PRODUCTION MANAGEMENT AND IMPROVEMENT INITIATIVES: CASE STUDIES OF TWO MALAYSIAN MANUFACTURING COMPANIES

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ABSTRACT

Currently, there are numerous Production Management and Improvement (PMI) initiatives that can be used by the manufacturing companies such as Lean Manufacturing, Material Requirement Planning, Manufacturing Resource Planning, Six Sigma, Agile Manufacturing and Flexible Manufacturing System. Unfortunately, there are very limited study on the selection and implementation of multiple PMI initiatives especially in Malaysian manufacturing companies. The objectives of this study are to identify the main PMI initiatives currently being implemented by the case companies, investigate the strengths and limitations of the main PMI initiatives, investigate the processes involved in selecting and implementing multiple PMI initiatives, and finally to propose a framework for the selection and implementation of PMI initiatives. The method of data collection in this study involved eight semi-structured interviews, document reviews and observations. Two automotive companies were selected as case companies: (1) Permintex Furukawa Autoparts Sdn. Bhd. and (2) Yokohama Industries Bhd. From the data collected, it was found that the case companies implemented Lean Manufacturing, Material Requirement Planning, Manufacturing Resource Planning, and Six Sigma as their main PMI initiatives. Finally a framework for selection and implementation of PMI initiatives has been developed using the acronym 'AIR' which indicates (1) Analyse, (2) Implement, (3) Reflection; with intention to assist organisations in selecting and implementing appropriate PMI initiatives. This study enriches the pool of reference materials and findings related to the selection and implementation of PMI initiatives in the Malaysian manufacturing companies.

ABSTRAK

Pada masa kini, terdapat pelbagai inisiatif Pengurusan Pengeluaran dan Penambahbaikan (PMI) yang boleh digunakan oleh syarikat-syarikat pembuatan seperti *Lean Manufacturing, Material Requirement Planning, Manufacturing Resource Planning, Six Sigma, Agile Manufacturing and Flexible Manufacturing System.* Namun begitu, sangat terhad kajian yang ditemui berkenaan pemilihan dan pelaksanaan inisiatif-inisiatif PMI terutamanya yang melibatkan syarikat-syarikat pembuatan di Malaysia. Objektif kajian ini adalah untuk mengenal pasti inisiatif-inisiatif PMI yang utama yang sedang dilaksanakan oleh syarikat-syarikat di mana kajian dilaksanakan, menyiasat kelebihan dan kekurangan inisiatif-inisiatif PMI utama tersebut, menyiasat proses yang terlibat dalam pemilihan dan perlaksanaan inisiatif-inisiatif PMI, dan akhir sekali mencadangkan satu rangka kerja bagi pemilihan dan pelaksanaan inisiatif PMI. Kaedah pengumpulan data di dalam kajian ini melibatkan lapan temubual separa berstruktur, ulasan dokumen dan pemerhatian. Dua syarikat automotif telah dipilih sebagai syarikat kajian kes: (1) Permintex Furukawa Autoparts Sdn. Bhd dan (2) Yokohama Industries Bhd. Daripada data yang dikumpulkan, didapati bahawa syarikat-syarikat kajian kes melaksanakan *Lean Manufacturing, Material Requirement Planning, Manufacturing Resource Planning,* dan *Six Sigma* sebagai inisiatif-inisiatif PMI yang utama. Akhirnya satu rangka kerja bagi pemilihan dan pelaksanaan inisiatif PMI telah dibangunkan dengan menggunakan 'AIR' singkatan yang menunjukkan (1) Analisis, (*Analysis*) (2) Melaksanakan (*Implement*), (3) Refleksi (*Reflection*); dengan hasrat untuk membantu organisasi dalam memilih dan melaksanakan inisiatif-inisiatif PMI yang bersesuaian. Kajian ini memperkayakan kumpulan bahan-bahan rujukan dan penemuan yang berkaitan dengan pemilihan dan pelaksanaan inisiatif-inisiatif PMI dalam syarikat-syarikat pembuatan di Malaysia.

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LIST OF ABBREVIATIONS

BEM	Business Excellence Model
BPR	Business Process Reengineering
CAx	Computer Aided Technology
CNC	Computer Numerical Control
DMAIC	Define, Measure, Analyse, Improve, Control
ERP	Enterprise Resource Planning
FEA	Finite Element Analysis
FMS	Flexible Manufacturing System
GUIDE	Goal-Understand-Identify-Decide-Evaluate
JIT	Just in Time
MRP	Material Requirement Planning
MRP II	Manufacturing Resource Planning
PLM	Product Lifecycle Management
PMI	Production Management and Improvement
QFD	Qualify Function Deployment
TQM	Total Quality Management
TRIZ	Theory of Inventive Problem Solving

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CHAPTER 1

INTRODUCTION

1.1 Introduction to the chapter

This chapter explained about the research background, the aim and objectives, the scopes, and the importance of the reasearch. The outline of the thesis is also included at the end of this chapter.

