellence, 21(7), 725-736.

DeLong, D. L., Kozak, R. A., & Cohen, D. H. 2007. Overview of the Canadian value-added wood products sector and the competitive factors that contribute to its success. Canadian Journal of Forest Research, 37(11), 2211-2226.

Dhingra, R., Kress, R., & Upreti, G. 2014. Does lean mean green? Journal of Cleaner Production, 85, 1-7.

Diamantopoulos, A. 2011. Incorporating formative measures into covariance-based structural equation models MIS Quarterly, 35(2), 335-358.

Dieste, M., Panizzolo, R., Garza-Reyes, J. A., & Anosike, A. 2019. The relationship between lean and environmental performance: Practices and measures. Journal of Cleaner Production, 224, 120-131.

Dombrowski U., Crespo I., & T., Z. 2010. Adaptive configuration of a lean production system in small and medium-sized enterprises. Production Engineering, 4(4), 341 - 348.

Dorsett, D. 2006. *Four learning approaches to enhancing employee productivity* (Vol. 7).

Duarte, P., & Amaro, S. 2018. Methods for modellingreflective-formative second order constructs in PLS: An application to online travel shopping. Journal of Hospitality and Tourism Technology, 9(3), 295-313.

Erdil, N. O., Aktas, C. B., & Arani, O. M. 2018. Embedding sustainability in lean six sigma efforts. Journal of Cleaner Production, 198 520-529.

Escuder, M., Tanco, M., & Santoro, A. 2018. Major barriers in Lean health care: an exploratory study in Uruguay. International Journal of Lean Six Sigma, 9(4), 466 - 481.

Farias, L. M. S., Santos, L. C., Gohr, C. F., Oliveira, L. C. d., & Amorim, M. H. d. S. 2019a. Criteria and practices for lean and green performance assessment: Systematic review and conceptual framework. Journal of Cleaner Production, 218, 746-762.

Farias, L. M. S., Santos, L. C., Gohr, C. F., & Rocha, L. O. 2019b. An ANP-based approach for lean and green performance assessment. Resources, Conservation & Recycling, 143, 77–89.

Fearne, A., & Fowler, N. 2006. Efficiency versus effectiveness in construction supply chains: the dangers of 'lean' thinking in isolation. Supply Chain Management: An International Journal, 11(4), 283-287.

Fercoq, A., Lamouri, S., & Carbone, V. 2016. Lean/green integration focused on waste reduction techniques. Journal of Cleaner Production, 137, 567-578.

Filho, M. G., Campos, F. C. d., & Assumpção, M. R. P. 2016. Systematic literature review with bibliometric analysis on Lean Strategy and manufacturing in industry segments. Gestao e Producao, 23(2), 408-418.

Freitas, J. G. d., Costa, H. G., & Ferraz, F. T. 2017. Impacts of Lean Six Sigma over organizational sustainability: A survey study. Journal of Cleaner Production, 156 262-275.

Fricke, C. F., & Buehlmann, U. 2012a. Lean and Virginia's wood industry - Part I: Awareness and implementation. BioResources, 7(4), 5074-5093.

Fricke, C. F., & Buehlmann, U. 2012b. Lean and Virginia's wood industry - Part II: Results and need for support. BioResources, 7(4), 5094-5108.

Gaebe, W. 1991. Spatial impacts of internationalisation in the automobile industry. Erdkunde, 45(2), 95-107.

Gagnon, M. A., & Michael, J. H. 2003. Employee strategic alignment at a wood manufacturer: An exploratory analysis using lean manufacturing. Forest Products Journal, 53(10), 24-29.

Galeazzo, A., Furlan, A., & Vinelli, A. 2014. Lean and green in action: Interdependencies and performance of pollution prevention projects. Journal of Cleaner Production, 85, 191-200.

Gandhi, N. S., Thanki, S. J., & Thakkar, J. J. 2018. Ranking of drivers for integrated lean-green manufacturing for Indian manufacturing SMEs. Journal of Cleaner Production, 171 675-689.

Garza-Reyes, J. A. 2015. Lean and green - a systematic review of the state of the art literature. Journal of Cleaner Production, 102, 18-29.

Garza-Reyes, J. A., Romero, J. T., Govindan, K., Cherrafi, A., & Ramanathan, U. 2018. A PDCA-based approach to Environmental Value Stream Mapping (EVSM). Journal of Cleaner Production, 180 335-348.

Gelei, A., Losonci, D., & Matyusz, Z. 2015. Lean production and leadership attributes – the case of Hungarian production managers. Journal of Manufacturing Technology Management, 26(4), 477-500.

Ghirann, G. 2012. *The basics of self-balancing processes: True lean continuous flow*. 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL Taylor & Francis Group.

Gholami, H., Jamil, N., Zakuan, N., Saman, M. Z. M., Sharif, S., Awang, S. R., et al. 2019. Social Value Stream Mapping (Socio-VSM): Methodology to Societal Sustainability Visualization and Assessment in the Manufacturing System. IEEE Access, 7, 131638-131648.

