CHAPTER 1

INTRODUCTION

1.0 Introduction

Lean Manufacturing Management (LMM) is a management system that contains only required resources and materials, manufactures only required quantity of quality products on time that meet customers' demands. The idea behind LMM is Manufacturing Planning and Control (MPC) system of the materials and information flow which involve both Manufacturing Resources Planning (MRP II), and Just-in-Time (JIT) techniques. In addition, Total Quality Management (TQM) is integrated to ensure the quality of the processes and products of the system. The capabilities of continuously improving the processes by identifying and eliminating manufacturing wastes are essential for effectiveness of LMM. The main benefit of effective LMM is high ratio of quality to cost of the products manufactured which finally contribute to high profitable organisation.

Lean Manufacturing has evolved from production shop floor to the whole organisation and from the individual organisation to all organisations in the supply chain [Hines *et. al.* (2004)]. The term itself is also extended to the terms such as Lean Enterprise, Lean Design, Lean Product Development, Lean Thinking, Lean Consumption, Lean Solution, and Lean Supply Chain [Womack *et. al.* (1990), Lamming (1996), Womack and Jones (2003), Womack and Jones (2005a), Womack and Jones (2005b), Baines *et. al.* (2006)]. In this study,

Collaborative Lean Manufacturing Management (CLMM) is the term used for this enhanced LMM that covers all areas within and across the organisation in the supply and value chain.

1.1 Automotive Industry in Malaysia

Automotive industry in Malaysia began in 1960s with the openings of several car assembly factories in Selangor with the first car, Volvo *144* rolled off the line in 1967 [Volvo Malaysia (2005)]. The incorporation of PROTON (Acronym in Malaysian Language for ***Per****usahaan* ***Oto****mobil* ***N****asional* or National Automobile Enterprise) on 7 May 1983 and the introduction of *Proton Saga* model in 1985 proved that Malaysian government is committed to involve seriously in car manufacturing and heavy industry. Now, after more than 20 years, there are four national-status car companies, i.e. PROTON, PERODUA (***Per****usahaan* ***O****tomobil Ke****dua*** or Second Automobile Enterprise), INOKOM (***In****dustri* ***O****tomotif* ***Kom****ersial* or Commercial Automotive Industry) and NAZA (Naza Automotive Manufacturing). In addition to this, there are a number of foreign companies that assemble imported vehicles such as Ford, BMW, Mercedes-Benz, Volvo, Toyota, Honda, and Nissan.

Automotive industry is considered as one of highly profitable sector of the Malaysia's economy. Since its establishment in 1985, PROTON has proved to be a success project to the Malaysian government where it once controlled more than 60% of the car market in Malaysia [Ahmad (2003b)]. With this good achievement, the second national car company, PERODUA was incorporated in 1995, which focusing on the manufacturing of small and compact cars. It is also a successful project when PERODUA cars dominate the small car segment

market. The success of both companies is however contributed by the protection by the government, which introduces and imposes various taxes to the imported cars [Ahmad (2003a)].

In spite of this, and in the light of global business liberalisation, Common Effective Preferential Tariff (CEPT) of ASEAN (Association of South-East Asian Nations) Free Trade Area (AFTA) is introduced. Malaysia is committed to reducing import duties for motor vehicles to 20 percent effective from January 2005 and subsequently to maximum of five percent from January 2008. In order to enhance competitiveness of domestic automotive industry in meeting the challenges of AFTA market opening, when the car sector is phased-in into the CEPT scheme, this pre-emptive review of the car import duty structure has been undertaken [MITI (2003)]. The government needs to evaluate the future direction of national car industry that includes strategic partnership, pricing competitiveness, product quality and reliability, marketing (for local and export) and cost reduction (in production and distribution).

With the implementation of AFTA, many foreign carmakers entered the Malaysian market, including from Korea, India and China. For example, Hyundai from Korea made the most significant gain in market share by managing 3.3% of the total industry volume in 2005 although it only entered the Malaysian automotive scene in 2004 [Kamiso (2005)]. Market of national cars experienced a dip, for example PROTON's local market share fell to 29.7% in 2007 from 65% in 2000. This phenomenon had already been predicted eight years before when former Director of PROTON, Yoshimi Fumio said [after Sulong (2000)]:

"*When the ASEAN Free Trade Area (AFTA) provisions come into effect in 2005, the PROTON market share could fall to only 30%...*"

To stay competitive, PROTON has put efforts to improve the quality of cars and reduce the cost. The development of its *Campro* engine for *Proton Gen-2,* which reduces production cost of 10–15 % and the quality certification by world-class German Standardisation Board, TUV for *Proton Savvy* is among of the steps taken [Anonymous (2003)]. For PERODUA, to be more competitive in the future, the company management set it to undergo a major operational revamp by localisation programme and streamline their business activities, from manufacturing to sales. PERODUA is facing a very challenging period, having now to compete with more carmakers in the below 1,000cc category, where previously it was one of only a few players in the segment [Kamiso (2004)].