1.2 Background of the research

Manufacturing includes the combination of manufacturing practices, research and development, processes, machines, tools, and equipment (Kalpakjian & Schmid, 2001). Over the time, it has been changing rapidly, though make it always be exciting, challenging and acquire a much more prominent profile (Kalpakjian & Schmid, 2001).

Manufacturing is one of an engineering discipline that focused on the process of converting the input into the output, as shown in Figure 1.1 (Slack et al., 2009). The inputs might be materials, informations, customers, people, facilities, etc. The outputs might be products or services (Slack et al., 2009).

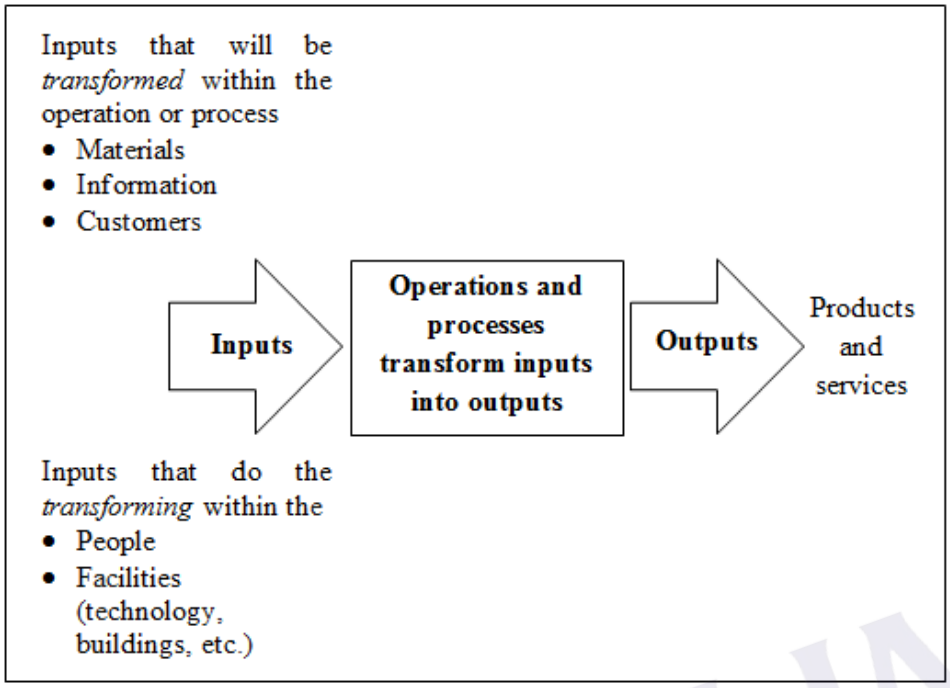

Figure 1.1: Operations and processes transform inputs into outputs (Slack et al., 2009)

Production management is controlled activities and coordination throughout the process of producing a product. Scheduling, cost, performance, quality and effective waste management is a part of it. It deals with converting an input (source) into an output (product) by a process between it. Figure 1.2 shows how production management deals with 6 M concept (manpower, money, machines, materials, methods and markets to fulfil the needs of a people (Rostamzadeh & Sofian, 2009).

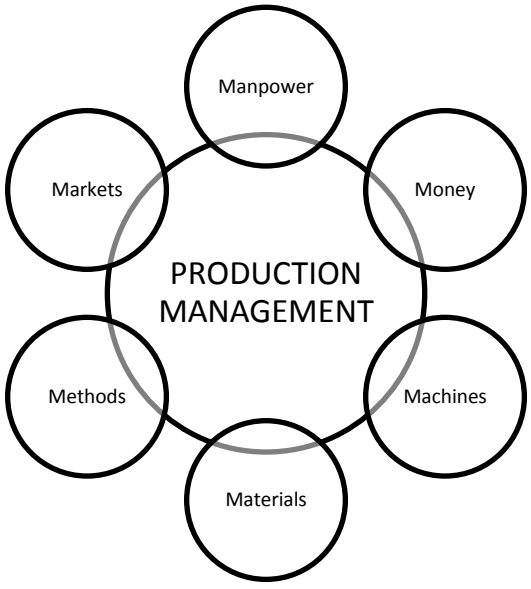

Figure 1.2: Production management 6M concept (Rostamzadeh & Sofian, 2009)

Improvement initiatives objective are to define specific ways to improve services and processes, based on the result of the data collected and evaluation throughout a study. It is important to study about improvement initiatives that focused on the production management because this can be a factor that contribute to the efficiency and productivity of the production in the company. Effective production management can keep costs down, enhance the potential to improve revenue, promote an appropriate allocation of capital resources, and develop the capabilities that provide for competitive advantage (Slack et al., 2009).

