UNIVERSITI PUTRA MALAYSIA

MODELLING AND DEVELOPMENT OF AN IMPROVED SORTING SYSTEM IN THE PLYWOOD GRADING LINE

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FK 2003 63

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By

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Thesis Submitted to the School of Graduates Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

November 2003

UPM

DEDICATION

To my loving wife, Rose Amnah and my kids, Effa, Rizal, Shidee, Rina and Syahin for their support and encouragement, I am deeply grateful. I dedicate in loving memories to my late parents Rasul bin Lokman and Rokiah binti Iskandar, may god bless them.

Abstract of thesis presented to the Senate of University Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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Chairman: **Associate Professor Napsiah Ismail, Ph.D.**

Faculty: **Engineering**

The main focus of this study is on the sorting method of graded plywood in the grading line. The plywood grading line is the final process in the production line. Due to the inefficiency of the sorting method, this line has low productivity, high labor usage and defectives due to improper sorting of the plywood by the operator. The collected statistics were analyzed and the output analysis deals with drawing the comparison between the existing grading line and the built model. This study has eight aspects measured in order to achieve the objectives. They are; time study, production rate, labor cost, labor productivity, capacity utilization, defective rate, investment cost and downtime. Overall comparison for sorting graded plywood between existing system and proposed systems (pneumatic and hydraulic systems), shows that, the sorting time was reduced to 20.3% using pneumatic sorting system whereas 10.9 % using hydraulic sorting system. Hence increasing the production rate by 38.9% and 32.5% accordingly.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan ijazah Master Sains

MEREKABENTUK MODEL DAN PEMBANGUNAN PENAMBAH BAIKAN SISTEM PENGAGIHAN DI DALAM BARIS PENGREDAN PAPAN LAPIS

Oleh

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November 2003

Pengerusi: **Profesor Madya Napsiah Ismail, Ph.D.**

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Fokus utama kajian ini ialah pada kaedah pengagihan papan lapis yang telah digredkan. Proses pengredan ini merupakan proses yang terakhir di dalam proses pengeluaran papan lapis. Teknik pengagihan yang tidak cekap pada sistem sedia ada, menyebabkan kadar pengeluaran yang rendah, kadar penggunaan buruh yang tinggi dan peningkatan kerosakan papan lapis akibat dari kesan tolakan yang tidak seragam dari operator. Kajian ini meliputi lapan aspek yang diuji iaitu kajian masa, kadar pengeluaran, kos buruh, produktiviti buruh, kapasiti penggunaan, kadar kerosakan, kos pelaburan dan lengah masa. Perbandingan secara keseluruhan antara sistem sedia ada dengan sistem cadangan (pneumatik dan haidraulik) menunjukkan melalui sistem cadangan banyak aspek telah ditingkatkan. Melalui sistem pneumatik didapati 20.3% masa pengagihan dapat dikurangkan, manakala 10.9% masa dapat dikurangkan melalui sistem haidraulik. Sekaligus ini meningkatkan kadar pengeluaran sebanyak 38.9% melalui sistem pneumatik dan 32.5% melalui sistem haidraulik.

ACKNOWLEDGEMENTS

This report was produced in co-operation with Mentiga Corporation Berhad in Pekan, Pahang and is based on a review of relevant literature and consultations with executives of focus groups and specialists. Their able and dedicated contributions, as well as the guidance provided by lecturers from University Putra Malaysia, Dr. Napsiah Ismail, Ir. Dr. Md. Yusof Ismail and Dr. Megat Mohamad Hamdan are gratefully acknowledged. I would also thank the mechanical engineering department of Politeknik Sultan Haji Ahmad Shah, Kuantan, Pahang for the equipment used.

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GLOSSARY

Automation: Automation is a system, process, or piece of equipment that is self-acting and self-regulating.

Basic time: Basic time is the time required to sort plywood to their respective station at standard rating.

Capacity: the maximum rate of output (production) for a process.

Contingency allowance: Contingency allowance is a small allowance of time, which may be included in a standard time to meet the legitimate and expected items of work or delay. It should not be greater than 5% of basic time.

Defective rate: Defective rate is a significant factor in manufacturing process. It determined the number of pieces plywood defected while in the process of sorting the goods. It is calculated per unit of time, such as hour, day, month, or year.

