KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA

SIMULATION STUDY ON THE PERFORMANCE OF FLOW SHOP SCHEDULING

Thesis submitted in accordance with the requirements of the
Kolej Universiti Teknikal Kebangsaan Malaysia for the Degree of
Bachelor of Manufacturing Engineering (Honours) (Manufacturing Process)

By

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

Signature	:	……………………………………………
Supervisor's Name	:	Puan Hajjah Seri Rahayu bt. Haji Kamat
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DEDICATION

"Especially to my family, lecturers and members who give
me a big support to complete the PSM project"

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ABSTRACT

An objective for this project to make some improvement in their performance and studied about the process flow between gating process and ranking process it is important to select which proposed alternative suitable for company to increase their productivity and profit. Therefore, in order to complete this project, I must know about the processing time and machining operations needed for the operator while doing their task.

For simulated the project, I had used the Witness software because is a powerful and easy to use simulation tool for modeling all types of manufacturing systems.

The planning of the project has been described in this report. There have eight chapters; introduction, literature review, methodology, data collection/data input, simulation model development, alternatives, result and discussion, and the last is conclusion and suggestion.

ABSTRAK

Objektif projek ini adalah untuk membuat perubahan ke atas prestasi dan mempelajari mengenai proses aliran di antara proses “gating” dan proses “ranking”. Ini adalah penting bagi memilih alternatif yang sesuai untuk diaplikasikan di syarikat tersebut untuk meningkatkan produktiviti dan keuntungan syarikat. Oleh itu, bagi menyelesaikan projek ini, saya perlu tahu tentang masa yang diperlukan bagi operator yang menjalankan proses dan operasi setiap mesin.

Untuk projek simulasi ini, saya menggunakan perisian Witness kerana ia mudah untuk dibangunkan dan boleh menghasilkan berbagai jenis model bagi setiap sistem pembuatan.

Perancangan untuk projek ini akan dihuraikan di dalam tesis ini. Ia mempunyai lapan tajuk iaitu pengenalan, kajian ilmiah, pengkaedahan, pengumpulan data/data masukan, pembangunan model simulasi, alternatif, keputusan dan perbincangan, dan akhir sekali adalah kesimpulan dan cadangan.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

N	The number of entities that are processed through the system.
T_i	The system time for an individual entity (arrival time – departure time)
D_i	The queue time for an individual entity (queue arrival time – service begin time)
B	Either 0 for idle or 1 for busy
Dt	The length of time that is observed
T	The total length of time for the simulation
Q	The number in the queue for a given length of time
P	Present value (RM), the value of a project, loan, or financial activity at the present time.
F	Future value (RM), the value of a project, loan, or financial at a future point in time.
i	Effective interest rate for a given period during which time the interest is to be compounded (e.g., !) percent per year).
n	Number of interest periods.
NP	Nested Partitioning
OCBA	Optimal Computing Budget Allocation
WIP	Work in Process
MRR	Material Requirement Planning
JIT	Just in Time
MPS	Master Production Scheduling
FIFO	First in First Out
SLP	Systematic Layout Planning
TOC	The Theory of Constraints
CCRs	Capacity Constrained Resourses

CHAPTER I
INTRODUCTION

1.1 Background

The general flow shop problem is defined so as determine that start/completion times for each operation job waiting to be processed in the shop that satisfies the following:

1) The technological constraints or processing the order for each job on all the resources.
2) Optimality (i.e., minimize or maximize a given objective function) or satisfiablity (i.e., a reasonably good performance with respect to one or more scheduling criteria) constraints.

Scheduling plays an important role in shop floor planning. A schedule shows the planned time when processing of a specific job will start on each machine that the job requires. It also indicates when the job will be completed on every machine. Thus a timetable for both jobs and machines. The starting time of a job on the first machine in its sequence of operation should also be the release time for the job (assuming zero lead time). If some lead time is necessary, the release time is correspondingly adjusted.

The term scheduling criteria defines a scalar value function, which measure the performance or effectiveness of a particular schedule. A performance measure is usually defined in terms of its shop or job completion characteristics and is given as a function of the job or operation completion times.

The processing of an order on a resource is called an operation. Each job must be processed through the machines in a particular order and may have no relation to the processing order of any other job. A special case of the general job shop-scheduling problem is defined as a flow shop problem, where all the jobs go through the same processing order. This special case is of particular interest because of the widespread simulation applications in flow processes, such as print shops, electronics manufacturing and assembly operations.