Goffnett, S. P., Lepisto, L., & Hayes, R. 2016. Using the socio-economic approach to management to augment lean six sigma. International Journal of Productivity and Performance Management, 65(1), 80-97.

Gold, A. H., Malhotra, A., & Segars, A. H. 2001. Knowledge management: an organizational capabilities perspective. Journal of Management Information Systems, 18(1), 185-214.

Gopalakrishnan, B., Mardikar, Y., Gupta, D., Jalali, S. M., & Chaudhari, S. 2012. Establishing baseline electrical energy consumption in wood processing sawmills for lean energy initiatives: A model based on energy analysis and diagnostics. Energy Engineering: Journal of the Association of Energy Engineering, 109(5), 40-80.

Grove, A. L., Meredith, J. O., MacIntyre, M., Angelis, J., & Neailey, K. 2010. UK health visiting: challenges faced during lean implementation. Leadership in Health Services, 23(3), 204-218.

Grushecky, S. T., Buehlmann, U., Schuler, A., Luppold, W., & Cesa, E. 2006. Decline in the U.S. furniture industry: A case study of the impacts to the hardwood lumber supply chain. Wood and Fiber Science, 38(2), 365-376.

Guerrero, J. E., Leavengood, S., Gutiérrez-Pulido, H., Fuentes-Talavera, F. J., & Silva-Guzmán, J. A. 2017. Applying lean six sigma in the wood furniture industry: A case study in a small company. Quality Management Journal, 24(3), 6-19.

Hadid, W., Mansouri, S. A., & Gallear, D. 2016. Is lean service promising? A socio-technical perspective. International Journal of Operations & Production Management, 36(6), 618-642.

Hair, J. F., Hult, T., Ringle, C. M., & Sarstedt, M. 2014a. *A Primer on Partial Least Squares Structural Equation Modeling*. Thousand Oaks, CA: SAGE Publications, Inc.

Hair, J. F., Hult, T., Ringle, C. M., & Sarstedt, M. 2017. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)* (2nd edition ed.). Thousand Oaks, California: SAGE Publications, Inc.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. 2019. When to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2-24.

Hair, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. 2014b. Partial least squares structural equation modeling (PLS-SEM) An emerging tool in business research. European Business Review, 26(2), 106-121.

Hajmohammad, S., Vachon, S., Klassen, R. D., & Gavronski, I. 2013. Lean management and supply management: Their role in green practices and performance. Journal of Cleaner Production, 39, 312-320.

Hallam, C., & Contreras, C. 2016. Integrating lean and green management. Management Decision, 54(9), 2157-2187.

Hallgren, M., & Olhager, J. 2009. Lean and agile manufacturing: external and internal drivers and performance outcomes. International Journal of Operations & Production Management, 29(10), 976-999.

Hassan, T. M. R. T., Yaacob, M. R., & Abdullatiff, N. K. 2014. Sustaining SMEs wood-based product manufacturing through best practices -the case of indigenous entrepreneurs in Kelantan. Paper presented at the The 5th Indonesia International Conference on Innovation, Entrepreneurship, and small Business (IICIES2013), Indonesia.

Helleno, A. L., Moraes, A. J. I. d., & Simon, A. T. 2017. Integrating sustainability indicators and Lean Manufacturing to assess manufacturing processes: Application case studies in Brazilian industry. Journal of Cleaner Production, 153 405-416.

Henao, R., Sarache, W., & Gomez, I. 2019. Lean manufacturing and sustainable performance: Trends and future challenges. Journal of Cleaner Production, 208, 99 - 116.

Henseler, J., Ringle, C. M., & Sarstedt, M. 2015. A new criterion for assessing discriminant validity in variance-based structural equation modelling. Journal of the Academy of Marketing Science, 43(1), 115-135.

Hogan, B. 2007. Worker involvement and assistance from outside enhance productivity and reduce waste at Hearth & Home Technologies. Manufacturing Engineering, 139(5).

Holmström, J., & Aavikko, P. 1994. Computer support for continuous improvements. Production Planning and Control, 5(2), 206-212.

Holweg, M. 2007. The genealogy of lean production. Journal of Operations Management, 25(2), 420-437.

Hopp, W. J., & Spearman, M. L. 2004. To pull or not to pull: What is the question? Manufacturing & Service Operations Management, 6(2), 133-148.

Hosseini Nasab, H., Aliheidari Bioki, T., & Khademi Zare, H. 2012. Finding a probabilistic approach to analyze lean manufacturing. Journal of Cleaner Production, 29-30, 73-81.

Hunter, S. L., Bullard, S., & Steele, P. H. 2004. Lean production in the furniture industry: The double D assembly cell. Forest Products Journal, 54(4), 32-38.

Huo, B., Gu, M., & Wang, Z. 2019. Green or lean? A supply chain approach to sustainable performance. Journal of Cleaner Production, 216, 152-166.