Recently, many Malaysian manufacturing companies are facing problem to reduce waste, production time, and process variation in their daily production activities. To address this issue, there are numerous production management and improvement (PMI) initiatives currently being used by the leading manufacturers such as Lean Manufacturing, Agile Manufacturing, Flexible Manufacturing System, Mass Customization, Six Sigma, Material Requirement Planning, Manufacturing Resource Planning, Computer Aided Technologies, Enterprise Resource Planning (Kalpakjian & Schmid, 2001).

1.3 Aim and objectives of the research

This project aims to develop a framework for selecting and implementing production management and improvement (PMI) initiatives based on Malaysia context. In order to achieve the research aim, the following objectives have been set:

- To identify the main PMI initiatives currently being implemented by the case companies.
- To investigate the strengths and limitations of the main PMI initiatives.
- To investigate the processes involved in selecting and implementing multiple PMI initiatives.
- To propose a framework for the selection and implementation of PMI initiatives.

1.4 Scopes of the research

The scopes of the research are described as follows:

- This study focus on the selection and implementation of three (3) main initiatives in the case companies.
- Case studies have been conducted in two manufacturing companies, Permintex Furukawa Autoparts Malaysia Sdn. Bhd. and Yokohama Industries Bhd.
- Data collected by conducting interviews, reviewing documents / records, and observation at the case companies.

1.5 Importance of the research

This research would be making the following important contributions:

- To enrich the pool of reference materials and findings related to the selection and implementation of PMI initiatives in the Malaysian manufacturing companies, since currently no studies on this matter have been found.
- To promote the implementation of appropriate PMI initiatives by highlighting the strengths and limitations of the several main improvement initiatives.
- To highlight the benefits of implementing the PMI initiatives in an organization.

1.6 Outline of the thesis

There are five chapters in this project report. The first chapter represents the introduction, background, aims, objectives, scopes, and importance of the research.

Chapter 2 describes the literature review on what have been highlighted by the previous researchers on the PMI initiatives.

Chapter 3 explained the research design and the methodology. This chapter also briefly explained the research approach, research procedures, and data collection methods.

Chapter 4 details the result of the data collected. It includes brief explanation about the profile of the case companies and the interviewees, the main PMI initiatives currently being used by the case companies, the strengths and limitations of three main PMI initiatives for both case companies, the process involved in selecting and implementing the PMI initiatives, and the proposed framework for selecting and implementing the PMI initiatives.

Chapter 5 concludes the findings related to the aims and the objectives. It also comprises the limitation of the research, and also the suggestion for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction to the chapter

The literature reviews in this chapter were related with PMI initiatives. This chapter includes the definition of production, overview of production and operations management, PMI initiatives that have been deployed in the manufacturing industries in Malaysia, and previous studies related to PMI initiatives. Finally, the summary of this chapter is carried out.

2.2 Definition of production

All intermediate processes that occur when producing a product from a raw material into semi-finished of finished product that includes in the modern manufacturing field are known as production (Slack et al., 2009). Intermediate process could be casting, forming, fabrication, and material removal (Kalpakjian & Schmid, 2001).

Kumar & Suresh (2009) defined production as a manufacturing operations that has a specific procedures or steps to change the raw materials into finished goods by either mechanical or chemical processes, so that the goods is in the best quality to be used by customers. They also stated that: production is a value addition process. At each stage of processing, there will be value addition.

Buffa (1980) stated that any process which goods and services are created known as production. Production also can be defined as the creation of finished goods and services using the factors of production that might be consist land, labour, capital, entrepreneurship and knowledge (Kalpakjian & Schmid, 2001).

2.3 Overview of production and operations management

Production management can be defined as the management activities which are involved in manufacturing a product. Operation management is preferably the same as the production management, but it more related to the concept of services management (Kumar & Suresh, 2009).

Production management is a term used to show what the management team do in order to make sure the firms create goods, while operation management shows the specialized area in management that converts or transform resources into goods and services (Buffa, 1980).

According to Panneerselvam (2012):

> "Production and operations management is the process, which combines and transforms various resources used in the production and operations subsystem of the organization into value added product in a controlled manner" (p. 2)

Buffa (1980) described that production management deals with decision-making related to production processes at minimum cost. In production management, the objectives are to produce the right quantity and quality of goods and services at the right time and right manufacturing cost (Kumar & Suresh, 2009). It also includes the optimum utilization of resources to produce the desired product. Customers' needs and satisfactions are the indicator to show the quality of a product. A good quality sometimes is not showing it is the best quality, but the quality can be determined by the cost of the product and the technical characteristics needed by the customers (Panneerselvam, 2012).

Besides, the production management goals are also to produce goods and services as per the estimated manufacturing cost with the minimum inputs of resources, produce right quality goods and services as per the established standards and specifications, produce goods and services as per the decided time schedule, minimize the use of resources to the optimum level, maximize the utilization of manpower, minimizing the total cost of production with continuous elimination of non-value added activities and improving labour productivity on the production shop floor (Kumar & Suresh, 2009).

