KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN

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Design and Analysis of Manufacturing System Using Simulation

Thesis submitted in accordance with the requirements of the
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Bachelor of Manufacturing Engineering (Honours) (Manufacturing Process)

By

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APPROVAL

This thesis submitted to the senate of KUTKM and has been accepted as fulfillment of the requirement for the Bachelor of Manufacturing Engineering (manufacturing Process) (Honours). The members of the supervisory committee are as follows:

……

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ABSTRACT

This report is about the application of simulation in manufacturing systems and describes how the WITNESS simulation tool supports the simulation solution deployment. There have several alternatives of simulation deployment are describe includes reduce and increase number of stations. To run the simulation project the line or area that needs an improvement must be studied. The related data is taken and doing an analysis. Finally create and select a model, put the command of element and validate it. This functionality is described in detail and related to real-world examples when possible.

DEDICATION

For my beloved parents, Said bin Tasu and Rapiah binti Abdullah

To my supervisor, Prof. Dr. Mohd Razali bin Muhamad

And their supportive spirit

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بِسْمِ اللهِ الرَّ حْمٰنِ الرَّ حِيْمِ

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Modern high technology manufacturing systems, such as those in the electronics, semiconductor, aerospace, and automotive industries, can be extremely complex. The complexity of these systems is due to factors such as (Czarnecki, et al., 1997):

a) Multiple part types made in the same facility/line,
b) Numerous manufacturing steps (300-500 steps is not uncommon),
c) Batch processing, very complex equipment which leads to high levels of preventive maintenance and downtime,
d) Multiple levels of subassemblies, just to name a few.

This complexity combined with the high cost of setting up and maintaining such a system necessitates the use of formal *models* of the system, rather than just relying on experience or simple rules of thumb for performance evaluation and decision making.

Models are intended to support management decisions about the system and a single model will often not be capable of supporting all decisions. Rather, different decisions require different models because various aspects of the design and operation of the system will be important for the questions being asked of the model. While spreadsheet and queuing models are useful for answering basic questions about

manufacturing systems, discrete event simulation models are often needed to answer detailed questions about how a complex manufacturing system will perform. Simulation models lend themselves to incorporating additional details about the manufacturing system and therefore often give more accurate estimates of manufacturing system behavior than the simpler models mentioned above, but usually at the cost of more computation.

In general, simulation is a practical methodology for understanding the high-level dynamics of a complex manufacturing system. Simulation has several strengths including (Bowden Jr., et al., 2003):

a) Time compression – the potential to simulate years of real system operation in a much shorter time.
b) Component integration – the ability to integrate complex system components to study their interactions.
c) Risk avoidance – hypothetical or potentially dangerous systems can be studied without
d) The financial or physical risks that may be involved in building and studying a real system.
e) Physical scaling – the ability to study much larger or smaller versions of a system,
f) Repeatability – the ability to study different systems in identical environments or the same system in different environments.
g) Control – everything in a simulated environment can be precisely monitored and exactly controlled.

Next, these are about a Manufacturing Issues Address by Simulation. The following are some of the specific issues that simulation is used to address in manufacturing (Law & McComas, 1999):

a) The need for and the quantity of equipment and personnel
b) Number, type, and layout of machines for a particular objective
c) Requirements for transporters, conveyors, and other support equipment (e.g., pallets and fixtures)
d) Location and size of inventory buffers
e) Evaluation of a change in product volume or mix
f) Evaluation of the effect of a new piece of equipment on an existing manufacturing system
g) Evaluation of capital investments
h) Labor-requirements planning
i) Number of shifts

Performance of a manufacturing system evaluation can be made through a simulation model using (Law & McComas, 1999):

a) Throughput analysis
b) Time-in-system analysis
c) Bottleneck analysis

The evaluations of operational procedures of the manufacturing system are performed in the following areas (Law & McComas, 1999):

a) Production scheduling
b) Inventory policies
c) Control strategies [e.g., for an automated guided vehicle system (AGVS)]

d) Reliability analysis (e.g., effect of preventive maintenance)
e) Quality-control policies

The following are some of the performance measures commonly estimated by simulation (Law & McComas, 1999):

a) Throughput
b) Time in system for parts
c) Times parts spend in queues
d) Queue sizes
e) Timeliness of deliveries
f) Utilization of equipment or personnel

1.2 PROBLEM STATEMENT

The use of simulation for manufacturing system and analysis is justified for the following reasons:

a) Experimentation with the real system is infeasible, disruptive and too expensive.
b) Other mathematical or analytical method will not work.
c) Need to examine systems as they would operate over a given time frame.
d) Need to compare alternative proposed system design, or alternative operating policies for a single system, to see which best meets the specified requirements.