Hussain, K., He, Z., Ahmad, N., Iqbal, M., & mumtaz, S. M. T. 2019. Green, lean, Six Sigma barriers at a glance: A case from the construction sector of Pakistan. Building and Environment, 161(106225), 1-16.

Islam, S. A., Hossain, S. M., Hassan, M., & Yeasmin, N. 2015. Improving workplace by using 5'S tool - A typical application of sorting method. International Journal of Services and Operations Management, 22(3), 323-335.

Jääskeläinen, A., & Uusi-Rauva, E. 2011. Bottom-up approach for productivity measurement in large public organizations. International Journal of Productivity and Performance Management, 60(3), 252-267.

Jabbour, C. J. C. 2013. Environmental training in organisations: From a literature review to a framework for future research. Resources, Conservation and Recycling, 74, 144-155.

Jabbour, C. J. C., De Sousa Jabbour, A. B. L., Govindan, K., Teixeira, A. A., & 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, 47, 129-140.

Jagoda, K., Lonseth, R., & Lonseth, A. 2013. A bottom-up approach for productivity measurement and improvement. International Journa of Productivity and Performance Management, 62(4), 387-406.

Jasti, N. V. K., & Kodali, R. 2014. A literature review of empirical research methodology in lean manufacturing. International Journal of Operations & Production Management, 34(8), 1080-1122.

Jayasingam, S., Fujiwara, Y., & Thurasamy, R. 2018. 'I am competent so I can be choosy': choosiness and its implication on graduate employability. Studies in Higher Education, 43(7), 1119-1134.

Jiménez, H. F., & Amaya, C. L. 2014. Lean Six Sigma in small and medium enterprises: A methodological approach. Ingeniare, 22(2), 263-277.

Johansson, G., & Sundin, E. 2014. Lean and green product development: Two sides of the same coin? Journal of Cleaner Production, 85, 104.

Karim, A., & Arif-Uz-Zaman, K. 2013. A methodology for effective implementation of lean strategies and its performance evaluation in manufacturing organizations. Business Process Management Journal, 19(1), 169-196.

Karlsson, A.-M., & Nikolaidou, Z. 2016. The textualization of problem handling: Lean discourses meet professional competence in eldercare and the manufacturing industry. Written Communication, 33(3), 275.

Kashif, M., Zarkada, A., & Ramayah, T. 2018. The impact of attitude, subjective norms, and perceived behavioural control on managers' intentions to behave ethically. Total Quality Management & Business Excellence, 29(5-6), 481-501.

Khaba, S., & Bhar, C. 2018. Lean awareness and potential for lean implementation in the Indian coal mining industry: An empirical study. International Journal of Quality & Reliability Management, 35(6), 1215 - 1231.

Khanchanapong, T., Prajogo, D., Sohal, A. S., Cooper, B. K., Yeung, A. C. L., & Cheng, T. C. E. 2014. The unique and complementary effects of manufacturing technologies and lean practices on manufacturing operational performance. International Journal of Production Economics, 153, 191-203.

Kheng, L. K., & Minai, M. S. 2016. The network characteristic of Chinese SMEs in Malaysia and their performance. Paper presented at the Proceedings of the ASEAN Entrepreneurship Conference 2014, Singapore.

Khudzari, J. M., Kurian, J., Tartakovsky, B., & Raghavan, G. S. V. 2018. Bibliometric analysis of global research trends on microbial fuel cells using Scopus database. Biochemical Engineering Journal, 136, 51-60.

Kline, R. B. 2011. *Principles and practice of structural equation modeling* (3rd ed.). New York: Guilford Press.

Koka, B. R., & Prescott, J. E. 2002. Strategic alliances as social capital: A multidimensional view. Strategic Management Journal, 23, 795–816.

Kowalchuk, K. 2006 *Cabinetmaker Goes from Batch Flow to Lean Operation/Interviewer: W. W. Products*. Wood & Wood Products, http://www.iswonline.com/wwp/200605/cabtec.cfm.

Krejcie, R. V., & Morgan, D. W. 1970. Determining sample size for research activities. Educational and Psychological Measurement, 30, 607-610.

Kumar Br, R., Sharma, M. K., & Agarwal, A. 2015. An experimental investigation of lean management in aviation. Journal of Manufacturing Technology Management, 26(2), 231-260.

Kurdve, M., Zackrisson, M., Wiktorsson, M., & Harlin, U. 2014. Lean and green integration into production system models - experiences from Swedish industry. Journal of Cleaner Production, 85, 180-190.

Kurilova-Palisaitiene, J., Sundin, E., & Poksinska, B. 2018. Remanufacturing challenges and possible lean improvements. Journal of Cleaner Production, 172, 3225 - 3236.

Lathin, D., & Mitchell, R. 2001. Learning from mistakes. Quality Progress, 34(6), 39-40.

Lermen, F. H., Echeveste, M. E., Peralta, C. B., Sonego, M., & Marcon, A. 2018. A framework for selecting lean practices in sustainable product development: The case study of a Brazilian agroindustry. Journal of Cleaner Production, 191 261-272.

