DEVELOPMENT OF PRODUCTION SEQUENCING SOFTWARE FOR INDUSTRY

MOHD ZAINI BIN JAMAK

A report submitted in partial fulfillment of the requirements
for the award of the degree of
Bachelor of Mechanical Engineering with Manufacturing Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2008

SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Manufacturing Engineering.

Signature :
Name of Supervisor: Mohd Fadzil Faisae Bin Ab. Rashid
Position : Supervisor
Date : 01 November 2008

Signature :
Name of Panel: Siti Haryani Binti Tomadi
Position : Panel
Date : 01 November 2008

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature :

Name : Mohd Zaini Bin Jamak

ID Number : ME 05058

Date : 01 November 2008

To my beloved father and mother,

Jamak Bin Ismail

Zainun Binti Ahmad

and her,

Nur Syazana Binti Hamzah

ACKNOWLEDGEMENTS

"In the name of Allah, the Most Merciful and the Most Beneficent"

Thanks to Allah S.W.T that gives strength and ability to complete this thesis successfully. Million of appreciations to research's supervisor, Mr. Mohd Fadzil Faisae B. Ab. Rashid for given me aids, critics, encouragement, guidance, and valuable advices in order to complete this project. Experiences that have been shared for 1 year will be very important assets for me in the future.

Also, to fellow colleagues especially Ms. Ashuura, Mr. Arif Syazni and representative from company, Miss Nurlida, Mr. Mokhtar, Mr. Shukor, Mr. Yazid, Mr. Abdul Hapidz and Mr. Arif for their guidance from a smallest part to an important part until this project are success. Without them, this thesis would not have been the same as presented here in this thesis.

Not forget to all best friends that shared everything together along with this project, for their understanding and courage, sharing all the moments without even care about themselves. Mohd Nizam, Zairul Ezree, Mohd Syafiq, Hazmil and Ahmad Syazwi. Love you all.

Very special and love appreciation to my father and mother, family and my special person that be an internal spirit and continual support to gives a big and deep effects to me when this project were held. Thanks for your caring and loves.

Last, but certainly not least, deeply thanks also goes to others who have provided assistance and various occasions whether direct or indirectly in the completion of this project.

ABSTRACT

The aim of this project is to develop a production sequencing software for specific company. Research has started with the trailing of a specific area in their production process that undergo problem in term of sequencing. Thus, in the first phase, all the problem sources and correlation in that area have been identified to overcome it using the sequencing element. Next, the problems that have been identified were solved through the development of software to provide an organized computerized sequencing system. The software has been developed by *Visual Basic .NET* that filled all the problem solving criteria and was simulated so that it is suitable with the environment of research area. At the final of the project, the production sequencing software have been developed successfully and accepted by company to improve the sequencing in research area.

ABSTRAK

Tujuan utama kajian ini dijalankan adalah untuk membangunkan alatan lembut turutan produksi untuk sesebuah syarikat tertentu. Kajian ini bermula dengan mengesan mana-mana kawasan tertentu dalam proses produksinya yang mengalami masalah berkaitan turutan. Oleh itu, dalam fasa pertama, semua punca dan perkaitan masalah di kawasan tersebut dikenalpasti bagi mengatasinya menggunakan elemen yang terdapat dalam turutan. Seterusnya, masalah yang telah dikenalpasti diselesaikan melalui pembangunan alatan lembut bagi menyediakan satu sistem turutan berkomputer yang tersusun. Alatan lembut tersebut dibangunkan menggunakan *Visual Basic .NET* yang memenuhi kriteria penyelesaian masalah dan disimulasikan supaya bersesuaian dengan persekitaran kawasan kajian. Di akhir projek ini, alatan lembut turutan produksi telah berjaya dibangunkan dan diterima oleh syarikat itu bagi kebaikan dan kelancaran turutan kawasan kajian tersebut.

TABLE OF CONTENTS

CHAPTER 4 RESULTS AND DISCUSSION

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

LIST OF FIGURES

Figure No. **Page**

LIST OF SYMBOLS

t_j	Processing time
r_j	Ready time
C_j	Completion time
F_j	Flow time
L_j	Lateness
T_j	Tardiness

LIST OF ABBREVIATIONS

ASDL	Abstract Syntax Description Language
CMC	Control, Monitor and Coach
CR	Critical Ratio
EDD	Earliest Due Date
FCFS	First Come, First Serve
FIFO	First In, First Out
GUI	Graphical User Interfaces
IDE	Integrated Development Environment
ISO	International Organization for Standardization
LPT	Longest Processing Time
MDE	Microsoft Development Environment
MRP	Material Requirement Planning
MSDOS	Microsoft Disk Operating System
MSSQLServer	Microsoft Structured Query Language
OHSAS	Occupational Safety and Health Administration
PU	Polyurethane
proomseq	Potting Room Sequence
SAP	Systems Applications And Products
SQL	Structured Query Language

CHAPTER 1

INTRODUCTION

1.1 Project Background

The concern for improving performance continuously and rapidly in production system in this competitive world is gathering momentum. Various method and performance measure has been focus in this area in order to go with a flow of global competition. One of the elements to achieve a world class manufacturing is through a scheduling system [1].

