UNIVERSITI PUTRA MALAYSIA

SYNERGISTIC MODEL DEVELOPMENT FOR LEAN MANUFACTURING IMPLEMENTATION AT SMALL AND MEDIUM ENTERPRISES IN MALAYSIA

MOHD SHAHRIZAN BIN YUSOFF

SYNERGISTIC MODEL DEVELOPMENT FOR LEAN MANUFACTURING IMPLEMENTATION AT SMALL AND MEDIUM ENTERPRISES IN MALAYSIA

By

MOHD SHAHRIZAN BIN YUSOFF

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

August 2018

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

SYNERGISTIC MODEL DEVELOPMENT FOR LEAN MANUFACTURING IMPLEMENTATION AT SMALL AND MEDIUM ENTERPRISES IN MALAYSIA

By

MOHD SHAHRIZAN BIN YUSOFF

August 2018

Chairman : Associate Professor Zulkiflle Bin Leman, PhD
Faculty : Engineering

Historically Lean Manufacturing (LM) is originally derived from Toyota Production System (TPS). The core functions of LM practices are to create high-quality products and to minimise non-value added (NVA) activities in a company. Although LM had successfully implemented in various large corporations around the world since the 1980s, however, the evidence of LM's adoption in Malaysian Small and Medium Enterprise (SMEs) were rarely documented. Malaysian SMEs predominantly characterised by low volume, highly mixed product yield as well as limited shop floor management and human control processes. Therefore, the focal objective of this study was to develop a model based on LM's philosophy to help Malaysian SMEs improving their competitiveness in manufacturing operations management by synergising or cooperation of the LM critical successful factors including the efficiency of production management and human resource development to create more positive impact on the sustainability of effective business management system. To achieve the objective of the study, three different research phases were integrated. The approaches cover methods of, research review, exploring the LM implementation in Malaysia using statistical inference and construction of Structural Equation Modelling (SEM) and industrial research in the real industry involving two SMEs in northern of peninsular Malaysia. The research review methods conducted by collecting qualitative research data, including observations and examination of documents to assess the impact of the implementation of the LM among the SMEs organisation. Then, for exploring the LM implementation among Malaysian SMEs, surveys with 250 sets of questionnaires were distributed. Quantitative data obtained with a response rate of 40% then was analysed by using descriptive and inferential statistics. Results of the descriptive statistical analysis show that most Malaysian SMEs provide positive feedback with the mean score above 3.00 against the proposed implementation of LM variables comprising elements of operations management efficiency, human resource development, and

preservation of the business. The findings from SEM results also confirmed that the LM variables did affect the performance of SMEs significantly. Then, the final model called as Synergistic LM for Malaysian SMEs (SyncLM) was developed using SEM. Lastly, the SyncLM model has verified its reliability through the implementation framework in two case studies of SMEs show a high tendency for them to implement and incorporate elements of the concept of LM that this synergy concept. The results showed that SyncLM model has managed to reduce 6.85% production time and 18.25% product defects for the first case study. Positive results are also obtained from second case study where the SyncLM model has successfully reduced 9.7% production time and 4.2% of product defects. Additionally, over 80% of the satisfaction scores have been achieved by respondents comprising management and employees from both companies with the implementation capability and effectiveness of benefits derived from the implementation of this SyncLM model. Therefore, it can be concluded that the SyncLM was able to improve the sustainability of the business functions of Malaysian SMEs.

Abstrak tesis yang dikemukan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PEMBANGUNAN MODEL SINERGI BAGI PELAKSANAAN PEMBUATAN *LEAN* BAGI SEKTOR INDUSTRI KECIL DAN SEDERHANA DI MALAYSIA

Oleh

MOHD SHAHRIZAN BIN YUSOFF

Ogos 2018

Pengerusi : Profesor Madya Zulkiflle Bin Leman, PhD
Fakulti : Kejuruteraan

Menurut sejarah, pembuatan *Lean* (LM) diasaskan daripada Sistem Pengeluaran Toyota (TPS). Teras kepada LM adalah untuk mewujudkan produk-produk berkualiti tinggi dan meminimumkan aktiviti pembaziran dalam proses pembuatan (NVA) didalam sesebuah organisasi. Walaupun LM telah berjaya dilaksanakan sejak tahun 1980-an di pelbagai syarikat gergasi dunia, namun penerimaannya dalam sektor industri kecil dan sederhana (PKS) Malaysia jarang didokumenkan. Halangan utama pelaksanaan LM di kalangan PKS Malaysia adalah kerana kebanyakannya mempunyai jumlah pengeluaran yang terhad serta hasil produk yang pelbagai. Keadaan ini semakin rumit apabila organisasi dalam PKS ini turut mengalami masalah pengurusan pengeluaran dan sumber manusia yang terhad. Oleh yang demikian, objektif utama kajian ini adalah membina satu model rangka kerja berasaskan falsafah LM untuk membantu PKS Malaysia meningkatkan daya saing mereka dalam pengurusan operasi pembuatan dengan memberi tumpuan kepada mensinergikan faktor serta faedah pelaksanaan LM. Sinergi dalam kajian ini adalah bermaksud mencantumkan elemen- elemen dari faktor kecekapan pengurusan operasi, pembangunan sumber manusia yang berkesan bagi mewujudkan kesan yang lebih positif pada kelestarian pada sistem pengurusan perniagaan. Bagi merealisasikan objektif kajian ini, tiga kaedah penyelidikan yang berbeza telah diintegrasikan. Ia meliputi kaedah kajian kepustakaan, kajian tinjauan pelaksanaan aktiviti LM di Malaysia menerusi taburan statistik dan pembinaan model berstruktur (SEM) serta kajian industri di dua buah syarikat berstatus SMEs di Malaysia. Menerusi kaedah kajian kepustakaan, beberapa kaedah pengumpulan data penyelidikan secara pemerhatian dan semakan dokumen dilaksanakan untuk menilai impak pelaksanaan kerangka kerja ke atas prestasi pembuatan organisasi PKS. Dalam kajian tinjauan pelaksanaan aktiviti LM di kalangan PKS Malaysia, sebanyak 250 keping borang soal selidik telah diedarkan dengan kadar maklum balas sebanyak 40% telah dianalisis

secara statistik deskriptif dan inferensi. Keputusan analisis statistik deskriptif mendapati, kebanyakan PKS memberikan maklum balas yang positif dengan nilai skor min melebihi 3.00 terhadap cadangan pemboleh ubah pelaksanaan LM yang terdiri daripada elemen kecekapan pengurusan operasi, pembangunan sumber manusia dan kelestarian fungsi perniagaan. Manakala dapatan analisis statistik inferensi menunjukkan, keputusan yang signifikan bagi kebanyakan pemboleh ubah pelaksanaan LM dan prestasi PKS. Keputusan analisis SEM mengesahkan pembinaan model terakhir kajian ini yang turut dikenali sebagai model SyncLM. Manakala data pengesahan kebolehlaksanaan model telah dijalankan pada dua buah syarikat PKS di lapangan industri. Keputusan daripada kajian kes telah menunjukkan menunjukkan bahawa model SyncLM telah berjaya mengurangkan masa pengeluaran 6.85% dan kecacatan produk 18.25% untuk kajian kes pertama. Hasil positif turut diperolehi dari kajian kes kedua dimana model SyncLM telah berhasil mengurangi 9.7% waktu produksi dan 4.2% kecacatan produk. Di samping itu, lebih daripada 80% skor kepuasan telah dicapai oleh responden yang terdiri daripada pengurusan dan pekerja dari kedua-dua syarikat dengan keupayaan pelaksanaan dan keberkesanan manfaat yang diperoleh daripada pelaksanaan model SyncLM ini. Oleh itu, dapat disimpulkan bahawa SyncLM mampu meningkatkan kelangsungan fungsi perniagaan PKS Malaysia.

ACKNOWLEDGEMENTS

IN THE NAME OF ALLAH, THE MOST GRACEFUL AND THE MOST MERCIFUL

This thesis is dedicated to my beloved parents Haji Yusoff bin Abdullah and Hajah Tom binti Hj. Abdullah who have never failed to give me moral support since the beginning of the study. It is also dedicated to lovely wife Hasliza binti Jali and my sons and daughter Muhammad Haikal bin Mohd Shahrizan, Nurshifa Azzarra binti Mohd Shahrizan and Muhammad Haziq Iman bin Mohd Shahrizan, who has been a source of motivation and inspiration. And not forgotten for my siblings, Norain Liyana, Muizzuddin, Diyana and Syazani for being supportive.