Lindskog, E., Vallhagen, J., Berglund, J., & Johansson, B. 2016. Improving lean design of production systems by visualization support. Procedia CIRP, 41, 602-607.

Longoni, A., & Cagliano, R. 2015. Cross-functional executive involvement and worker involvement in lean manufacturing and sustainability alignment. International Journal of Operations & Production Management, 35(9), 1332-1358.

Ludolph, R. 2006. Customer desires drive production. Upholstery Manufacturing, 19(2), 14-17.

Maalouf, M., & Gammelgaard, B. 2016. Managing paradoxical tensions during the implementation of lean capabilities for improvement. International Journal of Operations & Production Management, 36(6), 687-709.

Mamat, T. N. A. R. 2016. Framework for the establishment of the end-of-life vehicles management system in Malaysia. (Unpublished PhD's thesis), Universiti Tenologi Malaysia, Johor.

Mamun, A. A., Mohiuddin, M., Ahmad, G. B., Thurasamy, R., & Fazal, S. A. 2018. Recycling Intention and Behavior among Low-Income Households. Sustainability, 10(2407), 1-22.

Marodin, G. A., Frank, A. G., Tortorella, G. L., & Netland, T. 2018. Lean product development and lean manufacturing: Testing moderation effects. International Journal of Production Economics, 203, 301 - 310.

Marodin, G. A., Frank, A. G., Tortorella, G. L., & Saurin, T. A. 2016. Contextual factors and lean production implementation in the Brazilian automotive supply chain. Supply chain management-an international journal, 21(4), 417-432.

Marodin, G. A., & Saurin, T. A. 2015. Classification and relationships between risks that affect lean production implementation. Journal of Manufacturing Technology Management, 26(1), 57-79.

Matt, D. T. 2014. Adaptation of the value stream mapping approach to the design of lean engineer-to-order production systems: A case study. Journal of Manufacturing Technology Management, 25(3), 334-350.

Mayr, A., Weigelt, M., Kuhl, A., Grimm, S., Erll, A., Potzel, M., et al. 2018. Lean 4.0 - A conceptual conjuction of lean management and industry 4.0. 51st CIRP Conference on Manufacturing Systems, 72, 622 - 628.

Meiling, J., Backlund, F., & Johnsson, H. 2011. Managing for continuous improvement in off-site construction: evaluation of lean management principles. Engineering Construction and Architectural Management, 19(2), 141-158.

Melton, T. 2005. The benefits of lean manufacturing. Chemical Engineering Research and Design, 83(6), 662-673.

Miller, G., Pawloski, J., & Standridge, C. 2010. A case study of lean, sustainable manufacturing. Journal of Industrial Engineering and Management, 3(1), 11-32.

Mo, J. P. T. 2009. The role of lean in the application of information technology to manufacturing. Computers in Industry, 60(4), 266-276.

Mostafa, S., Dumrak, J., & Soltan, H. 2013. A framework for lean manufacturing implementation. Production and Manufacturing Research, 1(1), 44-64.

MTIB. 2017a.EStats http://www.mtib.gov.my/index.php?option=com_content&view=article&id=2034%3Amalaysiamajorexport&catid=44%3Astatistic&lang=en.(Date Accessed, October)

MTIB. 2017b.Invitation for MTIB Lean Management Programme 2018. http://www.mtib.gov.my/en/corporateinfo/archive/annoucement/2212invitation-for-mtib-lean-management-programme-2018 (Date Accessed, 24 October 2018)

MTIB. 2017c. MTIB Lean Management Programme 2017. http://www.mtib.gov.my/index.php?option=com_content&view=article&id=2398%3Amtibleanmanagementprogramme2017&catid=1%3Ahighlights&lang=en. (Date Accessed, October)

Mund, K., Pieterse, K., & Cameron, S. 2015. Lean product engineering in the South African automotive industry. Journal of Manufacturing Technology Management, 26(5), 703-724.

Mustalahti, I. 2018. The responsive bioeconomy: The need for inclusion of citizens and environmental capability in the forest based bioeconomy. Journal of Cleaner Production, 172, 3781-3790.

National-SME-Development-Council. 2013.SME Definitions. http://www.smecorp.gov.my/. (Date Accessed, 20 June 2019)

Nawanir, G., Kong Teong, L., & Norezam Othman, S. 2013. Impact of lean practices on operations performance and business performance. Journal of Manufacturing Technology Management, 24(7), 1019-1050.

Nayha, A. 2019. Transition in the Finnish forest-based sector: Company perspectives on the bioeconomy, circular economy and sustainability. Journal of Cleaner Production, 209 1294-1306.

Nieuwenhuis, P., & Katsifou, E. 2015. More sustainable automotive production through understanding decoupling points in leagile manufacturing. Journal of Cleaner Production, 95, 232-241.

Nightingale, D. S. 1998. Lean Aerospace Initiative. IIE Solutions, 30(11), 20-25.