Each operation requires a fixed or stochastic length of time to be completed, which is referred to as the processing time. In a general flow shop-scheduling problem is assumed to be sequence or shop condition independent, a highly contested assumption. Each operation may also require a setup time. A setup time is required for preparing a machine for a particular operation. The setup time may or may not be required based on the current setup of a machine. Therefore, in the general problem, the setup time is assumed to be dependent.

1.2 Problem statement

Consider again the scenario above, this time through the eyes of the plants manager, who see that although everyone is attempting to do a conscientious job, the efforts are often misdirected. The use of hot lists to set priorities in getting products out the door causes major disruptions and confusion on the shop floor. Schedule changes prompted by these hot lists satisfy some short-term requirements. Shipment dates are missed, the customers complain to the sales force.

Although there appears to be much work-in-process, the reality is that most of the work is setting in queues. In addition, a staggering amount of unplanned overtime and quality problems are mounting.

Symptoms of scheduling problems

1) Uncontrollable costs
2) Disruptions on the shop floor
3) Late deliveries to customers
4) Unplanned overtime/off-loading
5) High work-in- process
6) Frequent schedule changes
7) Customer complaints
8) Long queues

1.3 Objectives of the Research

The objective of this research is to doing for make some improvement in their performance and also studies about their relation between one area to another area whether it suitable or not.

The specific objectives of this project are:

1) To design and develop the performance of flow shop scheduling using Witness software (case study in Maruwa (M) Sdn Bhd).
2) Better use of resources through the identification of bottlenecks and spare capacity.
3) To understand manufacturing process at Maruwa (M) Sdn Bhd and simulation model by using Witness software.
4) To analysis existing system and proposed the new layout in gating and ranking process at Maruwa (M) Sdn Bhd.

1.4 Scope of Research

1) To establish problem definition, objective and methodology.
2) To analyze performance of flow shop scheduling at gating and ranking process.
3) To evaluation of operational procedures at gating and ranking process.
4) Determine the impact of random machine downtimes and performance of labor at gating and ranking process.
5) Data collection at gating and ranking process at Maruwa (M) Sdn Bhd.

CHAPTER II
LITERATURE REVIEW

2.1 Introduction to Manufacturing Simulation

Including research by Schott Miller and Dennis Pegden (2000), they were focus about manufacturing simulation has been one of the primary application areas of simulation technology. It has been widely used to improve and validate the designs of a wide range of manufacturing systems. The typical manufacturing model is usually used either to predict system performance or to compare two or more system designs or scenarios. Facility design applications may involve modeling many different aspects of the production facility, including equipment selection/layout, control strategies (push/pull logic), material handling design, buffer sizing, dispatching/scheduling strategies and material management. Depending on the objectives of the study, a detailed model of a facility level process can be very large and complex. Supply chain models are used to study an enterprise wide process that may encompass multiple production facilities, distribution centers and transportation systems.

In additional, the basic approach with simulation-based scheduling is to run the factory model using the starting state of the factory and the set of planned orders to be produced. Decision rules are incorporated into the model to make machine selection and routing decisions. The simulation constructs a schedule by simulating the flow of work through the facility and by making "smart" decisions based on the scheduling rules specified. Simulation-based scheduling, there are two types of decision rules that can be applied as each job step is scheduled:

1) An operation selection rule
2) A resource selection rule

If a resource becomes available and there are several operations waiting to be processed by the resource, the operation selection rule is used to select the operation that is processed next. If an operation becomes available and it can be processed on more than one resource, the resource selection rule is used to decide which resource is used to process the operation.

On the basis of such concepts and views of the meanings of manufacturing and systems so far discussed, manufacturing (or production) systems can now be defined in the following three aspects (K. Hitomi, 1975):

1. *The Structural Aspect of Manufacturing Systems.* Based on structural (or static) definition of the system, the manufacturing system is a unified assemblage of hardware, which includes workers, production facilities (including tools, jigs, and fixtures), materials-handling equipment, and other supplementary devices. Thus the structural aspect of the manufacturing system forms a static spatial structure of a plant, i.e., the plant layout. This aspect can be viewed as a production system. This phrase appeared in 1907. Since 1943 it has been also used to mean the inference mechanism operated by knowledge based systems in the field of artificial intelligence (a different terminology should be introduced for this meaning).
2. *The Transformational Aspect of Manufacturing Systems.* Based on a transformational (or functional) definition of the system, the manufacturing system is defined as the conversion process of the factors of production, particularly the raw materials, into the finished products, aiming at a maximum productivity. This system is concerned with the flow of materials (or material flow). This is a common method of defining production systems or, in some cases, machining systems.

