A MODEL FOR FULL-BLOWN IMPLEMENTATION OF LEAN MANUFACTURING SYSTEM IN MALAYSIAN AUTOMOTIVE INDUSTRY

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ABSTRACT

Lean manufacturing strategy is one of the known systems that are acknowledged to be capable and effective towards achieving tremendous growth and improvement. Implementations of lean within the automotive industry in Malaysia is not far-reaching as expected and is currently being adopted as a pick-and-choose system and being applied only in certain stages and known areas. This approach does not allow these organizations to fully explore and exploit the system's effectiveness; neither do they experience any massive improvements when measured against lean manufacturing success standards. Moreover, factors affecting the lean manufacturing implementation in Malaysia is still seldom debated or being discussed extensively in many other available in literature reviews. This study attempts, as its main objective, to develop a model for implementation of Lean Manufacturing System (LMS) within the manufacturing industry in Malaysia, specifically for the automotive parts manufacturing industry. This model would act as a comprehensive guideline for LMS implementation within an organization. The model was tested empirically and verified by using SEM model validation processes. A questionnaire-survey was administered to gauge levels of LMS adoption, utilization and acceptance in local outfits. The data were collected from about 200 automotive parts manufacturing companies over a period of six months with the collaboration of Malaysia Automotive Institute (MAI), a Malaysian government agency under MITI (Ministry of Trade and Industry). The data was then analyzed using the Structural Equation Modeling (SEM) software and the SPSS version 20 software. The results suggest that with LMS firms can develop a valuable key organizational capability in a more flexible manner where a firm's performance can be predicted and positive results materialize. The results from the SEM analysis demonstrated that effective implementation of LMS can influence all the six (6) dimensions of known

manufacturing efficiency tools and business performances indicators positively. It was particularly observed that waste in multiple levels within an organization can be reduced to bring about most significant expected benefits of LMS implementation for Malaysian automotive parts manufacturers which, respectively, is followed by other expected beneficial gains such as engineering performances, operational performance, non-financial performance, marketing performance, and financial performance. Although the in-depth regression analysis showed that even the effective implementation of a single lean tool such as just in time can result in significant performance improvements for a firm in question, however, the structural mode revealed that different tools of LMS mutually support and reinforce each other and the joint value of complementary LMS tools is significantly greater than the sum of their individual values. Thus LMS complementarily creates super-additive value synergy. The presented model of LMS implementation and relative findings are expected to offer valuable insights to practicing managers, lean experts, and policy makers responsible for assisting Malaysian automotive parts manufacturers with the full-blown of LMS implementation. Additionally, the model and findings of this study can serve as a benchmark measure of factors that can facilitate effective LMS implementation for future researchers in which, the same population, or others, at different industries, country, and times in the future can be accordingly replicated.

Keywords: LMS, Full-blown Model, Automotive industry, Operational Performances, Operational Standards

ABSTRAK

Strategi pembuatan “lean” adalah salah satu sistem yang diketahui dan diakui mampu dari segi keberkesananya kearah mencapai peningkatan yang memberangsangkan. Perlaksanaan “lean” dalam industri automotif di Malaysia tidak begitu meluas seperti yang diharapkan dan sedang hanya diguna-pakai sebagai sistem aplikasi yang dipilih dan diguna-pakai apabila perlu dan diperingkat-peringkat tertentu atau didalam bidang-bidang tertentu sahaja. Pendekatan secara ini tidak membenarkan sesebuah organisasi untuk meneroka dan mengeksploitasi sepenuhnya keberkesanan sistem “lean” ini. Pendekatan ini juga tidak membuahkan apa-apa pengertian yang bermanfaat, kerana mereka tidak akan berupaya melihat sebarang peningkatan besar-besaran apabila keputusan akhir organisasi diukur berdasarkan piawaian standard kejayaan “lean manufacturing”. Walau bagaimanapun, faktor-faktor yang mempengaruhi pelaksanaan pembuatan “lean” di Malaysia masih jarang dibahaskan atau dibincangkan didalam ulasan sastera. Objektif utama kajian ini adalah untuk membangunkan satu model pelaksanaan sistem pembuatan “lean” (LMS) yang berkesan untuk industri pembuatan di Malaysia, khususnya industri pembuatan automotif. Model ini bertindak sebagai satu garis panduan yang komprehensif bagi melaksanakan LMS didalam sesebuah organisasi. Model ini telah diuji melalui ujian empirikal dan keberkesananya telah disahkan menggunakan kaedah “Structural Equation Modelling Validation Process”. Satu set soalan kaji-selidik spesifik telah diolah dan diselanggara bagi usaha pengumpulan data dilaksanakan dengan baik. Data telah berjaya dikumpul daripada kira-kira 200 syarikat-syarikat pembuatan “automotive parts” sepanjang tempoh enam bulan berlandaskan usahasama rasmi dengan MAI, sebuah agensi kerajaan Malaysia di bawah MITI. Data dianalisa menggunakan perisian ‘Structural Equation Modelling’ (SEM) dan perisian SPSS versi 20. Keputusan menunjukkan sistem pembuatan “lean”

boleh meningkatkan keupayaan penting dan utama sesebuah organisasi melalui kaedah yang fleksibel, dimana prestasi sesebuah organisasi dapat dijangka dan direalisasikan . Keputusan analisis SEM menunjukkan bahawa pelaksanaan LMS secara efektif akan mempengaruhi semua dimensi dalam bidang pembuatan dan juga prestasi perniagaan secara positif. Daripada pemerhatian didapati bahawa “waste” dalam pelbagai bidang telah berjaya dikurangkan dan manfaat ketara ini telah dijangka dapat dicapai dengan pelaksanaan LMS oleh pengeluar “automotive parts” di Malaysia. Kesinambungan itu, organisasi-organizasi ini juga akan menikmati manfaat yang lain seperti kelebihan prestasi dari segi kejuruteraan, operasi, bukan kewangan, pemasaran, dan kewangan. Walaupun analisis regresi yang mendalam menunjukkan bahawa pelaksanaan “lean” dengan menggunakan hanya satu “lean tool” secara effektif, seperti “just-in-time” memberikan peningkatan prestasi yang ketara bagi sesebuah firma namun mod struktur telah mendedahkan bahawa kegunaan aplikasi “lean tools” secara keseluruhan akan saling menyokong antara satu sama lain serta keupayaan daya sistem adalah jauh lebih besar daripada jumlah nilai individu masing-masing dan ini dapat mengukuhkan lagi LMS. Oleh itu LMS yang lengkap akan mewujudkan satu sinergi dan tambahan nilai yang lebih hebat. Model pelaksanaan LMS dan penemuan relatif ini, dijangka dapat menawarkan satu perspektif berharga kepada pengurus, pakar “lean”,dan penggubal dasar kerana mereka inilah yang bertanggungjawab untuk membimbing pengusaha “automotive parts” di Malaysia dalam usaha melaksanakan LMS secara menyeluruh. Selain itu, model dan penemuan ini boleh dijadikan sebagai penanda aras kepada faktor-faktor yang boleh memudahkan dasar pelaksanaan LMS khusus kepada penyelidik-penyelidik akan datang, sama ada dari populasi, industri dan negara yang sama atau berbeza pada masa hadapan, akan dapat dinilai dan dikaji.

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Thank you and Best Regards.

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LIST OF ABBREVIATIONS

Abbreviation	Description
AFTA	ASEAN Free Trade Agreement
AVE	Average Variance Extracted
ANOVA	Analysis of Variance
CA	Cronbach's Alpha (α)
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CI	Continuous Improvement
CMIN	Chi-Square
CRM	Customer Relationship Management
DCN	Design for Customer Needs
DF	Degrees of Freedom
EE	Employee Empowerment
EFA	Exploratory Factor Analysis
EI	Employee Involvement
FMM	Federation of Malaysian Manufacturers
FP	Financial Performance
GFI	Goodness-of-Fit Index
HRM	Human Resource Management
IFI	Incremental Fit Index
JIT	Just-In-Time
KMO	Kaiser-Meyer-Olkin
LAI	Lean Advancement Initiative
LMS	LMS
LPS	Lean Production System
MAI	Malaysia Automotive Institute
MAJAICO	Malaysia Japanese Automotive Industries Cooperation
MANOVA	Multivariate Analysis of Variance
MATRADE	Malaysia External Trade Development Corporation
MIDA	Malaysian Investment Development Authority
MIFC	Material Information Flow Chart
MITI	Ministry of Industry and International Trade
MJEPA	Malaysia Japan Economic Partnership Agreement
ML	Management Leadership and Leadership
MPC	Manufacturing Planning and Control
NAP	National Automotive Policy
NFI	Normed Fit Index
NFP	Non-Financial Performance
OC	Organizational Change
OLM	Omnibus Lean Manufacturing

OP	Operational Performance
PS	Pull System
QFD	Quality Function Deployment
QM	Quality Management
R&D	Research and Development
RFI	Relative Fit Index
RMR	Root Mean Square Residuals
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Modeling
SME Corp	Small and Medium Enterprise Corporation Malaysia
SMED	Single Minute Exchange of Dies
SPC	Statistical Process Control
SPSS	Statistical Package for the Social Sciences
SRM	Supplier Relationship Management
SRMR	Standardized RMR
T	Training
TLI	Tucker-Lewis Index
TPM	Total Preventive Maintenance
TPS	Toyota Production Systems
TQM	Total Quality Management
TW	Teamwork
WR	Waste Reduction

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

This Chapter begins with the importance of the research topic in today's manufacturing and its relevance to automotive industry in Malaysia. Being a state-of-the-art manufacturing system, theoretical background on lean manufacturing applications has been discerned from various competent literatures and several field visits experience. Thereafter, research gaps or problem statements have been identified and are presented in this Chapter. Accordingly, the research objectives have been set and the scope and limitation of the research are placed. This Chapter ends with the summarization of the thesis organization.

LMS ideology is not new; essentially it is a manufacturing system that is applied by the manufacturing industry to achieve their main objectives of reducing wastage throughout their main production activities. However, , judging through existing implementation methods that are in fact less effective, the optimum advantages known of this particular system are not fully realized (Andrea et al., 2011). This study will identify the impediment factors that are related to the implementation of a LMS, as well as the activities that are involved throughout an implementation strategy.

1.1 Background

The manufacturing industry has gone through multiple changes and upgrade enhancements from its initial inception which started during the last industrial revolution. In consequence with the changing market demands and of evolving trends, the automobile manufacturing industry is not spared from dubious design and production obstacles that needed creative and effective solutions to effectively counter them. Fortunately, these solutions have led to many technological advances and work-systems modifications that is being applied and used worldwide. These changes have made this type of manufacturing industry as one of the main economic contributors to the world economy. Automotive manufacturing companies can be seen to be ramping up innovations to improve their offerings and they are confident that renewed growth in the sector is imminent in the near future. The highly competitive nature and the volatile business environment render cost-cutting is now a necessity in this modern age. For this reason many companies within this industry have continuously enhanced their manufacturing planning and control (MPC) systems to provide more effective ways to fulfill their customer requirements, in the prevailing vibrant market environment.

Automotive manufacturing companies in different countries or regions in many instances often differ in their product bundles, customer base and market segmentation (Digermenci, 2008). The automotive industry in Malaysia specifically, obviously possesses some differences in the same industry as compared to other countries owning similar capabilities. This industry, in Malaysia, currently faces a wide variety of challenges in order to be classified as world-class manufacturers as well as to being sustainable in this global competitive business environment (Norani et al., 2008; Noor Azlina et al., 2012b). Although the industry has a large number of supporting firms, improvement in the whole industry can be brought about and sustained through the integration of exceptional internal operations and sharing of improved inter-firm systems. To this end, a more flexible total system approach would be of much relevance to stay in-line with these constantly changing conditions.

A LMS with its tools and principles is flexible in nature, and one that can provide improvements within an organization and between organizations whom are willing to adopt its unique attributes, and are diligently working towards maintaining the value and gain better organizational performances (Hodge et al.; Shah & Ward, 2007; Jostein, 2009; Andrea et al., 2011; Bhasin, 2011b). LMS (LMS) is one of those proven strategies and has been regarded as a remedy for survival and toward being competitive in this global market. The ultimate goal of lean manufacturing is to create a smooth and high quality organization that is consistently able to be producing finished products that conforms to the customer's demand in the quality-looked while at the same time achieving minimal wastage of resources.

Many manufacturing companies were prompted to adopt or to change their current manufacturing system towards LMS for more productive strategies that can improve their organizational performance, maximize efficiency and thus increase competitiveness (Andrea et al., 2011). The Lean Manufacturing strategy is being supported by the Malaysian government (Wong et al., 2009; Noor Azlina et al., 2011; Rasli Muslimen et al., 2011) towards creating world class manufacturing level and one that could sustain a high degree of competitiveness in the global market. Thus, the implementation of LMS is considered to be very useful in the Malaysian automotive industry, in order for the industry to improve their operational performances as well as to remain competitive (Noor Azlina et al., 2011). Although many companies under this industry are interested in the LMS and trying to implement lean tools, however, prior studies have shown that the level of implementation and adoption of lean manufacturing in Malaysia has yet to become comprehensive and is currently being applied in certain stages and known areas only (Wong, et al., 2009; Noor Azlina et al., 2011) and the main reason for this obstacle is actually because most do not have, or lacking the technical know-how for a successful implementation (Pavnaskar et al., 2003).

Therefore, it can be suggested that a more comprehensive guideline of LMS implementation strategy is now a necessity and should be developed, based on the pertinent factors that is to be identified, examined and exemplified within this study. This should help companies become more successful in implementing and sustaining a LMS en route for gaining the optimum organizational performances that is intended.

This study is planned to gather and analyze industry data, identify working concepts and examine current practices that is applied within the Malaysian automotive industry. The hypotheses are set and test parallel to the consolidated data gathered from the industry and subsequently try to introduce a full-blown implementation model of LMS that should be utilized as a guiding reference and benchmark comparison during an intended LMS implementation. These process parameters should be followed thoroughly throughout the implementation initiatives and should be measured for efficiency results, prior to and after the assumed successful adoption of the LMS. This should push the Malaysian automotive industry in the direction of reaching a new stage of professionalism, which includes world class practices; that is visible and one that is constantly producing the best desired results. This will make for a better image and should provide an attraction for the world's major automobile makers, to invest within the Malaysian industrial shores.

1.2 Problem Statements

Automotive industry in Malaysia currently faces a number of challenges in order to be classified as a world class manufacturing as well as to be sustainable in the global competitive automobile manufacturing business. The current focus is mainly through competing with others via competitive pricing, including the fast time-to-market of products. However, by only focusing on a pricing strategy while having a looser stance on quality could have its drawbacks. As global customers are becoming highly educated and more open to new ideas and types of information, the preference has shifted to ingenious design forms, high quality materials used and build-up, technological advancements related to Research and Development (R&D), branding and image, as well as country of production. In line with this thinking, it is prevalent for manufacturing entities to address these needs accordingly, whilst striving for quality but still making their products attractive and affordable. To perform this, companies needs to be flexible in their production, which includes processes and internal systems; an employee mindset focused on upholding quality, product innovation and improving work systems; efficient management of inventories, starting from raw materials up to the finished products, that should emphasize on limiting wastage, thus lowering manufacturing cost and increasing revenues. These aspects of product quality and the various types of flexibility cannot be considered as marginal, because ultimately customer's perception matter. Product quality equates to value, but also to affordability, while it also relates to branding and a company's image within this competitive business.

The challenge now is becoming far more serious with the introduction of the "open market" concept under the ASEAN Free Trade Agreement (AFTA). Statistics has revealed that market share for the Malaysian automotive industry had dropped to less than 60 percent, directly impacted by this trade agreement. Furthermore, this scenario is predicted to worsen with the industry dominance expected to decline further with more liberalizations coming in the near future. Proactive solutions are indeed needed to ensure fast and effective efforts to reclaim any sense of stability towards this nationally important market segment. (Noor Azlina et al., 2011)

In order to sustain in this competitive scenario, many manufacturing companies have started-off to adopt or wanting to change their current manufacturing system to more productive strategies that can improve their performance, increase efficiency and thus competitiveness. Lean manufacturing strategy was implemented by many companies especially in Japan and elsewhere in the world, and had achieved tremendous growth and improvements (Burcher, 2006 and Shah & Ward, 2007).

However, the impact that a LMS provides through proper implementation strategies and adoption could not be gained by the Malaysian automotive industry, specifically by the automotive parts manufacturers. In a few instances, there were companies that failed to implement the LMS consistently due to the main barrier that has been identified in previous studies (Norani et al., 2010b). The major identified barrier in implementing LMS in the Malaysian automotive industry is the lack of lean understanding (Norani et al., 2011). This includes understanding about the conceptual idea of leanness systems including its application and tools. In addition to that, changing the work culture from current traditional thinking to a LMS-focus paradigm is also proving to be another barrier towards fully implementing and integrating this system.

The LMS's implementation should be applied as a total systems approach rather than a pick-and-choose adaptation when applying these lean tools and principles (Sanchez & Perez, 2001; Abdullah, 2006; Burcher, 2006; Shah & Ward, 2007; Vinodh & Joy, 2012). In this regard, a total systems approach ensures that sustainability and the ultimate goals of the LMS could be achieved. To the best of our knowledge, there are no clear guidelines or step-by-step procedure in effectively implementing a full-blown application of LMS (Chun, 2003; Pius et al., 2006; Bhasin & Burcher, 2006). In order to solve these problems and to ensure having a successful implementation, a set of implementation guideline is needed to be formed as a basis for guidance, comparison of performances over time and setting factors for those desiring to implement and adhere to the LMS.

1.3 Objectives

The main focus of this research is to develop a guideline that is able to sustain the rigors of actual LMS implementation, with its clear dimensions defined and having measureable performance improvements in place for the Malaysian automotive industry. A full-blown implementation strategy is needed for obtaining the optimum performance within the organization. To achieve the aim of this research, the following research questions and research objectives are identified.

1.3.1 Research Objectives (RO) and Research Questions (RQ)

The specific objectives and the research questions of the study are:

Objective 1

To determine the current state of LMS (LMS) application in the enterprises of Malaysian automotive industry in relation to the known key indicators using empirical data analysis.

To achieve the objective 1 for this study, two research questions are raised as:

RQ 1: Lean manufacturing is widely known as a 'soft-technology'. Knowingly or unknowingly, many manufacturing companies are applying some elements of it. Now, to what extent Malaysian automotive industry adopted any parts or elements of LMS till date? This would help to determine the present strength of the enterprises under this industry.

RQ 2 : What are the important characteristics of LMS that makes it distinct but develops a comprehensive understanding for its implementation that would benefit and that should help increase competitiveness of the Malaysian automotive industry?

Objective 2

To construct a model on implementation of a full-blown LMS for Malaysian automotive industry by consolidating all the major characteristics applicable therein using Structural equation modeling, MANOVA and statistical techniques.

To achieve the objective 1 for this study, two research questions are raised as::

RQ 3: What are the hidden potentials or driving factors in implementing a successful LMS in this industry? How do the people in the industry see the significance of these factors and how the factors can be loaded into the model?

RQ 4: If organizational determinants or performance indicators are adopted and implemented rigorously, would that sustain under an LMS implementation, thus consolidate its importance or relevance?

<u>Objective 3</u>

To set indicators as guidelines in the main areas of performance measurement in this industry and locate the prevailing impediments to be addressed for full-blown implementation of the LMS within firms under this industry.

To achieve the objective 3 for this study, a research question is raised as:

RQ5: What are the organizational reforms or endeavors required to strategically implement the LMS in the Malaysian automotive industry to ensure its competitive advantages?

<u>Objective 4</u>

To investigate through a few case studies whether the implementation of certain factors of LMS is rewarding in terms of indicated performances and to project the compatibility of a full-blown LMS implementation for higher levels of organizational performances.

To achieve the objective 4 for this study, a research question is raised as:

RQ6: Pointing to RQ 1, some case studies in a few enterprises of this industry may reveal if lean thinking is bringing positive results and impacts on organizational performances. Then, what is the projection that can be drawn when applying and adopting an organized full blown LMS in the industry for achieving and enhancing performances?

1.4 Scope and Limitations

Within the context of this study, the term business performance and organizational performance refers to the same indicator, which is inter-changeable at best.

Although this research was conducted based on a standard research design, it is not without some limitations. Firstly, this study is cross-sectional in nature, while the researcher should acknowledge that the natures of LMS dimensions are mostly dynamic and continuous. The cross-sectional data of this study also tends to have another certain limitation while explaining the direction of causality of the relationships among influencing factors, LMS implementation, and business (organization) performance. In this regard, it should be explained that the researcher was not able to measure the perception of surveyed informants at the time of LMS implementation. Although the researcher attempted to address this issue through requesting informants to ascertain their perceptions before LMS implementation, however, it cannot be absolutely asserted that the respondents were able to back-track their mind uninfluenced by the experience of LMS implementation. To address these two common concerns in cross-sectional research, the researcher tried to complement the findings of this study using a time-series data provided by two in-depth case studies. This approach is limited to some extents, regarding the fact that Malaysian automotive industry is a vast industry with hundreds of manufacturers operating, which implies that the case study performed in this research is limited in term of its generalization-ability towards the entire automotive industry in Malaysia.

Secondly, the research model and findings are limited in the sense that the generalization-ability of findings is narrowed down to automotive parts manufacturing companies and cannot be freely generalized to other industrial and service industries in Malaysia.

Thirdly, this issue also limits the generalization-ability of findings of this research to Malaysian culture. It is well agreed that the company culture in LMS implementation is very important and concepts such as management support and commitment and employees' motivation and preparation are imperative to LMS implementation success. The business environments for automotive parts manufacturers in Malaysia as a developing (and transitional) country versus advanced countries (e.g., western countries, Japan and South Korea) are largely different. Thus, the study is limited regarding the fact that it is not possible to freely generalize the findings against other automotive parts manufacturing companies in advanced countries.

1.5 Thesis Organization

There are six chapters in this thesis and the chapters in this thesis are arranged in an intelligible manner. Figure 1.1 shows the overall organization of the thesis. The details of each chapter are presented as follow:

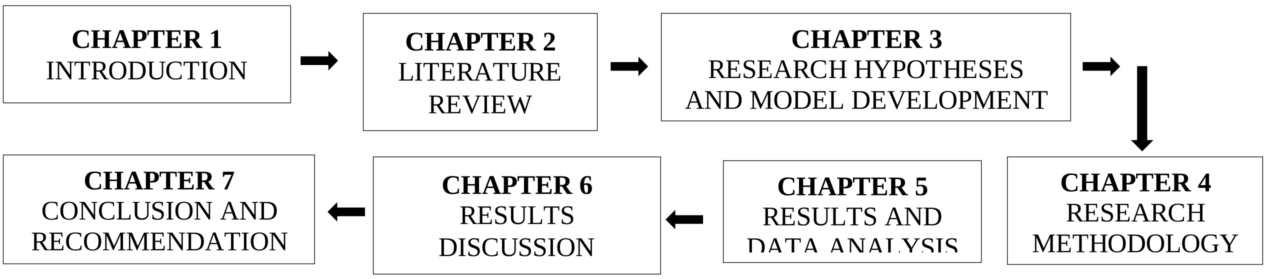


Figure 1.1 Chapters Organization in the Thesis

Chapter 1 : This chapter figures out the research background, problem statements, research questions and objectives, scope and limitation of the research work, significance study and the overall thesis organization.

Chapter 2 : This chapter is a review of articles that is related to lean manufacturing, the implementation of lean manufacturing and application of lean tools pertaining to the business (organization) performances. It concludes with important findings found within other literature review that eventually leads to the contribution of the model proposed in this research.

Chapter 3 : This chapter describes the identified research hypotheses and model development based on the findings from the literature review.

Chapter 4 : This chapter describes the methodology used in order to complete the research and to achieve the desired objectives. The chapter ends with a description of a model validation technique.

Chapter 5 : This chapter presents the results analysis from the surveys conducted. From the results, an analytical model for the study, from a lean practitioner in the Malaysian automotive parts manufacturers is developed.

Chapter 6 : This chapter discusses the overall research findings and discussion of the case studies through the application of the lean tools, and in verifying the benefit of lean implementation at selected organizations.

Chapter 7 : Throughout the study, recommendations for future study directions are discussed at the end of this chapter.

CHAPTER 2

LITERATURE REVIEW

This Chapter reviews literature on LMS, the activities pertaining to the implementation efforts as well as the benefits gain from the implementation activities. Section 2.1 and Section 2.2 highlights the history and the understanding concepts of LMS in the industry. The details of the LMS implementation are explained in Section 2.3 of the Chapter. Since the study is focuses on the Malaysian automotive industry, the literature pertaining to this scope are also discussed in this section. The influencing factors for the implementation of LMS are also discussed in this chapter in Section 2.4. In Section 2.5, the organizational performances through LMS implementation is also highlighted. The study gaps and Summary of the chapter are explained in the end of this Chapter.

2.1 Overview of LMS –Historical Background

Lean manufacturing is a management philosophy as well as a system that has brought a revolution in manufacturing organizations, especially to the automotive industry. First introduced in the 1950’s by Taiichi Ohno at Toyota Motor Company, this system is known as the Toyota Production System (TPS) and it is synonym with the waste reduction concept particularly in reducing the costs in automotive industry (Alsmadi et al., 2012). The term Lean Manufacturing System was popularized by Womack, Jones and Ross through the book of *The Machine that Changed the World* in 1990. This book was produced through a detailed academic study written by a group of scholars in Japan in 1980's. In the same or some other given names, the term 'western' was coined and used as a guide for organization in western countries (Holweg, 2007; Herron & Hicks, 2008; P. Yang & Yu, 2010; Azharul & Kazi, 2013) .

The evolution of lean manufacturing system is summarized in Figure 2.1. In this figure, the history of LMS is highlighted (adapted from Shah and Ward, 2007). It details the fine evolution of an automotive production philosophy that started with Henry Ford and later perfected by Japanese innovators at Toyota, that defined the principle concepts and tools, later become the Toyota Production Systems (TPS). Taiichi Ohno's thrust of TPS idealism on cost reduction through elimination of waste became a major paradigm shift in thinking about better manufacturing techniques, his proposal in having to produce only the kinds of units needed, at the time needed and in the quantities needed became a popular production philosophy.

Many scholars began looking at this unique ideology and concepts for improvements to understand its benefits, especially when limited resources became apparent due to unforeseen world crisis i.e. oil. Many articles, journals and books were produced, including one by Ohno himself detailing his idea further. It was during this time that many new diminutive elements of TPS were highlighted and discussed i.e. JIT, Kanban, and 'Lean; to describe Toyota's manufacturing system. This shows that Ohno’s concept is adaptable to others with regards to having an effective production system; it provided a new perspective, on how to counter inefficiencies in production and point ways to have better sustainability moving forward.

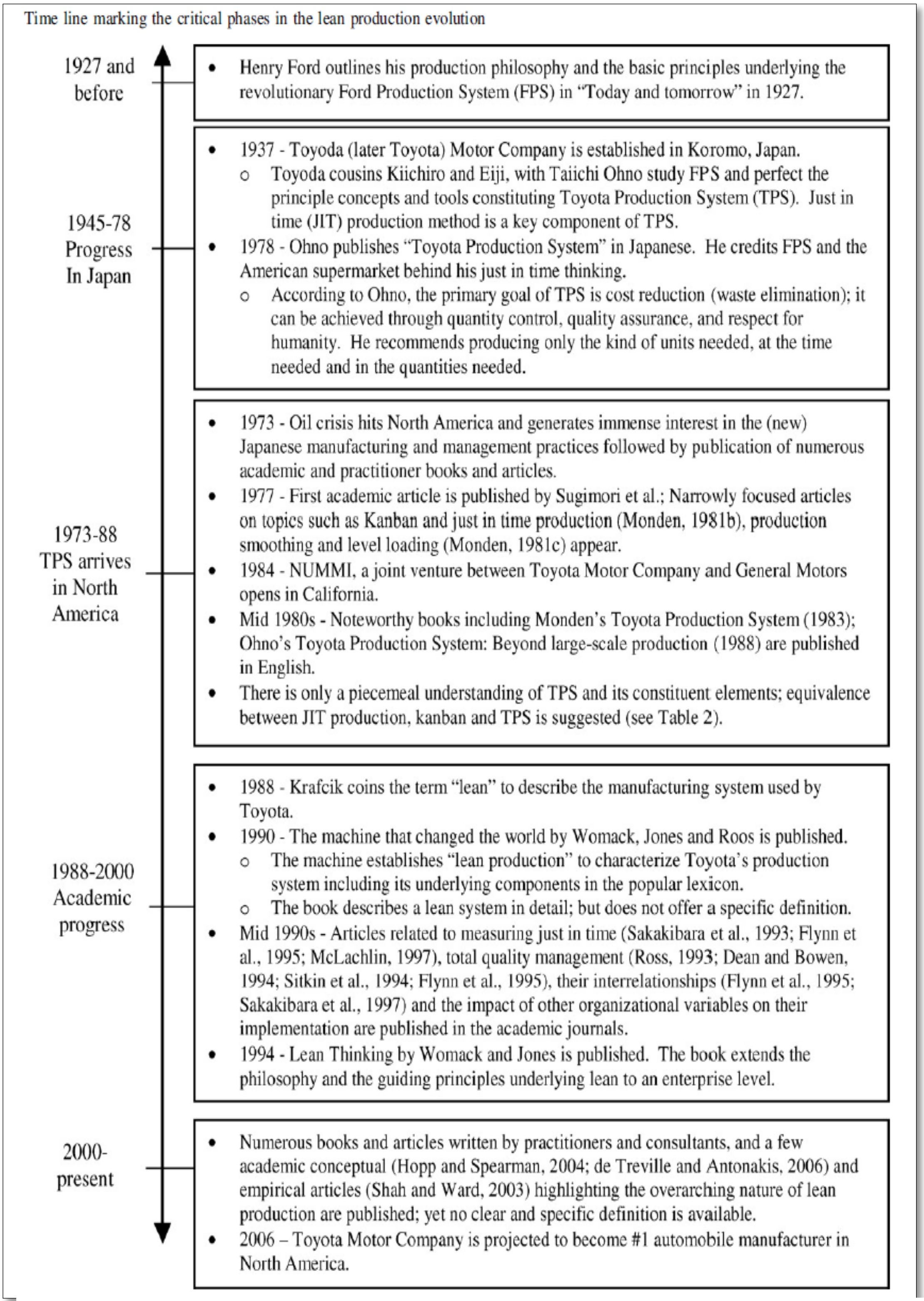


Figure 2.1: The Evolution of Lean Manufacturing System

(Adapted from Shah and Ward, 2007)

2.2 The Understanding Concept of LMS

Lean manufacturing system (LMS) has been defined on different perspectives by different researchers and authors (Shah & Ward, 2007; Jostein, 2009; Manimay, 2013). According to Manimay (2013), LMS has been viewed in 3 stages: (i) Lean is about elimination of "waste" from the production system and by eliminating the "waste" the organization is capable to produce the highest quality products that satisfies the ultimate customers, (ii) Lean as a rule driven system (based on the Toyota 3 + 1 rules for designing production system and applying systematic problem solving methods) (Spear & Bowen, 1999), and (iii) Lean is viewed as congregation of tools and techniques that aimed in eliminating waste.

Besides than Manimay (2013), Hines et al (2004) explained that lean exists at both strategic and operational levels but the other groups of researchers stated that lean primarily is a combination of philosophical and practical orientation towards tremendous improvement of a system (Sanjay Bhasin & Peter Burcher, 2006; Shah & Ward, 2007; Jannis et al., 2010).

Generally, the common understanding about LMS as the root is about the ideology of waste reduction concept. One definition of lean production is as follows:

> *Lean production is an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer and internal variability* (Shah and Ward, 2007)

LMS also is known as the management system that is based on the concept of elimination of waste in any processes that does not give any added value to the organization and their customers. Having this basis, a better understanding of lean could be made by efforts being focused on gearing up the LMS components, such as the important factors of LMS implementation and the activities that constitutes the LMS implementation. This is the other goal besides to achieve an increase in profit and competitiveness through maximizing the efficiency, as well as decreasing costs by eliminating wastes or non-value added activities (J. Motwani, 2003).

LMS concept was further expanded to encompass a wider understanding and approach into qualitative deliverables which is, LMS is needed in producing the products based on the customer requirements with the specific batch size, using the materials that are adequate and executed within the time frame intended. This is primarily thought off in order to eliminate the inventory stock that is associated with one of the types of waste (Willaiams et al., 1992; Braiden & Morrison, 1996; Karlsson & Ahlstrom, 1996; Sanchez & Perez, 2001; A. Pius, et al., 2006; Sanjay Bhasin & Peter Burcher, 2006; Holweg, 2007; Shah & Ward, 2007) and this inventory can be controlled or reduced either by reducing the throughput time (Shah & Ward, 2007). Based on the definition and the understanding concept derived from the previous literatures, the summarization of LMS concept is summarized in Fig 2.2.

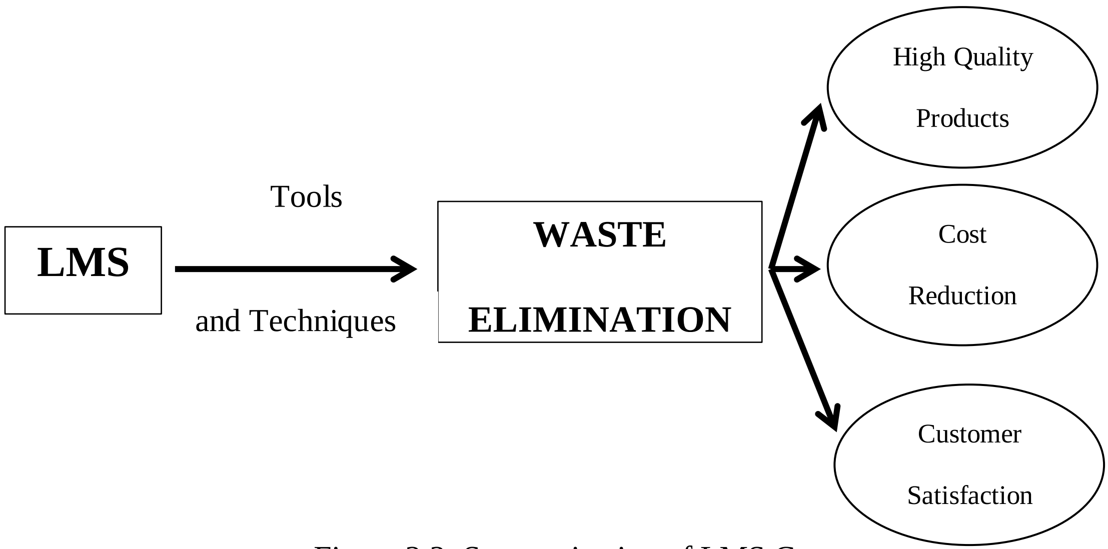


Figure 2.2: Summarization of LMS Concept

2.3 Implementation of LMS

In an economy that is rapidly expanding and outstanding for global developments, many industries are hard-pressed to ensure that their organization is growing in line with the world economic needs and striving to ensure their existence and survivability in business as well as to remain competitive. For manufacturing industries, a tremendous action needs to be taken in order to address this pressing issue, and LMS system is an acknowledged method to best tackle it head-on, with effective dimensions within it to counter unproductive aspects of product manufacturing, which at most times are globally similar in nature (Panizzolo, 1998; Shah & Ward, 2007; Shams et al., 2010; Todd et al., 2011; Gulshan & Singh, 2012; Manimay, 2013).

The implementation of LMS began to be popularized within the automotive industry, due to its known benefits, first made by the Japanese car manufacturing industry, Toyota, and later evaluated by western scholars and manufacturers upon comparing it with their own out-dated processes. LMS was successfully implemented by the automotive giant TOYOTA Motor Company, through the TPS system which was oriented on the work-culture within the TOYOTA Motor Company. This unique system approach to manufacturing was then deeply studied, referred to and applied around the world, and is known as the LMS (Gulshan & Singh, 2012).

Although, the LMS is oriented and based upon the manufacturing principles of the automotive industry, there are a huge number of companies that are struggling to implement the LMS effectively and reaping the benefits of an LMS implementation within their organization. Numerous studies were undertaken to study the root cause of this problem with failure by some companies to have successful implementations. The main reasons found, that hindered behind the drawback of the implementation efforts is mainly because:

1. The implementation of LMS was not applied as a total engrossing or covering all important aspects of a manufacturing outfit. LMS is thought to be a multi-dimensional approach that encompasses a wide variety of practices (Shah & Ward, 2003).
2. The implementation of LMS at most times were made based on a pick-and-choose system where the LMS practices were selected and implemented based on the certain principles or factors favored by that particular organization.

In a different perspective, the implementation of LMS could not be solely based on only a singular concept and it cannot be equated solely to just, e.g., Just-In-Time or Total Preventive Maintenance only, and this misconception has been commonly highlighted in a majority of prior studies (Cua et al., 2001; Shah & Ward, 2003; Gonzalez, 2005; Pius et al., 2006; Bhasin & Burcher, 2006; Bhasin, 2011a; Andrea et al., 2011; Norani et al., 2011).

In a study made by Shah and Ward (2003), where they introduced 4 “bundles” of LMS categories that consisted of 22 lean practices is a worth mentioning. The “bundles” are just-in-time (JIT), total quality management (TQM), total preventive maintenance (TPM) and human resource management (HRM). It was observed that 23 percent variation in operational performance was attributed to the use of these bundles (Manimay, 2013). It was also observed that plant size has a higher influence on LMS implementation, rather than on plant age and unionization. Shah and Ward (2007) argued in a proceeding paper that lean is more of a multi-dimensional construct and they introduced ten distinct factors or dimensions of LMS' which could characterize this enhancing production system. So, the main concept behind LMS that could be defined is, the philosophical perspective (highest level), the guiding rules (second level), and the tools and techniques (lowest level). The obvious predicament is that these tools and techniques resides at the lowest construct levels, but are widely applied for lean implementation in the industry (Shah & Ward, 2007; Manimay, 2013).

In another study done by Bhasin and Burcher (2006) has outlined 12 practices of LMS implementation. These practices were suggested to be applied throughout the LMS implementation process as a total approach. In the study, Bhasin and Burcher (2006) highlighted the following practices as describe in Table 2.1.

Table 2.1: Lean Practices and the Functions – Bhasin and Burcher (2006)

Lean Practices	Functions
Continuous Improvement/Kaizen	The continual pursuit of improvements in quality, cost, delivery and design.
Cellular Manufacturing:	It is vital to a group closely all the facilities required to make a product (or related group of products), in order to reduce transport, waiting and process time.
Kanban	A kanban system needs to be in place.
Single Piece Flow needs to be in operation	Where products precede, one complete product at a time through various operations in design, order taking and production, without interruptions, backflows or scrap.
Process Mapping exercise is required:	This is a detailed mapping of the order fulfillment process.
Single Minute Exchange of Dies (SMED)	In order to reduce the lead-time and improve flows it is necessary to eliminate delays in change-over times on machines.
Step Change/Kaikaku	There is a need to make radical improvements of an activity to eliminate waste.
Supplier Development	The organization needs to actively develop links with suppliers and working closely with them for mutual benefit.
Supplier Base Reduction	Further attempting to reduce the number of suppliers, an organization engages with.
Five S (5S) and General Visual Management	To reduce the clutter and inefficiency of any typical production and office environment.
Total Productive Maintenance (TPM)	This is aimed at improving the reliability, consistency and capacity of machines through maintenance regimes.
Value and the Seven Wastes	The notion of value should never be ignored and essentially is the capability provided to the customer at the right time at an appropriate price, as defined in each case by the customer.

Other than studies looking into lean practices, several other papers were also trying to identify the critical factors that constitute successful implementation of LMS. Among them was a study undertaken by Pius et al, (2006), in which the critical factors in LMS implementation within the Small Medium Enterprise (SME), was considered and analyzed. The study discovered and identified 4 critical factors (Leadership and Management, Financial Capabilities, Skills and Expertise and Organizational Culture). These critical success factors should enable the enhancement of critical decision-making process, to deliver and realize the ambitions of the organizations towards the implementation of lean manufacturing (Pius et al., 2006).

Another study done by Crute et al, (2003), identified 5 influencing factors in successful implementation of LMS in aerospace industry. The factors were - Change

Strategy, Site Culture, Product Focus, Senior Management Commitment and Consistency and Time and Space for Performances Improvement (Crute et al., 2003). These factors were used to implement the LMS by using "plant specific strategies" or similar to "project by project" implementation approach and this implementation would be extended throughout the organization accordingly, stage by stage.

Study conducted by Scherrer et al., (2009), proved that a successful implementation of LMS is entrusted to 3 driven factors that were identified in their case study, done at a selected company. Based on his study, it clearly showed that the Management Commitment and Involvement was the key factors in driving the successful implementation of LMS. The other being, the Employee empowerment was also important, where the employees are given the autonomy to make decisions pertaining to process changes and helps to increase the employees' responsibility and "ownership" sentiment towards the organization. The Information Transparency of lean goals will make the lean effort a success throughout the organization and will create performance improvements and long term sustainability in lean implementation strategy (Scherrer et al., 2009). Table 2.2 shows the summarization of the research studies pertaining to LMS implementation by Shah and Ward (2003), Bhasin (2006), Pius et al. (2006), Crute et al. (2003) and Scherrer (2009).

Table 2.2: Summarization of the Research pertaining to LMS Implementation

Researchers	Findings	Discussion
Shah and Ward (2003)	Introduce 4 "bundles" in LMS implementation.(JIT,TPM,TQM and HRM) and has grouped 22 practices in this 4 bundles. The implementation effects on 3 areas were discovered: 1. Unionization The observation about the difficulty of changing work force rules in a union environment.	In this study the researcher has identified 22 LM practices to explain the fundamental concepts of the LMS implementation that needs to be applied as a total systems approach rather than pick-and-choose methodology to have any optimum effect on organizational performance.

'Table 2.2, continued'

Researchers	Findings	Discussion
Shah and Ward (2003)	2. Age of Plant The implementation of LMS has a significant negative association with 5 out of 8 practices. The "old plants" less likely to implement cross-functional work force, cycle time reduction, JIT/continuous flow production, maintenance optimization, reengineered production process and self-directed work teams. 3. Size of Plant. The implementation of LMS has a significant positive association with 20 practices of LMS. The "large size" organization implements more practices compared to the "small size" organization. On the other hand, there is no significant relationship for another 2 practices (cross-functional work force, quality management programs)	The research that was done considered 3 main aspects that are expected to impact implementation activities in an organization. 1. Unionization This aspect is closely related to an organization's work culture and those that practices unionization, LMS can be viewed as a threat to the employees due to its effects on changing their work-style or culture. One that is from a traditional or non-lean organization towards one that is LMS compliant, therefore changing the union rules and work style or environment will not be a simple process. 2. Age of Plant Implementing LMS in organizations that has been in operation for a long time also has some limitations. A huge amount of investment is needed and would be one of the major obstructing factors. However, other factors such as leadership and management commitment will eventually counter this limitation. 3. Size of Plant Larger sized organizations are more focused and committed on applying LMS by having in place more than one practice as compared to much smaller plants. Mainly due to having a bigger capacity in manpower, facilities and financial support, which should be better at adapting to LMS. On the other hand, quality management programs are main activities that should be exercised and given precedence by both types or organizations because creation of quality will also drive sustainability of an organization.

'Table 2.2, continued'

Researchers	Findings	Discussion
Bhasin and Peter (2006)	In the paper, the researchers have introduced 12 practices of LMS implementation based on their reviewed. In the paper also, they have highlighted the underlying reason about the low rates of successful lean initiates. The identified obstacles for the implementation of LMS : 1. Lack of direction 2. Lack of planning 3. Lack of adequate project sequencing. Due to these obstacles, the researchers also have suggested the following action for the successful implementation of LMS: 1. simultaneously apply five or more of the technical tools; 2. view lean as a long term journey; 3. Install a continuous improvement viewpoint; 4. Make numerous cultural changes embracing empowerment and 5. Sponsor the lean principles through-out the value chain. The focus of the study was to treat the Lean as a philosophy or the mechanism or applying LMS as a comprehensive implementation.	• The successful implementation of LMS depends upon the way how the lean concept is understood and viewed. The researcher proposed that lean should be treated as an ideology and the way of thinking in their daily organizational activities as compared to only a problem-solving process that need to be applied. This is because the successful of the LMs implementation could not be clearly witnessed or gauged in a short time period. • The changes towards the whole system in an organization need to be dome thoroughly and efficiently for these purposes. Some researchers identified lean as a culture issue by which these researchers have placed the ideology of lean as the main perspective that needs to be emphasized if wanting to reap the full benefits of LMS itself.
Pius et al. (2006)	The researchers have identified 4 critical factors in LMS implementation: 1. Leadership and management commitment 2. Financial capabilities 3. Skills and expertise 4. Organizational culture These four factors are the main factors that determine the success of a LMS implementation within an organization.	• It has been agreed that the 4 identified factors are factors that should enable a successful LMS implementation in a particular organization. The commitment from management is crucial because it sets the directional aim of the organization and all relevant decision making process towards the determined goal. In fact the durational time frame taken to achieve this successful LMS implementation makes these factors even more relevant. Strategically having the needed financial capabilities to execute the LMS is another crucial factor and forms the decider for the others. Ultimately, organizational changes would tie-in with significant cost factors in training, workspace restructuring and operating procedures, just to name a few.

'Table 2.2, continued'

Researchers	Findings	Discussion
Pius et al. (2006) - cont.		• Through investments in resources of LMS, this factor should be considered taken care of at the beginning stage of the implementation. • Skills and expertise need to be upgraded and is important towards success and in order to sustain the system itself later. So the changes in organizational culture can be viewed as a measurement indicator of how this implementation of LMS bodes in with workforce acceptance as well as new work practices.
Crute et al. (2003)	In this research, 5 factors have been identified towards a successful LMS implementation 1. Change Strategy 2. Site Culture 3. Product Focus 4. Senior Management Commitment and Consistency 5. Time and Space for Performances Improvement The identified factors have been tested by case studies at 2 selected sites.	The study was done at a different type of industry (aerospace), whereby the factors of LMS implementation have been identified in through the use of surveys. Two sites were selected in the survey. The culture at these sites are the important factor in their LMS implementation, whereby from the study, the difference in results were obtained based on this issue.
Scherrer (2009)	3 factors have been identified as driving factors in LMS implementation. 1. Management commitment 2. Employee Empowerment 3. The Information Transparency A company had implemented LMS before and it was not successful. After taking into consideration these 3 important factors, this company tried a second attempt in their LMS implementation and achieved a successful result.	• From the study conducted the factor of management commitment is the most important factor that steers the direction of an implementation into a successful one. Other factors such as employee commitment and information transparency also played crucial parts in the success. • Based on their previous failed attempt at implementing LMS, the selected company placed an emphasis on these 3 factors fully and ultimately created an impact that was both powerful and transformative in their pursuit of change

As a conclusion, the successful implementation of LMS depends on the achievement in major factors that influencing the implementation strategy (e.g. management commitment and involvement, employee empowerment, information transparency and cultural change) and the implementation activities that to supports the operational and tactical aspects of LMS (e.g. JIT, Continuous Improvement, one-piece work flows) and provides evidence of performance improvements and sustainability of the lean program in the long-term (Shah & Ward, 2003; Pius et al., 2006; Shah & Ward, 2007; Scherrer et al., 2009).

2.3.1 Organizational Culture and LMS Implementation

LMS is known as an integrated of socio-technical system. Due to this the organizational culture inherently plays a larger role in any implementation of LMS that aims to be successful for an organization. Organizational Culture refers to an organization's integrated dimensions that involves that encompasses values, beliefs, and behaviors. Firms with strong cultures achieve higher results because employees sustain focus both on what to do and how to do it and are strongly supported from the top management.

By transforming its internal culture, the main focus within an LMS adoption in a company that subscribes to the TPS methods is called Kaizen-Continuous Improvement. This culture should be so engrained that continuous improvement that each employee is self-motivated to look for ways to improve those processes or functions that affect the company's ability to remain strong and progressive. Kaizen efforts should focus on not only improving all aspects of the company but also on the elimination of waste as described above.

All organizations adhere to a certain culture or work styles that are at most times unique in it and define how the particular company operates. In some companies this culture might be the norm that have existed for many years, thus employees are often faced with a dilemma when asked to make improvement changes or modifications to work styles that they are comfortable with.

Prior research have pointed that moving from traditional systems to an LMS based operations requires more of an organizational cultural change rather than change of the manufacturing or technical issues (Syed Azuan, 2013). When lean is viewed as a philosophy it forms the way of thinking, while tactics or processes become mechanisms to action these thoughts (Bhasin and Burcher, 2006).

This required organizational culture that is needed to support an LMS implementation needs to be in existence within any organizations wanting to adopt a successful lean initiative and to derive any sustained benefits from its tools and techniques. Pullin (2002), insists that lean should not be viewed as an abstract philosophy, rather one which includes both concepts - philosophy and practices; tools or process. To fully reap is beneficial benefits. Thus, development of a strategy needs to be in place prior to embracing this concept holistically.

Every region of the world has unique and societal and organizational cultures, warranting any success at LMS definitely will require a blend of Japanese corporate culture with the specific regions' societal and organizational culture (Syed Azuan, 2013). This makes understanding of social cultural differences and local behaviors become crucial. In an LMS implementation, there is a need for cultural adaptations - where organizational culture and national culture needs to be merged (Wong, 2007). LMS success will only prevail if the culture of an organization supports it, and probably fail if it's against it (Philip, 2010).

Toyota with its reputation of having high quality and profitability, continually implement their management principles and business philosophy through what they label as "lean learning enterprise", and how Toyota persistently adapts its culture to the local conditions in which they operate (Bhasin and Burcher, 2006). However, it is pertinent to note that their production system is not easy to emulate due to variation by which some processes are managed and the prevailing culture.

The move towards an LMS implementation might not have any significant benefits in the short term, as firms might not yet have the opportunity to realize its full benefits, which might take slightly longer. Leanness is a relative measure and should be viewed more as a philosophy or condition rather than as a process (Bhasin and Burcher, 2006). Even Ohno (1988) states that the Toyota production system went through a series of innovations spanning over 30 years.

The human factor is the most difficult part in managing an organization, deviating from focusing on this will impact in building the right company culture - a culture where people's basic needs are understood and respected. Physical changes to production needs to be in parallel with changes in management systems and cultural dynamics equivalently timed (Syed Azuan, 2013). Organizations must build improvement in culture by establishing a practice leadership involvement and continuously engaging the improvement initiatives through participative employee events and incentives.

The TPS organizational culture is basically comprises of 4 main Principles; (1) Philosophy – Long term thinking, (2) Process – Eliminate waste, (3) People and Partner- (4) Problem Solving

TPS is aimed at improving processes and making them more efficient while reducing defects. Not restricted to supply of materials and inventory management only, although it is an integral part of managing waste.

So, in the longer term increases in lean understanding becomes a transformative belief-system that works as an enabler towards all activities that adds value to the system and eliminates wasteful elements that effects a manufacturing outfit. Once all levels within the organization is able to embrace this philosophy, marked improvements should be seen in their organizational performances, albeit it being one that is measureable in terms of performance or one that is not visibly tangible.

2.3.2 Overview of LMS in Malaysia

In the following section, the review on LMS in Malaysia is discussed extensively. Our main focus is given to the automotive industry, as the main implementer of this system, the level of implementation along with the obstacles in implementation is highlighted. Past studies pertaining to LMS in Malaysia is also discussed. The direction of this industry by having the LMS concept and methodology applied and implemented is defined here.

2.3.2.1 Automotive Industry in Malaysia

The Malaysian Automotive industry is known to start in the early 1960s, with the definite goal of lessening the nations dependency on agriculture and agricultural based industries ("Market Watch 2012- The Malaysian Automotive and Supplier Industry," 2012). However, this industry only started to embark on its real journey through the establishment of the national car manufacturing company that introduced the first Malaysian car in 1985. Then in 1994, the second national car manufacturing company was founded, and it proved to be the second wave surge of a market demand for locally produced cars. The automotive industry in Malaysia became more vibrant, consequently dominated by both of these national car manufacturing entities, with a combined 56 percent stake in the domestic automotive market. Perhaps this industry is designated to boost the country’s industrialization process and enable the status of developed nation by the year of 2020 ("Market Watch 2012- The Malaysian Automotive and Supplier Industry," 2012).

Besides, as an ASEAN country member, Malaysia did agree and signed the ASEAN Free Trade Agreement (AFTA) in 1995, in which the main development aim of the agreement is to increase ASEAN's competitive edge as a production base in the world market through the elimination, within ASEAN, of tariffs and non-tariff barriers;

and so to attract more foreign direct investments to ASEAN. This "open market" concept or market liberalization has placed Malaysia becoming one of the competitors within the ASEAN market. In this sense, it is pertinent that all efforts and commitments need to be channeled towards the automotive industry in Malaysia, thus ensuring it stays at a stage that's competitive and comfortable.

Today, the automotive industry in Malaysia faces a very challenging problem, as it is being pressured to be competitive in the current global automotive market. The need for Malaysian manufacturers is to become a world-class level manufacturing industry that is recognized for churning quality products that can withstand competition in the global market. In fact due to this, the automotive industry is one of the important segments of Malaysia's economy; this industry has been given special and a high attention by the Malaysian government in order to intensify its organizational capability ("Market Watch 2012- The Malaysian Automotive and Supplier Industry," 2012). This is also to ensure that this industry will readily cope with the competitiveness level faced against a fast-changing global environment.

Many initiatives were introduced by the Malaysian government in efforts to lift the industry directionally unto a higher competitiveness level and be highly dynamic. Among the initiatives was to introduced a comprehensive National Automotive Policy (NAP) in 2006 and this policy is the main thrust for formulation of the strategic directions and transformations for the automotive industry (MITI, 2009). This policy was reviewed and revised to improve the long-term viability and competitiveness of the industry, leveraging the latest developments in the regional and global automotive industry and offering safer, greener and technologically more advanced vehicles (MITI, 2009). The complete review of NAP is attached in Appendix A.

Other than that, the government took effective steps by establishing a number of national bodies under the purview of the Ministry of Trade and Industry, that is a task to assist in helping to build Malaysia's automotive industry in a structured manner such as the Malaysian Investment Development Authority (MIDA), Malaysia External Trade Development Corporation (MATRADE), Small and Medium Enterprise Corporation Malaysia (SME Corp Malaysia) and Malaysia Automotive Institute (MAI).

A major change that was lead and organized by the Malaysian government was to introduce a program called the Malaysia Japanese Automotive Industries Cooperation (MAJAICO), that was initiated under the Malaysia Japan Economic Partnership Agreement (MJEPA) in July 2006, this initiative targeted towards developing and improving Malaysia automotive industry as a global player (SMECorp Malaysia). It was through this program that the LMS was first introduced and implemented by automotive manufacturers in Malaysia. This implementation journey is explained in section 2.5.2

Further, the establishment of Malaysia Automotive Institute (MAI) is another step taken by the government to make the industry to become more effective in developing the industry further. MAI's role was clearly spelled as to serve as a focal point and act as a coordination center for all matters, including formulating national automotive policy, managing manpower development programs, formulating and coordinating automotive related research and development that is related to the development of Malaysian automotive industry (MAI, 2012; Noor Azlina et al., 2012b). Through this role, MAI is hoped to be able to significantly improve the state of the Malaysian automotive industry and upgrading the level of its competency in Malaysia, as an instigator of change and development MAI is tasked to channel all of its resources in ensuring those efforts on improving and upgrading this industry is in-line with the dynamic direction of the global economy and the specifically within the automotive industry context.

One strategic decision taken by MAI, was essentially to launch the Lean Production System (LPS) program, it intended to focus on changes on manufacturing strategy from the traditional driven (push production) manufacturing system (Naufal et al., 2012) towards a LMS to the major automotive manufacturers including all the automotive parts manufacturers in Malaysia. This program is a continuation of an initial program under MAJAICO, looking into continuous improvements and was under the responsibility of SME Corp Malaysia.

Overall, having all these efforts and attention given onto the industry in Malaysia, it can be said that the industry today has begun to show positive improvements and the steps taken in this direction should enable it to achieve the goal of becoming an industry that is considered world-class with higher operating standards and quality from the current level of achievement. These concerted efforts coupled with a high commitment should make this aim achievable within the desired time frame.

2.3.3 Implementation of LMS in Malaysia and Past Studies Related to LMS.

Generally, LMS began to receive the proper attention in the year 2006 after the signing of the MAJAICO program, in which Malaysia and the Japanese government collaborated (Noor Azlina et al., 2012a; Noor Azlina et al., 2012b; Rahani & al-Ashraf, 2012). This 5-year program, allowed automotive manufacturers especially automotive parts manufacturers in Malaysia to improve their knowledge of LMS, encompassing its methods, characteristics and the right implementation strategy in their organization.

The implementation of LMS in Malaysia can be considered still in the early stages of its journey. The results of the MAJAICO program that ended in June 2011, shows as many as 87 automotive related companies were involved in this program and only thirteen companies were considered successful to be categorized as Model Company - a company that is able to implement LMS practices throughout its entire organization (Malaysia Automotive Institute, 2012) despite that, these great effort and initial commitment given by automotive companies needs to be recognized and highlighted as this is a positive first step in widening LMS implementation in Malaysia. Currently, this program is being pushed further and known as MAJAICO-LPS, a program managed by MAI. The target is to have as many as 100 automotive companies that has achieved “lean” standards recognition every year and further achieving 500 companies by the year 2015.

LMS was given attention and interest after the establishment of AFTA. This policy has showcased an emergence of positivity underway within the industry and LMS is there as an enabler for this, its numerous implementations amongst the Malaysian automotive parts’ manufacturers, proves that a lot of companies were working towards change. This is mainly because the industry needed to conform to demands of the market that orientates itself on competitive pricing, limited time-to-market as well as high quality products. These 3 objectives can only be achievable with changes in manufacturing strategy as well as work-culture that are more aggressive and one that is based on lean manufacturing ideology.

Despite the enthusiasm of manufacturing companies to implement the LMS within the automotive industry, most firms will end up being frustrated with their achievements, while some would just be glad to see their journey with LMS come to an end, but later finding bigger problems that is giving a negative impact on their business sustainability (Norani et al., 2011). Although the LMS is not a brand new system that was just recently created, but in Malaysia, the level of LMS implementation is still in its infancy (Baba et al., 2010; Norani et al., 2010b; Noor Azlina et al., 2011; Norani et al., 2011; Rasli , et al., 2011).

In this age of business, researches that are based on LMS in Malaysia are becoming popular and are expanding on a high rate. Multiple ways and techniques have been introduced to LMS implementation in Malaysia and in the automotive industry. These hard works, is to ensure to have LMS success in Malaysia and the implementation should be sustainable. Summarization of some of the relevant studies in the implementation of LMS in Malaysia is described in Table 2.3.

Table 2.3: Research Studies on LMS Implementation in Malaysian Automotive Industry

Author(s) and Year	**Objectives**	**Methodology**	**Results/Findings**
Wong et al. (2009)	- Investigate the level of adoption of LMS in Malaysian electrical and electronics industry. - Examine the tools and techniques used and obstacles in implementation.	- A survey based study and the total of 350 questionnaires were distributed with 12.6 percent of respondent rate. - Questionnaire design based on 14 key areas identified from literature review.	- The level of LMS implementation in this industry is between moderate to extensive. - Total implementation was adopted (14 key areas were implemented)
Puvaneswaran et al. (2009)	- Evaluate the degree of LMS implementation at the selected company (Aerospace industry in Malaysia) - Determines the roles of communication process as one of the successful drivers in LMS implementation	- A survey based study conducted in the selected company and the total of 53 questionnaires were distributed with 75.47 percent of respondent rate. - Questionnaire is adapted and modified from the literature review to suit the objectives of study.	- The company is in early stage of implementing the LMS. - The degree of communication process implementation effected the successful rate LMS in general. (*The study was done in a particular company and the result of this study does not reflect or represent the whole industry*).
Norani et al. (2010a)	- Investigate the LMS implementation in Malaysian automotive industry. - Determine the impact of organizational change to successful lean implementation.	- A survey based study-and the total of 150 questionnaires were sent to the respondent. The respond rate was 40 percent. - Questionnaire is adapted and modified from the literature review to suit the objectives of study.	- Organizational change has a positive relationship with lean implementation. - The 11 factors (except 1 only) of organizational change have a significant impact towards the LMS implementation level in the organization. - Company under "lean" category implemented most of the factors compare to "non-lean" and "in-transition" category.

‘Table 2.3, continued’

Norani et al. (2010b)	- Explore the lean manufacturing implementation in Malaysian Automotive Industry in Malaysia. - Examine the drivers and barriers that influence the LMS implementation in the selected industry.	- A survey based study , Involved only automotive parts manufacturers and ranges between medium to large firm size with the Total respondents of 61 respondent from 250 - Questionnaire design are based on and adapted from literature review.	- Majority of the respondent firms are classified as in-transition towards lean implementation (based on moderate mean values for each 5 variables. - The main barriers are : a. Lack of real understanding of lean manufacturing concepts and b. Employees’ attitude –resist to
Puvaneswaran et al., 2010	- Develop the integrated model of People Development System in LMS implementation.	- A case study based research in an aerospace company. - The research is extended from previous study by the same authors. - The model was implemented at the selected company for validity process.	- Integrated 3 main concepts; Respect for People, Skill and Knowledge and KPI to enhance the total employee involvement in LMS implementation. - The model used as a guideline for people development system.
Baba et al. (2010)	- investigate the LMS implementation stages in Malaysian manufacturing firms, - determine the obstacles in implementing the LMS in the organization.	- A Case study based selected 3 companies of large and medium sizes. - The study focuses on 3 important area : (a)Company background information (b)Lean implementation approach in case companies (c) The benefits gained from lean implementation	- The results summarized that the lean technique were implemented systematically but with different approaches. - The benefits from LMS - eliminate waste and those activities do not add value in process - All three companies agreed that employee resistance is the main obstacle in lean manufacturing.
Noor Azlina et al. (2011)	- Identify the level of implementation for Total Quality Management and LMS in the automotive industry. - Identify the key performance indicators that are used in Malaysian automotive industry.	- A survey based research with the questionnaire developed based on the previous literature. - Mainly focus 6 practices and 5 performance measure indicators. - Distributed to 30 companies with 93.3 percent of respond rate.	- Results showed that there is a relationship between Integrated - TQM and LMS Practices with the key performances. - The implementation of LMS was higher compared to TQM or integrated TQM and LM.

'Table 2.3, continued'

Rasli et al. (2011)	- Investigate on how to implement and what suitable approach to be used in order to be the successful LMS implementers in Malaysia.	- A case study based– performed in one of the automotive components manufacturer in Malaysia. - Selected based on its achievement as a TPS model company awarded by MAJAICO - Interviewed two executives that have direct experiences in implementing LMS in the organization. Case study – performed in one of the automotive components manufacturer in Malaysia.	- Shows the concept of project-based was used extensively in implementing the LMS by selecting a production line (as model line) and be the base line for the LMS implementation throughout the total implementation of LMS within the organization
Meysam et al. (2012a)	- Identify the general pattern/practices in implementation of LMS within the automotive and heavy industry. - Develop the framework in LMS for both industries.	- A survey based study performed in automotive and heavy machine industries in Malaysia. - Distributed 45 questionnaires with 34 completed returned. - Use 13 activities of JIT practices.	- The result showed that the implementation of activities is varies between types of industry. Automotive industry showed the implementation of more than a single activity.
Meysam et al. (2012b)	- Identify the critical success practices (CSP) of Just-In-Time (JIT) implementation amongst international company in Malaysia.	- A survey based study done in international company (owned) in Malaysia. - The questionnaire were adapted from the literature review - Distributed to 105 identified organizations and obtained 75.2% respondent rate. - 13 criteria/ activities pertaining to JIT were identified and being tested in the survey.	- The results showed the there is no specific items or activities being implemented under JIT for each type of industries. Different ways used by different industries. - The study concluded that for computer and electronic types of industry the planning oriented implementation identified as CSP, meanwhile for automotive parts and heavy machineries industry, kanban practice is the important practices.
Naufal, et al. (2012)	- Highlight the flow of activities to establish Kanban System in order to achieve the pull manufacturing system.	A Case Study based – selection of one companies, implementing the Kanban System, collect the data before and after for comparison and analyse to show the effectiveness of the system.	- Discussed about the implementation step of Kanban System through a case study method. - There is a significant results in reduction of lead times (40%), reduction in in process and finished good inventory by 23%-29% and optimization of finished good area by 4%.

'Table 2.3, continued'

Noor Azlina et al. (2012a)	- Develop Green Lean TQM IM framework for Malaysian automotive industry environment. - The framework was based on Green Lean TQM IM practices that is established in this study is specifically for Malaysian automotive industry based.	- A survey based study. questionnaire was - Developed based on 4 awards practices and 5 systems. - Distributed to 30 highly active automotive vendors in Malaysia and analyzed by Minitab v16.	- Results showed that high Lean and TQM and EMS practitioners companies are producing products for domestic market rather than export. - EMS IM has been commonly practiced compared to LM and TQM IM practices - It was found out that company with Green LTQ IM practices have generated more revenues and also have RND facilities
Noor Azlina et al. (2012b)	- Implement the Integrated TQM and LM practices in the selected organization.	- A case study method. A company was selected - The relevant data were collected and the simulation of current and expected conditions was simulated using the Delmia Quest Simulation. The recommendations for line improvement were done based on the simulation results.	- The recommendation for line improvement were done based on the simulation results
Rahani & al-Ashraf, (2012)	- Determine how lean manufacturing tools are utilized by using Visual Stream Mapping	- A Case study based – selection of one company and collected the data before and after implementation of Value Stream Mapping.	- 3 lean techniques were identified : a. production levelling b. improvement in task time c. minimizing handling time. - 4 problems related to the study were resolved. *(It is a case study research and the results were only being reporting as a comparison before and after implementation process.)*

Based on the literature review, the initial study pertaining to the LMS implementation in Malaysia was reported in 2009 (Puvaneswaran et al., 2009; Wong et al., 2009). Wong et al. (2009) have studied the implementation level of LMS in Malaysian electrical and electronics industry. In the study, they have used 14 key areas as a useful guideline for the organization in implementing the LMS (*Customers, Management and Culture, Safety and Ergonomics, Material Handling, Employees,* *Works Processes, Inventory, Tools and Techniques, Equipment, Layout, Scheduling, Quality, Suppliers and Product Design*). Their study also claimed that the LMS has been widely implemented in electrical and electronics industry. Perhaps the result shows that the average of organization implementation level is rated as "moderate-to-extensive" implementers. From the results also, the 14 key areas were rank based on the highly adapted and implemented in an organization. Table 2.4 shows the list of 14 areas based on the rank that identified in the study. Overall, the study has concluded that the implementation of all 14 key areas in LMS is more successful compared to implementation of a single key area or tool. Due to this, this study has become one of the most important research studies that are referenced pertaining to the LMS implementation in Malaysian, and subjected to parallels against the automotive industry.

Table 2.4: Ranking of the Implemented Key Areas

(Source from : Wong, et al., 2009)

Rank No	Key Areas
1	Customers
2	Management and Culture
3	Safety and Ergonomics
4	Material Handling
5	Employees
6	Work Processes
7	Inventory
8	Tools and Techniques
9	Equipment
10	Layout
11	Scheduling
12	Quality
13	Suppliers
14	Product Design

Puvanaswaran et.al (2009) in her research showed that communication process is an important element in having a successful LMS implementation. The study was conducted in one of the aerospace company in Malaysia through a case study method. Consequently, the study found that the level of LMS implementation in the selected company is still in its early stage and found that by having an effective communication processes will contribute to the success of lean practices in LMS.

Beside studies done on these two industries, studies pertaining to the implementation of LMS in Malaysian automotive industry was also done by (Norani et al., 2010a, 2010b; Noor Azlina et al., 2011; Norani et al., 2011; Rasli, et al., 2011; Meysam et al., 2012a; Meysam et al., 2012b; Naufal et al., 2012; Noor Azlina et al., 2012a, 2012b; Rahani & al-Ashraf, 2012).

Studies that was made by Norani et al. (2010b), shows that LMS implementation in Malaysian automotive industry is only to “some extent” as opposed to a major extent. Majority of the respondent firm are classified as “in-transition” level. Further, the study has identified the main barriers of LMS implementation in this industry. The details of the barriers will be discussed in the following section, in this chapter.

In another work done by the same authors, the impact of organizational change factors was identified in determining the successful of LMS implementation (Norani et al., 2010a). There were 11 factors under the Organizational Change group. The results showed that organizational change has a positive relationship with lean implementation and the 10 factors (except 1) of organizational change have a significant impact towards the LMS implementation level in the organization. The study summarized that company under “lean” category implemented most of the factors as compared to 'non-lean' and 'in-transition' category. The 11 factors of Organizational Change are shown in Table 2.5.

Table 2.5: Organizational Change Factors for Non-Lean, In-Transition and Lean Firms in Malaysian Automotive Industry

Source :Norani et al, (2010a)

	Description	**Mean**		
		Non- Lean	In-Transition	Lean
1	Change Readiness: The Management	3.32	3.39	4.25
2	Change Readiness: The Employees	3.66	3.85	4.37
3	Production Team	3.51	3.82	4.44
4	Leadership and Management Support: The Top Management	3.46	3.79	4.19
5	Leadership and Management Support: The Middle Management	3.40	3.65	4.33
6	Effective Communication	3.30	3.43	4.23
7	Employee Training	3.19	3.43	4.10
8	Change Agent System	3.40	3.69	4.07
9	Reward System	3.43	3.35	3.70
10	Review Process	4.00	3.89	4.36
11	Worker Empowerment		*Missing Data*	

Another study carried out by Noor Azlina et. al (2011) pertaining to the LMS implementation in Malaysia. In their research, they have proposed an integrated system of Total Quality Management (TQM) and LMS. They also have introduced 6 practices of an integrated TQM and LMS and identified 5 areas of performance measurement (*i.e. <u>Practices</u> : leadership, supplier, organization and customers management practices, product management, information management, human resource management and process management, <u>Performance Level</u>: customer involvement and satisfaction, leadership effectiveness, human resource management effectiveness, process and system approach and quality measurement practices)*. The studies concluded that the systematic quality system implementations are needed for controlling and monitoring the quality initiatives among automotive parts manufacturers in Malaysia. Besides, with various use of tools and techniques in LMS implementation have increased the success rate in implementation of this system.

Apart from the exploratory research that was done, case study based researches had also been done to further understand the LMS implementation in Malaysian automotive industry. These case studies research utilizes and encompasses real data from the selected companies and this is one of the best ways to measure the level of LMS implementation in the selected companies.

Naufal, et al. (2012) has highlighted the guidelines on implementing *Kanban* System (pull production) in an automotive parts manufacturer. *Kanban* System or known also as pull production system is one of the activities in LMS. The study was conducted at an identified company that had adapted the system. The *Kanban* system was implemented based on the given guidelines, the data before and after implementation of this activity was measured and compared in order to measure the effectiveness of this particular activity. Through this study, it was witnessed at the company that was selected, it showed improvements in lead time that was reduced by 40 percent, in-process and finished goods inventory were minimized by 23-29 percent and finished goods area were optimized by 4 percent.

Rahani & al-Ashraf, (2012), in their research had introduced LMS tool, which was a visually stream mapping used to implement the LMS. In this particular study, 3 lean techniques were identified; production leveling, improvement task time, and minimizing handling time. Besides, 4 problems related to the study were solved.

Another study was undertaken by Rasli et al. (2011) had identified how LMS implementation was applied within an automotive parts manufacturer that was identified as a potential subject. To implement the LMS, this company had formed a team to perform this mission, then identifying the needed improvements; they identified the waste reduction as a major activity. Project-based strategy was used, coupled with the full support and a clear direction from the top management in order to have some indication of success. Unfortunately, the study did not describe in detail of those activities that were applied in that company. Overall, this case study suggested that the company can be a benchmark for the others that want to start their journey towards implementing the LMS.

A case study conducted by Baba et al. (2010) pertaining to LMS implementation in Malaysia on the other hand, explains on the approaches and barriers that exist during an LMS implementation in 3 companies that he looked at. The companies were chosen from different types of industries. Basically, the study showed that every company had set their own framework based on their industry background, needs or aims. The companies had also given great attention to equip the worker with the understanding and knowledge through training and realized that training is an important element for implementing LMS. All of the companies gained high commitment from top management for these changes to take place. However, the implementations of Lean tools were limited and only utilizing a “pick and choose” concept based on the suitability of their production processes and products. Generally, the study provided some basis on the level of LMS implementation in Malaysia especially in the automotive industry, but not on a company-wide approach or as a total encompassing concept adoption.

In general, the results of this research verify important factors derived from previous studies; hence it is conceivable to say that the findings from this research strongly agree with known LMS parameters. In other words, it gives credence to similar research and should emphasize LMS importance towards organizational performance.

The explained researches or works in lean implementations, mostly mentions the need to have a total approach towards LMS, and not by applying only one factor or single activities, or as only a pick-and-choose system to achieve any beneficial gains (Shah & Ward, 2003; Wong et al., 2009; Norani et al., 2011). In fact in Malaysia, full blown implementation is not yet studied, while most organizations were found to have tried implementing lean manufacturing their own way without any proper guideline on how to implement the LMS properly and also effectively. It is found, the study on performances and the effect of LMS implementations is very limited and is mainly done in a general basis of the industry, without going deep into the specifics of LMS. This is due to the LMS being in its infancy and needs time to have any bearing on their measured performance.

These past research also suggested that the LMS activities needs to be taken in as a total approach concept or a full blown implementation, simply because the inter-relationship between its major attributes is relatable and closer than many understand, thus giving the best performance that is clearly effective to an organization. Having eliminated just one or any one of these unique factors will turn LMS into a system that is not pervasive and the effectiveness of the system cannot be measured through the performances (Sanchez & Perez, 2001; Crute et al., 2003; Shah & Ward, 2003; Papadopoulou & Ã–zbayrak, 2005; Andrew, 2006; Hung, 2006; Pius, et al., 2006; Bhasin & Burcher, 2006; Jostein, 2009; Jannis et al., 2010).

Looking at it in general, LMS in Malaysia is something new and the LMS with its implementation concept has not been widely accepted as a total system approach, especially for the automotive industry. This industry is still struggling to widen LMS implementation's acceptance to many more businesses entity and utilizing LMS as anew transformation tool or business strategy that is focused towards being competitive and having a world-class. The Malaysian government with their wonderful support has given a definite boost to this concept's acceptance, within the automotive industry particularly for the automotive parts manufacturer to implement LMS more widely in a continuous and sustainable manner.

2.3.4 The Barriers in LMS Implementation

To complete an implementation of LMS in an organization is not an easy task and one that could be achievable within a short time period. Some businesses endured up to 12 years of struggle just to have any measureable success in terms of realizing a total implementation of LMS in their operations (Bhasin, 2012). Based on this, it is unsurprising that many firms will fail or unable to continue with their desired implementation in any sustainable manner (Shah & Ward, 2003; Singh et al., 2010; Bhasin, 2012;Gulshan & Singh, 2012). Previous studies have revealed numerous barriers that prevent the implementation of LMS in an organization. The study done by Bhasin (2012) had identified 11 major obstacles in LMS implementation in UK manufacturing firms based on the size of the firms studied, Deloitte and Touch (2002) had identified 5 barriers in LMS implementation, while Panizzolo (2012) had identified 7 barriers in implementing LMS in Indian SMEs firms. Besides that, studies of LMS implementation barriers in Malaysia were done by Norani et al., (2011), Baba et al, (2010) and Wong et al., (2009)). The list of the identified barriers is shown in Table 2.6.

According to Bhasin (2012), the main obstacles with an LMS implementation in small size companies are related to financial constraints or cost of investment (75%), meanwhile for medium size companies and large size companies, it shows that the main obstacles that hindered the implementation was the insufficient supervisory skills to implement LMS (73% – medium and 64% -large). Besides Bhasin (2012), the Lean Enterprise Institute, through its web surveys that was undertaken, pointed that a negative tendency towards returning to known (old) ways of working, was a crucial harmful factor of LMS implementations; Lean Enterprise Institute (2005) as quoted by Bhasin (2012).

Deloitte and Touch (2002), in their research found that the company culture is a main barrier in achieving the successful implementation of LMS in UK. This proves that a LMS implementation is not something that can be easily applied and be used instantly; this system needs significant changes in a firm's working culture and more importantly one that is generated from within the organization itself. Besides

Bhasin (2012), Deloitte and Touch (2002), efforts made by Panizollo (2012) was able to list resistance to change and to adopt innovation as another main barrier of LMS implementation in Indian SME firms. It was identified that inadequate exposure to LMS itself and a thorough understanding of it, contributed to this problem.

The barriers of LMS implementation in Malaysia, especially in automotive industry is none the less incredible, few studies have been conducted in order to identify the obstacles that hindered the LMS implementation in Malaysia(Wong et al., 2009; Baba, et al., 2010; Anvari et al., 2011; Norani, et al., 2011). According to Norani et al., (2011), the major challenge in implementing LMS in Malaysian automotive industry was in understanding the real essence of LMS concept and its philosophy. In their studies, they have identified the "lack of lean understanding" as the main barrier to be faced by 3 types of organization (non-lean firms, in-transition firms and lean firms) and this is because LMS requires new knowledge understanding and cultural change adaptations during the implementation process (Norani et al., 2011). Besides, in order to have a successful LMS implementation in an organization or a company, LMS should be applied comprehensively and holistically in its principles and concepts (Crute et al., 2003; Norani et al., 2011).

Apart from that study made by Norani et al. (2011), Wong et al., (2009) similarly also investigated the obstacles of LMS implementation in Malaysia, specifically looking at the dimensions within the electrical and electronics industry. In his study, the major obstacle identified was "backsliding to the old ways of working", which is mainly due to employee resistance in implementing LMS. In other words, the employees are resisting change or unwilling to follow the new methods initiated from an LMS implementation, they figured that it might burden them with additional work, so they reverted their working style back to the old ways (Wong et al., 2009).

On a study completed by Baba et al (2010) on the other hand showed that resistance from the middle management is another main obstacle in a LMS implementation. This was based on an earlier research made by the Lean Enterprise Institute (Lean Enterprise Institute, 2005), their studies highlighted, this middle resistance occurs due to the lack of knowledge and understanding of LMS.

In general, the lack of knowledge or understanding of LMS concept or philosophy is regarded as an obstacle in LMS implementations in Malaysia. Therefore, in efforts to implement this invaluable but revolutionary system within an organization, the knowledge pertaining to LMS has to be provided to the entire workforce, in order to create the fundamental knowledge basis or understanding about LMS, thus creating an easy path in its implementation throughout the organization.

In studies undertaken involving these 3 countries, company or organizational culture is found to be one of the obstacles in obtaining a successful LMS implementation. By this note, transforming a firm's internal culture needs to be done from the start of this adoption process so that it limits potential problems that might arise in later stages of the implementation.

Overall, based on the obstacles consolidated and presented in above, it is feasible to derive elements that need to be looked into and scrutinized further in order to tackle the idea of having successful LMS implementation especially in Malaysia (based on the scope of this study). These known factors are not only present in the Malaysian automotive industry but has been cited by numerous research do to study on the LMS in the Malaysian context. Thus, understanding of these issues direct this research to investigate further the relevant issues pertaining to LMS implementation in Malaysia, its difficulties, perceived barriers, work culture, monetary restraints, LMS knowledge and its understanding. The study should also focus on the philosophical approach behind lean, because it is harder to define and understood, as compared to more measureable performance indicators brought about by lean approach improvements.

Table 2.6: The Previous Studies Realated to Barriers in LMS Implementation

Country	**UK**		**India**		**Malaysia**	
Researchers	Bhasin (2012)	Deloitte and Touch (2002)	Panizzolo (2012)	Norani et. al, (2011)	Baba et al., 2010 *(as quoted from Lean Enterprise Institute, 2005*)	Wong et. al,(2009)
Barriers in LMS Implementation	1. Cost of the Investment 2. Cultural issues 3. Employee attitudes/resistance to change 4. Insufficient external funding 5. Insufficient internal funding 6. Insufficient management time 7. Insufficient senior management skills to implement lean 8. Insufficient supervisory skills to implement lean 9. Insufficient understanding of the potential benefits 10. Insufficient workforce skills to implement lean 11. Need to convince shareholders/owners	1. Company Culture 2. Investment and Cost 3. Staff Attitudes 4. Change Issues, and 5. Misunderstanding of the Process and its Benefits.	1. Resistance to change and to adopt innovations 2. Lack of training and awareness among employees 3. Poor infrastructural facilities 4. Low priority by the management 5. Lack of vision 6. Threats of insecurity among employees 7. Downsizing of the staff	1. Lack of understanding of LMS concepts 2. Attitude of shop floor employees 3. Attitude of middle management 4. Lack of communication 5. Investment cost 6. Lack of senior management commitment 7. Company culture 8. Inability to quantify benefits 9. National culture 10. Nature of manufacturing facility	1. Middle management resistance 2. Lack of implementatio n know-how 3. Employees resistance 4. Supervisors resistance 5. Lack of crisis 6. Backsliding 7. Unknown 8. View as "flavor of the month" 9. Financial value not recognized 10. Failure to overcome opposition 11. Failure of past lean projects 12. Budget constraints	1. Backsliding to the old ways of working 2. Employee resistance 3. Budget constraints 4. Company culture 5. Lack of know-how to implement 6. Lack of time to implement 7. Does not practice what is preached 8. Financial benefits not recognized 9. Failure of past lean projects 10. Lack of top management support

2.4 Influencing Factors in LMS Implementation

LMS is a novel to the manufacturing industry especially for the automotive industry, however until now, the implementations seen achieved is still not industry-wide. There are a few factors known to contribute in making LMS having an important role to an implementation process, with an ultimate mission of it being a total success to a manufacturing outfit. Numerous studies have been completed to identify these beneficial factors that ushers the LMS implementations towards success (Ashok et al.; Gjerdrum & Mahad; Shah & Ward, 2003; Pius, et al., 2006; Alan & Martin, 2008; Farris, et al., 2009; Da´ vid et al., 2011; Andrea et al., 2011; Glover et al., 2011; Meysam et al., 2012b) these valuable main factors, considered highly important to LMS methodology are described in the following section.

2.4.1 Management and leadership commitment

Management leadership and commitment has been identified as the most important factor in a LMS implementation strategy. This group (management) plays an important role in maneuvering the organization in its business survival. All the important decisions and business goals are the main responsibilities shouldered by this particular group. Having an LMS implementation, will undoubtedly be a heavy burden and a major responsibility to them in ensuring the viability of the LMS adoption, and thus ensuring success (Boyer, 1996; Benito, 2005; Andrew, 2006; Pius et al., 2006; Anand & Rambabu, 2009; Anvari et al. 2010; Jannis et al., 2010; Tung et al., 2011; Bhasin, 2012).

Management commitment that is highly visible is essential, from aspects of financial and non-financial requirements to make this goal a reality. It is highly acknowledged and specified in some literatures, that in order to have system changes at a particular organization, the task is far from being simple and as expected costly to achieve, with regards to the amount of cash, time, energy and determined effort that is required (Steven et al., 1998; Andrew, 2006; Worley & Doolen, 2006 ; Bhasin, 2011. Investment in terms of time, money and effort will be required coupled with a high level commitment needs to be proven by the management via their leadership abilities, so that the workforce responds accordingly to this positivity; willing to change their mindset and behaviors, consequently having everyone's consolidated efforts working in total involvement mode and shaping a new work-culture. This should enable a better success rate of LMS implementations at their companies (Boyer, 1996; Pius, et al., 2006).