The author would also like to take this opportunity to express his appreciation to Assoc. Prof. Dr Zulkiflle Bin Leman as the chairman of supervisory committee in order to set up this thesis, he has given a lot of moral support and guidance to the completion of this thesis. Also to Prof. Dr Shamsuddin Bin Sulaiman, Prof. Ir. Dr Mohd Yusof Bin Ismail and Dr Mohd Idris Shah bin Ismail, co-supervisors who have provided many views, comments, advice, encouragement and motivation to strengthen the spirit of the author of the study.

A big thank you also goes to the sponsors, namely Majlis Amanah Rakyat (MARA), Universiti Kuala Lumpur (UniKL), Universiti Putra Malaysia (UPM) to finance research expenditures and other financial assistance. The Resource Center of Malaysian Productivity Center (MPC), for cooperation and guidance given by them.
The author hopes this thesis provides benefits to readers and provides an overview as well as a better understanding of the implementation of lean manufacturing in the industrial sector of small and medium enterprises (SMEs) in Malaysia and lean manufacturing impact on manufacturing performance, especially.

This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Zulkiflle Bin Leman, PhD
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Shamsuddin Bin Sulaiman, PhD
Professor
Faculty of Engineering
Universiti Putra Malaysia
(Member)

Mohd Idris Shah Bin Ismail, PhD
Senior Lecturer
Faculty of Engineering
Universiti Putra Malaysia
(Member)

Md Yusof Bin Ismail, PhD, PEng
Professor, Ir
Faculty of Engineering
International Islamic University Malaysia
(Member)

ROBIAH BINTI YUNUS, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software

Signature: _____ Date: _____

Name and Matric No: Mohd Shahrizan Bin Yusoff; GS38448

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) were adhered to.

Signature: _____
Name of Chairman of Supervisory Committee: Associate Professor Dr. Zulkiflle Bin Leman

Signature: _____
Name of Member of Supervisory Committee: Professor Dr. Shamsuddin Bin Sulaiman

Signature: _____
Name of Member of Supervisory Committee: Dr. Mohd Idris Shah Bin Ismail

Signature: _____
Name of Member of Supervisory Committee: Professor Ir Dr. Md Yusof Bin Ismail

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CI	Continuous improvement
FMM	Federation of Malaysian Manufacturers
GDP	Gross domestic product
HRM	Human resource management
ICT	Information & communication technology
IMP	Industrial master plan
LM	Lean manufacturing
MP	Mass production
MPC	Malaysia Productivity Corporation
NEP	New economy policy
NVA	Non-value added
OC	Organisational capabilities
OOM	Organisation operational management
OOV	Organisation operational value
OP	Operation production
QM	Quality management
SMIDEC	Small and medium industry corporation
SMED	Single minute exchange of dies
SMEs	Small and medium enterprise
TPS	Toyota production system
TQM	Total quality management
WI	Waste indicator
VA	Value added

CHAPTER 1

INTRODUCTION

This chapter is divided into six sections. The first section gives an overview of the research background. The following section discusses on research problem statement. The third section deal with the research aims and objectives while research focus is presented in the fourth section. The research question is presented in the fifth sections then followed while the last part highlights the whole thesis outline.

1.1 Introduction

Small and medium enterprises (SMEs) constitute to the largest cluster of industrial organisations in most countries such as Britain, Brazil, Italy, India and others (Filho et al., 2016). These firms have contributed significantly to manufacturing productivity and the economic growth of nations, especially in the current highly competitive and globalisation marketplace (Doh & Kim, 2014). The definitions of SMEs may vary across countries, but general classifications are commonly based on the number of employees, sales value, and the value of production equipment. For example, SMEs in Britain is defined by the following three criteria: the number of employees, annual turnover, and annual balance sheet total (Wilson & Roy, 2009). By contrast, Malaysia defines SMEs based on annual sales turnover or the number of full-time employees. Thus, the firms are divided into two sectors (SMIDEC, 2013): the first one covers manufacturing, manufacturing related services, and agriculture industries, whereas the other, includes services (such as ICT) and primary agriculture, as shown in Table 1.1

Table 1.1 : Definition and categories of Malaysian Small-Medium Enterprise (SMEs)

Size	Number of Full-Time Workers		Annual Sales (RM)	
	Manufacturing (include agro-based manufacturing)	Services Sector (include ICT and the main farm)	Manufacturing (include agro-based manufacturing)	Services Sector (include ICT and the main farm)
Macro	<5	<5	<250 000	<200 000
Small	<50	<20	<10 000 000	<1000000
Medium	<200	<50	<25 000 000	<5000000

(Source : SME Corporation Malaysia SMIDEC, 2013)

The manufacturing sector of Malaysian SMEs has developed significantly over the past five decades. In Malaysia, “New Economic Policy (NEP)” was introduced by former Prime Minister Tun Abdul Razak in 1971; this policy was then succeeded by the National Development Policy in 1991 (National Economic Advisory Council, 2010). The policies aimed to improve people’s welfare and to restructure ethnic

imbalance by introducing economy activities related to SMEs. SME development was also included in the second and the third industrial master plans (IMP2; IMP3); where both IMPs were envisaged to enhance the growth rate of manufacturing across the value chain and create opportunities for Malaysian SMEs.

To date, 20,445 SMEs have been established, and they constitute 93.8% of companies in the manufacturing sector, as recorded by the Small and Medium Development Corporation. These enterprises provide goods and supplies, such as beverages, textiles, petroleum, wood, rubber, and electrical or electronic components, to numerous customers (Hashim, 2012). As of the first quarter of 2015, the demand for SME products has reached up to MYR 48 billion. In addition, experts predicted that the total production of SMEs would be worth more than MYR 120 billion, or 50% of the total output in the manufacturing sector, by the year 2020 (Deros et al., 2006).

SME Corporation Malaysia has also reported that textiles and apparel establishments are the largest among the manufacturing categories of the SME sector, followed by food and beverages, metal, and metal products, as shown in Table 1.2. The findings are also supported by the Federation of Malaysian Manufacturers (FMM).

Table 1.2 : Distribution of SMEs in the manufacturing sector

Sector	Number of Establishment (K)	Proportion of SMEs (%)
Textiles and Apparel	3419	18.2
Food and Beverages	2949	15.2
Metal Product	2918	14.8
Wood product	2776	14.1
Paper product	1288	6.5
Machinery	1249	6.5

(Source : Federation of Malaysian Manufacturers 2013)

Malaysian SMEs also contribute considerably to the total imports and exports in Malaysia. This sector adds to local income generation via outside sales or import substitution and accounts for 40% of GDP, as per the 2014 report issued by the Malaysia International Trade and Industry (Salikin, Wahab, & Muhammad, 2014). Thus, many Malaysian SMEs endeavour to progress with the aim of attaining the status of World Class SMEs Organization.

1.2 Problem Statement

Over the past half century in the Malaysian SMEs is still heavily influenced by Mass Production (MP) concepts or activities. According to Hosseini et al., (2012), MP refers to the idea of "Fordism", founded by Ford Motor Corporation in the early 19th century

which claims to the manufacturer to produce large quantities of standardised products. Although the mission of this philosophy is to create a model of economic expansion and technological progress based, this methodology requires an organisation to produce in huge volumes manufactured using special purpose machinery and labour to maximise the profit obtained. Nevertheless, Hu (2013) pointed out that the implementation of the MP has created many flaws and waste during the production operation is carried out.

Also criticised the production methods for MP is Villa & Taurino (2013). He stated in his study MP production methods are in fact far more complex process as it is a large-scale manufacturing process or method. Even, Lucato et al. (2014) clarified that the traditional mass production is no longer relevant for today business culture as a consequence of large-scale production create high variability of cost including the resource, process, labour, inventory and high-risk goods produced could not be marketed properly.

Malaysian SMEs are dominantly characterised by low volume, highly mixed product yield, and customised orders with variable volume rates, rather than orders to stock, regular machine set ups or changeovers, and limited inventory processes (Chong et al., 2012; Rahman et al., 2013). Thus, when lead time on shop floors is high, the production environment is unstable, and "production cash flow" is reduced.