Most of the companies will have their own strategies; either to improve the tools that have been used by them or by reducing the unwanted things in their business to solve the problem arises. It is also to maximize the profit margin of the company itself (Ricondo & Viles, 2005).

2.4 Production management and improvement (PMI) initiatives

PMI initiatives in the present context refer to approaches, management systems, tools and/or techniques such as Lean Manufacturing, Material Resource Planning, etc.

Most of the previous studies only focused on one specific initiative, such as, 6 Sigma (Marria et al., 2012), Mass Customization (Heinung, 2011), Lean Manufacturing (Said, 2008; Yusuf, and Adeleye, 2002; Nave, 2002), Total Quality Management (Prajogo & Sohal, 2006).

Other than that, some of the studies focused on multiple initiatives, such as, Total Quality Management, Concurrent Engineering, Knowledge Management (Ng & Jee, 2012), Total Quality Management, Six Sigma, Lean, Business Process Reengineering, Business Process Management (Wieleman, 2011); Strategic Planning, Balanced Scorecard, Hoshin Management (Yang & Yeh, 2009); Total Quality Management, Six Sigma, ISO9001, Business Process Reengineering, Lean, Business Excellence (Thawesaengskulthai, 2007); Six Sigma, Lean (Bendell, 2005); Six Sigma, Total Quality Management, Business Process Reengineering, Lean (Ricondo & Viles, 2005); Lean, Six Sigma and System Approach (Pojasek, 2003); Agile and Lean Manufacturing (Sanchez & Perez, 2001)

Each of these studies tends to promote the particular initiative and goes into detail about the purpose, strengths, limitations and/or implementation process of the initiatives. Unfortunately, there are no studies have been found to address how to select and implement multiple PMI initiatives in the Malaysian manufacturing companies.

The following sub-sections explain nine (9) examples of PMI initiatives. These initiatives are Lean Manufacturing, Agile Manufacturing, Flexible Manufacturing System, Mass Customization, Six Sigma, Material Requirement Planning, Manufacturing Resource Planning, Computer Aided Technologies, Enterprise Resource Planning.

2.4.1 Lean Manufacturing

Lean is an operating philosophy that originally derived from the Toyota Production System. Taiichi Ono was the person who introducing lean as a faster method to produce vehicles (Rigby, 2007). Lean focuses on shortening the time that elapses between a customer's order and the shipment of the product or the provision of the service that fills the order (Womack et al., 1990). Lean manufacturing is a response to competitive pressures with limited resources (Sanchez & Perez, 2001).

Pojasek (2003) highlighted that lean only can be achieved when waste (anything that is not necessary to produce the product or service) has been eliminated from processes. The cost and cycle time was reduced, resulting a more agile and market-responsive company. When wastes were minimized from a production, it improved the quality of a product and also reduced the production time and cost (Holweg, 2007).

One of the tools in lean manufacturing is just-in-time (JIT). JIT is a production strategy that strives to improve a business return on investment by reducing in-process inventory and associated carrying costs. To meet JIT objectives, the process relies on signals or Kanban between different points in the process, which tell production when to make the next part. Kanban are usually 'tickets' but can be simple visual signals, such as the presence or absence of a part on a shelf. Implemented correctly, JIT focuses on continuous improvement and can improve a manufacturing organization's return on investment, quality, and efficiency. To achieve continuous improvement key areas of focus could be flow, employee involvement and quality (Slack et al., 2009).

2.4.2 Agile Manufacturing

Agile manufacturing is a response to complexity brought about by constant change. (Sanchez & Perez, 2001). It is a term applied to an organization that has created the processes, tools, and training to enable it to respond quickly to customer needs and market changes while still controlling costs and quality. Agility is an overall strategy focused on thriving in an unpredictable environment. Focusing on the individual customer, agile competition has evolved from the unilateral producer-centred customer-responsive companies inspired by the lean manufacturing refinement of mass production to interactive producer-customer relationships (Nave, 2002).

Agile manufacturing is the ability to accomplish rapid changeover between the manufacture of different assemblies. Rapid changeover is the ability to move from the assembly of one product to the assembly of a similar product with a minimum of change in tooling and software. Rapid changeover enables the production of small lot sizes, allowing for just-in-time production (Kalpakjian & Schmid, 2001).

An enabling factor in becoming an agile manufacturer has been the development of manufacturing support technology that allows the marketers, the designers and the production personnel to share a common database of parts and products, to share data on production capacities and problems - particularly where small initial problems may have larger downstream effects (Kalpakjian & Schmid, 2001).