Effective capacity: Effective capacity is the maximum output (production) that a process or firm can economically sustain under normal conditions.

Job flow time: The amount of shop time for the job.

Labor cost: Labor cost is referred to the salary of the labor worked over a certain period such as hour, day, month, or year.

Labor productivity: Labor productivity is an index of the output (plywood sorted) per person or hours worked. In other words it is also the ratio of the value of output to labor hours.

Makespan: The total amount of time required to complete a group of jobs.

Method study: Method study is concerned with the reduction of work content of an operation, while work measurement is mostly concerned with the investigation and reduction of any time associated with it and with the subsequent establishment of time standards for the operation when carried out in the improved fashion.

Peak capacity: Peak capacity is the maximum output (production) that a process can achieve under ideal conditions.

Process: A process is any activity or group of activities that takes one or more inputs (grading, distributing, and sorting), transform and add value to them, and provide one or more outputs.

Production rate: Production rate is a significant factor in manufacturing process. It determined in the number of pieces plywood to be sorted per unit of time, such as hour, day, month, or year.

Relaxation allowance: Relaxation allowance is the allowance to provide the worker the opportunity to recover from the physiology and psychological effects of specific work carried out under specified conditions and to allow attention to personal needs.

Simulation: Simulation is defined as experimental techniques usually performed on a computer, to analyze the behavior of any real-world operating system.

Standard time: Standard time is the time required for a qualified and well-trained person, working at a normal pace, to do a specific task.

System: A system encompasses a collection of elements (PLC, PC, Pneumatic cylinders, hydraulic cylinders, solenoid valves, , conveyor and the like) between which there is a mutual interaction (interconnection), which can be separated

from these environment of that system (system boundaries). The mutual interaction between the elements of a system realizes the system function, which can, in general, be divided into a number of specified attributes and properties.

Throughput: The number of jobs produced per unit of time.

Time study: Time study is a tool to work measurement that is used to determine the time required to sort graded plywood.

Utilization: Utilization is the degree to which equipment is currently being used.

Work measurement: Work measurement was defined, as a set of procedures for determining the amount of time required, under certain standard conditions of measurement, for tasks involving some human activity. The result of such a measurement is called a standard time.

Work study: Work study is a generic term for those techniques particularly method study and work measurement, which are used in all its contexts, and which lead systematically to the investigation of all the factors, which affect the efficiency and economy of the situation being received.

CHAPTER I

INTRODUCTION

1.1 Introduction

Competitive pressure and globalization have provided the impetus for innovation and management of new technology. The aspiration to develop Malaysia into an industrialized nation by the year 2020 has initiated the Government to emphasize on the modernization of Malaysian manufacturing industries by enhancement of technological capabilities via adoption of sophisticated technologies (Jantan et al., 2000). Today, the rapidly changing demands have rendered traditional assembly line manufacturing less effective. For the past few decades, researchers have devoted time and effort applying automation and modern computer technologies towards improving the productivity of traditional industries (Klinkhachorn et al., 1995).

Manufacturers have to change the basics layout or system of their plant to accommodate automation system, and one of these changes involve the implementation of the manufacturing cells. Implementing automation system also involves the substitution of machines and can be a complex decision for organizations. There are lots of criteria that should be considered in the implementation of automation system; some of these include total cost, time, labor requirements, work-in-process, space requirements, volume flexibility, and process/routing flexibility (Marcus Syn, 2003).

Demands for wood products are at all time high. Training tools and automated systems are needed to make major processing improvements and proper product allocation. Lack of automation in the primary processing area causes waste and low product yields, and increases demand for additional timber harvesting. Automation systems combined with computerized grading of plywood would help the accuracy of grading, reduce the number of times boards need to be graded and restacked and provide a means to increase the grade of some low-grade plywood (Araman, 1996).

In plywood industry high productivity demands have led to a growing interest of automatic systems. Increasing the capacity of production lines and in the same time preserving or increasing the quality level of the product requires highly automated and reliable measuring systems. Currently, the plywood grading system, are done manually (Lampinen et al., 1995). To be competitive, one must streamline operations and minimize production costs, while maintaining an acceptable margin of profit. Klinkhachorn et al. (1995) in his study of automated lumber processing system; grading the hardwood lumber using automation describes the effort of improving lumber industry in the U.S.A, specifically to automatically grade and analyze hardwood lumber.

