
UNIVERSITI PUTRA MALAYSIA

# A PACKING-LINE PRODUCTIVITY ASSESSMENT OF PARTICLEBOARD FURNITURE

TAN JIH TSAIR

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BY:

TAN JIH TSAIR

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2003

Supervisor: Dr. Khamaruddin Mohd. Noor
Faculty: Forestry

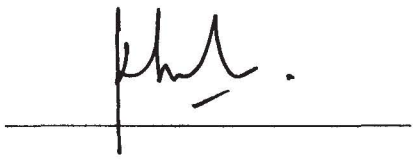
Malaysia, with its abundance of wood resources, is one of the traditional powerhouses of Asia's wood industry. In recent years, this sector has lost some of its edge simply because other countries have caught up, or have surpassed it in terms of competitiveness. Local manufacturers have no choice but to improve the production efficiency as well as the quality of their products if they want to remain competitive in the globalize market. In the production of panel particleboard furniture, the operations of packing department is more complicated and complex. The continuous packing process is affected by various factors, known and unknown, tangible and intangible. The objective of this paper is to study and analyze various factors contributing to the productivity of the packing line of particleboard furniture. The productivity and the frequency of the factors affecting the packing lines were measured and analyzed. The result showed that production planning, packing flow chart and work design (55%), insufficient of raw and supporting materials (21%), and the problems related to quality (14%) are the three most influencing factors to the productivity of packing lines, followed by insufficient of manpower arrangement (6%) and machinery breakdown (4%).

**APPROVAL SHEET**

Name of Candidate: Tan Jih Tsair

Title: A Packing-Line Productivity Assessment of Particleboard Furniture

Approved By:



(Dr. Khamaruddin Mohd. Noor)

Supervisor

(Assoc. Prof. Dr. Zaidon Ashaari)

Examiner

(Prof. Dr. Mohd. Hamami Sahri)

Dean
Faculty of Forestry
University Putra Malaysia

Date: May 2003

*DEDICATED TO MY BELOVED:*

*Father, Mother, Brother and Sisters*

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# CHAPTER ONE

# INTRODUCTION

## 1.0 GENERAL OVERVIEW

Malaysia, with its abundance of wood resources, is one of the traditional powerhouses of Asia's wood industry. In recent years, this sector has lost some of its edge simply because other countries have caught up, or have surpassed it in terms of competitiveness (Anon, 2002).

Malaysia's furniture industry appears to be at a crossroad in recent years- it is not competitive in terms of quality and image against the European, neither is it matching up in terms of cost against the likes of China, Thailand and Vietnam, countries with far lower production cost. Malaysia suffered a decline in the export of wood-based industrial products in year 2001. Production increased, but poor external demand caused exports of wood-based products to decrease by 18.8 per cent to RM14.6 billion in year 2001, compared to RM17.9 billion in 2000 (Anon, 2002).

Local furniture manufacturers have no choice but to improve the production efficiency as well as the quality of their products if they want to remain competitive in the globalize market. With the global marketplace, labor shortages and the explosion of e-Commerce, industrial experts, especially packaging professionals are looking for ways to reduce costs and increase

efficiency like never before, a solution that requires full packaging integration and service.

It is strategically important for enhancing competitive position and winning customer orders. In order to satisfy customers' delivery schedule, the target planned must be achieved for production in furniture production line.

## 1.1. PROBLEM STATEMENT

In the production of panel particleboard furniture, the operations of packing department is usually more complicated and complex than the other departments. Most of the furniture companies are still having problems with effective and efficient production. The continuous process of packing-line is affected by various factors. All the factors which influence the productivity are important. The success of managing and maintaining the packing line to achieve the production target is a major task for most managers.

In order to answer the problem, various research questions need to be answered:

1. What effect does the machinery breakdown has on the productivity of the packing line?
2. How does the manpower arrangement affect the productivity of the packing line?

3. What is the influence of supporting sections, for example raw materials, wood working departments, warehousing and so on, on the productivity of packing line?
4. Do the problems related to quality play a major role in determining the productivity of the packing line?
5. Is the productivity affected by the production planning, packing flow chart and work design?