Jeyaraman et al., (2010) and Hasle et al., (2012) had stated that the failure to implement lean manufacturing is related to "how to create overall lean strategies on the shop floor" with minimal negative influence from outside of the organisation. As per an in-depth examination of the situation, most problems can be categorised into a few clusters based on the 4 Ms, namely, man, machine, money, and method (or procedure). According to Moori et al., (2013), Man is referred to organisations whose operation includes management and support staff, whereas machine consists of the apparatuses and tools used on shop floors (Rahman et al., 2013). Money relates to the ability to pay or spend, and finally, method denotes the system or procedure applied in shop floors (Raisinghani et al., 2005)

For the first M which is money, the most critical points among the barriers to the adoption of lean manufacturing by Malaysian SMEs are related to investment cost (Rahman et al., 2013). The majority of enterprises believe that every manufacturing system requires considerable expenditure; some businesses expect to spend on automated machines, high-end computers and software, and the training and hiring of professional consultants as a result of lean manufacturing implementation (Wahab et al., 2013). Also, local SMEs are concerned with return on investments, while other organisations are concerned about over-budgeting and disruptions to production schedules in the event of delays (Dombrowski et al., 2014; Dora et al., 2013).

Another point of M to ponder is Man or how people are an essential element of any SMEs. Angelis et al., (2011) reported that lean manufacturing would succeed if every member of a company is committed and dedicated to the system. Many SMEs are self-managed; thus, knowledge and understanding of the lean manufacturing philosophy are crucial as this implementation may be rendered ineffective due to a lack of management support, poor procedure or standards, and vision. Al-Zuheri et al., (2012) concluded that the management is the main driver for lean manufacturing implementation initiatives in SMEs. However, the other barriers to this adoption involve company workers themselves; Schlosser (2013) stated that some employees disrupt the application at the shop floor given that most SMEs employ people with low skill levels who have a limited background in lean manufacturing. In certain cases, employees fear infringement and cannot foresee the advantage of this practice (Ling & Shan, 2009).

Thirdly, machines are another problem in lean manufacturing implementation, although they help SMEs operate efficiently. The point is highly variable and low-volume operations complicate machine setup by SMEs (Deo, 2013), and acquiring fast machines is not the ideal solution to this issue. Related factors, including the configuration time, process time, layout, number, and placement of machines, influence operating performance as well. Other aspects that contribute to NVA process wastes include a long setup period, significant distances between machines, transportation, and motion at shop floors. Azlina et al., (2011) also highlighted the failure of many local SMEs to maintain machines and equipment systematically.

Finally, researchers note situations wherein most local organisations collect, analyse, and report data without understanding their relevance to issues (Ling & Shan, 2009). Most data were not evaluated and were simply presented in "black and white" without considerable input. In a few cases, the methodologies used were too complicated. Then, there also cases where some SMEs merely copy findings from seminars or their mentors; this practice is ineffective because the researchers do not understand the relevance and implications of their results for implementation. Many reported cases exhibit the concept of "do it quickly, evaluate the result, and if the change is unsuccessful, try another solution." Ultimately, the competitive advantage of lean manufacturing is unfortunately not utilised. Proper and proven guideline s could have assisted the current and future SMEs in Malaysia to have high-efficiency LM outcome with least resources involved. In the light of discussion mentioned above, existing problem and elaborated the gaps in implementing lean manufacturing in Malaysian SMEs can be summarised as follow:

Table 1.3 : The gaps for implementing Lean Manufacturing among Malaysian SMEs

Categories	The Gaps
Man	Lack of technical knowledge
	Sabotage from support staff
	Lack of management support
Machine	High variation and low Volume
	Ineffective control system
	Poor layout design
Method	Not understand the relevance
	Distinctiveness from big multinational companies
Money	Wrong perception
	Small Capital
	Low cash flow management

(Source : Ling & Shan, 2009, Jeyaraman et al., 2010, Azlina et al., 2011, Angelis et al., 2011, Al-Zuheri et al., 2012, Hasle et al., (2012), Wahab et al., 2013 and Dora et al., 2013, Dombrowski et al., 2014)

1.3 Research Aim and Objectives

The aim of this research is to investigate and develop an effective lean manufacturing framework for SMEs organisation, especially for Malaysian SMEs. It can be done by transforming the raw data into usable, understandable and communicable information for the use of improving the quality management at operational management level among the SMEs organisation. The model is hoped to enable Malaysian SMEs to achieve better productivity improvement. The specific objectives of this research are:

i. To investigate the enablers variables for the LM implementation activities among the Malaysian SMEs.
ii. To examine the effect of the implementation of the LM activities on the Malaysian SMEs operational performance and waste reduction.
iii. To develop a Synergistic Lean Manufacturing (SyncLean) framework through the implementation of effective operational management practices and human resource development to enhance the sustainability of the SME business function.
iv. To test the feasibility of a framework built through SyncLean industry and its impact on SMEs in Malaysia.

1.4 Scope and Limitations

This study only focuses on Malaysian SMEs manufacturing sector which is defined by SMIDEC. Also, the process of data collection via surveys will only involve companies that are recognised practising LM by Malaysian Productivity Corporation (MPC) for better understanding of the impact of LM among SMEs in Malaysia.

The results of this study are expected to help businesses in Malaysia SMEs that are still lagging in understanding the importance of the application and the correlation of LM in improving the quality and performance of the company, particularly in human resource development towards preserving existing manufacturing systems. The implementation of the concept of evidence-based research and the vindication through structural equation modelling (SEM), the case also helped to improve the reliability of the research study.

1.5 Research Questions

This study explored the question of "What are the factors that lead to the implementation of LM among local SMEs?". There is also the question that gathers some concerns related to the internal environment of an organisation of SMEs and methods that can be used to increase the efficiency of the implementation of LM among local SMEs. These research questions were also raised to achieve the main objective of the thesis:

i. Why should Malaysian SMEs implement LM?
ii. What are the elements for implementing LM in this sector?
iii. What is the status of development for Lean Manufacturing among Malaysian SMEs?
iv. What are the relationship between the variables of human resources and the choice of strategic operation management to reduce waste in the organisation?
v. How can the execution of LM process based on the application of the concept of synergy LM improve operational performance of organisation?

1.6 Thesis Outline

This thesis contains six chapters. Chapter 1 provides the overview of the current practice of lean manufacturing among Malaysian SMEs industries and the objectives of this research. The whole research was described as to prepare readers for what this project is all about and the aims to be achieved. The problem statement was stated to explain why LM was chosen and it overview can be found in the first section. Then, Chapter 2 provides the reviews on the available literature which encompass critical thinking, ideas and approaches to this LM policy. This chapter also contains information on history, principles, research trend, along with tools and techniques used in the research areas.

In sequence with the discussion of many kinds of literature on lean manufacturing, Chapter 3 discusses the model development process that's been used throughout this research which is an explanatory mixed-method research (qualitative and quantitative approaches). Background and reasons for selecting these methods are also discussed in detail.

A preliminary framework has been developed from literature, and to be augmented through a survey in Chapter 4. A survey using structured questionnaire was designed which comprises of several sections including respondent profile and general knowledge on lean manufacturing concept, attitudes and behaviour. Then a structural equation model and the statistical approaches analysis are detailed out in this chapter.

Subsequently, Chapter 5 describes the step by step process on case studies that have been conducted in two SMEs companies in Malaysia. The use of a case study methodology is suitable for exploring a phenomenon within its real-life context, understanding the issues, and uncovering the strategies for continual improvement.

Finally, Chapter 6 summarises the whole research work encompass on how research aim and objectives were achieved based on the results obtained. Some recommendations for future action in lean manufacturing for SMEs are also provided at the end of this chapter.

REFERENCES

Aboelmaged, M. G. (2010). Six Sigma quality: a structured review and implications for future research. International Journal of Quality & Reliability Management, 27(3), 268–317.

Abdel-Maksoud, A., Cerbioni, F., Ricceri, F., & Velayutham, S. (2010). Employee morale, non-financial performance measures, deployment of innovative managerial practices and shop-floor involvement in Italian manufacturing firms. The British Accounting Review, 42(1), 36–55.