Nunes, J. R. R., Silva, J. E. A. R. d., Moris, V. A. d. S., & Giannetti, B. F. 2019. Cleaner Production in small companies: Proposal of a management methodology. Journal of Cleaner Production, 218 357-366.

Oak. 2019.Understanding the one-way ANOVA. http://oak.ucc.nau.edu/rh232/courses/EPS525/ Handouts/Understanding%20the%20One-way%20ANOVA.pdf. (Date Accessed, 7 July 2019)

Oliveira, R. I. d., Sousa, S. O., & Campos, F. C. d. 2019. Lean manufacturing implementation: bibliometric analysis 2007–2018. International Journal of Advanced Manufacturing Technology, 101(1-4), 979-988.

Olivella, J., & Gregorio, R. 2014. Organizational practices lean enterprises adopt to focus on value streams. Journal of Enterprise Transformation, 4(4), 309-328.

Owens, T., & Fernandez, O. 2014. *The Lean Enterprise: How corporations can innovate like startups*. Hoboken New Jersey.: Wiley & Sons, Inc.

Pakdil, F., & Leonard, K. M. 2015. The effect of organizational culture on implementing and sustaining lean processes. Journal of Manufacturing Technology Management, 26(5), 725-743.

Pampanelli, A. B., Found, P., & Bernardes, A. M. 2014. A lean & green model for a production cell. Journal of Cleaner Production, 85, 19-30.

Panwar, A., Jain, R., & Rathore, A. P. S. 2015. Lean implementation in Indian process industries – some empirical evidence. Journal of Manufacturing Technology Management, 26(1), 131-160.

Pearce, A., & Pons, D. 2019. Advancing lean management: The missing quantitative approach. Operations Research Perspectives, 6(100114), 1-14.

Pearce, A., Pons, D., & Neitzert, T. 2018a. Implementing lean—Outcomes from SME case studies. Operations Research Perspectives, 5, 94-104.

Pearce, D., Dora, M., Wesana, J., & Gellynck, X. 2018b. Determining factors driving sustainable performance through the application of lean management practices in horticultural primary production. Journal of Cleaner Production, 203 400-417.

Piercy, N., & Rich, N. 2015. The relationship between lean operations and sustainable operations. International Journal of Operations & Production Management, 35(2), 282-315.

Pirraglia, A., Saloni, D., & van Dyk, H. 2009. Status of lean manufacturing implementation on secondary wood industries including residential, cabinet, millwork, and panel markets. BioResources, 4(4), 1341-1358.

Podsakoff, N. P., Shen, W., & Podsakoff, P. M. 2006. The role of formative measurement models in strategic management research: review, critique, and implications for future research. Research Methodology in Strategy and Management, 3, 197-252.

Powell, D. 2013. ERP systems in lean production: new insights from a review of lean and ERP literature. International Journal of Operations & Production Management, 33(11/12), 1490-1510.

Prajogo, D., Oke, A., & Olhager, J. 2016. Supply chain processes linking supply logistics integration, supply performance, lean processes and competitive performance. International Journal of Operations & Production Management, 36(2), 220-238.

Prasad, S., Khanduja, D., & Sharma, S. K. 2016. An empirical study on applicability of lean and green practices in the foundry industry. Journal of Manufacturing Technology Management, 27(3), 408-426.

Rahani, A. R., & Al-Ashraf, M. 2012. Production flow analysis through value stream mapping: A lean manufacturing process case study. Procedia Engineering, 41, 1727-1734.

Rahiminezhad Galankashi, M., & Helmi, S. A. 2016. Assessment of hybrid Lean-Agile (Leagile) supply chain strategies. Journal of Manufacturing Technology Management, 27(4), 470-482.

Ramadas, T., & Satish, K. P. 2018. Identification and modeling of process barriers: Implementing lean manufacturing in small-and medium-size enterprises. International Journal of Lean Six Sigma.

Ramakrishnan, V., Nallusamy, S., & Rajaram Narayanan, M. 2018. Study on lean tools implementation in various Indian small and medium scale manufacturing industries. International Journal of Mechanical and Production Engineering Research and Development, 8(1), 969-976.

Ramayah, T., Yeap, J. A. L., Ahmad, N. H., Halim, H. A., & Rahman, S. A. 2017. Testing a Confirmatory model of Facebook Usage in SmartPLS using Consistent PLS. International Journal of Business and Innovation, 3(2), 01-14.

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

Ray, C. D., Laddad, A., & Ventura, J. A. 2007. The impact of cutting bill variability on product flow for a hardwood dimension mill as determined through discrete event simulation. Wood and Fiber Science, 39(4), 614-627.

Ray, C. D., Zuo, X., Michael, J. H., & Wiedenbeck, J. K. 2006. The lean index: Operational "lean" metrics for the wood products industry. Wood and Fiber Science, 38(2), 238-255.

Reeb, J. E., Leavengood, S., & Knowles, C. 2009. Needs assessment of the Oregon forest products industry. Forest Products Journal, 59(4), 35-39.