Many researchers have been studied in this field to improve the effectiveness of scheduling and one of the important criteria is production sequencing software. Scheduling techniques vary by type of production process depends on how the environment of production.

The purpose of this study is to develop sequencing software for specific production process in the specific company to make allocating decisions included start and finish times for tasks. The main objective is to study the current scheduling practices first in the production system and develop a suitable sequencing algorithm in the selected process area to build the software for the purpose of improving process performance. Several techniques are applied in this study in order to solve the problem that occurs at the process.

Some sequencing problems are difficult to solve and interesting to study. The analysis is beginning by examining the scheduling environment, including jobs, machines, measures of performance and algorithms. Then, the scheduling systems will be examine and recommend a new algorithm for the evolution of scheduling in term of sequencing [1].

The collection of data will be based on model selected that agreed by two parties, company and researcher. The analysis will be done by researching on current scheduling system and then come with one solution for improvement through the new recommendation algorithm before start to build the software.

1.2 Project Objectives

As a fundamental, the main purposes in carried out this project are:-

1. To develop a sequencing software for a specific process on a specific company.
2. To improve the sequence in which tasks are to be performed.

1.3 Problem Statement

According to [2], poor execution on the shop floor can lead to decreased sales, increased cost-of-goods-sold, and increased operating expenses. The manufacturing scheduling problem becomes even more complex it takes place in dynamic environment, where changes in the number of jobs or machine occur at any time. In dynamic manufacturing system changes rarely go as expected such as [3]; (1) new job with or rush job arrive, (2) resources breakdown or failure, (3) delay happen.

Flexible scheduling allows adjusting to new order, changed orders, breakdowns, material shortages, absenteeism, and capacity problems [3]. From [4], the common elements of scheduling problem; (1) Constraints of sources, (2) Ability of machinery in

the shop to complete jobs in a given amount of time, (3) The flow pattern of jobs through the job varies from job to job, (3) Jobs may arrive in batches or they may arrive such that the time between arrivals is constant. Jobs may also arrive with different priorities.

1.4 Project Scope

The scope of this project is focusing on these criteria:-

1. The research will be carried out on manufacturing based factory.
2. The target of a research is on specific production process as a research model.
3. Selection of software will be car/.ried out based on process and ability of company.
4. Propose new sequencing system on the model and depends on company whether to apply it or not.

1.5 Background of Selected Company

Vaccumschmelze (M) Sdn. Bhd. (VAC) was incorporated in 2001 with capacity of 25,000 $inch^2$ in Pekan, Pahang. This company is one of the operation centres for their mother company in Germany. The location was originated from sub-contractor of Filter Power and then have take over by VAC as one of their operation centre in Malaysia.

Each single company in manufacturing industry must have their own objective to achieve their goal whether short or long term. Same as VAC; that already set the objective to be the excellent operation centre among the VAC organization around the world. Management Policy of this company has already achieved the world class level such as ISO/TS 16949: 2002, ISO 14001: 2004, ISO 9001: 2000, and OHSAS 18001:1999.

The main customers for VAC products are Siemens VDO, Bosch, GEBR. SWOBODA GMBH. VAC produce an electronics parts for all their customer for used on transformer, ASDL (telecommunications), automotives industries, industrial application and also medical part. The demand for the products continuously exists according to order from their regular customers and makes them competitive in market.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The customer remains king in the competitive manufacturing environment. The capabilities of manufacturing plus the expectations of customers has led to increased pressure for both speed and variety. The manufacturing planning and control is concerned with planning and controlling all aspects of manufacturing, including managing materials, scheduling machines and people, and coordinating suppliers and key customers [5].

Process planning is the systematic determination of the detailed methods by which parts can be manufactured from raw material to finished products. That's mean, it refers the process of establishing strategies for producing finished products so that manufacturing resources are used efficiently [6].

Production control is the systematic planning, coordination and direction of all manufacturing activities to ensure that products (of adequate quality) are made on time and at reasonable cost [6].

To summarize, in production planning, we first make a plan anticipating the future events and after that follow the plan, whereas in production control we simply react to the events as they occur during the production [6].

So, this chapter will concentrated on all about production planning that consists of production scheduling and sequencing and understand overall of process of scheduling based on previous study and all related information.

2.2 Production Scheduling

2.2.1 Definition of Scheduling

Scheduling is the allocation of resources applying the limiting factors of time and cost to perform a collection of task. Scheduling theory is concerned primarily with mathematical models that relate to the scheduling function and the development of useful models and techniques [1].

Production scheduling is concerned with the allocation of resources and the sequencing of tasks to produce goods and services. Although allocation and sequencing decisions are closely related, it is very difficult to model mathematically the interaction between them. However, by using a hierarchical approach, the allocation and the sequencing problems can be solved separately. The allocation problem is solved first and its results are supplied as inputs to the sequencing problem [1].

Because of complexity of production scheduling there are different views of it [7]:-

1) Problem Solving Perspective

   Scheduling as an optimization problem. It is the formulation of scheduling as a combinatorial optimization problem isolated form the manufacturing planning and control system place.