This makes the management as an important factor; it cannot be ignored or understated because it is the key in achieving LMS as a total approach. It requires the ability to effectively align strategies, arrange the required steps and plan the actions needed to fulfill the LMS implementation requirements. (Steven et al., 1998; Andrew, 2006; Worley & Doolen, 2006 ; Bhasin, 2011a).

2.4.2 Employees Involvement

The implementation of LMS is not an easy task as it requires the involvement of the total workforce and to be working together in unison. Starting from the part that management plays in the change, the implementation process will not materialize if total involvement does not exists from the employees. This is simply because employees are at the heart of a company and are the functioning mechanism that moves the daily operations, guided by the policies and goals set by the management. These two factors are inter-relatable to one another and the well-functioning of both is required (Papadopoulou & Ã–zbayrak, 2005; Jannis et al., 2010; Da´ vid et al., 2011; Glover et al., 2011; Tung et al., 2011; Bhasin, 2012).

The successful implementation of LMS can only be achieved if and only when the total involvement from the employees of the organization is present (Pius et al., 2006). In order to have total involvement from this group or workers, they need to have a thorough understanding towards the LMS and with this; the management would probably have an easier time in executing all the intended plans for the implementation.

Pius et al, (2006) identified that the job enlargement/enrichment policies, worker's greater motivation and responsibility are all factors that if not understood or considered carefully lead to complete failure of any LMS implementation initiatives. Ironically, the above issues are one of the very many ignored by organizations while attempting to adopt and implement any improvement initiative (Pius, 2007). Factor of employee involvement needs to be given the proper attention to make the implementation workable.

2.4.3 Empowerment of Employee

Employee empowerment is also a crucial factor that leads to successful LMS implementation in the organization. Employee empowerment is a further extension of the earlier employee involvement in LMS agenda.

Few researchers have claimed that the empowerment has been seen as “a property of organizations, organizational teams and groups as well as a property of individual employees” (Byman, 1991, Katzenbach and Smith, 1994 and Ford and Fottler, 1995 as quoted by (Len Holden, 1999 and Richard, 2004). Based on this statement, the importance of employee empowerment has the transformational effects in an organization. Through employee empowerment, the total involvement from employees will be received and strategies made by the management will be executed more effectively during an implementation (Rosalind, 1995).

It is widely believed that through employee empowerment, employees are engaged in a goal and feels appreciated for their efforts and contributions, consequently the commitment they give is important and has a direct effect on the performance results and its measurement within the company.

Empowering the workforce does not equate to giving up control, guidelines can be established including boundaries, to set limits of operations. Management would need to set directional markers to guide the employees on performing their function in the right way, but lets the workforce find creative decision making on their goals and objectives. By freeing them to implement ideas within their work areas, it will be more productive than by merely following the direction of their superiors. The management should have faith in the abilities and talents of their own employees (Holden, 1999). Consequently, this approach greatly reduces or eliminates unnecessary non-value added process or procedures and enables the employees to contribute to the intended goals (Jawahar & Gary, 2002). This factor should not be ignored, as it is one of the most crucial factors within an LMS implementation.

2.4.4 Teamwork

LMS features teamwork as one of the important factor towards promoting and consolidating the employees' involvement and empowerment initiative. Through studies made by the Lean Advancement Initiative (LAI), claims that the teamwork is the heart for building the LMS culture in an organization (Amelsvoort & Benders, 1994).

Teamwork culture is widely used in various types of LMS implementation activities especially in continuous improvement activities because the main important technique in successful of this activity is through teamwork. Other than continuous improvement, the teamwork concept is also used in activities for total preventive maintenance and quality management (Rosemary, 2002; Farris et al., 2009; Glover et al., 2011; Manuel et al., 2011; Peter et al., 2012 ; Azharul & Kazi, 2013).

Teamwork promotes the total involvement of employees in the organization especially in LMS' implementation agenda. Through teamwork, it will create the feeling towards the employees that everyone was important (M. Yusof & Aspinwall, 2000), and everyone was recognized and valued for their contribution and efforts towards improving the organization performances and striving the successful results in all its intended purposes, mission and plans. Perhaps this creates the motivation amongst the employees to work in the same direction in order to achieve clear, understood and stretching goals for which they are accountable for (Bhasin, 2011a, 2011b). Teamwork also strengthens the ability of knowledge sharing, build leadership traits amongst the employee and enables effective manpower management, so the success of LMS implementation revolves around the empowered teamwork culture through the total involvement of organizational workforces (Todd et al., 2011; Gulshan & Singh, 2012).

2.4.5 Training

Training is another important factor in gaining a successful LMS implementation. The development of a comprehensive training program will be the initial steps that need to be taken by the organization in order to ensure the effective LMS implementation (Dankbaar, 1999; David 2006 ; Abdel-Maksoud et al., 2010; Paul et al., 2010; Tomas & Juan, 2011). This training program needs to be focused on building the in-depth understanding pertaining to the LMS amongst all level of employees in the organization. Perhaps, through the training program, employees owning multiple skill sets and techniques like, technical skills, problem-solving, and self-leadership would be able to utilize it when applying LMS methodology as a new manufacturing system.

In achieving a Lean culture for the whole organization, most companies tend to falter at the middle because the lack of noticeable improvements in their performances.

One of the main causes of this problem is the inadequate training provided to employees, in relation to LMS understanding (Bhasin, 2012). This is also related to the management's commitment towards lean training programs, in which training is often regarded as cost rather than investment (Boyer, 1996). This tendency will eventually have a negative impact on their strategy of LMS adoption.

Due to the reforms expected from LMS's implementation, it will be necessary to invest in training programs in order to build the foundation of LMS amongst the employees as well as to the development of new skills and attitude and would be more intended to be involved in different LMS activities, particularly through becoming multi-skilled and versatile in performing several jobs towards creating a new culture of Lean (Dankbaar, 1999). Through this, the inefficient employees would also be geared up in efforts to have LMS implementation a success, and their numbers reduced by providing technical, problem-solving, and self-leadership training across organization, employees would only benefit from this process.

2.4.6 Human Resource Management

Human resource management can be considered the 'steering-wheel' of an organization or the monitoring authority within an organization; it plays an important role that deals with labor specific issues, ranging from recruitment, training, development, assessment, welfare, promotions and all the way to rewards and recognitions. Human resource management practices is important in LMS implementation, as it is assisting the organization towards gaining the successful performances required (Rosalind, 1995; Helen & Gerry, 1996; Anvari et al, 2010; Ifechukwude & Spencer, 2010; Jannis, et al., 2010; Bhasin, 2011a; Andrea et al., 2011; Glover, et al., 2011; Tomas & Juan, 2011).

The changes in organizational culture also driven by human resource management. Effective implementation of this people strategy will enable the organizational mission in LMS implementation achievable. With this also, the intended achievement towards employee involvement and satisfaction by the utilization of effective human resource practices (Farris, et al., 2009).

Human resource management is also essential in overseeing policy developments pertaining to LMS (Rosalind, 1995). Focusing on promoting the continuous improvement, formation of cross-functional teams and providing cross-training, as well as establishing promotion-reward system in realizing the goal of LMS implementation. Furthermore, this management also provides a major impact to the organizational performances since the important asset of the organization, which are the employees, will be managed in a better way (Rosalind, 1995; Power & Sohal, 2000; Jannis, et al., 2010; Tomas & Juan, 2011). As a result, the human resource management factor cannot be taken lightly as it is the most important factor agent that contributes to preparing or allowing the overall LMS implementation to be done whilst continuing to churn out ‘skillful' employees that is capable in handling the changes required by LMS.

2.4.7 Customer Relationship Management

Customer focus is one of the important goals in LMS since this manufacturing system is oriented through the customer’s need and requirements. In LMS implementation, the production activity is taken place based on the customer’s orders (requirement) with delivery on-time within the desirable quantity as well as demanding for high quality of products. By achieving these needs and requirement, the organization will successfully eliminate the waste that has been identified as non-value substance by the customer. In fact, these will lead to maximizing the profitability of the organization (Shah & Ward, 2007; Naveen & Singh, 2008; Zhao et al., 2008; Fullerton & Wempe, 2009; Danuta & Haan, 2011; Demeter & Matyusz, 2011; Yang et al., 2011; Gulshan & Singh, 2012; Hofer, et al., 2012).

Customer relationship management is a two-way synergy between the customer and supplier in producing quality product or services that fulfills the needs of the customer. So, organizations need to uplift their relations of these two parties to another level, through a better relationship management strategy, this will make them more competitive in achieving higher revenues and profit margins. To ensure a healthy customer relationship management, a more thorough approach is needed to have direct involvement of customers in product design activity, in which the product is being tailored to the customer requirement and their feedback is crucial towards gaining the design acceptance rate of product by their customers (Ypatia et al., 2006; Sharon, 2007; Jayaram et al., 2008; Danuta & Haan, 2011; Agus & Hajinoor, 2012) and is significantly dependent on prices and recent information form customers.

Accordingly, customer relationship management practices need to be embraced and integrated with LMS policies, by building cooperation and partnerships with customers thus attaining crucial insights to customer's wants and needs by integrating customer knowledge Finally, effective customer relationship management in the implementation of LMS will give a better effect and positive benefits on the implementation as it benefits both parties involved (Naveen & Singh, 2008)

2.4.8 Supplier Relationships Management

Supplier relationships management is important in order to implement the pull production system through the implementation of LMS. Suppliers plays their part by being the enhancers in a company's production capability and is important in ensuring stable productivity, by way of to reduce/eliminate the waste of stock in the inventory system of the manufacturer (Ypatia et al., 2006). So, efforts to have a better or an effective supplier relationship management is required when deciding to have LMS implementations in an organization.

Among the issues that are related to this supplier relationship management are the quality of products supplies and poor management of delivery time and method. These issues can be considered as barriers to a LMS success in an organization (Aksoy & Öztürk, 2011; Bhasin, 2012). Steps for enhancements are needed if this element is found to be lacking. Supplier relationship would require a manufacturing entity to have an established long term and trusting relationships, in which through these relationships, a win-win situation can be gain between supplier and manufacturer through various types of improvement activities that can lead to the achievement of high organizational performance (Ypatia , et al., 2006).

Through this method, the information sharing network can be build and the manufacture will be well positioned to define all their requirements that are needed from the supplier. In a sense, it creates a work-culture in line with LMS principle requirements. All the suppliers that are involved in these long-term relationships group will be aware of these requirements and should ensure their role as a supplier that has the required functional LMS understanding (Manuela & Angel, 2011). With open communication and standardization operations with the supplier, trusting to achieving collaboration, information sharing and integration, willingness for improvement among suppliers, and compliance from supply partners. On this fact, an organization working in tandem with their suppliers need to work closely and create highly competitive supply chains in line with LMS principles (Manuela & Angel, 2011).

2.4.9 Organizational Change

Organizational change is an important basis for the implementation of LMS (Shah & Ward, 2007; Andrea et al., 2011). Transformation strategy warranted by lean implementations needs major overhauls within the organization itself. These changes affect current working methodology and processes, on people management, to reflect a shift towards a more lean culture (Norani et al., 2010).

The establishment of LMS culture requires strong and full commitment from the management in all aspects including unleashing the employees' expertise in supporting the organizational change towards the new culture. These organizational changes need the employees' commitment in changing their old work styles to lean work culture. The supports and commitment from all level of employees are needed in ensuring the success and sustainability of LMS implementation in the organization. As people are the soul of lean process, having the right perspective and attitude towards lean manufacturing is crucial to the success of lean transformation (Pius, et al., 2006; Norani et al., 2010a)

This factor is closely related to other factors, such as management commitment and leadership, human resource management, employee empowerment, customer relationship management and supplier relationship management, thus needs a special focus on itself (Penny & Bernard, 2000; Andrew, 2006; Pius et al., 2006; David 2006 ; Maike et al., 2009; Anvari et al.,2010; Norani et al., 2010a; Deflorin & Scherrer, 2011; Lyons et al., 2011; Azharul & Kazi, 2013)

2.4.10 Information Technology

The various types of activities within LMS such as maintenance (Riezebos & Klingenberg, 2009), just-in-time, quality management practices, new product development and design for customers' needs (Rai et al., 2006; Nambisan, 2009; Durmusoglu & Barczak, 2011), would be made easier and achieving a better success rate with effective IT strategies.

IT will effectively connect the different internal functions in organizations such as manufacturing, purchasing, and materials management, in information-intensive and hectic operations. IT also significantly increases the product development and manufacturing effectiveness at different levels. New product development and current manufacturing activities is supported by IT tools (Elliott et al., 2001), as IT provides sophisticated project management features that offers access to all manufacturing and product development information (Nambisan, 2009).

Current communication technologies such as E-mail and web meetings, has made the work flow simpler and information movement faster in manufacturing organizations with effectiveness in coordinating work, obtaining feedback, and thus enhanced information sharing and dissemination in their daily processes (Song et al., 2007; Durmusoglu & Barczak, 2011). New product development, quality, time-to-market period, are considerably optimized by the use of computers, aiding design, manufacturing applications and statistical tools (O'brien, 1997). It also enables manufacturers to respond to market changes and customer requests in a timely manner (Wu et al., 2006). This signifies the importance of IT regarding implementation of different LMS dimensions.

2.5 LMS Implementation Dimensions/Activities

LMS encompasses with a bundle of activities or tools that can be sectioned to reflect strategic advantages if the organization chooses to adapt it as a synergistic and inter-related method for the purpose of upgrading performance parameters. These activities or tools have been used widely in implementation of LMS and it became the key to achieve the main target in elimination of wastes, which in principle actually is echoing ways to reduce cost by continuing improvements, eventually reducing the cost of products or services, consequently growing company's profits, as mentioned in the previous section, LMS is thought to be a multi-dimensional approach that encompasses a wide variety of practices (Shah & Ward, 2003), hence its effectiveness will be immeasurable by only applying some LMS activities or tools, if wanting to become an organization that is a successful LMS implementer. Besides there are known reports of some organizations with misapplication of lean tools, in which a single tool was used to solve all of the problems pertaining to LMS implementation.

In addition, Allen (2000) as quoted by Bhasin and Burcher (2006) claims

> "*that lean manufacturing is a system approach. Each approach builds on the previous one, anchoring the systems as a whole…. introducing a scattering of lean tools that are not properly used…. simply bewilders the workforce*.

Therefore, applying the right tool at the right time for the right problems is the key in successful implementation of LMS (Hung, 2006), while at the same time increasing performance parameters of an organization.

Many activities or tools have been proposed about LMS, for its methodology and application. Perhaps application of these activities is correlated to each other and will provide an impact to organizations and their operations. Each activity is unique, in that it plays a certain role and solves a certain type of problem or issue. (Shah & Ward, 2003; Hung, 2006; Jostein, 2009). There are bundles of activities related to LMS implementation, and in the following section, the primary activities are introduced and discussed.

2.5.1 Just In Time

Just In Time (JIT) is the most fundamental activities in LMS (Papadopoulou & Ã–zbayrak, 2005). It is not too far fetch to state that JIT is the heart of LMS and without this particular activity being implemented, the LMS would not exist. The JIT has been summarized as, to produce the products in certain needed quantities that based on the customer demands by using the amount of material that is sufficient, at the latest possible time (produce the right product, in the right quantity, at the right time). Thus this leads to a situation to minimize or eliminate the inventory on stock (Cua et al., 2001; White & Prybutok, 2001; Fullerton et al., 2003; Alberto et al., 2008; Mackelprang & Nair, 2010; Andrea et al., 2011). JIT is also synonymous to the application of pull system or better known as *KANBAN* production system. The combination of these two activities, the elimination of waste could be made more effective.

2.5.2 Pull System

Pull system is a part of JIT and it also known as *Kanban* production system. The aim of this activity is to control the production process and flow and all that related to achieve the customer order within the specific quantity required at the specific time (Andrew, 2008; Slomp et al., 2009; Agus & Hajinoor, 2012). The system emphasizes a minimum level of inventory and the mechanism of pull system are to manage and control the flow of materials in manufacturing plant (Naufal et al., 2012). The materials in the production process can flow smoothly with specific containers and table (Hemamlini & Rajendran, 2000 ; Domingo et al., 2007; Chao, 2011). The implementation of pull system or *Kanban* system create the "one-piece flow" process and lead to achieve the continuous production by introducing the small –lot size of the output that is based on the customer demands as well as to achieve the zero inventory goals or specifically to elimination of waste of inventory.

2.5.3 Total Preventive Maintenance

The effectiveness of an outfit's maintenance strategy is important in achieving the successful implementation of LMS. The effective integration of maintenance function with engineering and other manufacturing functions in the organization can help to save huge amounts of time, money and other useful resources in dealing with reliability, availability, maintainability and performance issues (Ahuja & Khamba, 2008). Total Productive Maintenance (TPM) is an innovative approach to maintenance that optimizes equipment effectiveness throughout the lifetime of the equipment, eliminates breakdowns, speed losses and quality defects and promotes autonomous maintenance by operators through day-to-day activities involving total workforce (Bhadury, 2000; Ahuja & Khamba, 2008). The ultimate goals of TPM are zero defects, zero accident and zero breakdowns (Nakajima, 1988; Wilmot 1994; as quoted from Ahuja & Khamba, 2008). Overall TPM is a maintenance management system that is to enhance the goal of *overall equipment effectiveness,* secure an extensive preventive maintenance process, and achieve full staff involvement (Swanson, 2001; Chan et al., 2005; Chao, 2011).

2.5.4 Quality Management

The main aim of LMS is to continuously improve the productivity, speed, quality and flexibility in an organization through elimination of identified wastes. Preserving the quality of a produced product is a key to in achieving customer satisfaction (Sha'ri & Aspinwall, 2000). This is why, Quality management is important in achieving the goals of LMS.

There exists a variety of tools that is being used in quality improvement activity. Among the tools that are often used for implementations are the 5S activity, Setup Time Reduction program, Waste Minimization program, Recognition and Reward Program, Poka-Yoke systems, Continuous Improvement, Autonomous Maintenance, Pareto Analysis, Statistical Process Control (SPC – Control Charts, etc.) Problem Solving Techniques (Brainstorming, Cause-Effect Diagrams and 5-M Approach) Team Based Problem Solving, Bottleneck Analysis and Simulation activity (Jostes & Helms, 1994).

Some of the benefits of having an implementation of LMS are quality management activities in efforts of ensuring a success of LMS implementation are as follow: *(Adapted from Sha'ri and Aspinwell (2000))*.

- Improved product and service quality
- Lower cost
- Increased responsiveness to markets
- Increased responsiveness to customers and suppliers
- More flexibility
- Improved safety
- Reduced equipment downtime
- Smaller work-in-process inventories
- Increased long-term profitability

Sha'ri and Aspinwell (2000) have concluded that by ;

> "*Adopting a quality culture in LMS through the implementation of quality management initiatives in major aspects of the business wherever possible with full consideration towards building a continuous improvement culture based on realistic resources, financial and human, and in meeting customer needs according to priorities established for continued business success".*

2.5.5 Continuous Improvement

Continuous improvement (CI) is a pervasive and continual activities, outside the contributor's explicit contractual roles, to identify and achieve outcomes he/she believes contribute to the organizational goals (Manuel & Juan, 2009). It is also known as a focused and structured continuous improvement project or task, using a dedicated cross-functional team to address a targeted work area, to achieve specific goals in an accelerated time frame (Jagdeep & Singh, 2012).

Continuous improvement is widely used by organizations in order to improve the production quality, reduce the lead times and improve the delivery reliability (Jagdeep & Singh, 2012). This activity is associated with achieving the waste reduction goals towards the successful of LMS implementation in the organization. For an organization to achieve flexibility, responsiveness and the ability to adapt quickly to changes within its environment, the implementation of a sound strategy for CI is essential (Jagdeep & Singh, 2012).

Continuous Improvement activity is usually performed by a group of employees with the specific aims in improving the overall organizational performance. According to Imai (1986) as quoted by Jagdeep & Singh (2012), there are at least 3 types of continuous improvement: the individual-oriented, the group-oriented and management oriented. He also claimed that the group oriented is the most important one as it focuses on the company's strategy and involves every employee in the organization. This indirectly has introduced and promoted CI as a team working culture that can be used in an organization, and is regarded as one of the important success factors for organizational LMS implementations (Wickens, 1990). Berger (1997) as quoted by Jagdeep Singh & Singh (2012) has presented five types of CI. Table 2.7 describes the types of CI that been identified by Berger (1997). Overall, continuous improvement is the most important activity for an LMS implementation, and is an activity that requires the participation and commitment of all levels of the workforce within an organization. This activity could be a starting point for developing the new working culture towards seeking improvement and new changes that would bring out excellent performances to an organization (Brunet & New, 2003; Toni et al., 2008; Farris et al., 2009; Manuel & Juan, 2009; Phillip et al., 2010; Meiling et al., 2012).

Table 2.7: Types of Continuous Improvement

(Source from Berger (1997) as quoted by Jagdeep Singh & Singh (2012))

No	Types of Continuous Improvement	Description
1	Quality Control Circles	A group employee who meets regularly to discuss problems and issues related to quality so that they may examine the problems and come up with solutions.
2	Wide-Focus CI	A combination of the organic CI groups and expert task force CI. It is used for temporary operations and for CI in self-managed work groups by combining CI process teams.
3	Organic CI	Multifunctional work groups are integrated with improvement activities.
4	Expert Task Force CI	This form of CI is based on the reliance on temporary expert task force consisting of professional from quality, engineering and maintenance and therefore the span of improvement tasks requires considerable time and investment.
5	Individual CI	Improvements are set off by individuals and generally organized in the form of a suggestion system. Individuals come up with ideas and the implementation of the ideas is left to the specialists or management.

2.5.6 Design for Customer Needs

Customer focus is one of the hallmarks in LMS (Pius, et al., 2006). Customer satisfaction is important in sustaining the business. Customer involvement in the product design process is important towards ensuring to achieve very good customer satisfaction (Pius, et al., 2006) through this aim at satisfying the customer by understanding a particular customer's needs, the customers are provided with what they exactly want, at the time the customer needs it (Sha'ri & Elaine , 2000).

Among the tools that is often used to apply this activity of design for customer needs is through the use of Quality Function Deployment (QFD) tool that consolidates all internal and external efforts with regards to product development stakeholders on the specific needs of customers. Being implemented well, the use should lead to a higher level of error-free product designs, a quicker and a more accurate product development process (Sha'ri & Aspinwall, 2000).

Meanwhile, QFD - quality function deployment, is another important product development method, it specifies the need to translate important client requirements into activities that is needed for developing products and services. In another sense, to ascertain the technical requirements for individual stages of product development and production, QFD is an amazing tool. Its stages could be narrowed to strategies in marketing, planning, design, engineering, prototype evaluation and process development (Baba et al., 2010).

2.6 LMS Implementation and Organizational Performances

The benefits of LMS implementation can be described through our understanding by viewing organizational performances and their measureable indicators. Items like engineering performances, financial performances, non-financial performances and operational performances are often impacted directly or indirectly by quality improvements brought about by the successful implementation of LMS dimensions. Based on the previous literatures, there are 5 types of performances that usually used as the measurable indicators for gauging the effectiveness level of any LMS implementation and its subsequent performance in a manufacturing outfit. Below are these indicators:

2.6.1 Waste Reduction

Waste reduction efforts have direct effects on LMS implementation. Waste reduction is the pillar behind the Lean concept and is crucial towards successful LMS implementations. In manufacturing, waste or wastages has been defined, as any activity that absorbs valuable resources but creates less or no values (Jostein, 2009). Moreover, it is important to reiterate that the decision to embrace Lean should always be viewed as a business philosophy too; the best performing organizations, reflected the importance of this concept through measureable improvements in : (Bhasin, 2011b)

- higher profitability; improved employee performance; improved market share; increased competitiveness; and constant waste reduction

In addition, the LMS concept was further expanded to encompass a wider understanding and approach into qualitative deliverables which is, LMS is needed in producing the products based on the customer requirements with the specific batch size, using the materials that are adequate and executed within the time frame intended. This is primarily thought off in order to eliminate the inventory stock that is associated with one of the types of waste (Willaiams et al., 1992; Braiden & Morrison, 1996; Karlsson & Ahlstrom, 1996; Sanchez & Perez, 2001; A. Pius, et al., 2006; Sanjay Bhasin & Peter Burcher, 2006; Holweg, 2007; Shah & Ward, 2007) and this inventory can be controlled or reduced either by reducing the throughput time (Shah & Ward, 2007).

Basically, there are seven types of waste identified in LMS implementation. These identified wastes are explained in Table 2.8 as follows:

Table 2.8: Seven Types of Wastes

(Source adapted from Hung-da Wan 2006).

No	Type of Waste	Description
1	Overproduction	- Excess Production – batch production, bottlenecks, and curtain operations.
2	Time on Hand	- Waiting – down time, part shortages, and long lead time.
3	Transportation	- Transportation – poor utilization of space, operator travel distance, and material flow backtracking
4	Processing Itself	- Over Processing – redundant systems, misunderstood quality requirements, poor process design.
5	Inventory	- Stock – long changeover time, high raw material inventory, high WIP, high finished goods inventory, and excessive management decisions.
6	Movement	- Motion – low productivity, multiple handling, and operator idle time.
7	Making Defective Products	- Defects – poor process yield, employee turnover, low employee involvement, limited processing knowledge, and poor communications

2.6.2 Financial Performance

This performance indicator is the best measurable gauge or indicator for any type of business, after a year of doing business firms would generally compare their financial performance against the industry benchmark or other competitors in the same market. A positive number which should be higher than their spending as operational cost should indicate that the management is doing the right thing and their direction is right. Here profitability becomes a huge factor because big manufacturing organizations need to survive in the long run and a healthy financial performance ensures continuity. Mainly due to the amount of investments needed to set-up these large operations in the first place. Manufacturing organizations do spend a lot of monies to produce their final product and in this sense limiting wastages all along their manufacturing line should impact their profitability.

2.6.3 Non-Financial Performance

Non-financial gains on the other hand are not immediately quantifiable but the effects of LMS adoption should have noticeable gains over a period of time (Hofer, 2012). By having cultural and mindset changes instilled through training and improvements in work patterns, LMS should provide the foundation or access for this transformation. Improvement is the key here, so any significant increases in say efficiency of workers, improvements in worker behavior or even increase in ideas from employee suggestion schemes will ultimately benefit their manufacturing process or workflow and this eventually relates to improvements in quality.

2.6.4 Marketing Performance

Having a high quality product that is on target with the intended design is the basic goal of all manufacturing entities. Quality creates value, in the perception of eventual buyers or users or even the industry itself. It is easier to market a product with higher quality because a ready market will quickly absorb these valuable offerings, and high demand is created if the numbers are insufficient. Thus, it will be easier to market the product to the masses but by using lesser marketing cost to do it. Hence marketing performance would improve for these companies in the short in terms of higher revenues and more importantly increasing brand association and recognition in the long term.

2.6.5 Operational Performance

In value chain management LMS is a key integration mechanism that integrates the internal activities of the manufacturing organization against customer demand (Jayaram et al, 2008). Tuned-in to be more responsive to these demands, keeps their perspective in check. In essence it should be focused on having effective links on manufacturing design, planning, co-ordination and execution that strive to eliminate waste across their different manufacturing phases and to identify and eliminate any work-activities that are non-value adding to their internal processes. For instance pro-active maintenance schedule to decrease unexpected downtime, lesser production rejects due to better quality checks, better inventory management by working hand-in-hand with supplier and customer or the On-time ratio of product delivery to shelf. These tiny bits of improvement gains will affect a company's operational performance and increases their efficiency levels.

On benefits, from other prior researches, with the implementation of LMS in an organization, it points to upgrade in performance indicators that are both drastic and satisfying the initial need. Further, as an indirect consequence an organization can reduce the competitive threats brought by globalization (Chun, 2003). In doing so, the improvements in organizational performance, as a result of organizations implementing the lean manufacturing principles, have given organizations a competitive advantage and the benefits gains from the LMS implementation is indisputably highly valuable. This justifies the adoption of LMS intended to bring major changes on how an organization operates, and eventually will lead to positive after-effects on their business performance, competitiveness and ultimately its survivability or sustainability.

2.7 Research Gap

LMS is not a new system introduced in Malaysia, but it is pertinent to point out that its use, adoption or its implementation level in the domestic industry is still at moderate levels and below. Most automotive industry players in Malaysia have just started to implement LMS about 7 years ago. Based on available literature review, the study into LMS in the Malaysian context is also new and in that sense there are a lot of weaknesses present and multiple angles that still can be addressed further about this subject. Several known methods of LMS have not been seen applied successfully in the LMS implementations in Malaysia, especially in the automotive industry. The main research gaps that have been identified from this research are:

1. Previous studies done in efforts to identify the influencing factors of LMS, and also LMS implementation activities, but with a low variety. However, these influencing factors mainly needs to be addressed and studied closely in order to recognize and determine whether a total-approach of LMS or a full-blown can be accomplished successfully in the Malaysian automotive industry. By investigating a wide range of potential influencing factors or identifying its barriers would consequently provide a comparability of findings, being useful to the industry and its players. While also giving this study a chance to serve as a benchmark measure of determinants of LMS implementation for other researchers and their future research.
2. Previous studies mostly focused on the relationships between influencing factors of LMS and LMS implementation with practical applications through lean manufacturing activity *(LMS influencing factors → LMS implementation)* or one that is focused on the relationship of LMS implementation against other performances like financial, operations and other related measures *(LMS implementation → business performance)*. But to realize the full blown implementation of LMS, the relationship between influencing factors, LMS

implementation and also performance needs to be established and verified in order to form a better understanding about the LMS in a larger total sense. This would add more credibility to the findings as it would include many measureable parameters that could also be used, inferred to and probably later able to being replicated by other researchers *(influencing factors → LMS implementation → business performance).*

3. Previous studies also stated that, although many companies under this industry are interested in the LMS and trying to implement lean tools, it is well documented that the level of implementation and adoption of lean manufacturing in Malaysia has yet to become comprehensive and is currently being applied in certain stages and known areas only (Wong et al., 2009; Baba et al., 2010; Norani et al., 2010b, 2011; Noor Azlina, et al., 2011) and the main reason for this is because most do not have, or lack the technical know-how for a successful implementation (Pavnaskar et al., 2003; Norani et al., 2010b, 2011). Currently, there is a lack of structured frameworks to aid organizations in determining the impacts and the expected benefits of implementing lean manufacturing within their organizations. This study will offer to provide a comprehensive guideline of LMS implementation strategy, which needs to be established base on the pertinent LMS factors to be identified, examined and located. This should help guide companies towards becoming more successful in implementing LMS and as such be able to sustain a LMS *en route* to gaining the optimum organizational performances that is unique to LMS adoption or implementation. In short, this study is carried out with the aim to fill these identified gaps and seeks to make a significant contribution to the literature.

2.8 Summary

Chapter 2 describes and discusses about the implementation process of LMS in the automotive industry. Based on the review of multiple literatures that are available, it showed that the implementation of LMS needs to be applied as whole concept or using a total approach in order to reap its full potential and to witness improved business performances at an optimum level. This had been highlighted within the literature review, in which the "pick-and choose" application method is not the best way to implement LMS effectively in an organization. Besides, several gaps were identified in the field of Lean; it's influencing factors versus its application or implementation, its performance measurement- in non-financial, financial and also other dimensions and the lack of the development of a structured framework available for LMS implementations. Applying ten (10) known influencing factors of LMS (Management and Leadership Commitment, Employees Involvement, Empowerment of Employee, Teamwork, Training, Human Resource Management, Customer Relationship Management, Supplier Relationships Management and Organizational Change).

Through hypothesis testing and supported by six important dimensions of LMS (Just-in-Time, Total Preventive Maintenance, Quality Management, Pull System, Continuous Improvement and Design for Customer Needs) , this research is conducted with the aim of filling these gaps, via measurement of five organizational performance dimensions (Waste Reduction, Financial Performance, Non-Financial Performance, Marketing Performance and Operational Performance).

The implementation of LMS in Malaysia is also discussed in this chapter, specifically towards implementation that has been done within the automotive industry in Malaysia. Although the LMS concept has been known for a while its implementation in automobile producing countries is well documented, the LMS implementation in Malaysia is considered relatively new. This is supported by various studies and research in this field with particular emphasis to the Malaysian context. The obstacles in implementation of LMS are being highlighted at the end of this chapter. These obstacles are different according to organizational culture and also national culture based upon obstacles of implementation in Malaysia and also based on a study undertaken by Bhasin (2012b) in Europe. Bhasin's research has shown that the size of organization (small, medium and large industry) plays an important role in determining the degrees of obstacles of towards the implementation process. The end of this chapter, using a variety of past literatures, the development of conceptual framework as well as the hypotheses was able to be developed, while the detailed explanation of the conceptual framework and development of hypotheses for the current research are presented in the next chapter.

CHAPTER 3

RESEARCH HYPOTHESIS AND MODEL DEVELOPMENT

This study is carried out with the aim to fill the gaps that have been identified in the Literature Review section and seeks to make a significant contribution to the literature. The conceptual framework is presented in this chapter. The hypotheses are drawn in order to measure the relationship between the LMS factors, LMS implementation activities and also the organizational performances.

3.1 Conceptual Model

Basically, most of the studies are focused on a single aspect of lean and its implication. For example, Aksoy&Öztürk (2011) have conducted a study pertaining to the JIT production environments in the supplier selection and the performance evaluation and Chan et. al (2005) have focused to the implementation of TPM. Besides the conceptual model that was developed by Chong et. al (2001) was referred to in this research. Figure 3.1 shows the conceptual model of relationship among organizational support, JIT implementation and performance. Chong et. al (2001) identified 5 items (top management support; middle management support; first line supervisor support; production worker support; and staff worker support) under organizational support, that was needed to be measured with the JIT implementation in order to gauge the performances of the organization (internal quality level (defects, rework, etc.); external quality level (warranties, returns, etc.); labor productivity; employee behavior (turnover, absenteeism, etc.); throughput time (time from order release to job completion); inventory levels (raw materials, WIP, finished goods); and unit cost. Although the study was only focused on a single factor within an LMS implementation, the concept of relationship between factor, LMS activity and performance measure could be applied in this research, to be used as a benchmarking factor within the scope of a LMS implementation.

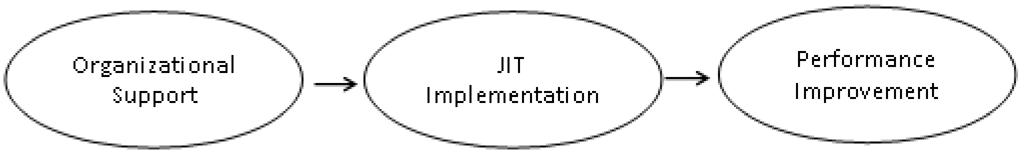


Figure 3.1: Proposed Model by Chong et. al (2001)

However in developing this particular conceptual framework, the study by Shah & Ward (2003) Bhasin and Burcher (2006), Pius et al, (2006) and Scherrer et al., (2009) were also utilized as the point of reference.

Shah &Ward (2003) has introduced the 22 lean practices under the 4 groups of LMS categories that have contributed towards the organizational performance while Bhasin and Burcher (2006) have outlined a set of 12 LMS practices in the organization with 5 major dimensions of performance (Financial, Customer/market measures, Process, People and Future). Pius et al. (2006) have discovered 4 critical factors (Leadership and Management, Financial Capabilities, Skills and Expertise and Organizational Culture) and Scherrer et al., (2009), proved 3 driven factors towards the successful of LMS Management Commitment and Involvement , Employee Empowerment and the Information Transparency. The details of these studies are explained previously in Chapter 2. Thus, in-line with these previous studies, the following conceptual framework in Figure 3.2 has been developed in order to fulfill the research gaps that have been identified in Chapter 2.

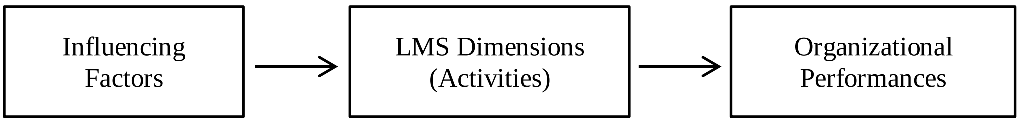


Figure 3.2: Conceptual Framework

3.2 Hypotheses

The conceptual model that has been proposed in this study is based on the extensive and comprehensive literature review from the various aspects of LMS implementation particularly for the Malaysian automotive industry. Basically, the study focused on the relationship between LMS factors, LMS implementation activities and also the organizational performances that will be recognized in this thesis as business performances. Eleven hypotheses were developed in order to reflect the mentioned relationships. These hypothesis and relative support from literature are listed in Table 3.1 and are presented as follows:

Table 3.1: Research Hypotheses

No	Hypothesis	Source
H1	Management leadership and commitment has a positive effect on the level of lean implementation.	Anvari (2010), Anand & Rambabu (2009), Andrew (2006), Bhasin 2012,2011), Boyer (1996), Gonzalez-Benito (2005) Jannis et al. (2010), Worley & Doolen (2006), Pius et al. (2006), Tung et al. (2011) and Steven et al. (1998). ***(13 sources)***
H2	Empowerment of employees has a positive effect on the level of lean implementation.	Bhasin (2012) , Da´ vid et al. (2011), Glover et al. (2011), Jannis et al. (2010), Papadopoulou & Ã–zbayrak, (2005), Rosalind (1995) and Tung et al. (2011) ***(7 sources)***
H3	Employee involvement has a positive effect on the level of lean implementation.	
H4	Employees' training has a positive effect on the level of lean implementation.	Tomas & Juan (2011), Gulshan & Singh (2012), Andrea et al. (2011) and Paul et al. (2010) ***(4 sources)***
H5	Teamwork has a positive effect on the level of lean implementation.	Azharul & Kazi (2013), Rosemary (2002), Farris et al. (2009), Glover, et al. (2011), Manuel et al. (2011), Monica & Camilla, (2012) and Peter et al. (2012) ***(7 sources)***
H6	Human resource management has a positive effect on the level of lean implementation.	Anvari (2010),Bhasin(2011),Tomas & Juan (2011), Andrea et al.(2011),Glover et al. (2011),Helen & Gerry (1996), Ifechukwude & Spencer, (2010),Jannis et al. (2010),Rosalind (1995) and Tomas & Juan (2011). ***(10 sources)***
H7	Customer Relationship Management has a positive effect on the level of LMS implementation	Danuta & Haan, (2011), Demeter & Matyusz, (2011), Gulshan & Singh (2012) Hofer et al. (2012), Naveen Gautam & Singh, (2008) R. Shah & P. Ward (2007), Rosemary & Yang et al. (2011), William, 2009 and Xiande Zhao et al. (2008) ***(7 sources)***

‘Table 3.1, continued’

No	Hypothesis	Source
H8	Supplier relationship management has a positive effect on the level of lean implementation.	Aslı Aksoy & Öztürk (2011), Manuela & Angel (2011), Sharon (2007), Stuart So & Hongyi Sun (2010) and Ypatia et al. (2006). ***(5 sources)***
H9	Organizational change has a positive effect on the level of lean implementation.	Anvari (2010), Azharul & Kazi, (2013), Andrew 2006), Deflorin & Scherrer-Rathje (2011), David (2006), Lyons et al (2011), Maike Scherrer et al. (2009), Norani Nordin et al.(2010), Penny & Bernard (2000) and Pius et al. (2006), ***(10 sources)***
H10	Information technology use has a positive effect on the level of lean implementation.	Benitez-Amado et al. (2010), Durmusoglu and Barczak (2011), Elliott et al. (2001), Nambisan (2009), Song et al. (2007), O’Brien et al. (2009), Riezebos and Klingenberg (2009), Rai et al. (2006) Swanson (1997), Tan et al. (2009), Tippins and Sohi (2003) and Wu et al. (2006) ***(11 sources)***
H11	Level of lean implementation has a positive effect on the business performance	Hofer et al. (2012), Maike Scherrer et al. (2009), Fullerton & Wempe (2009), Shah & Ward (2003), Sanjay (2008), Shams et al. (2010), Shahram & Cristian (2011) and Tung et al. (2011). **(8 sources)**

3.2.1 Management Leadership and Commitment and LMS Implementation.

LMS implementation is not an activity that is one part straightforward and another part swift by execution. In actuality it is a complicated process that needs an integration of all parts within an organization. Hence, strong leadership traits and a high management commitment is justifiably needed to ensure a successful LMS adoption in the organization (Pius et al., 2006; Riezebos & Klingenberg, 2009). In fact, management leadership and commitment are the two main factors in LMS implementation (Boyer, 1996; Gonzalez, 2005; Andrew, 2006; Pius, et al., 2006; Anand & Rambabu, 2009; Anvari et al, 2010; Jannis et al., 2010; Tung et al., 2011; Bhasin, 2012). These factors are the determinant points to how a system is being accepted and effectively implemented within an organization with some measure of success.

Commitment of financial aspects and non-financial aspects including the investments in matters of time, monies and energy is also needed to realize LMS' implementations. Management and leadership commitment is needed to clearly position the strategy of lean implementations, whilst also to manage and monitor the roll-out stages according to the determined set plans, including the total involvement of all parties, throughout the implementation progression of the strategy (Steven et al., 1998; Andrew, 2006; Worley & Doolen, 2006 ; Bhasin, 2011a) Even though, this important aspect of LMS has been determined and identified, however the effectiveness and the importance of this factor within the Malaysian automotive parts industry is yet to be confirmed, thus the following hypothesis is asserted:

H1: Management leadership and commitment has a positive effect on the level of LMS implementations

3.2.2 Empowerment of Employees, Employee Involvement and LMS Implementation.

Many researchers have highlighted about the importance of the employees involvement and employees empowerment as one of the successful factors in implementing LMS within an organization (Papadopoulou & Ã–zbayrak, 2005; Jannis et al., 2010; Da´ vid et al., 2011; Glover et al., 2011; Tung et al., 2011; Bhasin, 2012). Furthermore, these factors has become major factors in creating a 'lean culture' that is accepted as a working culture within a manufacturing based entity. It is widely believed that through employee empowerment, employees are engaged in a goal and feels appreciated for their efforts and contributions, consequently the commitment they give is important and has a direct effect on the performance results and its measurement within the company. This, more importantly increases employee involvement and eases the organization to execute activities geared towards achieving positive organizational performance. In addition, it also gives an implication on the organizational structure, shifting from a traditional hierarchies structure to a process structure (Rosalind, 1995) in which it allows more freedom for employees to implement new ideas and make changes based on shorter targets and the ultimate goal of the organization. Thus the following hypotheses have been proposed:

H2: Empowerment of employees has a positive effect on the level of LMS implementation

H3: Employee involvement has a positive effect on the level of LMS implementation

3.2.3 Training, Teamwork, Human Resource Management and LMS Implementation.

Human resource management can be considered the heart of an organization, it is an important element that deals with managing the work-force, ranging from employee recruitment, training and career development, assessment, welfare, promotions and rewards. In fact, human resource management practices are core components in LMS implementation via application of various type of lean manufacturing activities in assisting the organization towards gaining the successful performances (Rosalind, 1995; Helen & Gerry, 1996; Anvari et al., 2010; Ifechukwude & Spencer, 2010; Jannis et al., 2010; Bhasin, 2011a; Andrea et al., 2011; Glover et al., 2011; Tomas & Juan, 2011). Unfortunately, based on the study conducted by Tomas and Juan (2011), the study pertaining to the linkages between human resource management and LMS is still insufficient and perhaps it is practically unexplored, thus a research hypothesis that is relevant with this factor has been developed and is stated at the end of this section.

Initial steps that should be taken in ensuring an effective LMS implementation is by creating a training system that is detailed and comprehensive that focuses on development of employee understanding, building capability and skill in line with the LMS philosophy. HRM which is to shoulder this responsibility must acknowledge and uphold training as an important element towards success of the organization. Training should be viewed as providing a powerful impact on employees' performance while undertaking their job responsibilities. The trainings will affect the organizational change, moving towards lean cultures and increase the motivational drive among all the employees (Paul et al., 2010; Tomas & Juan; Furlan et al., 2011; Gulshan & Singh, 2012).

Besides training, creating a teamwork culture within an organization that has a bearing set on LMS is also important, teamwork culture is used widely in continuous improvement, total preventive maintenance and quality management activities in which efforts to reduce waste or the entire elimination of waste can be accomplished and be sustainable (Rosemary, 2002; Farris et al., 2009; Glover et al., 2011; Manuel et al., 2011; Peter et al., 2012 ; Azharul & Kazi, 2013). In addition, teamwork necessitates on knowledge sharing, leadership commitment and manpower management that is more effectual (Monica & Camilla, 2012; Peter et al., 2012). Prior to the previous research, it is expected that the factor of training, teamwork and human resource management are important in implementing LMS, thus the following hypotheses is proposed:

H4: Training has a positive effect on the level of LMS implementation

H5: Teamwork involvement has a positive effect on the level of LMS implementation

H6: Human Resource Management involvement has a positive effect on the level of LMS implementation

3.2.4 Customer Relationship Management and LMS Implementation.

Every organization envisions their business entity to being permanent in nature and one that provides high yielding profits. In order for that to take effect, customer relationship management has to be upgraded and given serious consideration to allow a marketing strategy that is both effective and enduring. The implementation of LMS in the organization can be regarded as a strategy that gives a deeper focus towards customer relationship management. This is through an LMS strategy that is oriented on customer-based production will adhere to the needs of the customer, by producing products that are based on the customer's requirement, with shorter lead times but in higher quality while simultaneously maximizes the profitability of the organization (Shah & Ward, 2007; Naveen & Singh, 2008; Zhao et al., 2008; Fullerton & Wempe, 2009; Danuta & Haan, 2011; Demeter & Matyusz, 2011; Yang et al., 2011; Gulshan & Singh, 2012; Hofer et al., 2012). Accordingly, the following hypothesis is proposed:

H7: Customer Relationship Management has a positive effect on the level of LMS implementation

3.2.5 Supplier Relationship Management and LMS Implementation

Supplier relationship plays a vital role in increasing productivity levels and quality of a given product for any organization (Sharon, 2007). The implementation of LMS within the organization forces the organization in having reputable suppliers that can align and that can understand upon the needs of the system. LMS is closely related with Just-in-Time (JIT) production where customer needs and satisfaction is given top priority through a method of produce and deliver the product on time, in the right amounts and with high quality (Ypatia et al., 2006; Stuart & Sun, 2010; Aksoy & Öztürk, 2011). On this fact, an organization and their suppliers need to work closely and make LMS as a foundation towards creating the highly competitive supply chains (Manuela & Angel, 2011). Thus the following hypothesis is posited:

H8: Supplier Relationship Management has a positive effect on the level of LMS implementation

3.2.6 Organizational Change and LMS Implementation

Organizational change is a driving force within an organization that intends to have a LMS implementation. Transformation strategy towards creating a lean organization needs major changes within the organization itself. This is because these changes not only affect the working methodology or processes, but eventually it will have an impact on people management, which should be shifting towards a lean culture. (Norani et al., 2010). This factor needs to be given special attention due to it being closely related to other factors, such as management commitment and leadership, human resource management, employee empowerment, customer relationship management and supplier relationship management. (Penny & Bernard, 2000; Andrew, 2006; Pius et al., 2006; David 2006 ; Scherrer et al., 2009; Anvari et al., 2010; Norani et al., 2010a; Deflorin & Scherrer, 2011; Lyons et al., 2011; Azharul & Kazi, 2013). Perhaps the organizational change is the key towards having sustainability of LMS in the organization. Thus, the following hypothesis is proposed:

H9: Organizational Change has a positive effect on the level of LMS implementation

3.2.7 Information Technology use and LMS Implementation.

Information Technology (IT) is a valuable organizational resource which can directly or indirectly provide business performance (Thong, 2001; Nguyen, 2009; Tan et al., 2009; Liang et al., 2010). In general, IT in organizations can be defined in terms of human IT resources (e.g., IT personnel and knowledge of IT) and technological IT resources (e.g., computer hardware and software) (Benitez-Amado et al., 2010). It is well agreed that IT enables the support to the decisions of planners and employees in organizations without completely taking over control (Riezebos & Klingenberg, 2009). IT tools can enhance different lean activities as they support effective and speedy data and information sharing within the firm itself and also with supply partners and customers (Rai et al., 2006). The literature suggests that current maintenance practice in majority of manufacturing organizations is usually heavily supported by IT. Regarding maintenance activities, IT enables the precise and optimized monitoring of maintenance activities, and efficient materials and spare parts management (Swanson, 1997). Moreover, IT can assist with minimizing and optimally timing inspection and maintenance (Riezebos & Klingenberg, 2009). The literature has also offered evidences on positive effect of IT on JIT activities. Ward and Zhou (2006) for example demonstrated that IT facilitate JIT effectiveness as (1) IT effectively connects the different internal functions in organizations such as manufacturing, purchasing, and materials management, and (2) in an information-intensive supply chain in which business partners are more closely connected both internally and externally, IT-enabled information sharing offers decreased information lead time and decision-making process time, and thus, decreased total lead time in the entire supply chain.

Moreover, IT can significantly increase the product development and manufacturing effectiveness at different levels. Process management in new product development and current manufacturing activities is supported by IT tools (Elliott et al.,

2001) as IT provides sophisticated project management features that offers access to all manufacturing and product development information (Nambisan, 2009). More importantly, computer-mediated communication technologies such as E-mail and web meetings have enabled manufacturing organizations with effectiveness in coordinating work, obtaining feedback, and thus enhanced information sharing and dissemination in their daily processes (Song et al., 2007; Durmusoglu & Barczak, 2011). Consistently, and concerning new product development, quality of new products, new product's time-to-market period, and future production costs are considerably optimized due the use of computer-aided design and manufacturing applications and statistical tools (O'brien, 1997). Finally, IT applications speed up information acquisition and information exchange (Tippins & Sohi, 2003) and enables manufacturers to respond to market changes and customer requests in a timely manner due to efficiency in information exchange and coordination activities (Wu et al., 2006).

H10: Information Technology has a positive effect on the level of LMS implementation

3.2.8 LMS Implementation and Organizational (Business) Performances

The LMS implementation has given a positive improvement upon organizational performance, that encompasses aspects of financial performance, marketing performance, non-financial performance and operational performance (Shah & Ward, 2003; Bhasin, 2008; Scherrer et al., 2009; Fullerton & Wempe, 2009; Shams et al., 2010; Shahram & Cristian, 2011; Tung et al., 2011; Hofer et al., 2012). Despite variations in performance effects of LMS, prior research has provided evidence that and LMS can potentially increase financial performance through improving organizational processes and cost efficiencies (Fullerton et al., 2003; Fullerton and Wempe, 2009). Lean manufacturing practices can also enhance manufacturing productivity by reducing setup times and work in process inventory, improving throughput times, and thus improve market performance (Tu et al., 2006; Yang et al., 2011). It has also been reported that LMS would increase the employees' morale and productivity, customer satisfaction due to reduced defects, faster time to market, and improved delivery. Additionally, LMS can considerably facilitate collaborative supply chain management and improve administrative productivity with redundancies eliminated across supply network. Accordingly, it is proposed that:

H11: Lean Manufacturing Implementation has a positive effect on Business Performances

3.3 Suggested Research Model of Full-Blown LMS implementation

Based on the hypothesis discussed in section 3.2, the suggested research model of full-blown LMS implementation for Malaysia auto part manufacturers is depicted as Figure 3.3 which assumes that some specific factors influence the full-blown implementation of LMS and fully implemented LMS can enhance different dimensions of organizational performance[1] positively.

[1] Similar to prior studies in operational research, organizational performance, business performance, and firm performance are interchangeable concepts in this study and referee to the organizational effectiveness in terms different metrics.

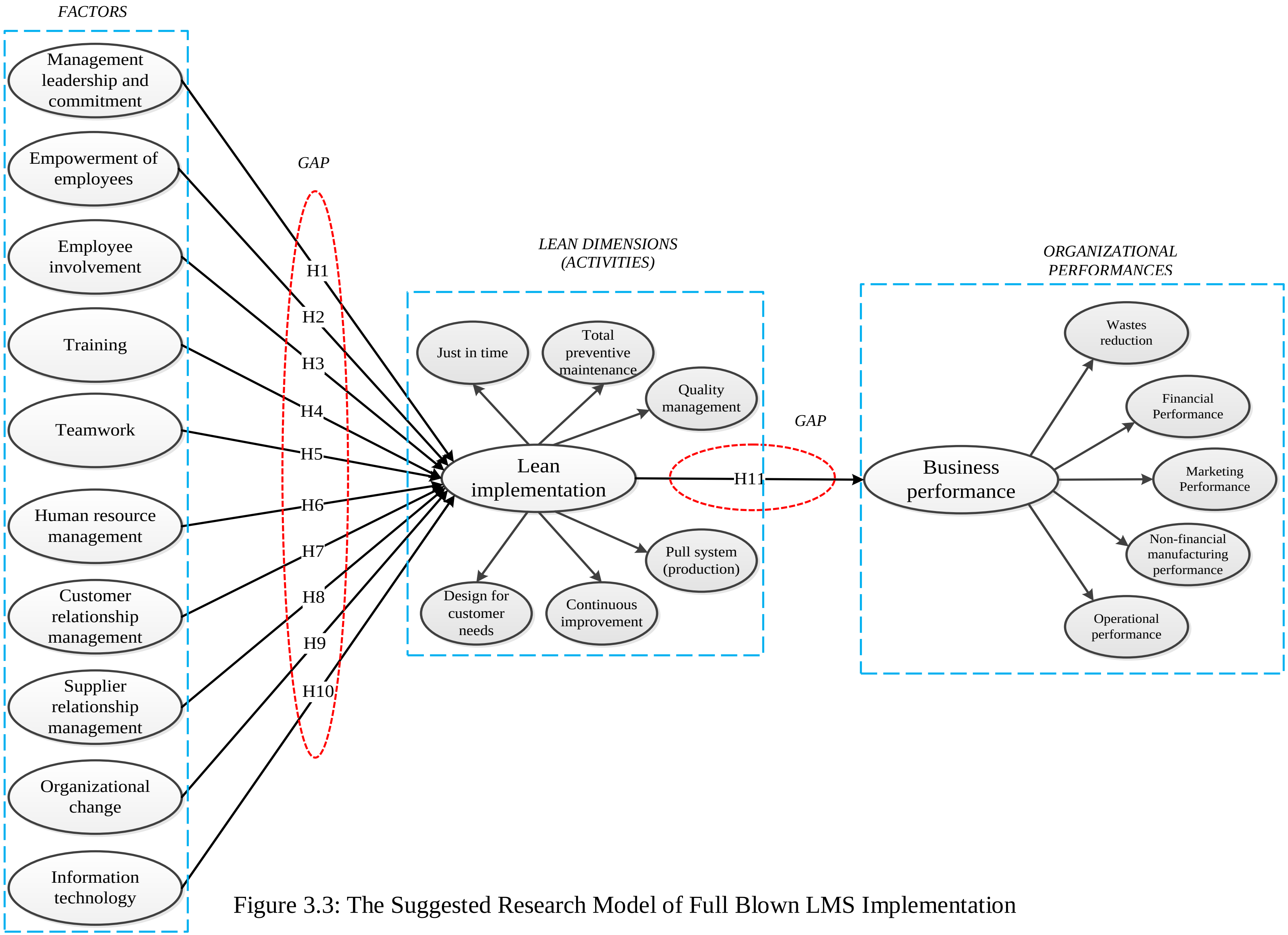


Figure 3.3: The Suggested Research Model of Full Blown LMS Implementation

3.3.1 Research Model Specification

Researchers spend major effort theoretically justifying structural relationships. However, the same effort should be done for theoretically justifying measurement relationships, thus, both structural and measurement relationships should be regarded as hypotheses to be conceptually justified and tested (Jarvis et al., 2003). Accordingly, it is crucial to correctly distinguish between formative and reflective indicator measurement models to avoid measurement model misspecification (Petter et al., 2007; Coltman et al., 2008).

Before explaining the specification of the research model, it is important to define the various terms that are used throughout this thesis regarding the research model. In this study, and consistent with prior literature e.g. Jarvis, et al., 2003; Petter, et al., 2007, *measures*, also known as *indicators* or *items*, are observable, quantifiable scores obtained through self-report survey of Malaysian automotive part manufacturers. This means that, for Just-In-Time (JIT) as an example, question JIT1, JIT2, JIT3, and JIT4 (Table 4.1) are four measures/indicators/ items. Construct (also known as latent variable or unobserved variable) cannot be observed directly. In fact constructs/latent variables/unobserved variables are examined using measures/indicators/ items. For example, the independent variable *employee empowerment (EE)* is a constructs/latent variables/unobserved variables which is examined through measures/ indicators/ items EE1, EE2, EE3, EE4, and EE5 (Table 4.1).

When measures/indicators/ items are used to examine an underlying constructs/latent variable that is unobservable, the measures/indicators/ items are referred to as reflective (Petter, et al., 2007). In reflective measurement models, the causality flows from the construct to the indicators (Coltman, et al., 2008). Reflective indicators account for observed variances or covariance (Petter, et al., 2007), and as explained by Fornel (1982, p. 442), reflective models minimize "the trace of the residual variances in the ‘outer’ (measurement) equations”. Alternatively, the measurement model is known as formative when it is changed in the indicators that determine changes in the value of the latent variable (the causality flows from indicators to the latent construct) (Diamantopoulos & Siguaw, 2006). This means that a formative model does not assume that the measures are all caused by a single underlying construct, rather, the formative model presumes that the measures all have an impact on (or cause) a single construct (Jarvis, et al., 2003). In this study, all constructs are modeled as reflective as following decision rules by Jarvis et al, (2003) and Petter et al., (2007) have recommend the appropriateness of reflective constructs;

- Indicators in this study share a common theme;
- Indicators in this study co-vary with each other considerably;
- Indicators in this study have the same antecedents and consequences; and
- Changes in the construct of this study do cause changes in the indicators.

Accordingly, in this study, all the influencing factors in the research model are conceptualized as the first-order reflective constructs (variables). The LMS and implementation and business performance however are presented as (two-dimensional) second-order reflective constructs. Contrary to one-dimensional (first-order) constructs, multidimensional constructs are latent variables with more than one dimension in which dimension can be measured using either reflective or formative indicators (Petter, et al., 2007). According to Law and Wong (1999, p. 144) the multiple dimensions of a multidimensional construct “are grouped under the same multidimensional construct because each dimension represents some portion of the overall latent construct” (Law & Wong, 1999). Consistent with the concept of multidimensional constructs, LMS implementation construct (latent variable) consists of a six more concrete (or first-order) sub-dimensions (first-order unobserved variables) including Just-In-Time (JIT), Total Preventive Maintenance (TPM), Quality Management (QM), Pull System (PS), Continuous Improvement (CI), and Design for Customer Needs (DCN). Business performance construct on the other hand consists of five more first-order reflective sub-dimensions comprising Waste Reduction (WR), Financial Performance (FP), Marketing Performance (MP), Non-Financial Performance (NFP) and Operational Performance(OP).

MacKenzie et al. (2005, p. 713) believe that choosing and analyzing a construct as multidimensional depends largely on the construct under study and "the generality or specificity of one's theoretical interest." In this study, LMS implementation and business performance have been modeled as second-order (two-dimensional) because two main reasons;

1. Petter et al. (2007, p. 627) recommend that "complex construct that is the main topic of study may deserve to be modeled as a multidimensional construct so as to permit a more thorough measurement and analysis." Consistently, the researcher has modeled LMS implementation and business performance as second-order because both these constructs are complex in nature (Rai et al., 2006; Shah & Ward, 2007) and understating the mechanism under which these two constructs within Malaysian automotive manufacturers are formed and altered are the main focus of this study;
2. The researcher believes and understands that full-blown implementation of LMS involves the simultaneous development and implementation of all the different dimensions of LMS. According to the theory of complementarities (Milgrom & Roberts, 1995), a set of resources (or business capabilities) is complementary when the returns to a resource/compatibility vary in the levels of returns to the other resources/capabilities. This theory explains that business resources and capabilities mutually support and reinforce each other and the joint value of complementary resources is greater than the sum of their individual values (Barua

& Whinston, 1998). Building on theory of complementarities, it was believed that by commitment to implementation of all dimensions of LMS, Malaysian manufacturers may achieve an organization-wide commitment to LMS and build a strategic management perspective of leanness in their organizations. By the same logic, the researcher assumes that sustained business performance improvement necessitates the improvement of different dimensions of current business performance.

3.4 Summary

The conceptual framework for the research has been developed in the early stage of the model development process. 11 hypotheses have been developed in order to measure the relationships between the identified influencing factors, LMS dimensions and performance dimensions. The 11 hypotheses were listed as follows and in the next Chapter 4, the methodology for this research was discussed.

H1: Management leadership and commitment has a positive effect on the level of LMS Implementations.

H2: Empowerment of employees has a positive effect on the level of LMS Implementation.

H3: Employee involvement has a positive effect on the level of LMS implementation

H4: Training has a positive effect on the level of LMS implementation

H5: Teamwork involvement has a positive effect on the level of LMS implementation

H6: Human Resource Management involvement has a positive effect on the level of LMS implementation

H7: Customer Relationship Management has a positive effect on the level of LMS implementation

H8: Supplier Relationship Management has a positive effect on the level of LMS implementation

H9: Organizational Change has a positive effect on the level of LMS implementation

H10: Information Technology has a positive effect on the level of LMS implementation

H11: Lean Manufacturing Implementation has a positive effect on Business Performances

CHAPTER 4

RESEARCH METHODOLOGY

This Chapter discusses the methodology applied for this research. It describes the research approach and strategies to answer the research questions and steps taken by the researcher to accomplish the research objectives. The Chapter also aims to provide with detailed and sufficient information regarding the reliability and validity of the research method used.

4.1 Overview

The literature laid down in Chapter 2 suggests that numerous definitions of ‘methodology’ have been provided across different research disciplines. The following definitions “*a sequenced set of operations employed in performing a particular function such that, given a methodology, the function can be performed in a predictable and repeatable way” (Dube et al., 2011)*), or “*the processes, techniques, or approaches employed in the solution of a problem or in doing something: a particular procedure or set of procedures*” (Black, 1999) have been considered for this research. Accordingly, Figure 4.1 explains the methodology which has been applied in this research. Extensive literature has been reviewed in order to come up with the determinants of LMS implementation and the pros and cons of its implementation, especially for automotive industry in Malaysia. Some case studies have also been conducted among the companies producing parts for this industry in order to find out the LMS adaptability indices, relevant standards, and projecting the future goals and requirements. Alternatively, a model for LMS implementation has been developed for assessing full-blown implementation of LMS in those companies. The relevant tools, techniques, and relative analyses have been placed in this Chapter.

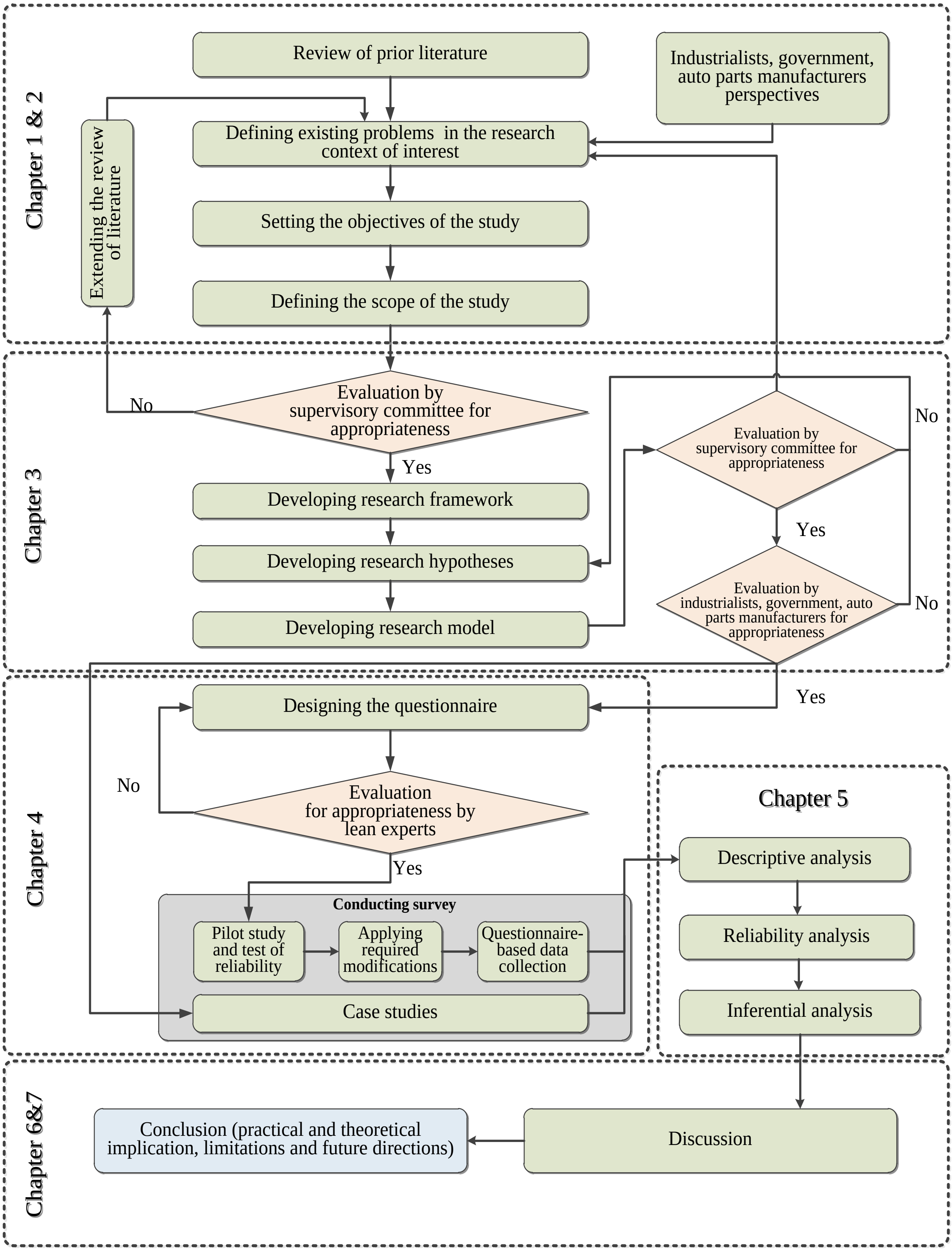


Figure 4.1: Research Methodology Decision Model

4.2 Research Design

The research design of this study offered adequate explanation of the study type (e.g., descriptive, correlational, or semi-experimental) and sub-type (e.g., cross-sectional or descriptive-longitudinal case study), research hypotheses, independent and dependent variables of the study, and data collection methods and statistical analysis approaches.

As the main objective of this work is to determine which of the factors identified within the literature affect the level of leanness in Malaysia automotive industries, as well as to investigate the relationships between implemented lean practices and performance improvement in this business, the purpose of this research can be described as mainly confirmatory research. In addition, since the aims of this study also is to seek explanations on how some chosen factors influence the LMS implementation decision behavior, this research can also be regarded as to some extent descriptive research.

Based on conventional perspectives and suggestions (Yin, 1994) to suit the research requirements, surveys and historical studies are found relevant for the descriptive phase, case studies are considered fit for the exploratory phase, and experiments are the sole method for explanatory or causal inquiries. However, more recent perspectives offered that these hierarchical perspectives are inaccurate, and each strategy can be applied for all exploratory, descriptive, or emancipatory research (Jaeger & Halliday, 1998; Stebbins, 2001). Since this research primarily aims to explain how a set of predetermined factors influence the level of LMS implementation and their relative usage, survey strategy was found appropriate for this purpose in order to see the views of a large number of practitioners, which indeed gives the researcher a scope of collecting data and information from a large number of experienced individuals. Thus, a survey strategy in this study was used to provide more general view of the LMS adoption. Additionally, it is imperative to explain that this research is mainly built on prior studies on LMS implementation, which were mainly conducted in developed countries. Given the potential cultural and industrial differences between developed countries and Malaysia, it can be assumed that prior LMS implementation models and identified factors may not fully capture the idiosyncrasies of LMS adoption by Malaysian automotive industry. Therefore, in addition to the large-scaled survey, case study strategy was also employed in this study as it could provide an ability to develop a detail and intensive knowledge on LMS implementation scenarios in a few Malaysian automotive parts manufacturers.

Keeping in mind that a research could be approached in either a qualitative or a quantitative method, whereas data would be considered quantitative if it was in numerical form and qualitative if the data was not in the form of measurable numbers as mentioned by Bernard (2000). As suggested by Taylor and Bogdan (1998), when there were few theoretical supports for a phenomenon under study, developing so-called precise hypotheses, operational definitions and research questions might not be feasible for this kind of study (Taylor & Bogdan, 1998). In such circumstance, qualitative research was taken as an appropriate method whereas it can be more exploratory in nature. However, quantitative approach is generally applied in researches with clearly stated hypotheses, which can be tested for acceptance or rejection (Stebbins, 2001). Through providing survey questionnaire that is having limited and particular choice of alternative answers, a quantitative method tries to explain the phenomenon from a broader perspective than qualitative approach (Bernard, 2000). Because there is a considerable literature on LMS implementation which leads this researcher to the development of a set of hypotheses under a conceptualized research models derived from validated items taken the currently available literature, results of this study could, however, be quantified. As a result, the researcher selected the quantitative approach for the survey part of the work because quantitative analysis of a large sample of enterprises was needed to test the hypotheses. This selection is consistent with the past and accepted researches on LMS implementation in different countries and manufacturing settings. They used quantitative approach to investigate this phenomenon e.g. (Shah & Ward, 2007; Fullerton & Wempe, 2009). Thus, by applying quantitative approach, the final analysis of this study and subsequently achieved results can be appropriately compared with the contemporary literatures. Additionally, using case studies in this research in part aims to gather a better in-depth understanding of LMS' implementations and usage application across the Malaysian automotive industry, this qualitative approach will be applied to gathered data and the interpreted via forming an impression and report the impression in both structured and a quantitative form.

4.3 Survey Administration

A survey is a tool of collecting information about a particular population by sampling some of its members, usually through a system of standardized questions. A standard paradigm generally used for survey administration suggested by prior researchers was used in this study (Churchill, 1979; Straub, 1989; Sethi & King, 1991). Figure 4.2 shows the research instrument development procedures used in this study. The procedures were divided into five steps; establishing domain of constructs, accumulating initial pools items, assessing adequacy of content, data collection and scale purification. All of these steps were explained in the following sections.

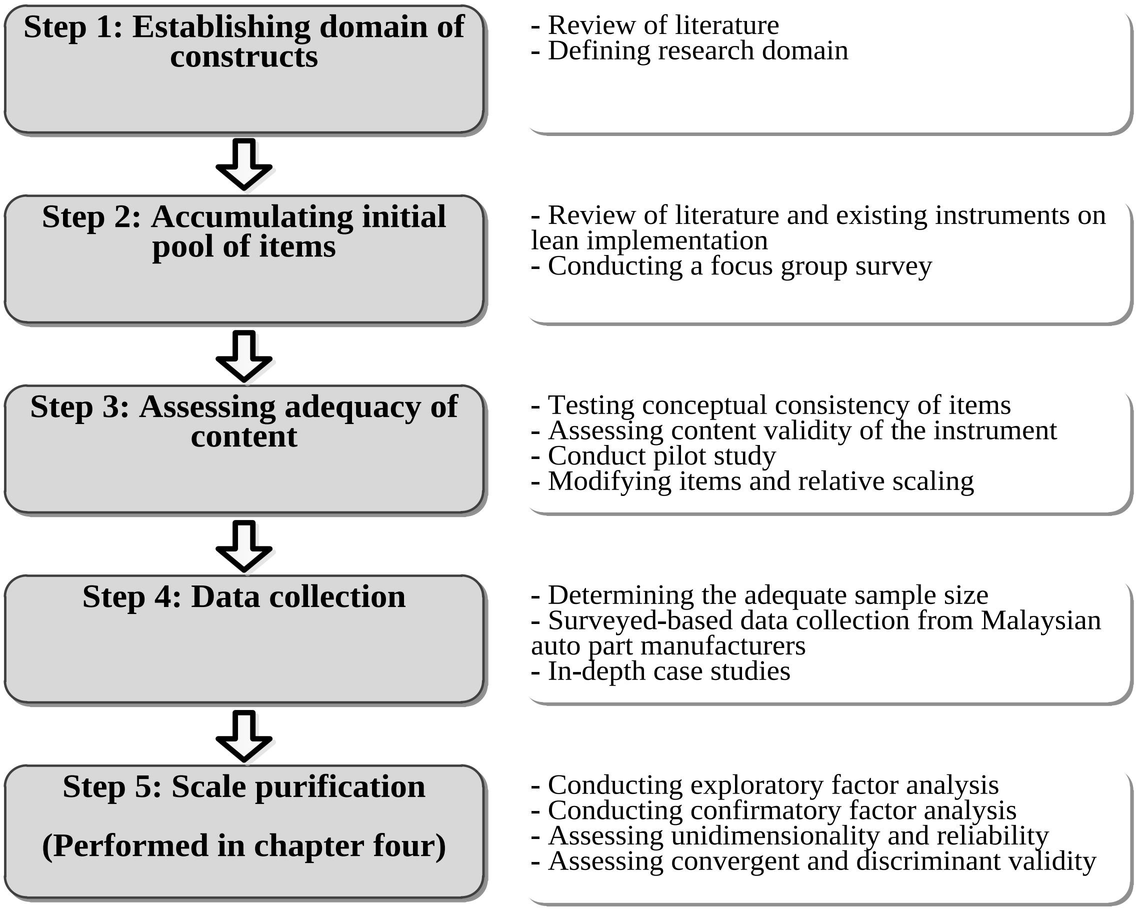


Figure 4.2: Research Instrument Development Procedures

4.3.1 Establishing the Domain of Constructs

At the first step, the domain of constructs used was identified. According to Churchill (1979), specifying the domain of the constructs is the very first step in the development of measures involved, thus, "*it is imperative . . . that researchers consult the literature when conceptualizing constructs and specifying domains*" (Churchill, 1979) - p. 67).Consistently, different categories of variables and their relevant items were accumulated based on the review of a large number of the relevant literature.

4.3.2 Accumulating Initial Pool of Items

At the second step, in order to establish the initial pool of items, an extensive review of literature was conducted to identify the existing instruments. Basically, the establishment of the initial pool of items in this study was adapted from the study that was conducted by Norani et al. (2010b) for the lean manufacturing implementation in Malaysian automotive industry. The questionnaire consists of 6 parts. The items in the main parts of section Conceiving LMS were adapted from Shah and Ward (2007) and Noraini et al. (2010b). The items in Business Performances were adapted from Fullerton and Wempe (2009) and Yang et al. (2011). Table 4.1 showed the lists sources from which majority of items were adapted.

Table 4.1: Previous Study used to Develop Initial Pool of Items

Variable	Source
Influencing factors	
Management Leadership and Commitment	Soriano and Forrester (2002), Worley and Doolen (2006).
Employees involvement	Flynn et al. (1999), Fullerton and Wempe (2009).
Empowerment of Employees	Babson (1995), Forrester (1995), Kumar and Motwani (1995), Ugboro and Obeng (2000).
Training	Brown et al. (1993), Flynn et al. (1999), Jayaram (1999)
Teamwork	Konecny and Thun (2011).
Human Resource Management	Jayaram (1999), Konecny and Thun (2011).
Customer Relationship Management	Bruce et al. (2004), Doolen and Hacker (2005), Moyano et al. (2012a).
Supplier Relationship Management	Doolen and Hacker (2005), Moyano et al. (2012a).
Organizational Change	Aladwani (2001), Motwani (2003), Smeds (1994).
Information Technology Infrastructure	Dowlatshahi and Cao (2006), Durmusoglu and Barczak (2011), Moyano et al. (2012b), Nambisan (2009).
Lean manufacturing dimensions	
JIT	Flynn et al. (1995a, b), Koufteros et al. (1998), Moyano et al. (2012a, b), Sakakibara et al. (1997), Soriano and Forrester (2002), Ward and Zhou (2006).
TPM	Dow et al. (1999), Moyano et al. (2012a, b), Shah and Ward (2007)
QM	Flynn et al. (1995a, b), Moyano et al. (2012), Sakakibara et al. (1997), Soriano and Forrester (2002).
PS	Shah and Ward (2003 and 2007), Sakakibara et al. (1993), Ward and Zhou (2006).
CI	Koufteros et al. (1998), Li et al. (2005), Shah and Ward (2003).
DCN	Ahmad et al. (2003), Cua et al. (2001), Flynn et al. (1995a, b), Shah and Ward (2003).
Business performance dimensions	
Waste reduction	Fullerton and Wempe (2009), Yang et al. (2011).
Financial performance	Fullerton and Wempe (2009), Yang et al. (2011).
Marketing performance	Konecny and Thun, (2011), Shah and Ward (2003), Yang et al. (2011).
Non-financial performance	Fullerton and Wempe (2009), Konecny and Thun, (2011), Shah and Ward (2003), Yang et al. (2011).
Operational performance	Fullerton and Wempe (2009), Konecny and Thun, (2011), Shah and Ward (2003).

Accordingly initial items that could capture the domain of the LMS implementation were extracted and a preliminary questionnaire was prepared. Subsequently, a focus group was established which included members of supervisory committee, academicians and four external experts (practitioners or LMS local experts from Malaysia Automotive Institute (MAI) and the automotive industry in Malaysia with high-level experience in the subject domain). These experts were therefore asked to assess the instruments for content validity purposes as well as to help identify any potential problems, ambiguity or unclear words in the questionnaire. The focus group was also asked to list additional variables and relative items that they thought were important in assessing LMS implementation phenomenon within the context of the Malaysian automotive industry.

4.3.3 Assessing Adequacy of Content

At the third step, and to ensure conceptual and content consistency of items, a group of academicians (3 academicians) who were familiar with the topic area, and a group of LMS practitioners (3 practitioners) from various automotive manufacturing companies evaluated the measurement items. This procedure of ensuring conceptual validity has been vastly used in the prior studies. After incorporating the suggested changes, the main questionnaire to assess the suggested research model were finalized and its main items are presented in Table 4.1. The student primarily tried to adapt items in Table 4.1 from validated existing scales of prior literature. Table 4.2 lists sources from which majority of items were adapted.

Table 4.2: Constructs of Dependent and Independent Variables[2] of Research Model of LMS Implementation

Constructs latent variables/ unobserved variables	**Coding**	**Measures/ indicators/ items**
Management and Leadership Commitment (ML)	ML1	Top management has set the clear policies in different areas of lean applications (set up time or change over time or lead time policy, inventory policies, building workers competency level policies, delivery, etc.)
	ML2	Top management inspires the employees for their total involvement to achieve the organization's mission, KRAs and goals. *
	ML3	Top management supports investment in the supporting manufacturing structure required for deployment of LMS
	ML4	Top management participates and is visibly involved in the lean manufacturing events and projects.
	ML5	Top management is committed to develop lean manufacturing programs via JIT, TQM, and TPM in the organization.
	ML6	Top management has chosen to adhere to lean principles in the face of short term operating objectives inconsistent with lean progress.*
Empowerment of Employees (EE)	EE1	The employees are free to allocate their time for doing improvement at workplace. (i.e. Kaizen activities, etc.).
	EE2	The employees have been given a broader range of tasks.*
	EE3	The employees have been given more planning responsibility.
	EE4	The employees get the foster trust values from the organization.
	EE5	The employees are encouraged to make day-to-day decisions at workplace to resolve problems.
Employee Involvement (EI)	EI1	There is employees' willful involvement in lean implementation activities.
	EI2	There is employees' spontaneous participation in decision making activities.
	EI3	There is employees' involvement in planning activities.*
	EI4	There is employees' sound involvement in continuous improvement activities.
	EI5	There is employees' involvement in problem solving activities.
Training (T)	T1	Organization sees training as an investment rather than a cost.
	T2	A training unit/department has been established for the purpose of organizing and conducting the training pertaining to lean manufacturing.
	T3	All levels within the organization received training pertaining to the lean manufacturing implementation.
	T4	All levels within the organization received training pertaining to the lean manufacturing tools and techniques*.
	T5	Training that changes employees' perspective towards lean manufacturing is given to the employees.*
	T6	Training that changes employees' understanding level towards lean manufacturing is given to the employees.
	T7	Employees are trained for multi-skill tasks.*

[2]In general, variables used in an experiment or survey research can be divided into two types namely *dependent variable* and *independent variable*. Dependent variable represents the output or effect, and is affected during the experiment. The independent variables however presumed as the inputs or causes. This means that dependent variable 'depends' on the independent variables, and in a model with casual relationships, the effect (arrow) is from independent variables to dependent variable. Accordingly, in this study, the nine potentially influencing factors (left side of the Figure 3.2) are independent variables, business (organizational) performance is the dependent variable, and LMS implantation can be considered as both dependent and independent variable.