Ringle, C. M., Sarstedt, M., & Straub, D. W. 2012. Editor's comments: a critical look at the use of PLS-SEM in MIS quarterly. MIS Quarterly, 36(1), iii-xiv.

Ros-Franch, S., Echevarría, J., Damborenea, S. E., Manceñido, M. O., Jenkyns, H. C., Al-Suwaidi, A., et al. 2019. Population response during an Oceanic Anoxic Event: The case of Posidonotis (Bivalvia) from the Lower Jurassic of the Neuquén Basin, Argentina. Palaeogeography, Palaeoclimatology, Palaeoecology, 525, 57-67.

Rosienkiewicz, M., Kowalski, A., Helman, J., & Zbieć, M. 2018. Development of lean hybrid furniture production control system based on glenday sieve, artificial neural networks and simulation modeling. Drvna Industrija, 69(2), 163-173.

Rybicka, J., Tiwari, A., Del Campo, P. A., & Howarth, J. 2015. Capturing composites manufacturing waste flows through process mapping. Journal of Cleaner Production, 91, 251-261.

Rymaszewska, A. D. 2014. The challenges of lean manufacturing implementation in SMEs. Benchmarking: An International Journal, 21(6), 987-1002.

Saeed, M. A., Farooq, M., Andrews, G. E., Phylaktou, H. N., & Gibbs, B. M. 2019. Ignition sensitivity of different compositional wood pellets and particle size dependence. Journal of Environmental Management, 232, 789-795.

Sagnak, M., & Kazancoglu, Y. 2016. Integration of green lean approach with six sigma: An application for flue gas emissions. Journal of Cleaner Production, 127, 112-118.

Sahoo, S., & Yadav, S. 2018. Lean implementation in small and medium sized enterprises. Benchmarking: An International Journal, 25(4), 1121 - 1147.

Samuel, D., Found, P., & Williams, S. J. 2015. How did the publication of the book "The Machine That Changed The World" change management thinking? Exploring 25 years of lean literature. International Journal of Operations & Production Management, 35(10), 1386-1407.

Samuel, R., & Ramayah, T. 2016. Employability, Mobility and Work-Life Balance: How do they relate for MBA holders in Malaysia? Pertanika Journal of Social Sciences & Humanities, 24(1), 359-374.

Sartal, A., Martinez-Senra, A. I., & Cruz-Machado, V. 2018. Are all lean principles equally eco-friendly? A panel data study. Journal of Cleaner Production, 177 362-370.

Sassanelli, C., Pezzotta, G., Rossi, M., Terzi, S., & Cavalieri, S. 2015. Towards a Lean Product Service Systems (PSS) Design: state of the art, opportunities and challenges. 7th Industrial Product-Service Systems Conference - PSS, industry transformation for sustainability and business, 30, 191-196.

Saurin, T. A., Marodin, G. A., & Ribeiro, J. L. D. 2011. A framework for assessing the use of lean production practices in manufacturing cells. International Journal of Production Research, 49(11), 3211 - 3230.

Schnellbach, P., & Reinhart, G. 2015. Evaluating the effects of energy productivity measures on lean production key performance indicators. 12th Global Conference on Sustainable Manufacturing, Procedia CIRP 26, 26, 492-497.

Scholtz, B., Mahmud, I., & Ramayah, T. 2016. Does Usability Matter? An Analysis of the Impact of Usability on Technology Acceptance in ERP Settings. Interdisciplinary Journal of Information, Knowledge, and Management, 11, 309-330.

Secchi, R., & Camuffo, A. 2016. Rolling out lean production systems: a knowledge-based perspective. International Journal of Operations & Production Management, 36(1), 61-85.

Seifullina, A., Er, A., Nadeem, S. P., Garza-Reyes, J. A., & Kumar, V. 2018. A lean implementation framework for the mining industry. IFAC PapersOnLine, 51(11), 1149 - 1154.

Shah, R., & Ward, P. T. 2003. Lean manufacturing: context, practice bundles, and performance. Journal of Operations Management, 21(2), 129-149.

Shah, R., & Ward, P. T. 2007. Defining and developing measures of lean production. Journal of Operations Management, 25(4), 785-805.

Sharma, A., & LaPlaca, P. 2005. Marketing in the emerging era of build-to-order manufacturing. Industrial Marketing Management, 34(5), 476-486.

Sharma, P., & Kulkarni, M. S. 2016. Framework for a dynamic and responsive: Time separated – lean-agile spare parts replenishment system in army. International Journal of Productivity and Performance Management, 65(2), 207-222.

Sharma, S., & Shah, B. 2016. Towards lean warehouse: Transformation and assessment using RTD and ANP. International Journal of Productivity and Performance Management, 65(4), 571-599.

Shashi, Centobelli, P., Cerchione, R., & Singh, R. 2019. The impact of leanness and innovativeness on environmental and financial performance: Insights from Indian SMEs. International Journal of Production Economics, 212, 111-124.