2) Decision making Perspective

Scheduling is a decision that a human must make. Schedulers perform a variety of tasks and use both formal and informal information to accomplish these. Schedulers must address uncertainty, manage bottlenecks, and anticipate the problems that people cause

3) Organizational Perspective

Systems level view that scheduling is part of the complex flow of information and decision-making that forms the manufacturing planning and control system. Such systems are typically divided into modules that perform different functions such as aggregate planning and material requirements planning

2.2.2 Simple Model of Production Scheduling

For the scheduling, its determine how to which machine a part will be routed for processing, which worker will operate a machine that produces a part, and the order in which the part are to be processed [3].

What makes scheduling so difficult in job shop is the variety of jobs that are processed. In addition, although the volume may be small, there are probably a great number of different orders in the shop at any one time [3].

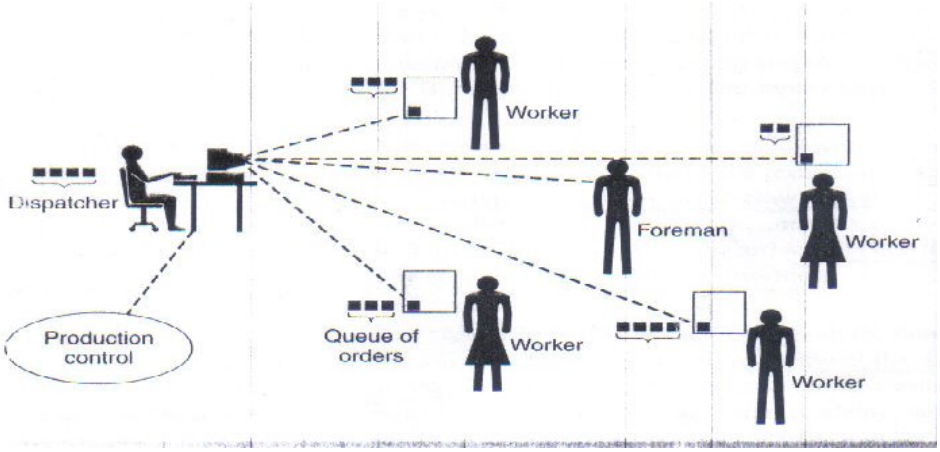

Figure 2.1: Typical scheduling process

A simple job shop-scheduling process shown is in Figure 2.1. At the start of the day, the job dispatcher selects and sequences the available jobs to be run at individual workstations. The dispatcher's decisions are based on the operations and routing requirements of each job, status of existing jobs on the machines, the queue of work before each machine, job priorities, material availability, anticipated job orders to be released later in the day, and worker and machine capabilities [3].

To help organize the schedule, the dispatcher draws on shop-floor information from the previous day and external information provided by central production control, process engineering, and so on. The dispatcher also meets with the foreman or supervisor of the department to discuss the feasibility of the schedule, especially with respect to workforce considerations and identifying potential bottlenecks [3].

2.2.3 Purpose of Scheduling in Manufacturing

According to [8], the purpose of scheduling in manufacturing is to minimize the production time and costs, by telling the production facility what to make, when, with which staff, and on which equipment in order to maximize the efficiency of operation and reduce costs.

The goals of different parts of the firm are not always the same. Some of the most common objectives in constructing a schedule are [9]:-

1. Meet due dates.
2. Minimize work-in-process (WIP) inventory.
3. Minimizing the average flow time through the system.
4. Provide for high machine/worker time utilization. (Minimizing machine/worker idle time)
5. Provide for accurate job status information.
6. Reduce setup times
7. Minimizing production and worker costs.

2.2.4 Terminology

In general, a scheduling problem is one in which n jobs must be processed through m machines. The complexity of the problem depends upon a variety of factors, such as what job sequences are permissible and what optimization criteria are chosen. In this section we define some of the terms that common used in scheduling [1].

Processing time (t_j). It is the time required to process job j. the processing time, t_j will normally include both actual processing time and set-up time.

Ready time (r_j). It is the time at which job j is available for processing. The ready time of a job is the difference between the arrival time of that job and the time at which that job is taken for processing. In the basic model, as per condition 1, r_j = for all jobs.
Due date (d_j). It is the time at which the job j is to be completed.

Completion time (C_j). It is the time which the job j is completed in a sequence. Performance measures for evaluating schedules are usually function of job completion time. Some, sample performance measures are Flow time, Lateness, Tardiness, etc.

Flow time (F_j). It is the amount of time job spends in the system. Flow time is a measure which indicates the waiting time of jobs in a system. This turn gives some idea about in-process inventory due to a schedule. It is the difference between the completion time and the ready time of the job j.

Lateness (L_j). It is amount of time by which the completion time of job j differs from the due date ($L_j = C_j - d_j$). Lateness is a measure which gives an idea about conformity of the jobs in a schedule to a given set of due dates of the jobs. Lateness can be either positive lateness or negative lateness of a job means that the job is completed before its due date. Negative lateness of a job means that the job is completed before its due date. The positive lateness is a measure of poor service. The negative lateness is a measure of