



**KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN  
MALAYSIA**

# **Manufacturing Modelling & Simulation In A Manufacturing Industry.**

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Manufacturing Engineering in Manufacturing Process

By

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**JUDUL: MANUFACTURING MODELING AND SIMULATION IN A MANUFACTURING INDUSTRY**
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# **DEDICATION**

*For My Father and Mother.*

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## ABSTRACT

This case study discuss the initial efforts to implement simulation modelling as a visual management and analysis tool at an assembly shop floor that produced door sash. Discrete-event simulation (DES) techniques are used for improving efficiency in manufacturing systems. It allows different test to be carried out by step-by-step alteration. The production shop floor was modelled using WITNESS software to identify bottleneck, and evaluate machine performance, cycle time that are essential for efficient production control. For Projek Sarjana Muda (PSM) report, it consists of the beginning construction of a case study title Manufacturing Modelling and Simulation in a Manufacturing Industry. Here, the problem statements and the objectives of this study have been identified. Besides that, scope of this study and the importance of the study and the outline of the study have been reviewed and discuss. For literature review, starting with searching information in reference books and internet especially in the journals for manufacturing information and its history, definition of modelling and simulation, its advantages and disadvantages, importance of simulation and review of previous case study are reviews in general. In methodology, a brief review of purpose of conducting the study are reviewed starting from the beginning of the study until the end of PSM and the basic steps of simulation are discussed. In data collection, general reviews of how the data have been collected are review starting from constructing the data table until the ending of data collection. In simulation modelling, a review of the results from the simulation that had been done is discussed. There are three alternatives that had been purposed in this case study. From here, the cost effectiveness analysis has been discussed in order to select the best alternatives that effective to be implement and at the same time increasing the output of the production line and save the company budget. For simulation analysis, the validation of the data and the findings is discussed briefly. From the analysis, the best alternative that possible to be implementing is alternative 1, terminate one point at CO<sub>2</sub> Robot Welding Process. This is because the production cost of CO<sub>2</sub> Robot Welding Machine and CO<sub>2</sub> Welding By Hand is the lowest among others alternatives.

## ABSTRAK

Kajian ini membincangkan pelaksanaan model simulasi, satu kaedah pengurusan berdasarkan penglihatan dan kaedah analisis yang dibuat di kilang pengeluaran bingkai tingkap pintu kereta. Kaedah simulasi berasingan (*Discrete-event simulation*) digunakan bagi memperbaiki dan meningkatkan lagi kecekapan sistem pembuatan. Ia membolehkan pelbagai ujian dilakukan melalui perubahan langkah demi langkah. Model pengeluaran di kilang tersebut dihasilkan dengan menggunakan perisian WITNESS untuk mengenal pasti proses yang mengambil masa yang lama untuk disiapkan, dan menilai prestasi mesin berdasarkan kitar masa (*cycle time*) untuk menilai kecekapan kawalan pembuatan. Projek Sarjana Muda (PSM) ini, mengandungi bahagian permulaan untuk melaksanakan kajian yang bertajuk 'Manufacturing Modelling and Simulation in a Manufacturing Industry'. Disini, pernyataan masalah, objektif, ruang lingkup kajian dan kepentingan kajian juga dinyatakan dan diulas dengan jelas. Bagi kajian ilmiah pula, ia bermula dengan mencari maklumat dalam buku rujukan dan internet, terutama dalam jurnal untuk mendapatkan maklumat dan sejarah industri pembuatan. Selain itu, takrifan model dan simulasi, kelebihan dan kelemahan serta kepentingan simulasi diulas dan dibincangkan secara umum. Dalam bahagian metodologi, ulasan ringkas mengenai cadangan pelaksanaan kajian diulas daripada mula sehingga tamat. Bagi pengumpulan data, ulasan umum bagaimana data yang diperlukan dikumpul, bermula dengan pembentukan jadual sehingga data yang diperlukan dicatatkan di dalam jadual. Dalam bahagian simulasi model, ulasan mengenai keputusan yang diperoleh dibincangkan. Terdapat tiga alternatif yang dicadangkan dalam kajian ini. Disini, analisis kos efektif dilakukan untuk mendapatkan keputusan alternatif mana yang akan dipilih dan pada masa yang sama kadar pengeluaran setiap jam dapat ditingkatkan. Dalam bahagian analisis simulasi, pengesahan data dan keputusan berdasarkan kos yang efektif dibincangkan secara umum. Daripada analisis yang dibuat, didapati alternatif yang berkemungkinan untuk diaplikasikan adalah alternatif 1, membuang satu titik yang perlu dikimpal menggunakan robot kimpalan. Ini kerana kos pengeluaran bagi proses ini adalah yang terendah untuk alternatif 1.