'Table 4.2, continued'

Constructs latent variables/ unobserved variables	Coding	Measures/ indicators/ items
Teamwork (TW)	TW1	In our organization teams are formed to solve problems.
	TW2	In our organization many problems have been solved through team efforts.
	TW3	In our organization team members' opinions and ideas are considered in decision making.
	TW4	In our organization teams are responsible in continuous process improvement.
	TW5	In our organization team enjoys freedom to make decisions.*
	TW6	In our organization team leaders are elected by their own team co-workers.*
Human Resource Management (HRM)	HRM1	Employees are provided with long term employments (organization holds its employees for a long time and does not replace them shortly).
	HRM2	Employees' performance levels are defined and they are happy with that.
	HRM3	Employees are happy with the reward system.*
	HRM4	Employees are rewarded for making efforts for improvement initiatives (cost reduction, higher quality, etc.).
	HRM5	In our organization, there is a low rate of employee turnover during lean manufacturing implementation activities.
Customer Relationship Management (CRM)	CRM1	Our customers are directly involved in current and future product offerings.
	CRM2	Our customers are directly involved in our in quality programs.
	CRM3	Our customers are directly involved in the new product development process.
Supplier Relationships Management (SRM)	SRM1	We have corporate level communication on important issues with our key suppliers.
	SRM2	Our key suppliers manage our inventory.
	SRM3	Our suppliers are directly involved in the new product development process.
	SRM4	Our suppliers are directly involved in our quality improvement program.
Organizational Change (OC)	OC1	Our organization understands that for lean manufacturing a lot of changes are needed and changes are generally undertaken.
	OC2	Employees are motivated to embrace change as an opportunity rather than a threat.
	OC3	Our organization encourages an environment of lean thinking.
	OC4	Our organization strives to increase the responsiveness of all the employees for change.
Information Technology (IT)	IT1	In our organization, every employee uses information technology to have access to all the information he/she requires to perform daily tasks.
	IT2	In our organization, we are setting up advanced computerized manufacturing technology (e.g., CAD/CAM, Robots, EDI, CMMS, etc.)
	IT3	In our organization we use computerized process floor plan management (e.g., material flow in/out plans, space management)
	IT4	In our organization, information system and technology is used in visualizing and monitoring the project/process status, task listing, and controlling progress of workflows.
	IT5	In our organization, we use computerized plant layout management and control (e.g., locations of machines/tools, line configuration, safety staircase).*

‘Table 4.2, continued’

LMS (LMS) dimensions		
Just in Time (JIT)	JIT1	Our vendors/suppliers supply us on a just-in-time basis.
	JIT2	We have long-term arrangements with our suppliers.
	JIT3	We receive daily shipments from most vendors/suppliers.*
	JIT4	we constantly restructure manufacturing processes and layout to obtain process focus and streamlining (e.g., reorganize plant within-a-plant; cellular layout, etc.**
Total Preventive Maintenance (TPM)	TPM1	We use planning and scheduling strategies for maintenance activities.
	TPM2	We do preventive maintenance during non-productive time.
	TPM3	We keep records of routine maintenance.
	TPM4	In our organization, large numbers of equipment on shop floor are currently under 6σ.*
	TPM5	There is a separate shift, or part of a shift, reserved for preventive maintenance activities.*
	TPM6	We use overall equipment effectiveness (OEE) as one of our TPM"s improvement programs for our equipment productivity.
	TPM7	We use total effective equipment performance (TEEP) as one of our TPM"s improvement programs for our equipment productivity.
Quality Management (QM)	QM1	We use single minute exchange of dies (SMED) as one of our Quality Management's improvement programs for our productivity.
	QM2	In our organization, large numbers of processes on shop floor are currently under Statistical Process Control (SPC).
	QM3	In our organization, the statistical techniques are used extensively to reduce process variance.
	QM4	In our organization, the charts showing defect rates are used as tools on the shop-floor.*
	QM5	In our organization, the fishbone type diagrams are used to identify causes of quality problems*
	QM6	In our organization, we communicate quality specifications to suppliers.
Pull System (PS)	PS1	Production is ‘pulled’ by the shipment of finished goods.
	PS2	Production at stations is "pulled' by the current demand of the next stations.
	PS3	We use a pull system to control our production.
	PS4	We use a *Kanban* pull system for production control.
Continuous Improvement (CI)	CI1	Quality improvement is a high priority for us.
	CI2	Continuous improvement of quality is stressed in all work processes throughout our organization.
	CI3	We have formal continuous improvement/ KAIZEN program.
	CI4	All employees believe that it is their responsibility to improve quality in the organization.*
	CI5	All employees constantly work to improve quality.
	CI6	All employees, at different levels are rewarded for quality improvement.*
Design for Customer Needs (DCN)	DCN1	We are frequently in close contact with our customer.
	DCN2	Our customers frequently visit our plant.*
	DCN3	Our very important objective is to obtain satisfied customers.
	DCN4	Our customers give us feedback on quality and delivery performance.
	DCN5	Our customer requirements are thoroughly analyzed in the new product design process.
Business Performance (BP) Dimensions		
Waste Reduction (WR)	WR1	After implementation of lean manufacturing our overproduction level has decreased significantly.
	WR2	After implementation of lean manufacturing our under production level has decreased significantly.
	WR3	After implementation of lean manufacturing the chance for making the right products at the first time has decreased significantly.
	WR4	After implementation of lean manufacturing our defective product(s) rate(s) has decreased significantly.
	WR5	After implementation of lean manufacturing our non-value added activities have decreased significantly.

‘Table 4.2, continued’

Business Performance (BP) Dimensions		
Waste Reduction (WR)	WR6	After implementation of lean manufacturing our ability to get proper jigs, figures, tools (excess motion) has …..*
Financial Performance (FP)	FP1	Compared to 3 years ago, sales indicator of our organization has increased significantly.
	FP2	Compared to 3 years ago indicator market share indicator of our organization has increased significantly.
	FP3	Relative to our main competitor(s), our performance in term of sales indicator is much better.*
	FP4	Relative to our main competitor(s), our performance in term of market share indicator is much better.
Marketing Performance (MP)	MP1	Compared to 3 years ago, Return on Sales (ROS) indicator of our organization has increased significantly.
	MP2	Compared to 3 years ago indicator Return on Investment (ROI) indicator of our organization has increased significantly.
	MP3	Relative to our main competitor(s), our performance in term of Return on Sales (ROS) indicator is much better.*
	MP4	Relative to our main competitor(s), our performance in term of Return on Investment (ROI) indicator is much better.*
	MP5	Relative to our main competitor(s), satisfaction of customers with our products is much better.
	MP6	Relative to our main competitor(s), sale growth of our products is much better.
Non-Financial Performance (NFP)	NFP1	We produce the product/part ONLY whenever needed
	NFP2	We do not produce for inventory
	NFP3	We change the schedule as per needed*
	NFP4	Overall, all activities in a process are synchronized
	NFP5	We could establish continuous flow production system
	NFP6	Our workforces are knowledge (K-) workers*
	NFP7	We have the labor productivity as targeted
	NFP8	We attempted and reduced the paper work*
Operational Performances (OP)	OP1	We reduced the unit manufacturing cost as per desired.
	OP2	We achieved the overall/total productivity level as per desired.
	OP3	Our product quality conforms to target specifications.
	OP4	We deliver the product to our customer/client within the expected due dates.
	OP5	We standardized layouts/configurations for a variety of products.*
	OP6	Our system is ready to support customers for any related assistance (after sale service, new features, etc.) to an extent of *
*These items have been removed from the final model analysis due to low reliability. ** This questioned was modified after the pilot study.		

Each of items presented in Table 4.1 was measured using a five-point *Likert* scale. The literature suggests that the five-point *Likert* scale is generally used by researchers, although many psychometricians advocate using seven or nine levels. Dawes (2008) recently demonstrated that the 5- and 7-point scales produce the same mean score as each other, once they are rescaled. Assuming that 5-point scale is more logical to distinguish the level of occurrence of an item than a larger scale and it is easier for the respondents to read and answer, the five-point *Likert* scale was employed for all the items that aim to capture information on a range of variables of interest in this study.

In order for testing and assuring the face validity of the questions presented in Table 4.1, the questionnaire was piloted on 35 practitioner of LMS amongst automotive parts' manufacturers in Malaysia, which is considered as the preliminary evaluation of the final questionnaire. The pilot test was employed to test the feasibility and organizational structure of this research project. Based on the feedback from the pilot study, the questionnaire was refined to improve its clarity. The summarization of the questionnaire feedback is presented in Table 4.3.

Table 4.3: The Summarization of Feedback from Pilot Study

No	**Comments**	**Action**
1	General Comment The questionnaire set included more than 10 pages of required responses and was too lengthy. Respondents needed considerable amount of time to answer all questions.	A brief but impactful explanation was given to respondents on the significance of this study and how it attempts to investigate aspects of LMS in a more holistic approach and to evaluate the effectiveness of LMS implementations in Malaysia. The respondents then understood the importance of this study and why it needed to be undertaken. The issue of the questionnaire having too much questions was less of an issue during the data collection process.
2	All terms used were easy to understand and all of the questions were clear and to the point.	No Action required
3	As for question in Section B (JIT) "we constantly restructure manufacturing processes and layout to obtain process focus and streamlining (e.g., reorganize plant within-a-plant; cellular layout, etc)", the separation of the process and layout will give valuable feedback since the restructuring of manufacturing processes and restructuring of layout are 2 very distinct options.	The question was modified. The results of cronbach alpha also exemplified that this question was not clear in its requirement from the respondents. The question were modified to : *B1d:* We constantly restructure the manufacturing processes based on process/product needed; B1e: We continuously restructure manufacturing layout to obtain process focus and streamlining (this items has been removed from the final model analysis due to low reliability).

Internal consistency reliability is the most commonly applied measure of evaluating survey instruments and scales (Tan, et al., 2009; M. Ghobakhloo et al., 2011). After the pilot test and to assess the internal consistency reliability of each multi-item construct of questionnaire, Cronbach's Alpha (α) coefficients was assessed. Cronbach's Alpha (CA) is known as an internal consistency estimate for the reliability of test scores because it would generally increase as an inter-correlation among test items increases (Cronbach & Shavelson, 2004). Differences in values of alpha coefficient were tested by using the SPSS software (V. 20.0.0, 2011). Table 4.4 shows a commonly accepted rule of thumb for describing the internal consistency using CA (Cortina, 1993; (Cronbach & Shavelson, 2004)

Table 4.4: Internal Consistency Classification based on CA

(Source: Cortina, 1993; Cronbach and Shavelson, 2004)

Cronbach's alpha level	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable (but still considerable)
$0.6 > \alpha \geq 0.5$	Poor
$0.5 < \alpha$	Unacceptable

As suggested by Yurdugul (2008), a sample of more that 30 would be for the robust estimate of the population coefficient alpha (Yurdugul, 2008). Given that the sample size in the pilot study phase is 35, the efficient alpha can be used as the measure of internal consistency at the pilot test phase. The results of CA tests revealed that for Management Leadership and Leadership (ML), Organizational Change (OC), IT, DCN, WR, and OP the CA values were more than 0.9 which show the excellent internal consistency. Most variables however presented good internal consistency as for Employee Empowerment (EE), Employee Involvement (EI), Teamwork (TW), Supplier Relationship Management (SRM), TPM, PS, CI, MP, and NFP the CA values were between 0.8 and 0.9. Results of pilot study also suggested that training (T), Human

Resource Management (HRM), Customer Relationship Management (CRM), QM, and FP have acceptable internal consistency ($0.8 < \alpha \leq 0.7$), and only one variable titled 'JIT' provided questionable internal consistency with the alpha value of 0.663. The results of reliability analysis of the pilot study demonstrated that the questionnaire was appropriate and reliable for final data collection and only the variable 'JIT' should be revised before data collection to ensure its reliability. In order to revise the variable 'JIT' the relevant result (Table 3.4) was investigated in detail. The result suggested that item *B1d* in variable 'JIT' is the most problematic item as the alpha value would have increased to 0…. if item *B1d* was deleted. Regarding the item *B1d* "we constantly restructure manufacturing processes and layout to obtain the process focus and streamlining (e.g., reorganize plant within-a-plant; cellular layout, etc.)" and through interviews with some of participants in the pilot test, it was found that restructuring manufacturing processes and restructuring manufacturing layout are independent actions to achieve process focus and streamlining. In other words, an automotive parts manufacturer plans and employs either manufacturing processes or restructuring manufacturing or both to achieve process focus and streamlining. Accordingly, item *B1d* was slightly modified and divided into two different items in the final questionnaire: (The final questionnaire used is shown in Appendix A)

B1d: *We constantly restructure the manufacturing processes based on process/product needed;*

B1e: *We continuously restructure manufacturing layout to obtain process focus and streamlining* (this items has been removed from the final model analysis due to low reliability).

Table 4.5: Results of CA Test for JIT in Pilot Study Phase

Reliability Statistics				
Cronbach's Alpha	N of Items			
.663	4			

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B1a	9.7714	4.182	.375	.677
B1b	10.0857	3.198	.643	.500
B1c	10.0571	3.585	.607	.540
B1d	10.0286	3.911	.306	.738

4.3.4 Questionnaire Administration

The effort to obtain an accurate research data as well as a high response rate has been made in this study. The study was supported by MAI through a collaboration work. MAI is a government organization under the Ministry of Industry and International Trade (MITI) and the purpose and function of the establishment is as a focal point and coordination center for the development of Malaysian automotive industry inclusive of all related matters towards the automotive industry.

The population of automotive parts manufacturing companies was selected in this study. The database of the companies was obtained from 2010 Federation of Malaysian Manufacturers (FMM) and MAI directories. (Invitation letter for respondents and documents of cooperation with mentioned authorities are provided in Appendix B). Automotive industry has about 400 (from the stated databases) companies and the questionnaire sets were distributed to 350 companies which have been or were expected to be actively engaged in LMS through two types of distribution methods:

1. Distributed directly through seminar series and workshop sessions organized by MAI;
2. Distributed directly through “drop off and collect” mode.

In order to obtain inaccurate and unbiased data, the multiple key informant technique has been used in the process of data collection. The questionnaire was targeted to be responded or answered by the persons who were in charged with different LMS implementation activities throughout the organization. The main target types of respondents were from Managing Directors, Manufacturing Managers, Operation Managers and appropriate personnel, who were directly involved and familiar with the LMS implementation activities within the firm. Finally, follow up activities were conducted via email reminders and telephone calls to encourage informants to fill up the questionnaire (Tanriverdi, 2005). The overall process of data collection was explained in Figure 4.3.

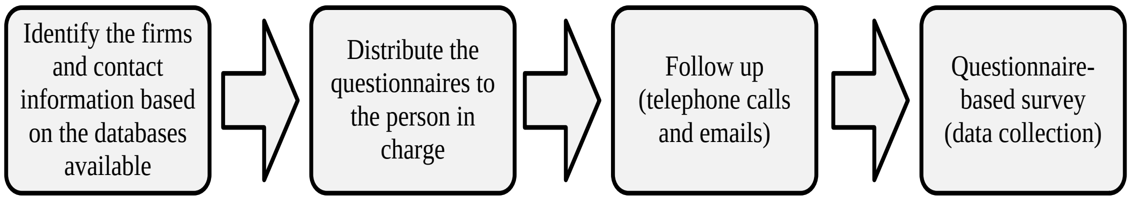


Figure 4.3: The Overall Process of Questionnaire-based Data Collection

4.3.5 Determining the adequacy of Sampling

Given that the research model of this study would be analyzed using the Structural Equation Modeling (SEM) and SPSS techniques, thus, the sample size had to be fitted with this technique. Determining an appropriate sample size for SEM is not an easy task. Although there are a number of rules of thumb in estimating the sample size, however, many of them do not have very firm scientific foundation In general, an appropriate sample size is needed for offering unbiased parameter estimates and accurate model fit information for SEM model is contingent upon model specifications, such as model size and complexity (Vinodh & Joy, 2012)

The literature suggests that the most common rule of thumb is that the minimum sample size should be no less than 200 (Vinodh & Joy, 2012). MacCallum et al., (1996) however argues that the vague, folklore rule of thumb suggesting the requisite sample size as e.g., "*n* >200" are relatively conservative because SEM models can perform well, even with a smaller samples such as n = 50 to 100 (MacCallum et al., 1996; Goodhue et al., 2006).

Anderson and Gerbing (1988 , pp.170 – 171) suggested that in reducing the bias and just getting the model to run, with "three or more indicators per factor, a sample size of 100 will usually be sufficient for convergence," and a sample size of 150 " will usually be sufficient for a convergent and proper solution" (Anderson & Gerbing, 1988)

Another stream of statistical research (McQuitty, 2004; Christopher, 2010) suggests that the exact minimum sample size required for SEM should be calculated in order to achieve a desired level of statistical power with a given model prior to data collection. However, majority of prior studies have adhered to the rule of thumb of 'critical sample size' of 200.

Because there is no definite method of determining the sample size for research using SEM model, and given that SEM is a large sample technique (Shah & Goldstein, 2006), this study adheres to the conservative rule of thumb of 'critical sample size' of 200. Having the sample of more than 200 will satisfy most of rules of thumb within prior literature.

4.3.6 Scale validation

Given all the constructs of this study are reflective, and the preferred method of data analysis is Structural equation modeling (SEM), the researcher follows the validation guidelines provided by Jarvis et al, (2003), and Straub et al. (2004). Accordingly, the assessment of reflective measurement model in this study involves the test of unidimensionality, internal consistency reliability, indicator reliability, convergent validity, and discriminant validity through performing standard decision rules. At this stage, the research needs to explain that when measuring and analyzing a model with multidimensional construct, two different strategies can be employed. The first strategy is to directly put all the first-order and second-order constructs to a single measurement model and run the analysis (Rai et al., 2006). This method is mostly applicable for simple models with only few constructs. The second strategy, which is a common practice among researchers (Petter et al., 2007) is to collapse the sub-construct items into a one-dimensional construct (Vijande et al., 2012). In this approach, and using the second-order Confirmatory Factor Analysis (CFA) for second-order constructs. After confirming the validity of second-order constructs, the second-order items are collapsed into a one-dimensional construct, and finally, the first-order CFA is performed as an assessment of the measurement model. This strategy is mostly suited for complex models with many first order constructs. The researcher believes that the second strategy of dealing with measurement model analysis is the appropriate strategy for this research because it is clear from Figure 3.2 that the research model of this model is very complex indeed as it includes 22 first-orders constructs. The researcher's decision to use the second strategy is consistent with the recommendation by Hair et al. (2006) measurement model may need to be modified in order to improve the fit because complex models with many constructs increases the number of parameters measured, and thus decreases the fitness of the model. Accordingly, the test of measurement model in this study involves two second-order CFA for dimensions of LMS implementation and business performance and one final first-order CFA (Hair et al., 2006). The process of performing measurement model analysis in explained in the decision model depicted in Figure 4.4.

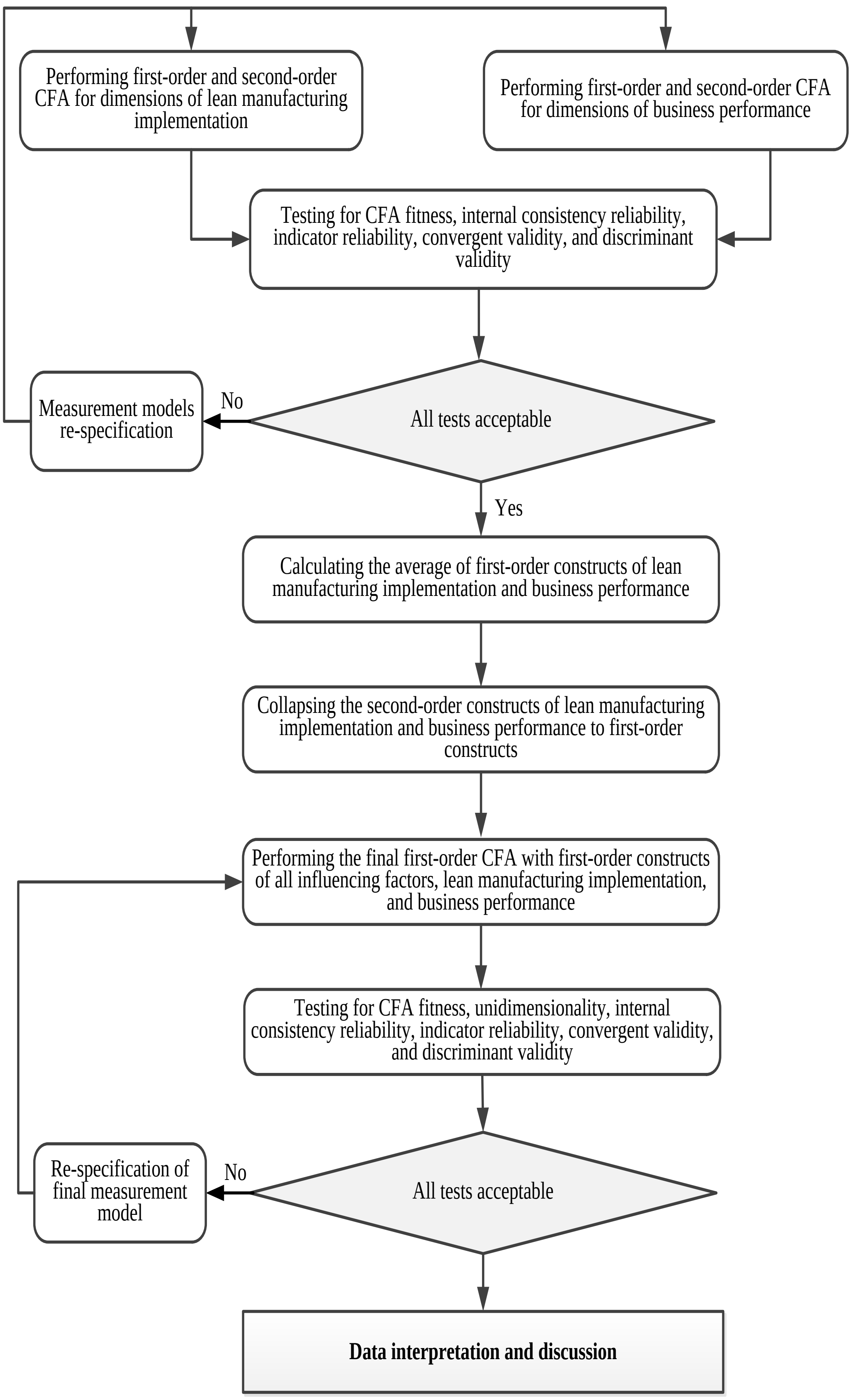


Figure 4.4: Process of Performing Measurement Model Analysis

4.4 Data Analysis Method and Validity Confirmation

As mentioned in section 4.3.6, the first preferred method of data analysis in this study is SEM, which is a tool for analyzing multivariate data that has been long known in operation management to be especially appropriate for theory testing. Structural equation models go beyond ordinary regression models to incorporate multiple independent and dependent variables as well as hypothetical latent constructs that clusters of observed variables might represent (Ho et al., 2006). They also provide a way to test the specified set of relationships among observed and latent variables as a whole, and allow theory testing even when experiments are not possible (Hair et al., 2006). As a result, these methods have become ubiquitous in all the social and behavioral sciences (Petter et al., 2007). This study aims to predict the relationships between a group of potentially influential factors, LMS, and business performance. As the most common analysis method, the hypothesized model testing via path analysis can be carried out with the conventional multiple regression technique. This means that path coefficients can be estimated by regressing the endogenous variable (10 influencing factors in this study) on to the exogenous variables (LMS and business performance), and then repeating the procedure by treating the exogenous variables as endogenous variables. The recent literature however argues that this method is typically piecemeal in nature and does not provide information regarding the hypothesized model's goodness-of-fit (Hair et al., 2006; Ho et al., 2006). Without information about the model's goodness-of-fit, it is difficult to assess the adequacy of the theory underlying the hypothesized model. SEM, on the other hand, is able to estimate the multiple and interrelated dependence relationships simultaneously since it tests the model as a whole, rather than in a piecemeal fashion. Therefore, statistics can be calculated to show the goodness-of-fit of the data to the hypothesized model (Petter et al., 2007). Using SEM will provide the student with following unique advantages (Hair et al., 2006; Ho et al., 2006; Petter et al., 2007):

Validity: Theories in the operation/management/social sciences frequently refer to variables (constructs) that cannot directly be observed (e.g., business performance), but that can only be inferred from observable variables (indicator variables). To operationalize these constructs, often many different variables come into consideration, and none of them may provide an optimal operationalization on its own. SEM however allows to make use of several indicator variables per construct simultaneously, which leads to more valid conclusions on the construct level. Using other methods of analysis would often result in less clear conclusions, and/or would require several separate analyses.

Reliability/measurement error: Data in survey research frequently contain a non-negligible amount of measurement error. SEM can take measurement error into account by explicitly including measurement error variables that correspond to the measurement error portions of observed variables. Therefore, conclusions about relationships between constructs are not biased by measurement error, and are equivalent to relationships between variables of perfect reliability.

Model complexity: Theories in the operation and management sciences frequently involve complex patterns of relationships or differences between a multitude of variables, conditions or groups (e.g., the research model of the study presented in Figure 3.2). SEM allows to model and test complex patterns of relationships, including a multitude of hypotheses simultaneously as a whole (including mean structures and group comparisons). Using other methods of analysis, this would frequently require several separate analyses.

Confirmatory approach: For hypotheses testing, simple statistical procedures usually provide tests on the basis of explained variance in single criterion variables. This is inappropriate for evaluating complex models containing a multitude of variables and relationships. In contrast, SEM allows to test complex models for their compatibility with the data in their entirety, and allows to test specific assumptions about parameters (e.g., that they equal zero, or that they are identical to each other) for their compatibility with the data.

The second data analysis technique used in this study is Multivariate Analysis of Variance (MANOVA). MANOVA is the multivariate form of the Analysis of Variance (ANOVA). ANOVA is a group of statistical models used to analyze the differences between group means and their associated procedures, in which the observed variance in a particular variable is partitioned into components attributable to different sources of variation (Iversen and Norpoth, 1987). In its simplest form, ANOVA provides a statistical test of whether or not the means of several groups are all equal, and therefore generalizes t-test to more than two groups. The MANOVA on the other hand is used to determine whether there are any differences between independent groups on more than one continuous dependent variable (Weinfurt, 1995). In this regard, it differs from an ANOVA, which only measures one dependent variable. It is imperative to understand that the MANOVA is an omnibus test statistic and cannot indicate which specific groups were significantly different from each other. Rather, and similar to performing multiple ANOVA, it only indicate that at least two groups were different. On the other word, MANOVA is simply equal to performing multiple ANOVA through performing only a single test.

4.4.1 Structural Equation Modeling Software

There are several software packages which can be used to perform an SEM. The student believes that the Amos software from IBM is the most suited software for performing SEM in this particular study. Amos integrates an easy-to-use graphical interface with an advanced computing engine for SEM. The publication-quality path diagrams of Amos provide a clear representation of models for students and fellow researchers. The numeric methods implemented in Amos are among the most effective and reliable available. Amos goes well beyond the usual capabilities found in other SEM programs. When confronted with missing data, Amos performs state-of-the-art estimation by full information maximum likelihood instead of relying on ad-hoc methods like listwise or pairwise deletion, or mean imputation.

Multiple models can be fitted in a single analysis. Amos examines every pair of models in which one model can be obtained by placing restrictions on the parameters of the other. The program reports several statistics appropriate for comparing such models. It provides a test of univariate normality for each observed variable as well as a test of multivariate normality and attempts to detect outliers. IBM Amos accepts a path diagram as a model specification and displays parameter estimates graphically on a path diagram. Path diagrams used for model specification and those that display parameter estimates are of presentation quality. They can be printed directly or imported into other applications such as word processors, desktop publishing programs, and general-purpose graphics programs. Review of prior studies on LMS implementation reveals that SEM (particularly conducted with Amos) is one of the most preferred methods of data analysis. Accordingly, the proposed research model and data collected were analyzed using SEM conducted with Amos (v20.0.0).

Table 4.6: Popularity of SEM in Lean Manufacturing Research Stream

Authors	Scope of research	Analysis method used
Fullerton and Wempe (2009)	Relationship between different dimensions of LMS and business performance.	1. SEM (with AMOS) for the assessment of proposed research model; 2. ANOVA (SPSS) for assessment of survivorship bias.
Yang et al. (2011)	Relationship between LMS, *environmental management practices* and business performance.	SEM (with AMOS) for the assessment of proposed research model.
Ward and Zhou (2006)	Relationship between-firm IT integration, lean/JIT practices, and customer lead time.	SEM (with LISREL[3]) for the assessment of proposed research model.
Inman et al. (20011)	Relationship between JIT, agile manufacturing and business performance.	1. SEM (with LISREL) for the assessment of proposed research model. 2. ANOVA (SPSS) for assessment of non-response bias.
Jabbour et al. (2013)	Relationship between LMS, human resources management and business performance.	SEM (PLS) for the assessment of proposed research model.
Boyle and Scherrer-Rathje (2009)	Identifying the best practices (e.g., lean manufacturing) managers use to improve manufacturing flexibility.	- MANOVA to determine any industry differences in the importance and use of the flexibility types; - MANOVA to identify if any differences exist in the importance of the different practices across the industries.
York and Miree (2004)	Relationship between TQM and business performance.	MANOVA to identify if any differences exist in the different dimensions of financial performance in term of different TQM-related metrics.

4.4.2 Validation of SEM

In general, SEM consists of two parts namely ‘the measurement model’ and ‘the structural equation model’. The measurement model specifies the rules governing how the latent variables are measured in terms of the observed variables, and it describes the measurement properties of the observed variables. That is, measurement models are concerned with the relations between observed and latent variables (Fornell and Larcker, 1981). Such models specify hypotheses about the relations between a set of observed variables, such as ratings or questionnaire items, and the unobserved variables or constructs they were designed to measure. The measurement model is important as it provides a test for the reliability of the observed variables employed to measure the latent variables (Hair et al., 2006). A measurement model that offers a poor fit to the

[3] Both AMOS and LISREL produce almost identical results because both use maximum likelihood estimation as the default estimation method. The student preferred Amos due to its many advantages over LISREL, e.g., more user-friendliness.

data suggests that at least some of the observed indicator variables are unreliable, and precludes the researcher from moving to the analysis of the structural model. The structural model however is of greater interest to the scholars as it offers a direct test of the theory of interest. Structural model incorporates the strengths of multiple regression analysis, factor analysis, and multivariate ANOVA (MANOVA) in a single model that can be evaluated statistically. Moreover, it permits directional predictions among a set of independent or a set of dependent variables, and it permits modeling of indirect effects (Ho et al., 2006). As recommended by Hair et al. (2006, p.734), performing a successful SEM entails a six-stage decision process:

1. Defining individual constructs;
2. Developing the overall measurement model;
3. Designing a study to produce empirical results;
4. Assessing the measurement model validity;
5. Specifying the structural model;
6. Assessing structural model validity.

The previous literature on statistical analysis recommends that the validity and robustness of the hypothesized model is adequately provided when the validly of both measurement model and structural model are ensured (e.g., Fornell and Larcker, 1981; Hair et al., 2006; Petter et al., 2007), which is particularly done by performing steps 4 and 6. The review of previous studies on LMS which offered structural equation models for studying implementation of lean manufacturing shows that studies by Fullerton and Wempe (2009), Inman et al. (2011), Jabbour et al. (2013), Shah and Ward (2003, 2007), Ward and Zhou (2006) and Yang et al. (2011) – as leading studies on LMS – merely performed steps 4 and 6 to demonstrate the validity and reliability of their proposed models. Accordingly, the students followed the widely accepted method of validating

SEM and assessed and ensured the validity of all measurement and structural model of the study.

4.4.2.1 Measurement and Structural Model Validity

The analysis of the measurement model is performed via CFA. The objective of CFA is to test whether the data fit a hypothesized measurement model. Model fit measures (goodness-of-fit indices/measures) could then be obtained to assess how well the proposed model captured the covariance between all the items or measures in the model. Absolute fit measures, incremental fit measures, and parsimonious fit measures are three main classes of goodness-of-fit measures (Hair, et al., 2006; Ho, 2006), which are briefly explained in the following:

- Absolute fit measures assess the extent to which the proposed measurement model predicts the observed covariance matrix. Root Mean Square Error of Approximation (RMSEA), chi-square statistic, Root Mean Square Residuals (RMR), and standardized RMR (SRMR) are among commonly used measures of absolute fit.
- Incremental fit measures compare the proposed model to some baseline model. This baseline model is usually referred to as the *independence* or *null* model. Comparative Fit Index (CFI), Goodness-of-Fit Index (GFI), Incremental Fit Index (IFI), Normed Fit Index (NFI), Relative Fit Index (RFI), and Tucker-Lewis Index (TLI) are the most commonly used measures of incremental fit. Despite some differences in methods of calculations, they indicate the improvement achieved by a proposed model over the independence model.
- Parsimonious fit measures which identify whether model fit has been achieved by “overfitting” the data with too many coefficients. Parsimonious fit measures are primarily used to compare models on the basis of some criteria that take parsimony as well into account.

To reach the conclusion that the CFA analysis using Amos itself is fit, the CFA should provide good results regarding goodness-of-fit indices explained above. It is imperative to notice that many golden rules for assessment of model fit have been provided by prior scholars. However, the review of literature (Stevens, 1996; Raykov, 1998; Bryne, 2001; Seyal et al., 2002; Hair, et al., 2006; Ho, 2006; J. H. Wu & Wang, 2006; Hsu & Lin, 2008) suggests that the most commonly used of existing rules are:

- RMSEA < 0.08;
- X^2/d.f (chi-square statistic or CMIN/DF) any value between 1 and 2;
- RMR and SRMR < 0.05;
- CFI, IFI, and TLI > 0.9 acceptable, and > 0.95 satisfactory;
- GFI, NFI, and RFI > 0.8 acceptable, and > 0.9 satisfactory.

At the next step and after conforming that all the goodness-of-fit indices meet to their thresholds, all the measurement models should have acceptable unidimensionality, internal consistency reliability, indicator reliability, convergent validity, and discriminant validity, as other key indices of measurement model validity:

Unidimensionality refers to a latent variable's property of having each of its measurement items relate to it better than to any others (Gerbing & Anderson, 1988) Although AMOS cannot directly measure unidimensionality, however, it can be analyzed using an Exploratory Factor Analysis (EFA) (Urbach et al., 2009). EFA enables us to test whether the measurement items converge in the corresponding constructs that each item loads with a high coefficient on only one factor and this factor is the same for all items that are supposed to measure it. In this study, EFA is performed using SPSS V.20.0.0. This test is done only once for the final CFA and after collapsing second-order constructs of LMS implementation and business performance to first-order constructs.

Internal consistency reliability generally refers to the extent to which all of the items (indicators) on a (sub) construct measure that underlying construct of interest (Hair, et al., 2006). Cronbach's alpha (CA) is the most widely used measure of internal consistency reliability. Despite popularity, CA suffers form few deficiencies. Thus, composite reliability (Werts et al., 1974) is regarded as an alternative measure of internal consistency reliability to CA, which was recommended by Chin (1998) as the preferred measure because it overcomes some of Cronbach's alpha's weaknesses. To ensure the acceptable and satisfactory internal consistency reliability, both CA and CR should pass the generally recommended minimum of 0.70 (Fornell & Bookstein, 1982). To assess CA for different variables of the study SPSS V.20 is used. Neither AMOS nor SPSS can conclude CR, thus, the student calculates CR values manually using the following formula (Hair et al., 2006. P. 777).

Indicator reliability is defined as "the extent to which a variable or set of variables is consistent regarding what it intends to measure" (Urbach et al., 2010, p. 192). In this study indicator reliability is determined using CFA with SEM, with the numbers of factors specified a priori. As recommended by Chin (1998), factors items with a loading of 0.70 and above are considered as reliable.

Convergent validity tests how well individual items reflecting a construct converge compared to items measuring different constructs (N. Urbach et al., 2010). According to Fornell and Larcker (1981) convergent validity is adequate when constructs have an Average Variance Extracted (AVE) of at least 0.5. AMOS does not directly calculate AVE, thus, AVE values should be calculated using following formula (Fornell & Larcker, 1981);

AVE = (sum of squared standardized loading) / (sum of squared standardized loading + sum of indicator measurement error)

Discriminant validity relates to the degree to which a given construct is different from other constructs (John & Reve, 1982). Accordingly, discriminant validity examines whether the items do not unintentionally measure something else (Urbach, et al., 2010). Chin (1998) explains that the AVE from the construct should be greater than the variance shared between the construct and other constructs in the model. In other words, if the square root of the AVE for a construct is greater than its correlations with other latent construct, then, the construct is considered to be distinct from other construct (Barclay et al., 1995).

Once the validity of all the measurement models in the study are ensured, the validity of the final structural model should also be examined. To ensure the validity of final structural model, all the steps explained above should be followed.

4.5 Case Studies Design

The case study research allows the researcher to understand the nature and complexity of the process of interest taking place. Accordingly, the value of combining different research methods in operation research discipline has received significant recent attention (Voss et al., 2002).

To account for the potential limitation of the survey conducted in this study, the case studies were conducted as the complementary method of studying the hypothesized relationships. Accordingly, the case study concept was described as an explorative and more specific study which investigates a contemporary phenomenon within a real–life context (Ebrahim, 2012). In an attempt to understand the actual implementation of LMS in the automotive parts manufacturing in Malaysia, and to study whether full-blown LMS implementation is associated with higher levels of business performance improvement, two case studies were conducted through a structured interview and direct observation approaches. The lists of companies that actively involved in implementation of LMS were obtained from MAI under their Lean Production System Program. The invitations to participate in the case study were sent to several companies. From the point of research adequacy, confidentiality and time constraint issues, only two companies were selected based on their interest and willingness to participate in implementation of LMS activities and agreed to share information on their LMS implementation journey.

The case studies were conducted by asking the relevant questions through a structured interview approach with the key personnel whom were responsible for LMS implementation. In these studies, a general manager or senior production manager were found as the responsible persons for LMS implementation in their respective companies. The questions were focused on several issues that are considered to be important when implementing LMS such as the adoption approach used by the organizations, the application of LMS tools and techniques, the effects of LMS, and the methods to overcome its barriers. Besides interviews, observations on the documents supplied and visits to the companies were made. The real life cases provided a platform where the implementation processes and experiences could be shared and mimicked by other manufacturing companies. Experiences that specifically contributed to LMS implementations that would be highly beneficial to other companies as well were also taken into account. The outcomes of the case studies are presented in Chapter 5.

4.6 Summary

Overall, this chapter defines and strives to explain the methodology being used in order to prepare this research accordingly and refined with topic details including the proposal of research hypotheses and conceptual model development; research design; questionnaire development, administration and data consolidation; case studies design, aim and evaluation parameters. Results Analysis and Discussion will be further discussed in Chapter 5 and Chapter 6.

CHAPTER 5

RESULTS AND ANALYSIS

This chapter presents the data analysis and results of the research. Through an empirical study of this information, a clear notion of the industry level with regards to lean implementations is presented. Descriptive statistics from the data analysis, including the demographic profile, lean benefits and barriers (perceived) by respondents, current LMS implementation levels versus expected future levels and current performance level versus future expected performance, and other study variables is in the first part. The second part discusses the results of the Structural Equation Modeling (SEM) technique analysis using the AMOS software.

5.1 Overview

After discussing an overview of the research methodology used to test the proposed research model in the previous chapter, this chapter presents the data analyses and discusses the results. First, the results of some descriptive analyses are presented to describe the empirical data of the study. Next, by using SEM, the measurement model validation is presented. This is followed by the structural path analysis and hypothesis testing. Finally, the relationships between different dimensions of LMS implementation and five sub-dimensions of business performance are analyzed in detail using several tests of multivariate analysis of variance. Different statistical techniques used for data analysis in this research are shown in Figure 5.1.

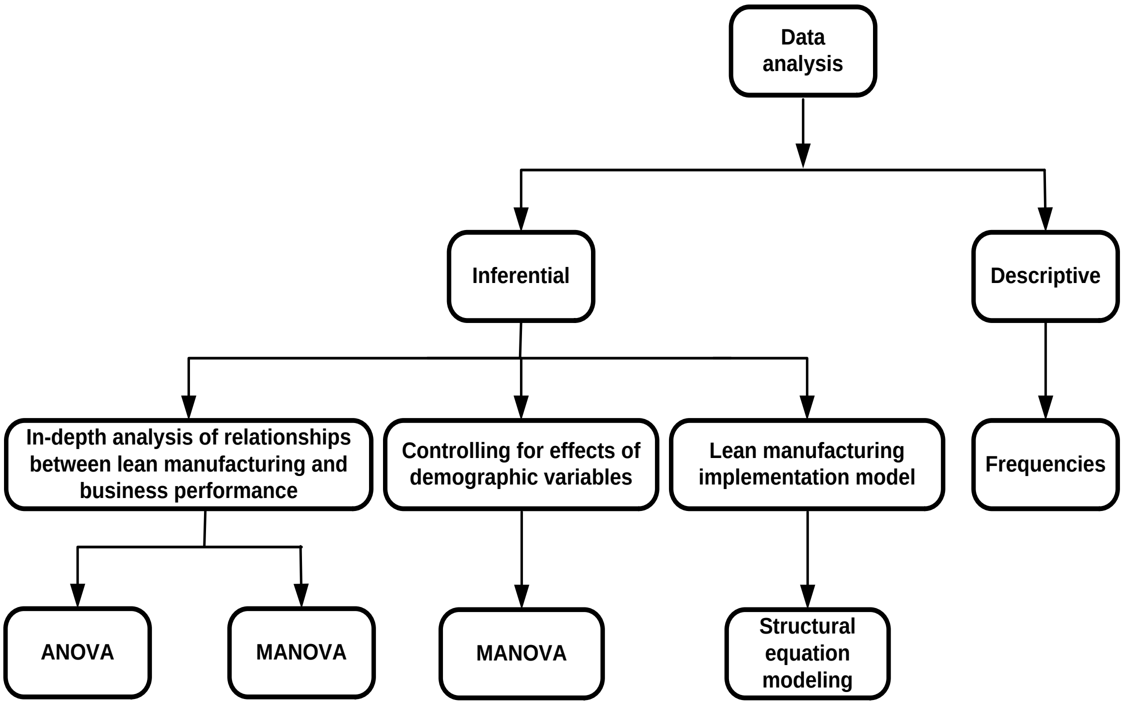


Figure 5.1: Statistical Analysis Conducted throughout the Study

5.2 Descriptive Statistics

As mentioned earlier that for this study data was collected using a questionnaire-based survey conducted between May and October 2012. The total number of completed responses was 204 (about 58.3 percent of responses received). For the research model to be analyzed using the SEM technique, this sample size should be adequate according to established literatures. The most common rule of thumb suggest that a reasonable sample size should be about 200 e.g., (Hair, et al., 2006). Therefore, the sample size for study meets this rule of thumb for SEM analysis. All businesses surveyed in this study are the Malaysian automotive part manufacturers that are located within Peninsular Malaysia. Table 5.1 presents the demographic information of the sample surveyed for the study.

Table 5.1: Demographics Information of the Surveyed Automotive Parts Companies.

Measure	Items	Frequency	Percent %
Firm maturity (years of establishment)	Below 5	29	14.22
	5-10	56	27.45
	10-15	59	28.92
	15-20	43	21.08
	20 and above	17	8.33
Business size (number of employees)	Below 50	3	1.5
	51-150	59	28.9
	151-250	78	38.2
	250 and above	64	31.4
Ownership	100% Local	123	60.3
	100% Foreign	18	8.8
	Mostly local	58	28.4
	Mostly foreign	5	2.5
New products introduced per year	1-3	123	60.29
	4-6	50	24.51
	7-9	20	9.80
	More than 10	11	5.40
Involved in LMS	Less than 1 year	50	24.51
	1-3 years	95	46.57
	3-5 years	46	22.55
	More 5 years	13	6.37
Number of product produced	1-5	45	22.06
	6-10	30	14.72
	11-15	39	19.12
	More than 15	90	44.10
Perceived understanding of lean manufacturing	Very Little	22	9.78
	Little	126	61.76
	Moderately	53	25.98
	Much	3	1.48
Target market (supplied to)	100% local market	88	43.14
	100% foreign market	1	0.49
	Mix market but mostly local	91	44.61
	Mix market but mostly foreign	24	11.76
Perceived level of lean implementation	Very Little	8	3.92
	Little	16	7.84
	Moderately	147	72.06
	Much	33	16.18

Table 5.1 presents the demographic information of the sample surveyed for the study. Most of the firms in Malaysia (about 58 percent) have been established for about 10 years and above in their respective products. Therefore, as a state-of-the-art manufacturing system, LMS features are expected to be known to them. Firms that have

been established longer (between 10-20 years from establishment date) were the majority in this survey sample. Medium sized companies was only the third largest group surveyed, defined with having 51-150 employees it constituted roughly 29 percent of total respondents, the majority came from larger companies numbered at 142 firms or 70 percent. Longer times of establishment and larger establishments could probably mean a higher exposure to LMS and its factors, but it is not a definite guarantee. 60 percent were locally-owned and 28 percent had locals as majority shares or owners. Companies that introduces about 1-3 new products per year are the most represented here, those that have been involved with LMS of between 1-3 years (47 percent) and 3-5 years (23 percent) represented the most number. It highlights that domestic automotive manufacturing companies mostly had less than 5 years of LMS experience. On the other hand, a majority of them produced product ranges of more than 15 items (63 percent).

Surprisingly, when the questionnaire asked about their lean understanding (perceived), the respondents revealed that only having a little (62 percent) and moderate (26 percent) grasp of LMS, it correlates with the earlier statement of the majority having less than 5 years of handling LMS at the workplace. Most of these companies support the local demand with only 12 percent supplying to outside markets, this is not surprising as most of these manufacturers supply to the two big automotive producers in Malaysia. As to their knowledge on lean implementation (perceived), many answered that moderate to high levels of on-going implementations were already in place; moderate (72 percent), high (16 percent).

5.2.1 Perceived Benefits of LMS

Two of the more important aspects to describe the data are *perceived benefits of lean manufacturing* and *perceived barriers* to *lean manufacturing implementation* among Malaysian automotive part manufacturers,

The automotive industry in Malaysia believe that through LMS implementation, the companies or firms will gain few of advantages. Based on this analysis, the main benefit of LMS is it reduces inventory, using only half of the resources to produce the same amount of output. Having the highest mean value (4.2) indicates that respondent realizes that inventory management and control is important. With leaner process flow the time delivery to customer should be shorter, as in any other product, quicker delivery means higher sales turnaround. LMS also requires product having quality, because quality equates value to customers, if perceived quality is evident a company remains competitive relative to their competitors. So, the other factors here like meeting customer demands and fulfilling customer directives is relatable to quality level mentioned earlier, eventually it should improve long term cost and leads to improved profit margin level of the company. The respondents here believe that by implementation of LMS, it would be beneficial for their organization. Table 5.2 suggests that respondents of this study generally believe that implementation of LMS would be considerably beneficial.

Table 5.2: Perceived Benefits of LMS Implementation

	Mean	Std. Deviation	Variance
Lean manufacturing reduces inventory.	4.431	0.628	0.394
Lean manufacturing reduces the delivery time of finish goods to customers	4.387	0.605	0.367
Lean manufacturing improves long term quality competitiveness	4.289	0.595	0.354
Lean manufacturing meets customer demand.	4.132	0.601	0.362
Lean manufacturing improve overall profit margin of companies	4.074	0.619	0.384

'Table 5.2, continued.'

	Mean	Std. Deviation	Variance
Lean manufacturing improves the competitiveness level /gap with the competitors	4.049	0.585	0.342
Lean manufacturing fulfills customer directives	3.980	0.612	0.374
Lean manufacturing improves long term cost competitiveness	3.897	0.607	0.369

5.2.2 Perceived Barriers to LMS Implementation

Although the Malaysian automotive part manufacturers realized about the advantage gain by implementing LMS in their companies, there are also some barriers that prevent the implementation of LMS in their organization. In Table 5.3, the perceived barriers of LMS implementation in Malaysian automotive industry have been identified. It shows a lower mean score as compared to the previous table (Table 5.2), unstable customer order, supplier delay on parts delivery and poor quality of supplied parts, are asking of barriers identified in LMS as customer relationship management (CRM) and supplier relationship management (SRM). The rest relates more to internal organizational factors like management commitment, work-culture, employee training, employee involvement, all of which are LMS factors, but does not seem to hinder its implementation according to the respondents.

Table 5.3: Perceived Barriers to LMS Implementation

	Mean	Std. Deviation	Variance
There is an unstable customer order	3.127	0.808	0.654
There is lack of process synchronization	2.809	0.700	0.490
There is a supplier delay on parts delivery	2.789	0.716	0.512
There is lack of financial supports to invest on necessary equipment for creating cellular production layout	2.721	0.896	0.803
There is no standardization/balance of workloads among the employees	2.716	0.767	0.589
The employees resist to change	2.657	0.695	0.483
There is inadequate continuous training and lack of knowledge in lean manufacturing	2.632	0.792	0.628

'Table 5.3, continued.'

	Mean	Std. Deviation	Variance
There is a lack of supports from employees in making lean manufacturing efficient and effective	2.608	0.711	0.506
There is a poor quality of supplied parts	2.593	0.869	0.755
There is a poor working culture	2.515	0.815	0.665
There is a poor communication from top management	2.275	0.814	0.663
There is lack of top management commitment and participation	2.108	0.835	0.698

5.2.3 Level of LMS Implementation – Activities

Table 5.4 shows the analysis of LMS activities during the lean implementation process. Design for customer need (DCN) showed the highest score, because for the Malaysian context, automotive products are manufactured oriented towards customer needs and requirements. It is also the case for many automotive producers in other countries. The dimension continuous improvements (CI) – shows high tendency when LMS is implemented as the respondents think that, continuous improvement – Kaizen is an integral part of LMS concept. Pull strategy (PS) has a lower mean score because it is lesser implemented in Malaysia, because the skill and knowledge of this dimension is less within the industry. Kanban which is based on customer order is hard to implement, due to order variability and many citing difficulties in raw material sourcing, especially from overseas. Many companies resort to having safety stock as buffer against stock-out. So, the pull strategy is often not easy to execute, although most are aware of its importance, further customer relationship (CRM) and supplier relationship management (SRM) in this sense needs to be exceptionally high to mitigate potential problems.

Quality Management (QM) such as TQM, Six sigma, SMED is already reflected within DCN, if to satisfy critical elements of customer's need, shows high correlation with other factors. Total preventive management (TPM), ranks third because most respondents probably have experience with this dimension because it is usually applied as a pick-choose activity of lean, as opposed to the total lean concept. The concept requires them to have repair planning & schedule (during off-days) as not to disrupt line-stoppage (break-downs). Just in time (JIT) which also should be quite familiar to many respondents, which is to produce – output units at the time and in the quantity needed – uses Kanban and pull production; supplier would send sufficient quantities (of the right quality) at right time of requirement. This is an important element of LMS, related to lowering inventory levels of raw material or finish products, lowering storage space and work-in-process. Under the LMS thinking, one of the top wastage sources in production is inventory. Future trends from respondents, as expected an increase by the same dimensions to continue being in the same rank. Figure 5.2 shows the comparison of current lean activities versus the future expectation.

Table 5.4.Mean Scores of Current LMS Implementation Level Compared to Future Expected Implementation

Lean activity	Mean	
	Current	Future (next three years)
Just in time		
JIT1	3.451	4.337
JIT2	3.510	4.101
JIT3	3.402	3.986
JIT average	**3.454**	**4.141**
Total preventive maintenance		
TPM1	3.387	3.880
TPM2	3.569	4.222
TPM3	3.672	4.568
TPM4	3.637	4.166
TPM5	3.446	4.205
TPM average	**3.542**	**4.208**
Quality management		
QM1	3.431	4.730
QM2	3.328	4.138
QM3	3.348	4.375
QM4	3.500	4.440
QM average	**3.402**	**4.421**
Pull system		
PS1	3.309	3.821
PS2	3.230	3.913
PS3	3.152	4.065
PS4	3.005	3.793
PS average	**3.174**	**3.898**

‘Table 5.4, continued.’

Lean activity	Mean	
	Current	Future (next three years)
Continuous improvement		
CI1	3.730	4.708
CI2	3.559	4.426
CI3	3.554	4.235
CI4	3.593	4.519
CI average	**3.609**	**4.472**
Design for customer need		
DCN1	3.838	4.532
DCN2	3.873	4.387
DCN3	3.740	4.505
DCN4	3.721	4.618
DCN average	**3.793**	**4.511**

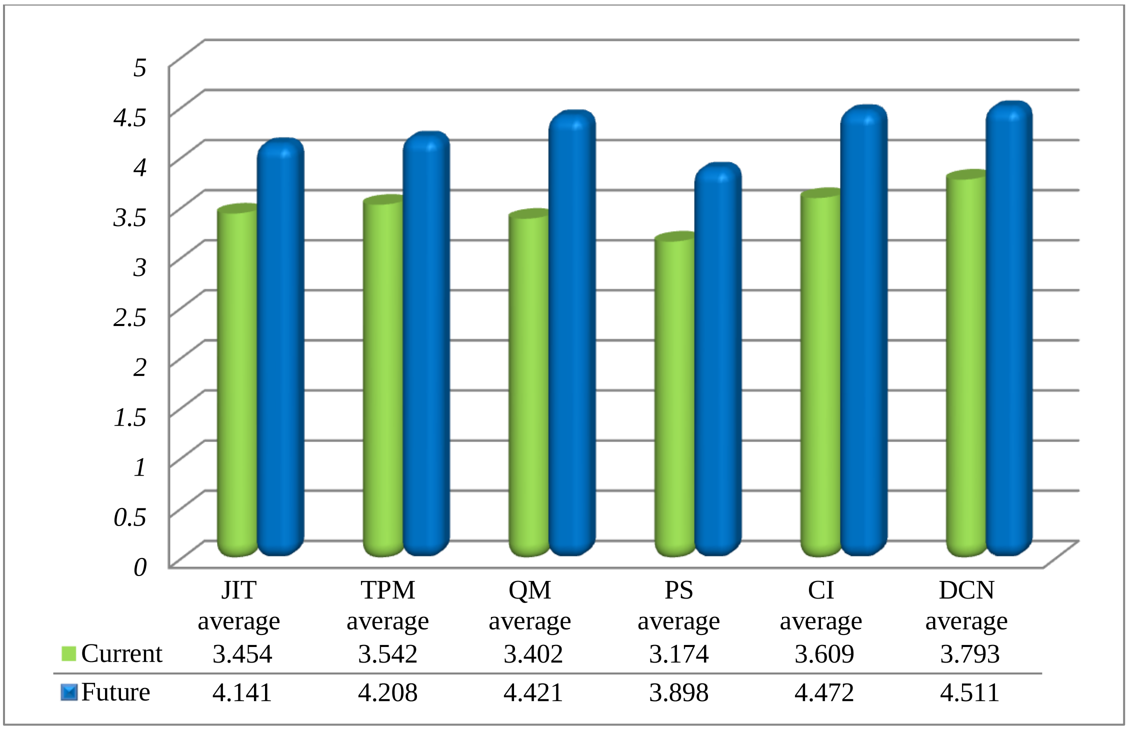


Figure 5.2: Current LMS Implementation Level Compared to Future Expected Implementation

In this study, the current performances level of LMS implementation has been studied in detail. Table 5.5 shows the detailed results of these performance metrics, and figure 5.3 illustrates it in graphical form. From the survey conducted most respondents seemed to understand the need to reduce wastage-Waste Reduction (WR), explains it achieving the highest mean score, this is unsurprising as waste elimination is at the core of LMS. Using less cost and resources but aiming to achieve more. Operational performance considered second in the list, with a LMS implementation and once all required factors are in order, it increases the level of operational performance (OP) as a whole, because individually, it reduces unit operating cost, increases productivity, reduces inventory while increasing production efficiency. The other 3 organizational performance namely, Financial Performance (FP), Marketing Performance (MP) and Non-Financial Performance (NFP) dimensions are also relevant within LMS but more importantly with the implementation of LMS, these results were already expected to show improvements, thus is reflected here in the survey results.

Future expectations shows that FP will surpass all the other dimensions, this is expected with lean implementations because as the initial part of lean exercises focuses heavily on waste reduction, subsequent years with LMS should improve MP, OP, FP while WR expected to fall or level itself off.

Table 5.5: Mean Scores of Current Performances Level Compared to Future Expected Performances.

	Mean	
	Current (current situation compared to 3 years ago)	Future (next three years compared to current situation)
Waste reduction		
WR1	3.569	4.101
WR2	3.505	3.893
WR3	3.534	4.213
WR4	3.569	4.302
WR5	3.588	4.007
WR average	**3.553**	**4.103**
Financial performance		
FP1	3.309	4.523
FP2	3.461	4.616
FP3	3.446	4.537
FP average	**3.405**	**4.559**

‘Table 5.4, continued.’

	Mean	
	Current (current situation compared to 3 years ago)	Future (next three years compared to current situation)
Marketing performance		
MP1	3.353	4.188
MP2	3.353	3.955
MP3	3.451	4.075
MP4	3.436	4.349
MP average	**3.398**	**4.142**
Non-financial performance		
NFP1	3.431	4.224
NFP2	3.289	3.883
NFP3	3.309	3.915
NFP4	3.353	4.097
NFP5	3.407	4.111
NFP average	**3.358**	**4.046**
Operational performance		
OP1	3.373	4.275
OP2	3.520	4.245
OP3	3.657	4.523
OP4	3.407	4.152
OP average	**3.489**	**4.299**

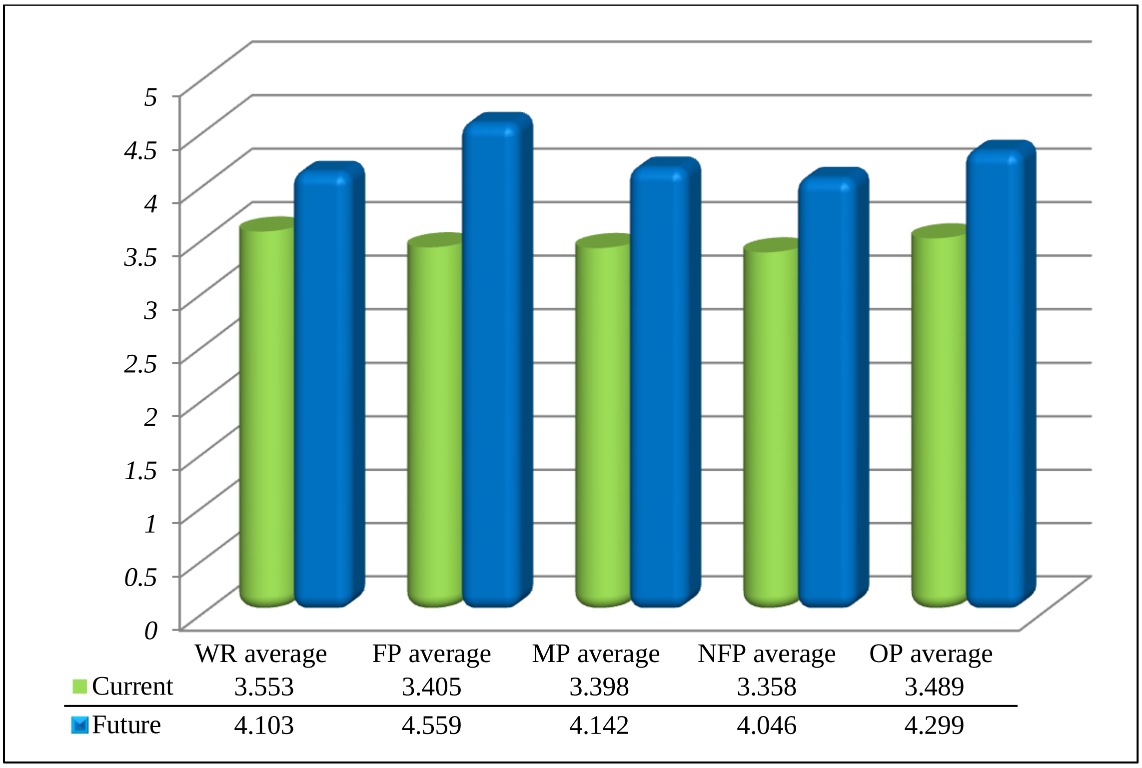


Figure 5.3: Current Performances Level Compared to Future Expected Performances Achievement.

5.3 Assessment of the Full Blown Model of LMS Implementation

To test the hypotheses of the study and the relationships between the independent exogenous variables and LMS implementation, and the relationship between LMS implementation and business performance, the research model of this study (Figure 4.2) was analyzed using SEM technique.

The review of SEM literature suggests that there have been some debates in the SEM community regarding whether a measurement model should be analyzed separately, before the analysis of a structural model (Wallace et al., 2004). In a single step (one-step) SEM analysis, both measurement and structural models are analyzed simultaneously using the statistical packages to test the hypotheses of a study. However, in the two-step analysis the measurement and structural models are performed sequentially (Fynes et al., 2005). As argued by Anderson and Gerbing (1988, p. 411) "there is much to gain in theory testing and the assessment of construct validity from separate estimation (and re-specification) of the measurement model prior to the simultaneous estimation of the measurement and structural sub odds", thus, and consistent with prior operation research literature (Wolff & Pett, 2006; Santos-Vijande, et al., 2012), the analysis of the data in this work includes two stages: first, the evaluation of the psychometric properties of the scales in form of separate measurement model analysis; and second, the test of the hypotheses in the conceptual path model.

5.3.1 First and Second-Order CFAs of Lean Manufacturing Implementation

The most fundamental event in SEM is the evaluation of measurement model validity (Hair, et al., 2006). As explained in Figure 5.4, the first step of evaluating measurement model in this study is to perform two separate first-order and second-order CFAs for lean manufacturing dimensions. Therefore, to test the model validity, the first-order and second-order CFAs were performed separately using AMOS software. The test of CFA includes testing for CFA fitness, internal consistency reliability, indicator reliability, convergent validity, and discriminant validity.

The first CFA performed in this study investigates the correlation of the six dimensions that constitute the LMS implementation, which include JIT, TPM, QM, PS, CI, and DCN. This measurement model is illustrated in Figure 5.4. The results of CFA analysis show a very satisfactory overall model fit (RMSEA= 0.029, CMIN/DF= 1.168, RMR= 0.19, SRMR= 0.037, CFI= 0.986, IFI= 4.4 shows that all CR and CA values are higher than the threshold value of 0.7 which indicate the adequate internal consistency (C. Fornell & Bookstein, 1982). Moreover, the measurement model of LMS implementation shows satisfactory indicator reliability because all the standardized factor loadings are above 0.70 (The complete AMOS output for this CFA is presented in Appendix C1). Table 4.6 also suggests that AVE for each of the variables is higher than 0.5 (AVE for JIT is 0.498 which is very close to 5.00, and thus acceptable), which provides evidence of convergent validity in the measurement model of interest (Fornell & Larcker, 1981). Finally, the results suggest that although few inter-correlations among latent variables are relatively high, however, all variables show the satisfactory discriminant validity as well. Table 5.7 lists the correlation matrix for the measurement model of LMS implementation, with correlations among constructs and the square root of AVE on the diagonal. Table 5.7 shows that the square root of AVE for each construct is larger than the correlation of that construct with all other constructs in the model, thus, discriminant validity is satisfied (Urbach et al., 2010).

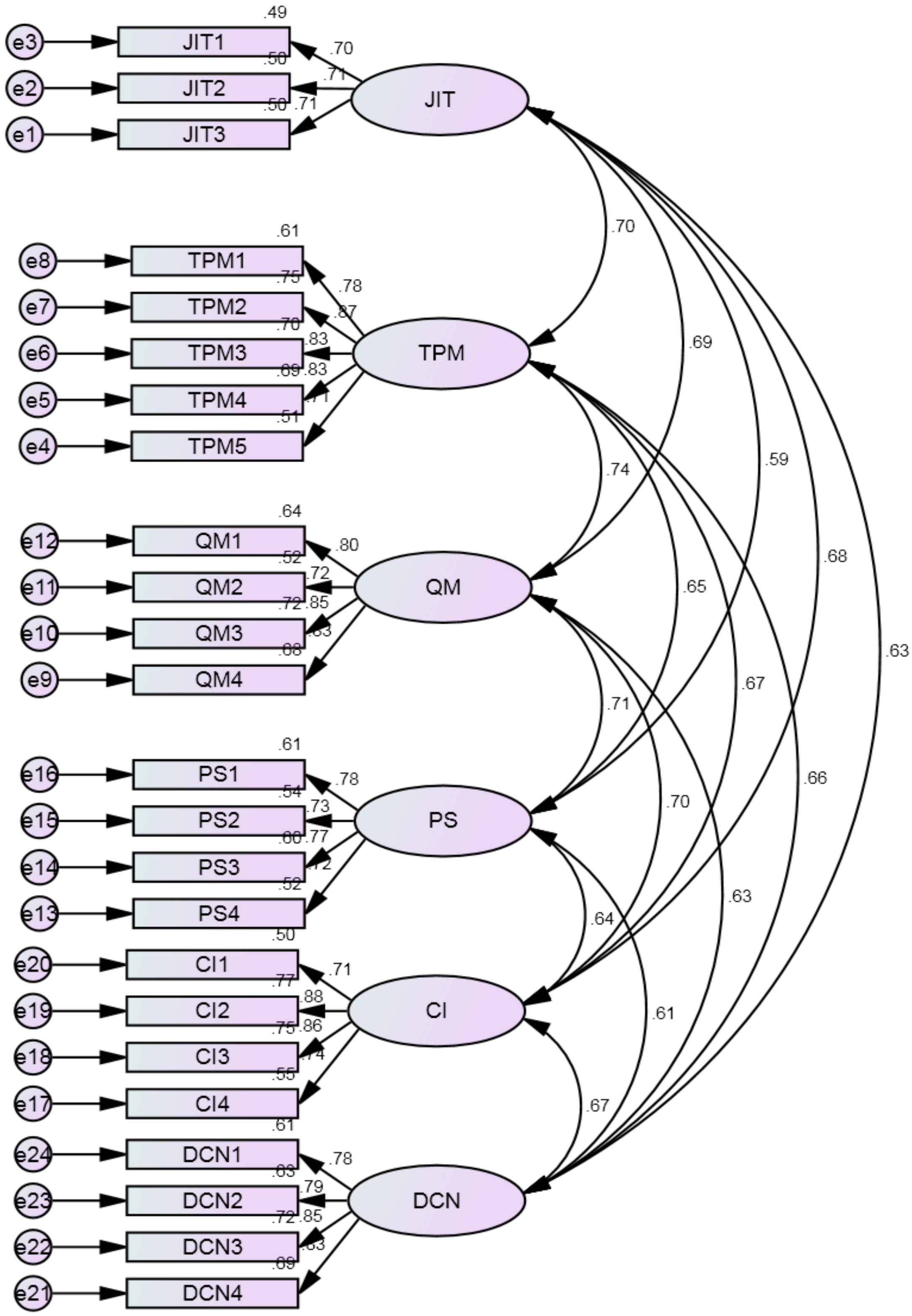


Figure 5.4: First-order CFA for Dimensions of LMS Implementation

Table 5.6: Measurement Model Analysis of LMS Implementation and Results of First-order CFA

Constructs	Parameter standardized loading	Composite reliability	Cronbach's alpha	Average variance extracted
Just in time		0.749	0.748	0.498
JIT1	0.709			
JIT2	0.707			
JIT3	0.702			
Total preventive maintenance		0.903	0.902	0.652
TPM1	0.715			
TPM2	0.833			
TPM3	0.834			
TPM4	0.868			
TPM5	0.778			
Quality management		0.877	0.875	0.641
QM1	0.827			
QM2	0.850			
QM3	0.718			
QM4	0.802			
Pull system		0.838	0.835	0.565
PS1	0.718			
PS2	0.772			
PS3	0.732			
PS4	0.783			
Continuous improvement		0.877	0.872	0.642
CI1	0.743			
CI2	0.864			
CI3	0.876			
CI4	0.708			
Design for customers' need		0.885	0.885	0.659
DCN1	0.829			
DCN2	0.847			
DCN3	0.791			
DCN4	0.778			

Table 5.7: Inter-construct Correlations with Square Root of the AVE on Diagonal

	JIT	TPM	QM	PS	CI	DCN
JIT	**0.706**					
TPM	0.698	**0.807**				
QM	0.694	0.737	**0.801**			
PS	0.589	0.652	0.709	**0.752**		
CI	0.683	0.668	0.701	0.643	**0.801**	
DCN	0.629	0.657	0.634	0.605	0.672	**0.812**

After performing the first-order CFA for dimensions of LMS implementation and confirming the positive inter-correlations among the reflective sub-dimensions, the second-order CFA is performed to test whether the lean manufacturing sub-dimensions converge on a single latent factor. The second-order CFA model for measuring LMS implementation latent variable is illustrated in Figure 5.5 followed by the results of CFA listed in Table 5.8. The results suggest that similar to first-order CFA, the second-order CFA of LMS implementation provides very satisfactory CFA fit (RMSEA= 0.027, CMIN/DF= 1.149, RMR= 0.20, SRMR= 0.039, CFI= 0.988, IFI= 0.988, TLI= 0.986, GFI= 0.905, NFI= 0.912, and RFI= 0.901). Consistently, the results also show that all CR and CA values are higher than 0.7 which account for high internal consistency (Claes Fornell, 1982). Similarly, the second-order CFA shows satisfactory indicator reliability because as all standardized factor loadings are above 0.70 (The complete AMOS output for this CFA is presented in Appendix C2). Finally, convergent validity is also satisfied given the AVE of the latent variable of LMS implementation is higher than 0.5 (C. Fornell & Larcker, 1981). The first-order and second-order CFAs for LMS implementation verify the multi-dimensional nature of the LMS implementation, which further proves that researcher’s decision to define LMS implementation as a second-order construct is technically valid.

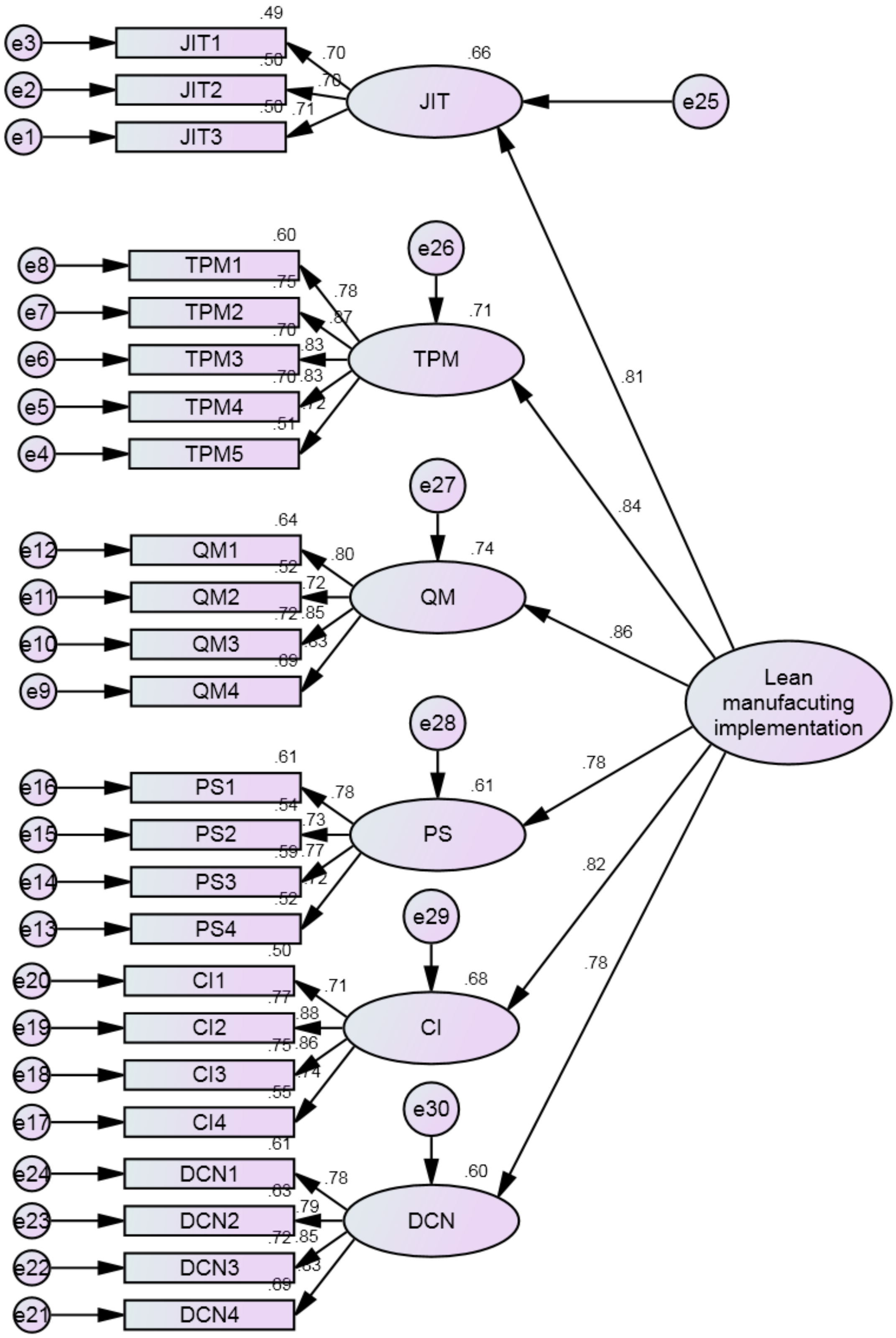


Figure 5.5: Second-order CFA for Dimensions of LMS Implementation

Table 5.8: Measurement Model of LMS Implementation and

Results of Second-order CFA

Constructs	Parameter standardized loading	Composite reliability	Cronbach's alpha	Average variance extracted
Lean manufacturing		0.923	0.889	0.666
JIT	0.809			
TPM	0.841			
QM	0.862			
PS	0.784			
CI	0.823			
DCN	0.775			

*Fit indices:*RMSEA= 0.027, CMIN/DF= 1.149, RMR= 0.20, SRMR= 0.039, CFI= 0.988, IFI= 0.988, TLI= 0.986, GFI= 0.905, NFI= 0.912, and RFI= 0.901

5.3.2 First and second-order CFAs of Business Performance

The next CFA performed in this study (illustrated in Figure 5.6) examines the correlation of the five dimensions that constitute the business performance latent variable, which comprise waste reduction, financial performance, marketing performance, non-financial performance, and operational performance. The results of first-order CFA analysis showed a very satisfying overall model fit in this case as all the fit indices satisfy their cutoff value (RMSEA= 0.028, CMIN/DF= 1.157, RMR= 0.19, SRMR= 0.039, CFI= 0.987, IFI= 0.987, TLI= 0.985, GFI= 0.912, NFI= 0.915, and RFI= 0.900).

Table 5.9 lists standardized factor loading, CR, CA, and AVE for different dimensions of business performance. It shows that all CR and CA values are higher than the threshold value of 0.7, which indicate adequate internal consistency(Claes Fornell, 1982). The measurement model of business performance also shows satisfactory indicator reliability because all the standardized factor loadings are above 0.70 (The complete AMOS output for this CFA is presented in Appendix C3). Likewise, Table 5.9 also shows that AVE for all variables is significantly higher than 0.5, thus, the measurement model provides acceptable convergent validity (Fornell & Larcker, 1981). Finally, the results suggest that although some inter-correlations among the latent variables are relatively high, however, all variables show the satisfactory discriminant validity as well.

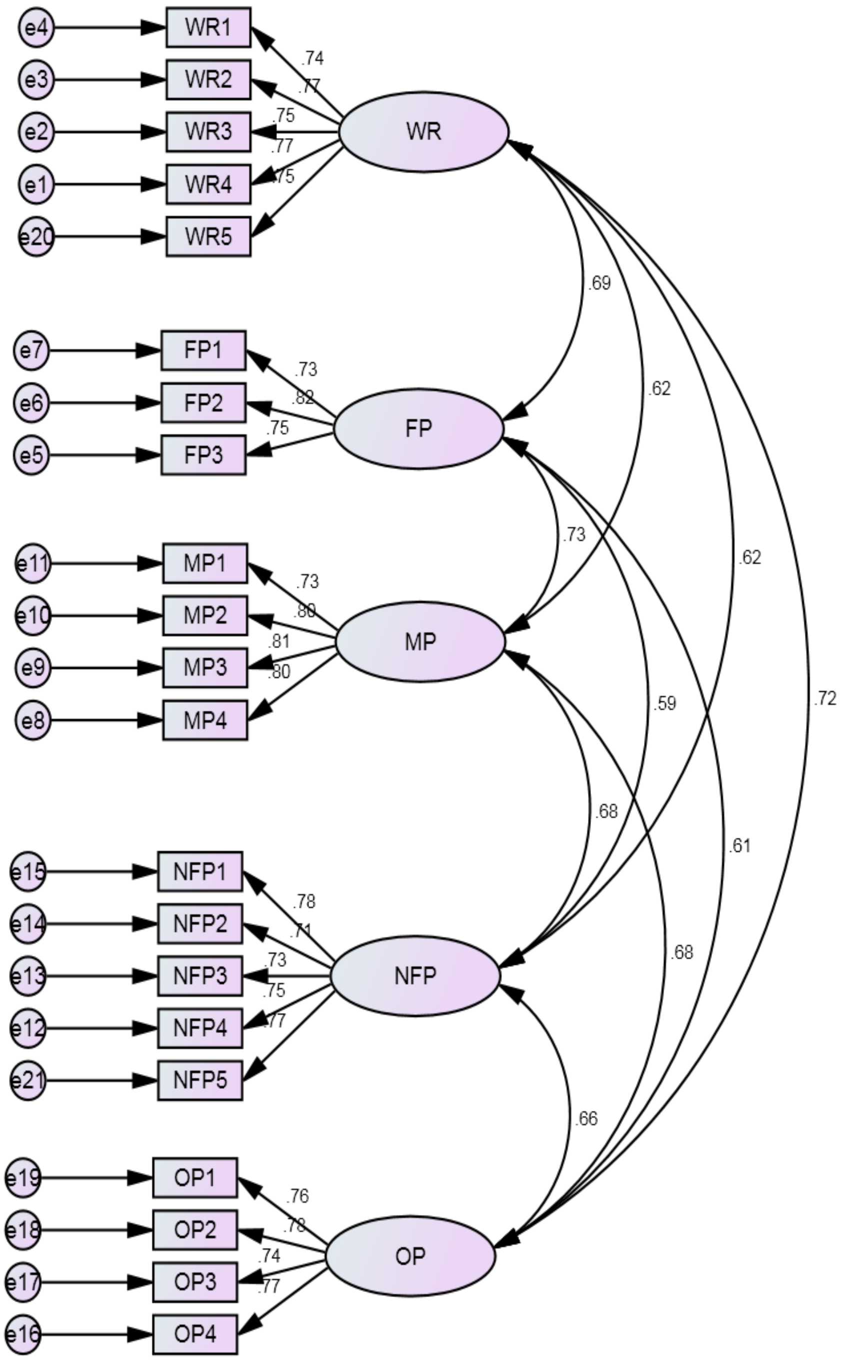


Figure 5.6: First-order CFA for Dimensions of Business Performance

Table 5.9: Measurement Model of Business Performance and Results of First-order CFA

Constructs	Parameter standardized loading	Composite reliability	Cronbach's alpha	Average variance extracted
Waste reduction		0.871	0.869	0.576
WR5	0.766			
WR4	0.770			
WR3	0.754			
WR2	0.768			
WR1	0.735			
Financial performance		0.813	0.813	0.593
FP3	0.752			
FP2	0.822			
FP1	0.733			
Marketing performance				
MP4	0.800	0.864	0.864	0.615
MP3	0.809			
MP2	0.800			
MP1	0.725			
Non-financial performance		0.862	0.861	0.555
NFP5	0.766			
NFP4	0.748			
NFP3	0.729			
NFP2	0.705			
NFP1	0.775			
Operational performance		0.848	0.843	0.582
OP4	0.773			
OP3	0.740			
OP2	0.776			
OP1	0.761			

Table 5.10 lists the correlation matrix for the measurement model of business performance, with correlations among constructs and the square root of AVE on the diagonal. Given all square root of AVE for each construct is larger than the correlation of that construct with all other constructs in the model, thus, discriminant validity is satisfied (Urbach, et al., 2010).

Table 5.10: Business Performance Inter-construct Correlations with Square Root of the AVE on Diagonal

	WR	FP	MP	NFP	OP
WR	**0.759**				
FP	0.692	**0.770**			
MP	0.624	0.729	**0.784**		
NFP	0.619	0.589	0.679	**0.745**	
OP	0.720	0.605	0.681	0.656	**0.763**

The first-order CFA for dimensions of business performance confirms the positive inter-correlations among the reflective sub-dimensions. According, and the next step, the second-order CFA was performed to test whether the business performance sub-dimensions converge on a single latent variable (The complete AMOS output for this CFA is presented in Appendix C4). The second-order CFA model for measuring business performance latent variable is illustrated in Figure 5.7, followed by the results of CFA listed in Table 5.11. This table demonstrates the items that are similar to the first-order CFA, the second-order CFA of business performance indeed, provides very satisfactory CFA fit as the analytical values are more affirmative towards the hypothesis (RMSEA= 0.031, CMIN/DF= 1.199, RMR= 0.21, SRMR= 0.044, CFI= 0.983, IFI= 0.984, TLI= 0.981, GFI= 0.908, NFI= 0.909, and RFI= 0.896). The results similarly reveal that all CR and CA values are higher than 0.7 which indicate high internal consistency (Fornell, 1982). Moreover, the second-order CFA has provided the satisfactory indicator reliability because as all the standardized factor loadings are above 0.70 (N. Urbach, et al., 2010). Finally, convergent validity is also satisfied given the AVE of the latent variable of LMS implementation is 0.659 which is considerably higher than the cutoff value of 0.5 suggested by Fornell and Larcker (1981). The results of the first-order and second-order CFAs for business performance collectively confirm that the business performance is multi-dimensional in nature and the researcher's decision as to define business performance as a second-order construct is technically sound.

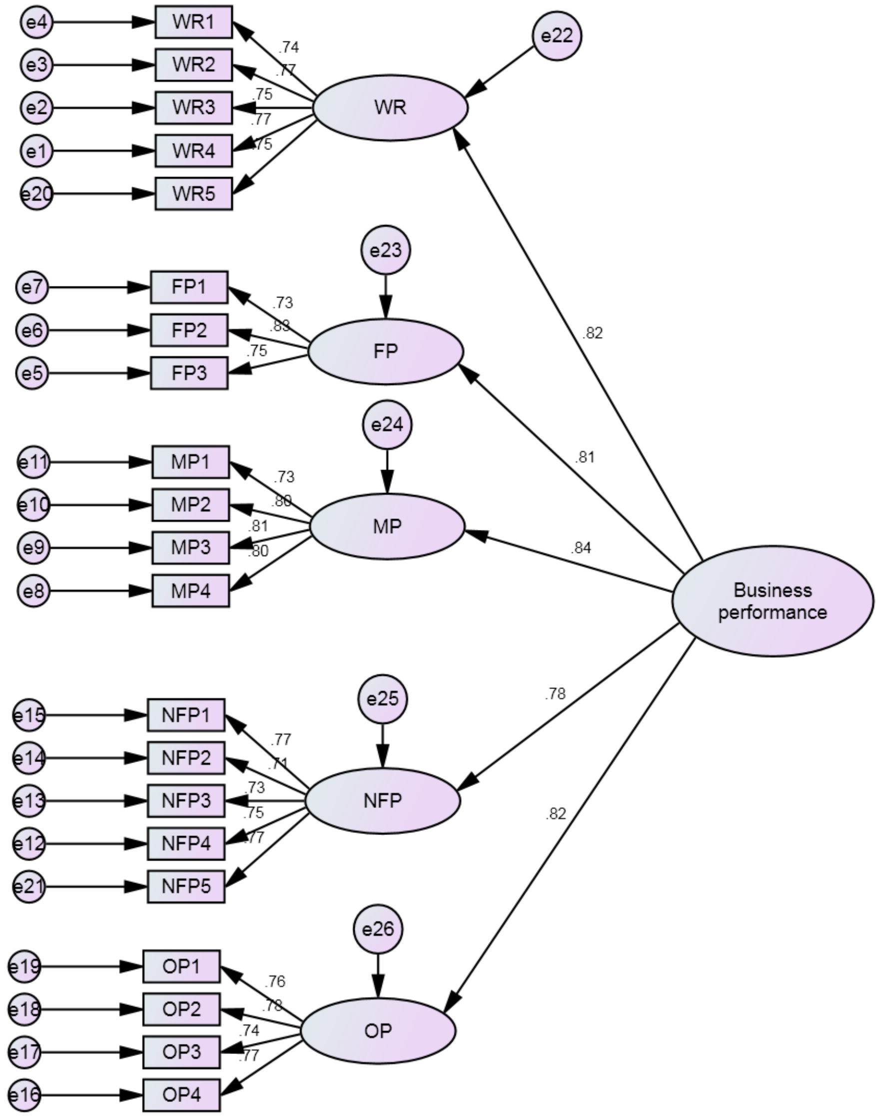


Figure 5.7: Second-order CFA for Dimensions of Business Performance

Table 5.11: Measurement Model of Business Performance and Results of Second-order CFA

Constructs	Parameter standardized loading	Composite reliability	Cronbach's alpha	Average variance extracted
Lean manufacturing		0.906	0.864	0.659
WR	0.815			
FP	0.807			
MP	0.837			
NFP	0.776			
OP	0.824			

*Fit indices:*RMSEA= 0.031, CMIN/DF= 1.199, RMR= 0.21, SRMR= 0.044, CFI= 0.983, IFI= 0.984, TLI= 0.981, GFI= 0.908, NFI= 0.909, and RFI= 0.896

5.3.3 Performing the Final First-Order CFA

Referring to Figure 5.8, the next step after collapsing the second-order constructs of LMS implementation and business performance to the first-order constructs is to conducting the final first-order CFA with first-order constructs of all influencing factors, LMS, and business performance. Accordingly, the final CFA performed in this study (illustrated in Figure 5.8) examines the correlation of the 12 different first-order reflective latent variables. From these 12 latent variables, 10 variables are influencing factors (management leadership, employee involvement, employee empowerment, training, teamwork, human resource management, customer relationship management, supplier relationship management, organizational change, and information technology). The two other latent variables are LMS implementation and business performance, those variables which were collapsed to first-order constructs from second-order constructs. Accordingly, the final measurement model presented in Figure 5.8 was analyzed using AMOS to complete the measurement model analysis.