Bozdogan (2010) stated that:

> "Agile manufacturing has thus been advanced as the answer to the imperatives of a new industrial paradigm characterized by an unpredictably changing market environment" (p. 7)

2.4.3 Flexible Manufacturing System

A flexible manufacturing system (FMS) is an automated and use modern technologies, consisting of machine cell types used to implement cellular manufacturing. The FMS includes flexible automation, CNC machines, distributed computer control, and automated material handling and storage (Shivanand et al., 2006). There is some amount of flexibility that allows the system to react in the case of changes. This flexibility is generally considered to fall into two categories, which both contain numerous subcategories (Kalpakjian & Schmid, 2001).

The first category, machine flexibility, covers the system's ability to be changed to produce new product types, and ability to change the order of operations executed on a part. The second category is called routing flexibility, which consists of the ability to use multiple machines to perform the same operation on a part, as well as the system's ability to absorb large-scale changes, such as in volume, capacity, or capability (Shivanand et al., 2006).

2.4.4 Mass Customization

To produce a custom made product, or better known as mass customization, a flexible computer aided manufacturing system is needed. Those systems combine the low unit costs of mass production processes with the flexibility of individual customization (Heinung, 2011).

Mass customization is the new frontier in business competition for both manufacturing and service industries. At its core is a tremendous increase in variety and customization without a corresponding increase in costs. At its limit, it is the mass production of individually customized goods and services. At its best, it provides strategic advantage and economic value (Kalpakjian & Schmid, 2001).

Mass customization involves balancing operational drivers by defining it as the capability to manufacture a relatively high volume of product options for a relatively large market (or collection of niche markets) that demands customization, without trade-offs in cost, delivery and quality (Kalpakjian & Schmid, 2001).

Chase et al., (2006) agreed that:

> "Mass customization is the method of effectively postponing the task of differentiating a product for a specific customer until the latest possible point in the supply network." (p. 419)

2.4.5 Six Sigma

The six sigma have had a lot of attention by academicians, researchers, and also the management (Bendell, 2005). It's been originally developed in 1986 by Motorola but then it was developed with high interest in General Electric (GE) in 1995. Today, the six sigma is used worldwide, across continents, across different sector of industry (Ricondo & Viles, 2005).

Pojasek (2003) said that:

> "The six sigma philosophy maintains that reducing "variation" will help solve process and business problems. By using a set of statistical tools to understand the fluctuation of a process, management can begin to predict the expected outcome of that process. If the outcome is not satisfactory, associated tools can be used to further understand the elements influencing the process. Most six sigma programs focus on process improvement to eliminate the causes of variation in processes while leaving the basic process intact." (p. 4)

Basu & Wright (2005) stated that:

> "Six Sigma is quality system that in effect aims for zero defects. Six Sigma in statistical terms means six deviations from the arithmetic mean, which equates to 99.99966 per cent of the total population, or 3.4 defects per million opportunities." (p. 382)

The purpose of process improvement is to eliminate the root causes of performance deficiencies (Thawesaengskulthai, 2007). These performance deficiencies may cause problems for the organisation, or may be preventing it from working as efficiently and effectively as it could. Five-step approach is used. Six Sigma widely known using the acronyms of DMAIC (Pojasek, 2003).

i. DEFINE – a serious problem is identified and a project team is formed and given the responsibility and resources for solving the problem.
ii. MEASURE – data that describes accurately how the process is working currently is gathered and analysed in order to produce some preliminary ideas about what might be causing the problem.
iii. ANALYSE – based upon these preliminary ideas, theories are generated as to what might be causing the problem and, by testing these theories, root causes are identified.
iv. IMPROVE – root causes are removed by means of designing and implementing changes to the offending process.
v. CONTROL – new controls are designed and implemented to prevent the original problem from returning and to hold the gains made by the improvement.

2.4.6 Material Requirement Planning

Material Requirement Planning (MRP) is a production planning system or a set of techniques that comprises bills of materials, inventory on hand, production schedule, which designed to ensure that a company has the parts and materials needed to produce its products and services at the right time and place and in the right amounts (Basu & Wright, 2005).

MRP is used to control inventory. It has been an important production planning and inventory control system that used to manage manufacturing processes. Most MRP systems are software based, while it is possible to conduct MRP by hand as well. Recently, the usage of computers to create schedules that identify the specific parts and materials required to produce an item, the exact quantities required of each, and the dates when orders should be released to suppliers and should be received for best timing within the production cycle, has being the important role in the production. The computers usually controlled by the production managers (Basu & Wright, 2005).

In order to implement the production plan, an adequate amount of the raw materials, components, and operating supplies must be available when needed. For relatively simple products with few components provided by numerous suppliers in the immediate vicinity, this is a relatively simple process. A telephone call may be sufficient to secure overnight delivery of needed materials, and management enjoys the luxury of minimal investments in inventory and little risk of production downtime resulting from lack of needed materials (Basu & Wright, 2005).

2.4.7 Manufacturing Resource Planning

Manufacturing Resource Planning (MRP II) is defined as a method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning, and has a simulation capability to answer "what-if" questions and extension of closed-loop MRP (Basu & Wright, 2005).