# TABLE OF CONTENTS

|   |           |
|---|-----------|
| Abstract  | i         |
| Table of Contents   | iii       |
| List of Figures   | vi        |
| List of Tables  | vii       |
| List of Abbreviations, Symbols, Specialized Nomenclature        | x         |
| <br>  |           |
| <b>1. INTRODUCTION</b>  | <b>1</b>  |
| 1.0 Introduction  | 1         |
| 1.1 Problem Statements  | 2         |
| 1.2 Objectives  | 3         |
| 1.3 Scope of the study  | 3         |
| 1.4 Importance of the study                                     | 5         |
| 1.5 Outline of the study  | 5         |
| <br>  |           |
| <b>2. LITERATURES REVIEW</b>                                    | <b>8</b>  |
| 2.0 Introduction  | 8         |
| 2.1 Introduction to manufacturing                               | 9         |
| 2.2 A brief history of manufacturing                            | 11        |
| 2.3 Manufacturing industry (automotive) environment in Malaysia | 12        |
| 2.4 Manufacturing modeling and simulation                       | 14        |
| 2.4.1 Definition of manufacturing modelling and simulation      | 15        |
| 2.4.2 Advantages and disadvantages of simulation                | 17        |
| 2.4.3 The important of modelling and simulation                 | 19        |
| 2.5 Building Alternatives Layout in Simulation                  | 20        |
| 2.6 Research areas in manufacturing modelling and simulation    | 21        |
| <br>  |           |
| <b>3. METHODOLOGY</b>   | <b>27</b> |
| 3.0 Introduction  | 27        |
| 3.1 Design of the study   | 27        |



|         |  |    |
|---------|--|----|
| 3.2     | Framework of the study   | 32 |
| 3.2.1   | Identify system suitable for DES                                 | 32 |
| 3.2.2   | Input data collection-Conceptual model                           | 32 |
| 3.2.3   | DES modelling  | 33 |
| 3.2.4   | Result analysis  | 33 |
| 3.2.5   | Implementation in real-world system                              | 34 |
| 3.2.6   | Follow-up of real-world changes                                  | 34 |
| 3.3     | Simulation software  | 36 |
| 3.4     | Simulation model   | 37 |
| <br>    |  |    |
| 4.      | <b>DATA COLLECTION</b>   | 39 |
| 4.0     | Introduction   | 39 |
| 4.1     | Introduction to study line                                       | 39 |
| 4.2     | Setting up data collection                                       | 41 |
| 4.2.1   | Process flow chart   | 41 |
| 4.2.2   | Standard operation procedure / work instruction                  | 44 |
| 4.3     | Data collection table  | 45 |
| 4.4     | Cycle time data in simulation                                    | 48 |
| 4.4.1   | Parts inter arrival time   | 48 |
| 4.4.2   | Machine cycle time   | 48 |
| <br>    |  |    |
| 5.      | <b>SIMULATION MODELLING</b>                                      | 56 |
| 5.0     | Introduction   | 56 |
| 5.1     | Model Verification and Validation                                | 56 |
| 5.2     | Actual Layout  | 57 |
| 5.2.1   | GX Model   | 57 |
| 5.2.2   | M Car Model  | 61 |
| 5.3     | Alternative Layout   | 64 |
| 5.3.1   | Ideas  | 64 |
| 5.3.2   | Layout   | 65 |
| 5.3.2.1 | Terminate one (1) point at CO <sub>2</sub> Robot Welding Process | 66 |

|   |           |
|---|-----------|
| 5.3.2.2 Adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand Process<br>using actual cycle time   | 68        |
| 5.3.2.3 Adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand process<br>using termination of one point cycle time at CO <sub>2</sub> Robot<br>Welding Process | 71        |
| <b>6. SIMULATION ANALYSIS</b>   | <b>74</b> |
| 6.0 Introduction  | 74        |
| 6.1 Simulation Analysis   | 75        |
| 6.1.1 Assumption  | 75        |
| 6.1.2 Company Output Target   | 76        |
| 6.1.3 Machine Cost  | 76        |
| 6.2 Cost Effectiveness Analysis   | 77        |
| <b>7. CONCLUSION AND RECOMMENDATION</b>   | <b>85</b> |
| 7.1 Conclusion  | 85        |
| 7.2 Recommendation  | 86        |
| <b>REFERENCES</b>   | <b>88</b> |
| <b>APPENDICES</b>   |           |
| A PSM 1 Ghant Chart   | 91        |
| B PSM 2 Ghant Chart   | 92        |
| C Automotive Article  | 93        |
| D Cycle time data for M Car (Wira) Front Door Sash LH/RH  | 106       |
| E Cycle time data for GX (Waja) Front Door Sash LH/RH   | 116       |