The results of first-order CFA analysis show an acceptable overall model fit in this case as all the absolute fit measures completely satisfy their cutoff value (RMSEA= 0.029, CMIN/DF= 1.174, RMR= 0.022, SRMR= 0.047), and all the incremental fit indices reach the corresponding acceptable threshold values (CFI= 0.969, IFI= 0.969, TLI= 0.965, GFI= 0.802, NFI= 0.824, and RFI= 0.806).

To test for unidimensionality, an EFA was conducted based on *principal axis factoring* method for extraction, and with rotation method of *Varimax with Kaiser Normalization*. In conventional EFA, the number of the selected factors is determined by the numbers of factors with an Eigenvalue exceeding 1.0 (N. Urbach, et al., 2010). In this study however, and to make the output of EFA comparable with CFA output, the researcher followed another common strategy and fixed EFA to extract 12 groups of factors. *Kaiser-Meyer-Olkin* (KMO)'s overall measure of sampling adequacy for this

EFA is 0.931 which indicates that the data is appropriate for factor analysis given that KMO should be above the generally recommended minimum value of 0.700 (Morteza Ghobakhloo et al., 2011). The results of EFA presented in Table 4.12 show that 11 of the extracted factors have Eigenvalue of more than 1.00 and only the 12^{th} group has the Eigenvalue of 0.917, which is still very close to 1.00. Interestingly, the pattern of extortion (12 factors in Table 4.13) fully supports the perception under which the final measurement instrument of this research (Figure 4.8) is formed. In other words, the pattern of extraction and grouping in EFA is identical to 12 groups of factors specified a priori in CFA. The literature suggests that an item loading is usually considered high if the loading coefficient is above 0.60, acceptable if the loading coefficient is between 0.600 and 0.400, and considered low (unacceptable) if the coefficient is below 0.40 (Gefen & Straub, 2005; Urbach, et al., 2010). The EFA results (Table 5.13) demonstrate that all the measurement items converge (load highly) only and only in their corresponding constructs, thus, the results demonstrate an acceptable level of unidimensionality.

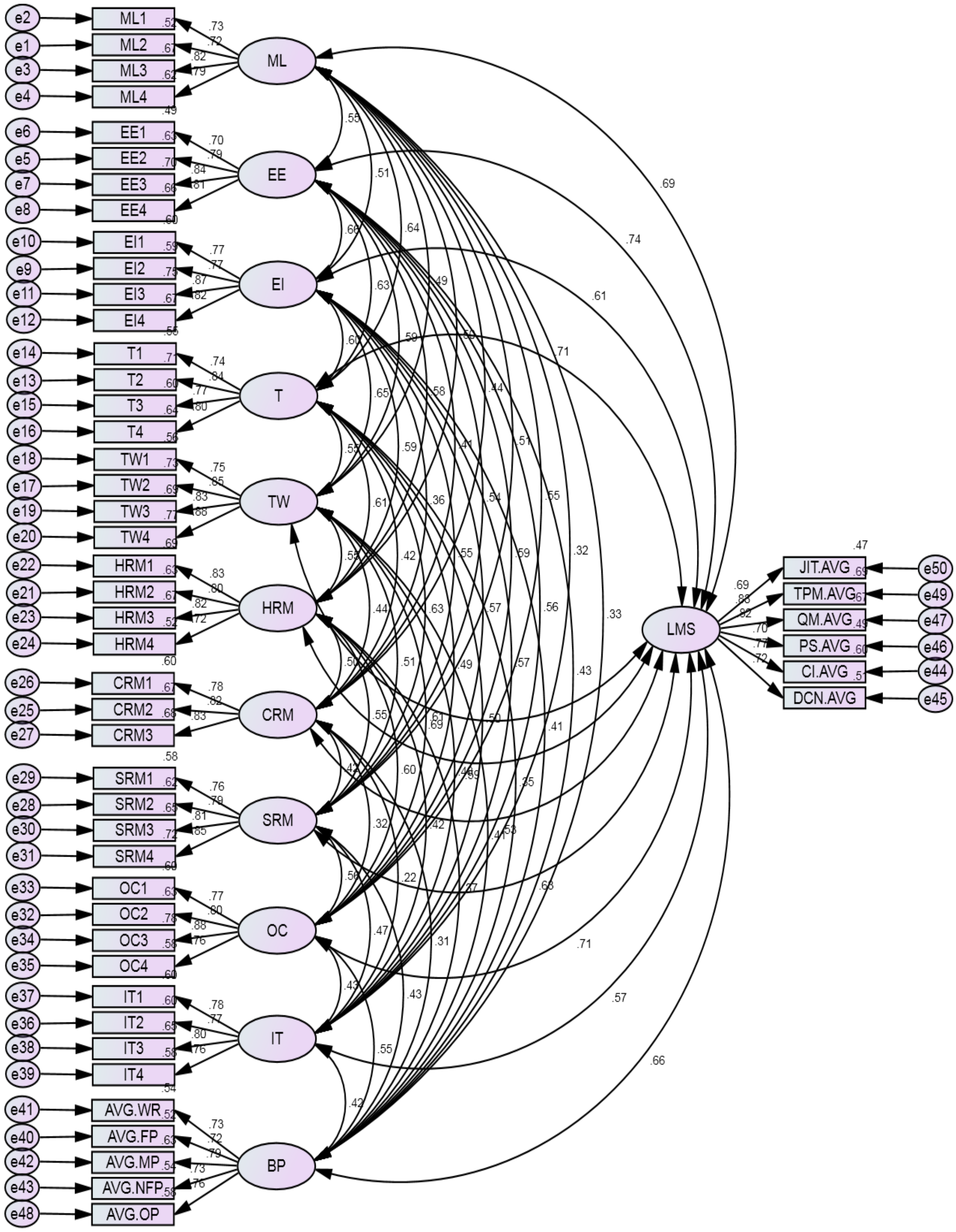


Figure 5.8: Measurement Model of Full-blown LMS Implementation

Table 5.12: Extraction Pattern with Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	18.392	36.784	36.784	18.392	36.784	36.784	3.805	7.609	7.609
2	2.861	5.722	42.506	2.861	5.722	42.506	3.234	6.468	14.078
3	2.424	4.849	47.355	2.424	4.849	47.355	3.225	6.450	20.527
4	1.871	3.742	51.097	1.871	3.742	51.097	3.158	6.316	26.844
5	1.860	3.720	54.817	1.860	3.720	54.817	3.154	6.309	33.152
6	1.780	3.560	58.377	1.780	3.560	58.377	3.020	6.040	39.192
7	1.503	3.006	61.383	1.503	3.006	61.383	2.972	5.944	45.136
8	1.442	2.885	64.268	1.442	2.885	64.268	2.961	5.922	51.057
9	1.372	2.744	67.012	1.372	2.744	67.012	2.946	5.891	56.949
10	1.280	2.559	69.571	1.280	2.559	69.571	2.938	5.877	62.826
11	1.014	2.029	71.600	1.014	2.029	71.600	2.691	5.382	68.207
12	0.917	1.835	73.435	0.917	1.835	73.435	2.614	5.228	73.435

Table 5.13: Rotated Component Matrix Along with Item Loadings

	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
AVG.WR	**.820**	.093	.043	-.021	.050	-.031	.037	.058	.082	-.009	.102	.100
AVG.FP	**.755**	.028	.125	.100	.168	.165	.041	-.038	.106	.056	-.047	.136
AVG.OP	**.749**	.056	.060	.063	.117	.054	.048	.157	.150	.012	.224	-.006
AVG.MP	**.737**	.098	.152	.122	.205	.008	.079	.074	.064	.142	.120	.068
AVG.NFP	**.702**	.002	.143	.071	.098	.079	.216	.105	-.031	.148	.204	-.009
ML4	.100	**.783**	.155	.122	.139	.083	.116	.094	.095	.093	.131	.085
ML2	.107	**.752**	.017	.144	.104	.055	.105	.030	.136	.127	.139	.082
ML3	.060	**.717**	-.006	.093	.175	.222	.188	.176	.138	.061	.146	.096
ML1	.005	**.716**	.038	.046	.088	.296	.010	.114	.076	.135	.053	.179
IT1	.085	.133	**.805**	.098	.139	.055	.098	.030	.130	.077	.112	-.050
IT2	.177	-.010	**.794**	.088	.061	.100	.035	.129	.050	.073	.143	.032
IT3	.146	.081	**.754**	.131	.044	.126	.108	.221	.128	.073	.067	.072
IT4	.083	.001	**.704**	.107	.090	.132	.187	.161	.229	.078	.102	.050
TW4	.141	.126	.130	**.774**	.206	.037	.127	.169	.147	.142	.173	.131
TW3	.044	.097	.197	**.755**	.160	.137	.019	.215	.108	.114	.171	.143
TW2	.210	.125	.097	**.733**	.146	.138	.165	.281	.115	.101	.137	.076
TW1	-.004	.153	.109	**.694**	.175	.239	.161	.042	.158	.185	.117	.117
OC3	.219	.197	.077	.148	**.752**	.183	.108	.143	.130	.196	.121	.039
OC2	.194	.094	.017	.196	**.735**	.111	.071	.106	.136	.185	.111	.118
OC1	.209	.118	.155	.153	**.733**	-.054	.199	.148	.160	.065	.112	.007
OC4	.130	.181	.165	.157	**.682**	.086	.138	.121	.090	.203	.181	.028
T4	-.011	.084	.150	.148	.075	**.755**	.084	.150	.201	.142	.193	.183
T2	.052	.254	.176	.035	.116	**.708**	.279	.149	.126	.152	.103	.130
T1	.168	.261	.047	.155	.079	**.662**	.196	.104	.156	.146	.071	.047
T3	.111	.196	.166	.213	.052	**.656**	.128	.173	.122	.195	.225	-.038
SRM2	.154	.050	.055	.166	.019	.101	**.823**	.087	.199	.096	-.007	.162
SRM3	.025	.201	.170	.072	.109	.168	**.778**	.103	.052	.145	.093	.146
SRM4	.146	.103	.167	.103	.236	.167	**.750**	.086	.100	.115	.169	.068
SRM1	.170	.161	.121	.096	.265	.217	**.578**	.273	.067	.186	.202	.027
EI4	.158	.147	.093	.081	.135	.170	.094	**.776**	.164	.199	.138	.042
EI3	.138	.152	.244	.214	.191	.094	.159	**.707**	.168	.151	.046	.088
EI1	.074	.074	.132	.229	.166	.295	.119	**.680**	.120	.079	.023	.205
EI2	.044	.107	.273	.227	.069	.041	.123	**.677**	.234	.172	.145	-.020
EE1	.137	.059	.129	.065	.042	.146	.103	.175	**.717**	.111	.171	.128
EE3	.068	.164	.207	.179	.210	.129	.117	.177	**.716**	.160	.094	.103
EE4	.169	.165	.156	.190	.160	.185	.107	.064	**.712**	.156	.196	-.013
EE2	.088	.193	.177	.115	.171	.135	.119	.242	**.654**	.100	.158	.157
HRM1	.047	.180	.153	.172	.207	.158	.122	.047	.038	**.781**	.052	.154
HRM3	.083	.091	.103	.077	.160	.123	.108	.179	.272	**.747**	.097	.137

‘Table 5.13, continued’

	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
HRM4	.200	.157	-.001	.155	.142	.096	.115	.225	.054	**.696**	.187	.028
HRM2	.042	.063	.122	.118	.130	.227	.170	.135	.184	**.684**	.034	.269
PS.AVG	.137	.127	.096	.136	.034	.207	.167	.155	.254	.132	**.649**	.139
JIT.AVG	.236	.082	.236	.142	.186	.113	.050	.058	.168	.114	**.587**	.193
CI.AVG	.278	.269	.179	.265	.201	.063	.177	.175	.208	.032	**.587**	-.023
DCN.AVG	.210	.205	.189	.237	.216	.183	.025	.004	.067	.155	**.557**	.213
QM.AVG	.278	.254	.098	.138	.282	.250	.171	.135	.235	.032	**.512**	.205
TPM.AVG	.279	.294	.172	.206	.239	.294	.142	.087	.216	.176	**.433**	.172
CRM3	.024	.157	-.017	.103	.024	.069	.093	.056	.126	.100	.109	**.840**
CRM2	.124	.069	.051	.046	.103	.044	.145	.145	.105	.094	.204	**.801**
CRM1	.133	.153	.042	.191	.019	.130	.092	.000	.029	.226	.041	**.770**

Table 5.14 lists the standardized factor loading, CR, CA, and AVE for different first-order latent variable in the measurement model. Table 5.14 shows that all CR and CA values are higher than threshold value of 0.7 which indicate the adequate internal consistency (Fornell, 1982). Moreover, the measurement model shows acceptable indicator reliability because almost all standardized factor loadings are above 0.70, and *JIT.AVG* with loading of 0.687, and *PS.AVG* with loading of 0.697 are the only exceptions that are also very close to 0.700 (The complete AMOS output for this CFA is presented in Appendix C5). Table 5.14 also suggests that AVE for all variables is significantly higher than 0.5 which provides evidence of convergent validity in the measurement model of interest (Fornell & Bookstein, 1982). Finally, the results suggest that although few inter-correlations among the latent variables are relatively high, however, all variables show satisfactory discriminant validity as well. Table 5.15 lists the correlation matrix for the measurement model of LMS implementation, with correlations among constructs and the square root of AVE on the diagonal. Table 5.15 shows that the square root of AVE for each construct is larger than the correlation of that construct with all other constructs in the model, thus, the discriminant validity is satisfied.

Table 5.14: Final Measurement Model and Results of First-order CFA

Constructs	Parameter standardized loading	Composite reliability	Cronbach's alpha	Average variance extracted
Management leadership		0.849	0.849	0.586
ML2	0.724			
ML1	0.726			
ML3	0.820			
ML4	0.787			
Employees empowerment		0.868	0.866	0.622
EE2	0.793			
EE1	0.701			
EE3	0.840			
EE4	0.814			
Employees involvement		0.882	0.881	0.653
EI2	0.770			
EI1	0.772			
EI3	0.867			
EI4	0.819			
Training		0.869	0.867	0.625
T2	0.840			
T1	0.743			
T3	0.774			
T4	0.802			
Team work		0.898	0.895	0.687
TW2	0.853			
TW1	0.746			
TW3	0.831			
TW4	0.880			
Human resource management		0.871	0.869	0.629
HRM2	0.796			
HRM1	0.829			
HRM3	0.820			
HRM4	0.724			
Customer relationship management				
CRM2	0.821	0.850	0.848	0.653
CRM1	0.777			
CRM3	0.826			
Supplier relationship management		0.877	0.875	0.642
SRM2	0.790			
SRM1	0.760			
SRM3	0.805			
SRM4	0.847			
Organizational change				
OC2	0.796	0.880	0.877	0.648
OC1	0.774			
OC3	0.883			
OC4	0.761			
Information technology				
IT2	0.773	0.860	0.859	0.606
IT1	0.776			
IT3	0.804			
IT4	0.759			

'Table 5.14, continued'

Constructs	Parameter standardized loading	Composite reliability	Cronbach's alpha	Average variance extracted
Lean manufacturing		0.889	0.889	0.571
CI.AVG	0.774			
DCN.AVG	0.715			
PS.AVG	0.697			
QM.AVG	0.818			
TPM.AVG	0.829			
JIT.AVG	0.687			
Business performance		0.865	0.864	0.561
AVG.FP	0.719			
AVG.WR	0.734			
AVG.MP	0.793			
AVG.NFP	0.734			
AVG.OP	0.763			

Table 5.15: Inter-construct Correlations with Square Root of the AVE on Diagonal

	ML	EE	EI	T	TW	HRM	CRM	SRM	OC	IT	OP	LMS
ML	**0.766**											
EE	0.551	**0.789**										
EI	0.505	0.655	**0.808**									
T	0.641	0.629	0.597	**0.791**								
TW	0.492	0.590	0.645	0.552	**0.829**							
HRM	0.500	0.583	0.586	0.609	0.550	**0.793**						
CRM	0.436	0.414	0.360	0.420	0.435	0.502	**0.808**					
SRM	0.507	0.537	0.555	0.626	0.511	0.548	0.418	**0.801**				
OC	0.547	0.589	0.568	0.495	0.608	0.600	0.325	0.557	**0.805**			
IT	0.320	0.564	0.569	0.497	0.484	0.416	0.223	0.474	0.429	**0.778**		
LMS	0.688	0.743	0.614	0.708	0.695	0.585	0.535	0.626	0.708	0.569	**0.756**	
OP	0.327	0.431	0.414	0.347	0.407	0.370	0.306	0.426	0.547	0.422	0.659	**0.749**

By performing the last step of the measurement model analysis decision plan presented in Figure 4.1, it can be concluded that rules governing how the latent variables in this study are measured in terms of the observed variables are clearly explained. In this section, evidences of adequate reliability of the observed variables employed to measure the latent variables of study were presented. Thus, it is possible now to proceed with the analysis of structural equation model. The final important point to mention is that as with many other multivariate techniques, normality is one of the main assumptions of SEM. Accordingly, variables used in SEM analysis need to be normally distributed. The literature suggests that skewness and kurtosis of less than +/- 1.0 generally determines the acceptable normality (Jiang et al., 2002; Schumacker &

Lomax, 2004). Knowing that skewness and kurtosis for all indicators of this study are less than +/- 1.0 (Appendix C1 to C6), thus, it is safe to assume that assumption of normality is not violated in this study.

5.4 Assessment of the Structural Model

After the validation of the measurement models, the structural model can be analyzed and the hypothesized relationships in the research model of the study can be assessed. As explained by Hair et al. (2006) recursive structural models cannot provide any better fit than measurement model. Accordingly, structural theory is valid when the fitness of structural model is close to the fitness of measurement mode, and conversely, it might lack validity if structural model fit is significantly worse than CFA fit (Anderson & Gerbing, 1992). Figure 5.9 illustrates the results of the structural test performed on the structural model. Accordingly, the test of the structural model includes the test structural path fitness (Ho, 2006), which are estimates of the path coefficients that show the strengths of the relationships between the dependent and independent variables of study (Hair, et al., 2006), and the R^2values, which represent the amount of variance explained by the independent variables (Rai, et al., 2006)

The goodness of fit indices of the structure model set the acceptable structural path fitness as all the absolute fit measures completely satisfy their cutoff value (RMSEA= 0.030, CMIN/DF= 1.179, RMR= 0.023, SRMR= 0.049), and all the incremental fit indices reach the respective acceptable threshold values (CFI= 0.967, IFI= 0.968, TLI= 0.968, GFI= 0.800, NFI= 0.822, and RFI= 0.806). Similarly, the structural model is suggestive to the adequate structural fit since ΔX^2 (the difference between Chi-Square values) value structural model with its CFA model is very insignificant (ΔX^2= 1319.597 - 1302.197 = 17.400). Consistently, there are no evidences of interpretational confounding because the comparison of CFA loading estimates with corresponding standardized factor loading from the structural model (complete AMOS output has been provided in Appendix C6) that shows inconsiderable variations (Hair, et al., 2006). Table 5.16 shows the significance of structural relationship among the research variables and the standardized path coefficients in which all except three of the hypotheses are strongly supported. The results obtained are consistent with H1, H2, H4, H5, H7, H9 and H10, each of management leadership, employee empowerment, training, teamwork, customer relationship management, organizational change, and information technology as influencing factors have a significant positive effect of LMS implementation. Among these seven significant influencing factors, organizational change has the most significant effect on LMS implementation (β =0.287, p<0.001). Conversely, there is no significant relationship between employee involvement, human resource management, and supplier relationship management as influencing factors with LMS implementation, which further indicate the rejection of H3, H6, and H8. The results show the decisions that are consistent with underlying theory, 10 influencing factors studied as determinant of LMS implementation account for 79.30 percent of the variance in the latent variable of LMS implementation. Finally, Table 5.16 reveals that is consistent with H11, LMS implementation has significant positive effect on business performance which accounts for 41.70 percent variance in the latent variable of business performance.

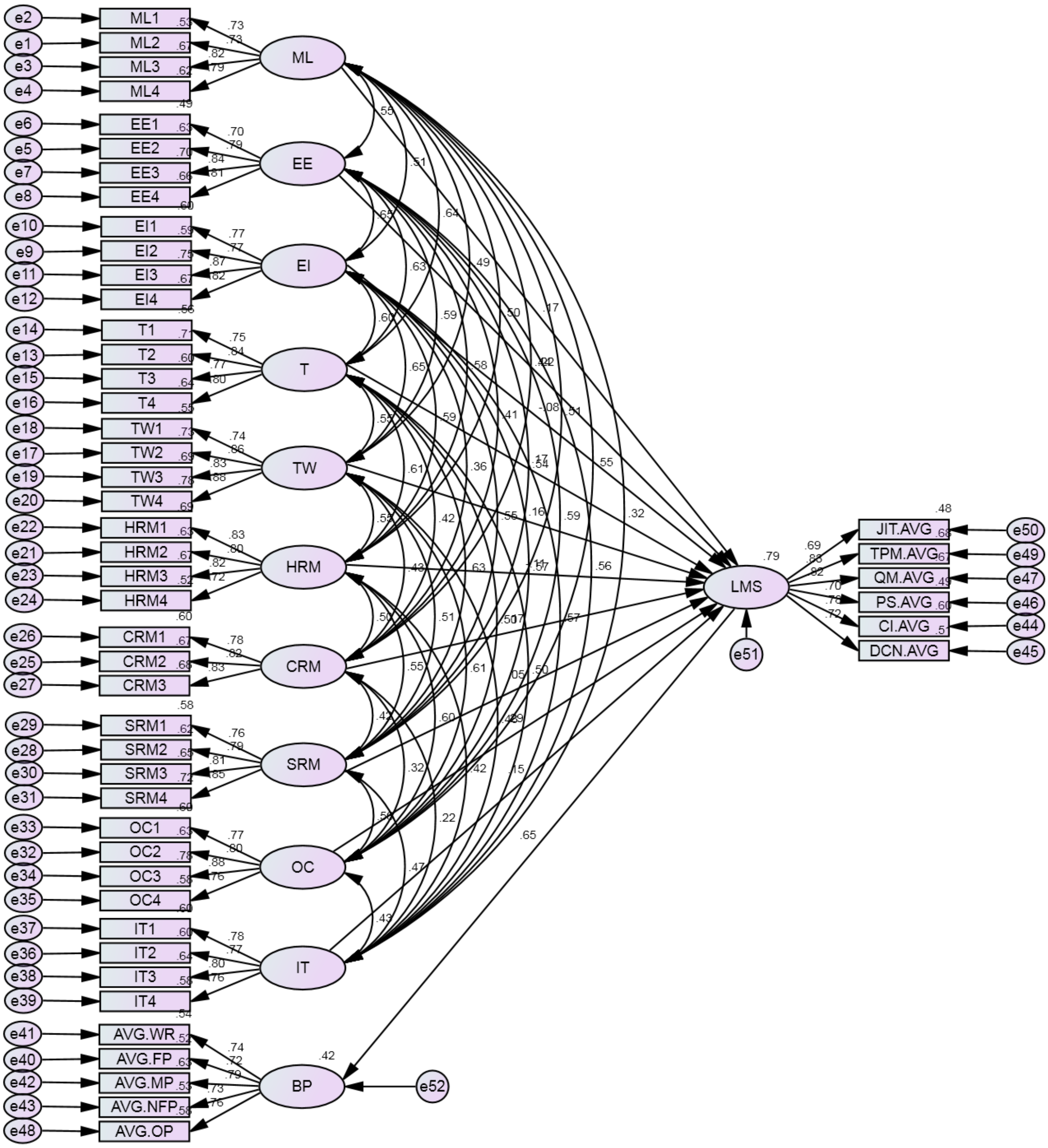


Figure 5.9: Structural Path Model with Standardized Estimates

Table 5.16: Results of Hypotheses Tests

Hypothesis	Relationship	*β*	Support
H1	Management leadership→ Lean manufacturing implementation	0.166*	Yes
H2	Employee empowerment→ Lean manufacturing implementation	0.221**	Yes
H3	Employee involvement →Lean manufacturing implementation	-0.084	No
H4	Training→ Lean manufacturing implementation	0.167*	Yes
H5	Teamwork→ Lean manufacturing implementation	0.159*	Yes
H6	Human resource management→ Lean manufacturing implementation	-0.112	No
H7	Customer relationship management→ Lean Manufacturing implementation	0.168**	Yes
H8	Supplier relationship management→ Lean manufacturing implementation	0.046	No
H9	Organizational change→ Lean manufacturing implementation	0.287***	Yes
H10	Information technology→ Lean manufacturing implementation	0.148*	Yes
H11	Lean manufacturing implementation→ Business performance	0.646***	Yes

* p < .05; ** p < .01; *** p < .001

5.5 Controlling for Effects of Demographics Variables

5.5.1 Firm maturity (years of establishment)

To test whether there are any differences in level of implementation of different lean dimensions in terms of firm maturity (years of establishment) Multivariate Analysis of Variance (MANOVA) was conducted using IBM SPSS V.20.0. MANOVA is a statistical test procedure for comparing multivariate (population) means of several groups (Huberty & Morris, 1989). Years of establishment in this study was questioned using a single question, which employs a five-point *Likert* scale. This scale ranges from (1), less than five years; (2), five to ten years; (3), ten to fifteen years (4), fifteen to twenty years; to (5), more than twenty years. The results of this test are discussed in following;

The first output of MANOVA is the descriptive statistics which is shown in Table 5.17, which offers valuable information as it provides the mean and standard deviation for the six different dependent variables (JIT, TPM, QM, PS, CI, and DCN), that have been split by the independent variable which is the level of firm maturity (The complete output of this MANOVA test is provided in Appendix C7). One of the basic assumptions of the MANOVA is the homogeneity of covariances. The results of *Box's*

Test of Equality of Covariance Matrices show that the assumption of homogeneity of covariances is not violated because $p > 0.001$ (Box's M=112.400, P=0.080), thus, it is valid to proceed with the rest of MANOVA test. The results of multivariate test suggests that there is a statistically significant difference in level of lean manufacturing implementation in terms of year of establishment of businesses (business maturity or company age) as; F (5, 678) = 7.378, $p < .0005$; *Wilk*'s $\lambda = 0.445$, partial $\varepsilon^2 = 0.183$.

At the next step and after understating that multivariate variance difference is significant (lean manufacturing in general is affected by the company age), univariate ANOVAs (analysis of variance) should be performed to see if there are any significant differences in level of implementation of each different dimensions of lean manufacturing in terms of years of establishment. It is important to mention that before performing univariate ANOVAs, the homogeneity of variances should be checked. The *Levene's Test of Equality of Error Variances* shows that all scores excluding the score of DCN have homogeneity of variances as $p>0.05$ (p_{JIT}= 0.203, p_{TPM}=0.220, p_{QM}= 0.350, p_{PS}=0.169, p_{CI}= 0.673, and p_{DCN}=0.005). Accordingly, *Tests of Between-Subjects Effect* are done for Just-in-time (JIT), Total Preventive Maintenance (TPM), Quality Management (QM), Pull System (PS), and Continuous Improvement (CI) to see if there are any significant differences in level of implementation of JIT, TPM, QM, PS, and CI in terms of years of establishment. Similarly, and for DCN as the only dimension violating the homogeneity of variances, the *Robust Tests of Equality of Means* is performed to check for differences in level of implementation in terms of years of establishment. The results of tests of between-subjects effect for JIT, TPM, QM, PS, and CI suggest that years of establishment has a statistically significant effect on JIT (F (4, 199) = 15.992; P <0.0005; partial ε^2 = 0.243), TPM (F (4, 199) = 25.909; P <0.0005; partial ε^2 = 0.342), QM (F (4, 199) = 26.595; P <0.0005; partial ε^2 = 0.348), PS (F (4, 199) = 21.360; P <0.0005; partial ε^2 = 0.300), and CI (F (4, 199) = 27.378; P <0.0005;

partial ε^2 = 0.355). Similarly, the robust test of equality of means for DCN suggests that there is a statistically significant difference in the level of implementation of DCN in terms of years of establishment as *p* value for *Wlech* statistics is less than 0.05 (*Wlech* =19.047, *p*=0.026). At the final step, these significant ANOVAs are followed up with *Tukey's HSD post-hoc* and *Games-Howell* tests which are shown in the multiple comparisons tables (MANOVA and ANOVA multiple comparisons tables in Appendix C7). An in-depth review of results of *Tukey's* HSD post-hoc tests suggests that for all the six dimensions of lean manufacturing, there is a significant difference in level of implementation when years of establishment in cases. In fact, for all the six dimensions, the mean difference between five different years of establishment (firm maturity) is negative. Accordingly, the results of different sub-tests of MANOVA collectively demonstrate that there is a negative relationship between the years of establishment of Malaysian automotive parts manufacturers and the extent to which they have implemented lean manufacturing. In other words, the MANOVA test suggests that the rate of LMS implementation applied in older companies does not necessarily translate into higher degrees of effectiveness (in all dimensions), if compared against younger Malaysian automotive parts manufacturers with higher aggressiveness levels of implementation efforts.

Table 5.17: Descriptive Statistics- Firm’s Maturity

Firm’s maturity		Mean	Std. Deviation	N
JIT.AVG	Below 5	3.8276	.48486	29
	5-10	3.6369	.48106	56
	10-15	3.4520	.40001	59
	15-20	3.2326	.58434	43
	20 and above	2.7843	.60025	17
	Total	3.4542	.56303	204

‘Table 5.17, continued’

Firm’s maturity		Mean	Std. Deviation	N
TPM.AVG	Below 5	4.0690	.46376	29
	5-10	3.8286	.51653	56
	10-15	3.4102	.41759	59
	15-20	3.3163	.59399	43
	20 and above	2.7294	.63222	17
	Total	3.5422	.62429	204
QM.AVG	Below 5	3.8103	.50734	29
	5-10	3.7188	.45242	56
	10-15	3.3220	.40750	59
	15-20	3.1047	.46686	43
	20 and above	2.6912	.62205	17
	Total	3.4020	.57306	204
PS.AVG	Below 5	3.5603	.49846	29
	5-10	3.3750	.51346	56
	10-15	3.1949	.37448	59
	15-20	2.9302	.54915	43
	20 and above	2.3971	.43354	17
	Total	3.1740	.56454	204
CI.AVG	Below 5	4.2155	.51636	29
	5-10	3.9107	.57688	56
	10-15	3.5212	.46952	59
	15-20	3.2209	.59814	43
	20 and above	2.8676	.53850	17
	Total	3.6091	.66681	204
DCN.AVG	Below 5	4.3017	.46951	29
	5-10	3.9509	.44318	56
	10-15	3.7924	.39159	59
	15-20	3.6105	.58833	43
	20 and above	2.8676	.63810	17
	Total	3.7929	.59477	204

5.5.2 Business size

In addition, and to understand if there are any differences in level of implementation of different lean dimensions in terms of business size the MANOVA test was used. Business size in this study has been defined as the total number of employees and was questioned using a single question, which employs a four-point *Likert* scale which is shown in Table 5.1.

The first output of MANOVA for this test is the descriptive statistics which is shown in Table 4.18, which offers valuable information as it provides the mean and standard deviation for the six different dependent variables (JIT, TPM, QM, PS, CI, and DCN), that have been split by the independent variable which is the level of firm maturity (The complete output of this MANOVA test is provided in Appendix C8). The results of Box's test of equality of covariance matrices show that the assumption of homogeneity of covariance is not violated because $p > 0.001$ (Box's M=112.400, P=0.815), thus, it is valid to proceed with the rest of MANOVA test. The results of multivariate test suggests that in general, there is no statistically significant difference in level of LMS implementation in terms of business size as; F (5, 678) = 1.449, p = 0.103; *Wilk*'s $\lambda = 0.887$, partial $\varepsilon^2 = 0.043$.

Table 5.18: Descriptive Statistics- Business Size

	Business size	Mean	Std. Deviation	N
JIT.AVG	<50	2.5556	.50918	3
	51-150	3.4068	.54340	59
	151-250	3.5000	.55505	78
	>250	3.4844	.56634	64
	Total	3.4542	.56303	204
TPM.AVG	<50	2.6667	.94516	3
	51-150	3.4881	.54617	59
	151-250	3.5205	.62364	78
	>250	3.6594	.65094	64
	Total	3.5422	.62429	204
QM.AVG	<50	2.7500	1.25000	3
	51-150	3.2924	.53770	59
	151-250	3.4263	.52858	78
	>250	3.5039	.59843	64
	Total	3.4020	.57306	204
PS.AVG	<50	2.5833	.72169	3
	51-150	3.1017	.56500	59
	151-250	3.1699	.51832	78
	>250	3.2734	.59715	64
	Total	3.1740	.56454	204
.AVG	<50	3.0000	.50000	3
	51-150	3.6186	.61999	59
	151-250	3.6090	.73036	78
	>250	3.6289	.63307	64
	Total	3.6091	.66681	204
DCN.AVG	<50	3.0833	1.12731	3
	51-150	3.8644	.57484	59
	151-250	3.7821	.60351	78
	>250	3.7734	.56645	64
	Total	3.7929	.59477	204

5.5.3 Years of involvement in LMS

Another application of MANOVA test in this study is to investigate whether higher experience with LMS among Malaysian auto part manufacturers is associated with any specific differences in level of implementation of different lean dimensions. Years of involvement in LMS system in this study was questioned using a single question, which employs a four-point *Likert* scales as shown in Table 5.1.

The first output of MANOVA to interpret is the descriptive statistics which is shown in Table 5.19. This Table lists the mean and standard deviation for the six different dependent variables namely JIT, TPM, QM, PS, CI, and DCN that have been split by different levels of involvement in LMS (the complete output of this MANOVA test is provided in Appendix C9). The results of Box's test of equality of covariance matrices show that the assumption of homogeneity of covariance is met because $p > 0.001$ (Box's M = 68.956, P=0.514). The results of multivariate test suggests that in general, there is a statistically significant difference in level of LMS implementation in terms of years of involvement in LMS system given; $F(18, 552) = 2.995, p = 0.000$; *Wilk*'s $\lambda = 0.768$, partial $\varepsilon^2 = 0.084$.

In this particular case, the Levene's Test of Equality of Error Variances explains that all scores have homogeneity of variances as $p>0.05$ (Appendix C9). Accordingly, Tests of Between-Subjects Effect are done for JIT, TPM, QM, PS, CI, and DCN to highlight potential significant differences in level of implementation of these six LMS dimensions in terms of levels of involvement in LMS. Results of these tests notify us that there is a significant difference in level of implementation of TPM ($F(3, 200) = 7.887$; $P < 0.0005$; partial $\varepsilon^2 = 0.106$), QM ($F(3, 200) = 6.363$; $P < 0.0005$; partial $\varepsilon^2 = 0.087$), PS ($F(3, 200) = 3.523$; $P < 0.025$; partial $\varepsilon^2 = 0.050$), CI ($F(3, 200) = 5.294$; $P < 0.001$; partial $\varepsilon^2 = 0.074$) and DCN ($F(3, 200) = 3.987$; $P < 0.001$; partial $\varepsilon^2 = 0.056$) between manufacturers with different level of involvement in LMS activities. In fact, the results suggest that in general, intensity of implementation of TPM, QM, PS, CI, and DCN for Malaysian automotive part manufacturers with more experience of involvement in LMS is higher compared to those manufactures new to LMS.

Table 5.19: Descriptive Statistics- Years of involvement in LMS

	Years involved in LMS	Mean	Std. Deviation	N
JIT.AVG	Less than 1 year	3.3000	0.56844	50
	1-3 years	3.4877	0.53882	95
	More than 3 years but Less 5 years	3.4638	0.54196	46
	More 5 years	3.7692	0.67199	13
	Total AVG	3.4542	0.56303	204
TPM.AVG	Less than 1 year	3.2240	0.67569	50
	1-3 years	3.5726	0.55399	95
	More than 3 years but Less 5 years	3.7217	0.57268	46
	More 5 years	3.9077	0.63043	13
	Total AVG	3.5422	0.62429	204
QM.AVG	Less than 1 year	3.1750	0.53273	50
	1-3 years	3.4684	0.54607	95
	More than 3 years but Less 5 years	3.3804	0.57189	46
	More 5 years	3.8654	0.59174	13
	Total AVG	3.4020	0.57306	204
PS.AVG	Less than 1 year	3.0150	0.64959	50
	1-3 years	3.2000	0.50212	95
	More than 3 years but Less 5 years	3.1848	0.53081	46
	More 5 years	3.5577	0.60513	13
	Total AVG	3.1740	0.56454	204
CI.AVG	Less than 1 year	3.3100	0.63197	50
	1-3 years	3.7368	0.61817	95
	More than 3 years but Less 5 years	3.6087	0.67629	46
	More 5 years	3.8269	0.79310	13
	Total AVG	3.6091	0.66681	204
DCN.AVG	Less than 1 year	3.585	0.59033	50
	1-3 years	3.9289	0.55981	95
	More than 3 years but Less 5 years	3.7391	0.60082	46
	More 5 years	3.7885	0.64425	13
	Total AVG	3.7929	0.59477	204

5.6 In-depth Analysis of Relationships between LMS Implementation and Business Performance

After controlling for effects of three important demographic variables, and to see whether difference in business performance improvement is associated with intensity of LMS implementation among Malaysian automotive parts manufacturers, seven (7) different MANOVA tests were performed. By performing the first six MANOVA test it is analyzed if increases in intensity of implantation of different dimensions of lean manufacturing (JIT, TPM, QM, PS, CI, and DCN) result in the improvement of business performance regarding the five different dimensions (WR, FP, MP, NFP and OP). In doing so, and to provide a practical scale of assessing the intensity of implementation of different lean dimensions, the average score for each of dimension were recorded into categorical data by defining;

- Any score ≤ 2.99, transform to 1 (Non implementers);
- 3 ≤ any score ≤ 3.99, transform to 2 (Transitional implementers);
- Any score ≥ 4.00, transform to 3 (Full implementers).

Accordingly, the scores of different dimensions of LMS implementation are transformed from continuous data to categorical data including three different categories. For the seventh MANOVA test, all the six dimension of LMS implementation are averaged into a comprehensive single variable called *Omnibus Lean Manufacturing (OLM)*. The seventh MANOVA test therefore aims to examine if any increase in intensity of OLM implementation among Malaysian automotive parts manufacturers results in the improvement of business performance regarding the five different dimensions (WR, FP, MP, NFP, and OP). In doing so, and to provide a practical scale of assessing the intensity of implementation of OLM, the score for OLM was recorded into the categorical data by defining;

- Any score ≤ 2.99, transform to 1 (Low implementation);

- $3 \leq$ any score ≤ 3.99, transform to 2 (Moderate implementation);
- Any score ≥ 4.00, transform to 3 (Full-blown implementation).

5.6.1 MANOVA Test of Just-in-Time (JIT)

Table 5.20 is the first output of MANOVA test for JIT which provides the mean and standard deviation for the three different categories of JIT implementation (The complete output of this MANOVA test is provided in Appendix C10). The Box's test of equality of covariance matrices suggests that $p > 0.001$ ($P = 0.004$), thus, the assumption of homogeneity of covariance is not violated and it is possible to proceed with the rest of MANOVA test. The results of multivariate test (Table in the said Appendix C10) indicates that there is a statistically significant difference in level of business performance in terms of level of JIT implementation as; F (3, 394) = 4.795, $p < .0005$; *Wilk*'s λ = 0.795, partial ε^2 = 0.108. Next, and after understating that multivariate variance difference is significant and firm performance is significantly affected by level of JIT implementation, univariate ANOVAs are performed to see if there are any significant differences in mean of each different dimensions of business performance in terms of levels of JIT implementation. The Levene's test of equality of error variances suggests that for FP, MP, NFP, and OP homogeneity of variances is not violated as $p >$ 0.05, thus, tests of between-subjects effect for FP, MP, NFP, and OP, and robust tests of equality of means for WR are performed to see if there are any significant differences in level of implementation of WR, FP, MP, NFP, and OP in terms of levels of JIT implementation.

The results of tests of between-subjects effect for FP, MP, NFP, and OP suggest that level of JIT implementation has significant effects on FP (F (2, 201) = 9.330; $P <$ 0.0005; partial ε^2 = 0.085), MP (F (2, 201) = 17.590; $P <$ 0.0005; partial ε^2 = 0.149), NFP (F (2, 201) = 10.890; $P <$ 0.0005; partial ε^2 = 0.098), and OP (F (2, 201) =

15.453; $P < 0.0005$; partial $\varepsilon^2 = 0.133$). Similarly, the robust test of equality of means for WR suggests that there is a statistically significant difference in level of WR in terms of level of JIT implementation as *p* value for *Wlech* statistics is less than 0.05 (*Wlech* =7.105, *p*=0.002). At the final step, these significant ANOVAs are followed up with *Tukey's HSD* post-hoc and Games-Howell tests which are shown in the multiple comparisons table (Table Multiple Comparisons in Appendix C10). These results suggest that there are positive significant relationships between the level of JIT implementation and the level of business performance achievement in all the five dimensions. In other words, among Malaysian automotive parts manufacturer, transitional implementers of JIT have achieved WR, FP, MP, and OP significantly more compared to non-implementers. Consistently, full implementers of JIT have been significantly more successful in achieving WR, FP, MP, NFP, and OP compared to non-implementers, and significantly more successful in achieving FP, MP, NFP, and OP compared to transitional implementers. The results also suggest that full implementers of JIT have benefited the most form OP and MP, respectively.

Table 5.20: Descriptive Statistics- JIT Implementation Level

JIT.impl.lvl		Mean	Std. Deviation	N
AVG.WR	Non implementers	3.1200	.74946	20
	Transitional Implementers	3.5522	.53521	138
	Full Implementers	3.7435	.42929	46
	Total AVG	3.5529	.55986	204
AVG.FP	Non implementers	3.0333	.69164	20
	Transitional Implementers	3.3816	.50713	138
	Full Implementers	3.6377	.53898	46
	Total AVG	3.4052	.55586	204
AVG.MP	Non implementers	3.0375	.66032	20
	Transitional Implementers	3.3351	.48846	138
	Full Implementers	3.7446	.43617	46
	Total AVG	3.3983	.53545	204

‘Table 5.20, continued’

JIT.impl.lvl		Mean	Std. Deviation	N
AVG.NFP	Non implementers	3.0800	.61009	20
	Transitional Implementers	3.3000	.51616	138
	Full Implementers	3.6522	.51022	46
	Total AVG	3.3578	.54942	204
AVG.OP	Non implementers	3.0000	.79885	20
	Transitional Implementers	3.4438	.56754	138
	Full Implementers	3.8370	.53546	46
	Total AVG	3.4890	.62693	204

5.6.2 MANOVA Test of Total Preventive Maintenance (TPM)

After understanding the impact of JIT implementation over performance achievement among Malaysian automotive part manufactures, the effect of TPM in performance achievement was tested using MANOVA test. Accordingly, the first output of this test for TPM is listed in Table 5.21, which provides the mean and standard deviation for the three different categories of TPM implementation. For this test, the assumption of homogeneity of covariance is violated and it is not possible to proceed with the rest of MANOVA test because the Box's test of equality of covariance matrices suggests $p<0.001$ (p=*0.000099).* Accordingly, the researcher performed five different ANOVA tests instead of the MANOVA test. The results of these five ANOVA tests are presented in Appendix C11. The results of these tests suggest that for all the five business performance dimensions (WR, FP, MP, NFP, and OP) the assumption of homogeneity of variance is met as the *Levene's test* Statistic has a significant value ($p>0.05$) for each of business performance dimensions. The ANOVA tests indicate that in all dimension of business performance there is a statistically significant mean difference between non-implementers, transitional implementers, and full implementers. The multiple comparison tables (Appendix C11) suggest that there are positive significant relationships between the level of TPM implementation and the level of business performance achievement in all the five dimensions. In other words, among Malaysian automotive parts manufacturer, transitional implementers of TPM have achieved WR, FP, MP, NFP, and OP significantly more compared to non-implementers. Consistently, full implementers of TPM have been significantly more successful in achieving MP, NFP, and OP compared to transitional implementers, and more successful in achieving WR, FP, MP, NFP, and OP compared to non-implementers.

Table 5.21: Descriptive Statistics – Total Preventive Maintenance

	TPM.impl.lvl	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.1154	.63793	26
	Transitional Implementers	3.5664	.52356	119
	Full Implementers	3.7186	.49982	59
	Total AVG	3.5529	.55986	204
AVG.FP	Non implementers	3.0256	.52428	26
	Transitional Implementers	3.3950	.49282	119
	Full Implementers	3.5932	.60669	59
	Total AVG	3.4052	.55586	204
AVG.MP	Non implementers	2.9904	.43864	26
	Transitional Implementers	3.3824	.49126	119
	Full Implementers	3.6102	.55567	59
	Total AVG	3.3983	.53545	204
AVG.NFP	Non implementers	2.8923	.43902	26
	Transitional Implementers	3.3378	.50673	119
	Full Implementers	3.6034	.54010	59
	Total AVG	3.3578	.54942	204
AVG.OP	Non implementers	2.9135	.51450	26
	Transitional Implementers	3.4874	.56920	119
	Full Implementers	3.7458	.62196	59
	Total AVG	3.4890	.62693	204

5.6.3 MANOVA Test of Quality Management (QM)

The third step for performing the in-depth analysis of relationships between LMS implementation and business performance is to conduct the MANOVA test for QM and performance achievement. Table 5.22 presents the first output of MANOVA test for QM which provides the mean and standard deviation for the three different categories of QM implementation (Appendix C12 provides the complete output of MANOVA test for QM). The Box's test of equality of covariance matrices revealed $p > 0.001$ ($p = 0.270$). Thus, the assumption of homogeneity of covariance is met and it is possible to proceed with the rest of MANOVA test. The results of multivariate test (Appendix C12) indicates that there is a statistically significant difference in level of business performance achievement in terms of level of QM implementation as; F (3, 394) = 7.905p <.0005; *Wilk's* λ = 0.694, partial ε^2 = 0.167. Next, and after understating that multivariate variance difference is significant and firm performance is significantly affected by level of QM implementation, univariate ANOVAs are performed to see if there are any significant differences in mean of different dimensions of business performance in terms of levels of QM implementation for Malaysian automotive part manufacturers. The Levene's test of equality of error variances suggests that for WR, FP, MP, NFP, and OP homogeneity of variances is not violated as p> 0.05, thus, tests of between-subjects effect are performed to reveal any significant differences in level of implementation of WR, FP, MP, NFP, and OP in terms of levels of QM implementation.

The results of tests of between-subjects effect for FP, MP, NFP, and OP suggest that level of QM implementation has significant effects on WR(F (2, 201) = 12.884; P < 0.0005; partial ε^2 = 0.114), FP (F (2, 201) = 17.959; P < 0.0005; partial ε^2 = 0.152), MP (F (2, 201) = 30.227; P < 0.0005; partial ε^2 = 0.231), NFP (F (2, 201) = 21.064; P < 0.0005; partial ε^2 = 0.173), and OP (F (2, 201) = 29.197; P < 0.0005; partial ε^2 = 0.225). Finally, and after understanding that ANOVAs are significant, *Tukey's HSD* post-hoc tests which are shown in the multiple comparisons table (Appendix C12) were performed. These results suggest that there are positive significant relationships between the level of QM implementation and the level of business performance achievement in all the five dimensions. This finding means that, among Malaysian automotive parts manufacturer, transitional implementers of QM have achieved WR, FP, MP, NFP, and OP significantly more compared to non-implementers. Consistently, full implementers of QM have been significantly more successful in achieving WR, FP, MP, NFP, and OP compared to both none and transitional implementers. The results finally reveal that

Malaysian automotive part manufacturers those who are full implementers of QM have particularly benefited from OP and MP, respectively.

Table 5.22: Descriptive Statistics – Quality Management

	QM.impl.lvl	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.1417	.61709	24
	Transitional Implementers	3.5318	.53239	129
	Full Implementers	3.8000	.47666	51
	Total AVG	3.5529	.55986	204
AVG.FP	Non implementers	2.9861	.51527	24
	Transitional Implementers	3.3592	.51305	129
	Full Implementers	3.7190	.51800	51
	Total AVG	3.4052	.55586	204
AVG.MP	Non implementers	2.8958	.43562	24
	Transitional Implementers	3.3450	.49033	129
	Full Implementers	3.7696	.43830	51
	Total AVG	3.3983	.53545	204
AVG.NFP	Non implementers	2.9250	.37677	24
	Transitional Implementers	3.3054	.52146	129
	Full Implementers	3.6941	.50176	51
	Total AVG	3.3578	.54942	204
AVG.OP	Non implementers	2.8542	.58475	24
	Transitional Implementers	3.4496	.54877	129
	Full Implementers	3.8873	.55523	51
	Total AVG	3.4890	.62693	204

5.6.4 MANOVA Test of Pull System (PS)

The fourth MANOVA test is aimed to test if the difference in business performance improvement is associated with intensity of PS implementation. The descriptive output of this test which is presented in Table 5.23 offers the mean and standard deviation for the three different categories of PS implementation (The complete output of MANOVA test for PS is provided in Appendix C13). The Box's test of equality of covariance matrices gives $p > 0.001$ (p=0.064), thus, the assumption of homogeneity of covariance is not violated and it is valid to proceed with the rest of MANOVA test. The results of multivariate test (Appendix C13) indicate that there is a statistically significant difference in level of business performance in terms of level of PS implementation as; F (3, 394) = 4.192, $p < .0005$; *Wilk*'s $\lambda = 0.817$, partial $\varepsilon^2 = 0.096$.

In the next step, and after confirming that multivariate variance difference is significant and firm performance is significantly affected by level of PS implementation among Malaysian automotive part manufacturers, more detailed univariate ANOVAs were performed. The Levene's test of equality of error variances suggests that for WR, FP, MP, NFP, and OP homogeneity of variances is not violated as $p > 0.05$, thus, tests of between-subjects effect for WR, FP, MP, NFP, and OP are performed to see the potential significant differences in level of implementation of WR, FP, MP, NFP, and OP in terms of levels of PS implementation.

The results of tests of between-subjects effect for WR, FP, MP, NFP, and OP explain that level of JIT implementation has significant effects on WR(F (2, 201) = 3.878; $P = 0.022$; partial $\varepsilon^2 = 0.37$, FP (F (2, 201) = 6.006; $P = 0.003$; partial $\varepsilon^2 = 0.56$), MP (F (2, 201) = 8.525; $P < 0.0005$; partial $\varepsilon^2 = 0.078$), NFP (F (2, 201) = 14.495; $P < 0.0005$; partial $\varepsilon^2 = 0.126$), and OP (F (2, 201) = 11.885; $P < 0.0005$; partial $\varepsilon^2 = 0.106$). At the final step, these significant ANOVAs are followed up with *Tukey's HSD* post-hoc tests which are shown in the multiple comparisons table (Appendix C13). Based on these results, it is concluded that there are positive significant relationships between the level of PS implementation and the level of business performance achievement in all the five dimensions. In fact, this finding suggests that among Malaysian automotive parts manufacturer, transitional implementers of PS have achieved NFP and OP significantly more compared to non-implementers. Consistently, full implementers of PS have been significantly more successful in achieving WR, FP, MP, NFP, and OP compared to transitional implementers. The results also revealed that NFP and OP, respectively, are performances dimensions that full implementers of PS have benefited the most from.

Table 5.23: Descriptive Statistics – Pull System

	PS.impl.lvl	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.3962	.54981	53
	Transitional Implementers	3.5832	.55472	131
	Full Implementers	3.7700	.54008	20
	Total AVG	3.5529	.55986	204
AVG.FP	Non implementers	3.2453	.48106	53
	Transitional Implementers	3.4198	.55714	131
	Full Implementers	3.7333	.59824	20
	Total AVG	3.4052	.55586	204
AVG.MP	Non implementers	3.2689	.46732	53
	Transitional Implementers	3.3855	.54707	131
	Full Implementers	3.8250	.42224	20
	Total AVG	3.3983	.53545	204
AVG.NFP	Non implementers	3.1509	.47702	53
	Transitional Implementers	3.3618	.54975	131
	Full Implementers	3.8800	.35777	20
	Total AVG	3.3578	.54942	204
AVG.OP	Non implementers	3.1887	.53687	53
	Transitional Implementers	3.5496	.60082	131
	Full Implementers	3.8875	.70466	20
	Total AVG	3.4890	.62693	204

5.6.5 MANOVA Test of Continuous Improvement (CI)

Consistent with other tests of MANOVA performed in this study, Table 5.24 is firstly presents as the first output of MANOVA test for CI, which provides the mean and standard deviation for the three different categories of CI implementation (The complete output of MANOVA test for CI is provided in Appendix C14). The Box's test of equality of covariance matrices suggests that the assumption of homogeneity of covariance is not violated $p > 0.001$ (p=0.265) and it is possible to proceed with the remaining inferential tests of MANOVA. The results of multivariate test indicates that there is a statistically significant difference in level of business performance in terms of level of CI implementation in this study as; F (3, 394) = 5.762 $p < .0005$; *Wilk's* λ = 0.761, partial $\varepsilon^2 = 0.128$. At the next step and after ensuring that there are differences in multivariate variance, and understanding the fact that firm performance is significantly affected by level of CI implementation, univariate ANOVAs are performed to see if there are any significant differences in mean of different dimensions of business performance in terms of levels of CI implementation. The Levene's test of equality of error variances suggests that for WR, FP, MP, NFP, and OP homogeneity of variances is not violated as $p > 0.05$, and therefore, tests of between-subjects effect are performed to see the potential significant differences in level of implementation of WR, FP, MP, NFP, and OP in terms of levels of CI implementation.

The tests of between-subjects effect for FP, MP, NFP, and OP and relative outputs demonstrated that level of CI implementation has significant effects on WR (F (2, 201) = 7.244; $P < 0.001$; partial $\varepsilon^2 = 0.067$),FP (F (2, 201) = 7.275; $P < 0.001$; partial $\varepsilon^2 = 0.068$), MP (F (2, 201) = 23.251; $P < 0.0005$; partial $\varepsilon^2 = 0.190$), NFP (F (2, 201) = 13.005; $P < 0.0005$; partial $\varepsilon^2 = 0.115$), and OP (F (2, 201) = 19.120; $P < 0.0005$; partial $\varepsilon^2 = 0.160$). Finally, these significant ANOVAs are followed up with *Tukey's HSD* post-hoc tests which are shown in the multiple comparisons table (Appendix C14). These results suggest that there are positive significant relationships between the level of CI implementation and the level of business performance achievement in all the five dimensions among the manufacturers studied in this research. The results explain that, among Malaysian automotive parts manufacturer, although there is no significant difference in level of achieving WR, FP, MP, NFP, and OP between transitional implementers and non-implementers of CI, however, full implementers of CI have been significantly more successful in achieving WR, FP, MP, NFP, and OP compared to both none and transitional implementers, which further signify the importance of deep implementation of CI for surveyed businesses. In this regards, the results suggest that full implementers of CI have benefited the most form OP and MP, respectively.

Table 5.24: Descriptive Statistics –Continuous Improvement

	CI.impl.lvl	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.3091	.60388	22
	Transitional Implementers	3.4673	.56418	98
	Full Implementers	3.7167	.50080	84
	Total AVG	3.5529	.55986	204
AVG.FP	Non implementers	3.1212	.49916	22
	Transitional Implementers	3.3367	.56733	98
	Full Implementers	3.5595	.51526	84
	Total AVG	3.4052	.55586	204
AVG.MP	Non implementers	3.1023	.44091	22
	Transitional Implementers	3.2296	.51357	98
	Full Implementers	3.6726	.45914	84
	Total AVG	3.3983	.53545	204
AVG.NFP	Non implementers	3.0545	.50965	22
	Transitional Implementers	3.2449	.52448	98
	Full Implementers	3.5690	.51624	84
	Total AVG	3.3578	.54942	204
AVG.OP	Non implementers	3.1023	.67989	22
	Transitional Implementers	3.3291	.55682	98
	Full Implementers	3.7768	.57301	84
	Total AVG	3.4890	.62693	204

5.6.6 MANOVA Test of Design for Customer Needs (DCN)

Regarding the last dimension of LMS, and to see if difference in business performance improvement is associated with intensity of DCN implementation, MANOVA test is performed. Table 5.25, as the first output of MANOVA test for DCN offers the mean and standard deviation for the three different categories of PS implementation (The complete output of MANOVA test for DCN is provided in Appendix C15). The Box's test of equality of covariance matrices suggests that as expected, the assumption of homogeneity of covariance is met $p > 0.001$ ($p=0.245$) and it is valid to proceed with the rest of MANOVA test. The results of multivariate test for DCN (Appendix C15) indicates that there is a statistically significant difference in level of business performance in terms of level of DCN implementation as; F (3, 394) = 3.303 $p < .0005$; *Wilk*'s $\lambda = 0.851$, partial $\varepsilon^2 = 0.077$. Accordingly, and having the difference in multivariate variance confirmed due to the fact that firm performance is significantly affected by level of DCN implementation, univariate ANOVAs are performed to see if there are any significant differences in mean of different dimensions of business performance in terms of levels of DCN implementation. The Levene's test of equality of error variances suggests that for WR, FP, MP, NFP, and OP homogeneity of variances is not violated as $p > 0.05$, thus, tests of between-subjects effect are performed to see if there are any significant differences in level of implementation of WR, FP, MP, NFP, and OP in terms of levels of DCN implementation.

The results of tests of between-subjects effect for FP, MP, NFP, and OP suggest that level of DCN implementation has significant effects on WR(F (2, 201) = 8.222; $P < 0.0005$; partial $\varepsilon^2 = 0.076$),FP (F (2, 201) = 9.079; $P < 0.0005$; partial $\varepsilon^2 = 0.083$), MP (F (2, 201) = 13.422; $P < 0.0005$; partial $\varepsilon^2 = 0.118$), NFP (F (2, 201) = 5.099; $P < 0.01$; partial $\varepsilon^2 = 0.048$), and OP (F (2, 201) = 9.289; $P < 0.0005$; partial $\varepsilon^2 = 0.085$). Finally, these significant ANOVAs are followed up with *Tukey*'s HSD post-hoc tests which are shown in the multiple comparisons table (Appendix 15). These results suggest that there are positive significant relationships between the level of DCN implementation and the level of business performance achievement in all the five dimensions. The results suggest that, among Malaysian automotive parts manufacturer, although there is no significant difference in level of achieving WR, FP, MP, NFP, and OP between transitional implementers and non-implementers of DCN, however, full implementers of DCN have been significantly more successful in achieving WR, FP, MP, NFP, and OP compared to non-implementers, and have been significantly more successful in achieving WR, FP, MP, and OP compared to transitional implementers. The results also suggest that full implementers of CI have benefited the most form OP and MP, respectively.

Table 5.25: Descriptive Statistics – Design for Customer Needs

	DCN.impl.lvl	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.1867	.62091	15
	Transitional Implementers	3.4410	.57331	78
	Full Implementers	3.6811	.50552	111
	Total AVG	3.5529	.55986	204
AVG.FP	Non implementers	3.0000	.56344	15
	Transitional Implementers	3.2991	.55981	78
	Full Implementers	3.5345	.51302	111
	Total AVG	3.4052	.55586	204
AVG.MP	Non implementers	3.0500	.56852	15
	Transitional Implementers	3.2340	.51651	78
	Full Implementers	3.5608	.48876	111
	Total AVG	3.3983	.53545	204
AVG.NFP	Non implementers	3.0267	.52300	15
	Transitional Implementers	3.2897	.52238	78
	Full Implementers	3.4505	.55167	111
	Total AVG	3.3578	.54942	204
AVG.OP	Non implementers	3.0333	.66726	15
	Transitional Implementers	3.3654	.59310	78
	Full Implementers	3.6374	.60089	111
	Total AVG	3.4890	.62693	204

5.6.7 MANOVA Test of Omnibus Lean Manufacturing (OLM)

As explained earlier, the seventh MANOVA test aims to examine if any increase in the intensity of OLM (average of all dimensions of lean) implementation among Malaysian automotive parts manufacturers results in the improvement of business performance. The first output of MANOVA test for OLM is listed in Table 5.26 which provides the mean and standard deviation for the three different categories of OLM (low implementation, moderate implementation, and full-blown implementation). The Box's test of equality of covariance matrices shows that $p<0.001$ ($p=0.000018$), thus, the assumption of homogeneity of covariance is not met and it is not valid to proceed with the rest of MANOVA test. Accordingly, the researcher performs five different ANOVA tests instead of the MANOVA test. The results of these five ANOVA tests are presented in Appendix C16. The Levene's test of equality of error variances shows that only scores of FP and OP met the homogeneity of variances as $p>0.05$ ($p_{JFP}= 0.642$ and $p_{OP}=0.731$). Accordingly, tests of *Between-Subjects effect* are done for FP and OP to see if there are any significant differences in achievement of FP and OP in terms of levels of OLM. Similarly, and for WR, MP, and NFP as the only dimension violating the homogeneity of variances, the *robust tests of equality of means* is performed to check for differences in level of business performance in terms of levels of OLM. The results of tests of between-subjects effect for FP and OP suggest that OLM has a statistically significant effect on both FP ($F\,(2,\ 201) = 22.745$; $P < 0.0005$) and OP ($F\,(2,\ 201) = 28.714$; $P < 0.0005$). Similarly, the robust tests of equality of means for WR, MP, and NFP suggest that there are statistically significant differences in level of achievement of WR, MP, and NFP in terms of level of OLM as *p* values for *Wlech* statistics are less than 0.05 ($Wlech_{WR} = 22.693$, $p = 0.000$; $Wlech_{MP} = 58.381$, $p = 0.000$; $Wlech_{NFP} = 56.736$, $p = 0.000$). At the final step, these significant ANOVAs are followed up with *Tukey's HSD post-hoc* and *Games-Howell* tests which are shown in the multiple comparisons table (Appendix C16). These results, collectively, suggest that there are positive significant relationships between the level of OLM and the level of business performance achievement in all the five dimensions. In other words, among Malaysian automotive parts manufacturer, moderate implementation of lean manufacturing results in significantly higher WR, FP, MP, NFP, and OP compared to low implementation. Consistently, full-blown implementation of LMS brings about significantly higher WR, FP, MP, NFP, and OP compared to moderate implementation. The results of multiple comparison also suggests that although transition from low implementation to moderate implementation will create significant improvement in all dimensions of business performance, however, business performance improvement resulted from migration from low implementation to full-blown implementation is considerably higher than business performance improvement resulted from migration from low implementation to moderate implementation.

Table 5.26: Descriptive Statistics-Omnibus Lean Manufacturing

	OLM	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.0250	.61943	24
	Transitional Implementers	3.5605	.51005	152
	Full Implementers	3.9643	.38893	28
	Total AVG	3.5529	.55986	204
AVG.FP	Non implementers	2.8472	.47119	24
	Transitional Implementers	3.4232	.50014	152
	Full Implementers	3.7857	.55344	28
	Total AVG	3.4052	.55586	204
AVG.MP	Non implementers	2.8125	.41865	24
	Transitional Implementers	3.3931	.48282	152
	Full Implementers	3.9286	.32530	28
	Total AVG	3.3983	.53545	204
AVG.NFP	Non implementers	2.8750	.42040	24
	Transitional Implementers	3.3276	.50980	152
	Full Implementers	3.9357	.32684	28
	Total AVG	3.3578	.54942	204
AVG.OP	Non implementers	2.8229	.54413	24
	Transitional Implementers	3.5016	.55827	152
	Full Implementers	3.9911	.55060	28
	Total AVG	3.4890	.62693	204

5.7 Summary

This research tried to provide an empirical study of the data by using the Structural Equation Modeling (SEM) technique analysis. By using SEM, the measurement model validation was presented with regards to the conceptual model. This was followed by the structural path analysis and hypothesis testing. The relationships between different dimensions of LMS implementation and five sub-dimensions of business performance were found and analyzed using several tests of multivariate analysis of variance. Although, 3 influencing factors (HRM,SRM and EI) were rejected by the our various tests, it is safe to mention that the positives of LMS outweighs its negatives, these 3 factors might be considered as a disadvantage for Malaysian automotive parts manufacturers, because these businesses have not been successful in involving their employees in activities and being ineffective towards having human resources practices and integrating them with lean manufacturing policies. This was reflected within the respondents' feedback based on their state of perception of current and future LMS application in the industry. However, as stated earlier these thoughts were mostly influenced by variances of employee's personal experience and exposure to LMS. Probably, not enough was done to cascade down lean understanding, lean awareness and an appreciation of lean advantages at their respective companies, but this could be rectified through increased training, increased top-down communication, employee involvement and empowerment, factors that we had discussed earlier. Companies would also need to have increased integration with their supplier relationship management practices with a LMS implementation; it is more than likely businesses would need to commit additional financial, capital and positioning personnel resources to upgrade the development of lean-oriented supplier relationship management.

The case studies presented a chance for the research to have an inside view of how an actual LMS implementation actually materializes, to an extent to be deemed a success. It also gives the research a chance to challenge the 3 rejected hypothesis and to see it within context of an actual LMS application, with organizational improvements and increases in business performance dimensions which were measureable.

So, after developing our early conceptual model based on ten probable best influencing factors, for applying the LMS within the Malaysian automotive industry context; testing the model empirically using available data from industry respondents, based on current perceived implementation efforts and levels. Then the researcher tried, to solidify or reconfirm or dispel doubts concerning the survey data, using actual case studies taken from willing LMS practitioners or known implementers; to highlight influencing factors, dimensions and its benefits towards business performance improvements. This test-analyze-compare method was done to ensure the factors were weighted against each other objectively based on different evaluation techniques to produce results that are correlated and highly justifiable.

Finally, the research has been able to propose a guideline for all automotive parts manufacturers to use as guidance before or during an intended LMS implementation, however it is pertinent to mention that for LMS, a full-blown implementation is the best way towards seeing major improvements in their company and the 10 distinct factors of LMS are highly inter-related elements, they are complementary to each other and has synergistic effects. This gives the LMS its unique character and superior ability towards achieving multiple performance goals.

CHAPTER 6

DISCUSSION

6.1 Overview

In this chapter, the results from data analysis shown in Chapter 4 are discussed. The results on hypotheses testing using industry data through the Structural Equation Modeling (SEM) technique are explained. Tests were done on conceptualized model and its refined version for implementation, highlighting the dimensions of LMS (LMS), its prominent factors, and dimensions of organizational performance measurement is placed in this Chapter. Two case studies are presented in support of the tested model, with an analysis of their actual full-blown implementation strategies, results and the research observations during actual case studies. Finally, a guideline for manufacturing entities under the Malaysian automotive industry for a full-blown LMS implementation, as a way to improve their organizational performances is proposed.

6.1.1 Discussion of the Results

The research model of this study initially proposed that ten main factors are potentially fundamental, hence critical for the full-blown implementation of LMS among Malaysian automotive part manufactures. These factors include management commitment and leadership, employee involvement, employee empowerment, training, teamwork, human resource management, customer relationship management, supplier relationship management, organizational change, and information technology. Consistent with H1: *Management Leadership and Commitment has a positive effect on the level of lean implementation* and as expected, it was found that management leadership and commitment toward lean manufacturing is a key enabler of full-blown LMS implementation. This finding in Malaysian context receives research support from previous studies (Boyer, 1996; Jaideep Motwani, 2003; A. Pius, et al., 2006; Worley &

Doolen, 2006), suggesting the significant positive relationship between management support and commitment for successful implementation of different LMS dimensions. LMS is an integrated and interdependent system involving many radical changes to adopting organizations. Successful LMS implementation requires developing underlying capabilities of the personnel and the manufacturing infrastructure. LMS implementation is generally expensive as it demands financial resources to hire consultants and to adopt new technologies and practices, as part of process reengineering, as well as to support the actual implementation of new ideas.

Similarly, LMS implementation may cause production be ceased temporarily in order for applying new practices or workforce to embrace new knowledge and expertise, which is costly indeed (Pius et al., 2006) but rewarding in the long-term. Moreover, it is suggested that for achieving LMS success, manufacturing also needs to allocate large amount of financial resources for redesigning internal organizational and technical processes, expediting new product development and marketing, and changing traditional and fundamental product distribution channels and customer service procedures. In such circumstances, management need to be committed and willing to provide infrastructural investments, offer excellent project management styles, and basis for knowledge enhancement amongst all personnel. This kind of support is particularly essential for providing a moral boost or supportive role across the organization. By being committed to LMS, manufacturers can create a firmer ground for long-term LMS success by reducing costs and improving use of resources.

Viewing from shop-floor perspective, the findings of the study suggest that there is a significant positive relationship between employees' empowerment and full blown LMS implementation among Malaysian automotive part manufacturers, which provide support for H2: *Empowerment of Employees has a positive effect on the level of lean implementation*. In other words, this finding explains that Malaysian automotive part manufactures with higher employees' empowerment toward lean manufacturing than of the current situation is required for achieving a full-blown LMS implementation. Past researchers in other places also found that traditional line-organization where power is limited to managerial seats need to be significantly changed for LMS implementation (Agus, 2005; Boyer, 1996; Cua et al., 2001; Fullerton and McWatters, 2002; and Pun et al., 2001). Employees' empowerment elevates employees' self-efficacy or confidence in accomplishing task objectives in different lean activities (Ugboro & Obeng, 2000). It is believed that by following empowerment strategy and freeing employees at different levels from the severe control obligated by firm's policies and strategies, workforce would have necessary freedom to take responsibility for their ideas, decisions, and actions, and as a result, employees would be energized by an enhanced competence to produce products and deliver services that meet or exceed suppliers' business partners' and customers' expectations.

The results however did not provide any evidence of significant relationship between employees' involvement and full-blown LMS implementation, without being empowered, which means the rejection of H3: *Employee Involvement has a positive effect on the level of lean implementation*. This finding reveals that high level of employees' involvement in LMS-related activities among Malaysian automotive part manufacturers has not resulted in higher LMS implementation level, which in fact, challenges the findings of majority of prior studies (Sohal, 1996; Fullerton & Wempe, 2009) signifying the significant positive effect of involvement over LMS implementation. This has attributed because of lack of autonomy given to the employees (Sohal, 1996) This condition might be considered as a disadvantage for Malaysian automotive part manufacturers because it seems that despite the importance of employees' involvement these businesses have not received that adequately for making effective participation of their employees to different lean manufacturing activities.

Malaysian automotive part manufacturers need to consider that effective involvement would enable their employees to be more at ease with changes resulted from implementation of LMS. Accordingly, automotive part manufacturers need to change their structure and management system to effectively involve employees at all levels in problem-solving and decision-making while implementing different LMS activities. By doing so, employees would have the feeling of acting at work with their own authority, and will reduce resistance to change and actively participate in problem solving activities, the condition which has been named *dominant element* for world-class manufacturing (Pun et al., 2001).

The results of this study also revealed that training and teamwork are two intra-organizational level factors which are crucial for full-blown implementation of LMS among Malaysian automotive part manufacturers. These findings which means the acceptance of H4: *Employees' Training has a positive effect on the level of lean implementation* and H5: *Teamwork has a positive effect on the level of lean implementation*, which provide empirical evidences to support the prior studies by Pius, et al., (2006), Åhlström & Karlsson, (1996), Åhlström, (1998), Hodge et al. (2011) and Panizzolo et al. (2012), showing the importance of training over LMS implementation and the works of Camuffo and Micelli (1997), Currie and Procter (2003), Kuipers and De Witte (2005) and Lee and Peccei (2007), suggesting teamwork as a cornerstone for the successful LMS implementation.

It is important to notice that organization-wide implementation of LMS requires high amount of business information to be distributed to employees. Employee empowerment, as an important determinant of LMS implementation requires employees to understand this information and be able to perform accordingly. Consequently, in order to genuinely implement all the dimensions of LMS, employees all over the organization need to receive training and engaging in team activities, using computer and IT tools, carrying out maintenance, performing statistical process control, using quality tools, and finally, basics of materials handling and control. Moreover, skilled and well-trained employees would be better able to seize all the advantages provided by new systems offered by LMS, and therefore would be more satisfied. Accordingly, the reluctance toward LMS-related changes could be overcome to some extent by training, which makes employees cope with changes. More importantly, and by providing technical, problem-solving, and self-leadership type training across the organization, employees would be more intended to be involved in different LMS activities, particularly through becoming multi-skilled and versatile in performing several jobs. Teamwork on the other hand, which was called the *heart of lean manufacturing* by Womack et al. (1990) allows employees easily and effectively share their knowledge, expertise, and experiences, and participate in problem-solving and decision-making activities, and move towards the common objectives pertaining to improved quality, efficiency, and productivity (Lee & Peccei, 2007). Malaysian automotive part manufacturers need to understand that by forming teams, particularly self-regulating ones, organizations would be closer to achieving full-blown LMS implementation as employees would be better empowered by receiving the necessary freedom of action, the time and space. Consistently, teams would encourage employees to be creative and provide recommendations for improvements for technical and organizational enhancements (Dankbaar, 1996).

The results of structural equation modeling revealed that traditional human resource management practice does not have any significant effect of LMS implementation which indicates the rejection of H6*: Human Resource Management has a positive effect on the level of lean implementation*, the way it is stated. This finding is apparently inconsistent with prior studies which have demonstrated that there is a positive link between human resource management and LMS implementation in Japan and United States automotive industry (MacDuffie, 1995; Taira, 2008). Indeed, human resources management styles in those countries are significantly different and there are a few layers in those countries. From rejection of H6, and given the fact that there are strong evidences within literature that human resource practices, when effectively integrated to lean manifesting practices, significantly contribute to improved organizational performance (MacDuffie, 1995), it is concluded that despite their efforts, Malaysian automotive part manufacturers have not been effective in their human resources practices and integrating them with lean manufacturing policies, and they are in a disadvantages position compared to world-class automotive part manufacturers. Accordingly, it is imperative for Malaysian automotive part manufacturers to know that lean manufacturing requires multi-skilled workers with considerable intellectual preparations. Similarly, employees need to have adequate operational and problem-solving skills (Taira, 2008) and should be motivated enough to contribute in discretionary efforts (MacDuffie, 1995). Hence, human resource management practices needs to be lean-oriented enough to identify, employ, train, and retain the right types of employees. In short, it is suggested that Malaysian automotive part manufacturers should integrate their current human resources management with their lean manufacturing policies.

For example, effective labor management relations, communication of organizational goals among employees, formation of cross-functional teams and providing cross-training, and establishing promotion/reward system for employees to have success in lean practices are examples of human resource management practices broadly used by world-class manufacturers successful in LMS implementation.

Despite the disadvantage of Malaysian automotive part manufacturers in integrating their human resources practices with their lean policies, the results however revealed that automotive part manufacturers, those who have engaged in customer relationship management practices have gotten closer to levels of full-blown LMS implementation. This finding of positive significant relationship between customer relationship management and full-blown LMS implementation among Malaysian automotive part manufacturers, which signifies the acceptance of H7: *Customer Relationship Management has a positive effect on the level of LMS implementation*, provides empirical support for prior studies recommending that effective and integrated relationship with customers in crucial to intense implementation of lean manufacturing dimensions (Sanjay Bhasin & Peter Burcher, 2006; Jostein, 2009; Bhasin, 2012). Accordingly, Malaysian automotive part manufactures those who are not yet adequately committed to customer relationship management practices need to consider that deeply and the successful implantation of LMS activities such as JIT and design for customer need is significantly dependent on prices and recent information and feedback from customers. Accordingly, customer relationship management practices need to be embraced and integrated with lean policies in order for building close cooperative and partnering relationships with customers and thus attaining in-depth and integrated customer knowledge. Similarly, and through the close relationship with customers and having 360 degree view of their inputs, organizations would be able to have detailed understating of customers' quality expectations and future product demands, and thus, would be able to more effectively devise their future quality and product design policies.

Another challenging finding of this study is the insignificant relationship between supplier relationship management and full-blown LMS implementation, which indicates the rejection of H8: *Supplier Relationship Management has a positive effect on the level of lean implementation*. This finding challenges prior studies arguing that supply chain process integration and effective management of relationship with suppliers considerably facilitate leanness and consequently business performance improvement among supply partners (Bruce et al., 2004; Simpson & Power, 2005; Shah

& Ward, 2007; Hajmohammad et al., 2012). Within the lean manufacturing literature, it is well agreed that management of the supply relationship is crucial to yawning implementation of LMS, particularly in automotive industry (Simpson & Power, 2005). The objective of LMS implementation is to dramatically reducing throughput times, decreasing delays for delivery of orders, achieving pollution prevention and waste reduction, increasing the quality of final products, and decreasing productions costs in all aspects and at different levels (Prastacos et al., 2002; Bruce, et al., 2004). It is clear that manufactures operating as a supply partner cannot alone achieve these objectives effectively. In fact, success of the LMS relies deeply on integration with the supply chain and in sharing the gains from mutual investment in performance improvement between all supply partners. For example, regarding the implementation of JIT as an important activity in LMS, the role of an effective supplier relationship management is undeniably essential to minimize potential problems, such as product shortages. Malaysian automotive part manufacturers need to know that successful implementation of JIT is unachievable unless there are open communication and a standardization of all things including the status of a production with the supplier, trust as a basis for achieving collaboration, information sharing and integration, willingness for improvement among suppliers, and compliance and collaboration among hub firm and all supply partners. Given the disadvantage position of Malaysian automotive part manufacturers in integrating their supplier relationship management practices with LMS implementation, it is recommended that these businesses to commit adequate financial, capital and personnel resources to the development of lean-oriented supplier relationship management, and convince their suppliers that their best interest also lies in accepting direction of LMS and integrated commitment to implementation of different lean activities.

Findings of the study also demonstrated that among the investigated influencing factors, organizational change is the most important determinant of LMS implementation in Malaysian automotive part manufacturers. This finding which provides support for acceptance of H9: *Organizational Change has a positive effect on the level of lean implementation* is in coherence to the prior works within the literature emphasizing the importance of openness to change and change management in successful implementation of novel manufacturing practices such as LMS (Smeds, 1994; Rosalind, 1995; Prastacos, et al., 2002; J. Motwani, 2003; Jostein, 2009; Bhasin, 2011b). There is no doubt that full-blown implementation of LMS necessitates significant changes across the organization. The example of LMS implementation among Japanese manufacturers shows that leanness has been associated with significant changes in organizational structure and operational procedures (Smeds, 1994). Moreover, full-blown LMS implementation is interrelated with continuous improvement across the organization, accordingly, changes are not limited to the time of LMS implementation, and thus, leanness entails continuous inter-organizational, technological and environmental changes. Migrating toward higher employees' empowerment, higher operational integration with suppliers and business partners, continuous product quality improvement, and continuous human resources improvement are examples of changes which should be undertaken for full-blown LMS implementation.

The results also show that information technology has a significant positive effect on full-blown LMS implementation, which indicates the acceptance of H10: *Information Technology use has a positive effect on the level of lean implementation*. This finding supports prior studies from different perspectives suggesting that IT has significantly facilitated effective implementation of JIT (Nicolaou, 2002; Ward & Zhou, 2006), maintenance activities (Pintelon et al., 1999; Garg & Deshmukh, 2006) quality management practices (Au & Choi, 1999; Thatcher & Oliver, 2001), new product development and design for customers needs (S.S. Durmusoglu, 2009; Serdar S. Durmusoglu & Barczak, 2011), and continuous improvement (Brynjolfsson & Hitt, 2000; Davenport & Short, 2003). It is important to mention that although prior studies have signified the importance of IT regarding implementation of different LMS dimensions, however, none of these studies have investigated the impact of IT on all-inclusive lean construct comprising all dimensions. Accordingly, the results of the study support and extend prior works by demonstrating that application of IT has enabled automotive part manufacturers to simultaneously support and improve all the dimensions of LMS. In this regard, the descriptive findings show that although the level of IT usage among Malaysian automotive part manufacturers are only slightly more than average (Figure 6.1), however, these businesses are in an advantageous position as they have been successful in transforming the value of their IT resources into deep implementation of LMS in all dimensions and consequently business performance. Based on this finding, Malaysian automotive parts manufacturers those who are at their early stages of moving toward full-blown LMS implementation need to notice that investment on human and technical IT resources and integrating them with lean activities would enhance the efficiency and acceptability of employee training, increase the effectiveness of teamwork through efficient and speedy information and knowledge sharing, improve productivity through computerized progress control, and assist all parties involved with LMS implementation with better decision on the next step in a change a process towards lean production (Riezebos & Klingenberg, 2009).