1.2 Problem Statement

In the light of globalisation and current competitive business environment, management should not only focus on the Lean Manufacturing within organisations, but also the Lean Manufacturing between the organisations in the supply chain. All members in the LMM chain from suppliers to customers must work together towards common objectives in order to make the Lean Manufacturing work effectively in the collaborative environment.

Although LMM is a system that improves competitiveness of the organisations, there are still problems related to it. The problems include suppliers' perception of being exploited, coping with product variability, and high pressure to shop floor workers [Cusumano (1994), Hines *et. al.* (2004)].

With the realisation that the Lean Manufacturing concept is not fully understood and adopted due to its business dynamic in nature, a frame work of CLMM is needed to investigate the gap between the practice and ideal system. Furthermore, people factors such as culture, openness, trust, willingness to change and commitment also play significant roles in the CLMM development.

1.3 Objectives

The problems stated in the previous section have motivated this research. The main objective of this research is to investigate the recent state of Lean Manufacturing philosophy practised in automotive industry and its supply chain, particularly in Malaysia. This research is also designed to capture the knowledge, understanding and culture within this industry community and to recommend the necessary actions which can be taken by the industry in developing and improving the CLMM. This main objective has led to the following systematically listed research objectives:

a) *Objective 1*: To design a conceptual model of CLMM: The model can be used to analyse the CLMM implementation in the automotive industry and its supply chain. The model integrates factors that represent particular issues such as internal and external lean chain, organisation competitive priorities and organisation resources that support the development of CLMM.

b) *Objective 2*: To convert the conceptual model into a hybrid Knowledge-Based (KB), Gauging Absences of Pre-Requisites (GAP), and Analytic Hierarchy Process (AHP) system: The conceptual model developed in the first objective then is converted into Knowledge-Based CLMM

(KBCLMM) structure. The KBCLMM structure is needed to enable the development of system using an expert system shell, and embed the GAP and AHP techniques in the KB system.

c) *Objective 3*: To verify and validate the KBCLMM by the use of published case studies and actual data from organisations within automotive industry in Malaysia: The developed KBCLMM then needs to be verified and validated to ensure the system works as planned, and has the capability in identifying and suggesting the areas that need improvement to support the development of CLMM.

d) *Objective 4*: To use the verification and validation results to improve the KB system: The KBCLMM System is then improved by using the results from the verification and validation process. Information retrieved from the organisations' data and knowledge gained from the interview with the experts can be used to improve the validity, reliability and consistency of the KBCLMM System.

e) *Objective 5*: To suggest future work based on the improved KB system: From the improved KB system, new research is recommended for future work.

1.4 Methodology

The methodology of this research is a combination of literature review, development of research model, detailed development of the strategic and operational of the KBCLMM System, and the verification and validation process. The methodology activities flow is shown in Figure 1.1.