According to Basu & Wright, 2005:

> "Manufacturing resource planning (MRP II) arose from an appreciation of the need to time and phase materials with resource availability so as to achieve a given output date. Manufacturing resource planning is an integrated computer-

based system. A computer-based approach is essential due to the amount of data required. Various software systems are available, each based on the same principles." (p. 55)

MRP II is a more advanced computer-based system designed to control all of a firm's resources, the system integrates planning data from individual departments, and produces a master business plan for the entire organization. MRP II then translates the business plan into marketing forecasts; requirements for inventory, materials handling, and personnel; and production schedules. All managers have access to this information (Basu & Wright, 2005).

With MRP II, a change in a marketing forecast will automatically produce an adjustment in production scheduling. Some MRP II software programs can even give managers advice on ways to solve manufacturing and other production problems. This is not exclusively a software function, but a marriage of people skills, dedication to database accuracy, and computer resources. It is a total company management concept for using human resources more productively (Basu & Wright, 2005).

2.4.8 Computer-aided Technologies

A computer-aided technology (CAx) is a term that refers to the use of computer technology to aid in the design, analysis, and manufacture of products. Generally, product developments were divided into three phases: (1) creative, (2) conceptual and (3) engineering phase. All phases of the complete life cycle of a product are supported by various IT-systems often called CAx systems (Dankword et al., 2004).

Advanced CAx tools merge many different aspects of the product lifecycle management (PLM), including design, finite element analysis (FEA), manufacturing, production planning, and product (Dankword et al., 2004).

2.4.9 Enterprise Resource Planning

Enterprise Resource Planning (ERP) systems integrate internal and external management information across an entire organization, embracing finance/accounting, manufacturing, sales and service, customer relationship management, etc. ERP systems automate this activity with an integrated software application. The purpose of ERP is to facilitate the flow of information between all business functions inside the boundaries of the organization and manage the connections to outside stakeholders. ERP systems can run on a variety of computer hardware and network configurations, typically employing a database as a repository for information (Kraemmerand et al., 2003).

In manufacturing fields, ERP usually integrate with engineering systems, bill of materials, work orders, scheduling, capacity, workflow management, quality control, manufacturing process, manufacturing projects, manufacturing flow, product life cycle management (Kraemmerand et al., 2003).

2.5 Previous studies related to PMI initiatives

There are a lot of previous studies that have been carried out, quite similar to this topic of study, but have some difference in their aims, objectives, and tools used.

Mohammad (2012) in his Doctoral thesis entitled “Development of a guidance model for the selection of organisational improvement initiatives” has develop a tool that can be used as a guideline before selecting the improvement initiatives to be implemented in an organisation. In this research, the Business Excellence Model (BEM) was used as an overarching framework for managing multiple improvement initiatives. This study carried out in New Zealand, Malaysia and Singapore. The methods used in this study were interviews and survey. These

interviews took place in New Zealand, Malaysia and Singapore. Meanwhile, the evaluation survey took place globally. This study covers various implementation areas such as processes, workforce, customers, partnership, leadership, strategy and policy with each area have a degree of suitability of improvement initiatives. Examples of initiatives that can be used to improve processes in the industry are Business Process Reengineering, Improvement Teams, Lean, Product Life Cycle Management, Quality Management System, Six Sigma and Statistical Process Control. The final guidance model used the acronym of 'GUIDE'.

Yang and Yeh (2009) in their research entitled "An integrated implementation model of strategic planning, BSC and Hoshin management" have used the Balanced Scorecard (BSC) Hoshin management as the technique for problem solving in production. They tried to blend the two techniques, but they found out that there are weaknesses occur when integrating these techniques. But in the end, the integrated model is effective to be implemented.

Thawesaengskulthai (2007) in his Doctoral thesis entitled "Selecting quality management and improvement initiatives: Case studies of industries in Thailand" has carried out a study on quality management at three (3) case company in Thailand (The Siam Cement Group, PTT, and Johnson's and Johnson's Thailand). The studies carried out in three (3) phases: establishing conceptual background, developing framework and testing the decision. The quality management and improvement initiatives can be assumed as a part of production and operations improvements initiatives. This is because quality tools such as Six Sigma, Total Quality Management, and Lean Manufacturing are also integrated or can be justified as part of the production management tools.

Hua et al., (2006) in their research entitled "Integration TRIZ with problem-solving tools: a literature review from 1995 to 2006" have tried to possibly integrate TRIZ with some problem-solving tools such as Qualify Function Deployment (QFD), Taguchi's Method, Axiomatic Design (AD), Six Sigma, etc. to be applied in

the industries such as transportation, manufacturing, and services. They have concluded that the integration of TRIZ and problem-solving tools is having a bright future to be used in the industries.