## LIST OF FIGURES

|     |  |    |
|-----|--|----|
| 1.1 | Front Door Sash Left Hand products.  | 4  |
| 1.2 | Summary of the outline study.  | 7  |
| 3.1 | Summary of framework of the study for semester one.  | 30 |
| 3.2 | Summary of framework of the study for semester two.  | 31 |
| 3.3 | Summary of the framework of the study (Source: Banks et al.)   | 35 |
| 3.4 | Model Design Steps.  | 36 |
| 4.1 | Layout of production line A.   | 40 |
| 4.2 | Process Flow Chart for GX and M Car Model.   | 42 |
| 4.3 | Process Flow Chart for GX (Waja) Front Door Sash LH/RH.  | 43 |
| 4.4 | Standard Operation Procedure / Work Instruction Sheet.   | 44 |
| 4.5 | Phase one data collection table.   | 47 |
| 5.1 | Actual production layout of GX Model.  | 59 |
| 5.2 | Actual production layout of M Car Model.   | 63 |
| 5.3 | Layout of GX Model and M Car Model for termination one point at Robot Welding Process.   | 66 |
| 5.4 | Purpose layout of adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand using actual cycle time for GX and M Car Model.               | 69 |
| 5.5 | Purpose layout of adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand Terminate one point of CO <sub>2</sub> Robot Welding Process. | 71 |
| 6.1 | Summary of Actual and Alternative output For GX and M Car model.   | 82 |

## LIST OF TABLES

|     |  |    |
|-----|--|----|
| 2.1 | Description of previous case study   | 24 |
| 2.2 | Summary of previous case study in simulation modelling.  | 25 |
| 4.1 | Parts inter arrival time for actual layout, alternative 1, alternative 2 and alternative 3.  | 52 |
| 4.2 | Machine / Process time for actual layout.  | 52 |
| 4.3 | Machine / Process time for alternative 1.  | 53 |
| 4.4 | Machine / Process time for alternative 2.  | 54 |
| 4.5 | Machine / Process time for alternative 3.  | 55 |
| 5.1 | Actual production results of GX Model.   | 60 |
| 5.2 | Actual part movement at hanger for GX Model.   | 60 |
| 5.3 | Actual production results of M Car Model.  | 63 |
| 5.4 | Actual part movement at hanger for M Car Model.  | 64 |
| 5.5 | Production results of Termination one point at CO <sub>2</sub> Robot Welding Process for GX Model.                                       | 67 |
| 5.6 | Movement of parts at hanger for GX Model using termination of one point cycle time.  | 67 |
| 5.7 | Production results of Terminate one point at CO <sub>2</sub> Robot Welding Process for M Car Model.                                      | 68 |
| 5.8 | Movement of parts at hanger for M Car Model using termination of one point cycle time.   | 68 |
| 5.9 | Production results of adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand Process using actual cycle time for GX Model. | 69 |



|      |  |    |
|------|--|----|
| 5.10 | Movement of parts at hanger for GX Model using actual cycle time adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand Process.   | 70 |
| 5.11 | Production results of adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand Process using actual cycle time for M Car Model.  | 70 |
| 5.12 | Movement of parts at the hanger for M Car Model using actual cycle time, adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand Process.   | 70 |
| 5.13 | Production results of adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand Process using termination one point cycle time at CO <sub>2</sub> Robot Welding Process for GX Model.           | 72 |
| 5.14 | Movement of parts at the hanger for GX Model when adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand Process using termination one point cycle time at CO <sub>2</sub> Robot Welding.    | 72 |
| 5.15 | Production results of adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand Process using termination one point cycle time at CO <sub>2</sub> Robot Welding Process for M Car Model.        | 73 |
| 5.16 | Movement of parts at the hanger for M Car Model when adding one CO <sub>2</sub> Robot Machine and CO <sub>2</sub> By Hand Process using termination one point cycle time at CO <sub>2</sub> Robot Welding. | 73 |
| 6.1  | Cost Estimation for Actual Production Layout (1 CO <sub>2</sub> Robot Machine and 1 CO <sub>2</sub> by Hand Equipment)   | 77 |
| 6.2  | Cost Estimation for Alternative 1 (1 CO <sub>2</sub> Robot Machine and 1 CO <sub>2</sub> by Hand Equipment)  | 78 |
| 6.3  | Cost Estimation for Alternative 2 (2 CO <sub>2</sub> Robot Machine and 2 CO <sub>2</sub> by Hand Equipment)  | 79 |