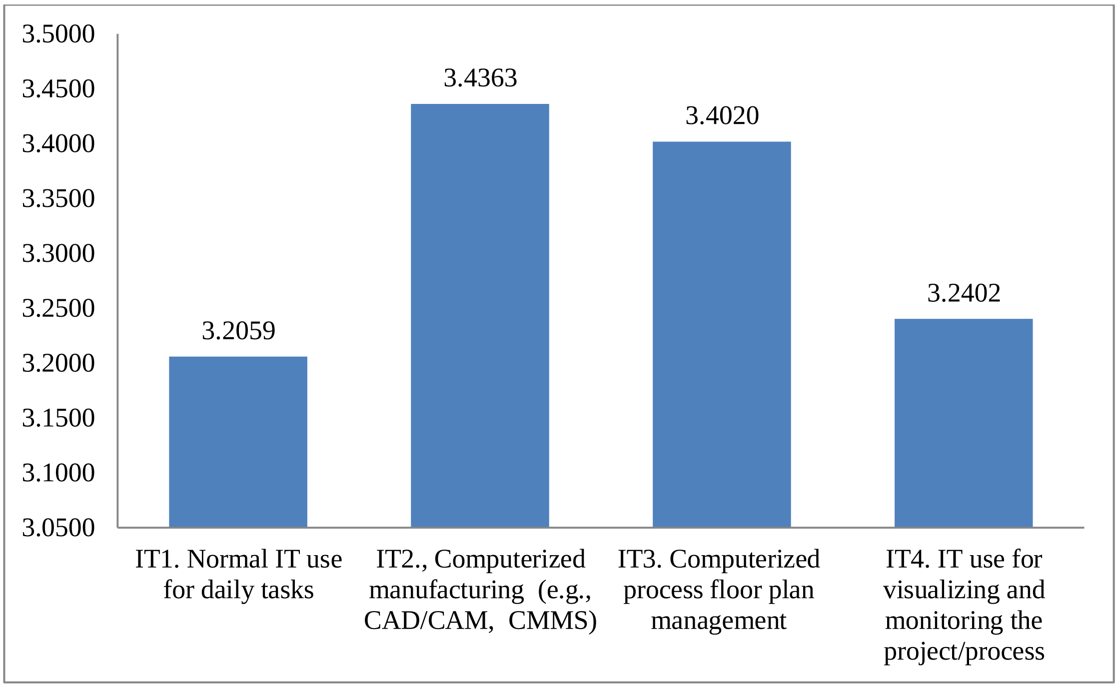


Figure 6.1: Frequency of IT usage by Malaysian Automotive Part Manufacturers

Finally, and consistent with H11: *Level of Lean Implementation has a positive effect on the business performance*, the results of this study revealed that there is a significant positive relationship between level of LMS implementation and business (organizational) performance improvement among Malaysian automotive part manufacturers. This finding empirically support the existing perspective that effective implementation of lean manufacturing activities will provide the adopting firms with performance improvement and improve different metrics (King & Lenox, 2001; Shah & Ward, 2003; Shah & Ward, 2007; Taj, 2008; R.R. Fullerton & Wempe, 2009; M. G. Yang, et al., 2011). As argued by Shah and Ward (2003), improvement in labor productivity and quality, and reduction in customer lead time, cycle time, and manufacturing costs are among the most frequently quoted advantages of LMS implementing for manufacturers. In this regards, the finding of this study revealed that Malaysian automotive part manufacturers are generally in an advantageous position as they have been successful in transforming their investment in LMS practices to performance improvements. In fact, data shows that those Malaysian automotive part manufacturers whom are committed to full-blown implementation of LMS have successfully gained performance improvement in all the five dimensions studied, namely waste reduction, marketing performance, financial performance, operational performance, and non-financial performance. It is imperative to refer to the results of different MANOVA test as they revealed that even moderate implementation of one or two LMS practices is associated with relative performance improvement compared to non-implementation. The data however recommends that sustained and competitive business performance improvement regarding all the metrics is achievable when the organization is committed to intense and deep implementation of all lean dimensions (activities) simultaneously.

6.1.2 A Full-Blown LMS Implementation and Business Performance Improvement

Lean manufacturing literature argues that there are variations in lean manufacturing's documented performance effects (Shah and Ward, 2003 and 2007; Wayhan and Balderson, 2007). Cua et al. (2001) argued that variation in performance effects of LM is due in part to managers' piecemeal adoption of lean manufacturing's various components (e.g., mere adoption of JIT). Consistently, Shah and Ward (2003) demonstrated that the synergistic effects of all lean LMS practices (dimensions) are associated with better manufacturing performance. More recently, Fullerton and Wempe (2009) reported that the mixed results of prior studies of the LM/performance relationship may be due in part to a failure to account for non-financial manufacturing performance measurement. Taking into consideration all the aforementioned arguments over LMS performance outcome, the propsed research model of the study assumed that implementaion of different LMS dimenstions and synergies resulted from their complementarity would be expected to improve financial performance and non-financial performance among Malaysian automotive part manufactureres.

The findings of the study provided robust evidences suporting the importance of full-blown LMS implementation among Malaysian automotive part manufactureres. Firstly, and followng privious studies on LMS implementation (e.g., Shah and Ward, 2007; Yang et al. 2011), the full-blown LMS implementaiton was defined as a second-order reflective construct which includes six different first-order sub-dimensions namely JIT, TPM, QM, PS, CI, and DCN. This means that implemementation of these six LMS practices reflects the full-blown LMS implementation. Figure 5.5 demonstrates that every single dimention of LMS implementaiton has a absolutely significat reflective weight ($\beta > 0.70$, $p < 0.001$), which means that all the LMS dimenstion are significantly inter-dependent. This result suggest that not implementing any dimension of LMS would decrease the regeression coefficient between variables 'LMS' and 'BP' in Figure 5.9. This means that highest levels of business performance improvements have only achieved by Malaysian automotive part manufacturers those who moved toward the full-blown LMS implementation.

Secondly, and to have a more precise analysis on the relationship between full-blown LMS implementation and business performance improvement among Malaysian automotive part manufactureres, a detailed MANOVA test is performed. In doing so, the scores for levels of implementation of different dimensions of LMS among surveyed manufactureres were summed up togather to show the level of commitment tword the full-blown LMS implemenation. This socre was furthuer transformed from continuous data into categorical data including three different categories. The results of MANOVA test revealed that there is a positive significant relationship between the level of commitment toward full-blown LMS implementation and the level of business performance achievement in all the five performance dimensions. The findings demonstrated that among Malaysian automotive parts manufacturer, moderate (transitional) implementation of lean manufacturing results in significantly higher waste reduction, financial performance, marketing performance, non-financial performance, and operational performance as compared to automotive part manufacturers having low LMS implementation. More importantly, it was observed that automotive part manufacturers with full-blown implementation of LMS have achieved significantly higher waste reduction, financial performance, marketing performance, non-financial performance, and operational performance as compared to Malaysian automotive part manufacturers with the moderate LMS implementation.

The results of multiple comparison also suggests that although transition from low LMS implementation to moderate LMS implementation will create significant improvement in all dimensions of business performance, however, business performance improvement resulted from migration from low LMS implementation to full-blown LMS implementation is considerably higher that business performance improvement resulted from migration from low LMS implementation to moderate LMS implementation. Figure 6.2 clearly illustrates the significant difference in performance achievement among non-implementers, transitional implementers and full-blown implementers.

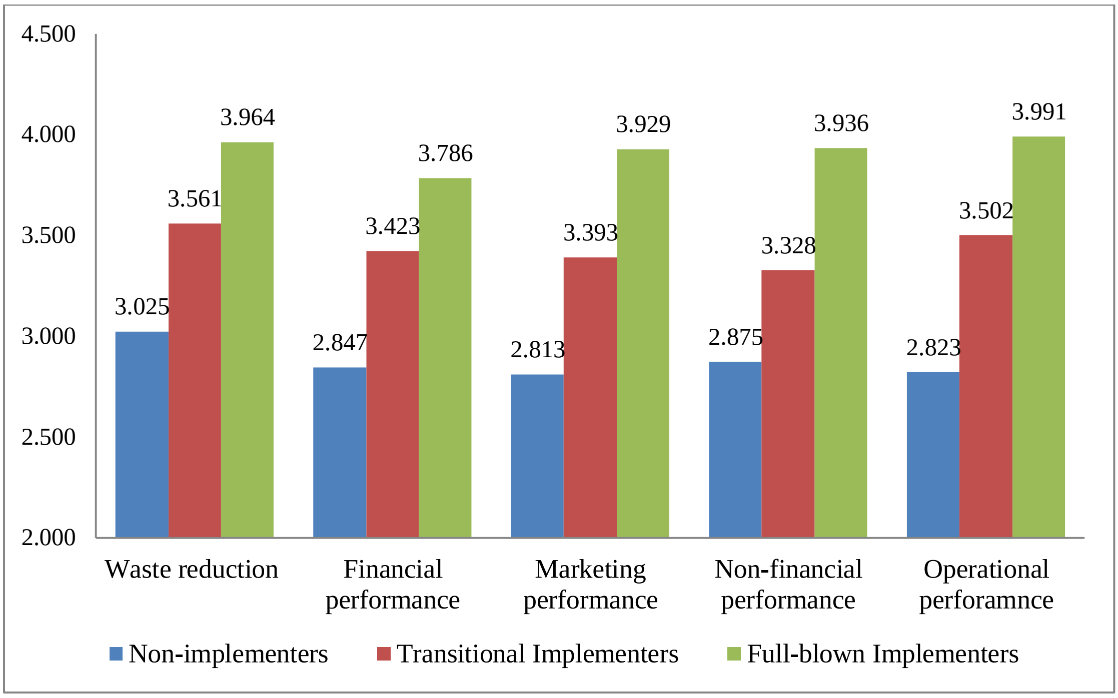


Figure 6.2: Performance Achievement Associated with Different Levels of LMS Implementation

The findings of MANOVA test and the findings of structural equation model, collectively, demonstrated that highest business performance achievement requires full-blown LMS implementation among Malaysian automotive part manufacturers. This finding provide supports for the economic theory of complementarities (Milgrom and Roberts 1990, 1995) which suggests that a set of organizational resources is complementary when the returns to a resource vary in the levels of returns to the other resources. This means that while some organizational resources are distinct, they are also inter-dependent. They mutually support and reinforce each other (Tanriverdi, 2005). The joint value of complementary resources is greater than the sum of their individual values (Barua and Whinston 1998). Thus, resource complementarity creates super-additive value synergy in a business. Considering each dimension of LMS as a valuable resource in an organization, the different dimensions of LMS are distinct in nature. However, many of them are considerably inter-dependent, and their successful implementation depends on successful implementation of other LMS practices. For example, successful QM would not be achieved without having effective TPM, CI practices, and even customer-oriented product design (DCN).

6.1.3 A Full-blown Model of LMS Implementation in Malaysian Automotive Industry.

Based on literature review on LMS influencing factors, dimensions and effects on business performance an early conceptual model was proposed derived from the above elemental factor of LMS. The conceptual model was introduced in Chapter 3, included in the model were 10 influencing factors (ML,EE,EI,HRM,OC,IT,CRM,SRM,T and TW) that affected LMS' full-blown implementation in the Malaysian automotive industry, 6 dimensions of LMS (PS,TPM,QM,JIT,CI and DCN) with a significant relationship between full-blown implementation and 5 dimensions of business (organizational) performance (WR,FP,MP,NFP and OP) that can be measured.

The model of full-blown LMS implementation for Malaysian automotive part manufacturers is presented in Figure 6.3. This explains that Malaysian automotive part manufacturers have not been successful in effectively integrating and aligning their employees' involvement, human resource management and supplier relationship management strategies and practices with LMS activities. The model however suggests that these manufacturers have shown promising result in supporting LMS implementation through providing the required supports and training, supporting employees' empowerment and teamwork, effective customer relationship management, following appropriate change management practices, and investment on and utilization of information system and technology applications.

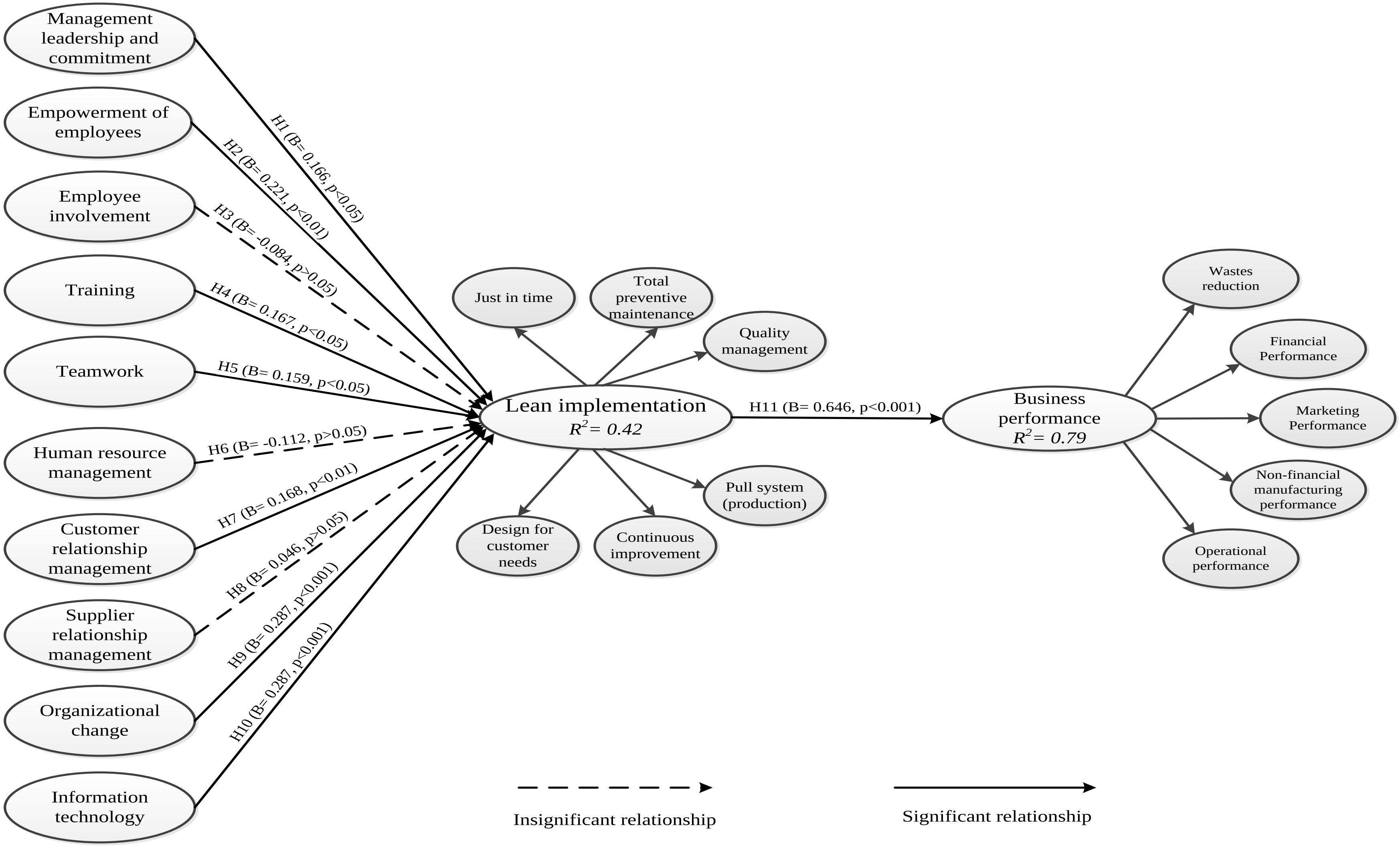


Figure 6.3: A Full-Blown Model of LMS Implementation in Malaysian Automotive Industry

6.1.4 Case Studies

As part of the research the case studies were conducted in order to gauge the depth of understanding on the actual implementation of LMS and the effectiveness of implementation in the automotive parts manufacturing in Malaysia. It is also conducted as a part of the complementary method of studying the hypothesized relationships. Two companies were selected and the process of the selection has been explained previously in Chapter 4. The details findings in the case studies are explained in the following sections.

6.1.5 Case Study 1

6.1.5.1 Company's Background

B2 Sdn Bhd (name changed for confidential purposes) was established on the 23rd April 1991 and has 100 percent local ownership. This company is listed as a second-tier automotive parts supplier to the national car manufacturers in Malaysia. The company has an authorized capital of RM5 million with paid-up capital of RM2.5 million, with a total of 73 personnel, the company produces Colorant, B-Compound and additives solution to the plastic industry. B2B Sdn Bhd was certified to be ISO 9001:2008 and ISO/TS 16949:2009

6.1.5.2 B2 Sdn Bhd and the Implementation of LMS

B2 Sdn Bhd had started their journey in implementing LMS in 2011. The company is still in its early stage of lean implementation. B2 Sdn Bhd has participated in the LPS program conducted by MAI and they have been supported and coached by MAI throughout their LMS implementation activities. In this program, the company has been provided with the 6-months to 12 months of training and coaching in order to build the foundation and in depth understanding of the LMS concepts. The total implementation of LMS in the organization is the ultimate aim by the end of the program. The company was also provided with close monitoring and coaching, as well as a team of consultant, which consists of a local expert and practitioner and also a Japanese expert that was appointed by MAI to assist the company during these LMS implementations and to ensure the major key aspects of the LMS is properly addressed and adhered to.

To ensure the effectiveness of the program and the LMS implementation is a success at the company, audit activities were run by MAI within the duration of the program. This audit was done 2 times during the program; the first was undertaken at the beginning of the program during the early process of LMS roll-off. The second audit was held after 6 to 12 months after the initial start off point, the audit results were used as a gauged in determining the current effectiveness and those results value used as a way-forward direction mark and in sustaining the LMS throughout the company's journey from the initial implementation point. Table 6.1 shows the summary of audit results for B2 Sdn Bhd before the implementation of LMS and after the implementation of LMS. The complete audit criteria of MAI program is provided in the Appendix D.

Table 6.1: The Summary of Lean Implementation Audit (Before and After)

Item	**Check Item**	**Before**	**After**
	Audit Date :	**2/8/2011**	**12/6/2012**
1	a. Top management involvement	1.5	4
	b. Independent organization (LPS Department)	1.5	4
	c. Dedicated staff for LPS Kaizen (exist?)	1.5	4
	d. Policy development condition	1	4
2	a. Ability of maintenance staff and re-ocurrence prevention	2	4
	b. Spare parts for equipment management	2.5	4
	c. Monozukuri (Making Things) Kaizen ability	2	4
	d. Die maintenance system	2.5	3.5
3	a.Time keeping (working, break time)	2.5	4
	b. Application of safety gears (safety boots, helmet, glasses etc)	3	4
	c. Entire factory Seiri and Seiton condition	2.5	3.5
4	a. Production progress control (by Hour)	2	3.5
	b.Plant management index (quality, safety, etc)	2	4
	c."Morning market"	2	3.5

'Table 6.1, continued'

Item	Check Item	Before	After
	Audit Date :	2/8/2011	12/6/2012
5	a. Plant employee training plan	3.5	3.5
	b. Skilled operator education and training	2.5	4.5
	c. Attendance rate, turnover rate (including foreign workers)	3.5	3.5
	d.Small group activity (Participation? Including foreign workers)	2	4.5
	e.Suggestion scheme (Including foreign workers)	2	4
6	a.Downtime at customer (happen? System to counter downtime exists?)	4	4
	b.Quality (Has target to achieve? Has a system?)	3	3
	c.Production control done periodically? Achieving the target?	3.5	3.5
	d.Operation ratio (operational availability)	3.5	3.5
	e.Safety (accident occur often? Medical leave?)	2	4
7	a."KANBAN" production (applicable to company practicing KANBAN only)	1.5	3
	b.On-site logistic (route / pull frequency)	2	3
8	a. Streamline of process flow and machine layout based on process order	3	3
	b. Production lot size (batch / small lot production / 1 piece flow)	3	3.5
	c. Setup time (achieving SMED? Any kaizen activities?)	2	3
9	a. Establishment of production plan and production control	2	3.5
	b. Takt production	1	3
	c. Man power arrangement	1.5	3.5
	d. Standardized operation (clarified & observed) - revised based on Kaizen activities?	2	3
10	a. Separation of man/machine work (labor saving and labor reducing)	3	3
11	a. Pokayoke application and maintenance	1	4
	b. Condition management of equipment/ device	2.5	4
	c. Location of defects	2.5	3
	d. Built in Quality system	2.5	3
Total		**87.5**	**137.5**
Average (Current Level)		**2.3**	**3.6**

Generally, in the beginning of the program started, the level of implementation of LMS at B2 Sdn Bhd was under the category of Level 2, which meant that, the level of LMS implementation is very limited, perhaps it could be considered as non-lean implementer category. This level was achieved as before the total implementation activities were conducted and it was a ground basis of company condition before involved in LPS program.

Meanwhile after a year of involvement in the program and the implementation of LMS in the company, it was clearly shown that the company condition had improved.

B2 Sdn Bhd has achieved an average of level 3.6, which indicated that the company has the foundation of LMS and the level of LMS implementation is in-transitional implementation level. The summary of the level assessment is shows in Table 6.2.

Table 6.2: Level Assessment of LPS Audit Program

$L \geq 4.0$	**Strong** foundation has been constructed. (**Total implementation of LMS**)	→	**Lean Firm**
$3.0 \leq \mathbf{L} \leq 4.0$	Foundation is **moderate.** (**Companywide activities are not enough.**)	→	**In-Transition Firm**
$\mathbf{L} < 3.0$	Foundation is **still weak**. (**Companywide activities have not been implemented**.)	→	**Non-Lean Firm**

In their efforts to be sustainable in the competitive market as well as to enlarge their market towards the global stage, the top management of B2 Sdn Bhd decided to take drastic steps and to implement the LMS in their company. This is because the top management believes and trusts that the positive aspect from the implementation of this manufacturing system is great, as opposed to not having any at all. Based on their bench-marking exercise against their industry peers, their business competitors that had adopted the LMS had some measure of success and with positive results shown after its adoption.

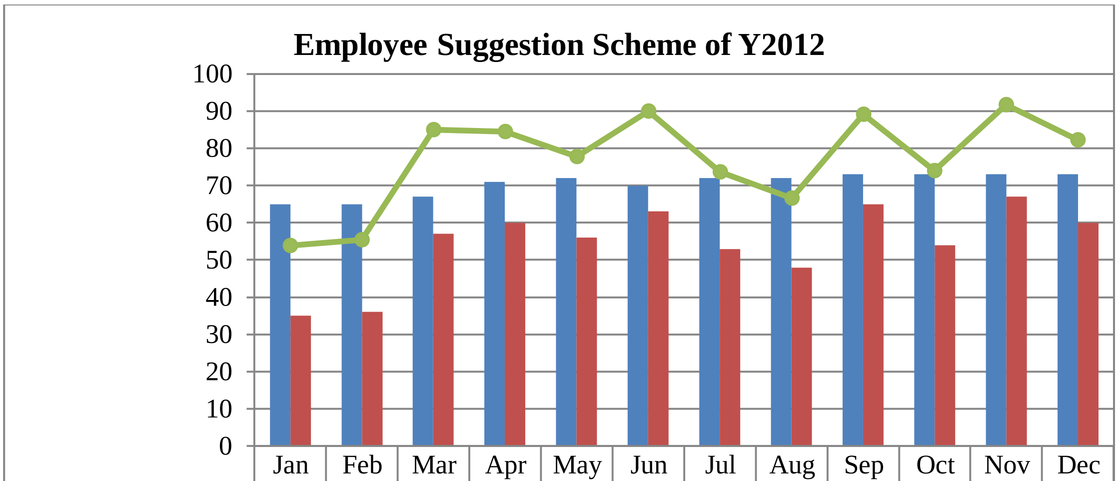
Going by this understanding and looking at this positive trend, the top management then decided to give a high commitment in this program, the company's policy was largely revamped and focused towards a lean production system, thus this prove their commitment to the program. The policy focuses on 3 core areas, namely (1) lowering costs through the elimination of waste in every area of the organization, (2) improving responsiveness to customer demands and (3) reducing time throughout the entire business process. Besides that, the establishment of a 'Lean Production System Department' proves further that their top management are serious in integrating LMS within their current work system. By establishing the lean production system department, it gives a greater opportunity for employees to be directly involve in LMS and give higher commitments in activities based on LMS concepts. Kaizen groups were then formed to impart improvement activities at the workplace, these groups consisted of employees from multiple sections and worked in unison to carry out kaizen activities.

The teamwork concept was not only applicable in the kaizen activities, but also applied to use in problem solving and decision making processes throughout the company. The workers in these kaizen teams were given ample time to practice and perform these activities at their workplace. This implementation process also has shown that when employees were given a broader range of tasks beside their main job function and responsibilities, it enhances their understanding of LMS to a higher degree whilst acknowledging its importance in being integrated within their work environment and processes.

To ensure the success of a total implementation of LMS is achieved, the management realized and understood that a lot of changes were needed in the company, a 'lean thinking' mindset needed to be instilled and a relevant environment needed to be created. This inter-working relationship was needed to be nurtured consistently and effectively to all levels of employee. B2 Sdn Bhd, needed a to have a working culture that is 'lean' oriented and that would only be achievable through continuous training programs, that is tailor-designed on 'lean'. Due to this fact, a training policy pertaining to the LMS was created and became the main agenda within their yearly company activities. The responsibility was given to HR department, for them to schedule and supervise accordingly. The policy is aiming to provide appropriate training to all employees whose activities have a significant impact upon the products and services produced.

The management, besides providing direction for the company, is also responsible for the career advancements and welfare of the employees; they had decided the employees' performance reward level clearly to all. An incentive based reward system was also introduced to encourage employee participation towards company's success, this appreciative stance should contribute to more ideas being created and highlighted to management. Employees were given monetary rewards as tokens for their contributions, RM5.00 for every improvement idea. Through this method the management targets about 12 ideas being generated per employee within one year. Figure 6.4 shows the participation rate of employee suggestion rate for the year of 2012. Three best suggestions will be selected and rewarded by the management.

Information technology has proven to be beneficial in the daily undertakings of the company, with the help of latest technology all major functions of the company were either performed faster and somewhat easier, thus improving the workloads of employees. Computer mediated communication is a prime example information technology used as an effective tool. The company has established their own internal messenger system for communication and information sharing network within their employees. This concerted effort, has indirectly supported the environmental friendly concept through it being paperless and minimizing 'wastage'.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No of Staff	65	65	67	71	72	70	72	72	73	73	73	73
No of ESS Receive	35	36	57	60	56	63	53	48	65	54	67	60
Percentage of ESS	54	55	85	85	78	90	74	67	89	74	92	82

Figure 6.4: Rate of Employee Participation in Employee Suggestion Scheme

Overall, over the duration of the first 6 months of the LMS implementation in B2 Sdn Bhd, the company strived to create some 'lean-culture' throughout the entire organization. After the understanding of 'lean-culture' was established thoroughly and the LMS being readily adopted by all employees in their daily activities, the implementation program was continued and extended further to include customer relations and also relationships with suppliers. Perhaps the LMS is one of the quality improvement programs that are needed for B2 Sdn Bhd, because indirectly this program involves customer and suppliers involvement. This is seen through the lean implementation activities that were undertaken such as just-in-time (JIT) concept, where the suppliers were required to supply the raw materials on a just-in-time basis. B2 Sdn Bhd also applied a pull production system that is used to control their inventories and other production activities. The examples and summarization of LMS implementation activities is highlighted in the following section.

6.1.5.3 LMS Implementation Activities at B2 Sdn Bhd

- **Activity 1: Total Preventive Maintenance (TPM)**

At B2B Sdn Bhd, the activity of total preventive maintenance was implemented in a very limited way and with the lack of supports from the top management due to the limited understanding of the TPM concept. In general, the following condition had been observed before the implementation of LMS undertaken:

a. The maintenance department was established with capacity of 3 technicians. The technicians are only responsible for the maintenance and repairing works (major or minor repairs) for the in-house made equipment and external made equipment (minor repairs only). The works of maintenance and major repairs for the external made equipment will be outsourced to the external party. This has led to the longer downtime for external made equipment and increase the cost of maintenance. The limited capacity of maintenance job done by the technicians were due to the lack of technical knowledge and skill especially related to the external made equipment training and their problem solving skill..

b. The “ownership” concept has been introduced by the management in order to implement an autonomous maintenance. Unfortunately the implementation level was still in a low level. The operators can only do minor jobs of maintenance works such as cleaning and monitoring the conditions of the equipment or machines. This was partly due to their limited technical knowledge in handling them. They usually waited for the external technician if any problems occurs with the machines or equipment breakdown. Thus, this also leads to a higher downtime due to their inability of detecting any abnormalities as well as to do any minor repairs.

c. There was improper planning of maintenance activities such as preventive and predictive maintenance. Most of the maintenance works were based on corrective maintenance. The rate of machine breakdown was high and the aim of “zero breakdowns” conditions was not achievable. The equipment failure rate was about 20 percent.

d. Spare parts and maintenance equipment are not kept in order and in state of control, such as no replacement of spare parts used or missing of equipment.

e. The importance of Safety issues (Environmental Health and Safety) are not being accentuated by the top management of B2 Sdn Bhd. Fundamentally, the employees were lacking in safety awareness and were not being provided with suitable personal protection equipment.

In line with the goal of an LMS implementation, the necessary actions were taken by enforcing the TPM effectively. The following actions have been taken by the company throughout their LMS implementation journey.

a. In order to strengthen the role of the maintenance department at B2 Sdn Bhd, a technical executive had been employed to lead the department. This person is responsible in maintenance planning and scheduling as well as coordinating the maintenance job orders by delegating the works within the group of technician based on their skill level and in ensuring all maintenance jobs were able to accomplish within a set timeframe. Other than that, the technical executive is also responsible to prepare a schedule of planning for technical training. That is needed to be given to all technicians under his scope of responsibility, this was to be based on the training need analysis (TNA) prepared by the HRM department. By preparing a detailed technical planning, the level of technical skill for each technician was upgraded on an average of 17 percent per year. Also through this training program, the company had managed to reduce the number of ‘outsource’ maintenance works by 50 percent. This contributed towards a cost reduction in maintenance cost by up to 35 percent.
b. The autonomous maintenance concept was widely implemented throughout the company. All the operators were given basic technical training and machine maintenance training in order for them to be able to perform minor repairs or to sense some abnormalities during the machine's operating time. This effort had proven to impact on lowering the rate of downtime (internal and not affecting the customers side due to the safety stock requirement) by as much as 30 percent.
c. Proper planning of maintenance activities had been done by introducing the preventive and predictive maintenance schedule. All of these maintenance activities were performed during the non-productive hours. This has led to the reduction of equipment failure rate from around 20 percent to only about 10 percent.

d. Training of the 5S (Seiri - Sorting, Seiton -Simplify or Setting in order, Seiso- cleanliness, Seiketsu - Standardizing and Shitsuke - Self-discipline) and safety had been given to all level of employees in order to increase the level of understanding towards those activity. The management of B2 Sdn Bhd had provided safety equipment which was complete and each employee was given personal protective equipment according to their individual job functions. The training on 5S that was given had proven to create a work culture that was more systematic and precise. The 5S is actually the main activity that has the upmost importance among all the other activities within a quality management system. This activity also became the turning point towards having a more significant LMS implementation. Based on the facts and description given on the above, Figure 6.5(a) (graphical) and Figure 6.5(b) (photo illustrations) shows the performance gain through these TPM activities.

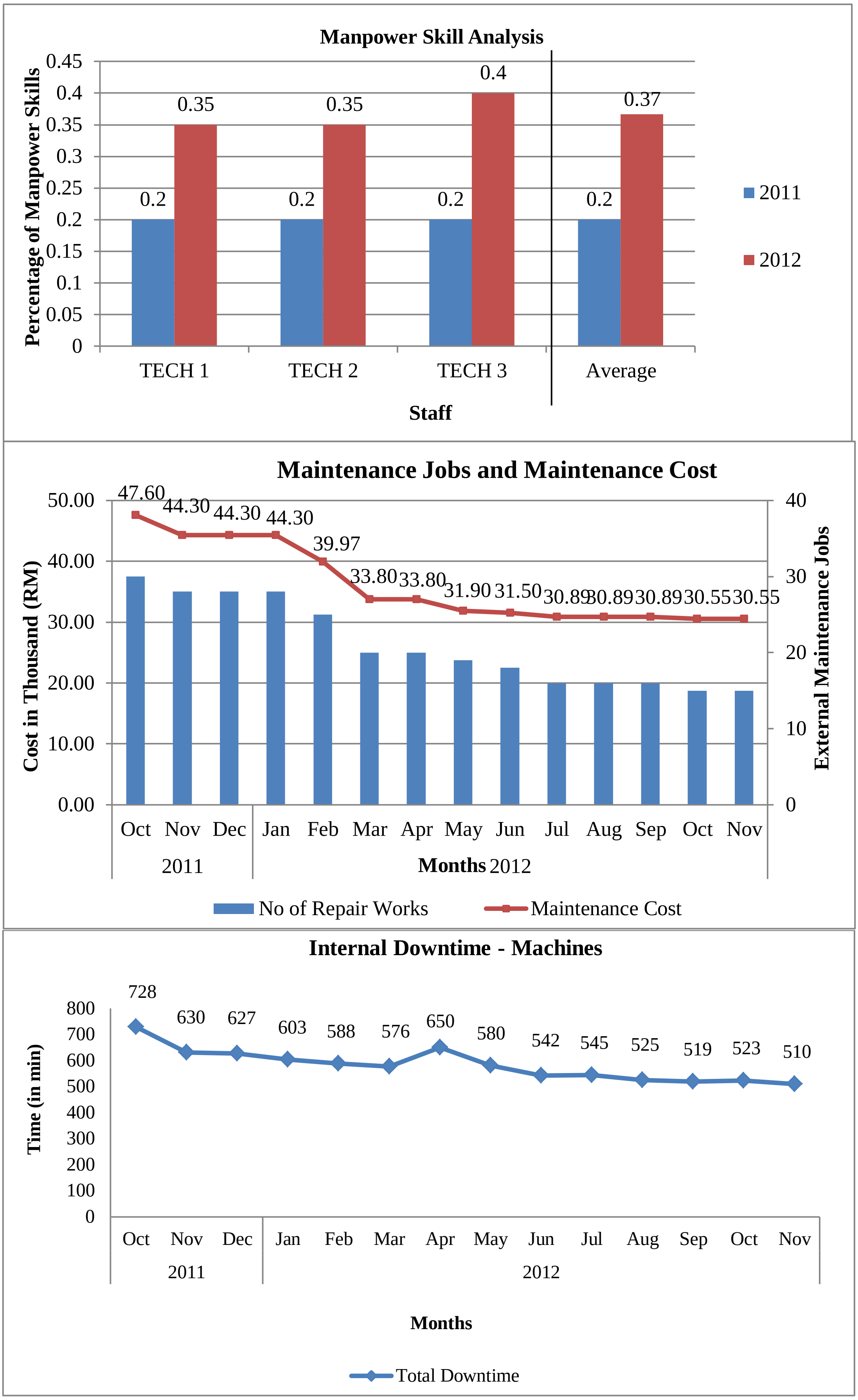


Figure 6.5(a): Performance Gain through Implementation of TPM Activities

Examples of Before and After the Implementation of 5S + Safety (6S) Activities

Figure 6.5(b):Improvement/Gain through Implementation of TPM Activities

- **<u>Activity 2: Continuous Improvement (KAIZEN ACTIVITY)</u>**

B2 Sdn Bhd has implemented continuous improvement or the KAIZEN approach specifically towards improving their quality matters, especially in eliminating wastage. Apart from having an employee suggestion scheme, the employees were encouraged to organize their own KAIZEN groups within their own work section. Furthermore, the company introduced a reward-based scheme in the form of cash, to the three best-performing teams each year. These KAIZEN groups indirectly formed a work culture that is based on valuing teamwork in the company. Starting from January 2012 up to June 2012, a total of 9 groups have been formed and these groups were comprised of three to four members each. This Kaizen approach was used by the company extensively and helped to form pull production system application and an inventory control system, whilst improving the quality in the organization. Figure 6.6 (photo illustration) shows the examples of Kaizen implementations within the company.

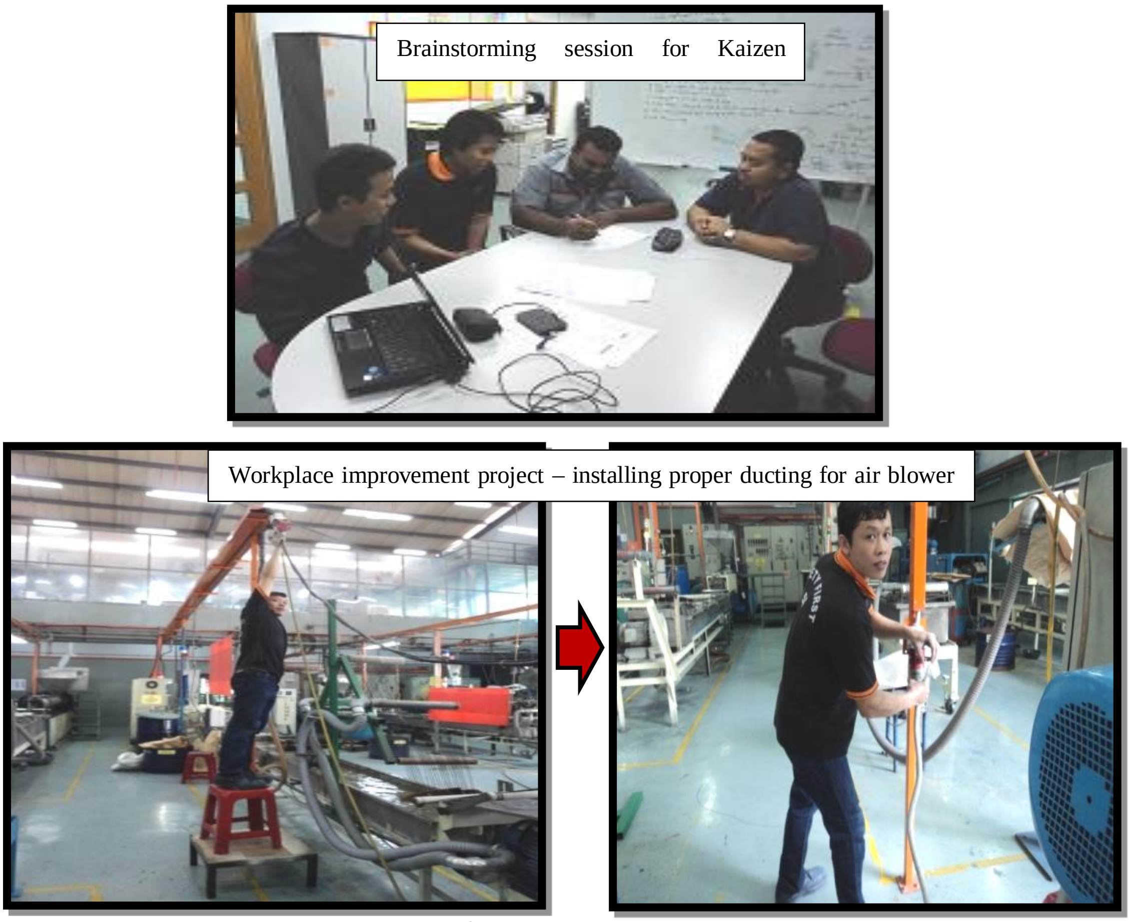


Figure 6.6: Examples of the Kaizen Implementation at B2 Sdn Bhd

- **Activity 3 : Pull Production System (Kanban)**

Pull production system was rolled-out at B2 Sdn Bhd in stages and during the initial stage, the material information flow chart (MIFC) was developed and then used by the management to identify the problems that were occurring in the company, especially all the barriers for an implementation of a pull production system. By using this tool, the management had identified several problems within the production process flow. The summarization of these problems and its solution steps/methods are described in Table 6.3 and Figure 6.7 (photo illustration)

Table 6.3: Summarization of the Identified Problems via MIFC and the Solutions

No	Problems	Description	Solutions
1	Poor 5S and Safety Implementation	Improper arrangement at the Colorant and Dryblend area. The same problems occurs at the store area where the area of finish goods and the raw materials were not in proper arrangement and these problems will lead to the mixing parts/ materials problem.	- Proper training has been conducted at the company. - The re-layout activity at store area has been done. - The proper tagging area has been installed. - An internal audit for 5S and Safety was carried out to gauge the implementation level of 5S and Safety activities. Figure 5.5 shows the improvement gain from this activity)
2	Long changeover time during product change process	The changeover time during production is high. It happens at the extruder machine during machine set up time - 83 min for dark color product and 112 min for light color product.	There were 3 main problems that occur; (a) the machine has a long heat-up time, (b)a long start-up process and (c) a long wash-up time. A new standard of procedure (SOP) was introduced. The supervisor needs to operate the machine 45 minutes before the production activity, this starts on every first day of week (Monday) for the heating up process. In other words, all of the activities are done before the machine is use for production activity and it is re-labelled as pre-setup time. This new SOP has reduced 70% of the time needed as compared to the previous time needed for dark colour (25 min) and 47% of time for light colour (60 min).

‘Table 6.3, continued’

3	Long in-process quality control time (IPQC)	The time for IPQC for dark color is 208 min.	In order to rectify this situation, a pilot study was conducted in the area that had been identified (L9 extrusion process for dark colour). The findings of the study show that there are 5 major problems that contributed to the IPQC time which were 1. Colour matcher competency, 2. Colour consistency, 3. Long sample collection time, 4. Injection process set-up time and 5. Production processes. A new SOP was introduced for a new colour checking /inspection process, while the production size has been reduced to batch sizes, so that the IPQC time can be reduced. The manpower skill chart also for IPQC activity was also established. This improvement activity has decreased the IPQC time from *208 min* to only *59 min.*
4	Low productivity rate in L9 process	This machine can only produce at the rate of 4kg/min/man. There were four major problems that were identified as obstacles in gaining a higher productivity rate. (1) Dry blend section- the section was found to be unable to cope with the large amount of compounds. (2) insufficient cooling and (3) So the drying system and the palletizer rubber roller is unable to withstand the constant high heat. (4) The insufficient spacing needed during the dry blend mixing process.	The solutions for these problems were: (1) A tumble unit had been added to the dry blend mixing in order to increase the capacity of material production. (2)The tumble unit supported this mixing action by improving the cooling and drying system, while it further enabled the mixer to process the additional amounts of material intended. (3) The process improvement activity began by lengthening the drying belt system, while an air sucking system had been added to the silo. The results show that within 10 months of improvement activity implementations, the productivity rate had increased from 4kg/min/man to 7.0kg/min/man.
5	Big production lot size	The production lot size is maximum up to 10MT	Based on the pull production system implementation, the production size was reduced from 20mt (5.5days) to 9mt (2.5days)
6	High stock of finish good	The stock for finish goods is kept for 17 days	After implementation of pull production system, the stock of finish good is reduced from 17 days to 10 days.
7	High stock of raw material	The stock for raw materials is kept for 31 days.	The raw materials stock is slightly decreasing to 20 days. This is due to the safety stock for raw materials that is imported from overseas.

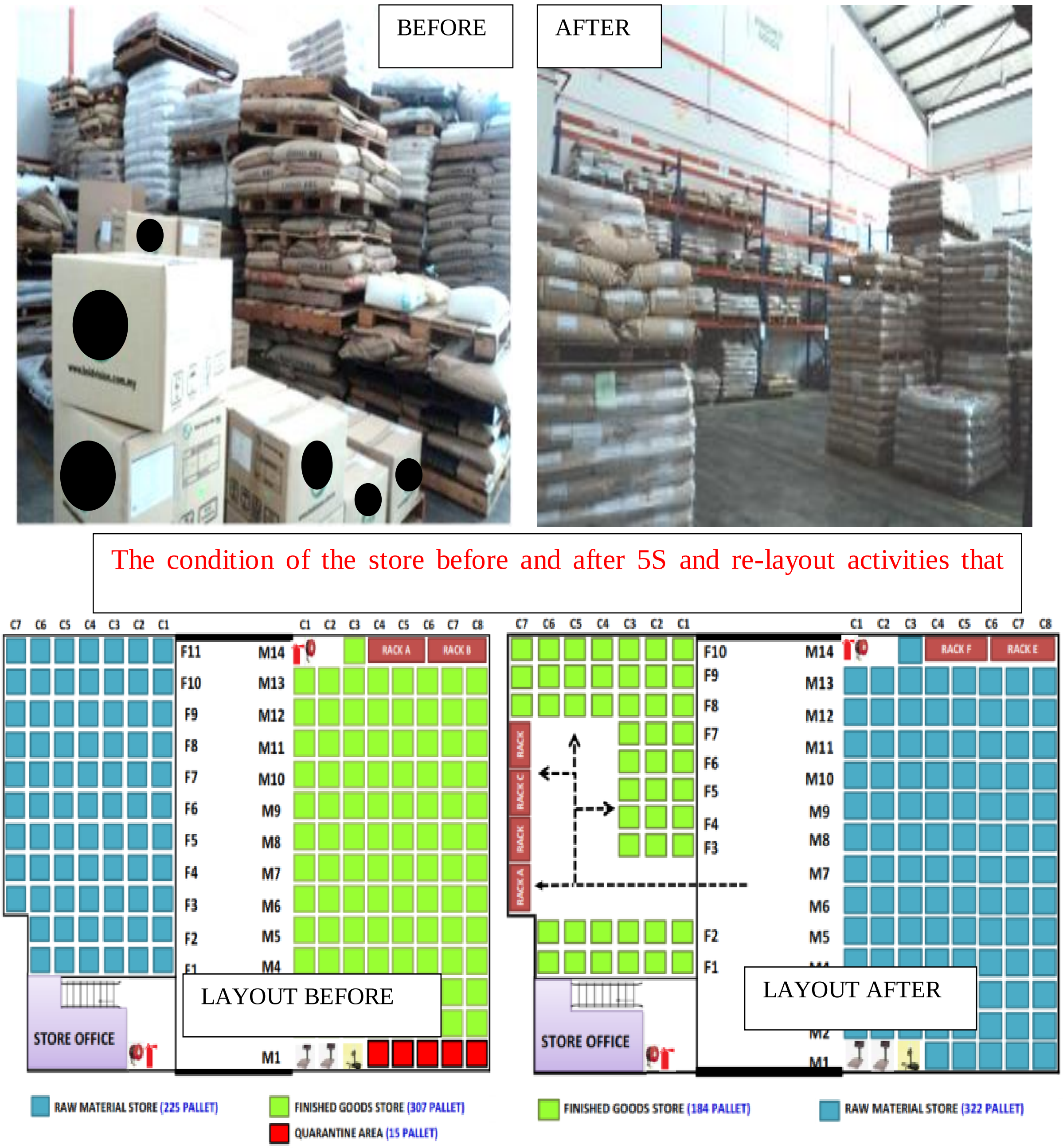


Figure 6.7: LMS Activity Before and After at the Inventory Store Area

Overall, B2 Sdn Bhd has put in place various lean activities in order to realize their aims of transforming their organization towards being a lean organization. Among the other activities that were undertaken such as quality management, in which these activities were aimed at a zero defect and a zero customer reject policy.

Other than that, this activity gave a lot of focus on upgrading work quality and product quality, a design focused on customer's need and also a more effective new products development process. In efforts to achieve higher waste reduction, on average the company had achieved a level of 40 percent waste reduction, mainly due to the implementation of just-in-time activities besides the pull production system. This can be witnessed through a drastic decrease in finish goods stock levels at the warehouse.

In terms of performance measure, the company was able to achieve more than a 30 percent increase in their financial performance figures, 40 percent in marketing performance, 65 percent of non –financial performance and 40 percent of their operational performance. This achievement was noticed after comparing results prior to wide LMS implementations, which was exactly 2 years from the initial start date at the company. This achievement was also based on the estimated figures given by Managing Director of the company, during the data collection process at their facility.

Although B2 Sdn Bhd has just started to embark its journey towards implementing a LMS within their organization, the initial achievements recorded have been remarkable. Positive indicators shows there are positive improvements when making these ‘change’ initiatives. The commitment afforded by the top management was the key success factor when implementing the LMSs adoption. Their strategic approach and policy direction towards a company-wide objective changed human mentality, enabled the process improvement to evolve albeit slowly but effectively. A total implementation strategy has given an impact that is enormous to the performance of the company and also had increased the capability, productivity, image and morale of the employees. In true sense, having adopted the LMS within all scopes of their organizational systems, has only reaped them positive benefits that will truly justify their survivability and profitability for years to come.

6.1.6 Case Study 2

6.1.6.1 Company's Background

N2 Sdn Bhd (this nick name is used to hold confidentiality) was established in 1993 with local ownership under a group of companies. This company is listed as a first-tier[4] automotive parts manufacturer for a national car manufacturer. The company has a total of 159 personnel and the company mainly produces aluminum alloys based products including the casting parts. Up to this date, the company has been certified with several international bodies' certifications. Among those certification received by this company are ISO 9002, QS 9000, ISO 9001:2000 and ISO/TS 16949 certifications. The company had first started its journey on LMS implementation in the year 2008. In the next section, the detail of the implementation strategy that was undertaken at N2 Sdn Bhd is explained.

6.1.6.2 N2 Sdn Bhd and the implementation of LMS

The LMS implementation in N2 Sdn Bhd has reached 5 years since the initial start. Generally, this company has faced many obstacles and challenges in realizing their goal of implementing LMS as a full blown approach. The journey of LMS in N2 Sdn Bhd started when the MAJAICO program, under the purview of the Malaysian government, was launched and targeted as a national agenda to upgrade the level of the Malaysian automotive industry to a global standard. As explained in the Chapter 2, MAJAICO program was a joint-effort between the governments of Malaysia and Japan, with an agenda to have transfer knowledge and technical exchanges under an exclusive agreement between both countries.

The top management of N2 Sdn Bhd made a good decision by participating in this program, as participants under this MAJAICO program, N2 Sdn Bhd was involved

[4] The First-tier automotive parts manufacturer is the one that produce and supply the products that are specifically for one of the OEMs

in a lot of training activities designed using lean tools. After completing all the relevant activities, they started to implement LMS with close monitoring approach and under the consultation of a Japanese expert made available for the program.

The MAJAICO Program was terminated in 2011 and then, an extension to it, was organized by MAI-a government agency, the main establishment of MAI was explained in the previous chapters regarding their role in this industry. N2 Sdn Bhd also underwent a LPS – Post MAJAICO program, intended to enhance the implementation strategy of LMS and towards sustaining the implementation efforts throughout the entire organization. This sub-program is dedicated for those companies that have been involved in implementations, gained knowledge as well as having previously been coordinating LMS under MAJAICO. More importantly, the program aims that all companies in this program will have to achieve a minimum level (level-3) for their implementation achievement. The definition of level was explained in previous Table 6.2.

The implementation of LMS in N2 Sdn Bhd was divided into 3 stages, which are the foundation stage, enhancement stage and sustainability stage. Currently, the company is focusing on the enhancement stage where the company is preparing to achieve the “Lean Firm” status, or in the other word is to implement the full-blown LMS throughout the company. In the beginning, the strategy for LMS implementation was idealized by their top management level after running a benchmarking exercise and assessing the performance level of other competitors in the industry. The management decided to make changes in achieving a higher level of company performance compared to their current achievement, especially in gaining market penetration, which can be considered good, but not exceptional. The management feels that they need to achieve more, in order to improve the management figured on instilling changes. However, just having a desire to excel was not adequate to totally achieve the dream, the company had to contend with the facts that they had limited resources especially with regards to financial ability. Due to this, the implementation of LMS at N2 Sdn Bhd was rolled out in stages but with a consistent and concise effort. (e.g: stage 1, stage 2. stage 3). A few factors were highlighted as important for this LMS implementation at N2 Sdn Bhd. These factors had been identified by the management team through several brainstorming and discussion sessions prior to this event. Table 6.4 shows the important factors that were highlighted by the team.

Table 6.4: Important Factors and Implementation of LMS in N2 Sdn Bhd

Factors	Description	Before LMS	After LMS
Top Management Commitment and Leadership	• To have a clear policy on LMS in the company and is aligned with the mission and vision of the company. • Involvement in companywide activities/projects. • Support the investment in continuous improvement activities (incl. LMS) • Set the Long-term planning, performance target.	• There was no policy pertaining to LMS in N2 Sdn Bhd. • There is high commitment (lead all the activities). • Given but with limited resources. • Both have been set and the information was shared amongst the employee.	• The policy has been developed during the second stage of implementation. • No change. • Given with the investment plan and prioritize to the important activities. • No change.
Organizational Change	• Lean thinking, waste reduction initiatives and set-up a working culture of "Do it Right The First Time"	• Not widely applied.	• Through awareness campaign and activities, the lean culture has been accepted and being practice gradually.
Employee Empowerment	• The employees should be given wider responsibility in planning the task. • There are certain limit that the decision making can be made at the supervisor level and line leader level. • Employees freely allocate their time for doing improvement activities including kaizen, 5S and small group works activities.	• The planning task is given to certain level of employees at a certain level. • The employees are encouraged to give some ideas but the decision making will be made by the authorize person, up to a certain level.	• The responsibility of planning the task and decision making processes has improved but still within certain activities such as in kaizen, small work group and plant workplace improvement activities, i.e. 5S.

'Table 6.4, continued'

Human Resource Management and Training	• Having the career development plan for employees i.e. training and skills development activities. • Having rewards and recognition for best employees, i.e., a suggestion scheme, kaizen activity. • Monitoring activity for attendance and turnover rates of employees.	• The career development plan was only developed at the certain level, i.e. supervisor and above. Career plans for operator level was non-existent. (due to foreign and contract worker issue). • An annual training plan for the employees in production plant exists, but was insufficient. • A suggestion scheme has yet to be developed. • The attendance rate is above 90% but still with 5% absenteeism – this has affected production activities (manpower shortage)	• The Annual plant employee training including skill and engineering development for plant improvement was established and executed • Suggestion scheme was develop with some amounts of monetary rewards. • Attendance rate improved to above 90%, absence rate below 5%, sometimes obstacle in production.
Employee Involvement	• Employees willing to be involved in all activities conducted by the company. • Employees actively participate in company's activities. • Employees more involved in decision making.	• The involvement of the employees are only at a certain stage within a certain level (mostly supervisor level and above) • There is small percentage of involvement by employees in companies activities	• There are improvements in the level of involvement in activities at all levels of the employees in the company. This is shown through the Kaizen groups and small work groups' establishment. • Both factors showed increase in involvement level, higher due to the main activities of Kaizen and small group work activities.
Customer Relationship Management	• There is zero downtime for customer parts otherwise if it happens; there exists a prompt system to counter the downtime. • There is an element of 'customer involvement' in product development and quality programs.	• A few month per year, downtime occurs and total downtime per year is within 60 minutes • The customer is being informed regarding any quality improvement programs but they are not required to participate and their involvement with new product development is only based on a request by the company.	• During a half-year period, no downtime occurs. • There is limited of involvement from the customers pertaining the quality improvements but there are sets of requirement to be followed by the company in order to achieve customer satisfaction.

‘Table 6.4, continued’

Supplier Relationship Management	• The supplier is directly involved in new product development processes. • The supplier is directly involved in the quality improvement program.	• The supplier is only involved when it is necessary. • The supplier is being informed pertaining to the quality improvement program at the company but their participation is not necessary.	• The supplier is being involved during the finalization stage of new product development processes. • There is a supplier unit that is responsible and acts as the medium between the company requirements and supplier's. The supplier is actively involved in the quality improvement activities.
Information Technology	• The information technology is used efficiently and effectively, i.e. all the reports-production, maintenance, inventory and others are kept in a computer-mediated system and can be access by all the employees. • Using advanced manufacturing technology, i.e. CAD/CAM, Robotics and etc.)	• The data management is being maintained using two-ways, manually and partly kept in a computer or database system. • The used of advanced manufacturing exists but up to certain level and depends on certain processes.	• Most of the data are being kept in a computerized-system. The company introduced the “paperless” at the certain area and processes. • No change

After almost five years of effort in implementing LMS at N2 Sdn Bhd, the level of LMS implementation is still in-transition level (LPS Audit: 3.73). This is quite obvious. Toyota took more than 20 years to perfect its JIT/TPS implementation. In this section, the journey of LMS implementation is explained and the example of LMS activities that were applied within the company is also illustrated in more detail.

6.1.6.3 LMS Implementation Activities at N2 Sdn. Bhd.

As mentioned in the previous section, the implementation strategy for LMS in N2 Sdn Bhd was divided into 3 stages (Stage 1: Model Line, Stage 2: Enhancement and Stage 3: Sustain/Maintain). In each stage, the company had listed and recognized several problems in their manufacturing process and applied some improvement activities based on an identified list.

- <u>Stage 1: “Project Based” strategy with Model Line Concept.</u>

The first step that was taken by N2 Sdn Bhd in its implementation process was to form a special committee that would oversee the whole implementation process in the company; this committee aptly named Kaizen was comprised of 5 team members. In essence the commitment shown by the top management of N2 Sdn Bhd was very positive; this could be said because the direct involvement of this team and its hands-on approach in leading the implementation of LMS activities made a visible impact. Their effort into LMS was not only supported by the management team, but also assisted through employee involvement to execute the implementation plans effectively. Through this coordinated seriousness at N2 Sdn Bhd, the management's commitment plus high employee involvement, it became a key success factor throughout the implementation of this valuable system.

The implementation of LMS at N2 Sdn Bhd was applied using a “project-based "strategy, in which they chose an area or production line to become a “model line” in the implementation of LMS. This strategy was decided due to several factors such as limited capacity of manpower resources for additional activity as well as budget constraints. Additionally, since this was the first time the company has been involved in major organizational transformation plan, the management believed that they are more on a trial and error mode. Hence through this “project-based” concept, a production line under the “Wet Painting Area” was selected by the Kaizen team, a model line. Initially, 3 main areas were identified as problematic and was having an impact on manufacturing performances, these problems were found to be at several production areas; Casting Area, Buffing Area and Wet Painting Area. Figure 6.8 shows a simplified process flows of production in N2 Sdn Bhd, included are the identified problems in production. But based on their brainstorming session as well as thorough discussion with the top management, N2 Sdn decided the Wet Painting Area to be their first project in their LMS implementation.

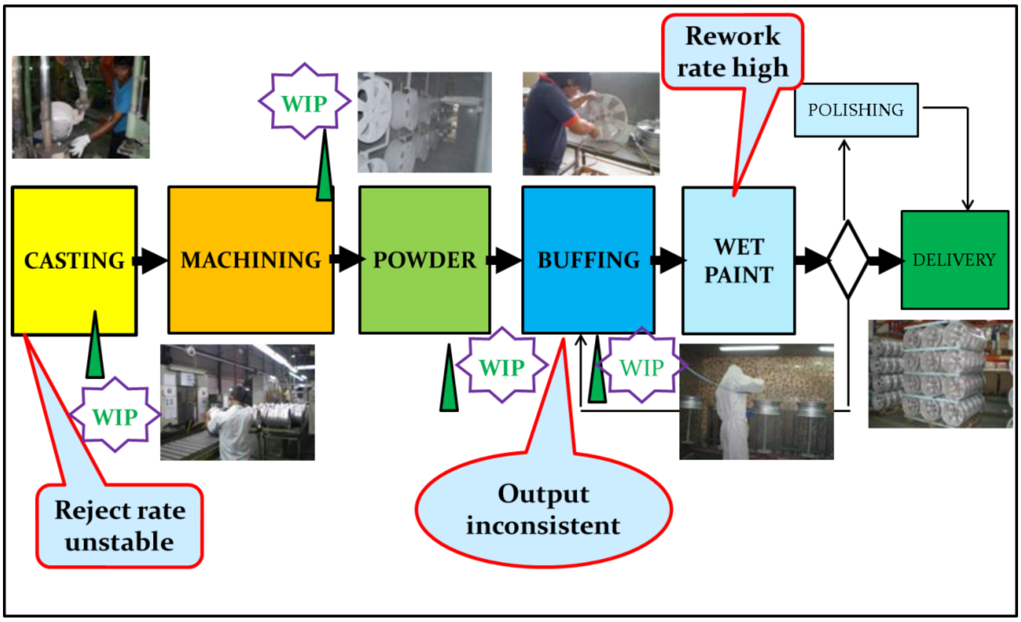


Figure 6.8: Simplified Manufacturing Flows at N2 Sdn Bhd

Based on the current productivity levels, Wet Painting Area is known to add about 30 percent of reworks rate. To ensure this implementation is successful, several continuous improvement teams were formed to help the special committee. The teamwork concept was seen applied within N2 Sdn Bhd, extensively as a work-culture in their daily activities. The continuous improvement teams were running thorough investigations on the current condition and of all aspects pertaining to the selected line. As a result, problems were identified as causes of low productivity rate of the Wet Painting Area. A root cause analysis was done and specific areas that contributed to the problem targeted. Figure 6.9 shows the simplified process flow at the Wet Paint Area.

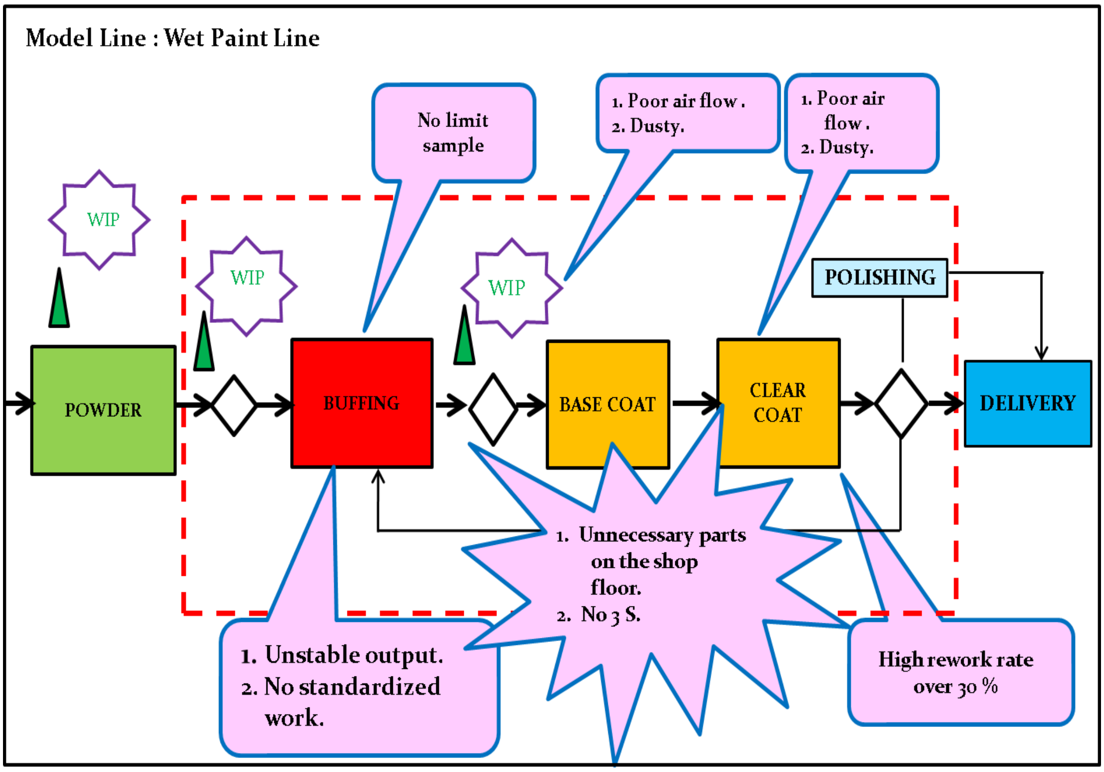


Figure 6.9: Production Process Flow at Wet Paint Line

Based on the teams investigation, a major problem identified with this line was the high percentage of rework rate (30 percent - Figure 6.10 (Graphical)) and the Buffing area found being a bottleneck area for the whole Wet Paint Line I. As a result, two continuous improvement activities known as KAIZEN THEME 1 and KAIZEN THEME 2 had been identified to eliminate or to reduce the problems. The KAIZEN THEME 1 was to improve the productivity at Buffing Line. There were two activities that needed to be improved, i.e. flow production and increasing the output rate per hour. For the flow production, the action taken was by implementing 5S whereby this activity was the initial activity for waste reduction initiatives. Then, a relay-out activity was done by using the work balance chart (yamazumi) in order to calculate the optimum manpower and maximizing output via a line balancing activity. In fact, the activity was continued by implementing the standardized work method. From both of the actions taken, the KAIZEN THEME 1 initiative was a success and an improvement of productivity was increased by 57.6 percent. The summarization of both activities for KAIZEN THEME 1 is explained in Figure 6.11(a) and 6.11(b)

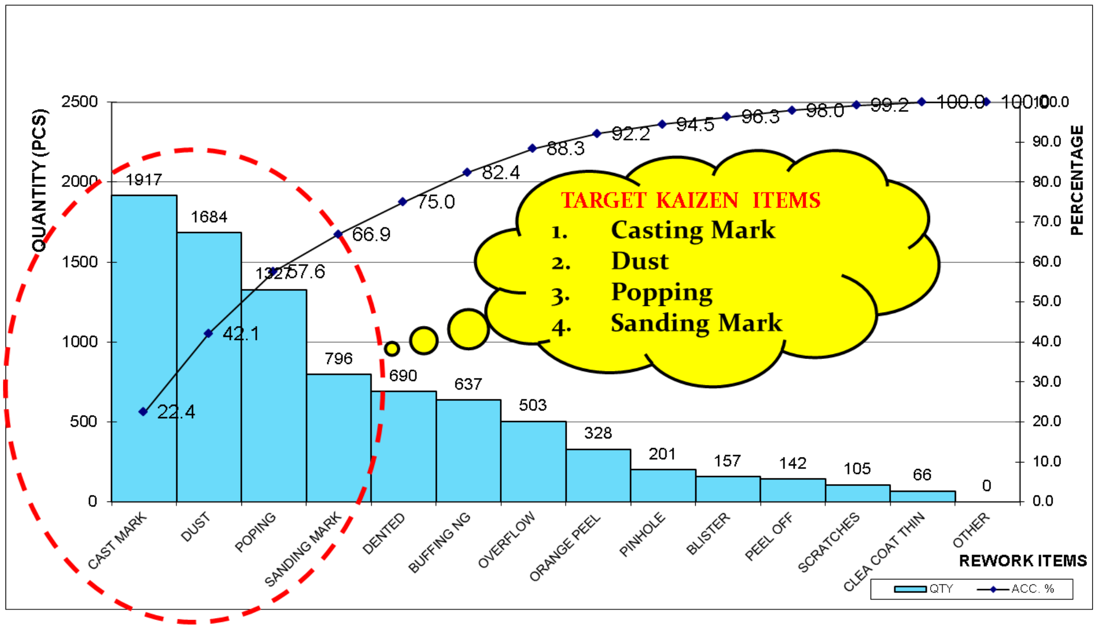


Figure 6.10: Quality Defects- Reworks Item for Wet Paint Line

STAGE 1: LMS IMPLEMENTATION ACTIVITIES AT N2 SDN BHD
MODEL LINE: WET PAINT LINE

KAIZEN THEME 1: Improvement of Productivity at Buffing Line

Activities	Present Status	Kaizen Target
Flow Production	There is no flow line (Individual Output)	3 processes in a line
Increase Output Rate per Hour	6pc/hr/person	8 pc/hr/person - increase by 35.6%

Problem Solving Actions : *Conduct 5S Activities*

STEP 1:

a. Proper area to put SOP
b. Incorporate working table with hanging air piping for air tool.
c. Proper tray to store sand paper.

Results: **BEFORE**

AFTER

Figure 6.11(a): KAIZEN 1- Improvement of Productivity at Buffer Line

STEP 2:

a. Clear out unnecessary parts
b. Proper dispose bins for unused sand paper
c. Proper space for parts in and out

Results: **BEFORE**

AFTER

‘Figure 6.11(a), continued’

STAGE 1: LMS IMPLEMENTATION ACTIVITIES AT N2 SDN BHD
MODEL LINE: WET PAINT LINE

KAIZEN THEME 1: Improvement of Productivity at Buffing Line

Activities	Present Status	Kaizen target
Flow Production	There is no flow line (Individual Output)	3 processes in a line
Increase Output Rate per Hour	6pc/hr/person	8 pc/hr/person - increase by 35.6%

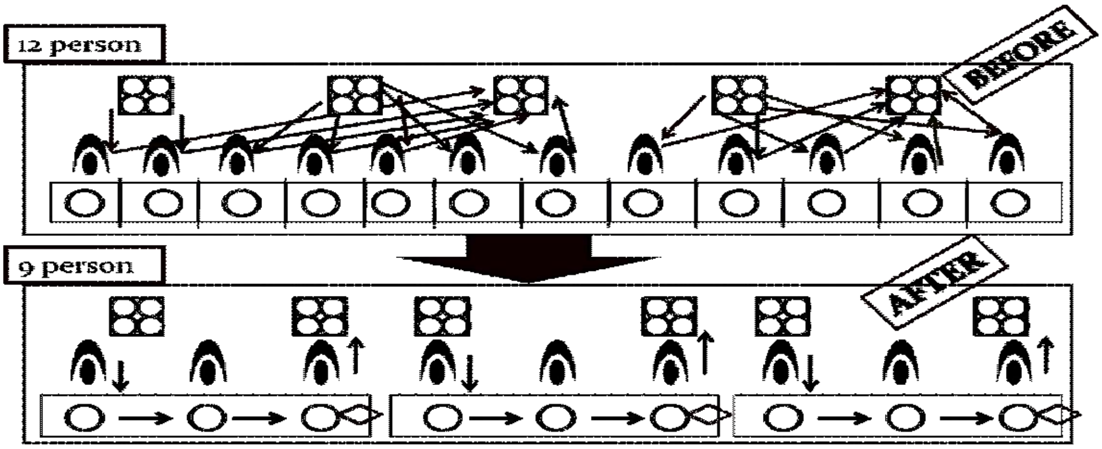
Problem Solving Actions: ***Relayout and Work Balancing***

STEP 1: Takt Time Manpower Calculation

Information	Values
Customer Requirement for May 2008	28284 pcs
No. of N2 Sdn Bhd working day/month	26 days
Working hour per day	1020 min
Wet paint rework pc rate	10 %
Worker efficiency	95 %
Daily Production Volume	1988 pcs/day
Takt time	46 sec/pc
Manpower	8.12 =9 person

STEP 2: Time Observation Sheet
STEP 3: Standardized Work Combination Table
STEP 4: Standardized Work Chart

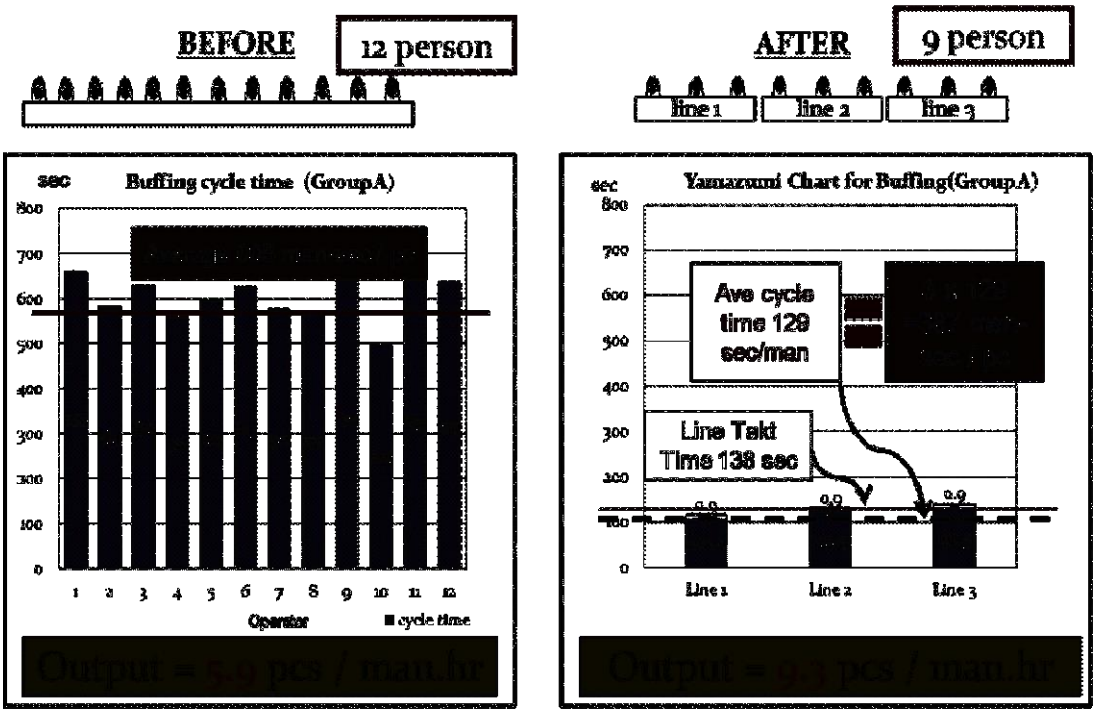
Results:



1. Reduce walking time.
2. Reduce individual operation into 3 operation flow line.
3. Reduce manpower from 12 to 9 person.
4. Incorporate QC check point at 3rd operation.

Figure 6.11(b): KAIZEN 1 - Improvement of Productivity at Buffer Line

Results:



'Figure 6.11(b), continued'.

Meanwhile, the KAIZEN Theme 2 focuses on the quality production at Wet Paint Line2, the main activities to be done here had been identified as ways in reducing the quality defects at this line. The first activity was aimed to reduce the rework piece per rate at the process base and the clear coat line. The current level being 30 percent rework, the activity was aimed to reduce the level to only 10 percent. The other activity was to set up Quality Control check points at each process. The activity started with 5S activities in order to remove all the waste and obstacles at the paint line. Since there is no Quality Control checkpoint at each of the processes, checkpoints were established and aimed to monitor. The results showed, the rate of rework of the product was reduced from 33 percent to 8.7 percent which about 75.5 a percent decrease. The result was achieved within 3 months time. The activities are summarized in Figures 6.12(a) and 6.12(b).

STAGE 1: LMS IMPLEMENTATION ACTIVITIES AT N2 SDN BHD
MODEL LINE: WET PAINT LINE

KAIZEN THEME 2: Reduction of Rework piece rate Base and Clear Coat Line

Activities	Present Status	Kaizen target
Reduction of rework pc rate at base & clear coat line	33%	10% (reduce to about 70%)
QC check point	No QC check point at buffing area	Set up QC check point at each process

<u>Problem Solving Actions:</u> ***Conduct 5S Activities***

STEP 1
a. Removal of all WIP from Wet Paint Line
b. Wet the floor to trap dust

RESULTS: **BEFORE**

AFTER

Figure 6.12(a): KAIZEN 2 - Reduction of Rework Piece Rate Base and Clear Coat Line

STEP 2
a. Humidity monitoring
b. Daily floor cleaning with cleaning machine

RESULTS: **BEFORE**

AFTER

‘Figure 6.12(a), continued’

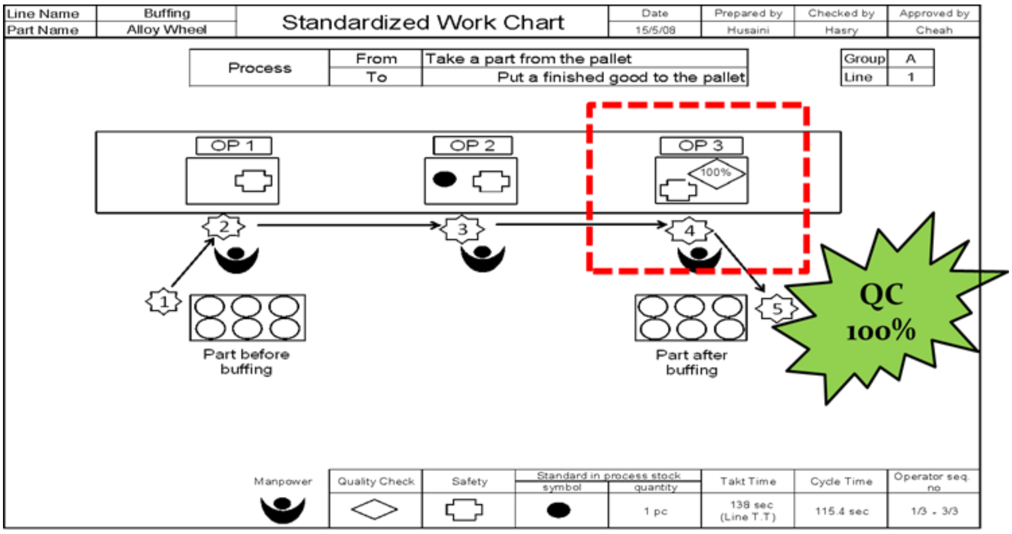
STAGE 1: LMS IMPLEMENTATION ACTIVITIES AT N2 SDN BHD
MODEL LINE: WET PAINT LINE

KAIZEN THEME 2: Reduction of Rework piece rate Base and Clear Coat Line

Activities	Present Status	Kaizen target
Reduction of rework pc rate at base & clear coat line	33%	10% (reduce to about 70%)
QC check point	No QC check point at buffing area	Set up QC check point at each process

<u>Problem Solving Actions:</u> ***QC Check Point***

STEP 1: Set up QC check point at operation no. 3



Results:

1. Quality Defect Items

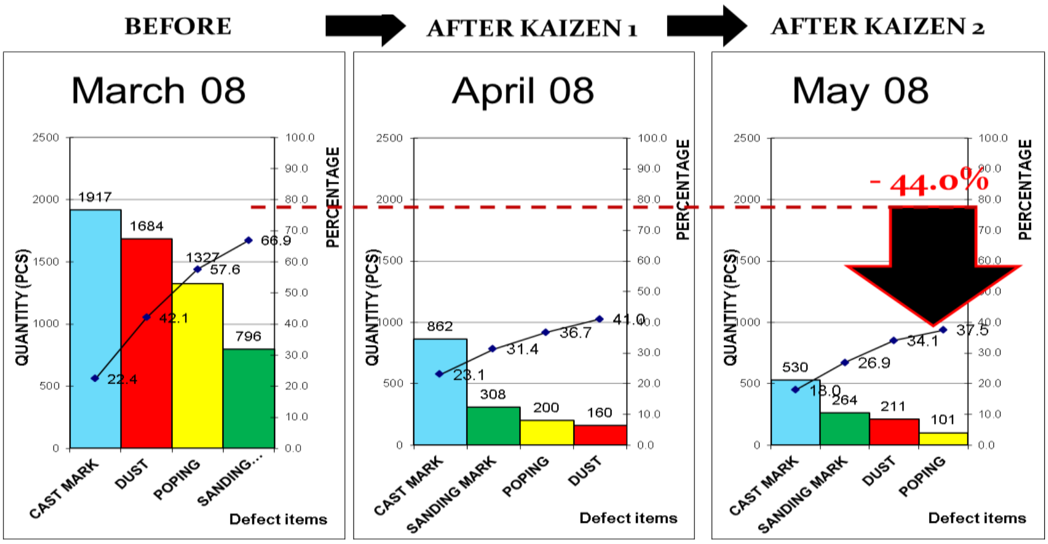
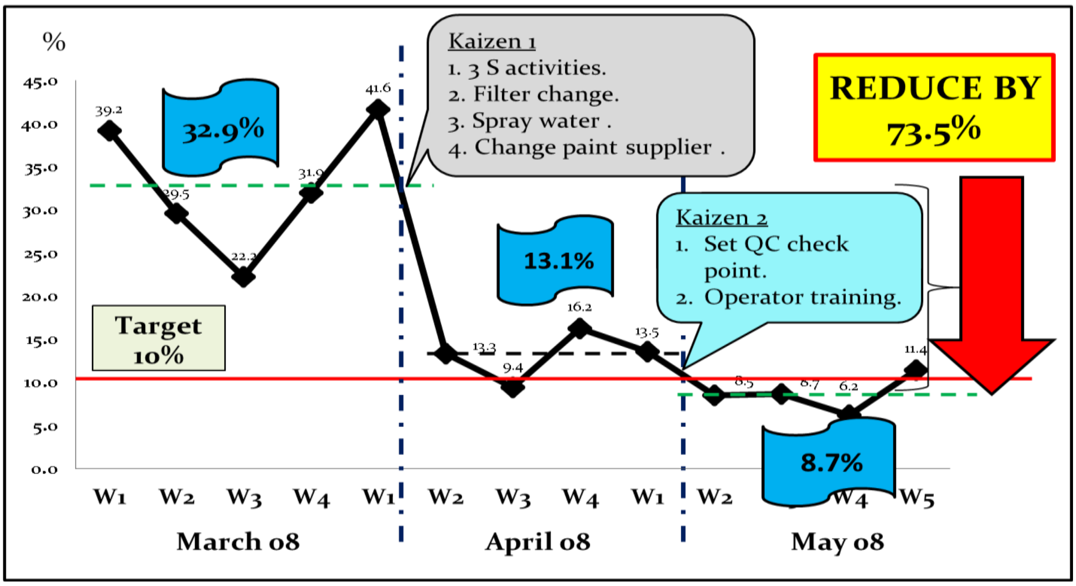


Figure 6.12(b): KAIZEN 2 - Reduction of Rework Piece Rate Base and Clear Coat Line

2. Rework PC Rate



'Figure 6.12(b), continued'.

After witnessing these success and improvements in stage 1, the company set the pace for further implementation of activities of continuous improvements based on the success of the selected model line. Up to now, almost all of the production area had been upgraded. Stage 2 is now on its way, in order to improve the level of implementation and at the same time making the company changes into a 'lean company' especially within the automotive industry and generally in Malaysia.

6.2 Discussion on Case Studies

Summarily, both manufacturers started implementing LMS by defining their goal and setting their company's direction towards its implementing as a total-approach concept or as we call it being a full-blown implementation. These companies were formed in the 1990s and thus they shared the same maturity level. However, N2 Sdn Bhd did start their journey slightly earlier for implementing LMS in their company. Despite this, it is now understood that the duration of implementation does not render it being more effective and should not be a gauge on how success is achieved at a particular company. In fact, comparing the two companies we can say that B2 Sdn Bhd had achieved a better implementation level, as N2 Sdn Bhd is still at the “in-transition" level for LMS.

There is no specific guideline or ways in implementing LMS that has been provided for the companies, this consequently make companies decide on having their own ways of implementation. B2 Sdn Bhd arranged a strategy to have a total implementation of lean, with a company-wide effort and made LMS a policy of the company. While at N2 Sdn Bhda “project-based" concept or model line implementation was championed as the main strategy in their LMS implementation at the plant. This strategy was instead taken because its concerns of having limited financial resources available at that point of time, this made the decision more sensible and thus a more cautious approach ensued. Nevertheless, an execution of a strategy that was well planned and defined, on whatever level or starting point, the expected results was to have key improvements gained after an implementation. Importantly, the main objectives in implementing lean as a full blown approach was a success.

Besides, both companies agreed and had believed that a LMS implementation would not be fully achievable, if there was no commitment, dedication and leadership direction given by the top management. This was the key factor in having this implementation work and taking the LMS as an effective total approach to their manufacturing processes.

Based on this case study, it is also found that the human resource management (HRM) played a key role in adopting LMS in the company and should also be a key factor LMS implementations in the Malaysian automotive industry. This observation contradicts with the survey results obtained from a large number of manufacturers but it is supported by the literature review. As per this researcher's opinion, this is due to bias coming from the respondents themselves, as the survey was taken from a large number of respondents from various companies and from different levels of the organizational structure, it was expected that these people had varying degrees of perception on LMS, its benefits, the levels of implementation and the rate of implementation at their respective companies or even the industry. Factors like duration of exposure or experience with the lean system, number of working-years with the company, self-inclusion on the strategy building or decision making and organizational approach (total vs. pick-and-choose), probably determined their understanding and outlook on LMS.

Some literature review reported resentments coming from employees that felt threatened by the new systems, mainly through fear of job loss and line managers thinking of the LMS as only a cost-cutting or labor-saving activity. What seemed to the be overwhelming theme here, is that the understanding of lean and its styles was not fully cascaded down to the line and having managers not grasping the full intent and benefits of the system itself.

Most literature review states that the human resources unit (HRM), acting on behalf of the top management or an organizing committee, would function as the 'champion' or driver of these intended changes. They would be tasked to organize training classes, forming relevant committees and groups, creating implementation schedules, making internal campaigns, monitoring the roll-out process and more importantly audit the results by themselves or through a capable third-party expert with the necessary qualifications. So, the HRM becomes an agent of change for the company, there is no doubt that a successful implementation requires a total commitment from top to bottom within the organization, but the HRM is the unit that consolidates all these efforts.