Bendell (2005) in his papepr entitled "Structuring business process improvement methodologies" based on his extensive consultancy and training experience with diverse business process improvement programmes has review the strengths and weaknesses of the Six sigma and lean manufacturing. He adds up that each business has their own path, thus it's up to them to choose what tools that they want to use for the improvement their company needs.

Ricondo and Viles (2005) in their research entitled "Six sigma and its link to TQM, BPR, lean and the learning organisation" has carried out a comparison between Six Sigma, Total Quality Management (TQM), Business Process Reengineering (BPR), Lean and the Learning Organisation business programmes, attending to their origins, principles, methodologies and tools and techniques. As a result, a framework is proposed to locate the different strategies depending on the problem-solving capabilities.

Pojaseb (2003) has conducted a research entitled "Lean, Six Sigma, and the Systems Approach: Management Initiatives for Process Improvement". This paper suggested the suitable process improvement methodology between lean, six sigma and system approach to be implemented in the organisation by giving the guideline in choosing the best approach.

Based on critical review, no previous study has been found focusing on the selection and implementation of PMI initiatives in the Malaysian manufacturing companies. Further research in this area is needed because from the studies that have been carried out by the previous researchers, a lot of PMI initiatives were used abroad. It is believed that the same scenario happened in Malaysia, many companies

in Malaysia also used PMI initiatives but they may not really know much about the better PMI initiatives to be carried out by them. This is the importance of this study, to assist the company to select and implement the PMI initiatives in their company respectively.

2.6 Summary of the chapter

A comprehensive understanding on production management and improvement initiatives has been gained from the literature review chapter. A good understanding is very important to make sure that the case study carried out smoothly throughout the given period.

From the literature review, the methodology of this case study has been obtained and developed. The next chapter emphasized the research design and data collection methods for this case study.

CHAPTER 3

METHODOLOGY

3.1 Introduction to the chapter

This chapter elaborates the research methodology that has been used to achieve the research aim and objectives. These include on how the study was carried out from the beginning till the end, the procedures of the research, the steps taken to ensure that the quality of the research is above the par, and the summary of the chapter.

3.2 Research approach

A case study is the problem of narrative about something that can be resolved through appropriate methods. The problems that can be solved through case study might likely includes a special, unique or interesting thing involves organization, process, people, or even things. (Yin & Robert, 2003).

Yin & Robert (2003) stated that:

> "a case study design should be considered when: (a) the focus of the study is to answer "how" and "why" questions; (b) you cannot manipulate the behaviour of those involved in the study; (c) you want to cover contextual conditions

because you believe they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context." (p. 240)

The information gained from a case study might provide much more details compared to the other methods. It also allows presentation of the data collected from multiple methods in order to strengthen the ideas towards the conclusion. The method could be find through several sources such as project documents, project reports, monitoring visits, mystery client reports, facility assessment reports, interviews, questionnaire/survey results, evaluation reports, and observation (Yin & Robert, 2003).

The steps in doing a case study might be different from one another. But basically there are some main processes involved that must be included to make sure that the result from the case study is reliable. Figure 3.1 summarises the main processes involved in the case study.

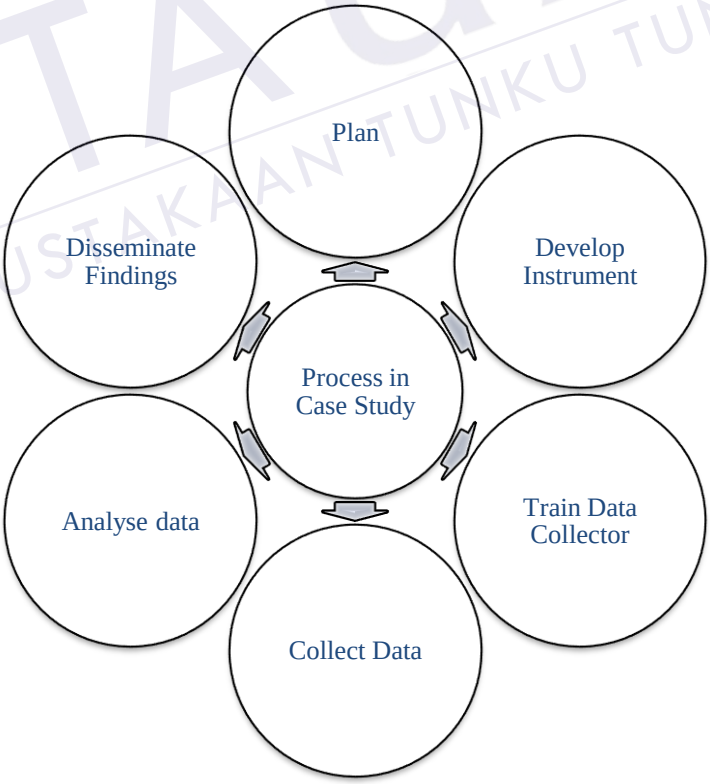

Figure 3.1: Processes involved in case study

3.3 Research procedures

This was the step-by-step procedures on how this studies being carried out. It began with literature review, until the result of the findings (as in Figure 3.2)