|     |  |    |
|-----|--|----|
| 6.4 | Cost Estimation for Alternative 3 (2 CO <sub>2</sub> Robot Machine and 2 CO <sub>2</sub> by Hand Equipment)  | 80 |
| 6.5 | Summary of Output per hour and Manufacturing cost per unit.  | 81 |
| 6.6 | Summary of idle and busy time for CO <sub>2</sub> Robot Welding Machine and CO <sub>2</sub> By Hand process. | 83 |

# **LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE**

|             |   |                                    |
|-------------|---|------------------------------------|
| BH          | - | By Hand                            |
| Bhd.        | - | Berhad                             |
| B.C         | - | Before Century                     |
| CIM         | - | Computer-Integrated Manufacturing  |
| CNC         | - | Computer Numerical Control         |
| Co.         | - | Company                            |
| DES         | - | Discrete-Event Simulation          |
| GX Model    | - | Waja Model                         |
| LH          | - | Left Hand                          |
| Ltd.        | - | Limited                            |
| M-Car Model | - | Wira Model                         |
| MS Cutting  | - | Metal Saw Cutting                  |
| Part 001    | - | A Pillar                           |
| Part 002    | - | B Pillar Outer                     |
| Part 003    | - | Glass Guide                        |
| PERODUA     | - | Perusahaan Otomobil Kedua Nasional |
| PLW (B)     | - | Plasma Welding Back                |
| PLW (S)     | - | Plasma Welding Surface             |
| PROTON      | - | Perusahaan Otomobil Nasional       |
| PSM 1       | - | Projek Sarjana Muda 1              |
| PSM 2       | - | Projek Sarjana Muda 2              |
| Sdn.        | - | Sendirian                          |
| SOP         | - | Standard Operation Procedure       |
| WIP         | - | Work In Process                    |
| ○           | - | Process                            |
| ◇           | - | Inspection                         |

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction.

The survival of any industry in today's competitive market place depends on response time, production costs and flexibility in manufacturing (Chase et al. 2001). Because of the complexity and dynamic behaviour of such systems, simulation modelling is becoming one of the most popular methods of evaluating their floor layout design and operating strategies (Hlupic and Paul, 1993), (Pidd, 1992), (O'Keefe and Haddock, 1991).

Nowadays, for a manufacturing company, an increased productivity and better overall efficiency of the production line are the most important goals for almost all manufacturing company.

Manufacturing modelling and simulation is a concept of creating real world problems in simulation software. The purpose of creating real problems in software is to reduce production cost and at the same time increasing output productivity.

This chapter will provide an overview of the case study titled Manufacturing Modelling and Simulation in a Manufacturing Industry. Generally, problem statement briefly discuss about the problems that manufacturing industry faced during the production of a products.



In this chapter, an overview of the objectives of this case study and scope of this case study will be reviewed. Basically, the objective of this study is to find an alternative way to increase productivity. This study will be done in one of the automotive factories in Malaysia. Here, the importance of the study to the manufacturing industry will be also reviewed. Lastly, in this chapter, the review of the study outline will be discussed in general.

## **1.1 Problem Statement.**

In a manufacturing industry, production floor layout involves the selection and the arrangement of equipment such as machine that will be used to produce a product, the buffer that will be used in the production floor, the tools that need to perform required process and resources such as raw material to manufacture a product. There are many methods exist by which a layout could be design to be analyzed.

Simulation software such as ARENA, Quest, ProModel and WITNESS was developed to allow the user to build several alternatives of the production floor layout in order to increase the productivity and identify the problems that the operator faced during the production of a product. By using the simulation software, the analysis of problems can be performing in a short time or in other hand within one hour because we can create the real world problems in the simulation software.