Shmueli, G., Hair, J. F., Cheah, J.-H., Ting, H., Vaithilingam, S., & Ringle, C. M. 2019. Predictive model assessment in PLS-SEM: guidelines for using PLSpredict. European Journal of Marketing, 53(11), 2322-2347.

Shmueli, G., Ray, S., Estrada, J. M. V., & Chatla, S. B. 2016. The elephant in the room: evaluating the predictive performance of PLS models. Journal of Business Research, 69(10), 4552-4564.

Shokri, A., Waring, T. S., & Nabhani, F. 2016. Investigating the readiness of people in manufacturing SMEs to embark on lean six sigma projects: An empirical study in the German manufacturing sector. International Journal of Operations & Production Management, 36(8), 850-878.

Soetara, A., Machfud, Affandi, M., & Maulana, A. 2018. The design on conceptual model for continuation of Lean Manufacturing (LM) implementation in Indonesia wood processing factory using soft system methodology. International Journal on Advanced Science, Engineering and Information Technology, 8(4), 1302-1306.

Spagnol, G. S., Min, L. L., & Newbold, D. 2013. Lean principles in Healthcare: an overview of challenges and improvements. 6th IFAC Conference on Management and Control of Production and Logistics, 229-234.

Stadnicka, D., & Litwin, P. 2019. Value stream mapping and system dynamics integration for manufacturing line modelling and analysis. International Journal of Production Economics, 208 400–411.

Stahlhofer, E. M., da Luz, R. P., Pessa, S. L. R., Laperuta, D. G. P., & da Luz, J. G. 2016. Implementation of Lean tools in small and medium sized enter-prises: A case study in a furniture industry. Espacios, 37(37).

Suhardi, B., Anisa, N., & Laksono, P. W. 2019. Minimizing waste using lean manufacturing and ECRS principle in Indonesian furniture industry. Cogent Engineering, 6(1), 1-13.

Suhardi, B., Sari, A. P., & Laksono, P. W. 2016. Implementation of standardization work to improve productivity in Indonesian furniture industry. Journal of Engineering and Applied Sciences, 11(12), 2602-2606.

Surin, E. F., Edward, O. T., Hussin, M. H. F., & Wahab, I. A. 2017. Recognising the importance of strategic business network on business performance of SME manufacturing firm in Malaysia: analysing the moderating influence of human capital and business environment. International Journal of Arts & Sciences,, 9(4), 31-44.

Taddeo, R., Simboli, A., Di Vincenzo, F., & Ioppolo, G. 2019. A bibliometric and network analysis of Lean and Clean(er) production research (1990/2017). Science of the Total Environment, 653, 765-775.

Taj, S., & Morosan, C. 2011. The impact of lean operations on the Chinese manufacturing performance. Journal of Manufacturing Technology Management, 22(2), 223-240.

Tammela, I., Canen, A. G., & Helo, P. 2013. Time-based competition: Relation to multiculturalism and logistics in international furniture companies. Benchmarking: An International Journal, 20(5), 588 - 606.

Tayyab, M., & Sarkar, B. 2016. Optimal batch quantity in a cleaner multi-stage lean production system with random defective rate. Journal of Cleaner Production, 139, 922-934.

Tehseen, S., Qureshi, Z. H., & Ramayah, T. 2018. Impact of network competence on firm's performances among Chinese and Indian entrepreneurs: a multigroup analysis. International Journal of Entrepreneurship, 22(3), 1-14.

Tehseen, S., Sajilan, S., Gadar, K., & Ramayah, T. 2017. Assessing Cultural Orientation as a Reflective-Formative Second Order Construct - A Recent PLS-SEM Approach. Review of Integrative Business and Economics Research, 6(2), 38-63.

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

Thanki, S. J., & Thakkar, J. 2014. Status of lean manufacturing practices in Indian industries and government initiatives: A pilot study. Journal of Manufacturing Technology Management, 25(5), 655-675.

Thanki, S. J., & Thakkar, J. 2018. Interdependence analysis of lean-green implementation challenges: a case of Indian SMEs. Journal of Manufacturing Technology Management, 29(2), 295 - 328.

Ufua, D. E., Papadopoulos, T., & Midgley, G. 2018. Systemic Lean Intervention: Enhancing Lean with Community Operational Research. European Journal of Operational Research, 268, 1134 - 1148.

Urban, W. 2015. The Lean Management Maturity Self-Assessment Tool Based on Organizational Culture Diagnosis. Paper presented at the 20th International Scientific Conference Economics and Management (ICEM-2015).

Vamsi Krishna Jasti, N., & Kodali, R. 2014. A literature review of empirical research methodology in lean manufacturing. International Journal of Operations & Production Management, 34(8), 1080-1122.

van Eck, N. J., & Waltman, L. 2017. VOSviewer manual. [Manual for VOSviewer version 1.6.6].

Velarde, G. J., Pirraglia, A., Van Dyk, H., & Saloni, D. E. 2011. Lean manufacturing in the US South Atlantic Region: An overview of the current state of implementation in the secondary wood industry. International Wood Products Journal, 2(1), 30-37.