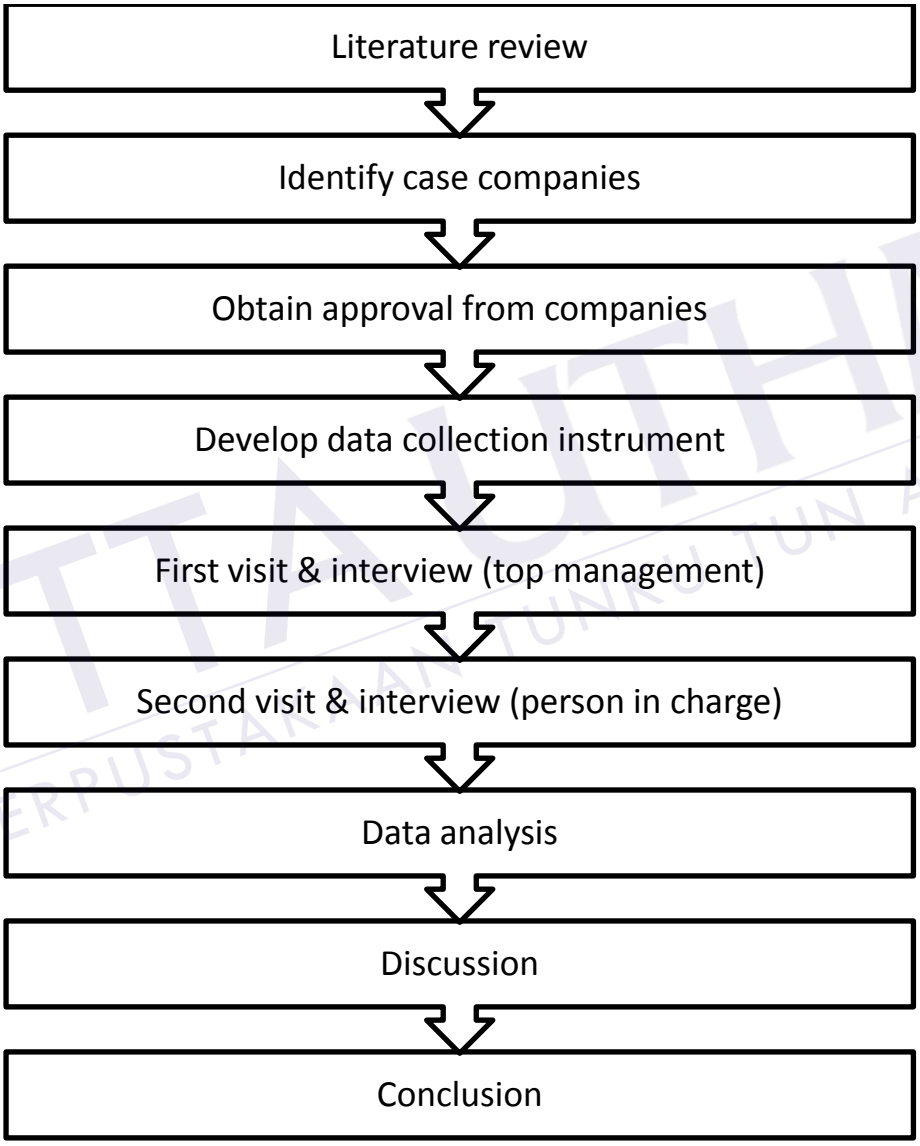

Figure 3.2: Flowchart of the research

3.3.1 Literature review

Reviewing the literature is a continuous process occurs from the beginning until the end of the study. This is important because sometimes there are new finding in the field of study. So, alteration can be made to suite the changes. In the beginning, a lot of literatures have to be carried out to have an understanding on the relevant issues from the previous study, then to identify the problem statement, and determining the objectives and aim of the study. From a fair understanding of the previous study, the methodology of the study has been developed.

3.3.2 Identify case companies

Identifying the place or company to carry out the study is something that is not easy. Most of the companies out there, especially in manufacturing industry have their own secret policy. So, it is hard to carry the study at the beginning.

It takes time to get a company. Fortunately, two manufacturing companies have given a green light to carry out this study. The first company is Permintex Furukawa Autoparts Sdn. Bhd. (Jitra, Kedah) and the second company is Yokohama Industries Bhd. (Semenyih, Selangor).

3.3.3 Obtain approval

In order to obtain approval from the case companies, some procedures must be carried out. Earlier, an information sheet has to be prepared. In the information sheet, it explained about the institution that is represented by the researcher, the title of the study, the invitation to give a help, the purpose of the study, the time taken to complete the interviews, and a brief background of the researcher.

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