The importance of Teamwork was also seen as another huge factor in the implementation of LMS. N2 Sdn Bhd made teamwork as their work-culture within the company, while at B2 Sdn Bhd the teamwork concept was applied on all levels of their daily task. It was not only applicable in the kaizen activities, but also applied to use in problem solving and decision making processes throughout the company. Other known factors of the LMS that were no less important like training, employee involvement, employee empowerment, organizational change, customer relationship management, supplier relationship management and information technology, were also seen as useful within the context of these two case studies analyzed.

There were two other LMS factors that were rejected by our empirical evaluation in this research namely; employee involvement and supplier relationship management. As stated earlier, the researcher felt that the opinions generated were skewed towards the negative because of their inability to fully understand, the whole concept of lean and lack of knowledge and skill in parallel to the LMS total approach. It was unfortunate that this group of survey respondents did not identify employee involvement and supplier relationship management as crucial, probably if another survey was taken with another group set of respondents, the outcome might be different altogether. It needs to be highlighted from literature review readings and based on the observation at the case study facility, that employee involvement too was a driving factor for them having successful implementation of LMS. Opinions from almost all other researchers (literature review) stating that employees are the 'heart' of the company and if employees execute their job function well, it only spells positive for the organization. Factors like teamwork, work-groups and Kaizen would not have a chance if employees were not directly involved in LMS' implementation.

Crucially, another important factor within LMS is on supplier relationship management, which is a concept that is even harder to grasp, simply because the inner-working of this element would not be known unless the employee is directly involved with inventory management, cost control (financial), JIT, production planning or logistics. In short, it is akin to having 'preventive maintenance', solving and identifying smaller issues with regards to raw material supply before having a much bigger problem i.e. supply stock-out, which is crucial in JIT process. Probably these respondents have not faced problems of supply shortages or input materials coming from overseas. As Shah & Ward (2007) have stated that as firms cannot afford to waste resources, selecting a group of key suppliers is crucial, limited in numbers but are performers that constantly delivers solutions and ones that can offer long term relationships. It proves that having good supplier relationship management will in effect limit or eliminate down-time within a manufacturing organization. The overall findings of the case studies were summarized in Table 6.5

Table 6.5 : Summarization of Overall Finding for case Studies.

Companies		
	B2 Sdn Bhd	N2 Sdn Bhd
Background	22 years, 100% local company, supplier to local automotive car makers.	20 years, 100% local under a group of companies, supplier to local automotive car makers.
Level Of Implementation	Started in 2011 - < 3 years , High level of TM commitment, achieved in-transition level.	Started in 2007, > 5 years, Divided to 3 stages of implementation plan-project based strategy due to financial constraint. Has achieved the in-transition level and towards the lean firm status.
Implication /Results	Increase employee involvement by 35% (training, employee suggestion scheme)	Increase the production rate to 57.6% through stage 1.
	Reduce Maintenance Outsource Works to 50 % and total maintenance cost to 35%	Reduced the rework rate from 33% to 8.7%
	Reduce machine failure rate to 10% and downtime rate to 30%	Reduce the manpower capacity by 25% - plant re-layout ad restructuring jobs function.
	Increase manpower skill by 17% (37%)	Develop the internal quality check procedure – reduced customer complaints
	Reduction up to 70% in setup time – introducing new SOP and concept.	Reduce downtime to only 60 minutes per year.

‘cont Table 6.5’

Companies		
	B2 Sdn Bhd	N2 Sdn Bhd
Implication /Results	Reduce the in process quality control from 208 minutes to only 59 minutes (approx. 80%)	
	Reduce the inventory of finished goods to 10 days (17 days) and raw material from 31 days to 20 days.	
Performance Measure	WR = 40% FP = 30% MP = 40% NFP = 65% OP = 40%	WR = 25% FP = 15% MP = 30% NFP = 35% OP = 25%

Basically, the implementation of LMS in Malaysia is aligned with the proposed guidelines that have been developed. Overall, LMS has been proven to be beneficial to manufacturers within the Malaysian automotive industry, it has provided a positive and proven working concept that if being adopted well, should be giving long term advantages to manufacturing outfits. The LMS implementation in Malaysia ranges from an implementation stage being 'in-transition' to being a major success. As more companies get to know the benefits through industry news or organized exchanges through government-lead initiatives, the LMS should provide a sustainable competitive advantage for the whole Malaysian industry. Thus, making it achieving a higher standard compared to the current level and recognized as a world-class automotive industry.

6.3 Proposed Guidelines for Full-blown Lean Manufacturing Implementation in Malaysian Automotive Industry

Based on the evidence gathered, a set of guidelines is now proposed by this researcher. This research has found that in order for achieving a full-blown LMS implementation in Malaysia, the Malaysian automotive part manufacturers need to ensure that:

1. Management at different levels is committed to LMS, fully support it, and provides the required financial and non-financial resources; -*Management Commitment & Leadership.*
2. Employees are encouraged to participate in and be highly involved with lean-centric activities, by engaging them through work-groups, suggestion schemes, top-down communications and employee-friendly policies. Which fosters good work-culture and allows more participation in lean practices, problem-solving and decision-making; -*Employee Involvement.*
3. Employees are effectively empowered to think strategically and have the liberty to make sound judgments concerning their job scope or job function, additionally able to participate in different lean practices, continues problem-solving and decision-making activities; -*Employee Empowerment.*
4. Adequate training regarding LMS should be provided for all employees and even middle and top management as skilled personnel would be more able to seize all the opportunities offered by LMS implementation; -*developing K-workers.*
5. Employees work as a team and teamwork is emphasized as it allows employees easily and effectively share their knowledge, expertise, and experiences and move toward the common objectives of continuous improvement; -*Teamwork.*
6. Organization is engaged in lean-oriented human resources management practice and existing practices are integrated with lean manufacturing policies; -*Human Resources Management.*

7. Customer relationship management practices are effectively embraced and integrated with lean policies in order for building close cooperative and partnering relationships with customers; -*Customer Relationship Management.*
8. Supplier relationship management in-line with lean objectives are observed, continuously applied and improved in ensuring effective communication and collaboration, and standardization of operations with suppliers and business partners; -*Supplier Relationship Management.*
9. The current structure and management system should be changed in a way to enable employees at all levels to effectively participate in problem-solving and decision-making while implementing different LMS activities; -*Organizational change.*
10. Adequate IT infrastructure and resources for LMS are provided to ensure efficiency and acceptability of lean-related training, and effectiveness of teamwork through efficient and speedy information and knowledge sharing. –*IT.*

Moreover, Malaysian automotive part manufacturers need to understand that:

a) Intense implementation of all LMS dimensions, AKA full-blown LMS implementation is a key and feasible business strategy for Malaysian automotive part manufacturers to achieve business performance in all dimensions;
b) Business performance improvement could be best achieved when companies implement all the dimensions of LMS, and when each of these dominations is implemented intensely;
c) A company as a whole, should be open to LMS-related organization changes, and appropriate change management policies are employed as full-blown implementation of LMS necessitates significant changes all over the organization to ensure continuous improvement.

6.4 Summary

This research tried to provide an empirical study based on extensive data analysis by using the relevant statistical methods and the Structural Equation Modeling (SEM) technique. By using SEM, the measurement model validation was presented with regards to the conceptual model. This was followed by the structural path analysis and hypothesis testing. The relationships between different dimensions of LMS implementation and five sub-dimensions of business performance were found and analyzed using several tests of multivariate analysis of variance. Although, 3 stated factors were rejected by the various tests, it is safe to mention that the positives of LMS outweighs its negatives, these factors might be considered as a prevailing disadvantage for Malaysian automotive parts manufacturers, because these businesses have not been successful in involving their employees in activities and being ineffective towards having human resources practices and integrating them with lean manufacturing policies. This is reflected within the respondents' feedback based on their state of perception of the current and future LMS application in the industry. However, as stated earlier these thoughts were mostly influenced by variances of employee's personal experience and exposure to LMS. Probably, not enough was done to cascade down lean understanding, lean awareness and an appreciation of lean advantages at their respective companies, but this could be rectified through increased training, increased top-down communication, employee involvement and empowerment, factors that we had discussed earlier. Companies would also need to have increased integration with their supplier relationship management practices with a LMS implementation; it is more than likely businesses would need to commit additional financial, capital and positioning personnel resources to upgrade the development of lean-oriented supplier relationship management.

The case studies presented a chance for the research to have an inside view of how an actual LMS implementation actually materializes, to an extent to be deemed a success. It also gives the research a chance to challenge the 3 rejected hypothesis and to see it within context of an actual LMS application, with organizational improvements and increases in business performance dimensions which were measureable.

So, after developing our early conceptual model based on ten probable best influencing factors, for applying the LMS within the Malaysian automotive industry context; testing the model empirically using available data from industry respondents, based on current perceived implementation efforts and levels. Then the researcher tried to solidify or reconfirm or dispel doubts concerning the survey data, using actual case studies taken from willing LMS practitioners or known implementers; to highlight influencing factors, dimensions and its benefits towards business performance improvements. This test-analyze-compare method was done to ensure the factors were weighted against each other objectively based on different evaluation techniques to produce results that are correlated and highly justifiable.

Finally, the research has been able to propose a guideline for all automotive parts manufacturers to use as guidance before or during an intended LMS implementation, however it is pertinent to mention that for LMS, a full-blown implementation is the best way towards seeing major improvements in their company and the 10 distinct factors of LMS are highly inter-related elements, they are complementary to each other and has synergistic effects. This gives the LMS its unique character and superior ability towards achieving multiple performance goals.

CHAPTER 7

CONCLUSION AND FUTURE RECOMMENDATION

7.1 Summary of the Work

This study had attempted to provide a better and clearer understanding on how a full blown LMS implementation would work in the Malaysian automotive parts manufacturer's context and the way it has a direct or indirect effect on several criteria of organizational performances.

In order to satisfy the requirements of the research, extensive literature review was done by collecting papers from a large number of journals of international repute, making several field visits to Malaysian automotive parts manufacturing enterprises, as for understanding and developing the relevance of LMS (LMS) in today's context. The research's problem statements, objectives and the scope were thus determined. A conceptual model was figured out as a guiding principle. Data collection was undertaken by means of survey and gathering of actual industry data, with the collaboration of the Malaysia Automotive Institute (MAI), the research gained a deeper access within the industry. Understanding the necessity of developing a generic LMS implementation scenarios on its current practices and future needs, a set of comprehensive questionnaire (considering an integrated system approach) was developed (following different stages and levels of validity). Focus was given to the Malaysian automotive industry in order to determine the current adoption rate among domestic manufacturers including its current implementation rates, the awareness of LMS as an improvement methodology, government's involvement via specific bodies, the driving factors on LMS implementation, number of industry members participation and then focusing on specific manufacturers that have managed to exercise a full blown implementation. Those data from hundreds of manufacturers were then consolidated and subjected to an empirical analysis to determine and establish LMS' importance within the Malaysian context. Later, a more comprehensive model was established based on industry data analysis.

Overall, the objectives of the research have been achieved. The prevailing results have shown a direct impact on organizational performance through a full blown LMS implementation that could be seen through the results of financial and non-financial performance measures. The summarization of this study are as follow:

- This study utilizes the relationship and the collaborative partnership with the Malaysian Automotive Institute (MAI) to leverage on their vast amounts of information and experience with regards to the Malaysian automotive manufacturing sector. The researcher fully appreciates the significance of consolidating real industry data with the help of MAI, to correctly gauge the rate of LMS implementation in the Malaysian automotive industry, with a narrowing focus towards the automotive parts manufacturer. It was pertinent in this research to understand the acceptance level of this world renown manufacturing system within the domestic industry, because acceptance and belief in this system is thrust through an adequate knowledge base, a concerted management efforts and with creative support programs from governmental agencies.
- This study has been able to propose a model for a full-blown LMS implementation using findings from other previous literature on this subject matter. The model was formed using inputs from 10 distinctive influencing factors-that is important for a LMS total approach, 6 inter-related LMS dimensions that sets the improvement parameters into action and the use of 5 performance dimensions that acts as performance measurement indicators to signal for any improvement gains. While it is acknowledge that certain benefits cannot be measured empirically, it is accepted that LMS inherent synergistic effects will be able create value over time.

- This study attempts to research and identify factors that should contribute towards the enhancement of the Malaysian automotive industry into being a world class industry, that is acknowledge globally of being capable to produce high-value vehicles. Specifically onto upgrading its current capability, professionalism, standard and recognition up to higher level in the highly competitive market of world automobile production. Through the use of ingenious, innovative and proven manufacturing systems or approach that would bring strategic advantages to the industry as a whole.
- Should the industry accepts LMS as a manageable tool for enhancing their competitiveness and adopting it as a 'total approach', the researcher beliefs advantageous gains would materialize for firms that takes the challenge simply because LMS concept provides synergistic and inter-relatable performance gains if approach, applied and sustained in the right way. Lesser emphasis should be given towards profits but a higher degree should be placed in creating value.

7.2 Conclusion

The main and generalized conclusions of this work are placed below:

1. This study managed to construct a conceptual model for implementation of LMS (LMS) in Malaysian automotive industry by consolidating all the major characteristics and factors. Despite this system is not a panacea to solve all problems, indeed, all aspects can be put coherently under a lean manufacturing framework. The uniqueness of LMS lies in its principle of eliminating waste, but increasing quality of product; upgrading knowledge & understanding through training of employees; focusing on mindset change & organizational changes to propel the main agenda; building strength in customer relationship management and supplier relationship management, to form unique synergies that allows flow of

expertise and cooperation between different classes within a manufacturing environment-material, technology, logistics, systems, design; usage of IT allows for rapid movements of data and information that enables increase sharing of knowledge between different entities among intra company subjects as well as inter-company. Taking all these into an aggregate consolidated determination, the LMS with its positive aspects should revolutionize the industry into having higher competitiveness levels relative to similar industry in foreign countries. To be truly in lean, this industry need to link its sister organizations and human force need to acquire an organization culture similar to the Japanese world-class organizations, where quality-orientation and willingness to contribute would be established in all tiers to achieve the common goals of the industry or organizations.

2. This research successfully assessed the level of the current lean manufacturing application in the industry by way of industry survey and the use of specific case studies. Focusing on major or key players within the industry, while focusing on their knowledge of LMS, their experience with LMS, their level of implementation and their level of successes with LMS' implementations. Members of the Malaysian automotive industry generally considers LMS (and its factors) beneficial in essence and will have positive benefits when applied accordingly. However, several prior reviews have measured the level of LMS implementations, and concluded that it is still in its infancy or early stages. Studies that was made by Norani Nordin et al. (2010b), shows that LMS implementation in Malaysian automotive industry is only to “some extent” as opposed to major. Many are still considered to be in a transitional level and some frustratingly are pick-and choose appliers, utilizing some of the more popular LMS principle but not the others. The fact is within the domestic auto part manufacturers in Malaysia, a full blown implementation is not yet industry-wide. Many were trying to self-adapt and trying to use some of the

more admired factors of LMS, they found that implementation was not easy and struggled to measure any quantifiable success.

MAJAICO program resulted in 87 manufacturing companies taking part, but only 13 became successful Model companies (15% success rate) -Defined as a company that is able to implement LMS practices throughout its entire organization (Malaysia Automotive Institute, 2012).

Lean manufacturing and its system cannot and would not have an impact if manufacturers blindly espouse to LMS' application without any strategic steps (guidelines) on proper and effective implementation. Eventually, they give up trying and revert back to their old ways of doing things. Acknowledging the LMS as integrated, highly inter-related elements, which are complementary to each other and has synergistic effects, is crucial. Many scholars looking into LMS explained that it not only exists at both the strategic and operational levels, but most researchers agreed and stated that LMS is also above all should combine philosophical and practical orientation.

3. This research consolidated all the gathered industry data, developed specific hypothesis, conducted multiple analyses, further refined the earlier conceptual model and later tested it against the researcher's hypothesis to prove LMS' relevance within the proposed model. Focus was given on noticeable performance improvements and deducing its sustainability moving forward into the future. This research has been able to introduce a refined model for a full-blown LMS implementation based on the results. This research has identified the major factors, indicators and dimensions relating to full blown LMS; there are seven (7) influencing factors that affect the levels of LMS implementation (based feedback from respondents) namely:

1) Management leadership and commitment has a positive effect on the level of lean implementation.
2) Empowerment of employees has a positive effect on the level of lean implementation.
3) Employees' training has a positive effect on the level of lean implementation.
4) Teamwork has a positive effect on the level of lean implementation.
5) Customer Relationship Management has a positive effect on the level of LMS implementation
6) Organizational change has a positive effect on the level of lean implementation.
7) Information technology use has a positive effect on the level of lean implementation;

Six (6) major inter-related dimensions of LMS that is crucial for implementation success:

1. JIT [Just-In-Time]
2. TPM [Total Preventive Maintenance]
3. QM [Quality Management]
4. PS [Pull System]
5. CI [Continuous Improvement]
6. DCN [Design for Customer Needs];

and five (5) dimensions of organizational performance that acts as performance measurement;

1. WR [Waste Reduction]
2. FP [Financial Performance]
3. MP [Marketing Performance]
4. NFP [Non-Financial Performance]
5. OP [Operational Performance];

that can be quantified by means of statistical computations over a determined time period. These attributes should be recognized as industry standards, because failing to distinguish them would hinder the implementation process and success of the LMS concept as a whole.

Based on the evidence gathered, a set of guidelines was able to be proposed by this research. This research has found that in order for achieving a full-blown LMS implementation in Malaysia, the Malaysian automotive part manufacturers need to ensure these ten elements are present for it to achieve a full-blown LMS implementation for all automotive parts manufacturers to use as guidance before or during an intended LMS implementation. The researcher positively belief that for LMS, a full-blown implementation is the preeminent approach towards seeing major improvements in company performance because the 10 distinct factors of LMS are highly inter-related elements, are complementary to each other and has synergistic effects. This gives the LMS with a full-blown implementation approach, its unique character and superior ability towards achieving multiple performance goals.

4. This research investigated the impact of a full blown implementation by evaluating the survey results in getting a general overview, of the domestic industry in Malaysia; its impact and implementation rates-known or perceived, its understanding and acceptance levels, its perceived benefits or barriers and its performance level-current versus future expectations. Then, centering on a few companies that had underwent actual implementations; which provided this research with authentic measurable data. By using the 5 dimensions of the organizational performance indicators to highlight positive improvements, consequently proving a full blown implementation of LMS facilitate increases organizational performances.

Based on the evidences gathered, some organizational reforms are required to strategically implement the LMS in the Malaysian auto industry to ensure its competitive advantage. On a macro level the government with their intervention policies will provide a base for the manufacturing industry to excel further, whether in the form of protectionisms or liberal incentives it will give organizational advantages to manufacturers wanting to upgrade their operational levels. On a more specific view or micro level, it seems that the management of organizations need to showcase enhanced commitment if desiring to have full-blown implementation of LMS within their current operations, because their leadership drive will have a causal effect on employees in their organization. This desire and tenacity to adopt lean would later be understood and embraced by everyone and multiple levels of the organization. While employees, in wanting also to have LMS principles in their daily routine, needs an upgrade of their knowledge of LMS applications and tools so that a higher level of understanding persist in the workforce thus better embracing the LMS philosophy. This can only be achieved through continuous training, free internal communication and hands-on approach (employee empowerment and involvement). Current systems will need to be examined in terms of its design so that eventual rectifications or modifications can be applied to be in-line with LMS principles. Government agencies with the expertise in LMS should be roped in to have more open discussions, in the form of exchanges of ideas or tie-ups, to cross reference effective strategies of LMS or performance data on a long term basis. Done correctly in a collective manner, this will create an industry unit that is working together, rather than only individualistic entities. More importantly manufacturing players should shift their focus slightly, with a lesser emphasis on profit margins, but rather on creating value in their own companies and ultimately for the industry. The benefits of this outlook will eventually materialize in the forms of increased organizational performance.

5. In ASEAN Malaysia is the third biggest car market with 3 car manufacturers, 8 car assemblers, 9 motor assemblers and more than 800 component manufacturers and employs more than 300,000 people either directly or indirectly**.** Malaysia has the biggest market for automobiles sales per year in South-East Asia, in 2011 the total production of motor vehicles amounted to 533,515 units, comprising of passenger vehicles and commercial vehicles. Presently, the automotive industry employs 47,574 workers, with 25,111 workers (motor vehicle assembly industry) and 22,463 workers (motor vehicles parts and accessories industry). So, the automotive industry has become an important and special industry to Malaysia.

No surprise that numerous government policies are drawn to protect and support the local automotive industry because the automotive industry is designated to boost the country‘s industrialization process and to enable it to reach the status of a developed nation by 2020. The Malaysian national automotive industry is a major component in Malaysia's industrial sectors, and represents a matter of national pride. Total investments alone, in the automotive sector had amounted RM1.923 billion in 2011, while it was RM1.91 billion in 2010**.** In which domestic investments amounted to RM1.35 billion (70% share of the total investments), while foreign investments totaled RM578.6 million (30% share). Mainly afforded by the government efforts to sustain the momentum of this industry by matter of promotion, foreign direct investments (FDI) and friendly corporate incentives to attract major international players to Malaysian soil.

The capability of the Malaysian industry in creating value is already obvious, (Noor Azlina et al., 2012), mentioned that, the World Trade Organization has listed Malaysia as the 11th nation that is capable to design and manufacture vehicles that meet world class standards; from a total of 146 other member countries. Consequently, there are more than 704 automotive components and parts manufacturers, and within that about 45 vendors in the automotive component industry achieving the capabilities and competency to design, develop, source components and parts. Having the ability to manufacture whole modules or component for the original equipment and replacement markets. Thus, the Malaysian automotive parts manufacturers has become one of the main producers and exporters of vehicle parts, components and accessories in the region, as well as being accepted in Japan, Germany and the UK. Mainly attributed to their excellent and acceptable quality, complying with international standards, but offering highly competitive prices.

Now, the next step is consolidating these best known values of the domestic auto manufacturing industry and integrating them with the proven LMS ideology to further enhance its effectiveness and synergies for the betterment of the industry as a whole. The government should continue to play a driving role through its various agencies, with proper guidelines established for the industry, managed by the overseeing authority. Then manufacturing entities that diligently adhere to this and its implementation, adaptability and performance are controlled and monitored, it should provide a strategic rule on how firms should behave and re-structure their operations according to definitive but measurable standard determinants. Firms should realize that in order to survive within this high cost, highly competitive industry, the only way is by creating values-internal and external. This can be done by observing known standards provided within effective manufacturing practices such as the LMS.

7.3 Practical Implications of the Research

To the best of the researcher's knowledge, this study is among the first studies which simultaneously investigate how a wide variety of influencing factors can facilitate or hinder an LMS implementation; what is the idea of full-blown LMS implementation, and what is the relationship between LMS implementation in different levels (non-implementation to full-blown implementation) and business performance improvement.

Although implementation of LMS has received significant attention by the scientific community, however, the literature shows some major limitations. In general, prior studies in LMS implementation context have investigated either the ***influencing factors → LMS implementation*** relationship or the ***LMS implementation → business performance*** **relationship.** While there is no doubt in the creditability of prior studies, three (3) main research gaps however were identified within these two (2) streams of research. Accordingly, this study has tried to make some significant contributions to the theory by addressing these gaps:

1. Previous studies focusing on ***influencing factors → LMS implementation*** relationship have introduced and investigated different sets (but with low variety) of influencing factors as the potential determinants of LMS implementation, which undermines the comparability of findings of these studies. To address this gap, the study investigated the impact of a wide variety of organizational and technological influencing factors on LMS implementation. Investigating a wide range of potential influencing factors and the consequent comparability of findings would enable the study to serve as a benchmark measure of determinants of LMS implementation for future researchers.
2. Prior studies on ***influencing factors → LMS implementation*** and the ***LMS implementation → business performance*** relationships suffers from the confusion and inconsistency associated with conceptualization of 'lean manufacturing/production', as recently argued by Shah and Ward (2007). It is recently argued that lean manufacturing is not a singular concept, and it cannot be equated solely to e.g., JIT or TPM, the mistake which had been commonly occurring in a majority of prior studies done. Regarding this gap, the proposed

conceptualization of lean manufacturing in this study enables capturing of the integrated nature of lean manufacturing. The comprehensive materialization of LMS in this study has addressed both the human and the process components on one hand, as well as organizational aspects (internal) and supplier/customer related (external) components on the other hand, which highlights the true mechanisms needed to achieve the actual performance improvement in all dimensions.

3. Previous studies focusing on ***influencing factors → LMS implementation*** relationship have generally offered a limited definition of business performance, which in most cases, are limited to few specific dimensions such as financial metrics. This limitation generally weakens the comparability and reliability of LMS-enabled business performance improvements reported by prior studies. This study however has offered and utilized an inclusive second-order measure of business performance. It is believed that this comprehensive measure of business performance will assist with better understanding of the mechanism by which LMS implementation results in performance improvement among the automotive parts manufacturers. In addition, this comprehensive measure of business performance will enhance comparability of this study with prior studies.

The research findings also have some practical and managerial implications. Malaysian automotive parts manufacturers need to understand that LMS is not a singular concept, and it should not be defined as a single practice such as JIT. The first step toward full-blown implementation of LMS involves the simultaneous development and implementation of all the six (6) different dimensions (JIT,TPM,QM,PS, CI and DCN) of lean manufacturing. It was empirically substantiated that by commitment to implementation of all dimensions of lean manufacturing, Malaysian automotive parts manufacturers may achieve an organization-wide commitment towards lean manufacturing and builds a strategic management perspective of leanness in their organizations. Consistently, the study revealed that due to synergies arising from the relatedness and complementarities of different dimensions of LMS, an absence of one dimension may negatively affect the implementation of other dimensions of LMS, leading to the possible failure of the entire lean activities among Malaysian automotive parts manufacturers.

It is also imperative for Malaysian automotive parts manufacturers to know that in addition to complementarities of different dimensions of LMS, the intensity of implementation within each of the different dimensions of LMS is another key enabler of a full-blown LMS implementation. In other words, it was found that by intensive implementation of all dimensions of LMS, Malaysian automotive parts manufactures have achieved significant performance improvements in terms of waste reduction (WR), financial performance (FP), manufacturing performance (MP), non-financial performance (NFP), and operational performance (OP). Accordingly, it is safe to conclude that full-blown LMS implementation is a viable strategy for Malaysian automotive parts manufacturers to ensure a sustained performance achievement.

7.4 Future Research Directions

The future research directions from the study are recommended as follows:

1. This approach is limited to some extents regarding the fact that Malaysia automotive industry is a vast industry with hundreds of manufacturers operating, producing multiple differentiated products or parts, which implies that the case study performed in this research was limited in terms of its generalization ability towards the entire Malaysian automotive industry. Accordingly, any future studies to be undertaken are suggested to be performed on a larger scale, looking

into non-manufacturing aspects of the industry, apart from the automotive parts manufacturing.

2. The research model and findings were limited and narrowed down to only include automotive parts manufacturing and cannot be freely generalized to other industrial and service industries in Malaysia. In this regards, the research model in its original format or modified version can be utilized in future research in different industries. LMS compatibility with other manufacturing industry such as electrical and electronics, or against non-manufacturing industries like hospital, food & beverage (F&B), health, agriculture or transportation industries. Then probably the benefits of LMS could be measured better and its adoption rate is clearer among Malaysian industries.
3. The particular focus on Malaysian automotive industry also limits the generalization ability of findings of this research to Malaysian culture. It is well agreed that the company culture in LMS implementation is very important and concepts such as management support and commitment and employees' motivation and preparation are imperative to LMS implementation success. The business environments for automotive parts manufacturers in Malaysia as a developing (and transitional) country versus advanced countries (e.g., western countries, Japan and South Korea) are largely different. Thus, it is not possible to freely generalize our findings to other automotive parts manufacturing industries in advanced countries. Future studies can use the findings of this study and compare or investigate parallels in automotive industries of different countries with different organizational cultures.
4. As this research was taking place, the prevailing knowledge, information, data and technology used is considered up to date that reflect the current manufacturing needs. So, it is probably imperative for future researchers to look

into the upcoming advancements or newer trends emerging in the automotive industry. One probable study area is on ‘environmental performance’ and its relation towards the LMS concept, because the global automotive industry outlook seems to be focusing on Green Technology. It is evidently deemed important as the Malaysian government supports Green Manufacturing concept within the National Automotive Policy (NAP) and provides tax –cut incentives on this new technology.

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APPENDICES

APPENDIX A: SURVEY QUESTIONNAIRE

A Study of Lean Manufacturing Implementation in Malaysian Automotive Industry

Introduction

A LMS with its tools and principles is flexible in nature that can provide improvements within an organization and between organizations who are willing to adopt its unique attributes, and are diligently working towards maintaining the value and set better operational standards. Lean Manufacturing strategy is being supported by the Malaysian government, towards creating world class manufacturing and that could face sustained high competitiveness in global market. The implementation of LMS is considered to be very useful in the automotive industry in Malaysia, in order for the industry to improve their operational performances as well as to remain competitive. The main objective of this study is to come up with a model or framework on sustained implementation of LMS for Malaysian Automotive Industry for obtaining a set of performance standards. The study would like to explore the application, causes and consequences of lean manufacturing standard in automotive industry in Malaysia pertaining to the implementation of LMS within the organization.

An Ardent Appeal

Please spend a part of your valuable time to answer the following questions. The information that would be generated from this research will be used to form an overall picture of the implementation of LMS in Malaysian automotive industry. The data/information provided by your organization will be used purely for the purpose of this research and these will not be published anywhere in the name of your organization without receiving your prior permission. Your cooperation in this regard will be highly valued and appreciated.

We hope that the appropriate person or persons will furnish this questionnaire to generate the most useful information.

THANKS AND REGARDS.

SECTION A: General Information - Organization Background

1. Does your organization fall under

☐ Large-scale company ☐ medium-size company ☐ small-scale company

2. What is the approximate number of employees in your organization?

☐ < 50 ☐ 51 – 150 ☐ 151 – 250 ☐ > 250

3. How many years have your organization been established?

☐ < 5 years ☐ 5 to 10 years ☐ > 10 years but < 15 years ☐ > 15 years

4. How many years have your organization been involved in LMS /Toyota Production System (TPS)?

☐ < 1 year ☐ 1 – 3 years ☐ > 3 years but < 5 years ☐ > 5 years

5. Please indicate, in general, the approximate capital (machine, equipment, etc.) size of your organization.

☐ RM1 – RM5 million ☐ RM5 – RM10 million ☐ RM10 – RM 50 million ☐ > RM50 million

6. What is the type of ownership of your organization?

☐ 100% Local ☐ 100% Foreign ☐ Joint Venture ____% Local ____ % Foreign

7. What are the main products that your organization produces? (Answer can be more than one).

☐ Plastic Parts ☐ Rubber Parts ☐ Metal Parts ☐ Electronic Parts

☐ Mechanical Devices ☐ Electrical Components ☐ Others. Please specify ____________________

8. How many product types does your organization produce? (e.g. Tail Gate Lower, Panel Cowl Top Inner , Hood, Console Floor Assy. = 4 products)

☐ 1-5 ☐ 6 -10 ☐ 11- 15 ☐ More than 15

9. Please list down the products that are being produced using the **Lean Manufacturing Concept**.

i. ________________________________ _____ ii. ____________________________________

iii. _____________________________________ iv. ____________________________________

v. _____________________________________ vi. ____________________________________

10. How many new products (completely new or innovation on your existing products or both) typically does your company/organization introduce per year?

☐ 1 – 3 ☐ 4-6 ☐ 7 – 9 ☐ More than 10

11. What is the type of production system applied in your organization? (Answer can be more than one).

☐ Job Shop ☐ Assembly Line ☐ Continuous Flow ☐ Batch Production

☐ Process ☐ Mass Production

12. Where does your organization supply the produces?

☐ 100% Local market ☐ 100% Foreign ☐ Mix Market ____% Local ____ % Foreign

13. Who are your customers (in terms of the % amount of revenue you earn)?

PROTON ______ % TOYOTA _______ % MITSUBISHI _______% ISUZU ________%

PERODUA ______ % HONDA _______ % SUZUKI ________ % HICOM ________ %

Others, please specify _____________________

14. To which the following is your organization certified to (if any)? (Answer can be more than one).

☐ ISO 9001:2004 ☐ ISO 9001:2008 ☐ISO/TS16949:2002 ☐ QS 9000

☐ Others, please specify ___________________________

15. To what extent you are familiar with the concept of **LMS**? (1 = very little , 2 = little , 3 = moderately , 4 = much , 5 = very much/fully)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

16. To what extent your organization has implemented **LMS**? (1 = very little , 2 = little , 3 = moderately , 4 = much , 5 = totally implemented)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

SECTION B: Conceiving LMS, its current Implementation, and future roadmap or expectation. **(*Please indicate the current/past by encircling (○) the right rank and the desired future state by putting tick marks (✓) at the left rank*).**

Management Leadership and Commitment										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
Top management has set the clear policies in different areas of lean applications (set up time or change over time or lead time policy, inventory policies, building workers competency level policies, delivery, etc.)	1	2	3	4	5	1	2	3	4	5
Top management inspires the employees for their total involvement to achieve the organization's mission, KRAs and goals.	1	2	3	4	5	1	2	3	4	5
Top management supports investment in the supporting manufacturing structure required for deployment of LMS (for machine, setting layout, etc.).	1	2	3	4	5	1	2	3	4	5
Top management is supportive for constant change and continuous improvement.	1	2	3	4	5	1	2	3	4	5
Top management participates and is visibly involved in the lean manufacturing events and projects.	1	2	3	4	5	1	2	3	4	5
Top management is committed to develop lean manufacturing programs via JIT, TQM, and TPM in the organization.	1	2	3	4	5	1	2	3	4	5
Top management has chosen to adhere to lean principles in the face of short term operating objectives inconsistent with lean progress.	1	2	3	4	5	1	2	3	4	5

Empowerment of Employees										
Statements	Current Implementation					Future Expectation				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
The employees are free to allocate their time for doing improvement at workplace. (i.e. Kaizen activities, etc.).	1	2	3	4	5	1	2	3	4	5
The employees have been given a broader range of tasks.	1	2	3	4	5	1	2	3	4	5
The employees have been given more planning responsibility.	1	2	3	4	5	1	2	3	4	5
The employees get the foster trust values from the organization.	1	2	3	4	5	1	2	3	4	5
The employees are encouraged to make day-to-day decisions at workplace to resolve problems.	1	2	3	4	5	1	2	3	4	5

Employee Involvement										
Statements	Current Implementation					Future Expectation				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
There is employees' willful involvement in lean implementation activities.	1	2	3	4	5	1	2	3	4	5
There is employees' spontaneous participation in decision making activities.	1	2	3	4	5	1	2	3	4	5
There is employees' involvement in planning activities (just previous question is enough).	1	2	3	4	5	1	2	3	4	5
There is employees' sound involvement in continuous improvement activities.	1	2	3	4	5	1	2	3	4	5
There is employees' involvement in problem solving activities.	1	2	3	4	5	1	2	3	4	5

Training										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
Organization sees training as an investment rather than a cost.	1	2	3	4	5	1	2	3	4	5
A training unit/department has been established for the purpose of organizing and conducting the training pertaining to lean manufacturing.	1	2	3	4	5	1	2	3	4	5
All levels within the organization received training pertaining to the lean manufacturing implementation.	1	2	3	4	5	1	2	3	4	5
All levels within the organization received training pertaining to the lean manufacturing tools and techniques.	1	2	3	4	5	1	2	3	4	5
Training that changes employees' perspective towards lean manufacturing is given to the employees.	1	2	3	4	5	1	2	3	4	5
Training that changes employees' understanding level towards lean manufacturing is given to the employees.	1	2	3	4	5	1	2	3	4	5
Employees are trained for multi-skill tasks.	1	2	3	4	5	1	2	3	4	5

Teamwork										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
In our organization teams are formed to solve problems.	1	2	3	4	5	1	2	3	4	5
In our organization many problems have been solved through team efforts.	1	2	3	4	5	1	2	3	4	5

In our organization team members' opinions and ideas are considered in decision making.	1	2	3	4	5	1	2	3	4	5
In our organization teams are responsible in continuous process improvement.	1	2	3	4	5	1	2	3	4	5
In our organization team enjoys freedom to make decisions.	1	2	3	4	5	1	2	3	4	5
In our organization team leaders are elected by their own team co-workers.	1	2	3	4	5	1	2	3	4	5
Human Resource Management										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
Employees are provided with long term employments (organization holds its employees for a long time and does not replace them shortly).	1	2	3	4	5	1	2	3	4	5
Employees' performance levels are defined and they are happy with that.	1	2	3	4	5	1	2	3	4	5
Employees are happy with the reward system.										
Employees are rewarded for making efforts for improvement initiatives (cost reduction, higher quality, etc.).	1	2	3	4	5	1	2	3	4	5
In our organization, there is a low rate of employee turnover during lean manufacturing implementation activities.	1	2	3	4	5	1	2	3	4	5
Customer relationship management										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
Our customers are directly involved in current and future product offerings.	1	2	3	4	5	1	2	3	4	5

Our customers are directly involved in our in quality programs.	1	2	3	4	5	1	2	3	4	5
Our customers are directly involved in the new product development process.	1	2	3	4	5	1	2	3	4	5
Supplier relationships management										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
We have corporate level communication on important issues with our key suppliers.	1	2	3	4	5	1	2	3	4	5
Our key suppliers manage our inventory.	1	2	3	4	5	1	2	3	4	5
Our suppliers are directly involved in the new product development process.	1	2	3	4	5	1	2	3	4	5
Our suppliers are directly involved in our quality improvement program.	1	2	3	4	5	1	2	3	4	5
Organizational Change										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
Our organization understands that for lean manufacturing a lot of changes are needed and changes are generally undertaken.	1	2	3	4	5	1	2	3	4	5
Employees are motivated to embrace change as an opportunity rather than a threat.	1	2	3	4	5	1	2	3	4	5
Our organization encourages an environment of lean thinking.	1	2	3	4	5	1	2	3	4	5
Our organization strives to increase the responsiveness of all the employees for change.	1	2	3	4	5	1	2	3	4	5

Information Technology										
Statements	Current Implementation					Future Expectation				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
In our organization, every employee used information technology to have access to all the information he/she requires to perform their daily tasks.	1	2	3	4	5	1	2	3	4	5
In our organization, information system and technology is used in visualizing and monitoring the project/process status, task listing, and controlling progress of workflows	1	2	3	4	5	1	2	3	4	5
In our organization we use computerized process floor plan management (e.g., material flow in/out plans, space management)	1	2	3	4	5	1	2	3	4	5
In our organization, we are setting up advanced manufacturing technology (e.g., CAD/CAM, Robots, EDI, CMMS, etc.)	1	2	3	4	5	1	2	3	4	5
In our organization, we use computerized plant layout management and control (e.g., locations of machines/tools, line configuration, safety staircase).	1	2	3	4	5	1	2	3	4	5
Note: CAD: Computer-Aided Design, CAM: Computer Aided Manufacturing, EDI: Electronic Data Interchange, CMMS: Computerized Maintenance Management System										

SECTION C: Lean Implementation Activities

(*Please indicate the* level of implementation for any of the following practices in your organization *(encircle) and tick (✓) the relevant rank for future expectation)*

Just in Time										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
Our vendors/suppliers supply us on a just-in-time basis.	1	2	3	4	5	1	2	3	4	5
We have long-term arrangements with our suppliers.	1	2	3	4	5	1	2	3	4	5
We receive daily shipments from most vendors/suppliers.	1	2	3	4	5	1	2	3	4	5
We constantly restructure the manufacturing processes based on process /product needed	1	2	3	4	5	1	2	3	4	5
We continuously restructure manufacturing layout to obtain process focus and streamlining	1	2	3	4	5	1	2	3	4	5
Total Preventive Maintenance										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
We use planning and scheduling strategies for maintenance activities.	1	2	3	4	5	1	2	3	4	5
We do preventive maintenance during non-productive time.	1	2	3	4	5	1	2	3	4	5
We keep records of routine maintenance.	1	2	3	4	5	1	2	3	4	5
There is a separate shift, or part of a shift, reserved for preventive maintenance activities.	1	2	3	4	5	1	2	3	4	5

In our organization, large numbers of equipment on shop floor are currently under 6σ.	1	2	3	4	5	1	2	3	4	5
We use overall equipment effectiveness (OEE) as one of our TPM"s improvement programs for our equipment productivity.	1	2	3	4	5	1	2	3	4	5
We use total effective equipment performance (TEEP) as one of our TPM"s improvement programs for our equipment productivity.	1	2	3	4	5	1	2	3	4	5

Quality Management

Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
We use single minute exchange of dies (SMED) as one of our Quality Management's improvement programs for our productivity.	1	2	3	4	5	1	2	3	4	5
In our organization, large numbers of processes on shop floor are currently under Statistical Process Control (SPC).	1	2	3	4	5	1	2	3	4	5
In our organization, the statistical techniques are used extensively to reduce process variance.	1	2	3	4	5	1	2	3	4	5
In our organization, the charts showing defect rates are used as tools on the shop-floor.	1	2	3	4	5	1	2	3	4	5
In our organization, the fishbone type diagrams are used to identify causes of quality problems.	1	2	3	4	5	1	2	3	4	5
In our organization, we communicate quality specifications to suppliers.	1	2	3	4	5	1	2	3	4	5

Pull System (Production)

Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
Production is 'pulled' by the shipment of finished goods.	1	2	3	4	5	1	2	3	4	5

Production at stations is “pulled’ by the current demand of the next stations.	1	2	3	4	5	1	2	3	4	5
We use a pull system to control our production.	1	2	3	4	5	1	2	3	4	5
We use a *Kanban* pull system for production control.	1	2	3	4	5	1	2	3	4	5
Continuous Improvement										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
Quality improvement is a high priority for us.	1	2	3	4	5	1	2	3	4	5
Continuous improvement of quality is stressed in all work processes throughout our organization.	1	2	3	4	5	1	2	3	4	5
We have formal continuous improvement/ KAIZEN program.	1	2	3	4	5	1	2	3	4	5
All employees believe that it is their responsibility to improve quality in the organization.	1	2	3	4	5	1	2	3	4	5
All employees constantly work to improve quality.	1	2	3	4	5	1	2	3	4	5
All employees, at different levels are rewarded for quality improvement.	1	2	3	4	5	1	2	3	4	5
Design for Customer Needs										
Statements	**Current Implementation**					**Future Expectation**				
	Not at all	A little	Moderately	Much	A great deal	Not at all	A little	Moderately	Much	A great deal
We are frequently in close contact with our customer.	1	2	3	4	5	1	2	3	4	5
Our customers frequently visit our plant.	1	2	3	4	5	1	2	3	4	5

Our very important objective is to obtain satisfied customers.	1	2	3	4	5	1	2	3	4	5
Our customers give us feedback on quality and delivery performance.	1	2	3	4	5	1	2	3	4	5
Our customer requirements are thoroughly analyzed in the new product design process.	1	2	3	4	5	1	2	3	4	5

SECTION D: Perception on Barriers to Implement Lean Manufacturing

Statements *Please indicate the degree to which you disagree or agree with the following statements*	Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree
There is lack of top management commitment and participation.	1	2	3	4	5
There is lack of financial supports to invest on necessary equipment for creating cellular production layout.	1	2	3	4	5
There is inadequate continuous training and lack of knowledge in lean manufacturing.	1	2	3	4	5
There is in adequate supports from employees in making lean manufacturing efficient and effective. (Employees are not adequately motivated or involved).	1	2	3	4	5
There are no standardization/balance workloads among the employees. (are not yet uniform enough among the workers).	1	2	3	4	5
There is inadequate of process synchronization.	1	2	3	4	5
There is an unstable customer order.	1	2	3	4	5
There is poor communication from top management.	1	2	3	4	5
There is a supplier delay on parts delivery.	1	2	3	4	5
There is poor quality of supplied parts.	1	2	3	4	5
There is poor working culture.	1	2	3	4	5
The employees are resist to change.	1	2	3	4	5

SECTION E: Perceived Benefits of LMS Implementation.

Statements *Please indicate the degree to which you disagree or agree with the following statements*	Strongly Disagree	Disagree	Somewhat agree	Agree	Strongly Agree
Lean manufacturing implementation improves long term cost competitiveness.	1	2	3	4	5
Lean manufacturing implementation improves long term quality competitiveness.	1	2	3	4	5
Lean manufacturing implementation improves improve overall profit margin of companies.	1	2	3	4	5
Lean manufacturing implementation reduces inventory.	1	2	3	4	5
Lean manufacturing implementation meets customer demand.	1	2	3	4	5
Lean manufacturing implementation fulfills customer directives (pressure from customers).	1	2	3	4	5
Lean manufacturing implementation improves the competitiveness level /gap with the competitors.	1	2	3	4	5
Lean manufacturing implementation reduces the delivery time of finish goods to customers.	1	2	3	4	5

SECTION F: ORGANIZATIONAL PERFORMANCES

	Current Achievement of Organizational Performance *(Please indicate the level of improvement in any of following metrics in you organization compared to 3 years ago)*					**Future Direction** **(***Please indicate the expected level of improvement in any of following metrics in you organization in the next three (3) years compared to your current situation)*				
F1 : Waste Reduction	Significantly increased	Somewhat increased	No Change	Somewhat decreased	Significantly decreased	Significantly increased	Somewhat increased	No Change	Somewhat decreased	Significantly decreased
After implementation of lean manufacturing our overproduction level has....	1	2	3	4	5	1	2	3	4	5
After implementation of lean manufacturing our under production level has ….	1	2	3	4	5	1	2	3	4	5
After implementation of lean manufacturing the chance for making the right products at the first time has ….	1	2	3	4	5	1	2	3	4	5
After implementation of lean manufacturing our defective product(s) rate(s) has ….	1	2	3	4	5	1	2	3	4	5
After implementation of lean manufacturing our non-value added activities have ….	1	2	3	4	5	1	2	3	4	5
After implementation of lean manufacturing our ability to get proper jigs, figures, tools (excess motion) has ….	1	2	3	4	5	1	2	3	4	5
F2 : Financial Performance	Deteriorated more than 10%	Stayed about the same	Improved 10–30%	Improved 30–50%	Improved more than 50%.	Deteriorated more than 10%	Stayed about the same	Improved 10–30%	Improved 30–50%	Improved more than 50%.
Compared to 3 years ago, **Sales** indicator of our organization	1	2	3	4	5	1	2	3	4	5

Compared to 3 years ago indicator **Market Share** indicator of our organization	1	2	3	4	5	1	2	3	4	5
	Much worse	Worse	About the same	Better	Much better	Much worse	Worse	About the same	Better	Much better
Relative to our main competitor(s), our performance in term of **Sales** indicator is	1	2	3	4	5	1	2	3	4	5
Relative to our main competitor(s), our performance in term of **Market Share** indicator is	1	2	3	4	5	1	2	3	4	5
F3 : Marketing Performance	Deteriorated more than 10%	Stayed about the same	Improved 10–30%	Improved 30–50%	Improved more than 50%.	Deteriorated more than 10%	Stayed about the same	Improved 10–30%	Improved 30–50%	Improved more than 50%.
Compared to 3 years ago, **Return on Sales (ROS)** indicator of our organization	1	2	3	4	5	1	2	3	4	5
Compared to 3 years ago indicator **Return on Investment (ROI)** indicator of our organization	1	2	3	4	5	1	2	3	4	5
	Much worse	Worse	About the same	Better	Much better	Much worse	Worse	About the same	Better	Much better
Relative to our main competitor(s), our performance in term of **Return on Sales (ROS)** indicator is	1	2	3	4	5	1	2	3	4	5
Relative to our main competitor(s), our performance in term of **Return on Investment (ROI)** indicator is	1	2	3	4	5	1	2	3	4	5
Relative to our main competitor(s), satisfaction of customers with our products	1	2	3	4	5	1	2	3	4	5
Relative to our main competitor(s), sale growth of our products	1	2	3	4	5	1	2	3	4	5

	Current Achievement of Organizational Performance (Please indicate the level of improvement in any of following metrics in you organization compared to three (3) years ago)					Future Direction (Please indicate the expected level of improvement in any of following metrics in you organization in the next three (3) years compared to your current situation)				
F4 : Non-Financial Performance	Below 20%	About 25%	About 50%	About 75%	All (100%)	Below 20%	About 25%	About 50%	About 75%	All (100%)
We produce the product/part ONLY whenever needed	1	2	3	4	5	1	2	3	4	5
We do not produce for inventory	1	2	3	4	5	1	2	3	4	5
We change the schedule as per needed	1	2	3	4	5	1	2	3	4	5
Overall, all activities in a process are synchronized	1	2	3	4	5	1	2	3	4	5
We could establish continuous flow production system	1	2	3	4	5	1	2	3	4	5
Our workforces are knowledge (K-) workers	1	2	3	4	5	1	2	3	4	5
We have the labor productivity as targeted	1	2	3	4	5	1	2	3	4	5
We attempted and reduced the paper work	1	2	3	4	5	1	2	3	4	5
F5 : Operational Performances	Below 20%	About 25%	About 50%	About 75%	All (100%)	Below 20%	About 25%	About 50%	About 75%	All (100%)
We reduced the unit manufacturing cost as per desired to an extent of	1	2	3	4	5	1	2	3	4	5
We achieved the overall/total productivity level as per desired to an extent of	1	2	3	4	5	1	2	3	4	5
Our product quality conform to target specifications to an extent of	1	2	3	4	5	1	2	3	4	5
We deliver the product to our customer/client within the expected due dates to an extent of	1	2	3	4	5	1	2	3	4	5
We standardized layouts/configurations for a variety of products to an extent of	1	2	3	4	5	1	2	3	4	5
Our system is ready to support customers for any related assistance (after sale service, new features, etc.) to an extent of	1	2	3	4	5	1	2	3	4	5

Thank you for participating in this study. All responses will be treated with highly confidential and no single set of responses will be identifiable.

WARM THANKS AND KIND REGARDS

APPENDIX B: COLLABORATION LETTER WITH MAI AND LETTER OF INVITATION FOR PARTICIPATION IN SURVEY

MALAYSIA AUTOMOTIVE INSTITUTE
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Tel : 03-8318 7742
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MAI/CSD/LPS/4/2012

16 APRIL 2012

Head of Department
Department of Design and Manufacture Engineering
Faculty of Engineering
University of Malaya
50603 Kuala Lumpur

Attn: Prof. Ir. Dr. Ramesh Singh A/L Kuldip Singh

Dear Sir,

Collaboration Offer with Malaysia Automotive Institute (MAI) towards the completion of a PhD Research

This letter acts as an official offer of assistance in the form of a collaboration, from the Malaysia Automotive Institute (MAI) to a student by the name of **Eida Nadirah binti Roslin**, currently pursuing her PhD research, which is in working progress under the purview of Department of Design and Manufacture, Faculty of Engineering, University of Malaya (UM), Kuala Lumpur, Malaysia.

The research titled **'A Model for Full-Blown Implementation of Lean Manufacturing System in Malaysian Automotive Industry for Achieving Operational Standards';** of which the study proposal and research plan was submitted to us earlier, had been reviewed and deliberated by our panel committee. We are pleased to announce that the proposal merits value and the research plan is in line with our missions within MAI towards improving the Malaysian automotive quality standards.

In this regard, we would appreciate your participation in the collaboration and would allow yourself access into MAI's wealth of data and information pertaining to lean manufacturing's current implementations which could include determining factors, standards, classifications, adoption methods, quality improvements and success rates, within the Malaysian automotive industry. This list should not be exhaustive as we would be open to any other available data from your side as well. The relative duration of this collaboration is proposed to be from the month of **April 2012 to October 2012**, subject to any timing changes arising later, that is not anticipated during the period.

Through the input provided from MAI, it should provide yourself with the necessary foundation to allow the development of a working model, identify and forming a 'problem statement', developing research objectives, developing questions, hypothesis testing and verification and finally forming and proposing the final study conclusions.

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You had also mentioned that your faculty is interested in the inner working of the lean manufacturing systems and its implementation in Malaysia. So, within this collaboration we are looking towards identifying problems, refining the system and subsequently proposing an adaptable standard for use within the automotive industry in Malaysia.

The advantages that yourself and your department will gain by working with MAI on this thesis are:

1. The study should be partly done on MAI's behalf to improve the quality of research within this sector. In return for our assistance, yourself and the faculty should share the findings with MAI and will give credit to persons or information where it's due.
2. Reduce cost on acquiring paid data from other independent source, and have full access to analyze the industry data that MAI currently have in our databases.
3. Core competitive edge, as MAI is at the forefront of automobile industry research and UM being a leading research university in multiple fields. MAI constantly strives to improve quality of its research through meaningful collaborations with industry experts and academia.

MAI is confident of a research outcome that is of high quality, impactful and catered to specific problems identified within the industry. The ultimate goal of this collaboration is to offer solutions for the betterment of the industry and thus improving the quality of our automotive industry.

MAI welcomes the chance for yourself, your faculty and UM to work hand-in-hand with us towards the successful completion of your research. Hopefully, this collaboration will be a success and contributes towards our nation building efforts.

For any further enquiries, please do not hesitate to contact the undersigned or Mr. Jamal email: jamal@mai.org.my; mobile: 017-3638010 and Mr. Zaki email: zaki@mai.org.my; mobile: 012-6534587.

Thanks and best regards.

MOHAMAD MADANI SAHARI
Chief Executive Officer

UNIVERSITI MALAYA

21 June 2012

Dear Production Engineer/Product Manager/..

....

Assalamu'alikum wr. wb./Good day/Salam Satu Malaysia

Dear Sir/Madam,

Request to furnish the enclosed questionnaire on application of LEAN MANUFACTURING

On behalf of our research colleague **Pn. Eida Nadirah Roslin**, a PhD Candidate, we make this appeal for your kind support by furnishing the attached questionnaire with facts and figures that you are rich with. We will do the relevant analyses on the level of application of Lean Manufacturing in your manufacturing setting or organization. We also intend to explore the use of the pertinent standards in Malaysian automotive parts manufacturing.

This may be informed that this study will be done for the benefits of Malaysian Automotive Industry and our PhD candidate.

2. The study will identify the key issues/factors and their relationships in order to develop a methodology for an effective implementation of lean manufacturing for further improvement of the desired performances.

3. Please be assured that any data/information you provide shall be kept confidential and not be published anywhere in the name of your company.

4. We will be glad and thankful if you would consider our request and furnish the questionnaire with the realistic data. Should there be any queries, please feel free to contact me at 03-79674455 or email ahmed@um.edu.my .

With thanks and regards,

Yours faithfully,

....

Assoc. Prof. Dr. Shamsuddin Ahmed
Department of Engineering Design and Manufacture
Faculty of Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia

DR. SHAMSUDDIN AHMED
Associate Professor
Department of Engineering Design and Manufacture
Faculty of Engineering
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Malaysia

Appendix C1: AMOS Output for First-order CFA of Lean Manufacturing

Notes for Group (Group number 1)

The model is recursive.
Sample size = 204

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	30	0	0	0	0	30
Labeled	0	0	0	0	0	0
Unlabeled	18	15	30	0	0	63
Total	48	15	30	0	0	93

Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
DCN1	2	5	-0.402	-2.344	0.55	1.603
DCN2	2	5	-0.666	-3.881	0.826	2.408
DCN3	2	5	-0.512	-2.986	0.327	0.953
DCN4	2	5	-0.475	-2.772	0.247	0.72
CI1	2	5	-0.316	-1.842	-0.071	-0.207
CI2	1	6	-0.085	-0.498	-0.076	-0.223
CI3	2	5	0.046	0.266	-0.295	-0.86
CI4	1	5	-0.481	-2.804	0.4	1.167
PS1	1	5	-0.134	-0.783	0.81	2.361
PS2	2	5	-0.031	-0.18	-0.318	-0.926
PS3	2	5	0.242	1.409	0.144	0.419
PS4	1	5	-0.131	-0.765	-0.111	-0.325
QM1	2	5	-0.186	-1.083	-0.303	-0.884
QM2	2	5	0.04	0.235	-0.237	-0.692
QM3	1	5	-0.214	-1.246	0.074	0.216
QM4	1	5	-0.802	-4.677	0.715	2.084
TPM1	1	5	-0.531	-3.095	0.545	1.59
TPM2	1	5	-0.489	-2.853	0.246	0.717
TPM3	1	5	-0.583	-3.402	0.782	2.281
TPM4	1	5	-0.395	-2.303	0.305	0.888
TPM5	1	5	0.018	0.102	0.271	0.791
JIT1	1	5	-0.199	-1.163	0.04	0.116
JIT2	2	5	-0.332	-1.936	-0.203	-0.592
JIT3	2	5	-0.045	-0.26	-0.258	-0.752
Multivariate					60.693	12.269

Computation of degrees of freedom (Default model)

Number of distinct sample moments:	300
Number of distinct parameters to be estimated:	63
Degrees of freedom (300 - 63):	237

Result (Default model)

Minimum was achieved
Chi-square = 276.870
Degrees of freedom = 237
Probability level = .039
Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P
JIT3	<---	JIT	0.907	0.108	8.431	***
JIT2	<---	JIT	0.914	0.109	8.411	***
JIT1	<---	JIT	1			
TPM5	<---	TPM	1			
TPM4	<---	TPM	1.346	0.118	11.418	***
TPM3	<---	TPM	1.171	0.102	11.434	***
TPM2	<---	TPM	1.296	0.109	11.873	***
TPM1	<---	TPM	1.153	0.108	10.667	***
QM4	<---	QM	1			
QM3	<---	QM	1.004	0.071	14.087	***
QM2	<---	QM	0.758	0.068	11.199	***
QM1	<---	QM	0.925	0.071	12.996	***
PS4	<---	PS	1			
PS3	<---	PS	0.904	0.09	10.018	***
PS2	<---	PS	0.837	0.088	9.548	***
PS1	<---	PS	0.923	0.091	10.139	***
CI4	<---	CI	1			
CI3	<---	CI	1.016	0.082	12.32	***
CI2	<---	CI	1.191	0.095	12.48	***
CI1	<---	CI	0.855	0.086	9.983	***
DCN4	<---	DCN	1			
DCN3	<---	DCN	1.022	0.073	13.946	***
DCN2	<---	DCN	0.952	0.075	12.716	***
DCN1	<---	DCN	0.854	0.069	12.441	***

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
JIT3	<---	JIT	0.709
JIT2	<---	JIT	0.707
JIT1	<---	JIT	0.702
TPM5	<---	TPM	0.715
TPM4	<---	TPM	0.833
TPM3	<---	TPM	0.834
TPM2	<---	TPM	0.868
TPM1	<---	TPM	0.778
QM4	<---	QM	0.827
QM3	<---	QM	0.85
QM2	<---	QM	0.718
QM1	<---	QM	0.802
PS4	<---	PS	0.718
PS3	<---	PS	0.772
PS2	<---	PS	0.732
PS1	<---	PS	0.783
CI4	<---	CI	0.743
CI3	<---	CI	0.864
CI2	<---	CI	0.876
CI1	<---	CI	0.708
DCN4	<---	DCN	0.829
DCN3	<---	DCN	0.847
DCN2	<---	DCN	0.791
DCN1	<---	DCN	0.778

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P
JIT	<-->	TPM	0.179	0.031	5.847	***
JIT	<-->	QM	0.209	0.034	6.069	***
JIT	<-->	PS	0.171	0.033	5.206	***
JIT	<-->	CI	0.217	0.037	5.832	***
JIT	<-->	DCN	0.19	0.033	5.733	***
TPM	<-->	QM	0.213	0.032	6.619	***
TPM	<-->	PS	0.182	0.031	5.841	***
TPM	<-->	CI	0.204	0.033	6.077	***
TPM	<-->	DCN	0.19	0.03	6.238	***
QM	<-->	PS	0.232	0.036	6.37	***
QM	<-->	CI	0.25	0.038	6.527	***
QM	<-->	DCN	0.215	0.034	6.396	***
PS	<-->	CI	0.222	0.038	5.849	***
PS	<-->	DCN	0.198	0.034	5.824	***
CI	<-->	DCN	0.241	0.038	6.386	***

Correlations: (Group number 1 - Default model)

			Estimate
JIT	<-->	TPM	0.698
JIT	<-->	QM	0.694
JIT	<-->	PS	0.589
JIT	<-->	CI	0.683
JIT	<-->	DCN	0.629
TPM	<-->	QM	0.737
TPM	<-->	PS	0.652
TPM	<-->	CI	0.668
TPM	<-->	DCN	0.657
QM	<-->	PS	0.709
QM	<-->	CI	0.701
QM	<-->	DCN	0.634
PS	<-->	CI	0.643
PS	<-->	DCN	0.605
CI	<-->	DCN	0.672

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P
JIT	0.267	0.052	5.173	***
TPM	0.246	0.043	5.717	***
QM	0.339	0.048	6.992	***
PS	0.316	0.057	5.571	***
CI	0.377	0.063	5.993	***
DCN	0.341	0.049	7	***
e1	0.217	0.028	7.641	***
e2	0.223	0.029	7.674	***
e3	0.275	0.035	7.741	***
e4	0.236	0.026	9.174	***
e5	0.197	0.024	8.09	***
e6	0.147	0.018	8.071	***
e7	0.136	0.018	7.405	***
e8	0.214	0.024	8.745	***
e9	0.157	0.02	7.703	***
e10	0.131	0.018	7.204	***
e11	0.183	0.02	8.928	***
e12	0.161	0.02	8.113	***
e13	0.297	0.035	8.383	***
e14	0.175	0.023	7.715	***
e15	0.191	0.023	8.235	***

e16	0.17	0.023	7.542	***
e17	0.305	0.035	8.795	***
e18	0.132	0.019	6.921	***
e19	0.162	0.025	6.559	***
e20	0.274	0.03	9.036	***
e21	0.155	0.021	7.549	***
e22	0.14	0.02	7.159	***
e23	0.185	0.023	8.172	***
e24	0.162	0.019	8.329	***

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
DCN1	0.605
DCN2	0.625
DCN3	0.717
DCN4	0.687
CI1	0.502
CI2	0.767
CI3	0.746
CI4	0.552
PS1	0.613
PS2	0.536
PS3	0.596
PS4	0.516
QM1	0.642
QM2	0.515
QM3	0.723
QM4	0.684
TPM1	0.605
TPM2	0.753
TPM3	0.696
TPM4	0.694
TPM5	0.511
JIT1	0.493
JIT2	0.5
JIT3	0.503

Modification Indices (Group number 1 - Default model)

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e24	<-->	QM	4.445	0.026
e17	<-->	e18	4.121	0.035
e16	<-->	DCN	4.943	0.032
e15	<-->	e24	5.332	-0.034
e15	<-->	e18	5.094	0.032
e14	<-->	DCN	4.956	-0.033
e12	<-->	e22	4.079	-0.027
e11	<-->	e16	8.336	0.042
e9	<-->	DCN	6.195	0.035
e8	<-->	CI	12.007	-0.053
e8	<-->	JIT	5.154	0.035
e5	<-->	CI	4.239	0.031
e5	<-->	PS	4.311	-0.032
e5	<-->	e17	4.927	0.045
e3	<-->	CI	4.055	-0.036
e3	<-->	e24	5.553	-0.042
e3	<-->	e23	6.97	0.051
e3	<-->	e15	6.197	-0.048
e2	<-->	e20	4.774	0.044
e2	<-->	e9	6.491	0.042

Regression Weights: (Group number 1 - Default model)

			M.I.	Par Change
DCN1	<---	QM4	4.669	0.094
CI1	<---	JIT2	5.367	0.134
PS1	<---	DCN2	4.83	0.102
PS1	<---	QM2	4.681	0.115
PS3	<---	*DCN4*	*4.567*	*-0.099*
QM2	<---	*CI4*	*4.19*	*0.078*
QM4	<---	*DCN1*	*5.584*	*0.115*
TPM1	<---	*CI2*	*4.904*	*-0.092*
TPM1	<---	*CI4*	*4.254*	*-0.086*
TPM4	<---	*CI4*	*5.516*	*0.098*
JIT2	<---	*CI1*	*4.022*	*0.099*

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P
Default model	63	276.87	237	0.039
Saturated model	300	0	0	
Independence model	24	3209.124	276	0

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	0.019	0.906	0.881	0.716
Saturated model	0	1		
Independence model	0.22	0.178	0.106	0.163

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2
Default model	0.914	0.9	0.987	0.984
Saturated model	1		1	
Independence model	0	0	0	0

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	0.859	0.785	0.847
Saturated model	0	0	0
Independence model	1	0	0

NCP

Model	NCP	LO 90	HI 90
Default model	39.87	2.561	85.434
Saturated model	0	0	0
Independence model	2933.124	2754.425	3119.17

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	1.364	0.196	0.013	0.421
Saturated model	0	0	0	0
Independence model	15.808	14.449	13.569	15.365

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.029	0.007	0.042	0.997
Independence model	0.229	0.222	0.236	0

AIC

Model	AIC	BCC	BIC	CAIC
Default model	402.87	420.566	611.911	674.911
Saturated model	600	684.27	1595.436	1895.436
Independence model	3257.124	3263.866	3336.759	3360.759

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.985	1.801	2.209	2.072
Saturated model	2.956	2.956	2.956	3.371
Independence model	16.045	15.165	16.961	16.078

HOELTER

Model	HOELTER 0.05	HOELTER 0.01
Default model	201	214
Independence model	20	22

Appendix C2: AMOS Output for Second-Order CFA of Lean Manufacturing

Notes for Group (Group number 1)
The model is recursive.
Sample size = 204

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	37	0	0	0	0	37
Labeled	0	0	0	0	0	0
Unlabeled	23	0	31	0	0	54
Total	60	0	31	0	0	91

Assessment of normality (Group number1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
DCN1	2	5	-0.402	-2.344	0.55	1.603
DCN2	2	5	-0.666	-3.881	0.826	2.408
DCN3	2	5	-0.512	-2.986	0.327	0.953
DCN4	2	5	-0.475	-2.772	0.247	0.72
CI1	2	5	-0.316	-1.842	-0.071	-0.207
CI2	1	6	-0.085	-0.498	-0.076	-0.223
CI3	2	5	0.046	0.266	-0.295	-0.86
CI4	1	5	-0.481	-2.804	0.4	1.167
PS1	1	5	-0.134	-0.783	0.81	2.361
PS2	2	5	-0.031	-0.18	-0.318	-0.926
PS3	2	5	0.242	1.409	0.144	0.419
PS4	1	5	-0.131	-0.765	-0.111	-0.325
QM1	2	5	-0.186	-1.083	-0.303	-0.884
QM2	2	5	0.04	0.235	-0.237	-0.692
QM3	1	5	-0.214	-1.246	0.074	0.216
QM4	1	5	-0.802	-4.677	0.715	2.084
TPM1	1	5	-0.531	-3.095	0.545	1.59
TPM2	1	5	-0.489	-2.853	0.246	0.717
TPM3	1	5	-0.583	-3.402	0.782	2.281
TPM4	1	5	-0.395	-2.303	0.305	0.888
TPM5	1	5	0.018	0.102	0.271	0.791
JIT1	1	5	-0.199	-1.163	0.04	0.116
JIT2	2	5	-0.332	-1.936	-0.203	-0.592
JIT3	2	5	-0.045	-0.26	-0.258	-0.752
Multivariate					60.693	12.269

Result (Default model)
Minimum was achieved
Chi-square = 282.614
Degrees of freedom = 246
Probability level = .054

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
JIT	<---	Lean_manufacuting_implementation	1.000				
TPM	<---	Lean_manufacuting_implementation	.998	.136	7.325	***	
QM	<---	Lean_manufacuting_implementation	1.200	.151	7.973	***	
PS	<---	Lean_manufacuting_implementation	1.052	.151	6.965	***	
CI	<---	Lean_manufacuting_implementation	1.208	.164	7.375	***	
DCN	<---	Lean_manufacuting_implementation	1.078	.143	7.519	***	
JIT3	<---	JIT	.906	.107	8.434	***	
JIT2	<---	JIT	.909	.108	8.385	***	
JIT1	<---	JIT	1.000				
TPM5	<---	TPM	1.000				
TPM4	<---	TPM	1.345	.118	11.447	***	

			Estimate	S.E.	C.R.	P	Label
TPM3	<---	TPM	1.169	.102	11.448	***	
TPM2	<---	TPM	1.295	.109	11.906	***	
TPM1	<---	TPM	1.148	.108	10.654	***	
QM4	<---	QM	1.000				
QM3	<---	QM	1.001	.071	14.105	***	
QM2	<---	QM	.757	.067	11.230	***	
QM1	<---	QM	.921	.071	12.975	***	
PS4	<---	PS	1.000				
PS3	<---	PS	.901	.090	10.000	***	
PS2	<---	PS	.837	.088	9.559	***	
PS1	<---	PS	.922	.091	10.136	***	
CI4	<---	CI	1.000				
CI3	<---	CI	1.015	.082	12.353	***	
CI2	<---	CI	1.188	.095	12.496	***	
CI1	<---	CI	.853	.085	9.992	***	
DCN4	<---	DCN	1.000				
DCN3	<---	DCN	1.023	.074	13.909	***	
DCN2	<---	DCN	.953	.075	12.694	***	
DCN1	<---	DCN	.856	.069	12.447	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
JIT	<---	Lean_manufacuting_implementation	.809
TPM	<---	Lean_manufacuting_implementation	.841
QM	<---	Lean_manufacuting_implementation	.862
PS	<---	Lean_manufacuting_implementation	.784
CI	<---	Lean_manufacuting_implementation	.823
DCN	<---	Lean_manufacuting_implementation	.775
JIT3	<---	JIT	.710
JIT2	<---	JIT	.705
JIT1	<---	JIT	.703
TPM5	<---	TPM	.716
TPM4	<---	TPM	.834
TPM3	<---	TPM	.834
TPM2	<---	TPM	.869
TPM1	<---	TPM	.776
QM4	<---	QM	.829
QM3	<---	QM	.850
QM2	<---	QM	.718
QM1	<---	QM	.799
PS4	<---	PS	.719
PS3	<---	PS	.771
PS2	<---	PS	.733
PS1	<---	PS	.783
CI4	<---	CI	.745
CI3	<---	CI	.864
CI2	<---	CI	.875
CI1	<---	CI	.708
DCN4	<---	DCN	.828
DCN3	<---	DCN	.847
DCN2	<---	DCN	.791
DCN1	<---	DCN	.779

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Lean_manufacuting_implementation	.176	.040	4.366	***	
e25	.092	.025	3.708	***	
e26	.072	.016	4.583	***	

	Estimate	S.E.	C.R.	P	Label
e27	.087	.019	4.617	***	
e28	.122	.027	4.585	***	
e29	.122	.025	4.807	***	
e30	.136	.024	5.657	***	
e1	.216	.028	7.605	***	
e2	.225	.029	7.685	***	
e3	.274	.036	7.704	***	
e4	.235	.026	9.168	***	
e5	.196	.024	8.077	***	
e6	.148	.018	8.075	***	
e7	.135	.018	7.380	***	
e8	.216	.025	8.763	***	
e9	.155	.020	7.651	***	
e10	.131	.018	7.202	***	
e11	.183	.020	8.917	***	
e12	.163	.020	8.130	***	
e13	.296	.035	8.367	***	
e14	.176	.023	7.721	***	
e15	.191	.023	8.212	***	
e16	.170	.023	7.528	***	
e17	.304	.035	8.777	***	
e18	.132	.019	6.895	***	
e19	.163	.025	6.572	***	
e20	.274	.030	9.033	***	
e21	.156	.021	7.553	***	
e22	.141	.020	7.153	***	
e23	.185	.023	8.163	***	
e24	.161	.019	8.306	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
DCN	.601
CI	.677
PS	.614
QM	.744
TPM	.708
JIT	.655
DCN1	.607
DCN2	.625
DCN3	.717
DCN4	.686
CI1	.501
CI2	.766
CI3	.747
CI4	.555
PS1	.613
PS2	.538
PS3	.594
PS4	.516
QM1	.639
QM2	.516
QM3	.722
QM4	.687
TPM1	.602
TPM2	.754
TPM3	.695

	Estimate
TPM4	.695
TPM5	.512
JIT1	.495
JIT2	.497
JIT3	.505

Modification Indices (Group number 1 - Default model)

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e16	<-->	e30	4.319	0.031
e15	<-->	e24	4.95	-0.032
e15	<-->	e18	5.154	0.032
e14	<-->	e30	4.992	-0.033
e12	<-->	e22	4.677	-0.029
e11	<-->	e16	8.427	0.043
e10	<-->	e12	4.003	0.025
e9	<-->	e30	4.223	0.029
e8	<-->	e29	12.244	-0.054
e8	<-->	e25	4.881	0.035
e5	<-->	e28	4.105	-0.031
e5	<-->	e17	4.64	0.043
e3	<-->	e24	5.695	-0.042
e3	<-->	e23	6.828	0.05
e3	<-->	e15	6.876	-0.051
e2	<-->	e20	4.674	0.044
e2	<-->	e9	6.421	0.041

Regression Weights: (Group number 1 - Default model)

			M.I.	Par Change
DCN1	<---	QM4	4.043	0.088
CI1	<---	JIT2	5.532	0.136
PS1	<---	DCN2	4.612	0.1
PS1	<---	QM2	5.298	0.122
PS3	<---	DCN4	4.525	-0.099
QM2	<---	CI4	4.057	0.077
QM4	<---	DCN1	4.556	0.104
TPM1	<---	CI2	5.138	-0.094
TPM1	<---	CI4	4.513	-0.089
TPM4	<---	CI4	4.929	0.092
JIT2	<---	CI1	4.423	0.104

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN /DF
Default model	54	282.614	246	0.054	1.149
Saturated model	300	0	0		
Independence model	24	3209.124	276	0	11.627

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	0.02	0.905	0.884	0.742
Saturated model	0	1		
Independence model	0.22	0.178	0.106	0.163

Baseline Comparisons

Model	NFI	RFI	IFI	TLI	CFI
	Delta1	rho1	Delta2	rho2	
Default model	0.912	0.901	0.988	0.986	0.988
Saturated model	1		1		1
Independence model	0	0	0	0	0

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	0.891	0.813	0.88
Saturated model	0	0	0
Independence model	1	0	0

NCP

Model	NCP	LO 90	HI 90
Default model	36.614	0	82.352
Saturated model	0	0	0
Independence model	2933.124	2754.425	3119.17

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	1.392	0.18	0	0.406
Saturated model	0	0	0	0
Independence model	15.808	14.449	13.569	15.365

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE	
Default model	0.027	0	0.041	0.999	
Independence model	0.229	0.222	0.236	0	

AIC

Model	AIC	BCC	BIC	CAIC	
Default model	390.614	405.782	569.792	623.792	
Saturated model	600	684.27	1595.436	1895.436	
Independence model	3257.124	3263.866	3336.759	3360.759	

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.924	1.744	2.15	1.999
Saturated model	2.956	2.956	2.956	3.371
Independence model	16.045	15.165	16.961	16.078

HOELTER

Model	HOELTER	HOELTER
	0.05	0.01
Default model	204	216
Independence model	20	22

Appendix C3: AMOS Output for First-order CFA of Business Performance

Notes for Group (Group number 1)
The model is recursive.
Sample size = 204

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	26	0	0	0	0	26
Labeled	0	0	0	0	0	0
Unlabeled	16	10	26	0	0	52
Total	42	10	26	0	0	78

Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
NFP5	2.000	5.000	-.270	-1.572	-.407	-1.185
WR5	2.000	5.000	-.962	-5.607	.277	.808
OP1	2.000	5.000	-.240	-1.399	-.598	-1.744
OP2	1.000	5.000	-.680	-3.963	.340	.990
OP3	2.000	5.000	-.158	-.920	-.575	-1.677
OP4	2.000	5.000	-.119	-.694	-.337	-.983
NFP1	1.000	5.000	-.220	-1.285	.235	.684
NFP2	2.000	5.000	-.103	-.600	-.501	-1.460
NFP3	2.000	5.000	.281	1.638	-.140	-.407
NFP4	2.000	5.000	-.322	-1.876	-.562	-1.639
MP1	2.000	5.000	-.122	-.712	-.363	-1.059
MP2	1.000	5.000	-.047	-.271	.398	1.161
MP3	2.000	5.000	-.430	-2.506	-.435	-1.267
MP4	2.000	5.000	-.450	-2.626	-.439	-1.281
FP1	2.000	5.000	.222	1.294	.017	.050
FP2	2.000	5.000	-.289	-1.688	-.292	-.850
FP3	2.000	5.000	-.406	-2.370	-.380	-1.107
WR1	2.000	5.000	-.907	-5.290	.137	.399
WR2	2.000	5.000	-.332	-1.933	-.221	-.644
WR3	2.000	5.000	-.619	-3.607	-.108	-.315
WR4	1.000	5.000	-.790	-4.607	.453	1.321
Multivariate					22.086	5.075

Computation of degrees of freedom (Default model)

Number of distinct sample moments: 231
Number of distinct parameters to be estimated: 52
Degrees of freedom (231 - 52): 179
Result (Default model)
Minimum was achieved
Chi-square = 207.119
Degrees of freedom = 179
Probability level = .074
Estimates (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
WR4	<---	WR	1.000				
WR3	<---	WR	.935	.086	10.852	***	

			Estimate	S.E.	C.R.	P	Label
WR2	<---	WR	.954	.086	11.086	***	
WR1	<---	WR	.900	.085	10.560	***	
FP3	<---	FP	1.043	.106	9.833	***	
FP2	<---	FP	1.196	.113	10.546	***	
FP1	<---	FP	1.000				
MP4	<---	MP	1.000				
MP3	<---	MP	.988	.080	12.342	***	
MP2	<---	MP	1.014	.083	12.180	***	
MP1	<---	MP	.908	.084	10.810	***	
NFP4	<---	NFP	1.000				
NFP3	<---	NFP	1.156	.115	10.072	***	
NFP2	<---	NFP	1.080	.111	9.730	***	
NFP1	<---	NFP	1.119	.104	10.733	***	
OP4	<---	OP	1.000				
OP3	<---	OP	1.139	.109	10.475	***	
OP2	<---	OP	.983	.089	11.020	***	
OP1	<---	OP	1.070	.099	10.805	***	
WR5	<---	WR	.901	.084	10.745	***	
NFP5	<---	NFP	1.041	.098	10.607	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
WR4	<---	WR	.770
WR3	<---	WR	.754
WR2	<---	WR	.768
WR1	<---	WR	.735
FP3	<---	FP	.752
FP2	<---	FP	.822
FP1	<---	FP	.733
MP4	<---	MP	.800
MP3	<---	MP	.809
MP2	<---	MP	.800
MP1	<---	MP	.725
NFP4	<---	NFP	.748
NFP3	<---	NFP	.729
NFP2	<---	NFP	.705
NFP1	<---	NFP	.775
OP4	<---	OP	.773
OP3	<---	OP	.740
OP2	<---	OP	.776
OP1	<---	OP	.761
WR5	<---	WR	.747
NFP5	<---	NFP	.766

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
WR	<-->	FP	.178	.029	6.124	***	
WR	<-->	MP	.176	.029	6.051	***	
WR	<-->	NFP	.162	.027	5.879	***	
WR	<-->	OP	.220	.034	6.453	***	
FP	<-->	MP	.172	.027	6.380	***	
FP	<-->	NFP	.129	.023	5.518	***	

			Estimate	S.E.	C.R.	P	Label
FP	<-->	OP	.154	.027	5.637	***	
MP	<-->	NFP	.162	.026	6.280	***	
MP	<-->	OP	.190	.030	6.345	***	
NFP	<-->	OP	.170	.028	6.048	***	

Correlations: (Group number 1 - Default model)

			Estimate
WR	<-->	FP	.692
WR	<-->	MP	.624
WR	<-->	NFP	.619
WR	<-->	OP	.720
FP	<-->	MP	.729
FP	<-->	NFP	.589
FP	<-->	OP	.605
MP	<-->	NFP	.679
MP	<-->	OP	.681
NFP	<-->	OP	.656

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
WR	.308	.049	6.232	***	
FP	.215	.038	5.676	***	
MP	.258	.039	6.597	***	
NFP	.221	.037	5.956	***	
OP	.302	.049	6.201	***	
e1	.212	.026	8.216	***	
e2	.205	.024	8.397	***	
e3	.195	.024	8.236	***	
e4	.212	.025	8.573	***	
e5	.180	.023	7.750	***	
e6	.147	.023	6.325	***	
e7	.185	.023	8.003	***	
e8	.145	.019	7.793	***	
e9	.133	.017	7.645	***	
e10	.149	.019	7.796	***	
e11	.192	.022	8.670	***	
e12	.174	.021	8.308	***	
e13	.261	.031	8.505	***	
e14	.261	.030	8.707	***	
e15	.184	.023	7.980	***	
e16	.204	.026	7.884	***	
e17	.324	.039	8.294	***	
e18	.193	.025	7.841	***	
e19	.251	.031	8.038	***	
e20	.198	.023	8.464	***	
e21	.168	.021	8.097	***	

Modification Indices (Group number 1 - Default model)
Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e17	<-->	e19	6.644	-.060
e16	<-->	e19	5.119	.043
e15	<-->	FP	4.143	-.025
e14	<-->	FP	5.360	.033
e14	<-->	e18	6.434	-.047
e13	<-->	OP	4.258	-.034
e13	<-->	e14	6.486	.053
e11	<-->	NFP	4.574	.026
e8	<-->	e12	4.510	-.029
e7	<-->	e17	6.033	-.050
e7	<-->	e13	6.650	.047
e6	<-->	OP	4.396	.029
e6	<-->	e19	5.672	.042
e6	<-->	e14	5.543	.041
e6	<-->	e11	4.303	-.031
e5	<-->	e15	5.764	-.038
e5	<-->	e12	7.832	.042
e4	<-->	NFP	4.950	-.029
e4	<-->	e17	5.465	.050
e1	<-->	e10	7.005	.040

Regression Weights: (Group number 1 - Default model)

			M.I.	Par Change
OP2	<---	NFP2	4.117	-.096
MP4	<---	NFP4	5.925	-.115
FP1	<---	OP3	5.039	-.088
FP1	<---	NFP3	4.330	.092
FP2	<---	OP1	4.912	.092

Model Fit Summary
CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	52	207.119	179	.074	1.157
Saturated model	231	.000	0		
Independence model	21	2426.412	210	.000	11.554

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.019	.912	.887	.707
Saturated model	.000	1.000		
Independence model	.190	.217	.139	.198

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.915	.900	.987	.985	.987
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.852	.780	.842
Saturated model	.000	.000	.000

Model	PRATIO	PNFI	PCFI
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	28.119	.000	67.974
Saturated model	.000	.000	.000
Independence model	2216.412	2061.546	2378.655

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	1.020	.139	.000	.335
Saturated model	.000	.000	.000	.000
Independence model	11.953	10.918	10.155	11.718

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.028	.000	.043	.994
Independence model	.228	.220	.236	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	311.119	323.760	483.662	535.662
Saturated model	462.000	518.155	1228.486	1459.486
Independence model	2468.412	2473.517	2538.092	2559.092

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.533	1.394	1.729	1.595
Saturated model	2.276	2.276	2.276	2.552
Independence model	12.160	11.397	12.959	12.185

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	208	222
Independence model	21	22

Appendix C4: AMOS Output for Second-order CFA of Business Performance

Notes for Group (Group number 1)
The model is recursive.
Sample size = 204

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	32	0	0	0	0	32
Labeled	0	0	0	0	0	0
Unlabeled	20	0	27	0	0	47
Total	52	0	27	0	0	79

Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
NFP5	2.000	5.000	-.270	-1.572	-.407	-1.185
WR5	2.000	5.000	-.962	-5.607	.277	.808
OP1	2.000	5.000	-.240	-1.399	-.598	-1.744
OP2	1.000	5.000	-.680	-3.963	.340	.990
OP3	2.000	5.000	-.158	-.920	-.575	-1.677
OP4	2.000	5.000	-.119	-.694	-.337	-.983
NFP1	1.000	5.000	-.220	-1.285	.235	.684
NFP2	2.000	5.000	-.103	-.600	-.501	-1.460
NFP3	2.000	5.000	.281	1.638	-.140	-.407
NFP4	2.000	5.000	-.322	-1.876	-.562	-1.639
MP1	2.000	5.000	-.122	-.712	-.363	-1.059
MP2	1.000	5.000	-.047	-.271	.398	1.161
MP3	2.000	5.000	-.430	-2.506	-.435	-1.267
MP4	2.000	5.000	-.450	-2.626	-.439	-1.281
FP1	2.000	5.000	.222	1.294	.017	.050
FP2	2.000	5.000	-.289	-1.688	-.292	-.850
FP3	2.000	5.000	-.406	-2.370	-.380	-1.107
WR1	2.000	5.000	-.907	-5.290	.137	.399
WR2	2.000	5.000	-.332	-1.933	-.221	-.644
WR3	2.000	5.000	-.619	-3.607	-.108	-.315
WR4	1.000	5.000	-.790	-4.607	.453	1.321
Multivariate					22.086	5.075

Notes for Model (Default model) Computation of degrees of freedom (Default model)
Number of distinct sample moments: 231
Number of distinct parameters to be estimated: 47
Degrees of freedom (231 - 47): 184
Result (Default model) Minimum was achieved
Chi-square = 220.571
Degrees of freedom = 184
Probability level = .034

Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
WR	<---	Business_performance	.998	.124	8.061	***	
FP	<---	Business_performance	.824	.108	7.618	***	
MP	<---	Business_performance	.940	.112	8.393	***	

			Estimate	S.E.	C.R.	P	Label
NFP	<---	Business_performance	.808	.105	7.687	***	
OP	<---	Business_performance	1.000				
WR4	<---	WR	1.000				
WR3	<---	WR	.934	.087	10.796	***	
WR2	<---	WR	.955	.086	11.055	***	
WR1	<---	WR	.901	.086	10.539	***	
FP3	<---	FP	1.038	.107	9.702	***	
FP2	<---	FP	1.210	.115	10.499	***	
FP1	<---	FP	1.000				
MP4	<---	MP	1.000				
MP3	<---	MP	.988	.080	12.322	***	
MP2	<---	MP	1.012	.083	12.136	***	
MP1	<---	MP	.908	.084	10.799	***	
NFP4	<---	NFP	1.000				
NFP3	<---	NFP	1.155	.114	10.094	***	
NFP2	<---	NFP	1.084	.111	9.794	***	
NFP1	<---	NFP	1.112	.104	10.694	***	
OP4	<---	OP	1.000				
OP3	<---	OP	1.136	.109	10.412	***	
OP2	<---	OP	.985	.090	10.996	***	
OP1	<---	OP	1.073	.099	10.796	***	
WR5	<---	WR	.903	.084	10.737	***	
NFP5	<---	NFP	1.037	.098	10.605	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
WR	<---	Business_performance	.815
FP	<---	Business_performance	.807
MP	<---	Business_performance	.837
NFP	<---	Business_performance	.776
OP	<---	Business_performance	.824
WR4	<---	WR	.769
WR3	<---	WR	.752
WR2	<---	WR	.768
WR1	<---	WR	.736
FP3	<---	FP	.746
FP2	<---	FP	.830
FP1	<---	FP	.731
MP4	<---	MP	.801
MP3	<---	MP	.810
MP2	<---	MP	.799
MP1	<---	MP	.725
NFP4	<---	NFP	.750
NFP3	<---	NFP	.730
NFP2	<---	NFP	.709
NFP1	<---	NFP	.772
OP4	<---	OP	.772
OP3	<---	OP	.738
OP2	<---	OP	.776
OP1	<---	OP	.763
WR5	<---	WR	.748
NFP5	<---	NFP	.765

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Business_performance	.205	.041	5.004	***	
e22	.103	.022	4.617	***	
e23	.074	.018	4.201	***	
e24	.077	.017	4.465	***	
e25	.088	.018	4.813	***	
e26	.097	.022	4.373	***	
e1	.212	.026	8.194	***	
e2	.206	.025	8.385	***	
e3	.195	.024	8.203	***	
e4	.211	.025	8.544	***	
e5	.184	.024	7.784	***	
e6	.142	.023	6.042	***	
e7	.186	.023	7.986	***	
e8	.144	.019	7.741	***	
e9	.133	.017	7.594	***	
e10	.150	.019	7.772	***	
e11	.192	.022	8.642	***	
e12	.173	.021	8.284	***	
e13	.260	.031	8.488	***	
e14	.258	.030	8.669	***	
e15	.187	.023	8.018	***	
e16	.205	.026	7.862	***	
e17	.326	.039	8.290	***	
e18	.193	.025	7.795	***	
e19	.249	.031	7.985	***	
e20	.197	.023	8.424	***	
e21	.169	.021	8.100	***	

Modification Indices (Group number 1 - Default model)

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e22	<-->	e24	4.610	-.024
e17	<-->	e19	6.614	-.060
e16	<-->	e19	5.010	.042
e15	<-->	e26	4.990	.032
e15	<-->	e23	5.531	-.030
e14	<-->	e18	6.803	-.048
e13	<-->	e26	4.474	-.035
e13	<-->	e14	6.038	.051
e11	<-->	e25	5.699	.030
e8	<-->	e12	4.205	-.028
e7	<-->	e26	6.199	-.035
e7	<-->	e17	6.389	-.052
e7	<-->	e13	6.592	.047
e6	<-->	e19	4.346	.037
e6	<-->	e14	4.610	.037
e6	<-->	e12	4.270	-.030
e5	<-->	e15	6.051	-.039
e5	<-->	e12	7.340	.041
e4	<-->	e25	4.647	-.028
e4	<-->	e17	5.597	.051
e1	<-->	e10	6.448	.039

Regression Weights: (Group number 1 - Default model)

			M.I.	Par Change
OP2	<---	NFP2	4.186	-.097
OP3	<---	WR1	4.271	.132
MP4	<---	NFP4	5.323	-.109
MP4	<---	WR2	4.210	-.089
FP1	<---	OP3	6.020	-.096
WR1	<---	OP3	4.307	.085

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	47	220.571	184	.034	1.199
Saturated model	231	.000	0		
Independence model	21	2426.412	210	.000	11.554

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.021	.908	.884	.723
Saturated model	.000	1.000		
Independence model	.190	.217	.139	.198

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.909	.896	.984	.981	.983
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.876	.797	.862
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	36.571	3.336	78.024
Saturated model	.000	.000	.000
Independence model	2216.412	2061.546	2378.655

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	1.087	.180	.016	.384
Saturated model	.000	.000	.000	.000
Independence model	11.953	10.918	10.155	11.718

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.031	.009	.046	.986
Independence model	.228	.220	.236	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	314.571	325.997	470.523	517.523
Saturated model	462.000	518.155	1228.486	1459.486
Independence model	2468.412	2473.517	2538.092	2559.092

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.550	1.386	1.754	1.606

Model	ECVI	LO 90	HI 90	MECVI
Saturated model	2.276	2.276	2.276	2.552
Independence model	12.160	11.397	12.959	12.185

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	200	214
Independence model	21	22

Appendix C5: AMOS Output for Final First-order CFA

Notes for Group (Group number 1)
The model is recursive.
Sample size = 204

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	62	0	0	0	0	62
Labeled	0	0	0	0	0	0
Unlabeled	38	66	62	0	0	166
Total	100	66	62	0	0	228

Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
JIT.AVG	1.667	5.000	-.512	-2.988	.909	2.649
TPM.AVG	1.400	5.000	-.474	-2.766	.598	1.743
AVG.OP	1.750	4.750	-.457	-2.666	-.089	-.261
QM.AVG	1.500	4.750	-.345	-2.010	.024	.069
PS.AVG	1.500	4.750	-.119	-.691	.376	1.097
DCN.AVG	2.000	5.000	-.739	-4.310	.979	2.853
CI.AVG	1.750	5.000	-.145	-.847	-.046	-.134
AVG.NFP	1.800	4.600	-.285	-1.662	.052	.153
AVG.MP	1.750	4.500	-.435	-2.534	-.167	-.487
AVG.WR	2.000	5.000	-.831	-4.847	.381	1.111
AVG.FP	2.000	5.000	-.293	-1.710	.460	1.342
IT4	2.000	5.000	.369	2.154	-.130	-.378
IT3	2.000	5.000	.151	.878	-.220	-.641
IT1	2.000	5.000	.250	1.457	-.055	-.160
IT2	2.000	5.000	.072	.422	-.285	-.830
OC4	1.000	5.000	-.039	-.227	-.118	-.344
OC3	1.000	5.000	.008	.044	-.133	-.388
OC1	1.000	5.000	-.065	-.377	-.403	-1.175
OC2	1.000	5.000	-.107	-.623	-.313	-.913
SRM4	2.000	5.000	.251	1.463	-.083	-.242
SRM3	2.000	5.000	.478	2.790	.289	.844
SRM1	1.000	5.000	.060	.350	.232	.675
SRM2	1.000	5.000	.270	1.575	-.044	-.129
CRM3	2.000	5.000	.043	.254	-.418	-1.219
CRM1	2.000	5.000	.037	.218	-.556	-1.622
CRM2	2.000	5.000	-.040	-.231	-.302	-.880
HRM4	1.000	5.000	-.309	-1.804	.108	.314
HRM3	2.000	5.000	-.014	-.083	-.405	-1.179
HRM1	2.000	5.000	-.088	-.513	-.529	-1.541
HRM2	1.000	5.000	.144	.838	-.064	-.187
TW4	2.000	5.000	-.037	-.215	-.249	-.727
TW3	2.000	5.000	-.124	-.721	-.227	-.662
TW1	2.000	5.000	-.074	-.431	-.472	-1.377
TW2	1.000	5.000	-.265	-1.545	.273	.795
T4	2.000	5.000	-.009	-.052	-.393	-1.145
T3	1.000	5.000	-.092	-.535	.362	1.055
T1	2.000	5.000	.101	.591	-.290	-.846

Variable	min	max	skew	c.r.	kurtosis	c.r.
T2	2.000	5.000	-.258	-1.506	-.715	-2.084
EI4	2.000	5.000	-.116	-.676	-.344	-1.003
EI3	1.000	5.000	.054	.316	.256	.748
EI1	2.000	5.000	.118	.686	-.073	-.213
EI2	2.000	5.000	.470	2.740	.399	1.164
EE4	2.000	5.000	.052	.303	-.209	-.609
EE3	2.000	5.000	.064	.371	-.192	-.560
EE1	2.000	5.000	.458	2.673	.299	.872
EE2	2.000	5.000	-.044	-.257	-.237	-.691
ML4	2.000	5.000	-.199	-1.162	-.197	-.575
ML3	2.000	5.000	.034	.199	-.215	-.627
ML1	2.000	5.000	-.211	-1.231	-.245	-.715
ML2	2.000	5.000	-.282	-1.647	-.162	-.473
Multivariate					93.045	9.215

Notes for Model (Default model)
Computation of degrees of freedom (Default model)
Number of distinct sample moments: 1275
Number of distinct parameters to be estimated: 166
Degrees of freedom (1275 - 166): 1109
Result (Default model)
Minimum was achieved
Chi-square = 1302.197
Degrees of freedom = 1109
Probability level = .000

Estimates (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
ML2	<---	ML	1.000				
ML1	<---	ML	.988	.102	9.659	***	
ML3	<---	ML	1.067	.099	10.792	***	
ML4	<---	ML	1.068	.103	10.417	***	
EE2	<---	EE	1.000				
EE1	<---	EE	.871	.084	10.345	***	
EE3	<---	EE	1.044	.081	12.841	***	
EE4	<---	EE	1.014	.082	12.379	***	
EI2	<---	EI	1.000				
EI1	<---	EI	1.018	.090	11.339	***	
EI3	<---	EI	1.218	.094	12.908	***	
EI4	<---	EI	1.099	.091	12.136	***	
T2	<---	T	1.000				
T1	<---	T	.923	.079	11.757	***	
T3	<---	T	.834	.067	12.420	***	
T4	<---	T	.973	.075	13.050	***	
TW2	<---	TW	1.000				
TW1	<---	TW	.883	.072	12.322	***	
TW3	<---	TW	.933	.064	14.534	***	
TW4	<---	TW	.976	.061	15.869	***	
HRM2	<---	HRM	1.000				
HRM1	<---	HRM	.939	.074	12.645	***	

			Estimate	S.E.	C.R.	P	Label
HRM3	<---	HRM	.943	.076	12.486	***	
HRM4	<---	HRM	.835	.078	10.749	***	
CRM2	<---	CRM	1.000				
CRM1	<---	CRM	1.009	.088	11.413	***	
CRM3	<---	CRM	1.065	.089	12.019	***	
SRM2	<---	SRM	1.000				
SRM1	<---	SRM	.834	.073	11.349	***	
SRM3	<---	SRM	.902	.074	12.151	***	
SRM4	<---	SRM	.939	.073	12.868	***	
OC2	<---	OC	1.000				
OC1	<---	OC	1.079	.091	11.866	***	
OC3	<---	OC	1.143	.082	13.887	***	
OC4	<---	OC	.955	.082	11.611	***	
IT2	<---	IT	1.000				
IT1	<---	IT	.973	.088	11.020	***	
IT3	<---	IT	1.025	.090	11.424	***	
IT4	<---	IT	1.039	.097	10.768	***	
AVG.FP	<---	BP	1.000				
AVG.WR	<---	BP	1.029	.106	9.734	***	
AVG.MP	<---	BP	1.063	.102	10.467	***	
AVG.NFP	<---	BP	1.010	.104	9.733	***	
CI.AVG	<---	LMS	1.000				
DCN.AVG	<---	LMS	.824	.077	10.678	***	
PS.AVG	<---	LMS	.762	.074	10.358	***	
QM.AVG	<---	LMS	.908	.072	12.565	***	
AVG.OP	<---	BP	1.198	.119	10.101	***	
TPM.AVG	<---	LMS	1.003	.079	12.779	***	
JIT.AVG	<---	LMS	.749	.074	10.185	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
ML2	<---	ML	.724
ML1	<---	ML	.726
ML3	<---	ML	.820
ML4	<---	ML	.787
EE2	<---	EE	.793
EE1	<---	EE	.701
EE3	<---	EE	.840
EE4	<---	EE	.814
EI2	<---	EI	.770
EI1	<---	EI	.772
EI3	<---	EI	.867
EI4	<---	EI	.819
T2	<---	T	.840
T1	<---	T	.743
T3	<---	T	.774
T4	<---	T	.802
TW2	<---	TW	.853
TW1	<---	TW	.746
TW3	<---	TW	.831
TW4	<---	TW	.880
HRM2	<---	HRM	.796

			Estimate
HRM1	<---	HRM	.829
HRM3	<---	HRM	.820
HRM4	<---	HRM	.724
CRM2	<---	CRM	.821
CRM1	<---	CRM	.777
CRM3	<---	CRM	.826
SRM2	<---	SRM	.790
SRM1	<---	SRM	.760
SRM3	<---	SRM	.805
SRM4	<---	SRM	.847
OC2	<---	OC	.796
OC1	<---	OC	.774
OC3	<---	OC	.883
OC4	<---	OC	.761
IT2	<---	IT	.773
IT1	<---	IT	.776
IT3	<---	IT	.804
IT4	<---	IT	.759
AVG.FP	<---	BP	.719
AVG.WR	<---	BP	.734
AVG.MP	<---	BP	.793
AVG.NFP	<---	BP	.734
CI.AVG	<---	LMS	.774
DCN.AVG	<---	LMS	.715
PS.AVG	<---	LMS	.697
QM.AVG	<---	LMS	.818
AVG.OP	<---	BP	.763
TPM.AVG	<---	LMS	.829
JIT.AVG	<---	LMS	.687

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
EE	<-->	EI	.174	.028	6.253	***	
EE	<-->	T	.201	.032	6.260	***	
EE	<-->	TW	.185	.030	6.085	***	
EE	<-->	HRM	.183	.031	5.866	***	
EE	<-->	CRM	.132	.029	4.544	***	
EE	<-->	SRM	.187	.034	5.548	***	
EE	<-->	OC	.191	.032	5.930	***	
EE	<-->	IT	.173	.031	5.650	***	
EE	<-->	BP	.093	.020	4.602	***	
EE	<-->	LMS	.207	.031	6.750	***	
EI	<-->	T	.174	.029	6.018	***	
EI	<-->	TW	.184	.029	6.395	***	
EI	<-->	HRM	.167	.029	5.850	***	
EI	<-->	CRM	.105	.026	4.063	***	
EI	<-->	SRM	.176	.031	5.647	***	
EI	<-->	OC	.168	.029	5.766	***	
EI	<-->	IT	.159	.028	5.659	***	
EI	<-->	BP	.081	.018	4.468	***	
T	<-->	TW	.190	.032	5.912	***	
T	<-->	HRM	.210	.034	6.136	***	

			Estimate	S.E.	C.R.	P	Label
T	<-->	CRM	.147	.032	4.645	***	
T	<-->	SRM	.240	.038	6.241	***	
T	<-->	OC	.176	.033	5.337	***	
T	<-->	IT	.167	.032	5.250	***	
T	<-->	BP	.082	.021	3.917	***	
TW	<-->	HRM	.186	.032	5.806	***	
TW	<-->	CRM	.150	.031	4.854	***	
TW	<-->	SRM	.192	.035	5.513	***	
TW	<-->	OC	.212	.034	6.237	***	
TW	<-->	IT	.160	.031	5.226	***	
TW	<-->	BP	.094	.021	4.519	***	
TW	<-->	LMS	.208	.031	6.730	***	
HRM	<-->	CRM	.172	.033	5.276	***	
HRM	<-->	SRM	.205	.036	5.630	***	
HRM	<-->	OC	.210	.035	6.008	***	
HRM	<-->	IT	.137	.030	4.541	***	
HRM	<-->	BP	.086	.021	4.097	***	
HRM	<-->	LMS	.175	.030	5.886	***	
CRM	<-->	SRM	.160	.035	4.592	***	
CRM	<-->	OC	.115	.031	3.744	***	
CRM	<-->	IT	.075	.029	2.628	.009	
CRM	<-->	BP	.072	.021	3.472	***	
CRM	<-->	LMS	.163	.029	5.529	***	
SRM	<-->	OC	.216	.038	5.721	***	
SRM	<-->	IT	.174	.035	5.012	***	
SRM	<-->	BP	.110	.024	4.571	***	
SRM	<-->	LMS	.208	.034	6.132	***	
OC	<-->	IT	.146	.031	4.679	***	
OC	<-->	BP	.131	.024	5.460	***	
OC	<-->	LMS	.219	.033	6.610	***	
IT	<-->	BP	.096	.021	4.484	***	
IT	<-->	LMS	.166	.029	5.697	***	
BP	<-->	LMS	.135	.022	6.069	***	
ML	<-->	EE	.154	.028	5.451	***	
ML	<-->	EI	.128	.025	5.132	***	
ML	<-->	T	.197	.032	6.078	***	
ML	<-->	TW	.148	.029	5.182	***	
ML	<-->	HRM	.150	.029	5.114	***	
ML	<-->	CRM	.134	.029	4.609	***	
ML	<-->	SRM	.169	.033	5.162	***	
ML	<-->	OC	.170	.031	5.451	***	
ML	<-->	IT	.094	.026	3.584	***	
ML	<-->	BP	.067	.019	3.621	***	
ML	<-->	LMS	.183	.030	6.210	***	
EI	<-->	LMS	.155	.026	6.020	***	
T	<-->	LMS	.216	.032	6.723	***	

Correlations: (Group number 1 - Default model)

			Estimate
EE	<-->	EI	.655
EE	<-->	T	.629
EE	<-->	TW	.590

			Estimate
EE	<-->	HRM	.583
EE	<-->	CRM	.414
EE	<-->	SRM	.537
EE	<-->	OC	.589
EE	<-->	IT	.564
EE	<-->	BP	.431
EE	<-->	LMS	.743
EI	<-->	T	.597
EI	<-->	TW	.645
EI	<-->	HRM	.586
EI	<-->	CRM	.360
EI	<-->	SRM	.555
EI	<-->	OC	.568
EI	<-->	IT	.569
EI	<-->	BP	.414
T	<-->	TW	.552
T	<-->	HRM	.609
T	<-->	CRM	.420
T	<-->	SRM	.626
T	<-->	OC	.495
T	<-->	IT	.497
T	<-->	BP	.347
TW	<-->	HRM	.550
TW	<-->	CRM	.435
TW	<-->	SRM	.511
TW	<-->	OC	.608
TW	<-->	IT	.484
TW	<-->	BP	.407
TW	<-->	LMS	.695
HRM	<-->	CRM	.502
HRM	<-->	SRM	.548
HRM	<-->	OC	.600
HRM	<-->	IT	.416
HRM	<-->	BP	.370
HRM	<-->	LMS	.585
CRM	<-->	SRM	.418
CRM	<-->	OC	.325
CRM	<-->	IT	.223
CRM	<-->	BP	.306
CRM	<-->	LMS	.535
SRM	<-->	OC	.557
SRM	<-->	IT	.474
SRM	<-->	BP	.426
SRM	<-->	LMS	.626
OC	<-->	IT	.429
OC	<-->	BP	.547
OC	<-->	LMS	.708
IT	<-->	BP	.422
IT	<-->	LMS	.569
BP	<-->	LMS	.659
ML	<-->	EE	.551

			Estimate
ML	<-->	EI	.505
ML	<-->	T	.641
ML	<-->	TW	.492
ML	<-->	HRM	.500
ML	<-->	CRM	.436
ML	<-->	SRM	.507
ML	<-->	OC	.547
ML	<-->	IT	.320
ML	<-->	BP	.327
ML	<-->	LMS	.688
EI	<-->	LMS	.614
T	<-->	LMS	.708

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
ML	.268	.047	5.671	***	
EE	.292	.045	6.527	***	
EI	.241	.038	6.280	***	
T	.352	.049	7.114	***	
TW	.338	.046	7.379	***	
HRM	.337	.052	6.551	***	
CRM	.350	.053	6.652	***	
SRM	.417	.064	6.490	***	
OC	.361	.055	6.600	***	
IT	.323	.052	6.199	***	
BP	.159	.028	5.629	***	
LMS	.265	.041	6.415	***	
e1	.242	.029	8.447	***	
e2	.234	.028	8.428	***	
e3	.149	.021	7.027	***	
e4	.188	.025	7.653	***	
e5	.172	.021	8.027	***	
e6	.229	.026	8.923	***	
e7	.133	.019	7.170	***	
e8	.153	.020	7.699	***	
e9	.166	.020	8.468	***	
e10	.170	.020	8.444	***	
e11	.119	.018	6.706	***	
e12	.143	.018	7.798	***	
e13	.147	.021	7.156	***	
e14	.243	.028	8.590	***	
e15	.164	.020	8.270	***	
e16	.184	.023	7.877	***	
e17	.127	.017	7.483	***	
e18	.211	.024	8.887	***	
e19	.132	.017	7.918	***	
e20	.094	.014	6.746	***	
e21	.195	.025	7.891	***	
e22	.135	.019	7.291	***	
e23	.146	.020	7.478	***	
e24	.214	.025	8.704	***	
e25	.169	.026	6.485	***	

	Estimate	S.E.	C.R.	P	Label
e26	.233	.031	7.475	***	
e27	.185	.029	6.363	***	
e28	.250	.031	8.014	***	
e29	.211	.025	8.388	***	
e30	.184	.024	7.785	***	
e31	.144	.021	6.916	***	
e32	.209	.026	8.180	***	
e33	.281	.033	8.442	***	
e34	.134	.021	6.221	***	
e35	.239	.028	8.579	***	
e36	.217	.028	7.856	***	
e37	.201	.026	7.808	***	
e38	.186	.025	7.333	***	
e39	.256	.032	8.041	***	
e40	.149	.017	8.577	***	
e41	.144	.017	8.433	***	
e42	.106	.014	7.680	***	
e43	.138	.016	8.434	***	
e44	.177	.020	8.891	***	
e45	.172	.019	9.251	***	
e46	.163	.017	9.333	***	
e47	.108	.013	8.459	***	
e48	.163	.020	8.109	***	
e49	.121	.015	8.311	***	
e50	.167	.018	9.373	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
JIT.AVG	.472
TPM.AVG	.688
AVG.OP	.583
QM.AVG	.669
PS.AVG	.485
DCN.AVG	.511
CI.AVG	.599
AVG.NFP	.539
AVG.MP	.630
AVG.WR	.539
AVG.FP	.517
IT4	.577
IT3	.646
IT1	.602
IT2	.597
OC4	.579
OC3	.779
OC1	.600
OC2	.633
SRM4	.718
SRM3	.649
SRM1	.578
SRM2	.625
CRM3	.682

	Estimate
CRM1	.604
CRM2	.675
HRM4	.524
HRM3	.672
HRM1	.688
HRM2	.634
TW4	.774
TW3	.691
TW1	.556
TW2	.727
T4	.644
T3	.599
T1	.552
T2	.706
EI4	.671
EI3	.751
EI1	.596
EI2	.592
EE4	.662
EE3	.705
EE1	.491
EE2	.629
ML4	.619
ML3	.672
ML1	.528
ML2	.525

Modification Indices (Group number 1 - Default model)

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e50	<-->	ML	4.084	-.025
e46	<-->	OC	4.433	-.027
e44	<-->	CRM	9.010	-.050
e44	<-->	T	5.016	-.030
e43	<-->	e45	5.159	-.028
e42	<-->	e46	4.081	-.022
e41	<-->	e48	5.454	.029
e39	<-->	e41	4.711	-.035
e36	<-->	e50	7.640	.042
e35	<-->	e48	5.817	-.039
e35	<-->	e42	6.819	.035
e34	<-->	e47	6.590	.029
e33	<-->	T	6.713	-.045
e31	<-->	e35	4.777	.036
e30	<-->	ML	4.159	.028
e29	<-->	SRM	10.030	-.056
e29	<-->	EI	5.852	.031
e29	<-->	e47	4.003	.025
e29	<-->	e36	5.895	-.044
e29	<-->	e30	4.111	-.033
e28	<-->	OC	6.146	-.042
e28	<-->	SRM	4.989	.043
e28	<-->	EE	5.012	.034

			M.I.	Par Change
e28	<-->	e41	4.687	.034
e28	<-->	e30	8.239	.052
e26	<-->	e45	4.398	.034
e26	<-->	e44	8.305	-.049
e25	<-->	e31	4.475	.032
e23	<-->	EE	7.267	.032
e22	<-->	EI	5.179	-.024
e22	<-->	EE	5.175	-.026
e22	<-->	e48	4.948	-.029
e22	<-->	e42	6.133	.027
e21	<-->	CRM	4.894	.041
e21	<-->	e44	4.730	-.033
e20	<-->	e44	5.400	.026
e20	<-->	e32	4.724	.028
e19	<-->	BP	4.359	-.020
e19	<-->	e41	4.180	-.024
e19	<-->	e23	5.888	-.030
e19	<-->	e21	6.532	.035
e18	<-->	BP	4.157	-.023
e18	<-->	e40	8.065	.040
e18	<-->	e31	4.381	-.032
e18	<-->	e30	4.939	.036
e18	<-->	e25	9.377	-.051
e17	<-->	BP	7.631	.026
e17	<-->	e37	5.639	-.034
e16	<-->	SRM	4.368	-.036
e16	<-->	ML	6.470	-.035
e16	<-->	e27	9.614	.053
e16	<-->	e21	8.741	.048
e15	<-->	CRM	6.866	-.043
e15	<-->	e44	5.214	.031
e15	<-->	e29	5.310	.035
e14	<-->	BP	4.947	.028
e14	<-->	e18	5.217	-.041
e13	<-->	SRM	4.659	.034
e13	<-->	TW	5.283	-.031
e13	<-->	e30	5.777	.036
e13	<-->	e18	4.708	.033
e12	<-->	IT	5.144	-.033
e12	<-->	TW	5.144	-.029
e11	<-->	e46	5.303	-.028
e10	<-->	CRM	5.639	.040
e10	<-->	T	8.494	.039
e10	<-->	e24	5.239	-.035
e10	<-->	e20	5.098	-.026
e9	<-->	IT	4.326	.031
e8	<-->	CRM	5.373	-.038
e8	<-->	e15	4.927	.030
e8	<-->	e13	7.130	-.036
e7	<-->	e23	4.976	.029
e7	<-->	e17	4.913	-.026

			M.I.	Par Change
e6	<-->	e42	5.598	-.031
e6	<-->	e28	4.375	.041
e6	<-->	e21	5.400	.040
e6	<-->	e11	7.142	-.039
e5	<-->	e17	5.777	.031
e4	<-->	e46	5.658	-.034
e4	<-->	e37	4.874	.038
e4	<-->	e16	4.226	-.033
e3	<-->	e50	4.514	-.028
e3	<-->	e30	5.599	.035
e3	<-->	e22	5.652	-.031
e3	<-->	e13	4.385	.029
e2	<-->	e43	4.048	-.030
e2	<-->	e19	7.951	.042
e1	<-->	e16	5.017	-.040
e1	<-->	e15	5.348	.038

Regression Weights: (Group number 1 - Default model)

			M.I.	Par Change
JIT.AVG	<---	IT2	4.822	.088
JIT.AVG	<---	ML3	5.365	-.102
CI.AVG	<---	CRM	6.863	-.149
CI.AVG	<---	CRM3	7.243	-.110
CI.AVG	<---	CRM1	12.283	-.143
CI.AVG	<---	HRM2	5.181	-.098
AVG.MP	<---	OC4	5.681	.081
AVG.MP	<---	HRM1	5.722	.093
AVG.WR	<---	HRM	5.570	-.123
AVG.WR	<---	TW	5.407	-.120
AVG.WR	<---	T	4.652	-.110
AVG.WR	<---	IT4	6.708	-.096
AVG.WR	<---	SRM4	4.481	-.085
AVG.WR	<---	HRM1	7.929	-.123
AVG.WR	<---	TW3	8.256	-.126
AVG.WR	<---	TW1	6.158	-.103
AVG.WR	<---	T1	4.641	-.084
AVG.WR	<---	EI2	4.340	-.094
IT4	<---	EE2	4.064	.115
IT2	<---	SRM1	6.074	-.126
OC1	<---	T4	5.259	-.128
SRM3	<---	BP	4.575	-.192
SRM3	<---	AVG.OP	4.344	-.112
SRM3	<---	AVG.WR	4.600	-.129
SRM1	<---	LMS	7.129	.188
SRM1	<---	BP	5.278	.214
SRM1	<---	OC	10.327	.196
SRM1	<---	HRM	4.941	.141
SRM1	<---	T	4.261	.128
SRM1	<---	EI	9.906	.235
SRM1	<---	ML	4.172	.147
SRM1	<---	TPM.AVG	4.337	.117
SRM1	<---	QM.AVG	10.041	.193

			M.I.	Par Change
SRM1	<---	CI.AVG	6.459	.133
SRM1	<---	AVG.NFP	4.989	.142
SRM1	<---	AVG.MP	5.674	.156
SRM1	<---	IT3	4.156	.098
SRM1	<---	OC3	11.517	.152
SRM1	<---	OC1	6.852	.109
SRM1	<---	OC2	5.588	.109
SRM1	<---	HRM4	6.441	.132
SRM1	<---	HRM1	5.364	.123
SRM1	<---	T3	8.136	.156
SRM1	<---	EI4	12.087	.184
SRM1	<---	EI3	8.882	.151
SRM1	<---	EI2	6.765	.142
SRM1	<---	ML1	4.495	.105
SRM2	<---	OC	6.768	-.176
SRM2	<---	ML	4.567	-.171
SRM2	<---	DCN.AVG	6.964	-.172
SRM2	<---	CI.AVG	4.974	-.130
SRM2	<---	OC4	9.023	-.154
SRM2	<---	OC3	8.165	-.142
SRM2	<---	T3	5.651	-.144
SRM2	<---	ML1	5.270	-.126
CRM3	<---	BP	5.217	-.219
CRM3	<---	AVG.OP	4.248	-.118
CRM3	<---	AVG.NFP	5.496	-.154
CRM3	<---	AVG.MP	6.929	-.177
CRM1	<---	HRM1	4.167	.118
CRM2	<---	AVG.MP	4.118	.129
HRM4	<---	BP	5.014	.207
HRM4	<---	AVG.OP	7.468	.151
HRM4	<---	AVG.WR	6.147	.154
HRM3	<---	EE3	5.395	.105
HRM1	<---	AVG.OP	4.416	-.099
HRM1	<---	AVG.WR	4.035	-.106
HRM1	<---	EI3	5.011	-.096
HRM1	<---	EE3	5.076	-.099
HRM1	<---	EE1	5.777	-.106
HRM2	<---	CRM3	4.237	.093
HRM2	<---	T4	5.215	.109
TW4	<---	T4	4.152	-.072
TW4	<---	EI1	4.235	-.081
TW3	<---	AVG.WR	5.202	-.116
TW1	<---	T	5.000	.136
TW1	<---	AVG.OP	4.057	-.110
TW1	<---	SRM3	4.761	.103
TW1	<---	T4	5.528	.111
TW1	<---	T2	7.819	.135
TW1	<---	ML3	4.435	.107
TW2	<---	AVG.NFP	5.633	.123
TW2	<---	AVG.MP	5.234	.122
T4	<---	AVG.MP	4.242	-.129

			M.I.	Par Change
T4	<---	CRM3	5.370	.102
T4	<---	ML4	5.105	-.108
T4	<---	ML2	6.106	-.116
T3	<---	CI.AVG	4.417	.098
T3	<---	CRM2	4.012	-.086
T3	<---	TW2	4.132	.092
T2	<---	SRM3	5.171	.098
T2	<---	TW3	5.151	-.108
T2	<---	TW2	4.325	-.095
EI4	<---	IT4	4.573	-.081
EI4	<---	IT1	4.914	-.092
EI4	<---	TW1	4.999	-.096
EI1	<---	CRM1	5.722	.097
ML4	<---	IT1	5.817	.115
ML3	<---	SRM3	4.020	.087
ML1	<---	AVG.NFP	5.415	-.155

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	166	1302.197	1109	.000	1.174
Saturated model	1275	.000	0		
Independence model	50	7396.736	1225	.000	6.038

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.022	.802	.773	.698
Saturated model	.000	1.000		
Independence model	.167	.132	.097	.127

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.824	.806	.969	.965	.969
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.905	.746	.877
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	193.197	107.347	287.294
Saturated model	.000	.000	.000
Independence model	6171.736	5904.110	6446.012

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	6.415	.952	.529	1.415
Saturated model	.000	.000	.000	.000
Independence model	36.437	30.403	29.084	31.754

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.029	.022	.036	1.000
Independence model	.158	.154	.161	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	1634.197	1745.592	2185.005	2351.005
Saturated model	2550.000	3405.592	6780.603	8055.603
Independence model	7496.736	7530.288	7662.642	7712.642

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	8.050	7.627	8.514	8.599
Saturated model	12.562	12.562	12.562	16.776
Independence model	36.930	35.611	38.281	37.095

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	186	191
Independence model	36	37

Appendix C6: AMOS Output for Structural Equation Model

Notes for Group (Group number 1)
The model is recursive.
Sample size = 204

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	64	0	0	0	0	64
Labeled	0	0	0	0	0	0
Unlabeled	49	45	62	0	0	156
Total	113	45	62	0	0	220

Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
JIT.AVG	1.667	5.000	-.512	-2.988	.909	2.649
TPM.AVG	1.400	5.000	-.474	-2.766	.598	1.743
AVG.OP	1.750	4.750	-.457	-2.666	-.089	-.261
QM.AVG	1.500	4.750	-.345	-2.010	.024	.069
PS.AVG	1.500	4.750	-.119	-.691	.376	1.097
DCN.AVG	2.000	5.000	-.739	-4.310	.979	2.853
CI.AVG	1.750	5.000	-.145	-.847	-.046	-.134
AVG.NFP	1.800	4.600	-.285	-1.662	.052	.153
AVG.MP	1.750	4.500	-.435	-2.534	-.167	-.487
AVG.WR	2.000	5.000	-.831	-4.847	.381	1.111
AVG.FP	2.000	5.000	-.293	-1.710	.460	1.342
IT4	2.000	5.000	.369	2.154	-.130	-.378
IT3	2.000	5.000	.151	.878	-.220	-.641
IT1	2.000	5.000	.250	1.457	-.055	-.160
IT2	2.000	5.000	.072	.422	-.285	-.830
OC4	1.000	5.000	-.039	-.227	-.118	-.344
OC3	1.000	5.000	.008	.044	-.133	-.388
OC1	1.000	5.000	-.065	-.377	-.403	-1.175
OC2	1.000	5.000	-.107	-.623	-.313	-.913
SRM4	2.000	5.000	.251	1.463	-.083	-.242
SRM3	2.000	5.000	.478	2.790	.289	.844
SRM1	1.000	5.000	.060	.350	.232	.675
SRM2	1.000	5.000	.270	1.575	-.044	-.129
CRM3	2.000	5.000	.043	.254	-.418	-1.219
CRM1	2.000	5.000	.037	.218	-.556	-1.622
CRM2	2.000	5.000	-.040	-.231	-.302	-.880
HRM4	1.000	5.000	-.309	-1.804	.108	.314
HRM3	2.000	5.000	-.014	-.083	-.405	-1.179
HRM1	2.000	5.000	-.088	-.513	-.529	-1.541
HRM2	1.000	5.000	.144	.838	-.064	-.187
TW4	2.000	5.000	-.037	-.215	-.249	-.727
TW3	2.000	5.000	-.124	-.721	-.227	-.662
TW1	2.000	5.000	-.074	-.431	-.472	-1.377
TW2	1.000	5.000	-.265	-1.545	.273	.795
T4	2.000	5.000	-.009	-.052	-.393	-1.145
T3	1.000	5.000	-.092	-.535	.362	1.055

Variable	min	max	skew	c.r.	kurtosis	c.r.
T1	2.000	5.000	.101	.591	-.290	-.846
T2	2.000	5.000	-.258	-1.506	-.715	-2.084
EI4	2.000	5.000	-.116	-.676	-.344	-1.003
EI3	1.000	5.000	.054	.316	.256	.748
EI1	2.000	5.000	.118	.686	-.073	-.213
EI2	2.000	5.000	.470	2.740	.399	1.164
EE4	2.000	5.000	.052	.303	-.209	-.609
EE3	2.000	5.000	.064	.371	-.192	-.560
EE1	2.000	5.000	.458	2.673	.299	.872
EE2	2.000	5.000	-.044	-.257	-.237	-.691
ML4	2.000	5.000	-.199	-1.162	-.197	-.575
ML3	2.000	5.000	.034	.199	-.215	-.627
ML1	2.000	5.000	-.211	-1.231	-.245	-.715
ML2	2.000	5.000	-.282	-1.647	-.162	-.473
Multivariate					93.045	9.215

Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
JIT.AVG	1.667	5.000	-.512	-2.988	.909	2.649
TPM.AVG	1.400	5.000	-.474	-2.766	.598	1.743
AVG.OP	1.750	4.750	-.457	-2.666	-.089	-.261
QM.AVG	1.500	4.750	-.345	-2.010	.024	.069
PS.AVG	1.500	4.750	-.119	-.691	.376	1.097
DCN.AVG	2.000	5.000	-.739	-4.310	.979	2.853
CI.AVG	1.750	5.000	-.145	-.847	-.046	-.134
AVG.NFP	1.800	4.600	-.285	-1.662	.052	.153
AVG.MP	1.750	4.500	-.435	-2.534	-.167	-.487
AVG.WR	2.000	5.000	-.831	-4.847	.381	1.111
AVG.FP	2.000	5.000	-.293	-1.710	.460	1.342
IT4	2.000	5.000	.369	2.154	-.130	-.378
IT3	2.000	5.000	.151	.878	-.220	-.641
IT1	2.000	5.000	.250	1.457	-.055	-.160
IT2	2.000	5.000	.072	.422	-.285	-.830
OC4	1.000	5.000	-.039	-.227	-.118	-.344
OC3	1.000	5.000	.008	.044	-.133	-.388
OC1	1.000	5.000	-.065	-.377	-.403	-1.175
OC2	1.000	5.000	-.107	-.623	-.313	-.913
SRM4	2.000	5.000	.251	1.463	-.083	-.242
SRM3	2.000	5.000	.478	2.790	.289	.844
SRM1	1.000	5.000	.060	.350	.232	.675
SRM2	1.000	5.000	.270	1.575	-.044	-.129
CRM3	2.000	5.000	.043	.254	-.418	-1.219
CRM1	2.000	5.000	.037	.218	-.556	-1.622
CRM2	2.000	5.000	-.040	-.231	-.302	-.880
HRM4	1.000	5.000	-.309	-1.804	.108	.314
HRM3	2.000	5.000	-.014	-.083	-.405	-1.179
HRM1	2.000	5.000	-.088	-.513	-.529	-1.541
HRM2	1.000	5.000	.144	.838	-.064	-.187
TW4	2.000	5.000	-.037	-.215	-.249	-.727
TW3	2.000	5.000	-.124	-.721	-.227	-.662
TW1	2.000	5.000	-.074	-.431	-.472	-1.377
TW2	1.000	5.000	-.265	-1.545	.273	.795

Variable	min	max	skew	c.r.	kurtosis	c.r.
T4	2.000	5.000	-.009	-.052	-.393	-1.145
T3	1.000	5.000	-.092	-.535	.362	1.055
T1	2.000	5.000	.101	.591	-.290	-.846
T2	2.000	5.000	-.258	-1.506	-.715	-2.084
EI4	2.000	5.000	-.116	-.676	-.344	-1.003
EI3	1.000	5.000	.054	.316	.256	.748
EI1	2.000	5.000	.118	.686	-.073	-.213
EI2	2.000	5.000	.470	2.740	.399	1.164
EE4	2.000	5.000	.052	.303	-.209	-.609
EE3	2.000	5.000	.064	.371	-.192	-.560
EE1	2.000	5.000	.458	2.673	.299	.872
EE2	2.000	5.000	-.044	-.257	-.237	-.691
ML4	2.000	5.000	-.199	-1.162	-.197	-.575
ML3	2.000	5.000	.034	.199	-.215	-.627
ML1	2.000	5.000	-.211	-1.231	-.245	-.715
ML2	2.000	5.000	-.282	-1.647	-.162	-.473
Multivariate					93.045	9.215

Estimates (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
LMS	<---	IT	.135	.059	2.265	.024	
LMS	<---	OC	.246	.067	3.699	***	
LMS	<---	SRM	.037	.056	.668	.504	
LMS	<---	CRM	.147	.053	2.751	.006	
LMS	<---	HRM	-.100	.067	-1.488	.137	
LMS	<---	TW	.141	.064	2.212	.027	
LMS	<---	T	.145	.074	1.972	.049	
LMS	<---	EI	-.089	.082	-1.085	.278	
LMS	<---	EE	.211	.077	2.751	.006	
LMS	<---	ML	.166	.073	2.255	.024	
BP	<---	LMS	.501	.067	7.535	***	
ML2	<---	ML	1.000				
ML1	<---	ML	.984	.102	9.651	***	
ML3	<---	ML	1.064	.099	10.801	***	
ML4	<---	ML	1.066	.102	10.434	***	
EE2	<---	EE	1.000				
EE1	<---	EE	.871	.084	10.342	***	
EE3	<---	EE	1.043	.081	12.810	***	
EE4	<---	EE	1.016	.082	12.391	***	
EI2	<---	EI	1.000				
EI1	<---	EI	1.017	.090	11.353	***	
EI3	<---	EI	1.217	.094	12.917	***	
EI4	<---	EI	1.097	.090	12.141	***	
T2	<---	T	1.000				
T1	<---	T	.929	.079	11.833	***	
T3	<---	T	.834	.067	12.401	***	
T4	<---	T	.969	.075	12.946	***	
TW2	<---	TW	1.000				
TW1	<---	TW	.878	.071	12.314	***	

			Estimate	S.E.	C.R.	P	Label
TW3	<---	TW	.928	.064	14.537	***	
TW4	<---	TW	.974	.061	15.962	***	
HRM2	<---	HRM	1.000				
HRM1	<---	HRM	.939	.074	12.649	***	
HRM3	<---	HRM	.943	.075	12.487	***	
HRM4	<---	HRM	.835	.078	10.746	***	
CRM2	<---	CRM	1.000				
CRM1	<---	CRM	1.009	.088	11.416	***	
CRM3	<---	CRM	1.065	.089	12.018	***	
SRM2	<---	SRM	1.000				
SRM1	<---	SRM	.835	.074	11.333	***	
SRM3	<---	SRM	.904	.074	12.149	***	
SRM4	<---	SRM	.939	.073	12.847	***	
OC2	<---	OC	1.000				
OC1	<---	OC	1.079	.091	11.835	***	
OC3	<---	OC	1.143	.083	13.853	***	
OC4	<---	OC	.957	.082	11.625	***	
IT2	<---	IT	1.000				
IT1	<---	IT	.975	.088	11.018	***	
IT3	<---	IT	1.025	.090	11.393	***	
IT4	<---	IT	1.041	.097	10.765	***	
AVG.FP	<---	BP	1.000				
AVG.WR	<---	BP	1.028	.105	9.789	***	
AVG.MP	<---	BP	1.057	.101	10.475	***	
AVG.NFP	<---	BP	.998	.103	9.690	***	
CI.AVG	<---	LMS	1.000				
DCN.AVG	<---	LMS	.825	.077	10.715	***	
PS.AVG	<---	LMS	.762	.073	10.383	***	
QM.AVG	<---	LMS	.908	.072	12.588	***	
AVG.OP	<---	BP	1.192	.118	10.119	***	
TPM.AVG	<---	LMS	.999	.078	12.747	***	
JIT.AVG	<---	LMS	.751	.073	10.245	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
LMS	<---	IT	.148
LMS	<---	OC	.287
LMS	<---	SRM	.046
LMS	<---	CRM	.168
LMS	<---	HRM	-.112
LMS	<---	TW	.159
LMS	<---	T	.167
LMS	<---	EI	-.084
LMS	<---	EE	.221
LMS	<---	ML	.166
BP	<---	LMS	.646
ML2	<---	ML	.726
ML1	<---	ML	.725
ML3	<---	ML	.819
ML4	<---	ML	.787
EE2	<---	EE	.793
EE1	<---	EE	.701

			Estimate
EE3	<---	EE	.839
EE4	<---	EE	.815
EI2	<---	EI	.770
EI1	<---	EI	.772
EI3	<---	EI	.866
EI4	<---	EI	.818
T2	<---	T	.840
T1	<---	T	.747
T3	<---	T	.774
T4	<---	T	.799
TW2	<---	TW	.855
TW1	<---	TW	.744
TW3	<---	TW	.829
TW4	<---	TW	.881
HRM2	<---	HRM	.796
HRM1	<---	HRM	.829
HRM3	<---	HRM	.820
HRM4	<---	HRM	.723
CRM2	<---	CRM	.821
CRM1	<---	CRM	.777
CRM3	<---	CRM	.826
SRM2	<---	SRM	.790
SRM1	<---	SRM	.760
SRM3	<---	SRM	.806
SRM4	<---	SRM	.847
OC2	<---	OC	.796
OC1	<---	OC	.774
OC3	<---	OC	.882
OC4	<---	OC	.763
IT2	<---	IT	.772
IT1	<---	IT	.777
IT3	<---	IT	.803
IT4	<---	IT	.760
AVG.FP	<---	BP	.722
AVG.WR	<---	BP	.737
AVG.MP	<---	BP	.793
AVG.NFP	<---	BP	.729
CI.AVG	<---	LMS	.776
DCN.AVG	<---	LMS	.717
PS.AVG	<---	LMS	.698
QM.AVG	<---	LMS	.819
AVG.OP	<---	BP	.763
TPM.AVG	<---	LMS	.828
JIT.AVG	<---	LMS	.690

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
EE	<-->	EI	.174	.028	6.253	***	
EE	<-->	T	.201	.032	6.259	***	
EE	<-->	TW	.186	.031	6.088	***	
EE	<-->	HRM	.183	.031	5.865	***	
EE	<-->	CRM	.132	.029	4.542	***	

			Estimate	S.E.	C.R.	P	Label
EE	<-->	SRM	.187	.034	5.546	***	
EE	<-->	OC	.191	.032	5.928	***	
EE	<-->	IT	.173	.031	5.648	***	
EI	<-->	T	.174	.029	6.020	***	
EI	<-->	TW	.185	.029	6.405	***	
EI	<-->	HRM	.167	.029	5.851	***	
EI	<-->	CRM	.105	.026	4.064	***	
EI	<-->	SRM	.176	.031	5.647	***	
EI	<-->	OC	.168	.029	5.766	***	
EI	<-->	IT	.159	.028	5.658	***	
T	<-->	TW	.191	.032	5.917	***	
T	<-->	HRM	.210	.034	6.136	***	
T	<-->	CRM	.147	.032	4.642	***	
T	<-->	SRM	.240	.038	6.243	***	
T	<-->	OC	.176	.033	5.340	***	
T	<-->	IT	.167	.032	5.246	***	
TW	<-->	HRM	.186	.032	5.809	***	
TW	<-->	CRM	.150	.031	4.856	***	
TW	<-->	SRM	.192	.035	5.517	***	
TW	<-->	OC	.213	.034	6.241	***	
TW	<-->	IT	.160	.031	5.225	***	
HRM	<-->	CRM	.172	.033	5.276	***	
HRM	<-->	SRM	.205	.036	5.629	***	
HRM	<-->	OC	.210	.035	6.007	***	
HRM	<-->	IT	.137	.030	4.541	***	
CRM	<-->	SRM	.159	.035	4.592	***	
CRM	<-->	OC	.115	.031	3.744	***	
CRM	<-->	IT	.075	.029	2.627	.009	
SRM	<-->	OC	.216	.038	5.719	***	
SRM	<-->	IT	.173	.035	5.011	***	
OC	<-->	IT	.146	.031	4.679	***	
ML	<-->	EE	.154	.028	5.454	***	
ML	<-->	EI	.129	.025	5.135	***	
ML	<-->	T	.197	.032	6.085	***	
ML	<-->	TW	.149	.029	5.188	***	
ML	<-->	HRM	.151	.029	5.116	***	
ML	<-->	CRM	.134	.029	4.611	***	
ML	<-->	SRM	.170	.033	5.164	***	
ML	<-->	OC	.170	.031	5.455	***	
ML	<-->	IT	.094	.026	3.586	***	

Correlations: (Group number 1 - Default model)

			Estimate
EE	<-->	EI	.655
EE	<-->	T	.629
EE	<-->	TW	.590
EE	<-->	HRM	.583
EE	<-->	CRM	.413
EE	<-->	SRM	.537
EE	<-->	OC	.589
EE	<-->	IT	.564
EI	<-->	T	.597

			Estimate
EI	<-->	TW	.645
EI	<-->	HRM	.586
EI	<-->	CRM	.360
EI	<-->	SRM	.555
EI	<-->	OC	.569
EI	<-->	IT	.569
T	<-->	TW	.552
T	<-->	HRM	.609
T	<-->	CRM	.420
T	<-->	SRM	.627
T	<-->	OC	.495
T	<-->	IT	.497
TW	<-->	HRM	.549
TW	<-->	CRM	.435
TW	<-->	SRM	.511
TW	<-->	OC	.608
TW	<-->	IT	.484
HRM	<-->	CRM	.502
HRM	<-->	SRM	.548
HRM	<-->	OC	.600
HRM	<-->	IT	.416
CRM	<-->	SRM	.418
CRM	<-->	OC	.325
CRM	<-->	IT	.223
SRM	<-->	OC	.558
SRM	<-->	IT	.474
OC	<-->	IT	.429
ML	<-->	EE	.551
ML	<-->	EI	.505
ML	<-->	T	.641
ML	<-->	TW	.492
ML	<-->	HRM	.500
ML	<-->	CRM	.436
ML	<-->	SRM	.507
ML	<-->	OC	.547
ML	<-->	IT	.320

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
ML	.269	.047	5.684	***	
EE	.292	.045	6.522	***	
EI	.242	.038	6.288	***	
T	.352	.049	7.108	***	
TW	.340	.046	7.412	***	
HRM	.338	.052	6.552	***	
CRM	.350	.053	6.652	***	
SRM	.416	.064	6.479	***	
OC	.361	.055	6.592	***	
IT	.322	.052	6.189	***	
e51	.055	.011	4.902	***	
e52	.093	.018	5.307	***	
e1	.241	.029	8.419	***	

	Estimate	S.E.	C.R.	P	Label
e2	.235	.028	8.429	***	
e3	.149	.021	7.011	***	
e4	.187	.025	7.628	***	
e5	.173	.022	8.025	***	
e6	.229	.026	8.919	***	
e7	.134	.019	7.186	***	
e8	.152	.020	7.668	***	
e9	.166	.020	8.457	***	
e10	.169	.020	8.438	***	
e11	.119	.018	6.711	***	
e12	.143	.018	7.802	***	
e13	.147	.021	7.134	***	
e14	.240	.028	8.537	***	
e15	.164	.020	8.254	***	
e16	.187	.024	7.917	***	
e17	.125	.017	7.426	***	
e18	.212	.024	8.901	***	
e19	.133	.017	7.954	***	
e20	.093	.014	6.724	***	
e21	.195	.025	7.891	***	
e22	.135	.019	7.289	***	
e23	.146	.020	7.478	***	
e24	.214	.025	8.706	***	
e25	.169	.026	6.484	***	
e26	.233	.031	7.472	***	
e27	.185	.029	6.368	***	
e28	.251	.031	8.025	***	
e29	.211	.025	8.388	***	
e30	.183	.024	7.769	***	
e31	.144	.021	6.916	***	
e32	.209	.026	8.170	***	
e33	.281	.033	8.437	***	
e34	.134	.022	6.202	***	
e35	.238	.028	8.553	***	
e36	.218	.028	7.864	***	
e37	.201	.026	7.788	***	
e38	.186	.025	7.346	***	
e39	.255	.032	8.026	***	
e40	.147	.017	8.504	***	
e41	.142	.017	8.358	***	
e42	.106	.014	7.630	***	
e43	.141	.017	8.437	***	
e44	.176	.020	8.826	***	
e45	.171	.019	9.203	***	
e46	.162	.017	9.292	***	
e47	.107	.013	8.382	***	
e48	.163	.020	8.056	***	
e49	.122	.015	8.269	***	
e50	.165	.018	9.327	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
LMS	.793
BP	.417
JIT.AVG	.477
TPM.AVG	.685
AVG.OP	.583
QM.AVG	.671
PS.AVG	.488
DCN.AVG	.514
CI.AVG	.602
AVG.NFP	.532
AVG.MP	.628
AVG.WR	.544
AVG.FP	.522
IT4	.578
IT3	.645
IT1	.604
IT2	.596
OC4	.582
OC3	.779
OC1	.599
OC2	.633
SRM4	.718
SRM3	.650
SRM1	.578
SRM2	.624
CRM3	.682
CRM1	.604
CRM2	.675
HRM4	.523
HRM3	.672
HRM1	.688
HRM2	.634
TW4	.775
TW3	.687
TW1	.553
TW2	.731
T4	.638
T3	.599
T1	.559
T2	.705
EI4	.670
EI3	.751
EI1	.596
EI2	.593
EE4	.664
EE3	.703
EE1	.491
EE2	.628
ML4	.620
ML3	.671
ML1	.526

	Estimate
ML2	.527

Covariances: (Group number 1 - Default model)

			M.I.	Par Change
e52	<-->	OC	5.428	.027
e46	<-->	OC	5.660	-.032
e44	<-->	CRM	9.103	-.052
e44	<-->	TW	4.199	.028
e44	<-->	T	4.594	-.029
e43	<-->	SRM	4.113	.030
e43	<-->	e45	5.099	-.028
e42	<-->	e46	4.100	-.022
e41	<-->	e48	5.161	.028
e40	<-->	e48	4.245	-.026
e39	<-->	e41	4.494	-.034
e36	<-->	e50	7.533	.042
e35	<-->	e48	5.607	-.039
e35	<-->	e42	7.231	.036
e34	<-->	e47	6.538	.029
e34	<-->	e44	4.102	-.028
e33	<-->	SRM	4.015	.042
e33	<-->	T	7.670	-.049
e31	<-->	e35	4.713	.035
e30	<-->	ML	4.151	.029
e29	<-->	OC	6.379	.041
e29	<-->	SRM	9.425	-.054
e29	<-->	EI	5.058	.028
e29	<-->	e36	5.816	-.044
e29	<-->	e30	4.234	-.034
e28	<-->	OC	8.394	-.052
e28	<-->	SRM	5.011	.044
e28	<-->	e41	4.518	.034
e28	<-->	e30	8.243	.052
e26	<-->	HRM	4.228	.035
e26	<-->	e45	4.732	.036
e26	<-->	e44	7.983	-.048
e25	<-->	e31	4.492	.032
e24	<-->	e52	4.111	.025
e23	<-->	EE	8.628	.036
e22	<-->	EI	5.045	-.024
e22	<-->	EE	6.203	-.030
e22	<-->	e48	4.806	-.029
e22	<-->	e42	6.333	.027
e21	<-->	e44	4.695	-.033
e20	<-->	e44	5.466	.027
e20	<-->	e32	4.812	.028
e19	<-->	SRM	4.185	-.030
e19	<-->	e52	4.539	-.021
e19	<-->	e41	4.321	-.024
e19	<-->	e23	5.843	-.030
e19	<-->	e21	6.544	.036
e18	<-->	e52	7.227	-.032

			M.I.	Par Change
e18	<-->	e40	7.493	.039
e18	<-->	e31	4.520	-.032
e18	<-->	e30	4.907	.036
e18	<-->	e25	9.304	-.051
e17	<-->	e52	5.359	.023
e17	<-->	e37	5.362	-.033
e16	<-->	SRM	4.703	-.038
e16	<-->	ML	5.333	-.033
e16	<-->	e52	6.051	-.029
e16	<-->	e27	9.831	.054
e16	<-->	e21	8.761	.049
e15	<-->	CRM	4.513	-.036
e15	<-->	e51	4.301	.020
e15	<-->	e44	5.262	.032
e15	<-->	e29	5.266	.035
e15	<-->	e28	4.056	-.034
e14	<-->	e18	5.201	-.041
e13	<-->	SRM	4.254	.033
e13	<-->	TW	7.006	-.036
e13	<-->	e30	6.140	.037
e13	<-->	e18	5.147	.034
e12	<-->	TW	4.085	-.026
e12	<-->	e29	4.026	.030
e11	<-->	T	4.095	-.026
e11	<-->	e46	5.673	-.029
e10	<-->	CRM	4.685	.037
e10	<-->	T	7.961	.039
e10	<-->	e24	5.144	-.035
e10	<-->	e20	5.056	-.025
e9	<-->	IT	4.093	.031
e8	<-->	CRM	4.220	-.034
e8	<-->	e15	4.789	.030
e8	<-->	e13	7.401	-.037
e7	<-->	e48	4.020	-.026
e7	<-->	e23	4.984	.029
e7	<-->	e17	5.190	-.027
e6	<-->	e42	5.816	-.031
e6	<-->	e28	4.268	.040
e6	<-->	e21	5.441	.040
e6	<-->	e11	7.159	-.039
e5	<-->	e17	5.546	.030
e4	<-->	IT	5.025	.038
e4	<-->	e46	5.364	-.033
e4	<-->	e37	5.071	.038
e3	<-->	e50	4.332	-.028
e3	<-->	e30	5.979	.037
e3	<-->	e22	5.481	-.031
e3	<-->	e13	4.451	.029
e2	<-->	e43	4.687	-.032
e2	<-->	e19	8.345	.043
e1	<-->	e16	4.820	-.039

	M.I.	Par Change
e1 <--> e15	5.212	.037

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	156	1319.597	1119	.000	1.179
Saturated model	1275	.000	0		
Independence model	50	7396.736	1225	.000	6.038

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.023	.800	.772	.702
Saturated model	.000	1.000		
Independence model	.167	.132	.097	.127

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.822	.805	.968	.964	.967
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.913	.751	.884
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	200.597	113.999	295.433
Saturated model	.000	.000	.000
Independence model	6171.736	5904.110	6446.012

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	6.500	.988	.562	1.455
Saturated model	.000	.000	.000	.000
Independence model	36.437	30.403	29.084	31.754

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.030	.022	.036	1.000
Independence model	.158	.154	.161	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	1631.597	1736.281	2149.224	2305.224
Saturated model	2550.000	3405.592	6780.603	8055.603
Independence model	7496.736	7530.288	7662.642	7712.642

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	8.037	7.611	8.505	8.553
Saturated model	12.562	12.562	12.562	16.776
Independence model	36.930	35.611	38.281	37.095

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	185	190
Independence model	36	37

Appendix C7: SPSS Output MANOVA and ANOVA Test of Business Maturity

Between-Subjects Factors

		Value Label	N
Firm maturity	1.00	Below 5	29
	2.00	5-10	56
	3.00	10-15	59
	4.00	15-20	43
	5.00	20 and above	17

Descriptive Statistics

	Firm.maturity	Mean	Std. Deviation	N
JIT.AVG	Below 5	3.8276	.48486	29
	5-10	3.6369	.48106	56
	10-15	3.4520	.40001	59
	15-20	3.2326	.58434	43
	20 and above	2.7843	.60025	17
	Total	3.4542	.56303	204
TPM.AVG	Below 5	4.0690	.46376	29
	5-10	3.8286	.51653	56
	10-15	3.4102	.41759	59
	15-20	3.3163	.59399	43
	20 and above	2.7294	.63222	17
	Total	3.5422	.62429	204
QM.AVG	Below 5	3.8103	.50734	29
	5-10	3.7187	.45242	56
	10-15	3.3220	.40750	59
	15-20	3.1047	.46686	43
	20 and above	2.6912	.62205	17
	Total	3.4020	.57306	204
PS.AVG	Below 5	3.5603	.49846	29
	5-10	3.3750	.51346	56
	10-15	3.1949	.37448	59
	15-20	2.9302	.54915	43
	20 and above	2.3971	.43354	17
	Total	3.1740	.56454	204
CI.AVG	Below 5	4.2155	.51636	29
	5-10	3.9107	.57688	56
	10-15	3.5212	.46952	59
	15-20	3.2209	.59814	43
	20 and above	2.8676	.53850	17
	Total	3.6091	.66681	204
DCN.AVG	Below 5	4.3017	.46951	29
	5-10	3.9509	.44318	56
	10-15	3.7924	.39159	59
	15-20	3.6105	.58833	43
	20 and above	2.8676	.63810	17
	Total	3.7929	.59477	204

Box's Test of Equality of Covariance Matrices[a]

Box's M	112.401
F	1.225
df1	84
df2	21154.746
Sig.	.080

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + Firm.maturity

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.988	2697.252[b]	6.000	194.000	.000	.988	16183.510	1.000
	Wilks' Lambda	.012	2697.252[b]	6.000	194.000	.000	.988	16183.510	1.000
	Hotelling's Trace	83.420	2697.252[b]	6.000	194.000	.000	.988	16183.510	1.000
	Roy's Largest Root	83.420	2697.252[b]	6.000	194.000	.000	.988	16183.510	1.000
Firm.maturity	Pillai's Trace	.620	6.017	24.000	788.000	.000	.155	144.414	1.000
	Wilks' Lambda	.445	7.378	24.000	677.995	.000	.183	152.082	1.000
	Hotelling's Trace	1.106	8.871	24.000	770.000	.000	.217	212.906	1.000
	Roy's Largest Root	.970	31.840[c]	6.000	197.000	.000	.492	191.039	1.000

a. Design: Intercept + Firm.maturity
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
JIT.AVG	1.501	4	199	.203
TPM.AVG	1.446	4	199	.220
QM.AVG	1.115	4	199	.350
PS.AVG	1.626	4	199	.169
CI.AVG	.587	4	199	.673
DCN.AVG	3.825	4	199	.005

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + Firm.maturity

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[g]
Corrected Model	JIT.AVG	15.654[a]	4	3.913	15.992	.000	.243	63.969	1.000
	TPM.AVG	27.093[b]	4	6.773	25.909	.000	.342	103.636	1.000
	QM.AVG	23.223[c]	4	5.806	26.595	.000	.348	106.382	1.000
	PS.AVG	19.434[d]	4	4.858	21.360	.000	.300	85.441	1.000
	CI.AVG	32.040[e]	4	8.010	27.378	.000	.355	109.512	1.000
	DCN.AVG	24.891[f]	4	6.223	26.391	.000	.347	105.565	1.000
Intercept	JIT.AVG	1894.306	1	1894.306	7741.078	.000	.975	7741.078	1.000
	TPM.AVG	1989.454	1	1989.454	7609.951	.000	.975	7609.951	1.000
	QM.AVG	1830.773	1	1830.773	8386.575	.000	.977	8386.575	1.000
	PS.AVG	1578.506	1	1578.506	6939.879	.000	.972	6939.879	1.000
	CI.AVG	2078.145	1	2078.145	7103.126	.000	.973	7103.126	1.000
	DCN.AVG	2266.691	1	2266.691	9613.334	.000	.980	9613.334	1.000
Firm.maturity	JIT.AVG	15.654	4	3.913	15.992	.000	.243	63.969	1.000
	TPM.AVG	27.093	4	6.773	25.909	.000	.342	103.636	1.000
	QM.AVG	23.223	4	5.806	26.595	.000	.348	106.382	1.000

	PS.AVG	19.434	4	4.858	21.360	.000	.300	85.441	1.000
	CI.AVG	32.040	4	8.010	27.378	.000	.355	109.512	1.000
	DCN.AVG	24.891	4	6.223	26.391	.000	.347	105.565	1.000
Error	JIT.AVG	48.697	199	.245					
	TPM.AVG	52.024	199	.261					
	QM.AVG	43.441	199	.218					
	PS.AVG	45.263	199	.227					
	CI.AVG	58.221	199	.293					
	DCN.AVG	46.921	199	.236					
Total	JIT.AVG	2498.444	204						
	TPM.AVG	2638.680	204						
	QM.AVG	2427.625	204						
	PS.AVG	2119.875	204						
	CI.AVG	2747.438	204						
	DCN.AVG	3006.563	204						
Corrected Total	JIT.AVG	64.351	203						
	TPM.AVG	79.117	203						
	QM.AVG	66.664	203						
	PS.AVG	64.697	203						
	CI.AVG	90.261	203						
	DCN.AVG	71.812	203						

a. R Squared = .243 (Adjusted R Squared = .228)
b. R Squared = .342 (Adjusted R Squared = .329)
c. R Squared = .348 (Adjusted R Squared = .335)
d. R Squared = .300 (Adjusted R Squared = .286)
e. R Squared = .355 (Adjusted R Squared = .342)
f. R Squared = .347 (Adjusted R Squared = .333)
g. Computed using alpha = .05

Post Hoc Tests
Firm.maturity

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Firm.maturity	(J) Firm.maturity	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
JIT.AVG	Below 5	5-10	.1907	.11317	.446	-.1209	.5022
		10-15	.3756*	.11219	.009	.0668	.6845
		15-20	.5950*	.11887	.000	.2678	.9223
		20 and above	1.0433*	.15111	.000	.6273	1.4593
	5-10	Below 5	-.1907	.11317	.446	-.5022	.1209
		10-15	.1849	.09229	.268	-.0691	.4390
		15-20	.4043*	.10030	.001	.1282	.6805
		20 and above	.8526*	.13698	.000	.4755	1.2297
	10-15	Below 5	-.3756*	.11219	.009	-.6845	-.0668
		5-10	-.1849	.09229	.268	-.4390	.0691
		15-20	.2194	.09919	.179	-.0536	.4925
		20 and above	.6677*	.13617	.000	.2928	1.0425
	15-20	Below 5	-.5950*	.11887	.000	-.9223	-.2678
		5-10	-.4043*	.10030	.001	-.6805	-.1282
		10-15	-.2194	.09919	.179	-.4925	.0536
		20 and above	.4482*	.14172	.015	.0581	.8384

	20 and above	Below 5	-1.0433*	.15111	.000	-1.4593	-.6273
		5-10	-.8526*	.13698	.000	-1.2297	-.4755
		10-15	-.6677*	.13617	.000	-1.0425	-.2928
		15-20	-.4482*	.14172	.015	-.8384	-.0581
TPM.AVG	Below 5	5-10	.2404	.11697	.244	-.0816	.5624
		10-15	.6588*	.11596	.000	.3396	.9780
		15-20	.7527*	.12286	.000	.4145	1.0909
		20 and above	1.3396*	.15618	.000	.9096	1.7695
	5-10	Below 5	-.2404	.11697	.244	-.5624	.0816
		10-15	.4184*	.09539	.000	.1558	.6810
		15-20	.5123*	.10367	.000	.2269	.7977
		20 and above	1.0992*	.14159	.000	.7094	1.4889
	10-15	Below 5	-.6588*	.11596	.000	-.9780	-.3396
		5-10	-.4184*	.09539	.000	-.6810	-.1558
		15-20	.0939	.10252	.891	-.1883	.3761
		20 and above	.6808*	.14074	.000	.2933	1.0682
	15-20	Below 5	-.7527*	.12286	.000	-1.0909	-.4145
		5-10	-.5123*	.10367	.000	-.7977	-.2269
		10-15	-.0939	.10252	.891	-.3761	.1883
		20 and above	.5869*	.14648	.001	.1836	.9901
	20 and above	Below 5	-1.3396*	.15618	.000	-1.7695	-.9096
		5-10	-1.0992*	.14159	.000	-1.4889	-.7094
		10-15	-.6808*	.14074	.000	-1.0682	-.2933
		15-20	-.5869*	.14648	.001	-.9901	-.1836
QM.AVG	Below 5	5-10	.0916	.10689	.912	-.2027	.3859
		10-15	.4883*	.10596	.000	.1966	.7800
		15-20	.7057*	.11227	.000	.3966	1.0148
		20 and above	1.1192*	.14272	.000	.7263	1.5121
	5-10	Below 5	-.0916	.10689	.912	-.3859	.2027
		10-15	.3967*	.08717	.000	.1567	.6367
		15-20	.6141*	.09474	.000	.3533	.8749
		20 and above	1.0276*	.12938	.000	.6714	1.3838
	10-15	Below 5	-.4883*	.10596	.000	-.7800	-.1966
		5-10	-.3967*	.08717	.000	-.6367	-.1567
		15-20	.2174	.09368	.143	-.0405	.4753
		20 and above	.6309*	.12861	.000	.2768	.9849
	15-20	Below 5	-.7057*	.11227	.000	-1.0148	-.3966
		5-10	-.6141*	.09474	.000	-.8749	-.3533
		10-15	-.2174	.09368	.143	-.4753	.0405
		20 and above	.4135*	.13386	.019	.0450	.7820
	20 and above	Below 5	-1.1192*	.14272	.000	-1.5121	-.7263
		5-10	-1.0276*	.12938	.000	-1.3838	-.6714
		10-15	-.6309*	.12861	.000	-.9849	-.2768
		15-20	-.4135*	.13386	.019	-.7820	-.0450
PS.AVG	Below 5	5-10	.1853	.10911	.437	-.1150	.4857
		10-15	.3654*	.10816	.008	.0677	.6632
		15-20	.6301*	.11460	.000	.3146	.9456

		20 and above	1.1633*	.14568	.000	.7622	1.5643
	5-10	Below 5	-.1853	.10911	.437	-.4857	.1150
		10-15	.1801	.08898	.258	-.0649	.4250
		15-20	.4448*	.09670	.000	.1786	.7110
		20 and above	.9779*	.13207	.000	.6144	1.3415
	10-15	Below 5	-.3654*	.10816	.008	-.6632	-.0677
		5-10	-.1801	.08898	.258	-.4250	.0649
		15-20	.2647*	.09563	.048	.0014	.5279
		20 and above	.7979*	.13128	.000	.4364	1.1593
	15-20	Below 5	-.6301*	.11460	.000	-.9456	-.3146
		5-10	-.4448*	.09670	.000	-.7110	-.1786
		10-15	-.2647*	.09563	.048	-.5279	-.0014
		20 and above	.5332*	.13664	.001	.1570	.9093
	20 and above	Below 5	-1.1633*	.14568	.000	-1.5643	-.7622
		5-10	-.9779*	.13207	.000	-1.3415	-.6144
		10-15	-.7979*	.13128	.000	-1.1593	-.4364
		15-20	-.5332*	.13664	.001	-.9093	-.1570
CI.AVG	Below 5	5-10	.3048	.12375	.103	-.0359	.6455
		10-15	.6943*	.12267	.000	.3566	1.0320
		15-20	.9946*	.12997	.000	.6368	1.3524
		20 and above	1.3479*	.16522	.000	.8930	1.8027
	5-10	Below 5	-.3048	.12375	.103	-.6455	.0359
		10-15	.3895*	.10091	.001	.1117	.6673
		15-20	.6898*	.10967	.000	.3879	.9917
		20 and above	1.0431*	.14978	.000	.6307	1.4554
	10-15	Below 5	-.6943*	.12267	.000	-1.0320	-.3566
		5-10	-.3895*	.10091	.001	-.6673	-.1117
		15-20	.3003*	.10846	.048	.0017	.5988
		20 and above	.6535*	.14889	.000	.2436	1.0634
	15-20	Below 5	-.9946*	.12997	.000	-1.3524	-.6368
		5-10	-.6898*	.10967	.000	-.9917	-.3879
		10-15	-.3003*	.10846	.048	-.5988	-.0017
		20 and above	.3533	.15496	.156	-.0733	.7799
	20 and above	Below 5	-1.3479*	.16522	.000	-1.8027	-.8930
		5-10	-1.0431*	.14978	.000	-1.4554	-.6307
		10-15	-.6535*	.14889	.000	-1.0634	-.2436
		15-20	-.3533	.15496	.156	-.7799	.0733
DCN.AVG	Below 5	5-10	.3508*	.11109	.016	.0450	.6567
		10-15	.5094*	.11012	.000	.2062	.8125
		15-20	.6913*	.11668	.000	.3700	1.0125
		20 and above	1.4341*	.14833	.000	1.0257	1.8424
	5-10	Below 5	-.3508*	.11109	.016	-.6567	-.0450
		10-15	.1585	.09059	.406	-.0909	.4079
		15-20	.3404*	.09846	.006	.0694	.6115
		20 and above	1.0832*	.13446	.000	.7131	1.4534
	10-15	Below 5	-.5094*	.11012	.000	-.8125	-.2062
		5-10	-.1585	.09059	.406	-.4079	.0909

		15-20	.1819	.09736	.338	-.0861	.4499
		20 and above	.9247*	.13366	.000	.5568	1.2927
	15-20	Below 5	-.6913*	.11668	.000	-1.0125	-.3700
		5-10	-.3404*	.09846	.006	-.6115	-.0694
		10-15	-.1819	.09736	.338	-.4499	.0861
		20 and above	.7428*	.13912	.000	.3598	1.1258
	20 and above	Below 5	-1.4341*	.14833	000	-1.8424	-1.0257
		5-10	-1.0832*	.13446	.000	-1.4534	-.7131
		10-15	-.9247*	.13366	.000	-1.2927	-.5568
		15-20	-.7428*	.13912	.000	-1.1258	-.3598

Based on observed means.
The error term is Mean Square(Error) = .236.
*. The mean difference is significant at the .05 level.

Oneway

Descriptives
DCN.AVG

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
						Lower Bound	Upper Bound			
Below 5		29	4.3017	.46951	.08719	4.1231	4.4803	3.00	5.00	
5-10		56	3.9509	.44318	.05922	3.8322	4.0696	2.75	4.75	
10-15		59	3.7924	.39159	.05098	3.6903	3.8944	2.50	4.75	
15-20		43	3.6105	.58833	.08972	3.4294	3.7915	2.25	5.00	
20 and above		17	2.8676	.63810	.15476	2.5396	3.1957	2.00	4.00	
Total		204	3.7929	.59477	.04164	3.7108	3.8750	2.00	5.00	
Model	Fixed Effects			.48558	.03400	3.7259	3.8599			
	Random Effects				.19062	3.2636	4.3221			.15257

Test of Homogeneity of Variances
DCN.AVG

Levene Statistic	df1	df2	Sig.
3.825	4	199	.005

ANOVA
DCN.AVG

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24.891	4	6.223	26.391	.000
Within Groups	46.921	199	.236		
Total	71.812	203			

Robust Tests of Equality of Means
DCN.AVG

	Statistic[a]	df1	df2	Sig.
Welch	19.047	4	68.220	.000

a. Asymptotically F distributed.

Post Hoc Tests

Multiple Comparisons
Dependent Variable: DCN.AVG

	(I) Firm.maturity	(J) Firm.maturity	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound

Tukey HSD	Below 5	5-10	.35083*	.11109	.016	.0450	.6567
		10-15	.50935*	.11012	.000	.2062	.8125
		15-20	.69126*	.11668	.000	.3700	1.0125
		20 and above	1.43408*	.14833	.000	1.0257	1.8424
	5-10	Below 5	-.35083*	.11109	.016	-.6567	-.0450
		10-15	.15852	.09059	.406	-.0909	.4079
		15-20	.34043*	.09846	.006	.0694	.6115
		20 and above	1.08325*	.13446	.000	.7131	1.4534
	10-15	Below 5	-.50935*	.11012	.000	-.8125	-.2062
		5-10	-.15852	.09059	.406	-.4079	.0909
		15-20	.18191	.09736	.338	-.0861	.4499
		20 and above	.92473*	.13366	.000	.5568	1.2927
	15-20	Below 5	-.69126*	.11668	.000	-1.0125	-.3700
		5-10	-.34043*	.09846	.006	-.6115	-.0694
		10-15	-.18191	.09736	.338	-.4499	.0861
		20 and above	.74282*	.13912	.000	.3598	1.1258
	20 and above	Below 5	-1.43408*	.14833	.000	-1.8424	-1.0257
		5-10	-1.08325*	.13446	.000	-1.4534	-.7131
		10-15	-.92473*	.13366	.000	-1.2927	-.5568
		15-20	-.74282*	.13912	.000	-1.1258	-.3598
Games-Howell	Below 5	5-10	.35083*	.10540	.013	.0534	.6483
		10-15	.50935*	.10100	.000	.2230	.7957
		15-20	.69126*	.12510	.000	.3407	1.0419
		20 and above	1.43408*	.17763	.000	.9143	1.9539
	5-10	Below 5	-.35083*	.10540	.013	-.6483	-.0534
		10-15	.15852	.07814	.259	-.0582	.3753
		15-20	.34043*	.10750	.018	.0400	.6409
		20 and above	1.08325*	.16571	.000	.5894	1.5771
	10-15	Below 5	-.50935*	.10100	.000	-.7957	-.2230
		5-10	-.15852	.07814	.259	-.3753	.0582
		15-20	.18191	.10319	.403	-.1072	.4710
		20 and above	.92473*	.16294	.000	.4362	1.4133
	15-20	Below 5	-.69126*	.12510	.000	-1.0419	-.3407
		5-10	-.34043*	.10750	.018	-.6409	-.0400
		10-15	-.18191	.10319	.403	-.4710	.1072
		20 and above	.74282*	.17889	.002	.2208	1.2648
	20 and above	Below 5	-1.43408*	.17763	.000	-1.9539	-.9143
		5-10	-1.08325*	.16571	.000	-1.5771	-.5894
		10-15	-.92473*	.16294	.000	-1.4133	-.4362
		15-20	-.74282*	.17889	.002	-1.2648	-.2208

*. The mean difference is significant at the 0.05 level.