Verma, N., & Sharma, V. 2016. Energy Value Stream Mapping a Tool to develop Green Manufacturing. Paper presented at the International Conference on

Manufacturing Engineering and Materials, ICMEM 2016, Nový Smokovec, Slovakia.

Verrier, B., Rose, B., & Caillaud, E. 2016. Lean and green strategy: The lean and green house and maturity deployment model. Journal of Cleaner Production, 116, 150-156.

Verrier, B., Rose, B., Caillaud, E., & Remita, H. 2014. Combining organizational performance with sustainable development issues: the lean and green project benchmarking repository. Journal of Cleaner Production, 85, 83-93.

Viana, Á. L., Lucas Filho, F. C., de Mello, M. S. V. N., Santos, R. M. S., Lacerda, F. A. S., Lira, H. N. F., et al. 2017. Reduction of costs that do not add value through process improvement: Case study in the production of furniture. Espacios, 38(43).

Vilkas, M., Koreckaja, I., Katiliūtė, E., & Bagdonienė, D. 2015. Adoption of lean production: Preliminary evidence from Lithuania. Procedia - Social and Behavioral Sciences, 213, 884-889.

Vizzotto, M. J., Fredo, A. R., Ciconet, B., Rizzotto, M. F., Tondolo, V. A. G., & Zanandrea, G. 2015. Identification of lean manufacturing implementation dificulties: A case study in the furniture industry. Espacios, 36(19), 20.

Voorhees, C. M., Brady, M. K., Calantone, R., & Ramirez, E. 2016. Discriminant validity testing in marketing: an analysis, causes for concern, and proposed remedies. Journal of the Academy of Marketing Science, 44, 119-134.

Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. 2011. *Probability & Statistics for Engineers & Scientists* (9th edition ed.). Boston, MA: Pearson.

Wang, X., Jin, Q., Wang, L., Bai, S., Mikulčić, H., Vujanović, M., et al. 2019. Synergistic effect of biomass and polyurethane waste co-pyrolysis on soot formation at high temperatures. Journal of Environmental Management, 239, 306-315.

Wanitwattanakosol, J., & Sopadang, A. 2011. A framework for implementing lean manufacturing system in small and medium enterprises. Applied Mechanics and Materials, 110-116, 3997 - 4003.

Waurzyniak, P. 2008. How the metal furniture builder cut waste, improved manufacturing processes, and won the Shingo Prize. Manufacturing Engineering, 141(5).

Welo, T., Tonning, O. R. B., & Rølvåg, T. 2013. Lean Systems Engineering (LSE): Hands-on experiences in applying LSE to a student eco-car build project. Procedia Computer Science, Conference on Systems Engineering Research (CSER'13) 16, 492-501.

Wickramasinghe, V., & Wickramasinghe, G. L. D. 2016. Variable pay and job performance of shop-floor workers in lean production. Journal of Manufacturing Technology Management, 27(2), 287-311.

Wiengarten, F., Gimenez, C., Fynes, B., & Ferdows, K. 2015. Exploring the importance of cultural collectivism on the efficacy of lean practices. International Journal of Operations & Production Management, 35(3), 370-391.

Williams, K., Haslam, C., Williams, J., Cutler, T., Adcroft, A., & Sukhdevjohal, S. 1992. Against Lean Production. Economy and Society, 21(3), 321-354.

Womack, J. P., & Jones, D. T. 2003. *Lean thinking: Banish waste and create wealth in your corporation* (Second edition ed.). New York: Simon & Schuster.

Womack, J. P., Jones, D. T., & Roos, D. 1990. *The machine that changed the world.* New York: Simon & Schuster.

Wong, W. P., & Wong, K. Y. 2014. Synergizing an ecosphere of lean for sustainable operations. Journal of Cleaner Production, 85, 51-66.

Wong, Y. C., & Wong, K. Y. 2011. A Lean Manufacturing Framework for the Malaysian Electrical and Electronics Industry. 2011 3rd International Conference on Information and Financial Engineering, 12, 1-34.

Xue, Y., Liang, H., & Wu, L. 2011. Punishment, Justice, and Compliance in Mandatory IT Settings. Information Systems Research, 22(2), 400-414.

Yang, M. G., Hong, P., & Modi, S. B. 2011. Impact of lean manufacturing and environmental management on business performance: An empirical study of manufacturing firms. International Journal of Production Economics, 129(2), 251-261.

Yasukawa, K., Brown, T., & Black, S. 2014. Disturbing practices: Training workers to be lean. Journal of Workplace Learning, 26(6/7), 392-405.

Yu, Y., Wang, X., Zhong, R. Y., & Huang, G. Q. 2017. E-commerce logistics in supply chain management: Implementations and future perspective in furniture industry. Industrial Management & Data Systems, 117(10), 2263-2286.

Zu, X., Fredendall, L. D., & Douglas, T. J. 2008. The evolving theory of quality management: The role of six sigma. Journal of Operations Management, 26(5), 630-650.