Agarwal, R., Grassl, W., & Pahl, J. (2012). Meta-SWOT: introducing a new strategic planning tool. Journal of Business Strategy, 33(2), 12–21.

Al-Aomar, R. (2011). Handling multi-lean measures with simulation and simulated annealing. Journal of the Franklin Institute, 348(7), 1506–1522.

Al-Zuheri, A., Luong, L., & Xing, K. (2012). The Role of Randomness of a Manual Assembly Line with Walking Workers on Model Validation. *Procedia CIRP*, *3*, 233–238.

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.

Arena, M., & Azzone, G. (2012). A process-based operational framework for sustainability reporting in SMEs. Journal of Small Business and Enterprise Development, 19(4), 669–686.

Ashok Sarkar, S., Ranjan Mukhopadhyay, A., & Ghosh, S. K. (2013). Root cause analysis, Lean Six Sigma and test of hypothesis. The TQM Journal, 25(2), 170–185.

Assarlind, M., Gremyr, I., & Bäckman, K. (2012). Multi-faceted views on a Lean Six Sigma application. International Journal of Quality & Reliability Management, 29(1), 21–30.

Astrachan, C. B., Patel, V. K., & Wanzenried, G. (2014). A comparative study of CB-SEM and PLS-SEM for theory development in family firm research. Journal of Family Business Strategy, 5(1), 116–128.

Angelis, J., Conti, R., Cooper, C., & Gill, C. (2011). Building a high-commitment lean culture. Journal of Manufacturing Technology Management, 22(5), 569–586.

Anvari, A. R., Norzima, Z., Rosnay, M.Y, Hojjati, M.S.H. and Ismail, Y. (2010). A Comparative Study on Journey of Lean Manufacturing Implementation, Asian International Journal of Science and Technology in Production and Manufacturing Engineering Vol. 3,No. 2, 77–85.

Andersson, R., Eriksson, H., & Torstensson, H. (2006). Similarities and differences between TQM, six sigma and lean. The TQM Magazine, 18(3), 282–296.

Arlbjørn, J. S. (2013). Evidence of lean: a review of international peer-reviewed journal articles. European Business Review, 25(2), 174–205.

Azis, Y., & Osada, H. (2010). Innovation in management system by Six Sigma: an empirical study of world-class companies. International Journal of Lean Six Sigma, 1(3), 172–190

Bakri, A. H., Rahim, A. R. A., Yusof, N. M., & Ahmad, R. (2012). Boosting Lean Production via TPM. Procedia - Social and Behavioral Sciences, 65(ICIBSoS), 485–491.

Balian, E.S. (1995). The Graduate Research Guidebook: A Practical Approach to Doctorate/

Master Research. USA: University Press of America.

Begam, M.S, Sekkizhar. J, Swamynathan. R. (2013). Current Trends on Lean Management – A review, International Journal of Lean Thinking. Vol 4, No 2, 1-7.

Bhamu, J., & Sangwan, K. S. (2014). Lean manufacturing: literature review and research issues. International Journal of Operations & Production Management (Vol. 34).

Bhasij, S. (2012). An appropriate change strategy for lean success. Management Decision, 50(3), 439–458.

Bhasin, S., & Burcher, P. (2006). Lean viewed as a philosophy. Journal of Manufacturing Technology Management, 17(1), 56–72.

Bhasin, S. (2012). Performance of Lean in large organisations. Journal of Manufacturing Systems, 31(3), 349–357.

Blackburn, R. a., Hart, M., & Wainwright, T. (2013). Small business performance: business, strategy and owner-manager characteristics. Journal of Small Business and Enterprise Development, 20(1), 8–27.

Bloomfield, R., Mazhari, E., Hawkins, J., & Son, Y.-J. (2012). Interoperability of manufacturing applications using the Core Manufacturing Simulation Data (CMSD) standard information model. Computers & Industrial Engineering, 62(4), 1065–1079.

Bozdogan, K., & Development, I. (2010). Towards an integration of the Lean enterprise system, total quality management, six sigma and related, International Journal of Operations & Production, 6, 1–23.

Burnes, B., Cooper, C. & West, P. (2003). Organisational learning: the new management paradigm. Management Decision 41(5): 452-464.

C Kalpakjian, S. & Schmid, S.R. (2010). Manufacturing Engineering and Technology. Singapore: Pearson

Castro, H., Putnik, G. D., & Shah, V. (2012). A review of agile and lean manufacturing as issues in selected international and national research and development programs and roadmaps. The Learning Organization, 19(3), 267–289.

Chase, Jacobs & Aquilano. (2006). Operation Management. Boston: McGraw Hill.

Chauhan, G. (2012). Measuring parameters of lean manufacturing realization. Measuring Business Excellence, 16(3), 57–71.

Chavez, R., Yu, W., Jacobs, M., Fynes, B., Wiengarten, F., & Lecuna, A. (2015). Internal lean practices and performance: The role of technological turbulence. International Journal of Production Economics, 160, 157–171.

Chen, J. C., Cheng, C.-H., & Huang, P. B. (2013). Supply chain management with lean production and RFID application: A case study. Expert Systems with Applications, 40(9), 3389–3397.

Chiarini, A. (2012). Lean production: mistakes and limitations of accounting systems inside the SME sector. Journal of Manufacturing Technology Management, 23(5), 681–700.

Chong, A., Cheah, H., Wong, W. P., & Deng, Q. (2012). Challenges of Lean Manufacturing Implementation : A Hierarchical Model, (1997), 2091–2099.

Chowdary, B. V., & George, D. (2012). Improvement of manufacturing operations at a pharmaceutical company: A lean manufacturing approach. Journal of Manufacturing Technology Management, 23(1), 56–75.

Chua, Y.P. (2006). Kaedah dan Statistik Penyelidikan: Asas Statistik Penyelidikan. Buku 2. Kuala Lumpur: McGraw-Hill.

Chua, Y.P. (2008). Asas Statistik Penyelidikan: Analisis Data Skala Ordinal dan Skala Nominal. Buku 3. Kuala Lumpur: McGraw-Hill.

Chua, Y.P. (2014). Kaedah dan Statistik Penyelidikan: Ujian Regresi, Analisis Faktor dan Analisis SEM. Buku 5. Kuala Lumpur: McGraw-Hill.

Chua, Y.P. (2014). Kaedah dan Statistik Penyelidikan: Kaedah Penyelidikan. Buku 1. Kuala Lumpur: McGraw-Hill.

Coakes, S.J. & Steed, L.G. (2003). SPSS: Analysis Without Anguish: version 11.0 for Windows. Brisbane: Jacaranda Wiley.

Creswell, J.W. (2009). Research Design: Qualitative, Quantitative and Mixed Methods Approaches. 3rd Edition. California: Sage.

Creswell, J.W. & Clerk, V.L. (2007). Designing and Conducting Mixed Methods Research. California: Sage.

Custer, R.L., Scarcella, J. A. & Stewart, B R. (1999). The modified Delphi technique: a rotational modification. Journal of Vocational and Technical Education 15(2): 1-10.

Custer, R.L., Scarcella, J. A. & Stewart, B R. (1999). The modified Delphi technique: a rotational modification. Journal of Vocational and Technical Education 15(2): 1-10

Deif, A. (2012). Assessing Lean Systems Using Variability Mapping. Procedia CIRP, 3, 2–7.

Deros, B. M. (2014). Critical Success Factors for Implementing Lean Manufacturing in Malaysian Automotive Industry, 8(10), 1191–1200.

Deshmukh, S. V., & Chavan, A. (2012). Six Sigma and SMEs: a critical review of literature. International Journal of Lean Six Sigma, 3(2), 157–167.

Dickson, E. W., Singh, S., Cheung, D. S., Wyatt, C. C., & Nugent, A. S. (2009). Application of lean manufacturing techniques in the Emergency Department. The Journal of Emergency Medicine, 37(2), 177–82.

Doh, S., & Kim, B. (2014). Government support for SME innovations in the regional industries: The case of government financial support program in South Korea. *Research Policy*, *43*(9), 1–13.

Dombrowski, U., & Mielke, T. (2013). Lean Leadership – Fundamental Principles and their Application. *Procedia CIRP*, *7*, 569–574.