## 1.2. RESEARCH OBJECTIVE

The overall objective of this paper is to study and analyze various factors contributing to the productivity of the packing line of particleboard furniture. In order to accomplish this objective, the specific objectives are developed:

1. To study the effects of machinery's breakdown on the total productivity of packing lines.
2. To study the effects of manpower arrangement on packing lines.
3. To analyze whether the problems related to quality can cause productivity losses to the packing lines?
4. To look into the influence of supporting sections on the packing lines.
5. To study the effect of production planning, packing flow chart and work design on the packing lines.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.0 INTRODUCTION

This chapter review on several aspects on the production of particleboard furniture, production packing line and the productivity and production performance. The first part reviews the manufacturing of particleboard from raw material to finished products. The second part reviews the general topics in packing and finally the third part reviews the productivity and production performance in details.

## 2.1. MANUFACTURING OF PARTICLEBOARD FURNITURE

Particleboard is an engineered wood product used as core material in the construction of home and office furniture, shelving and kitchen cabinets, as well as commercial and institutional fixtures. The production of this environmentally friendly product begins with milling or grinding wood residue into a uniform particle size. The material is then dried, combined with resin and pressed into large panels. These larger panels are then cooled and cut into small panel sizes. The finished product is sanded and packaged for shipment. Particleboard is sold to original equipment manufacturers, commercial laminators, wholesale distributors and building material retailers. The manufacturing of particleboard furniture is categorized into two main processes, namely Manufacturing Process I, from raw material to particleboard (www.heveapac.com.my), and Manufacturing Process II, from particleboard to finished product (www.heveapac.com.my). Figure 1 and Figure 2 describe the two process flows.

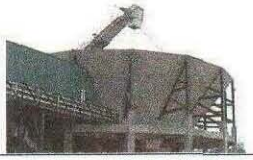
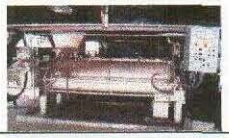
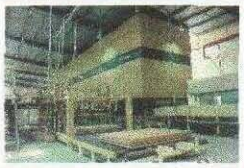
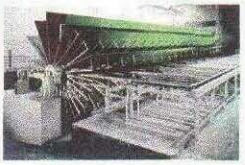
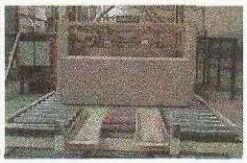
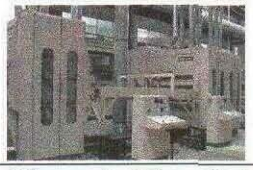
| | |
|---|---|
|  | RAW MATERIAL<br>The fiber materials are Rubberwood logs, branches and wood residues. Rubberwood is a light-colored, medium density homogeneous material suitable for producing high quality particleboard. |
|  | CHIPPING AND FLAKING<br>The Rubberwood materials are chipped before being reduced to fine flakes of the desired thickness and length. This contributes to the optimum strength and smooth finish on the surfaces of the boards. |
|  | DRYING AND SCREENING<br>The wet flakes are dried in a smoke gas dryer to the required moisture level. The dried flakes are then screened to separate fine and core particles and stored in the surface and core silo. |
|  | GLUE MIXING AND BLENDING<br>The surface and core particles are separately mixed with glue, wax emulsion and other additive metered accurately to achieve quality of high standard. |
|  | MAT FORMING<br>The resinated particles are spread by air and mechanical forming, incorporated by Computerized Programmable Control System, ensuring consistent mat density and uniform weight distribution. |
|  | HOT PRESS<br>The Hot Press that operates automatically on Programmable Logic Control compresses the mat under high pressure and controlled temperature to form boards of precise thickness. |
|  | STAR COOLING<br>The finished boards coming out from the Hot Press are weighted automatically to make sure that the determined density is obtained and then placed on the Star Cooler to allow glue setting. |
|  | SIZING<br>The master panel boards are checked for bonding conformance and thickness tolerance before being side trimmed and cut accurate dimension. The panels are staked for intermediate storage. |
|  | SANDING<br>The raw boards are stored for final curing to stabilize the board properties. These boards will later be calibrated to accurate thickness, sanded to fine surface finished and graded. |