This study tries to illustrate the flow of an existing plant layout in order to identify the problems occur in actual layout. The creation of several alternatives of plant layout will be purposed based on the company requirement to increase the production output and at the same time try to reduce the operating cost. The

proposed plant layout is implemented in the simulation software to solve existing production floor layout performance problem.

## **1.2 Objectives.**

The main objective of this study was to simulate the manufacturing process for manufacturing door sash and evaluate effectiveness of the process in terms of machine utilization and systems performance. Besides that, the other objectives of the study are:

1. To identify problems in existing production floor layout.
2. To design and improve manufacturing production floor layout by using simulation software and by observation during the collection data of cycle time.
3. To measure manufacturing performance such as production quantity, lead time, bottle neck and by using cost effectiveness analysis.

## **1.3 Scope of the Study.**

This study will analyze an industry specific problem of production floor layout in order to increase the productivity and try to solve it through several alternative production floor layouts. At the moment, this study will be conduct at Ingress Precision Sdn. Bhd. Located in Kawasan Perindustrian Nilai. This company is one of the subsidiaries of Ingress Corporation Berhad which produce an automotive part for Proton and Perodua as it major customer. The core products of this company are Door Sash, one of the components to make a car door. In order to produce a complete set of car doors, there are 4 types of Door Sash that have been produced in this company. They are:

1. Front Door Sash Left Hand.
2. Front Door Sash Right Hand.
3. Rear Door Sash Left Hand.
4. Rear Door Sash Right Hand.

For a moment, this study will be focused at Front Door Sash Left Hand for M-Car (Wira) model and GX (Waja) model. Both of the products were chosen because the cycle time of both products is the longest in this company factory and at the same time, the output per hour cannot achieve the target that had been set by the company. At the end of this study, a new proposed of production floor layout will be chosen.

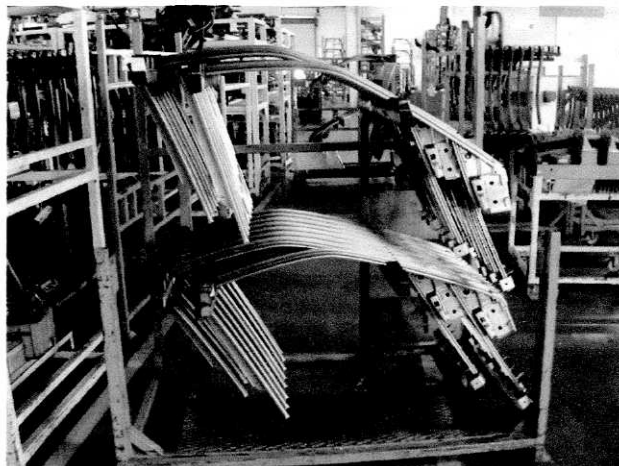


Figure 1.1: Front Door Sash Left Hand products.

#### **1.4 Importance of the Study.**

The importance of this study is to come out with a good solutions that could improved the cycle time of a products by introducing a framework model that can be used with other models that have almost the same process with other models. At the same time, by performing this study, it will hope to help other people to identify what are the problems occurred and come out with several of solutions for these problems.

#### **1.5 Outline of the Study.**

This study will be divided into seven chapters. In the first chapter, the introduction of the study will be discussed. This chapter will be provided with the problem statement of the study. Then the objectives of this study will be reviewed. An overview of scope of the study also will be discussed in this chapter. Lastly, the importance of the study will be review to identify the importance of manufacturing modelling and simulation.

For chapter two, the literature review of the study will be discussed. This chapter will provide with introduction to manufacturing. Here, an overview of manufacturing will be discussed. Then, a brief history of manufacturing will be discussed in this chapter. Manufacturing industry (automotive) environment in Malaysia will be reviewed as it is the main sector that will be studied. Then, the review of manufacturing modelling and simulation, definition of manufacturing modelling and simulation will be discussed and lastly, the important of modelling and simulation will be review including the review of the previous study that have been conducted by researchers.



In chapter three, the review of methodology will be review. The design of the study and the framework of the study will be review at first. Then, the introduction of simulation software, simulation software that will be used and the advantages and the disadvantages of this software will be discussed.

In chapter four, the data collection of this study will be discussed briefly. In this chapter, the setting up of the data collection will be discussed. Followed by the data collection table and the examples of the data that have been collected will be discussed.

In chapter five, the review of simulation modelling is discuss in a brief. In chapter six, a view of discussion of the finding that has been analyzed will be review. Lastly, in chapter seven, the discussion on the recommendation and the conclusion of the study will be reviewed. The next page shows the summary of the outline of this study.