Gerber Scientific's engineering expertise has propelled the company's deep technical capabilities in computerized grading system noted that the manual method requires highly skilled craftsmen and is very labor-intensive, while the automated method requires very expensive and complex equipment few shops can afford. Both processes are inconsistent in terms of the quality they provide.

High competition in the sawmill industry requires increasing the speed of the production lines and at the same time to preserve or increase the quality of the final products. Thus the potential in automated grading is very high provided that the grading accuracy is sufficient with respect to the current standards (Holliday, 1999).

These studies (Marcus Syn, 2003; Araman, 1996; Klinkhachorn et al., 1995; and Holliday, 1999) show that problems faced by timber concessionaires in other parts of the world are similar. This is merely to establish the fact that of this study is not confined to a local problem but it is a universal problem.

Acceptance of new technology and innovation as strategic weapons for competitive advantage in the plywood grading line is referred to as new and better way of doing things. Hence the main focus of this study is on the sorting method of graded plywood in the grading line, which is hope to produce maximum productivity and quality output within time while keeping the operation and costs to a minimum. The study will take place in one of the world's largest timber concessionaires under the ASPA Group (Amanah Saham Pahang Berhad), which is Mentiga Corporation Berhad in Pekan, Pahang.

1.2 Background Problem

For the year reviewed in 1995, the Malaysian economy continues to achieve strong overall growth. Production in the manufacturing sector increases by 12.2 percent over 1995. The timber and wood based industries however registered

lower production rates. The tropical plywood market has remained relatively stagnant since mid-1995. Supply of plywood is fairly elastic with many mills presently operating below their capacity (Mentiga Corporation Berhad, Annual report, 1996).

The slowdown in the Malaysian economy during the second half of 1997 has affected the performance of Mentiga Corporation Berhad's group. The Group recorded a turnover of RM114 million in 1997 against RM127 million in 1996, a decline of 10.2 percent. The decrease in turnover was mainly due to depreciation in world market prices of plywood. Plywood product substitute such as OSB, MDF, fibre cement and other complimentary products are gaining larger market share (Mentiga Corporation Berhad Annual report, 1997).

In view of the unfavorable developments and difficult conditions, the Group recorded a lower turnover of RM66 million in1998 against RM114 million in 1997, a decline of 42%. Accordingly the group suffered a loss of RM 18 million after taxation in 1998 compared to profit of RM1 million in 1997. The decrease in turnover was mainly due to stagnant market for wood namely plywood (Mentiga Corporation Berhad Annual report, 1998).

Indeed, the year 2000 has been another difficult year for the Group and the Company. The economy downturn of 1997, which had not recovered fully during the financial year, continued to affect the performance of the Group. The decrease in operating revenue achieved by the Group was mainly due to lower contributions from the manufacturing division in sale volume and lower selling prices. This is caused by the availability of cheaper plywood produced from other

tropical countries like Indonesia and Brazil (Mentiga Corporation Berhad Annual report, 2000).

According to the company daily, and monthly production report from March to May 2002, the graded plywood production rate is below the target of the company. The output rate per day is 261 pieces while the target is 328 pieces per day. It is 20.5% below the target. In addition, it was found that the company has very high labor usage for sorting graded plywood. The average cost of these laborers per day is RM265.59 and per hour is RM33.21. It was found that the average percentage of the defective rate per week is 0.88% and per month is 0.014%

Modification to the sorting system in the grading line should be done. Using automation system as an alternative could increase the graded plywood production rate, lower the labor usage and reduce graded plywood defective rate. Hence the productivity will be increased and the price of this plywood product could be reduced in order to compete with other plywood product substitutes and cheaper plywood produced from tropical country.

1.3 Problem Statement

The plywood grading line is the final process in the production line. Through the existing plywood grading line, the plywood is sorted into four grades. The finished plywood is firstly placed on a hydraulic platform by a forklift. There is one operator grading the plywood manually with a chalk and two other operators