



## **Faculty of Manufacturing Engineering**

# **DESIGN AND SIMULATION OF PROPOSED AUTOMATION SYSTEM IN EXISTING MANUFACTURING ENVIRONMENT**

**Zainila binti Salam**

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(Manufacturing System Engineering)**

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**DESIGN AND SIMULATION OF PROPOSED AUTOMATION SYSTEM IN  
EXISTING MANUFACTURING ENVIRONMENT**

**ZAINILA BINTI SALAM**

**A thesis submitted  
in fulfillment of the requirements for the degree of Master of Manufacturing  
Engineering (Manufacturing System Engineering)**

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## DECLARATION

I hereby, declared this report entitled "Design and Simulation of Proposed Automation System in Existing Manufacturing Environment" is the results of my own research except as cited in references.

Signature : *Zainila*  
Author's Name : ZAINILA SALAM  
Date : 25 JULY 2013

## APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Master of Manufacturing (Manufacturing System Engineering). The member of supervisory committee is as follow:



-----  
Supervisor

**DR. ZAMBERI BIN JAMALUDIN**  
*Pensyarah Kanan*  
Fakulti Kejuruteraan Pembuatan  
Universiti Teknikal Malaysia Melaka

## **DEDICATION**

To my beloved husband, sons, daughter and parents,  
for the support and encouragement, love and cares in the entire master program.

## ABSTRACT

The manual operation may impact fluctuation in daily productivity. Manual processing also lead to increase in the number of queues, poor management of Work in Process (WIP) resulting in that impact low productivity. The objective of this project is to propose an automation system that would improve productivity on actual manufacturing assembly area and validate the proposed system with maximize headcount utilization. This project develop modelling of the production system was performed using through ARENA simulation software that evaluates the impact of manufacturing productivity before and after the implementation of the proposed automation system improvement. The system simulation development will be based on assembly processt at PHN Industry, USJ. The main results showed that productivity has improved by 39% due to changes in implementation of conveyor system as part of the automation development based on simulation study. This validates the changes to the work process flow through a simple conveyor system to replace MHS. Further improvement on the simulation process in areas such as queue analysis on the time and number of parts waiting time could add greater complexity to the model resulting in increased of productivity.

## ABSTRAK

Operasi secara manual boleh menyebabkan ketidaktentuan dalam produktiviti harian. Pemprosesan secara manual juga akan menambah masa menunggu dan juga masa pemprosesan yang panjang - Work in Process (WIP) yang akan menyebabkan produktiviti rendah. Objektif projek ini adalah untuk memperkenalkan sistem automasi yang akan menambah produktiviti barangan yang akan dipasang di kawasan pemasangan sedia ada dan juga menilai sistem automasi yang dicadangkan yang akan memaksimumkan jumlah pengeluaran dan juga pengendalian pengurusan operator lebih efektif. Projek ini membangunkan sistem modeling melalui perisian simulasi ARENA yang akan menilai keberkesanan penghasilan produktiviti sebelum dan selepas automasi. Pembangunan sistem simulasi ini adalah berdasarkan kepada proses pemasangan di PHN Industri, USJ. Hasil kajian dari analisa-analisa yang berkaitan dapat menambah pengeluaran produktiviti kepada 39% melebihi jangkaan yang ditetapkan dari pihak pengurusan. Ini disebabkan oleh implementasi sistem penghantaran yang lebih efektif melalui aplikasi konveyor. Penyelidikan ini akan memberi impak yang lebih baik sekiranya kajian terhadap “masa menunggu” dan “jumlah bahan yang menunggu” di setiap proses di kaji dengan lebih mendalam dimana dapat membantu pihak pengurusan dalam aplikasi automasi.

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## LIST OF ABBREVIATION

M/P	-	Mounting Pole
LNB	-	Low Noise Block
REFL	-	Reflector

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

The needs and applications of automated based technology in manufacturing industry is rapidly growing to be competitive and comparative in globalization demand. There are many different type of production automation system in the market today with the objective to improve its productivity, efficiency, cost and time to deliver the finish products. The examples of the automated production system are automated storage and material handling system such as Auto Guided Vehicles, Pick and Place, Robot Vision System and conveyor system where the usage will lead to significant increases in productivity and profit.

The study is focussed for Product Line A, at PHN Industry, USJ where the material handler systems are operated manually with highly dependence on operators for the movement of the parts. Due to high demand of the products recently, the production team is facing continuous challenge in meeting the productivity target everyday. The team is evaluating an automated Material Handler System as part of the productivity improvement plan.

Evaluating through a supplier is not convincing enough, thus, the research is required to evaluate using simulation model to gain insight into manufacturing systems.

There are several type of simulation software to perform as per requirement such as ARENA, TAMCAM, SIMAN, and WITNESS which are considered common for the experts to use as representing the actual model. This is because using simulation model is cheaper rather than trial and error of the physical parts which is known to be costly and lead to failure if mis-managed.

## **1.2 Problem statement**

One of the most significant factors causing the failure in meeting production yield is the interruption in material flow. The reasons, among others, are the high dependence on human operations, machine breakdowns, lengthy setup time, and long distance between machines and their unpredictable production schedules.