1.3 OBJECTIVES

The outcome of the project is to be achieved through the following objectives:

a) To developed a primary model of a manufacturing system using WITNESS simulation package.
b) To study the effects of varying the design parameters on the performance of the manufacturing system.

1.4 SCOPE OF PROJECT

WITNESS simulation package will be used package to develop a simulation in manufacturing system and then to know clearly about the effects when we using a several types of parameter at different values. The design of manufacturing system is normally confronted with the ‘what if’ question. Physically, to answer such question will incur high cost. Hence, simulation is used as an alternative. A manufacturing system will be selected as a case study. Various design options will be tested. For a selected design layout, various design parameters will be changed and the effects will be studied.

CHAPTER 2
LITERATURE REVIEW

2.1 MANUFACTURING SYSTEM

A manufacturing system is defined as a collection of integrated equipment and human resources, whose function is to perform one or more processing and/or assembly operations on a starting raw material, part, or set of parts. The integrated equipment includes production machines and tools, material handling and work positioning devices, and computer systems. Human resources are required either full time or periodically to keep the system running. The manufacturing system is where the value-added work is accomplished on the part or product. The position of the manufacturing system in the larger production system is seen in Figure 2.1 Examples of manufacturing systems includes (Groover, 2001):

a) One worker tending one machine, which operates on semi-automatic cycle
b) A cluster of semi-automatic machines, attended by one worker
c) A fully automated assembly machine, periodically attended by a human worker
d) A group of automated machines working on automatic cycles to produce a family of similar parts
e) A team of workers performing assembly operations on a production line.

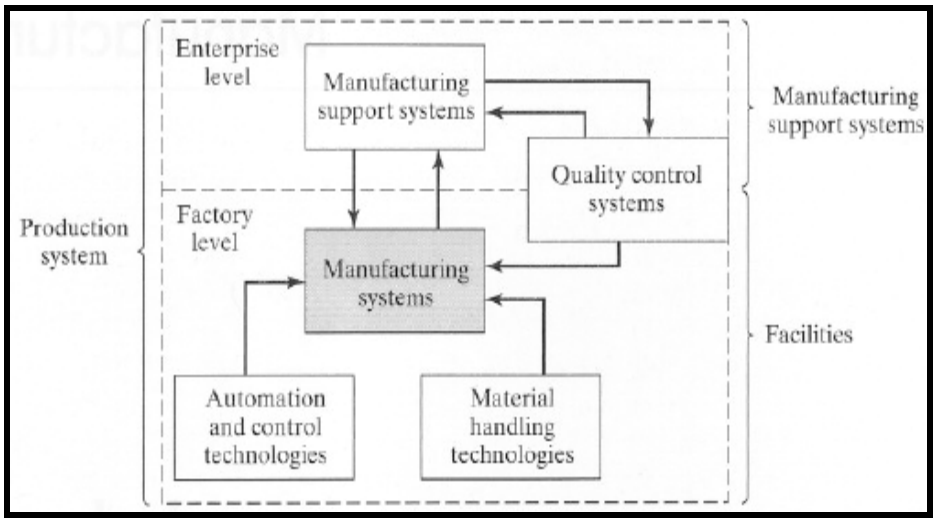

Figure 2.1: The position of the manufacturing system in the larger production system.

2.1.1 Manufacturing System Components

Manufacturing system consists of several components. In a given system, these components usually include (Groover, 2001):

a) Production machines plus tools, fixtures, and other related hardware.
b) Material handling system.
c) Computer systems to coordinate and/or control the above components.
d) Human workers.