Appendix C8: SPSS Output for MANOVA Test of Business Size

Between-Subjects Factors

		Value Label	N
Business size	1.00	<50	3
	2.00	51-150	59
	3.00	151-250	78
	4.00	>250	64

Descriptive Statistics

	Business size	Mean	Std. Deviation	N
JIT.AVG	<50	2.5556	.50918	3
	51-150	3.4068	.54340	59
	151-250	3.5000	.55505	78
	>250	3.4844	.56634	64
	Total	3.4542	.56303	204
TPM.AVG	<50	2.6667	.94516	3
	51-150	3.4881	.54617	59
	151-250	3.5205	.62364	78
	>250	3.6594	.65094	64
	Total	3.5422	.62429	204
QM.AVG	<50	2.7500	1.25000	3
	51-150	3.2924	.53770	59
	151-250	3.4263	.52858	78
	>250	3.5039	.59843	64
	Total	3.4020	.57306	204
PS.AVG	<50	2.5833	.72169	3
	51-150	3.1017	.56500	59
	151-250	3.1699	.51832	78
	>250	3.2734	.59715	64
	Total	3.1740	.56454	204
CI.AVG	<50	3.0000	.50000	3
	51-150	3.6186	.61999	59
	151-250	3.6090	.73036	78
	>250	3.6289	.63307	64
	Total	3.6091	.66681	204
DCN.AVG	<50	3.0833	1.12731	3
	51-150	3.8644	.57484	59
	151-250	3.7821	.60351	78
	>250	3.7734	.56645	64
	Total	3.7929	.59477	204

Box's Test of Equality of Covariance Matrices[a]

Box's M	35.268
F	.803
df1	42
df2	105732.286
Sig.	.815

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + Business.Size

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.917	358.378[b]	6.000	195.000	.000	.917	2150.267	1.000
	Wilks' Lambda	.083	358.378[b]	6.000	195.000	.000	.917	2150.267	1.000
	Hotelling's Trace	11.027	358.378[b]	6.000	195.000	.000	.917	2150.267	1.000
	Roy's Largest Root	11.027	358.378[b]	6.000	195.000	.000	.917	2150.267	1.000
Business.Size	Pillai's Trace	.127	1.448	18.000	591.000	.103	.042	26.063	.904
	Wilks' Lambda	.878	1.449	18.000	552.029	.103	.043	24.566	.881
	Hotelling's Trace	.135	1.449	18.000	581.000	.103	.043	26.089	.904
	Roy's Largest Root	.083	2.733[c]	6.000	197.000	.014	.077	16.397	.866

a. Design: Intercept + Business.Size
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
JIT.AVG	.033	3	200	.992
TPM.AVG	.500	3	200	.683
QM.AVG	2.444	3	200	.065
PS.AVG	.171	3	200	.916
CI.AVG	.862	3	200	.462
DCN.AVG	1.001	3	200	.394

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + Business.Size

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[g]
Corrected Model	JIT.AVG	2.777[a]	3	.926	3.007	.031	.043	9.021	.703
	TPM.AVG	3.388[b]	3	1.129	2.982	.032	.043	8.946	.699
	QM.AVG	2.695[c]	3	.898	2.809	.041	.040	8.426	.670
	PS.AVG	1.989[d]	3	.663	2.115	.100	.031	6.345	.535
	CI.AVG	1.143[e]	3	.381	.855	.465	.013	2.566	.234
	DCN.AVG	1.846[f]	3	.615	1.759	.156	.026	5.276	.454
Intercept	JIT.AVG	442.580	1	442.580	1437.565	.000	.878	1437.565	1.000
	TPM.AVG	469.503	1	469.503	1239.941	.000	.861	1239.941	1.000
	QM.AVG	444.349	1	444.349	1389.258	.000	.874	1389.258	1.000
	PS.AVG	388.396	1	388.396	1238.745	.000	.861	1238.745	1.000
	CI.AVG	506.969	1	506.969	1137.757	.000	.850	1137.757	1.000
	DCN.AVG	555.395	1	555.395	1587.600	.000	.888	1587.600	1.000
Business.Size	JIT.AVG	2.777	3	.926	3.007	.031	.043	9.021	.703
	TPM.AVG	3.388	3	1.129	2.982	.032	.043	8.946	.699
	QM.AVG	2.695	3	.898	2.809	.041	.040	8.426	.670
	PS.AVG	1.989	3	.663	2.115	.100	.031	6.345	.535
	CI.AVG	1.143	3	.381	.855	.465	.013	2.566	.234
	DCN.AVG	1.846	3	.615	1.759	.156	.026	5.276	.454

Error	JIT.AVG	61.574	200	.308					
	TPM.AVG	75.730	200	.379					
	QM.AVG	63.969	200	.320					
	PS.AVG	62.708	200	.314					
	CI.AVG	89.117	200	.446					
	DCN.AVG	69.967	200	.350					
Total	JIT.AVG	2498.444	204						
	TPM.AVG	2638.680	204						
	QM.AVG	2427.625	204						
	PS.AVG	2119.875	204						
	CI.AVG	2747.438	204						
	DCN.AVG	3006.563	204						
Corrected Total	JIT.AVG	64.351	203						
	TPM.AVG	79.117	203						
	QM.AVG	66.664	203						
	PS.AVG	64.697	203						
	CI.AVG	90.261	203						
	DCN.AVG	71.812	203						

a. R Squared = .043 (Adjusted R Squared = .029)
b. R Squared = .043 (Adjusted R Squared = .028)
c. R Squared = .040 (Adjusted R Squared = .026)
d. R Squared = .031 (Adjusted R Squared = .016)
e. R Squared = .013 (Adjusted R Squared = -.002)
f. R Squared = .026 (Adjusted R Squared = .011)
g. Computed using alpha = .05

Post Hoc Tests
Business size
Multiple Comparisons
Tukey HSD

Dependent Variable	(I) Business size	(J) Business size	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
JIT.AVG	<50	51-150	-.8512*	.32839	.050	-1.7020	-.0004
		151-250	-.9444*	.32645	.022	-1.7902	-.0987
		>250	-.9288*	.32777	.026	-1.7780	-.0796
	51-150	<50	.8512*	.32839	.050	.0004	1.7020
		151-250	-.0932	.09573	.765	-.3412	.1548
		>250	-.0776	.10014	.866	-.3370	.1819
	151-250	<50	.9444*	.32645	.022	.0987	1.7902
		51-150	.0932	.09573	.765	-.1548	.3412
		>250	.0156	.09358	.998	-.2268	.2581
	>250	<50	.9288*	.32777	.026	.0796	1.7780
		51-150	.0776	.10014	.866	-.1819	.3370
		151-250	-.0156	.09358	.998	-.2581	.2268
TPM.AVG	<50	51-150	-.8215	.36419	.112	-1.7650	.1221
		151-250	-.8538	.36204	.089	-1.7918	.0841
		>250	-.9927*	.36350	.034	-1.9345	-.0510
	51-150	<50	.8215	.36419	.112	-.1221	1.7650
		151-250	-.0324	.10617	.990	-.3074	.2427
		>250	-.1712	.11106	.415	-.4590	.1165
	151-250	<50	.8538	.36204	.089	-.0841	1.7918
		51-150	.0324	.10617	.990	-.2427	.3074
		>250	-.1389	.10378	.540	-.4077	.1300
	>250	<50	.9927*	.36350	.034	.0510	1.9345
		51-150	.1712	.11106	.415	-.1165	.4590
		151-250	.1389	.10378	.540	-.1300	.4077
QM.AVG	<50	51-150	-.5424	.33472	.369	-1.4095	.3248

		151-250	-.6763	.33274	.180	-1.5383	.1858
		>250	-.7539	.33409	.112	-1.6194	.1116
	51-150	<50	.5424	.33472	.369	-.3248	1.4095
		151-250	-.1339	.09758	.518	-.3867	.1189
		>250	-.2115	.10207	.166	-.4760	.0529
	151-250	<50	.6763	.33274	.180	-.1858	1.5383
		51-150	.1339	.09758	.518	-.1189	.3867
		>250	-.0776	.09538	.848	-.3247	.1695
	>250	<50	.7539	.33409	.112	-.1116	1.6194
		51-150	.2115	.10207	.166	-.0529	.4760
		151-250	.0776	.09538	.848	-.1695	.3247
PS.AVG	<50	51-150	-.5184	.33140	.402	-1.3769	.3402
		151-250	-.5865	.32944	.286	-1.4400	.2670
		>250	-.6901	.33078	.161	-1.5471	.1669
	51-150	<50	.5184	.33140	.402	-.3402	1.3769
		151-250	-.0682	.09661	.895	-.3185	.1821
		>250	-.1717	.10106	.327	-.4336	.0901
	151-250	<50	.5865	.32944	.286	-.2670	1.4400
		51-150	.0682	.09661	.895	-.1821	.3185
		>250	-.1036	.09444	.692	-.3482	.1411
	>250	<50	.6901	.33078	.161	-.1669	1.5471
		51-150	.1717	.10106	.327	-.0901	.4336
		151-250	.1036	.09444	.692	-.1411	.3482
CI.AVG	<50	51-150	-.6186	.39507	.400	-1.6422	.4049
		151-250	-.6090	.39274	.409	-1.6265	.4085
		>250	-.6289	.39432	.384	-1.6505	.3927
	51-150	<50	.6186	.39507	.400	-.4049	1.6422
		151-250	.0097	.11517	1.000	-.2887	.3081
		>250	-.0103	.12048	1.000	-.3224	.3019
	151-250	<50	.6090	.39274	.409	-.4085	1.6265
		51-150	-.0097	.11517	1.000	-.3081	.2887
		>250	-.0199	.11258	.998	-.3116	.2717
	>250	<50	.6289	.39432	.384	-.3927	1.6505
		51-150	.0103	.12048	1.000	-.3019	.3224
		151-250	.0199	.11258	.998	-.2717	.3116
DCN.AVG	<50	51-150	-.7811	.35006	.118	-1.6880	.1258
		151-250	-.6987	.34799	.189	-1.6003	.2028
		>250	-.6901	.34940	.201	-1.5953	.2151
	51-150	<50	.7811	.35006	.118	-.1258	1.6880
		151-250	.0824	.10205	.851	-.1820	.3467
		>250	.0910	.10675	.829	-.1856	.3675
	151-250	<50	.6987	.34799	.189	-.2028	1.6003
		51-150	-.0824	.10205	.851	-.3467	.1820
		>250	.0086	.09976	1.000	-.2498	.2671
	>250	<50	.6901	.34940	.201	-.2151	1.5953
		51-150	-.0910	.10675	.829	-.3675	.1856
		151-250	-.0086	.09976	1.000	-.2671	.2498

Based on observed means.
The error term is Mean Square (Error) = .350.
*. The mean difference is significant at the .05 level.

Appendix C9: SPSS Output MANOVA Test of Years of Involvement in LMS

Between-Subjects Factors

		Value Label	N
Years involved in LMS	1.00	Less than 1 year	50
	2.00	1-3 years	95
	3.00	More than 3 years but Less 5 years	46
	4.00	More 5 years	13

Descriptive Statistics

	Years involved in LMS	Mean	Std. Deviation	N
JIT.AVG	Less than 1 year	3.3000	.56844	50
	1-3 years	3.4877	.53882	95
	More than 3 years but Less 5 years	3.4638	.54196	46
	More 5 years	3.7692	.67199	13
	Total	3.4542	.56303	204
TPM.AVG	Less than 1 year	3.2240	.67569	50
	1-3 years	3.5726	.55399	95
	More than 3 years but Less 5 years	3.7217	.57268	46
	More 5 years	3.9077	.63043	13
	Total	3.5422	.62429	204
QM.AVG	Less than 1 year	3.1750	.53273	50
	1-3 years	3.4684	.54607	95
	More than 3 years but Less 5 years	3.3804	.57189	46
	More 5 years	3.8654	.59174	13
	Total	3.4020	.57306	204
PS.AVG	Less than 1 year	3.0150	.64959	50
	1-3 years	3.2000	.50212	95
	More than 3 years but Less 5 years	3.1848	.53081	46
	More 5 years	3.5577	.60513	13
	Total	3.1740	.56454	204
CI.AVG	Less than 1 year	3.3100	.63197	50
	1-3 years	3.7368	.61817	95
	More than 3 years but Less 5 years	3.6087	.67629	46
	More 5 years	3.8269	.79310	13
	Total	3.6091	.66681	204
DCN.AVG	Less than 1 year	3.5850	.59033	50
	1-3 years	3.9289	.55981	95
	More than 3 years but Less 5 years	3.7391	.60082	46
	More 5 years	3.7885	.64425	13
	Total	3.7929	.59477	204

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.974	1228.198[b]	6.000	195.000	.000	.974	7369.190	1.000
	Wilks' Lambda	.026	1228.198[b]	6.000	195.000	.000	.974	7369.190	1.000

	Hotelling's Trace	37.791	1228.198[b]	6.000	195.000	.000	.974	7369.190	1.000
	Roy's Largest Root	37.791	1228.198[b]	6.000	195.000	.000	.974	7369.190	1.000
G4	Pillai's Trace	.251	2.995	18.000	591.000	.000	.084	53.910	.999
	Wilks' Lambda	.768	2.995	18.000	552.029	.000	.084	50.693	.999
	Hotelling's Trace	.277	2.984	18.000	581.000	.000	.085	53.712	.999
	Roy's Largest Root	.141	4.634[c]	6.000	197.000	.000	.124	27.804	.987

a. Design: Intercept + G4
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[g]
Corrected Model	JIT.AVG	2.590[a]	3	.863	2.796	.041	.040	8.387	.668
	TPM.AVG	8.370[b]	3	2.790	7.887	.000	.106	23.661	.989
	QM.AVG	5.808[c]	3	1.936	6.363	.000	.087	19.089	.966
	PS.AVG	3.247[d]	3	1.082	3.523	.016	.050	10.570	.777
	CI.AVG	6.640[e]	3	2.213	5.294	.002	.074	15.881	.927
	DCN.AVG	4.053[f]	3	1.351	3.987	.009	.056	11.962	.831
Intercept	JIT.AVG	1521.656	1	1521.656	4927.583	.000	.961	4927.583	1.000
	TPM.AVG	1610.912	1	1610.912	4553.973	.000	.958	4553.973	1.000
	QM.AVG	1493.252	1	1493.252	4907.506	.000	.961	4907.506	1.000
	PS.AVG	1299.621	1	1299.621	4229.861	.000	.955	4229.861	1.000
	CI.AVG	1623.532	1	1623.532	3883.088	.000	.951	3883.088	1.000
	DCN.AVG	1751.300	1	1751.300	5169.167	.000	.963	5169.167	1.000
G4	JIT.AVG	2.590	3	.863	2.796	.041	.040	8.387	.668
	TPM.AVG	8.370	3	2.790	7.887	.000	.106	23.661	.989
	QM.AVG	5.808	3	1.936	6.363	.000	.087	19.089	.966
	PS.AVG	3.247	3	1.082	3.523	.016	.050	10.570	.777
	CI.AVG	6.640	3	2.213	5.294	.002	.074	15.881	.927
	DCN.AVG	4.053	3	1.351	3.987	.009	.056	11.962	.831

Error	JIT.AVG	61.761	200	.309					
	TPM.AVG	70.748	200	.354					
	QM.AVG	60.856	200	.304					
	PS.AVG	61.450	200	.307					
	CI.AVG	83.621	200	.418					
	DCN.AVG	67.759	200	.339					
Total	JIT.AVG	2498.444	204						
	TPM.AVG	2638.680	204						
	QM.AVG	2427.625	204						
	PS.AVG	2119.875	204						
	CI.AVG	2747.438	204						
	DCN.AVG	3006.563	204						
Corrected Total	JIT.AVG	64.351	203						
	TPM.AVG	79.117	203						
	QM.AVG	66.664	203						
	PS.AVG	64.697	203						
	CI.AVG	90.261	203						
	DCN.AVG	71.812	203						

a. R Squared = .040 (Adjusted R Squared = .026)
b. R Squared = .106 (Adjusted R Squared = .092)
c. R Squared = .087 (Adjusted R Squared = .073)
d. R Squared = .050 (Adjusted R Squared = .036)
e. R Squared = .074 (Adjusted R Squared = .060)
f. R Squared = .056 (Adjusted R Squared = .042)
g. Computed using alpha = .05

Box's Test of Equality of Covariance Matrices[a]

Box's M	68.956
F	.983
df1	63
df2	7214.228
Sig.	.514

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + G4

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
JIT.AVG	.101	3	200	.960
TPM.AVG	1.120	3	200	.342
QM.AVG	.687	3	200	.561
PS.AVG	1.997	3	200	.116
CI.AVG	.660	3	200	.577
DCN.AVG	.289	3	200	.833

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + G4

Multiple Comparisons
Tukey HSD

Dependent Variable	(I) Years involved in LMS	(J) Years involved in LMS	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
JIT.AVG	Less than 1 year	1-3 years	-.1877	.09709	.217	-.4393	.0638
		More than 3 years but Less 5 years	-.1638	.11353	.474	-.4579	.1304
		More 5 years	-.4692*	.17300	.036	-.9174	-.0210

	1-3 years	Less than 1 year	.1877	.09709	.217	-.0638	.4393
		More than 3 years but Less 5 years	.0240	.09982	.995	-.2347	.2826
		More 5 years	-.2815	.16433	.320	-.7073	.1442
	More than 3 years but Less 5 years	Less than 1 year	.1638	.11353	.474	-.1304	.4579
		1-3 years	-.0240	.09982	.995	-.2826	.2347
		More 5 years	-.3055	.17455	.301	-.7577	.1468
	More 5 years	Less than 1 year	.4692*	.17300	.036	.0210	.9174
		1-3 years	.2815	.16433	.320	-.1442	.7073
		More than 3 years but Less 5 years	.3055	.17455	.301	-.1468	.7577
TPM.AVG	Less than 1 year	1-3 years	-.3486*	.10391	.005	-.6179	-.0794
		More than 3 years but Less 5 years	-.4977*	.12151	.000	-.8125	-.1829
		More 5 years	-.6837*	.18516	.002	-1.1634	-.2040
	1-3 years	Less than 1 year	.3486*	.10391	.005	.0794	.6179
		More than 3 years but Less 5 years	-.1491	.10683	.504	-.4259	.1277
		More 5 years	-.3351	.17588	.229	-.7907	.1206
	More than 3 years but Less 5 years	Less than 1 year	.4977*	.12151	.000	.1829	.8125
		1-3 years	.1491	.10683	.504	-.1277	.4259
		More 5 years	-.1860	.18682	.752	-.6700	.2980
	More 5 years	Less than 1 year	.6837*	.18516	.002	.2040	1.1634
		1-3 years	.3351	.17588	.229	-.1206	.7907
		More than 3 years but Less 5 years	.1860	.18682	.752	-.2980	.6700
QM.AVG	Less than 1 year	1-3 years	-.2934*	.09638	.014	-.5431	-.0437
		More than 3 years but Less 5 years	-.2054	.11270	.266	-.4974	.0865
		More 5 years	-.6904*	.17173	.000	-1.1353	-.2455
	1-3 years	Less than 1 year	.2934*	.09638	.014	.0437	.5431
		More than 3 years but Less 5 years	.0880	.09908	.811	-.1687	.3447
		More 5 years	-.3970	.16312	.074	-.8196	.0256
	More than 3 years but Less 5 years	Less than 1 year	.2054	.11270	.266	-.0865	.4974
		1-3 years	-.0880	.09908	.811	-.3447	.1687
		More 5 years	-.4849*	.17327	.029	-.9338	-.0361
	More 5 years	Less than 1 year	.6904*	.17173	.000	.2455	1.1353
		1-3 years	.3970	.16312	.074	-.0256	.8196
		More than 3 years but Less 5 years	.4849*	.17327	.029	.0361	.9338
PS.AVG	Less than 1 year	1-3 years	-.1850	.09685	.227	-.4359	.0659
		More than 3 years but Less 5 years	-.1698	.11324	.440	-.4632	.1236
		More 5 years	-.5427*	.17257	.010	-.9898	-.0956
	1-3 years	Less than 1 year	.1850	.09685	.227	-.0659	.4359
		More than 3 years but Less 5 years	.0152	.09957	.999	-.2427	.2732
		More 5 years	-.3577	.16392	.132	-.7824	.0670
	More than 3 years but Less 5 years	Less than 1 year	.1698	.11324	.440	-.1236	.4632
		1-3 years	-.0152	.09957	.999	-.2732	.2427
		More 5 years	-.3729	.17411	.144	-.8240	.0782
	More 5 years	Less than 1 year	.5427*	.17257	.010	.0956	.9898
		1-3 years	.3577	.16392	.132	-.0670	.7824
		More than 3 years but Less 5 years	.3729	.17411	.144	-.0782	.8240
CI.AVG	Less than 1 year	1-3 years	-.4268*	.11297	.001	-.7195	-.1342
		More than 3 years but Less 5 years	-.2987	.13210	.111	-.6409	.0436

		More 5 years	-.5169	.20131	.053	-1.0385	.0046
	1-3 years	Less than 1 year	.4268*	.11297	.001	.1342	.7195
		More than 3 years but Less 5 years	.1281	.11615	.688	-.1728	.4291
		More 5 years	-.0901	.19121	.965	-.5855	.4053
	More than 3 years but Less 5 years	Less than 1 year	.2987	.13210	.111	-.0436	.6409
		1-3 years	-.1281	.11615	.688	-.4291	.1728
		More 5 years	-.2182	.20310	.705	-.7444	.3080
	More 5 years	Less than 1 year	.5169	.20131	.053	-.0046	1.0385
		1-3 years	.0901	.19121	.965	-.4053	.5855
		More than 3 years but Less 5 years	.2182	.20310	.705	-.3080	.7444
DCN.AVG	Less than 1 year	1-3 years	-.3439*	.10170	.005	-.6074	-.0805
		More than 3 years but Less 5 years	-.1541	.11892	.566	-.4622	.1540
		More 5 years	-.2035	.18121	.676	-.6729	.2660
	1-3 years	Less than 1 year	.3439*	.10170	.005	.0805	.6074
		More than 3 years but Less 5 years	.1898	.10455	.269	-.0811	.4607
		More 5 years	.1405	.17213	.847	-.3055	.5864
	More than 3 years but Less 5 years	Less than 1 year	.1541	.11892	.566	-.1540	.4622
		1-3 years	-.1898	.10455	.269	-.4607	.0811
		More 5 years	-.0493	.18283	.993	-.5230	.4243
	More 5 years	Less than 1 year	.2035	.18121	.676	-.2660	.6729
		1-3 years	-.1405	.17213	.847	-.5864	.3055
		More than 3 years but Less 5 years	.0493	.18283	.993	-.4243	.5230

Based on observed means.
The error term is Mean Square(Error) = .339.
*. The mean difference is significant at the .05 level.

Appendix C10: SPSS Output of MANOVA Test for JIT

Between-Subjects Factors

		Value Label	N
JIT.impl.lvl	1.00	Non implementers	20
	2.00	Transitional Implementers	138
	3.00	Full Implementers	46

Descriptive Statistics

JIT.impl.lvl		Mean	Std. Deviation	N
AVG.WR	Non implementers	3.1200	.74946	20
	Transitional Implementers	3.5522	.53521	138
	Full Implementers	3.7435	.42929	46
	Total	3.5529	.55986	204
AVG.FP	Non implementers	3.0333	.69164	20
	Transitional Implementers	3.3816	.50713	138
	Full Implementers	3.6377	.53898	46
	Total	3.4052	.55586	204
AVG.MP	Non implementers	3.0375	.66032	20
	Transitional Implementers	3.3351	.48846	138
	Full Implementers	3.7446	.43617	46
	Total	3.3983	.53545	204
AVG.NFP	Non implementers	3.0800	.61009	20
	Transitional Implementers	3.3000	.51616	138
	Full Implementers	3.6522	.51022	46
	Total	3.3578	.54942	204
AVG.OP	Non implementers	3.0000	.79885	20
	Transitional Implementers	3.4438	.56754	138
	Full Implementers	3.8370	.53546	46
	Total	3.4890	.62693	204

Box's Test of Equality of Covariance Matrices[a]

Box's M	58.436
F	1.809
df1	30
df2	10752.560
Sig.	.004

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + JIT.impl.lvl

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.974	1487.880[b]	5.000	197.000	.000	.974	7439.399	1.000
	Wilks' Lambda	.026	1487.880[b]	5.000	197.000	.000	.974	7439.399	1.000
	Hotelling's Trace	37.763	1487.880[b]	5.000	197.000	.000	.974	7439.399	1.000
	Roy's Largest Root	37.763	1487.880[b]	5.000	197.000	.000	.974	7439.399	1.000
JIT.impl.lvl	Pillai's Trace	.211	4.662	10.000	396.000	.000	.105	46.616	1.000
	Wilks' Lambda	.795	4.795[b]	10.000	394.000	.000	.108	47.948	1.000
	Hotelling's Trace	.251	4.927	10.000	392.000	.000	.112	49.270	1.000
	Roy's Largest Root	.220	8.729[c]	5.000	198.000	.000	.181	43.644	1.000

a. Design: Intercept + JIT.impl.lvl
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AVG.WR	5.108	2	201	.007
AVG.FP	.513	2	201	.600
AVG.MP	3.041	2	201	.050
AVG.NFP	.158	2	201	.854
AVG.OP	1.318	2	201	.270

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + JIT.impl.lvl

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[f]
Corrected Model	AVG.WR	5.419[a]	2	2.709	9.356	.000	.085	18.712	.977
	AVG.FP	5.328[b]	2	2.664	9.330	.000	.085	18.661	.977
	AVG.MP	8.669[c]	2	4.335	17.590	.000	.149	35.180	1.000
	AVG.NFP	5.991[d]	2	2.995	10.890	.000	.098	21.780	.990
	AVG.OP	10.633[e]	2	5.317	15.453	.000	.133	30.906	.999
Intercept	AVG.WR	1373.490	1	1373.490	4742.731	.000	.959	4742.731	1.000
	AVG.FP	1279.423	1	1279.423	4480.613	.000	.957	4480.613	1.000
	AVG.MP	1295.908	1	1295.908	5258.712	.000	.963	5258.712	1.000
	AVG.NFP	1274.215	1	1274.215	4632.521	.000	.958	4632.521	1.000
	AVG.OP	1338.154	1	1338.154	3889.396	.000	.951	3889.396	1.000
JIT.impl.lvl	AVG.WR	5.419	2	2.709	9.356	.000	.085	18.712	.977
	AVG.FP	5.328	2	2.664	9.330	.000	.085	18.661	.977
	AVG.MP	8.669	2	4.335	17.590	.000	.149	35.180	1.000
	AVG.NFP	5.991	2	2.995	10.890	.000	.098	21.780	.990
	AVG.OP	10.633	2	5.317	15.453	.000	.133	30.906	.999
Error	AVG.WR	58.209	201	.290					
	AVG.FP	57.395	201	.286					
	AVG.MP	49.533	201	.246					
	AVG.NFP	55.287	201	.275					
	AVG.OP	69.154	201	.344					
Total	AVG.WR	2638.800	204						
	AVG.FP	2428.222	204						
	AVG.MP	2414.063	204						
	AVG.NFP	2361.400	204						
	AVG.OP	2563.063	204						
Corrected Total	AVG.WR	63.628	203						
	AVG.FP	62.723	203						
	AVG.MP	58.202	203						
	AVG.NFP	61.277	203						
	AVG.OP	79.788	203						

a. R Squared = .085 (Adjusted R Squared = .076)
b. R Squared = .085 (Adjusted R Squared = .076)
c. R Squared = .149 (Adjusted R Squared = .140)
d. R Squared = .098 (Adjusted R Squared = .089)
e. R Squared = .133 (Adjusted R Squared = .125)
f. Computed using alpha = .05

Multiple Comparisons
Tukey HSD

Dependent Variable	(I) JIT.impl.lvl	(J) JIT.impl.lvl	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
AVG.WR	Non implementers	Transitional Implementers	-.4322*	.12876	.003	-.7362	-.1282
		Full Implementers	-.6235*	.14414	.000	-.9638	-.2831
	Transitional Implementers	Non implementers	.4322*	.12876	.003	.1282	.7362
		Full Implementers	-.1913	.09162	.095	-.4076	.0250
	Full Implementers	Non implementers	.6235*	.14414	.000	.2831	.9638
		Transitional Implementers	.1913	.09162	.095	-.0250	.4076
AVG.FP	Non implementers	Transitional Implementers	-.3483*	.12785	.019	-.6502	-.0464
		Full Implementers	-.6043*	.14313	.000	-.9423	-.2664
	Transitional Implementers	Non implementers	.3483*	.12785	.019	.0464	.6502
		Full Implementers	-.2560*	.09098	.015	-.4709	-.0412
	Full Implementers	Non implementers	.6043*	.14313	.000	.2664	.9423
		Transitional Implementers	.2560*	.09098	.015	.0412	.4709
AVG.MP	Non implementers	Transitional Implementers	-.2976*	.11877	.035	-.5781	-.0172
		Full Implementers	-.7071*	.13296	.000	-1.0210	-.3931
	Transitional Implementers	Non implementers	.2976*	.11877	.035	.0172	.5781
		Full Implementers	-.4094*	.08452	.000	-.6090	-.2099
	Full Implementers	Non implementers	.7071*	.13296	.000	.3931	1.0210
		Transitional Implementers	.4094*	.08452	.000	.2099	.6090
AVG.NFP	Non implementers	Transitional Implementers	-.2200	.12548	.188	-.5163	.0763
		Full Implementers	-.5722*	.14047	.000	-.9039	-.2405
	Transitional Implementers	Non implementers	.2200	.12548	.188	-.0763	.5163
		Full Implementers	-.3522*	.08929	.000	-.5630	-.1413
	Full Implementers	Non implementers	.5722*	.14047	.000	.2405	.9039
		Transitional Implementers	.3522*	.08929	.000	.1413	.5630
AVG.OP	Non implementers	Transitional Implementers	-.4438*	.14034	.005	-.7752	-.1125
		Full Implementers	-.8370*	.15711	.000	-1.2079	-.4660
	Transitional Implementers	Non implementers	.4438*	.14034	.005	.1125	.7752

		Full Implementers	-.3931*	.09986	.000	-.6289	-.1573
	Full Implementers	Non implementers	.8370*	.15711	.000	.4660	1.2079
		Transitional Implementers	.3931*	.09986	.000	.1573	.6289

Based on observed means.
The error term is Mean Square (Error) = .344.
*. The mean difference is significant at the .05 level.

Appendix C11: SPSS Output of MANOVA and ANOVA Tests for TPM

Between-Subjects Factors

		Value Label	N
TPM.impl.lvl	1.00	Non implementers	26
	2.00	Transitional Implementers	119
	3.00	Full Implementers	59

Descriptive Statistics

	TPM.impl.lvl	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.1154	.63793	26
	Transitional Implementers	3.5664	.52356	119
	Full Implementers	3.7186	.49982	59
	Total	3.5529	.55986	204
AVG.FP	Non implementers	3.0256	.52428	26
	Transitional Implementers	3.3950	.49282	119
	Full Implementers	3.5932	.60669	59
	Total	3.4052	.55586	204
AVG.MP	Non implementers	2.9904	.43864	26
	Transitional Implementers	3.3824	.49126	119
	Full Implementers	3.6102	.55567	59
	Total	3.3983	.53545	204
AVG.NFP	Non implementers	2.8923	.43902	26
	Transitional Implementers	3.3378	.50673	119
	Full Implementers	3.6034	.54010	59
	Total	3.3578	.54942	204
AVG.OP	Non implementers	2.9135	.51450	26
	Transitional Implementers	3.4874	.56920	119
	Full Implementers	3.7458	.62196	59
	Total	3.4890	.62693	204

Box's Test of Equality of Covariance Matrices[a]

Box's M	71.703
F	2.257
df1	30
df2	19732.937
Sig.	.000

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + TPM.impl.lvl

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.979	1863.199[b]	5.000	197.000	.000	.979	9315.994	1.000
	Wilks' Lambda	.021	1863.199[b]	5.000	197.000	.000	.979	9315.994	1.000
	Hotelling's Trace	47.289	1863.199[b]	5.000	197.000	.000	.979	9315.994	1.000
	Roy's Largest Root	47.289	1863.199[b]	5.000	197.000	.000	.979	9315.994	1.000

TPM.impl.lvl	Pillai's Trace	.210	4.648	10.000	396.000	.000	.105	46.478	1.000
	Wilks' Lambda	.791	4.894[b]	10.000	394.000	.000	.110	48.943	1.000
	Hotelling's Trace	.262	5.140	10.000	392.000	.000	.116	51.397	1.000
	Roy's Largest Root	.256	10.130[c]	5.000	198.000	.000	.204	50.649	1.000

a. Design: Intercept + TPM.impl.lvl
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AVG.WR	2.756	2	201	.066
AVG.FP	.995	2	201	.372
AVG.MP	1.976	2	201	.141
AVG.NFP	.640	2	201	.528
AVG.OP	.378	2	201	.685

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + TPM.impl.lvl

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[f]
Corrected Model	AVG.WR	6.619[a]	2	3.310	11.669	.000	.104	23.338	.994
	AVG.FP	5.844[b]	2	2.922	10.326	.000	.093	20.651	.987
	AVG.MP	7.005[c]	2	3.502	13.751	.000	.120	27.502	.998
	AVG.NFP	9.240[d]	2	4.620	17.845	.000	.151	35.690	1.000
	AVG.OP	12.502[e]	2	6.251	18.674	.000	.157	37.348	1.000
Intercept	AVG.WR	1695.060	1	1695.060	5976.385	.000	.967	5976.385	1.000
	AVG.FP	1571.387	1	1571.387	5552.957	.000	.965	5552.957	1.000
	AVG.MP	1561.700	1	1561.700	6131.261	.000	.968	6131.261	1.000
	AVG.NFP	1515.308	1	1515.308	5853.016	.000	.967	5853.016	1.000
	AVG.OP	1613.342	1	1613.342	4819.502	.000	.960	4819.502	1.000
TPM.impl.lvl	AVG.WR	6.619	2	3.310	11.669	.000	.104	23.338	.994
	AVG.FP	5.844	2	2.922	10.326	.000	.093	20.651	.987
	AVG.MP	7.005	2	3.502	13.751	.000	.120	27.502	.998
	AVG.NFP	9.240	2	4.620	17.845	.000	.151	35.690	1.000
	AVG.OP	12.502	2	6.251	18.674	.000	.157	37.348	1.000
Error	AVG.WR	57.009	201	.284					
	AVG.FP	56.879	201	.283					
	AVG.MP	51.197	201	.255					
	AVG.NFP	52.038	201	.259					
	AVG.OP	67.285	201	.335					
Total	AVG.WR	2638.800	204						
	AVG.FP	2428.222	204						
	AVG.MP	2414.063	204						
	AVG.NFP	2361.400	204						
	AVG.OP	2563.063	204						
Corrected Total	AVG.WR	63.628	203						
	AVG.FP	62.723	203						
	AVG.MP	58.202	203						
	AVG.NFP	61.277	203						
	AVG.OP	79.788	203						

a. R Squared = .104 (Adjusted R Squared = .095)

b. R Squared = .093 (Adjusted R Squared = .084)
c. R Squared = .120 (Adjusted R Squared = .112)
d. R Squared = .151 (Adjusted R Squared = .142)
e. R Squared = .157 (Adjusted R Squared = .148)
f. Computed using alpha = .05

Oneway

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
AVG.WR	2.756	2	201	.066
AVG.FP	.995	2	201	.372
AVG.MP	1.976	2	201	.141
AVG.NFP	.640	2	201	.528
AVG.OP	.378	2	201	.685

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
AVG.WR	Between Groups	6.619	2	3.310	11.669	.000
	Within Groups	57.009	201	.284		
	Total	63.628	203			
AVG.FP	Between Groups	5.844	2	2.922	10.326	.000
	Within Groups	56.879	201	.283		
	Total	62.723	203			
AVG.MP	Between Groups	7.005	2	3.502	13.751	.000
	Within Groups	51.197	201	.255		
	Total	58.202	203			
AVG.NFP	Between Groups	9.240	2	4.620	17.845	.000
	Within Groups	52.038	201	.259		
	Total	61.277	203			
AVG.OP	Between Groups	12.502	2	6.251	18.674	.000
	Within Groups	67.285	201	.335		
	Total	79.788	203			

Robust Tests of Equality of Means

		Statistic[a]	df1	df2	Sig.
AVG.WR	Welch	9.103	2	62.466	.000
AVG.FP	Welch	9.495	2	63.346	.000
AVG.MP	Welch	15.136	2	67.727	.000
AVG.NFP	Welch	20.297	2	68.748	.000
AVG.OP	Welch	20.829	2	67.557	.000

a. Asymptotically F distributed.

Post Hoc Tests

Multiple Comparisons

Dependent Variable		(I) TPM.impl.lvl	(J) TPM.impl.lvl	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
AVG.WR	Tukey HSD	Non implementers	Transitional Implementers	-.45100*	.11529	.000	-.7232	-.1788
			Full Implementers	-.60326*	.12536	.000	-.8993	-.3073
		Transitional Implementers	Non implementers	.45100*	.11529	.000	.1788	.7232
			Full Implementers	-.15226	.08480	.174	-.3525	.0480
		Full Implementers	Non implementers	.60326*	.12536	.000	.3073	.8993

			Transitional Implementers	.15226	.08480	.174	-.0480	.3525
	Games-Howell	Non implementers	Transitional Implementers	-.45100*	.13400	.005	-.7799	-.1221
			Full Implementers	-.60326*	.14102	.000	-.9468	-.2597
		Transitional Implementers	Non implementers	.45100*	.13400	.005	.1221	.7799
			Full Implementers	-.15226	.08086	.148	-.3441	.0396
		Full Implementers	Non implementers	.60326*	.14102	.000	.2597	.9468
			Transitional Implementers	.15226	.08086	.148	-.0396	.3441
AVG.FP	Tukey HSD	Non implementers	Transitional Implementers	-.36932*	.11516	.004	-.6412	-.0974
			Full Implementers	-.56758*	.12522	.000	-.8633	-.2719
		Transitional Implementers	Non implementers	.36932*	.11516	.004	.0974	.6412
			Full Implementers	-.19826	.08470	.053	-.3983	.0017
		Full Implementers	Non implementers	.56758*	.12522	.000	.2719	.8633
			Transitional Implementers	.19826	.08470	.053	-.0017	.3983
	Games-Howell	Non implementers	Transitional Implementers	-.36932*	.11231	.006	-.6441	-.0946
			Full Implementers	-.56758*	.12966	.000	-.8799	-.2553
		Transitional Implementers	Non implementers	.36932*	.11231	.006	.0946	.6441
			Full Implementers	-.19826	.09099	.080	-.4148	.0183
		Full Implementers	Non implementers	.56758*	.12966	.000	.2553	.8799
			Transitional Implementers	.19826	.09099	.080	-.0183	.4148
AVG.MP	Tukey HSD	Non implementers	Transitional Implementers	-.39197*	.10926	.001	-.6499	-.1340
			Full Implementers	-.61978*	.11880	.000	-.9003	-.3393
		Transitional Implementers	Non implementers	.39197*	.10926	.001	.1340	.6499
			Full Implementers	-.22782*	.08036	.014	-.4176	-.0381
		Full Implementers	Non implementers	.61978*	.11880	.000	.3393	.9003
			Transitional Implementers	.22782*	.08036	.014	.0381	.4176
	Games-Howell	Non implementers	Transitional Implementers	-.39197*	.09710	.001	-.6283	-.1556
			Full Implementers	-.61978*	.11240	.000	-.8899	-.3497
		Transitional Implementers	Non implementers	.39197*	.09710	.001	.1556	.6283
			Full Implementers	-.22782*	.08521	.024	-.4304	-.0252
		Full Implementers	Non implementers	.61978*	.11240	.000	.3497	.8899
			Transitional Implementers	.22782*	.08521	.024	.0252	.4304
AVG.NFP	Tukey HSD	Non implementers	Transitional Implementers	-.44551*	.11015	.000	-.7056	-.1854
			Full Implementers	-.71108*	.11977	.000	-.9939	-.4283
		Transitional Implementers	Non implementers	.44551*	.11015	.000	.1854	.7056
			Full Implementers	-.26557*	.08102	.004	-.4569	-.0743
		Full Implementers	Non implementers	.71108*	.11977	.000	.4283	.9939
			Transitional Implementers	.26557*	.08102	.004	.0743	.4569
	Games-Howell	Non implementers	Transitional Implementers	-.44551*	.09783	.000	-.6834	-.2076
			Full Implementers	-.71108*	.11116	.000	-.9784	-.4437
		Transitional Implementers	Non implementers	.44551*	.09783	.000	.2076	.6834
			Full Implementers	-.26557*	.08427	.006	-.4658	-.0653
		Full Implementers	Non implementers	.71108*	.11116	.000	.4437	.9784
			Transitional Implementers	.26557*	.08427	.006	.0653	.4658

AVG.OP	Tukey HSD	Non implementers	Transitional Implementers	-.57393*	.12525	.000	-.8697	-.2782
			Full Implementers	-.83230*	.13619	.000	-1.1539	-.5107
		Transitional Implementers	Non implementers	.57393*	.12525	.000	.2782	.8697
			Full Implementers	-.25837*	.09212	.015	-.4759	-.0408
		Full Implementers	Non implementers	.83230*	.13619	.000	.5107	1.1539
			Transitional Implementers	.25837*	.09212	.015	.0408	.4759
	Games-Howell	Non implementers	Transitional Implementers	-.57393*	.11360	.000	-.8505	-.2973
			Full Implementers	-.83230*	.12937	.000	-1.1436	-.5210
		Transitional Implementers	Non implementers	.57393*	.11360	.000	.2973	.8505
			Full Implementers	-.25837*	.09633	.023	-.4873	-.0294
		Full Implementers	Non implementers	.83230*	.12937	.000	.5210	1.1436
			Transitional Implementers	.25837*	.09633	.023	.0294	.4873

*. The mean difference is significant at the 0.05 level.

Appendix C12: SPSS Output of MANOVA Test of QM

General Linear Model

Between-Subjects Factors

		Value Label	N
QM.impl.lvl	1.00	Non implementers	24
	2.00	Transitional Implementers	129
	3.00	Full Implementers	51

Descriptive Statistics

	QM.impl.lvl	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.1417	.61709	24
	Transitional Implementers	3.5318	.53239	129
	Full Implementers	3.8000	.47666	51
	Total	3.5529	.55986	204
AVG.FP	Non implementers	2.9861	.51527	24
	Transitional Implementers	3.3592	.51305	129
	Full Implementers	3.7190	.51800	51
	Total	3.4052	.55586	204
AVG.MP	Non implementers	2.8958	.43562	24
	Transitional Implementers	3.3450	.49033	129
	Full Implementers	3.7696	.43830	51
	Total	3.3983	.53545	204
AVG.NFP	Non implementers	2.9250	.37677	24
	Transitional Implementers	3.3054	.52146	129
	Full Implementers	3.6941	.50176	51
	Total	3.3578	.54942	204
AVG.OP	Non implementers	2.8542	.58475	24
	Transitional Implementers	3.4496	.54877	129
	Full Implementers	3.8873	.55523	51
	Total	3.4890	.62693	204

Box's Test of Equality of Covariance Matrices[a]

Box's M	36.502
F	1.143
df1	30
df2	16376.192
Sig.	.270

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + QM.impl.lvl

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.980	1933.231[b]	5.000	197.000	.000	.980	9666.153	1.000
	Wilks' Lambda	.020	1933.231[b]	5.000	197.000	.000	.980	9666.153	1.000
	Hotelling's Trace	49.067	1933.231[b]	5.000	197.000	.000	.980	9666.153	1.000
	Roy's Largest Root	49.067	1933.231[b]	5.000	197.000	.000	.980	9666.153	1.000

QM.impl.lvl	Pillai's Trace	.308	7.214	10.000	396.000	.000	.154	72.142	1.000
	Wilks' Lambda	.694	7.905[b]	10.000	394.000	.000	.167	79.047	1.000
	Hotelling's Trace	.439	8.599	10.000	392.000	.000	.180	85.991	1.000
	Roy's Largest Root	.432	17.120[c]	5.000	198.000	.000	.302	85.598	1.000

a. Design: Intercept + QM.impl.lvl
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AVG.WR	2.196	2	201	.114
AVG.FP	.156	2	201	.855
AVG.MP	1.964	2	201	.143
AVG.NFP	1.718	2	201	.182
AVG.OP	.312	2	201	.733

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + QM.impl.lvl

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[f]
Corrected Model	AVG.WR	7.230[a]	2	3.615	12.884	.000	.114	25.768	.997
	AVG.FP	9.509[b]	2	4.755	17.959	.000	.152	35.917	1.000
	AVG.MP	13.458[c]	2	6.729	30.227	.000	.231	60.455	1.000
	AVG.NFP	10.618[d]	2	5.309	21.064	.000	.173	42.129	1.000
	AVG.OP	17.961[e]	2	8.981	29.197	.000	.225	58.393	1.000
Intercept	AVG.WR	1589.147	1	1589.147	5663.647	.000	.966	5663.647	1.000
	AVG.FP	1467.393	1	1467.393	5542.611	.000	.965	5542.611	1.000
	AVG.MP	1451.736	1	1451.736	6521.490	.000	.970	6521.490	1.000
	AVG.NFP	1426.940	1	1426.940	5661.628	.000	.966	5661.628	1.000
	AVG.OP	1504.600	1	1504.600	4891.521	.000	.961	4891.521	1.000
QM.impl.lvl	AVG.WR	7.230	2	3.615	12.884	.000	.114	25.768	.997
	AVG.FP	9.509	2	4.755	17.959	.000	.152	35.917	1.000
	AVG.MP	13.458	2	6.729	30.227	.000	.231	60.455	1.000
	AVG.NFP	10.618	2	5.309	21.064	.000	.173	42.129	1.000
	AVG.OP	17.961	2	8.981	29.197	.000	.225	58.393	1.000
Error	AVG.WR	56.398	201	.281					
	AVG.FP	53.214	201	.265					
	AVG.MP	44.744	201	.223					
	AVG.NFP	50.659	201	.252					
	AVG.OP	61.826	201	.308					
Total	AVG.WR	2638.800	204						
	AVG.FP	2428.222	204						
	AVG.MP	2414.063	204						
	AVG.NFP	2361.400	204						
	AVG.OP	2563.063	204						
Corrected Total	AVG.WR	63.628	203						
	AVG.FP	62.723	203						
	AVG.MP	58.202	203						
	AVG.NFP	61.277	203						
	AVG.OP	79.788	203						

a. R Squared = .114 (Adjusted R Squared = .105)

b. R Squared = .152 (Adjusted R Squared = .143)
c. R Squared = .231 (Adjusted R Squared = .224)
d. R Squared = .173 (Adjusted R Squared = .165)
e. R Squared = .225 (Adjusted R Squared = .217)
f. Computed using alpha = .05

Post Hoc Tests
Multiple Comparisons
Tukey HSD

Dependent Variable	(I) QM.impl.lvl	(J) QM.impl.lvl	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
AVG.WR	Non implementers	Transitional Implementers	-.3901*	.11775	.003	-.6682	-.1121
		Full Implementers	-.6583*	.13112	.000	-.9679	-.3487
	Transitional Implementers	Non implementers	.3901*	.11775	.003	.1121	.6682
		Full Implementers	-.2682*	.08762	.007	-.4751	-.0613
	Full Implementers	Non implementers	.6583*	.13112	.000	.3487	.9679
		Transitional Implementers	.2682*	.08762	.007	.0613	.4751
AVG.FP	Non implementers	Transitional Implementers	-.3731*	.11438	.004	-.6431	-.1030
		Full Implementers	-.7328*	.12737	.000	-1.0336	-.4321
	Transitional Implementers	Non implementers	.3731*	.11438	.004	.1030	.6431
		Full Implementers	-.3598*	.08511	.000	-.5607	-.1588
	Full Implementers	Non implementers	.7328*	.12737	.000	.4321	1.0336
		Transitional Implementers	.3598*	.08511	.000	.1588	.5607
AVG.MP	Non implementers	Transitional Implementers	-.4491*	.10489	.000	-.6968	-.2015
		Full Implementers	-.8738*	.11679	.000	-1.1495	-.5980
	Transitional Implementers	Non implementers	.4491*	.10489	.000	.2015	.6968
		Full Implementers	-.4246*	.07804	.000	-.6089	-.2404
	Full Implementers	Non implementers	.8738*	.11679	.000	.5980	1.1495
		Transitional Implementers	.4246*	.07804	.000	.2404	.6089
AVG.NFP	Non implementers	Transitional Implementers	-.3804*	.11160	.002	-.6439	-.1169
		Full Implementers	-.7691*	.12427	.000	-1.0625	-.4757
	Transitional Implementers	Non implementers	.3804*	.11160	.002	.1169	.6439
		Full Implementers	-.3887*	.08304	.000	-.5848	-.1926
	Full Implementers	Non implementers	.7691*	.12427	.000	.4757	1.0625
		Transitional Implementers	.3887*	.08304	.000	.1926	.5848
AVG.OP	Non implementers	Transitional Implementers	-.5954*	.12329	.000	-.8866	-.3043
		Full Implementers	-1.0331*	.13729	.000	-1.3573	-.7089
	Transitional Implementers	Non implementers	.5954*	.12329	.000	.3043	.8866
		Full Implementers	-.4376*	.09174	.000	-.6543	-.2210
	Full Implementers	Non implementers	1.0331*	.13729	.000	.7089	1.3573
		Transitional Implementers	.4376*	.09174	.000	.2210	.6543

Based on observed means.
The error term is Mean Square(Error) = .308.
*. The mean difference is significant at the .05 level.

Appendix C13: SPSS Output of MANOVA Test of PS

General Linear Model

Between-Subjects Factors

		Value Label	N
PS.impl.lvl	1.00	Non implementers	53
	2.00	Transitional Implementers	131
	3.00	Full Implementers	20

Descriptive Statistics

	PS.impl.lvl	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.3962	.54981	53
	Transitional Implementers	3.5832	.55472	131
	Full Implementers	3.7700	.54008	20
	Total	3.5529	.55986	204
AVG.FP	Non implementers	3.2453	.48106	53
	Transitional Implementers	3.4198	.55714	131
	Full Implementers	3.7333	.59824	20
	Total	3.4052	.55586	204
AVG.MP	Non implementers	3.2689	.46732	53
	Transitional Implementers	3.3855	.54707	131
	Full Implementers	3.8250	.42224	20
	Total	3.3983	.53545	204
AVG.NFP	Non implementers	3.1509	.47702	53
	Transitional Implementers	3.3618	.54975	131
	Full Implementers	3.8800	.35777	20
	Total	3.3578	.54942	204
AVG.OP	Non implementers	3.1887	.53687	53
	Transitional Implementers	3.5496	.60082	131
	Full Implementers	3.8875	.70466	20
	Total	3.4890	.62693	204

Box's Test of Equality of Covariance Matrices[a]

Box's M	52.634
F	1.633
df1	30
df2	10624.141
Sig.	.016

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + PS.impl.lvl

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.975	1561.949[b]	5.000	197.000	.000	.975	7809.746	1.000
	Wilks' Lambda	.025	1561.949[b]	5.000	197.000	.000	.975	7809.746	1.000
	Hotelling's Trace	39.643	1561.949[b]	5.000	197.000	.000	.975	7809.746	1.000
	Roy's Largest Root	39.643	1561.949[b]	5.000	197.000	.000	.975	7809.746	1.000
PS.impl.lvl	Pillai's Trace	.188	4.120	10.000	396.000	.000	.094	41.197	.998

	Wilks' Lambda	.817	4.192[b]	10.000	394.000	.000	.096	41.916	.999
	Hotelling's Trace	.217	4.263	10.000	392.000	.000	.098	42.629	.999
	Roy's Largest Root	.181	7.170[c]	5.000	198.000	.000	.153	35.849	.999

a. Design: Intercept + PS.impl.lvl
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[f]
Corrected Model	AVG.WR	2.364[a]	2	1.182	3.878	.022	.037	7.756	.696
	AVG.FP	3.537[b]	2	1.768	6.006	.003	.056	12.012	.878
	AVG.MP	4.551[c]	2	2.275	8.525	.000	.078	17.049	.965
	AVG.NFP	7.724[d]	2	3.862	14.495	.000	.126	28.989	.999
	AVG.OP	8.438[e]	2	4.219	11.885	.000	.106	23.770	.994
Intercept	AVG.WR	1510.432	1	1510.432	4955.525	.000	.961	4955.525	1.000
	AVG.FP	1413.411	1	1413.411	4800.015	.000	.960	4800.015	1.000
	AVG.MP	1435.489	1	1435.489	5377.959	.000	.964	5377.959	1.000
	AVG.NFP	1411.865	1	1411.865	5299.078	.000	.963	5299.078	1.000
	AVG.OP	1475.887	1	1475.887	4157.715	.000	.954	4157.715	1.000
PS.impl.lvl	AVG.WR	2.364	2	1.182	3.878	.022	.037	7.756	.696
	AVG.FP	3.537	2	1.768	6.006	.003	.056	12.012	.878
	AVG.MP	4.551	2	2.275	8.525	.000	.078	17.049	.965
	AVG.NFP	7.724	2	3.862	14.495	.000	.126	28.989	.999
	AVG.OP	8.438	2	4.219	11.885	.000	.106	23.770	.994
Error	AVG.WR	61.264	201	.305					
	AVG.FP	59.186	201	.294					
	AVG.MP	53.651	201	.267					
	AVG.NFP	53.554	201	.266					
	AVG.OP	71.350	201	.355					
Total	AVG.WR	2638.800	204						
	AVG.FP	2428.222	204						
	AVG.MP	2414.063	204						
	AVG.NFP	2361.400	204						
	AVG.OP	2563.063	204						
Corrected Total	AVG.WR	63.628	203						
	AVG.FP	62.723	203						
	AVG.MP	58.202	203						
	AVG.NFP	61.277	203						
	AVG.OP	79.788	203						

a. R Squared = .037 (Adjusted R Squared = .028)
b. R Squared = .056 (Adjusted R Squared = .047)
c. R Squared = .078 (Adjusted R Squared = .069)
d. R Squared = .126 (Adjusted R Squared = .117)
e. R Squared = .106 (Adjusted R Squared = .097)
f. Computed using alpha = .05

Multiple Comparisons
Tukey HSD

Dependent Variable	(I) PS.impl.lvl	(J) PS.impl.lvl	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound

AVG.WR	Non implementers	Transitional Implementers	-.1870	.08988	.096	-.3992	.0252
		Full Implementers	-.3738*	.14488	.028	-.7159	-.0317
	Transitional Implementers	Non implementers	.1870	.08988	.096	-.0252	.3992
		Full Implementers	-.1868	.13254	.338	-.4997	.1262
	Full Implementers	Non implementers	.3738*	.14488	.028	.0317	.7159
		Transitional Implementers	.1868	.13254	.338	-.1262	.4997
AVG.FP	Non implementers	Transitional Implementers	-.1746	.08834	.121	-.3831	.0340
		Full Implementers	-.4881*	.14240	.002	-.8243	-.1518
	Transitional Implementers	Non implementers	.1746	.08834	.121	-.0340	.3831
		Full Implementers	-.3135*	.13027	.045	-.6211	-.0059
	Full Implementers	Non implementers	.4881*	.14240	.002	.1518	.8243
		Transitional Implementers	.3135*	.13027	.045	.0059	.6211
AVG.MP	Non implementers	Transitional Implementers	-.1166	.08411	.350	-.3152	.0820
		Full Implementers	-.5561*	.13558	.000	-.8763	-.2360
	Transitional Implementers	Non implementers	.1166	.08411	.350	-.0820	.3152
		Full Implementers	-.4395*	.12403	.001	-.7324	-.1466
	Full Implementers	Non implementers	.5561*	.13558	.000	.2360	.8763
		Transitional Implementers	.4395*	.12403	.001	.1466	.7324
AVG.NFP	Non implementers	Transitional Implementers	-.2109*	.08403	.034	-.4093	-.0125
		Full Implementers	-.7291*	.13546	.000	-1.0489	-.4092
	Transitional Implementers	Non implementers	.2109*	.08403	.034	.0125	.4093
		Full Implementers	-.5182*	.12392	.000	-.8108	-.2256
	Full Implementers	Non implementers	.7291*	.13546	.000	.4092	1.0489
		Transitional Implementers	.5182*	.12392	.000	.2256	.8108
AVG.OP	Non implementers	Transitional Implementers	-.3609*	.09699	.001	-.5900	-.1319
		Full Implementers	-.6988*	.15635	.000	-1.0680	-.3296
	Transitional Implementers	Non implementers	.3609*	.09699	.001	.1319	.5900

		Full Implementers	-.3379*	.14303	.050	-.6756	-.0002
	Full Implementers	Non implementers	.6988*	.15635	.000	.3296	1.0680
		Transitional Implementers	.3379*	.14303	.050	.0002	.6756

Based on observed means.
The error term is Mean Square(Error) = .355.
*. The mean difference is significant at the .05 level.

Appendix C14: SPSS output of MANOVA Test of CI

General Linear Model

Between-Subjects Factors

		Value Label	N
CI.impl.lvl	1.00	Non implementers	22
	2.00	Transitional Implementers	98
	3.00	Full Implementers	84

Descriptive Statistics

	CI.impl.lvl	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.3091	.60388	22
	Transitional Implementers	3.4673	.56418	98
	Full Implementers	3.7167	.50080	84
	Total	3.5529	.55986	204
AVG.FP	Non implementers	3.1212	.49916	22
	Transitional Implementers	3.3367	.56733	98
	Full Implementers	3.5595	.51526	84
	Total	3.4052	.55586	204
AVG.MP	Non implementers	3.1023	.44091	22
	Transitional Implementers	3.2296	.51357	98
	Full Implementers	3.6726	.45914	84
	Total	3.3983	.53545	204
AVG.NFP	Non implementers	3.0545	.50965	22
	Transitional Implementers	3.2449	.52448	98
	Full Implementers	3.5690	.51624	84
	Total	3.3578	.54942	204
AVG.OP	Non implementers	3.1023	.67989	22
	Transitional Implementers	3.3291	.55682	98
	Full Implementers	3.7768	.57301	84
	Total	3.4890	.62693	204

Box's Test of Equality of Covariance Matrices[a]

Box's M	36.619
F	1.147
df1	30
df2	12895.271
Sig.	.265

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + CI.impl.lvl

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.978	1749.460[b]	5.000	197.000	.000	.978	8747.298	1.000
	Wilks' Lambda	.022	1749.460[b]	5.000	197.000	.000	.978	8747.298	1.000
	Hotelling's Trace	44.403	1749.460[b]	5.000	197.000	.000	.978	8747.298	1.000

	Roy's Largest Root	44.403	1749.460[b]	5.000	197.000	.000	.978	8747.298	1.000
CI.impl.lvl	Pillai's Trace	.241	5.438	10.000	396.000	.000	.121	54.378	1.000
	Wilks' Lambda	.761	5.762[b]	10.000	394.000	.000	.128	57.616	1.000
	Hotelling's Trace	.310	6.085	10.000	392.000	.000	.134	60.846	1.000
	Roy's Largest Root	.299	11.841[c]	5.000	198.000	.000	.230	59.206	1.000

a. Design: Intercept + CI.impl.lvl
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AVG.WR	1.205	2	201	.302
AVG.FP	1.122	2	201	.328
AVG.MP	.793	2	201	.454
AVG.NFP	.018	2	201	.982
AVG.OP	.720	2	201	.488

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + CI.impl.lvl

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[f]
Corrected Model	AVG.WR	4.278[a]	2	2.139	7.244	.001	.067	14.488	.933
	AVG.FP	4.234[b]	2	2.117	7.275	.001	.068	14.551	.934
	AVG.MP	11.038[c]	2	5.519	23.521	.000	.190	47.043	1.000
	AVG.NFP	7.021[d]	2	3.510	13.005	.000	.115	26.010	.997
	AVG.OP	12.753[e]	2	6.377	19.120	.000	.160	38.241	1.000
Intercept	AVG.WR	1629.658	1	1629.658	5519.113	.000	.965	5519.113	1.000
	AVG.FP	1485.268	1	1485.268	5104.176	.000	.962	5104.176	1.000
	AVG.MP	1481.419	1	1481.419	6313.455	.000	.969	6313.455	1.000
	AVG.NFP	1441.418	1	1441.418	5339.913	.000	.964	5339.913	1.000
	AVG.OP	1542.346	1	1542.346	4624.675	.000	.958	4624.675	1.000
CI.impl.lvl	AVG.WR	4.278	2	2.139	7.244	.001	.067	14.488	.933
	AVG.FP	4.234	2	2.117	7.275	.001	.068	14.551	.934
	AVG.MP	11.038	2	5.519	23.521	.000	.190	47.043	1.000
	AVG.NFP	7.021	2	3.510	13.005	.000	.115	26.010	.997
	AVG.OP	12.753	2	6.377	19.120	.000	.160	38.241	1.000
Error	AVG.WR	59.350	201	.295					
	AVG.FP	58.489	201	.291					
	AVG.MP	47.164	201	.235					
	AVG.NFP	54.257	201	.270					
	AVG.OP	67.034	201	.334					
Total	AVG.WR	2638.800	204						
	AVG.FP	2428.222	204						
	AVG.MP	2414.063	204						
	AVG.NFP	2361.400	204						
	AVG.OP	2563.063	204						
Corrected Total	AVG.WR	63.628	203						
	AVG.FP	62.723	203						
	AVG.MP	58.202	203						
	AVG.NFP	61.277	203						
	AVG.OP	79.788	203						

a. R Squared = .067 (Adjusted R Squared = .058)
b. R Squared = .068 (Adjusted R Squared = .058)
c. R Squared = .190 (Adjusted R Squared = .182)
d. R Squared = .115 (Adjusted R Squared = .106)
e. R Squared = .160 (Adjusted R Squared = .151)
f. Computed using alpha = .05

Post Hoc Tests
CI.impl.lvl

Multiple Comparisons
Tukey HSD

Dependent Variable	(I) CI.impl.lvl	(J) CI.impl.lvl	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
AVG.WR	Non implementers	Transitional Implementers	-.1583	.12820	.434	-.4610	.1444
		Full Implementers	-.4076*	.13014	.006	-.7149	-.1003
	Transitional Implementers	Non implementers	.1583	.12820	.434	-.1444	.4610
		Full Implementers	-.2493*	.08080	.007	-.4401	-.0585
	Full Implementers	Non implementers	.4076*	.13014	.006	.1003	.7149
		Transitional Implementers	.2493*	.08080	.007	.0585	.4401
AVG.FP	Non implementers	Transitional Implementers	-.2155	.12726	.210	-.5160	.0850
		Full Implementers	-.4383*	.12919	.002	-.7434	-.1333
	Transitional Implementers	Non implementers	.2155	.12726	.210	-.0850	.5160
		Full Implementers	-.2228*	.08021	.016	-.4122	-.0334
	Full Implementers	Non implementers	.4383*	.12919	.002	.1333	.7434
		Transitional Implementers	.2228*	.08021	.016	.0334	.4122
AVG.MP	Non implementers	Transitional Implementers	-.1273	.11428	.506	-.3972	.1425
		Full Implementers	-.5703*	.11601	.000	-.8443	-.2964
	Transitional Implementers	Non implementers	.1273	.11428	.506	-.1425	.3972
		Full Implementers	-.4430*	.07203	.000	-.6131	-.2730
	Full Implementers	Non implementers	.5703*	.11601	.000	.2964	.8443
		Transitional Implementers	.4430*	.07203	.000	.2730	.6131
AVG.NFP	Non implementers	Transitional Implementers	-.1904	.12257	.269	-.4798	.0991
		Full Implementers	-.5145*	.12443	.000	-.8083	-.2207
	Transitional Implementers	Non implementers	.1904	.12257	.269	-.0991	.4798
		Full Implementers	-.3241*	.07725	.000	-.5066	-.1417
	Full Implementers	Non implementers	.5145*	.12443	.000	.2207	.8083
		Transitional Implementers	.3241*	.07725	.000	.1417	.5066
AVG.OP	Non implementers	Transitional Implementers	-.2268	.13624	.221	-.5485	.0949
		Full Implementers	-.6745*	.13831	.000	-1.0011	-.3479
	Transitional Implementers	Non implementers	.2268	.13624	.221	-.0949	.5485
		Full Implementers	-.4477*	.08587	.000	-.6505	-.2450
	Full Implementers	Non implementers	.6745*	.13831	.000	.3479	1.0011
		Transitional Implementers	.4477*	.08587	.000	.2450	.6505

Based on observed means.
The error term is Mean Square(Error) = .334.
*. The mean difference is significant at the .05 level.

Appendix C15: SPSS Output of MANOVA Test of DCN

General Linear Model

Between-Subjects Factors

		Value Label	N
DCN.impl.lvl	1.00	Non implementers	15
	2.00	Transitional Implementers	78
	3.00	Full Implementers	111

Descriptive Statistics

	DCN.impl.lvl	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.1867	.62091	15
	Transitional Implementers	3.4410	.57331	78
	Full Implementers	3.6811	.50552	111
	Total	3.5529	.55986	204
AVG.FP	Non implementers	3.0000	.56344	15
	Transitional Implementers	3.2991	.55981	78
	Full Implementers	3.5345	.51302	111
	Total	3.4052	.55586	204
AVG.MP	Non implementers	3.0500	.56852	15
	Transitional Implementers	3.2340	.51651	78
	Full Implementers	3.5608	.48876	111
	Total	3.3983	.53545	204
AVG.NFP	Non implementers	3.0267	.52300	15
	Transitional Implementers	3.2897	.52238	78
	Full Implementers	3.4505	.55167	111
	Total	3.3578	.54942	204
AVG.OP	Non implementers	3.0333	.66726	15
	Transitional Implementers	3.3654	.59310	78
	Full Implementers	3.6374	.60089	111
	Total	3.4890	.62693	204

Box's Test of Equality of Covariance Matrices[a]

Box's M	38.194
F	1.166
df1	30
df2	5127.746
Sig.	.245

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + DCN.impl.lvl

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.969	1220.078[b]	5.000	197.000	.000	.969	6100.388	1.000
	Wilks' Lambda	.031	1220.078[b]	5.000	197.000	.000	.969	6100.388	1.000
	Hotelling's Trace	30.966	1220.078[b]	5.000	197.000	.000	.969	6100.388	1.000
	Roy's Largest Root	30.966	1220.078[b]	5.000	197.000	.000	.969	6100.388	1.000
DCN.impl.lvl	Pillai's Trace	.150	3.222	10.000	396.000	.001	.075	32.224	.988

	Wilks' Lambda	.851	3.303[b]	10.000	394.000	.000	.077	33.034	.990
	Hotelling's Trace	.173	3.384	10.000	392.000	.000	.079	33.837	.991
	Roy's Largest Root	.160	6.321[c]	5.000	198.000	.000	.138	31.607	.996

a. Design: Intercept + DCN.impl.lvl
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AVG.WR	1.576	2	201	.209
AVG.FP	.535	2	201	.586
AVG.MP	.015	2	201	.985
AVG.NFP	.647	2	201	.524
AVG.OP	.081	2	201	.922

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + DCN.impl.lvl

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[f]
Corrected Model	AVG.WR	4.812[a]	2	2.406	8.222	.000	.076	16.444	.959
	AVG.FP	5.197[b]	2	2.598	9.079	.000	.083	18.158	.974
	AVG.MP	6.857[c]	2	3.429	13.422	.000	.118	26.845	.998
	AVG.NFP	2.959[d]	2	1.479	5.099	.007	.048	10.198	.817
	AVG.OP	6.750[e]	2	3.375	9.289	.000	.085	18.577	.976
Intercept	AVG.WR	1200.852	1	1200.852	4103.814	.000	.953	4103.814	1.000
	AVG.FP	1092.717	1	1092.717	3818.001	.000	.950	3818.001	1.000
	AVG.MP	1095.186	1	1095.186	4287.361	.000	.955	4287.361	1.000
	AVG.NFP	1077.917	1	1077.917	3715.133	.000	.949	3715.133	1.000
	AVG.OP	1138.167	1	1138.167	3132.259	.000	.940	3132.259	1.000
DCN.impl.lvl	AVG.WR	4.812	2	2.406	8.222	.000	.076	16.444	.959
	AVG.FP	5.197	2	2.598	9.079	.000	.083	18.158	.974
	AVG.MP	6.857	2	3.429	13.422	.000	.118	26.845	.998
	AVG.NFP	2.959	2	1.479	5.099	.007	.048	10.198	.817
	AVG.OP	6.750	2	3.375	9.289	.000	.085	18.577	.976
Error	AVG.WR	58.816	201	.293					
	AVG.FP	57.526	201	.286					
	AVG.MP	51.344	201	.255					
	AVG.NFP	58.319	201	.290					
	AVG.OP	73.037	201	.363					
Total	AVG.WR	2638.800	204						
	AVG.FP	2428.222	204						
	AVG.MP	2414.063	204						
	AVG.NFP	2361.400	204						
	AVG.OP	2563.063	204						
Corrected Total	AVG.WR	63.628	203						
	AVG.FP	62.723	203						
	AVG.MP	58.202	203						
	AVG.NFP	61.277	203						
	AVG.OP	79.788	203						

a. R Squared = .076 (Adjusted R Squared = .066)
b. R Squared = .083 (Adjusted R Squared = .074)

c. R Squared = .118 (Adjusted R Squared = .109)
d. R Squared = .048 (Adjusted R Squared = .039)
e. R Squared = .085 (Adjusted R Squared = .075)
f. Computed using alpha = .05

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) DCN.impl.lvl	(J) DCN.impl.lvl	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
AVG.WR	Non implementers	Transitional Implementers	-.2544	.15251	.220	-.6145	.1057
		Full Implementers	-.4944*	.14881	.003	-.8458	-.1430
	Transitional Implementers	Non implementers	.2544	.15251	.220	-.1057	.6145
		Full Implementers	-.2401*	.07992	.008	-.4288	-.0513
	Full Implementers	Non implementers	.4944*	.14881	.003	.1430	.8458
		Transitional Implementers	.2401*	.07992	.008	.0513	.4288
AVG.FP	Non implementers	Transitional Implementers	-.2991	.15083	.119	-.6553	.0570
		Full Implementers	-.5345*	.14717	.001	-.8820	-.1870
	Transitional Implementers	Non implementers	.2991	.15083	.119	-.0570	.6553
		Full Implementers	-.2354*	.07904	.009	-.4220	-.0488
	Full Implementers	Non implementers	.5345*	.14717	.001	.1870	.8820
		Transitional Implementers	.2354*	.07904	.009	.0488	.4220
AVG.MP	Non implementers	Transitional Implementers	-.1840	.14249	.402	-.5204	.1525
		Full Implementers	-.5108*	.13904	.001	-.8391	-.1825
	Transitional Implementers	Non implementers	.1840	.14249	.402	-.1525	.5204
		Full Implementers	-.3268*	.07467	.000	-.5032	-.1505
	Full Implementers	Non implementers	.5108*	.13904	.001	.1825	.8391
		Transitional Implementers	.3268*	.07467	.000	.1505	.5032
AVG.NFP	Non implementers	Transitional Implementers	-.2631	.15186	.196	-.6217	.0955
		Full Implementers	-.4238*	.14818	.013	-.7737	-.0739
	Transitional Implementers	Non implementers	.2631	.15186	.196	-.0955	.6217
		Full Implementers	-.1607	.07958	.110	-.3486	.0272
	Full Implementers	Non implementers	.4238*	.14818	.013	.0739	.7737
		Transitional Implementers	.1607	.07958	.110	-.0272	.3486

AVG.OP	Non implementers	Transitional Implementers	-.3321	.16995	.127	-.7333	.0692
		Full Implementers	-.6041*	.16583	.001	-.9956	-.2125
	Transitional Implementers	Non implementers	.3321	.16995	.127	-.0692	.7333
		Full Implementers	-.2720*	.08906	.007	-.4823	-.0617
	Full Implementers	Non implementers	.6041*	.16583	.001	.2125	.9956
		Transitional Implementers	.2720*	.08906	.007	.0617	.4823

Based on observed means.
The error term is Mean Square(Error) = .363.
*. The mean difference is significant at the .05 level.

Appendix C16: SPSS Output of MANOVA and ANOVA Tests for OLM

General Linear Model

Between-Subjects Factors

		Value Label	N
OLM	1.00	Non implementers	24
	2.00	Transitional Implementers	152
	3.00	Full Implementers	28

Descriptive Statistics

	OLM	Mean	Std. Deviation	N
AVG.WR	Non implementers	3.0250	.61943	24
	Transitional Implementers	3.5605	.51005	152
	Full Implementers	3.9643	.38893	28
	Total	3.5529	.55986	204
AVG.FP	Non implementers	2.8472	.47119	24
	Transitional Implementers	3.4232	.50014	152
	Full Implementers	3.7857	.55344	28
	Total	3.4052	.55586	204
AVG.MP	Non implementers	2.8125	.41865	24
	Transitional Implementers	3.3931	.48282	152
	Full Implementers	3.9286	.32530	28
	Total	3.3983	.53545	204
AVG.NFP	Non implementers	2.8750	.42040	24
	Transitional Implementers	3.3276	.50980	152
	Full Implementers	3.9357	.32684	28
	Total	3.3578	.54942	204
AVG.OP	Non implementers	2.8229	.54413	24
	Transitional Implementers	3.5016	.55827	152
	Full Implementers	3.9911	.55060	28
	Total	3.4890	.62693	204

Box's Test of Equality of Covariance Matrices[a]

Box's M	79.245
F	2.443
df1	30
df2	13779.695
Sig.	.000

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + OLM

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Intercept	Pillai's Trace	.979	1801.311[b]	5.000	197.000	.000	.979	9006.557	1.000
	Wilks' Lambda	.021	1801.311[b]	5.000	197.000	.000	.979	9006.557	1.000
	Hotelling's Trace	45.719	1801.311[b]	5.000	197.000	.000	.979	9006.557	1.000
	Roy's Largest Root	45.719	1801.311[b]	5.000	197.000	.000	.979	9006.557	1.000

OLM	Pillai's Trace	.378	9.229	10.000	396.000	.000	.189	92.293	1.000
	Wilks' Lambda	.632	10.159[b]	10.000	394.000	.000	.205	101.589	1.000
	Hotelling's Trace	.566	11.098	10.000	392.000	.000	.221	110.981	1.000
	Roy's Largest Root	.537	21.247[c]	5.000	198.000	.000	.349	106.233	1.000

a. Design: Intercept + OLM
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AVG.WR	4.424	2	201	.013
AVG.FP	.443	2	201	.642
AVG.MP	5.615	2	201	.004
AVG.NFP	3.140	2	201	.045
AVG.OP	.313	2	201	.731

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + OLM

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[f]
Corrected Model	AVG.WR	11.436[a]	2	5.718	22.020	.000	.180	44.041	1.000
	AVG.FP	11.576[b]	2	5.788	22.745	.000	.185	45.491	1.000
	AVG.MP	16.113[c]	2	8.057	38.476	.000	.277	76.951	1.000
	AVG.NFP	15.084[d]	2	7.542	32.818	.000	.246	65.636	1.000
	AVG.OP	17.730[e]	2	8.865	28.714	.000	.222	57.428	1.000
Intercept	AVG.WR	1325.615	1	1325.615	5105.120	.000	.962	5105.120	1.000
	AVG.FP	1204.465	1	1204.465	4733.319	.000	.959	4733.319	1.000
	AVG.MP	1223.218	1	1223.218	5841.644	.000	.967	5841.644	1.000
	AVG.NFP	1224.228	1	1224.228	5326.967	.000	.964	5326.967	1.000
	AVG.OP	1267.418	1	1267.418	4105.096	.000	.953	4105.096	1.000
OLM	AVG.WR	11.436	2	5.718	22.020	.000	.180	44.041	1.000
	AVG.FP	11.576	2	5.788	22.745	.000	.185	45.491	1.000
	AVG.MP	16.113	2	8.057	38.476	.000	.277	76.951	1.000
	AVG.NFP	15.084	2	7.542	32.818	.000	.246	65.636	1.000
	AVG.OP	17.730	2	8.865	28.714	.000	.222	57.428	1.000
Error	AVG.WR	52.192	201	.260					
	AVG.FP	51.148	201	.254					
	AVG.MP	42.089	201	.209					
	AVG.NFP	46.193	201	.230					
	AVG.OP	62.057	201	.309					
Total	AVG.WR	2638.800	204						
	AVG.FP	2428.222	204						
	AVG.MP	2414.063	204						
	AVG.NFP	2361.400	204						
	AVG.OP	2563.063	204						
Corrected Total	AVG.WR	63.628	203						
	AVG.FP	62.723	203						
	AVG.MP	58.202	203						
	AVG.NFP	61.277	203						
	AVG.OP	79.788	203						

a. R Squared = .180 (Adjusted R Squared = .172)
b. R Squared = .185 (Adjusted R Squared = .176)

c. R Squared = .277 (Adjusted R Squared = .270)
d. R Squared = .246 (Adjusted R Squared = .239)
e. R Squared = .222 (Adjusted R Squared = .214)
f. Computed using alpha = .05

Multiple Comparisons
Tukey HSD

Dependent Variable	(I) OLM	(J) OLM	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
AVG.WR	Non implementers	Transitional Implementers	-.5355*	.11193	.000	-.7998	-.2712
		Full Implementers	-.9393*	.14175	.000	-1.2740	-.6046
	Transitional Implementers	Non implementers	.5355*	.11193	.000	.2712	.7998
		Full Implementers	-.4038*	.10480	.000	-.6512	-.1563
	Full Implementers	Non implementers	.9393*	.14175	.000	.6046	1.2740
		Transitional Implementers	.4038*	.10480	.000	.1563	.6512
AVG.FP	Non implementers	Transitional Implementers	-.5760*	.11080	.000	-.8376	-.3144
		Full Implementers	-.9385*	.14032	.000	-1.2698	-.6072
	Transitional Implementers	Non implementers	.5760*	.11080	.000	.3144	.8376
		Full Implementers	-.3625*	.10374	.002	-.6074	-.1175
	Full Implementers	Non implementers	.9385*	.14032	.000	.6072	1.2698
		Transitional Implementers	.3625*	.10374	.002	.1175	.6074
AVG.MP	Non implementers	Transitional Implementers	-.5806*	.10051	.000	-.8179	-.3433
		Full Implementers	-1.1161*	.12729	.000	-1.4166	-.8155
	Transitional Implementers	Non implementers	.5806*	.10051	.000	.3433	.8179
		Full Implementers	-.5355*	.09411	.000	-.7577	-.3133
	Full Implementers	Non implementers	1.1161*	.12729	.000	.8155	1.4166
		Transitional Implementers	.5355*	.09411	.000	.3133	.7577
AVG.NFP	Non implementers	Transitional Implementers	-.4526*	.10530	.000	-.7013	-.2040
		Full Implementers	-1.0607*	.13335	.000	-1.3756	-.7458
	Transitional Implementers	Non implementers	.4526*	.10530	.000	.2040	.7013
		Full Implementers	-.6081*	.09859	.000	-.8409	-.3753
	Full Implementers	Non implementers	1.0607*	.13335	.000	.7458	1.3756
		Transitional Implementers	.6081*	.09859	.000	.3753	.8409
AVG.OP	Non implementers	Transitional Implementers	-.6787*	.12205	.000	-.9669	-.3905
		Full Implementers	-1.1682*	.15457	.000	-1.5331	-.8032
	Transitional Implementers	Non implementers	.6787*	.12205	.000	.3905	.9669
		Full Implementers	-.4894*	.11427	.000	-.7592	-.2196
	Full Implementers	Non implementers	1.1682*	.15457	.000	.8032	1.5331
		Transitional Implementers	.4894*	.11427	.000	.2196	.7592

Based on observed means.
The error term is Mean Square(Error) = .309.
*. The mean difference is significant at the .05 level.

Oneway OLM
Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
AVG.WR	4.424	2	201	.013

AVG.FP	.443	2	201	.642
AVG.MP	5.615	2	201	.004
AVG.NFP	3.140	2	201	.045
AVG.OP	.313	2	201	.731

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
AVG.WR	Between Groups	11.436	2	5.718	22.020	.000
	Within Groups	52.192	201	.260		
	Total	63.628	203			
AVG.FP	Between Groups	11.576	2	5.788	22.745	.000
	Within Groups	51.148	201	.254		
	Total	62.723	203			
AVG.MP	Between Groups	16.113	2	8.057	38.476	.000
	Within Groups	42.089	201	.209		
	Total	58.202	203			
AVG.NFP	Between Groups	15.084	2	7.542	32.818	.000
	Within Groups	46.193	201	.230		
	Total	61.277	203			
AVG.OP	Between Groups	17.730	2	8.865	28.714	.000
	Within Groups	62.057	201	.309		
	Total	79.788	203			

Robust Tests of Equality of Means

		Statistic[a]	df1	df2	Sig.
AVG.WR	Welch	22.693	2	44.325	.000
AVG.FP	Welch	23.055	2	42.914	.000
AVG.MP	Welch	58.381	2	48.802	.000
AVG.NFP	Welch	56.736	2	50.037	.000
AVG.OP	Welch	29.212	2	43.475	.000

a. Asymptotically F distributed.

Post Hoc Tests

Multiple Comparisons

Dependent Variable		(I) OLM	(J) OLM	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
AVG.WR	Tukey HSD	Non implementers	Transitional Implementers	-.53553*	.11193	.000	-.7998	-.2712
			Full Implementers	-.93929*	.14175	.000	-1.2740	-.6046
		Transitional Implementers	Non implementers	.53553*	.11193	.000	.2712	.7998
			Full Implementers	-.40376*	.10480	.000	-.6512	-.1563
		Full Implementers	Non implementers	.93929*	.14175	.000	.6046	1.2740
			Transitional Implementers	.40376*	.10480	.000	.1563	.6512
	Games-Howell	Non implementers	Transitional Implementers	-.53553*	.13304	.001	-.8646	-.2064
			Full Implementers	-.93929*	.14625	.000	-1.2962	-.5824
		Transitional Implementers	Non implementers	.53553*	.13304	.001	.2064	.8646
			Full Implementers	-.40376*	.08434	.000	-.6080	-.1995
		Full Implementers	Non implementers	.93929*	.14625	.000	.5824	1.2962
			Transitional Implementers	.40376*	.08434	.000	.1995	.6080
AVG.FP	Tukey HSD	Non implementers	Transitional Implementers	-.57602*	.11080	.000	-.8376	-.3144
			Full Implementers	-.93849*	.14032	.000	-1.2698	-.6072

		Transitional Implementers	Non implementers	.57602*	.11080	.000	.3144	.8376
			Full Implementers	-.36247*	.10374	.002	-.6074	-.1175
		Full Implementers	Non implementers	.93849*	.14032	.000	.6072	1.2698
			Transitional Implementers	.36247*	.10374	.002	.1175	.6074
	Games-Howell	Non implementers	Transitional Implementers	-.57602*	.10439	.000	-.8326	-.3194
			Full Implementers	-.93849*	.14209	.000	-1.2817	-.5953
		Transitional Implementers	Non implementers	.57602*	.10439	.000	.3194	.8326
			Full Implementers	-.36247*	.11218	.007	-.6368	-.0881
		Full Implementers	Non implementers	.93849*	.14209	.000	.5953	1.2817
			Transitional Implementers	.36247*	.11218	.007	.0881	.6368
AVG.MP	Tukey HSD	Non implementers	Transitional Implementers	-.58059*	.10051	.000	-.8179	-.3433
			Full Implementers	-1.11607*	.12729	.000	-1.4166	-.8155
		Transitional Implementers	Non implementers	.58059*	.10051	.000	.3433	.8179
			Full Implementers	-.53548*	.09411	.000	-.7577	-.3133
		Full Implementers	Non implementers	1.11607*	.12729	.000	.8155	1.4166
			Transitional Implementers	.53548*	.09411	.000	.3133	.7577
	Games-Howell	Non implementers	Transitional Implementers	-.58059*	.09400	.000	-.8111	-.3501
			Full Implementers	-1.11607*	.10527	.000	-1.3716	-.8606
		Transitional Implementers	Non implementers	.58059*	.09400	.000	.3501	.8111
			Full Implementers	-.53548*	.07289	.000	-.7113	-.3596
		Full Implementers	Non implementers	1.11607*	.10527	.000	.8606	1.3716
			Transitional Implementers	.53548*	.07289	.000	.3596	.7113
AVG.NFP	Tukey HSD	Non implementers	Transitional Implementers	-.45263*	.10530	.000	-.7013	-.2040
			Full Implementers	-1.06071*	.13335	.000	-1.3756	-.7458
		Transitional Implementers	Non implementers	.45263*	.10530	.000	.2040	.7013
			Full Implementers	-.60808*	.09859	.000	-.8409	-.3753
		Full Implementers	Non implementers	1.06071*	.13335	.000	.7458	1.3756
			Transitional Implementers	.60808*	.09859	.000	.3753	.8409
	Games-Howell	Non implementers	Transitional Implementers	-.45263*	.09526	.000	-.6859	-.2194
			Full Implementers	-1.06071*	.10573	.000	-1.3173	-.8041
		Transitional Implementers	Non implementers	.45263*	.09526	.000	.2194	.6859
			Full Implementers	-.60808*	.07433	.000	-.7872	-.4290
		Full Implementers	Non implementers	1.06071*	.10573	.000	.8041	1.3173
			Transitional Implementers	.60808*	.07433	.000	.4290	.7872
AVG.OP	Tukey HSD	Non implementers	Transitional Implementers	-.67873*	.12205	.000	-.9669	-.3905

			Full Implementers	-1.16815*	.15457	.000	-1.5331	-.8032
		Transitional Implementers	Non implementers	.67873*	.12205	.000	.3905	.9669
			Full Implementers	-.48943*	.11427	.000	-.7592	-.2196
		Full Implementers	Non implementers	1.16815*	.15457	.000	.8032	1.5331
			Transitional Implementers	.48943*	.11427	.000	.2196	.7592
	Games-Howell	Non implementers	Transitional Implementers	-.67873*	.11995	.000	-.9739	-.3836
			Full Implementers	-1.16815*	.15220	.000	-1.5360	-.8003
		Transitional Implementers	Non implementers	.67873*	.11995	.000	.3836	.9739
			Full Implementers	-.48943*	.11348	.000	-.7662	-.2127
		Full Implementers	Non implementers	1.16815*	.15220	.000	.8003	1.5360
			Transitional Implementers	.48943*	.11348	.000	.2127	.7662

*. The mean difference is significant at the 0.05 level.