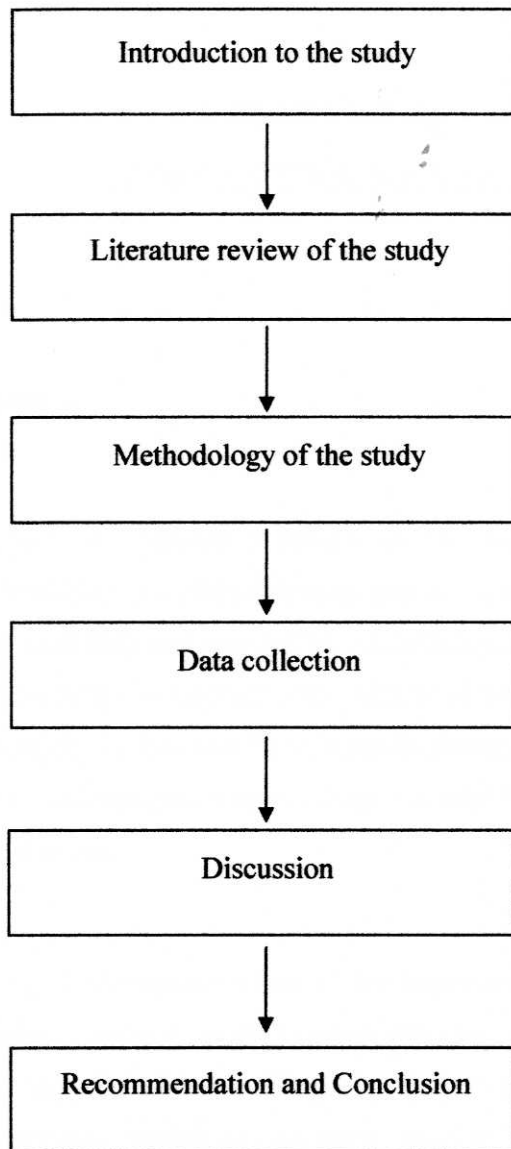


Figure 1.2: Summary of the outline study.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 Introduction.**

This chapter will provide a review of the concepts of Manufacturing Modelling and Simulation in a Manufacturing Industry which leading to the research in manufacturing modelling and simulation. Manufacturing, in its broadest sense, is the process of converting raw material into finish good products that can be used by consumer or customers. In the other hand, manufacturing industry can be defined as an industry which produces products in a large quantity to sell to the customers for the used of the customers.

Modelling and simulation is one of the techniques that have been used to analyze the situation in order to make a correct decision or tools that help human in order to make a correct decision making. For this research, we will be focus on discrete-event simulation models or continuous models. A brief discussion on the issues related to discrete-event simulation models or continuous models is also given.

Since this research involving modelling of a production line, the production line modelling is also reviewed. Discussions include identifying the layout of the machine, modelling a framework and condition of the equipment will be used in this research. Finally, a review of performance measures used by previous researchers is conducted before concluding the chapter.

## 2.1 Introduction to Manufacturing.

Generally, manufacturing in its broadest sense, can be defined as the process of converting raw materials into a required products. Kalpakjian, S & Schmid, S.R 2001 notes that manufacturing encompasses:

1. The design of the product.
2. The selection of raw materials.
3. The sequence of process through which the product will be manufactured.

Manufacturing can be said as a backbone of industrialized nations. Its important is emphasized by the fact that as one of the economic activity, it comprises approximately about 20 percent to 30 percent of the value of all goods and services that have been produced. Nowadays, a country's level of manufacturing activities can be said directly related to its economic health. The higher level of manufacturing activity in a country, the higher standard of living of its people.

Manufacturing is also involves activities in which the manufactured products used to make other products such as a large presses to shape sheet metal for car bodies, roll forming process to make doors for cars and machinery to make bolt and nuts. Another important aspect of manufacturing activities is the servicing and maintenance of this machinery during the machine useful life cycle.

Kalpakjian, S & Schmid, S.R 2001, in Manufacturing Engineering and Technology, Fourth Edition state that the word manufacturing is derived from the Latin word, *manu factus* which means made by hand. The word manufacture first appeared in the year 1567 and appeared again in 1683. In this modern world, manufacturing involves making products from raw materials by the means of various processes, machinery, and operations through a well organized plan for each activity