3. *The Procedural Aspect of Manufacturing Systems.* Based on a procedural definition of the system, the manufacturing system is the operating procedures of production. This constitutes the so-called management cycle, i.e., planning, implementation, and control. This process was recognized in Germany in the late 19th century, and Fayol established the functions of this process in 1916. Planning is selection, from among the alternatives, of the future course of action; implementation executes practical activities according to the plan (schedule); and control is measurement and correction of the performance of the activities to make sure that the management objectives and plans are being accomplished. Hence the manufacturing system plans and implements the productive activities to convert raw materials into products and controls this process to reduce or eliminate deviation of the actual performance from the plan. This procedure-production management-constitutes the flow of information (or information flow) for effective and economical production.

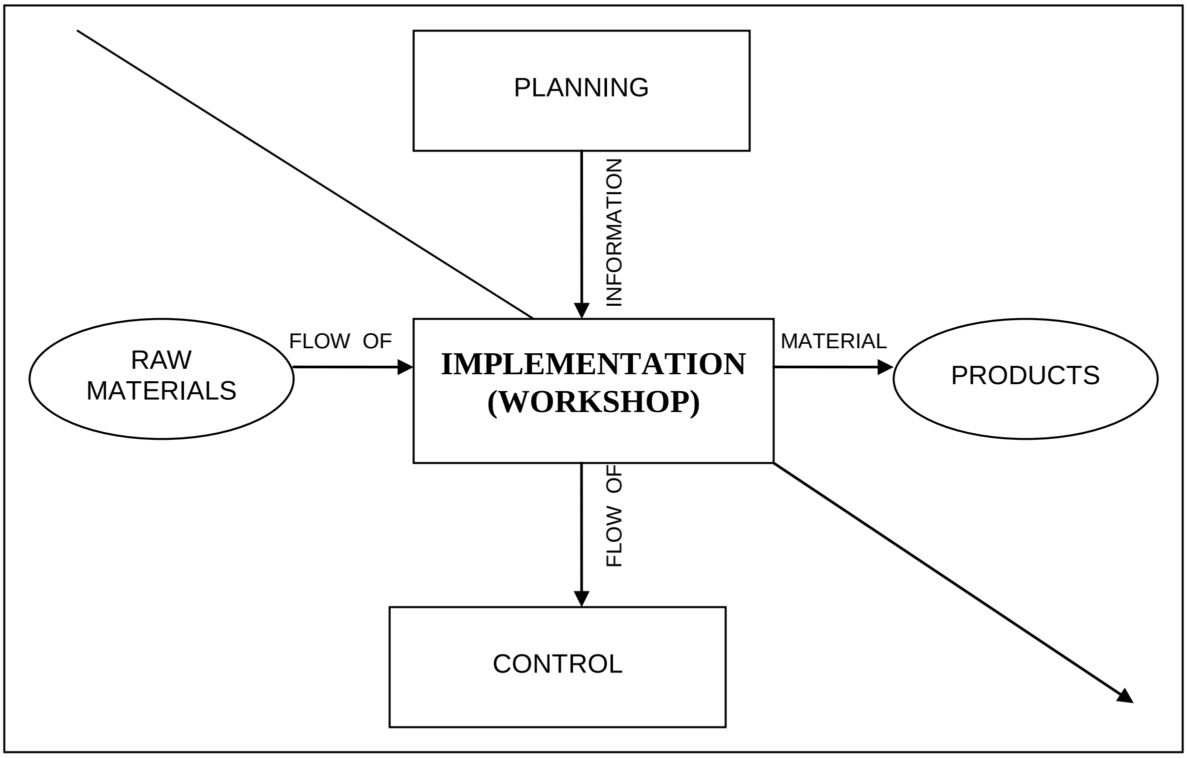

Figure 2.1: Three flows concerning manufacturing: flow of material, flow of information and flow of costs (K. Hitomi, 1978).