Dora, M., Kumar, M., Van Goubergen, D., Molnar, A., & Gellynck, X. (2013). Operational performance and critical success factors of lean manufacturing in European food processing SMEs. Trends in Food Science & Technology, 31(2), 156–164.

Dorsch, J. J., Yasin, M. M., & Czuchry, A. J. (2013). Application of root cause analysis in a service delivery.

Driel, H. Van, & Dolfsma, W. (2009). Path dependence, initial conditions, and routines in organizations: The Toyota production system re-examined. Journal of Organizational Change Management, 22(1), 49–72.

Edison, H., bin Ali, N., & Torkar, R. (2013). Towards innovation measurement in the software industry. Journal of Systems and Software, 86(5), 1390–1407.

Evans & Lindsay. (2008). The management and control of quality. New York: South-Western Cengage Learning.

Hair Jr, J., Sarstedt, M., Hopkins, L., & G. Kuppelwieser, V. (2014). Partial least squares structural equation modeling (PLS-SEM). European Business Review, 26(2), 106–121.

Fadly Habidin, N., & Mohd Yusof, S. (2013). Critical success factors of Lean Six Sigma for the Malaysian automotive industry. International Journal of Lean Six Sigma, 4(1), 60–82.

Farahani, R. Z., Rezapour, S., Kardar, L., & Rouhollahi, Z. (2011). Logistics Operations and Management. Logistics Operations and Management. Elsevier.

Filho, M.G, Gilberto, M. D. & Gunasekaran, A. (2016) Lean manufacturing in Brazilian small and medium enterprises: implementation and effect on performance, International Journal of Production Research, 54(24): 45-59.

Flumerfelt, S., Siriban-Manalang, A. B., & Kahlen, F.-J. (2012). Are agile and lean manufacturing systems employing sustainability, complexity and organizational learning? The Learning Organization, 19(3), 238–247.

Federation of Malaysian Manufacturers (FMM). (2013). FMM Directory 2013. Kuala Lumpur: FMM.

Folinas, D., Aidonis, D., Triantafillou, D., & Malindretos, G. (2013). Exploring the Greening of the Food Supply Chain with Lean Thinking Techniques. Procedia Technology, 8, 416–424.

Fullerton, R. R., & Wempe, W. F. (2009). Lean manufacturing, non-financial performance measures, and financial performance. International Journal of Operations & Production Management (Vol. 29).

Gadre, A., Cudney, E., & Corns, S. (2011). Model Development of a Virtual Learning Environment to Enhance Lean Education. Procedia Computer Science, 6, 100–105.

Gamme, I., & H. Aschehoug, S. (2014). Assessing lean's impact on operational integration. International Journal of Quality and Service Sciences, 6(2/3), 112–123.

Ghosh, M. (2013). Lean manufacturing performance in Indian manufacturing plants, 24(1), 113–122.

Ghosh, M. (2013). Lean manufacturing performance in Indian manufacturing plants. Journal of Manufacturing Technology Management, 24(1), 113–122.

Gnoni, M. G., Andriulo, S., Maggio, G., & Nardone, P. (2013). "Lean occupational" safety: An application for a Near-miss Management System design. Safety Science, 53, 96–104.

Gottmann, J., Pfeffer, M., & Sihn, W. (2013). Process oriented production evaluation. Procedia CIRP, 12, 336–341.

Gudem, M., Steinert, M., Welo, T., & Leifer, L. (2013). Redefining customer value in lean product development design projects. Journal of Engineering, Design and Technology, 11(1), 71–89.

Gupta, P., Seetharaman, A., & Raj, J. R. (2013). The usage and adoption of cloud computing by small and medium businesses. International Journal of Information Management, 33(5), 861–874.

Gurumurthy, A., & Kodali, R. (2011). Design of lean manufacturing systems using value stream mapping with simulation: A case study. Journal of Manufacturing Technology Management, 22(4), 444–473.

Hadi, N. ul. (2015). Conceptual Framework of Factors Affecting SMEs Manufacturing Business Performance. Review of Integrative Business & Economics Research, 42(July), 250–259.

Hair, J. F. M. Hut, G. Tomas. (2013). A Primer On Partial Least Squares Structural Equation Modeling (PLS-SEM). New York: Sage Publications.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2012). Partial Least Squares: The Better Approach to Structural Equation Modeling? Long Range Planning, 45(5–6), 312–319.

Hallström, I., & Hallstro, I. (2001). Quality improvement in the care of patients with hip fracture.

Halling, B. (2013). Experienced Barriers to Lean in Swedish Manufacturing and Health Care, 4(2).

Hamdani, J., & Wirawan, C. (2012). Open Innovation Implementation to Sustain Indonesian SMEs. Procedia Economics and Finance, 4(Icsmed), 223–233.

Hami, N., Muhamad, M. R., & Ebrahim, Z. (2012). The Impact of Sustainable Manufacturing Practices on Sustainability Performance. Jurnal Teknologi (Sciences and Engineering), 58, 85–88.

Hashim, F. (2012). Challenges For The Internationalization Of Smes and The Role of Government: The Case of Malaysia. *Journal of International Business and Economy*, *13*(1), 97–122.

Hasle, P., Bojesen, A., Jensen, P. L., & Bramming, P. (2012). Lean and the working environment: a review of the literature. International Journal of Operations & Production Management, 32(7), 829–849.

Helms, M. M., Rodríguez, M. a., Ríos, L. D. L., & Hargrave, W. B. (2011). Entrepreneurial potential in Argentina: a SWOT analysis. Competitiveness Review: An International Business Journal Incorporating Journal of Global Competitiveness, 21(3), 269–287.

Herron, C., & Braiden, P. M. (2006). A methodology for developing sustainable quantifiable productivity improvement in manufacturing companies. International Journal of Production Economics, 104(1), 143–153.

Hicks, B. J. (2007). Lean information management: Understanding and eliminating waste. International Journal of Information Management, 27(4), 233–249.

Ho, S. K. M. (2010). Integrated lean TQM model for global sustainability and competitiveness. The TQM Journal, 22(2), 143-158.

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

Holtskog, H. (2013). Continuous Improvement Beyond the Lean Understanding. Procedia CIRP, 7, 575–579.

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.

Hsueh, C.-C., & Chen, D.-Z. (2015). A taxonomy of patent strategies in Taiwan's small and medium innovative enterprises. Technological Forecasting and Social Change, 92, 84–98.

Hu, Q., Mason, R., Williams, S. J., & Found, P. (2015). Lean implementation within SMEs: a literature review. Journal of Manufacturing Technology Management, 26(7), 980–1012.

Hu, S. J. (2013). Evolving Paradigms of Manufacturing: From Mass Production to Mass Customization and Personalization. Procedia CIRP, 7, 3–8.

Hsu, C.C. & Sandford, B.A. (2007). The Delphi technique: making sense of consensus. Practical Assessment, Research & Evaluation 12(10): 1-8.

Huang, Y., Liu, C., Zha, X. F., & Li, Y. (2010). A lean model for performance assessment of machinery using second generation wavelet packet transform and Fisher criterion. Expert Systems with Applications, 37(5), 3815–3822.

Huertas- Quintero, L. a. M., Conway, P. P., Segura- Velandia, D. M., & West, a. a. (2011). Root cause analysis support for quality improvement in electronics manufacturing. Assembly Automation, 31(1), 38–46.

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.

Jeyaraman, K., & Teo, L. K. (2010). A conceptual framework for critical success factors of lean Six Sigma: Implementation on the performance of electronic manufacturing service industry. International Journal of Lean Six Sigma, 1(3), 191–215.

Jha, R., Sigma, S., & Management, P. (2012). An Exploratory Factor Analysis on Pragmatic Lean ERP Implementation for SMEs, (2000), 474–479.

Johannsen, F., & Leist, S. (2009). A Six Sigma approach for integrated solutions. Managing Service Quality, 19(5), 558–580.

Johansson, P. E. C., Lezama, T., Malmsköld, L., Sjögren, B., & Ahlström, L. M. (2013). Current State of Standardized Work in Automotive Industry in Sweden. Procedia CIRP, 7, 151–156.