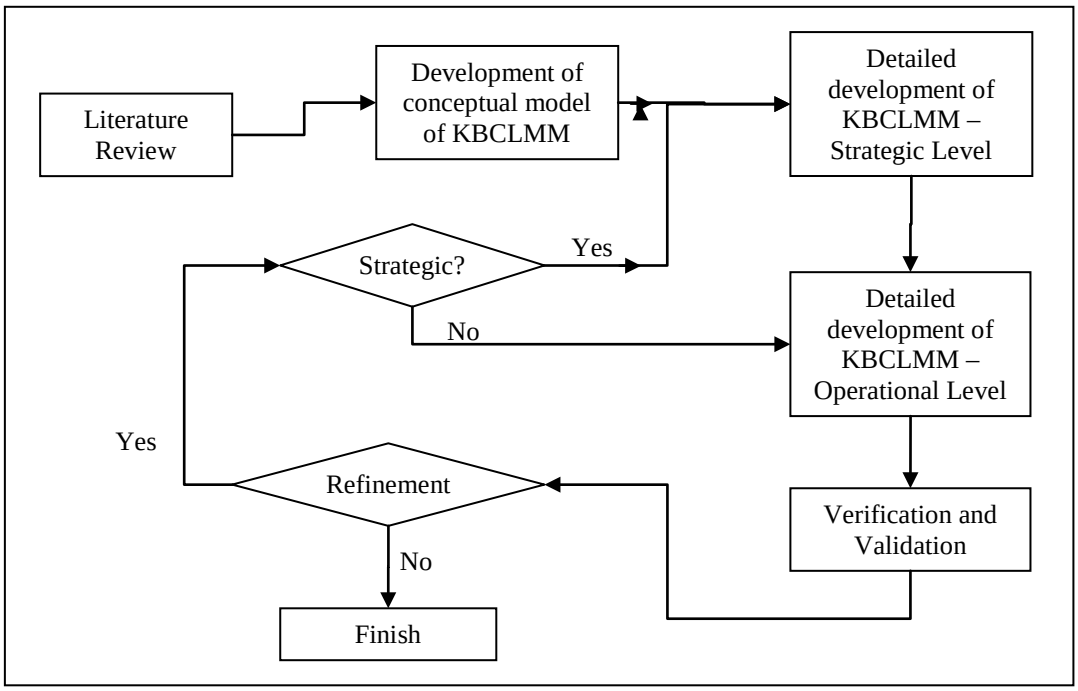

Figure 1.1: Research Methodology Activities Flow

1.4.1 Literature Review

An extensive review of literature relevant to the scope of the research has been conducted, which contributes in identifying the key variables for developing the research model and the design of questions and explanations needed in the KB system. From the literature review process, the concepts, scope and principles that influence the development of CLMM are formulated. The first stage of the literature review relates to the Lean Manufacturing Management and its relation to the development of CLMM, while in the second stage, the review focuses on the tool (KB methodology) that supports the CLMM development. Both these aspects are reviewed in Chapter 2 and Chapter 3.

1.4.2 Model Development

The KBCLMM Model is the most detailed part in the research development process and consists of two stages. Planning Stage (Stage 1)

consists of *Organisation Environment*, *Business Collaborative* and *Lean Manufacturing* components. Design Stage (Stage 2) consists of *Organisation CLMM Capability* and *Organisation CLMM Alignment* components. Each of these components consists of sub-components and activities that represent particular issues in the CLMM development.

Since the CLMM is supported by the KB methodology, it is known as the Knowledge-Based Collaborative Lean Manufacturing Management (KBCLMM) System. From the conceptual model, all components are transformed into the KBCLMM System structure, which is embedded with the GAP and AHP techniques, and thus, key areas of potential improvement in the CLMM are identified for each activity along with the identification of both qualitative and quantitative aspects for CLMM implementation. The conceptual model of KBCLMM is described in Chapter 4.

1.4.3 Data Collection, Verification, Validation and Analysis

In order to address the real situation of CLMM operation, the research verification, validation and analysis are conducted for an automotive manufacturer's Lean Manufacturing Chain in Malaysia. Published case studies are also used to verify and validate several modules for their validity and reliability.

1.5 Significance of the Study

This research explores the use of a hybrid Knowledge-Based/GAP/AHP system to plan, design, and implement a CLMM in automotive and automotive-related manufacturers. The system developed will be able to be used by the policy makers in making new strategies and introducing new business policies.

1.6 Outline of the Thesis

This thesis consists of eight chapters. The introduction to the research, its background, problem statements, research objectives, methodology, and significance of the research are included in this chapter, Chapter 1.

Chapter 2 presents the literature review in the area of Collaborative Lean Manufacturing Management (CLMM) which includes Just-in-Time (JIT), Manufacturing Resources Planning (MRP II), and Total Quality Management (TQM), and the integration of these systems.

A review on Knowledge-Based System (KBS) literature and its application in Production and Operations Management (POM) are presented in Chapter 3. Literature of Analytic Hierarchy Process (AHP) and Gauging Absences of Pre-requisites (GAP) Analysis, which are embedded in the KBCLMM System, is also reviewed.

Chapter 4 presents the conceptual model and basic framework of CLMM, including brief description of every component in the planning, design, and implementation stages, followed by the description of the KBCLMM System structure.

Chapter 5 describes in detail the Planning Stage (Stage 1) of the KBCLMM System, which includes *Organisation Environment Perspective* (Level 0), *Collaborative Business Perspective* (Level 1), and *Lean Manufacturing Perspective* (Level 2).

Chapter 6 presents the Design Stage (Stage 2) of the KBCLMM System, which includes detailed description of *Organisation CLMM Capability* –

Competitive Priorities Perspective (Level 3), *Organisation CLMM Capability – Resources Perspective* (Level 4), and *Organisation CLMM Alignment – Process Perspective* (Level 5).

Chapter 7 describes the details of the verification and validation of the KBCLMM System. It covers the verification and validation through the published case studies and the industrial case studies.

In the final Chapter 8, overall conclusion of this research, achievement of the research objectives, and recommendation for the future research are presented.