Increasing the flow of materials enables reduction in lead times, thus increasing production yields and customer satisfaction through consistent delivery schedules.

The most significant approach in solving the above matters however, is via automation through conveyor system as this would minimise human dependency, hence increase the speed of material flow as well as production throughput.

## **1.3 Objectives of the project**

The objectives of this project are:

- i. To propose an automation system that would improve productivity on actual existing manufacturing assembly area.
- ii. To evaluate the proposed automation system that will maximize headcount utilization

Simulation software such as ARENA will be used in this project. Arena is an easy-to-use, powerful modeling and simulation software tool that allows the user to construct a

simulation model and run experiments on the model. The software generates several reports as a result of a simulation run.

#### **1.4 Scope of work**

The scopes of this project are:

- i. The application of ARENA which is focus on simulation work in actual existing manufacturing environment.
- ii. Improvement considering increasing in productivity to the industry.
- iii. Automation technology to be considered includes conveyor system.
- iv. The scope of this study is limited to the assembly process of Product A at PHN Industry Sdn Bhd.
- v. Management problems are not considered in this study, nor will any changes in management behaviour be proposed. Other issues that will not be included in the study and recommendations are as follows:
  - a. Assumption is made in the experiment of this study that labours are readily available for work. Management has the obligation to provide more workers should they agree to adopt the recommendations.
  - b. Problems about the workers' behaviour that may influence the productivity are considered to be out of scope.
  - c. The study does not suggest any brand name of future equipment to be employed. The criterion used is only the machine properties.
  - d. Costs incurred in providing new layouts, facilities and spaces are not considered in the study.

- e. Also not in scope is the improvement of safety and regulations in the workplace.

## **1.5 Significance of Project**

This outcomes of this project will contribute towards knowledge enhancement in the conveyor application on existing workplace that upon implementation would benefits the company (**PHN Industry Sdn Bhd**) in terms of profit, men power saving, if it is successfully executed and produce good result. Those employees whom will involved directly with this study can share their knowledge among them based on their own expertises.

## **1.6 Outline of Report**

The report is outline in five main chapters where Chapter 2 details out the finding of the previous research done on the ARENA simulation with regards to conveyor system. The focus of the literature review to understand the gaps, development approach, analysis and recommendation of the previous research with regards to automation on conveyor system using simulation models. This chapter will also brief the definition of the ARENA software layout as focus of the subjects. The analysis of the manufacturing findings of previous research with the application of conveyor system in the manufacturing industries will be studied in detail to evaluate concerns and issues.

Chapter three will split into two main sections. The first half is development of simulation model in ARENA software which separated by two main models which defined as current production model and conveyor system model. Current production models will be built using current production flow and layout to validate the system entities and

features are performing as current system. The second part of the chapter will design the experimental approach to verify its performance towards the research objective. Alternative hypothesis will be defined with the propose detail analysis method which entirely populated a summary of inferential statistics.

Chapter four will display and briefly discussed the detail results of the finding. This chapter also evaluate whether the alternative hypothesis is rejected or accepted with regards to the analysis and findings. Chapter 5 will detail out the discussion analysis which derive and analyzed the result from chapter four whether the objectives of the findings are comparable not only to the subjected comparison studies but also to the studies done by previous researchers. This chapter also will evaluate whether the objectives of the research are achieved.

Conclusion and Recommendation will be discussed in Chapter six based on current analysis study. This chapter will present the analysis of the current development which can be enhanced for future reference to the company in terms of the optimum length of AGV to maximize production capacity.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

This chapter consist of review literature on automated material handling system and simulation. The literature review is based on previous and current research.

#### **2.1 Automation Technology**

##### **2.1.1 Definition of Automation Technology**

Automation is creating and applying the technology which monitors and controls production of goods and services. The technologies included range from robotics and expert systems, telemetry and communications, electro optics, cyber security, measurement and control of process , sensors, wireless applications, systems integration and test measurement. Today, we can see the replacement of employees with the use of computers, machines and robots.

##### **2.1.2 Components and Application of Automation Technology**

Automation is the outcome of the integration of several other components, namely material handling, storage, sensors, control system, actuators including vision system. Many industries have adopted automation technology. Some of which include:

- i. Manufacturing , including food and pharmaceutical, chemical and petroleum, pulp and paper.
- ii. Transportation , including automotive, aerospace, and rail
- iii. Utilities , including water and wastewater, oil and gas, electric power, and telecommunications
- iv. Military operations , including security, environmental control, energy management, safety, and other building automation and many others.

Time and money are two elements that are vital to be kept on track. Automation technology makes it possible for them to have a rather inversely proportional relationship, the decreasing in time consumption with increasing profit gain. In each industry, automation is involved in every framework namely installation, integration, and design, and production, maintenance, marketing and sales.

Many systems are made for automation process. Some of them are:

- i. Programmable logic controller
- ii. Electronic control using logic gates
- iii. Hard wired logic control
- iv. Pneumatic control
- v. Manual control

## **2.2 Automated Material Handling System**

Selection of proper material handling equipment is very important in designing a material handling system to enhance the production process, provide effective utilization of power, increase production, and improve system flexibility. But it is not an easy task (Chan et al., 2001).