Jun, S. P., Seo, J. H., & Son, J. K. (2013). A study of the SME Technology Roadmapping Program to strengthen the R&D planning capability of Korean SMEs. Technological Forecasting and Social Change, 80(5), 1002–1014.

Kahraman, C., Kaya, I., & Çevikcan, E. (2011). Intelligence decision systems in enterprise information management. Journal of Enterprise Information Management, 24(4), 360–379.

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

Keyser, R. S., & Sawhney, R. S. (2013). Reliability in lean systems. International Journal of Quality & Reliability Management, 30(3), 223–238.

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.

Krajewski, L.J, Ritzman, L.P. (2005). Operations management: Processes and value chains. Singapore: Pearson.

Koe, W.-L., Omar, R., & Sa'ari, J. R. (2015). Factors Influencing Propensity to Sustainable Entrepreneurship of SMEs in Malaysia. Procedia - Social and Behavioral Sciences, 172, 570–577.

Kuhlang, P., Edtmayr, T., & Sihn, W. (2011). Methodical approach to increase productivity and reduce lead time in assembly and production-logistic processes. CIRP Journal of Manufacturing Science and Technology, 4(1), 24–32.

Kumar, G., & Nath Banerjee, R. (2012). Collaboration in supply chain. International Journal of Productivity and Performance Management, 61(8), 897–918.

Kumar, M., Antony, J., Singh, R. K., Tiwari, M. K., & Perry, D. (2006). Implementing the Lean Sigma framework in an Indian SME: a case study. Production Planning & Control, 17(4), 407–423.

Lay, Y.F. & Khoo, C.H. (2009). Introduction to Statistical Analysis in Social Science Research. Kuala Lumpur: Venton.

Laohavichien, T., & Wanarat, S. (2013). A Structural Equation Model Assessment of Lean, Journal of Information and Social Science, 31(2), 260–273.

Levy, M., Powell, P., & Galliers, R. (1999). Assessing information systems strategy development frameworks in SMEs. Information & Management, 36(5), 247–261.

Liker, J.K, Hoseus, M. 2008. Toyota culture: The heart and soul of the Toyota way. New York: McGraw-Hill.

Lin, H. W., Nagalingam, S. V., Kuik, S. S., & Murata, T. (2012). Design of a Global Decision Support System for a manufacturing SME: Towards participating in Collaborative Manufacturing. International Journal of Production Economics, 136(1), 1–12.

Ling, T. N., & Shan, L. Y. (2009). Knowledge Management Adoption among Malaysia SMEs : Critical Factors, 250–257.

Lucato, W. C., Calarge, F. A., Junior, M. L., & Calado, R. D. (2014). Performance evaluation of lean manufacturing implementation in Brazil. International Journal of Productivity and Performance Management, 63(5), 529–549.

Maleyeff, J. (2012). The continuing evolution of Lean Six Sigma. The TQM Journal, 24(6), 542–555.

Mahmood, W., & Gambang, J. (2013). A Review on Optimistic Impact of Cleaner Production on Manufacturing Sustainability.

MPC (Malaysia Productivity Corporation). 2014. Senarai Persijilan Amalan Persekitaran Berkualiti. Petaling Jaya: MPC.

Marhani, M. A., Jaapar, A., Bari, N. A. A., & Zawawi, M. (2013). Sustainability Through Lean Construction Approach: A Literature Review. Procedia - Social and Behavioral Sciences, 101, 90–99.

Marin-garcia, J. A., & Carneiro, P. (2010). Questionnaire validation to measure the application degree of alternative tools to mass production, 5(4), 268–276.

Marksberry, P., Badurdeen, F., Gregory, B., & Kreafle, K. (2010). Management directed kaizen: Toyota's Jishuken process for management development. Journal of Manufacturing Technology Management, 21(6), 670–686.

Martínez-Jurado, P. J., Moyano-Fuentes, J., & Jerez-Gómez, P. (2014). Human resource management in Lean Production adoption and implementation processes: Success factors in the aeronautics industry. BRQ Business Research Quarterly, 17(1), 47–68.

Massa, S. and Testa, S. (2008). Innovation and SMEs: misaligned perspectives and goals among entrepreneurs, academics and policy makers. Technivation, Vol. 28, 393-407.

Masoumik, S. M., Abdul-Rashid, S. H., & Olugu, E. U. (2015). Importance-performance Analysis of Green Strategy Adoption within the Malaysian Manufacturing Industry. Procedia CIRP, 26, 646–652.

Matt, D. T., & Rauch, E. (2013). Implementation of Lean Production in Small Sized Enterprises. Procedia CIRP, 12, 420–425.

Mazur, L. M., Chen, S.-J. & Prescott, B. (2008). Pragmatic evaluation of the Toyota Production System (TPS) analysis procedure for problem solving with entry-level nurses. Journal of Industrial Engineering and Management, 1(2), 240–268.

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

Mohd Najib Abdul Ghaffar. (1999). Penyelidikan Pendidikan. Skudai: Penerbit Universiti Teknologi Malaysia.

Moori, R. G., Pescarmona, A., & Kimura, H. (2013). Lean Manufacturing and Business Performance in Brazilian Firms. Journal of Operations and Supply Chain Management, 6(1), 91–105.

Moyano-Fuente Monecke, A., & Leisch, F. (2012). semPLS : Structural Equation Modeling Using Partial Least Squares, 48(3).

Moyano-Fuentes, J., & Sacristán-Díaz, M. (2012). Learning on lean: a review of thinking and research. International Journal of Operations & Production Management, 32(5), 551–582.

Mujtaba, S., Feldt, R., & Petersen, K. (2010). Waste and Lead Time Reduction in a Software Product Customization Process with Value Stream Maps. 2010 21st Australian Software Engineering Conference, 139–148.

Nachmias, C.F. & Nachmias, D. (1992). Research Methods in the Social Sciences. 4th Edition. New York: St Martin's Press.

Nabhani, F., & Shokri, A. (2009). Reducing the delivery lead time in a food distribution SME through the implementation of six sigma methodology, 20(7), 957–974.

Näslund, D. (2008). Lean, six sigma and lean sigma: fads or real process improvement methods: Business Process Management Journal, 14(3), 269–287.

National Economic Advisory Council. (2010). New Economic Model For Malaysia-part 1:Strategic Policy Directions, 49–52.

Negahban, A., & Smith, J. S. (2014). Simulation for manufacturing system design and operation: Literature review and analysis. Journal of Manufacturing Systems.

Ng, K. C., Lim, C. P., Chong, K. E., & Goh, G. G. G. (2013). Elimination of waste through value Add/Non value add process analysis to improve cost productivity in manufacturing — A case study. 2013 IEEE International Conference on Industrial Engineering and Engineering Management, 410–414.

Nguyen, T. H., Newby, M., & Macaulay, M. J. (2013). Information Technology Adoption in Small Business: Confirmation of a Proposed Framework. Journal of Small Business Management, 53(1), 207–227.

Näslund, D. (2008). Lean, six sigma and lean sigma: fads or real process improvement methods: Business Process Management Journal, 14(3), 269–287.

Nor Aini Haji Idris, Md Zahir Kechot, Hairunnizam Wahid & Nafisah Mohamed. 2004. Peranan Kerajaan dalam Pembangunan Industri Pembuatan. Bangi: Penerbit UKM.

Nordin, N. (2012). Validation of Lean Manufacturing Implementation Framework Using Delphi Technique. Jurnal Teknologi (Sciences and Engineering), 59, 1–6.

Okhovat, M. A., Khairol, M., Mohd, A., & Nehzati, T. (2012). Development of world class manufacturing framework by using six-sigma , total productive maintenance and lean, 7(50), 4230–4241.

Othman, T. (2015). SPSS: Analasis data kuantitatif untuk penyelidik muda. Bangi: MPWS Rich Publication.

Othman, T. (2013). Asas penulisan tesis penyelidikan & Statistik. Kuala Lumpur: UPM Press.

Patel, N., Chauhan, N., & Trivedi, P. (2015). Benefits of Value Stream Mapping as A Lean Tool Implementation Manufacturing Industries : A Review, 1(8), 53–57.

Pepper, M. P. J., & Spedding, T. a. (2010). The evolution of lean Six Sigma. International Journal of Quality & Reliability Management, 27(2), 138–155.

Plenert, G. (2007). Reinventing Lean. Reinventing Lean. Elsevier.

Peças, P., & Henriques, E. (2006). Best practices of collaboration between university and industrial SMEs. Benchmarking: An International Journal, 13(1/2), 54–67.

Peters, F., Potter, L., & Min, K. J. (2008). Developing Students ' Understanding of Global Issues through Lean Manufacturing. Education, (2006), 21–26.

Pettersen, J. (2009). Defining lean production: some conceptual and practical issues. The TQM Journal, 21(2), 127–142.

Peças, P., & Henriques, E. (2006). Best practices of collaboration between university and industrial SMEs. Benchmarking: An International Journal, 13(1/2), 54–67.

Pham, D. T., & Thomas, A. J. (2012). Fit manufacturing: a framework for sustainability. Journal of Manufacturing Technology Management, 23(1), 103–123.

Plenert, G. (2007). Reinventing Lean. Reinventing Lean. Elsevier.

Powell, D., Alfnes, E., Strandhagen, J. O., & Dreyer, H. (2013). The concurrent application of lean production and ERP: Towards an ERP-based lean implementation process. Computers in Industry, 64(3), 324–335.

Poór, P., Kamaryt, T., & Šimon, M. (2015). Introducing autonomous maintenance by implementing OTH hybrid positions and TPM methods in metallurgical company. International Journal of Engineering and Technology, 7(3), 817–824.

Prasanna, M. (2013). Lean Six Sigma in SMEs: an exploration through literature review. Journal of Engineering, Design and Technology, 11(3), 224–250.

Prasanna, M., & Vinodh, S. (2008). Lean Six Sigma in SMEs : an exploration through literature review.

Puvanasvaran, P., Megat, H., Sai Hong, T., & Mohd.Razali, M. (2009). The roles of communication process for an effective lean manufacturing implementation. Journal of Industrial Engineering and Management, 2(1), 128–152.

Puvanasvaran, A.P. (2014). Lean manufacturing tools and techniques. Melaka: Penerbit Universiti UTEM.

Puvanasvaran, A.P . (2011). Implementation of lean process management through enhanced problem-solving capabilities. Melaka: Penerbit Universiti UTEM.

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.

Rahman, N. A. A., Sharif, S. M., & Esa, M. M. (2013). Lean Manufacturing Case Study with Kanban System Implementation. Procedia Economics and Finance, 7(Icebr), 174–180. 3

Rahman, S., Laosirihongthong, T., & Sohal, A. S. (2010). Impact of lean strategy on operational performance: a study of Thai manufacturing companies. Journal of Manufacturing Technology Management, 21(7), 839–852.

Raisinghani, M. S., Ette, H., Pierce, R., Cannon, G., & Daripaly, P. (2005). Six Sigma: concepts, tools, and applications. Industrial Management & Data Systems, 105(4), 491–505.

Ratanakomut, S., & Kitcharoen, N. (2013). a Study of Factors That Affecting Service Quality of Passenger Service Department in Airlines (Airasia , Thailand), 9–18.

Ray Tricker (2016). ISO 9001:2015 for Small Businesses, London: Taylor & Francis Ltd

Raymond, M. J & Eleanor, J. 2002. System development: A project management approach. New York: John Wiley & Sons, Inc.

Resta, B., Powell, D., Gaiardelli, P., & Dotti, S. (2015). Towards a framework for lean operations in product-oriented product service systems. CIRP Journal of Manufacturing Science and Technology.

Rezaei, S. (2015). Journal of Retailing and Consumer Services Segmenting consumer decision-making styles (CDMS) toward marketing practice : A partial least squares (PLS) path modeling approach. Journal of Retailing and Consumer Services, 22, 1–15.

Robbins, S.P. (2011). Fundamental of Management. New Jersey: Pearson.

Rodríguez-Entrena, M., Salazar-Ordóñez, M., & Sayadi, S. (2013). Applying partial least squares to model genetically modified food purchase intentions in southern Spain consumers. Food Policy, 40, 44–53.

Rose, A.M.N., Deros, B.Md., Rahman, M.N.Ab. & Nordin, N. (2011). Lean manufacturing best practices in SMEs. International Conference on Industrial Engineering and Operation Management, 1(1), 872–877.

Saleh, A. S., & Ndubisi, N. O. (2006). An Evaluation of SME Development in Malaysia. International Review of Business Research Papers, 2(1), 1–14.

Salleh, N. A. M., Kasolang, S., & Jaafar, H. A. (2012). Review study of developing an integrated TQM with LM framework model in Malaysian automotive industry. The TQM Journal, 24(5), 399–417.

Salleh, N. A. M., Kasolang, S., & Jaffar, A. (2012). Simulation of Integrated Total Quality Management (TQM) with Lean Manufacturing (LM) Practices in Forming Process Using Delmia Quest. Procedia Engineering, 41, 1702–1707.

Salikin, N., Wahab, N. A., & Muhammad, I. (2014). Strengths and Weaknesses among Malaysian SMEs: Financial Management Perspectives. Procedia - Social and Behavioral Sciences, 129, 334–340.

Sarstedt, M., Ringle, C. M., Smith, D., Reams, R., & Hair, J. F. (2014). Partial least squares structural equation modeling (PLS-SEM): A useful tool for family business researchers. Journal of Family Business Strategy, 5(1), 105–115.

Sawhney, R., Subburaman, K., Sonntag, C., Rao, P. R. V., & Capizzi, C. (2010). A modified FMEA approach to enhance reliability of lean systems. International Journal of Quality & Reliability Management, 27(7), 832–855.

Schlosser, F. (2013). Identifying and Differentiating Key Employees from Owners and Other Employees in SMEs. *Journal of Small Business Management*, *53*(1), 37–53.

Sekaran, U. (1992). Research Methods for Business: A Skill Building Approach. 2nd Edition. USA: John Wiley & Sons.

Simpson, M., Sykes, G., & Abdullah, A. (1998). Case study : transitory JIT at Proton Cars , Malaysia, 28(2), 121–142.

Singh, R. & Mangat, N.S. (1996). Element of Survey Sampling. Netherlands: Kluwer Academic Publishers.

Singh, B., Garg, S. K., Sharma, S. K., & Grewal, C. (2010). Lean implementation and its benefits to production industry. International Journal of Lean Six Sigma, 1(2), 157–168.

SME Corp (SME Corporation Malaysia). (2013). Garis Panduan Definisi Baharu PKS. Kuala Lumpur: SME Corp.

Stake, R.E. (1995). The Art of Case Study Research. Thousand Oaks: Sage.

Sundar, R., Balaji, a. N., & Kumar, R. M. S. (2014). A Review on Lean Manufacturing Implementation Techniques. Procedia Engineering, 97, 1875–1885.

Susilawati, A., Tan, J., Bell, D., & Sarwar, M. (2013). Develop a framework of performance measurement and improvement system for lean manufacturing activity.

Sullivan, W. G., McDonald, T. N., & Van Aken, E. M. (2002). Equipment replacement decisions and lean manufacturing. Robotics and Computer-Integrated Manufacturing, 18(3–4), 255–265.

Syarifah, A. (2004). Asas Pengurusan Pemasaran Industri. Kuala Lumpur: Pearson.

Taghizadegan, S. (2006). Essentials of Lean Six Sigma. Essentials of Lean Six Sigma. Elsevier.

Taj, S. (2008). Lean manufacturing performance in China: assessment of 65 manufacturing plants. Journal of Manufacturing Technology Management, 19(2), 217–234.

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

Tjahjono, B., Ball, P., Vitanov, V. I., Scorzafave, C., Nogueira, J., Calleja, J., Yadav, A. (2010). Six Sigma: a literature review. International Journal of Lean Six Sigma, 1(3), 216–233.

Tyagi, S., Choudhary, A., Cai, X., & Yang, K. (2015). Value stream mapping to reduce the lead-time of a product development process. International Journal of Production Economics, 160, 202–212.

Thammatutto, C., & Charoensiriwath, C. (2011). Improving production efficiency through Lean Flexible Cellular Manufacturing Simulation. 2011 IEEE International Conference on Quality and Reliability,

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

Thomas, A., & Barton, R. (2006). Developing an SME based six sigma strategy. Journal of Manufacturing Technology Management, 17(4), 417–434.

Thomas, A., Barton, R., & Chuke-Okafor, C. (2009). Applying lean six sigma in a small engineering company – a model for change. Journal of Manufacturing Technology Management, 20(1), 113–129.

Towill, D. R. (2010). Industrial engineering the Toyota Production System, 16(3), 327–345.

Tuan, N., Nhan, N., Giang, P., & Ngoc, N. (2016). The effects of innovation \on firm performance of supporting industries in Hanoi – Vietnam. Journal of Industrial Engineering and Management, 9(2), 413–431.

Vogt, P.W. (2007). Quantitative Research Methods for Professionals. Boston: Allyn and Bacon.

Van Dijk, W. W., Danner, U., Nieweg, M., & Sumter, S. (2003). Positive-negative asymmetry in the evaluation of trivial stimuli. Journal of Social Psychology 143(6): 783- 784.

Villa, A., & Taurino, T. (2013). From JIT to Seru, for a Production as Lean as Possible. Procedia Engineering, 63, 956–965.

Vlachos, I., & Bogdanovic, A. (2013). Lean thinking in the European hotel industry. Tourism Management, 36, 354–363.

Wahab, A. N. A., Mukhtar, M., & Sulaiman, R. (2013). A Conceptual Model of Lean Manufacturing Dimensions. Procedia Technology, 11(Iceei), 1292–1298.

Wan mohamad Asyraf Wan Afthanorhan, . (2014). Hierarchical component using reflective-formative measurement model in Partial Least Square Structural Equation Modeling (PLS-SEM). International Journal of Mathematics and Statistics Invention (IJMSI), 2(2), 55–71.

Wiliams, C. (2009). Principles of management. New York: South-Western Cengage Learning

Wilson, M. M. J., & Roy, R. N. (2009). Enabling lean procurement: a consolidation model for small- and medium-sized enterprises. Journal of Manufacturing Technology Management, 20(6), 817–833.

Wilson, C.D.H., Williams, I.D. & Kemp, S. (2012). An evaluation of the impact and effectiveness of environmental legislation in small and medium- sized enterprises: experiences from the UK. Business Strategy and the Environment (21), 141-156.

Wong, W. P., & Wong, K. Y. (2013). 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. 3rd International Conference on Information and Financial Engineering, 12(1), 30–34.

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

Xu, L. X. X., Wang, F. Y., Lim, R., Toh, M. H., & Valliappan, R. (2013). Lean implementation in small and medium enterprisesA Singapore context. International Conference on Industrial Engineering Management, 1592–1596.

Yang, F. A., & Yu, S. B. (2010). The Barriers to SMEs ' Implementation of Lean Production and Countermeasures Based on SMS in Wenzhou. International Journal of Innovation, Management and Technology, 1(2), 220–225.

Yin, R.K. (2003). Case Study Research: Design and Methods. 3rd Edition. London: Sage.

Yin, R.K. (1993). Applications of Case Study Research. Beverly Hills: Sage.

Yusof, S.M. & Aspinwall, E. 2000. A conceptual framework for TQM implementation for SMEs. The TQM Magazine 12(1): 31-36.

Zainun Tuanmat, T., & Smith, M. (2011). The effects of changes in competition, technology and strategy on organizational performance in small and medium manufacturing companies. Asian Review of Accounting, 19(3), 208–220.

Zainudin, A. (2014). Research Methodology and Data Analysis. Kuala Lumpur: Penerbit UITM Press.

Zainudin, A. & Julina, T. A. (2013). Research proposal: A comprehensive guide in writing a research proposal Kuala Lumpur: Penerbit UITM Press.

Zainudin, A. (2014b). A handbook on SEM for academicians and practitioners. Bangi: MPWS rich publication.

Zakaria, Z. (1999). Statistik Pengurusan. Edisi Pertama. Sintok: Penerbit Universiti Utara Malaysia.

Zakaria, Z. & Som, H.M. (2001). Analisis Data: Menggunakan SPSS WINDOWS. Skudai: Penerbit Universiti Teknologi Malaysia.

Zainun Tuanmat, T., & Smith, M. (2011). The effects of changes in competition, technology and strategy on organizational performance in small and medium manufacturing companies. Asian Review of Accounting, 19(3), 208–220.

Zelbst, P. J., Green, K. W., Abshire, R. D., & Sower, V. E. (2010). Relationships among market orientation , JIT , TQM , and agility, 110(5), 637–658.

ZubarH, A. (2013). Leanness Evaluation in 6 Manufacturing MSMEs using AHP & SEM Techniques. International Journal of Mechanical & Mechatronics Engineering IJMME-IJENS, 13(29), 136006–9292.

BIODATA OF STUDENT

Mohd Shahrizan Bin Yusoff was born in Kuala Terengganu, Terengganu Darul Iman on April 9, 1983. He received his bachelor degree in Mechanical Engineering from Universiti Sains Malaysia. He received his M.Eng in Manufacturing System from Universiti Putra Malaysia in 2011. Mr Shahrizan is currently a lecturer at Universiti Kuala Lumpur, Malaysian Spanish Institute. His research interest includes lean manufacturing system, operation management and computer added manufacturing (CAM).

LIST OF PUBLICATIONS

Journal

Shahrizan Yusoff, Z. Leman, S. Sulaiman, M.I.S. Ismail, and M.Y. Ismail (2018). Lean Manufacturing mplementation: A Case Study At Small Jig Fabrication Shoop Floor. International Journal of Innovative Research and Development, 20 (9), 321-328.

Shahrizan Yusoff, Z. Leman, S. Sulaiman, M.I.S. Ismail, and M.Y. Ismail (2018). Lean manufacturing implementation from the perspective of small and medium enterprises, International Journal of Innovative Science and Research Technology, 3 (10), 446-450.

Journal (Submission)

Shahrizan Yusoff, Z. Leman, S. Sulaiman, M.I.S. Ismail, and M.Y. Ismail (2018). Delphi Technique for Validation of Lean Manufacturing Framework for Malaysian SMEs, Engineering Management Journal

Shahrizan Yusoff, Z. Leman, S. Sulaiman, M.I.S. Ismail, and M.Y. Ismail (2018). SWOT Analysis on Implementing Lean Manufacturing among Malaysian SMEs, Management and Production Engineering Journal

Conferences

Shahrizan Yusoff, Z. Leman, S. Sulaiman, M.I.S. Ismail, and M.Y. Ismail (2016). Improving Operational Management for Manufacturing Competitiveness among Malaysian SMEs Using Lean Manufacturing: A Scientific Feel. Paper presented at Conference on Language, Education, Engineering and Technology 2016, Langkawi, 30 September 2016 - 2 October 2016 (pp. 91-98).

UNIVERSITI PUTRA MALAYSIA

STATUS CONFIRMATION FOR THESIS / PROJECT REPORT AND COPYRIGHT

ACADEMIC SESSION : _____

TITLE OF THESIS / PROJECT REPORT :

SYNERGISTIC MODEL DEVELOPMENT FOR LEAN MANUFACTURING IMPLEMENTATION AT SMALL AND MEDIUM ENTERPRISES IN MALAYSIA

NAME OF STUDENT: MOHD SHAHRIZAN BIN YUSOFF

I acknowledge that the copyright and other intellectual property in the thesis/project report belonged to Universiti Putra Malaysia and I agree to allow this thesis/project report to be placed at the library under the following terms:

1. This thesis/project report is the property of Universiti Putra Malaysia.
2. The library of Universiti Putra Malaysia has the right to make copies for educational purposes only.
3. The library of Universiti Putra Malaysia is allowed to make copies of this thesis for academic exchange.

I declare that this thesis is classified as :

*Please tick (√)

☐	**CONFIDENTIAL**	(Contain confidential information under Official Secret Act 1972).
☐	**RESTRICTED**	(Contains restricted information as specified by the organization/institution where research was done).
☐	**OPEN ACCESS**	I agree that my thesis/project report to be published as hard copy or online open access.

This thesis is submitted for :

☐ **PATENT** Embargo from _____ (date) until _____ (date)

Approved by:

_____
(Signature of Student)
New IC No/ Passport No.:

Date :

_____
(Signature of Chairman of Supervisory Committee)
Name:

Date :

[Note : If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization/institution with period and reasons for confidentially or restricted.]