Figure 1: Manufacturing Process I: from raw material to particleboard
Source: http://www.heveapac.com.my/process.html

| | |
|---|---|
|  | LAMINATION FOR MELAMINE<br>The graded plain boards may be laminated with melamine impregnated or coated decorative paper. |
|  | COMPUTER AIDED DESIGN (CAD)- RESEARCH AND DEVELOPMENT<br>Most of the Products Development are designed in 2-dimension and 3-dimension with the use of CAD to optimize the wastage and optimally utilized. |
|  | LAMINATING (PAPER AND POLYVINYL ACCETATE -PVAC)<br>Hot Laminated with high quality of Polyvinyl Acetate-PVAC glue. |
|  | PANEL SAW<br>Automatic cutting length eliminated down times. Automatic cutting height guarantees optimum cutting quality. |
|  | GROOVING<br>Universal saw machine for obtaining groove. |
|  | ROUTER<br>Router machines are used for panel with profile or various shape or pattern. |
|  | COMPUTER NUMERICAL CONTROL (CNC)<br>Panels can be sent to CNC process such as routing, drilling, grooving and even edge banding all in one go using Homag WoodWod software. |
|  | EDGE BANDING<br>The edges or sides of the furniture panel are laminated with edge band. |
|  | HORIZONTAL AND VERTICLE DRILLING<br>Horizontal drilling supports 21 spindle drilling head, pneumatic work piece clamps, panel stop and height adjustment according to panel thickness. |
|  | PACKING<br>All the finished parts or panels are prepared and arranged in packing line to facilitate accurate packing process. Flat-packed Ready-To-Assembly furniture is transferred to warehouse for storage and shipment. |

Figure 2: Manufacturing Process II: from particleboard to finished product.
Source: http://www.heveapac.com.my/process2.html

## 2.2. PACKING

Packing is defined as 'the assembly of items into a unit, intermediate, or exterior pack with necessary blocking, bracing, cushioning, weatherproofing, reinforcement and marking' (www.dscc.dla.mil).

Today's package is more than a shipping container- it's an extension of organization's brand. If boxes arrive damaged or products are ruined, it's more than a packaging problem- it's the organization's reputation.

With residential deliveries steadily increasing due to the growth of eCommerce, the package the product arrives in becomes even more important and is taking on greater significance. The box must do more than protect the contents; it must support the brand (www.3M.com).

The need for speed has never been more important or necessary. Top-of-the-line packaging products from case erectors to dispenserless padded tapes combine multiple functions to help boost productivity. eCommerce is another consideration affecting operation efficiency.

To keep up, many organizations must address the need of both pallet and parcel shipments. As single parcels travel the packaging line, equipment must adjust to multiple box sizes and variable address information.

Packaging lines must be flexible and scalable to easily gear up for peak shipping seasons and trim down during slower months. Addressing the needs of both pallet and parcel shipments will become a reality for many organizations making operational efficiencies more difficult to achieve.

3M research indicates that package engineers and operation managers rate package integrity as the most important factor in shipping. Box failure spells trouble. But even the toughest corrugated cardboard is vulnerable at the seams. As parcel shipments increase due to rising residential deliveries and online ordering, companies must package their products to handle a distribution system with higher drop rates, more handling, and multiple impacts.

## 2.3. PRODUCTIVITY AND PRODUCTION PERFORMANCE

Productivity is not just higher production. It is also not a ratio between output and input, which just denotes numerical efficiency. Productivity is best utilization of resources, known and unknown, tangible and intangible, active and potential (Joglekar, 2003). Being a relative concept there is no rigid measurement for productivity. But it is there where atmosphere of "Work comes first" exists- where there is an atmosphere of creativity; where one finds innovation and its immediate appreciation; where teamwork exists.

On the other hand, productivity is absent where such attitudes are lacking and lethargy is spread all over. The enterprise must utilize its resources

effectively to discharge its function of creating wealth. A mistake most commonly committed is to assign some particular value as the production capacity of a particular resource and by permuting and combining all such values the management arrives at a figure called as target- a word most commonly loved and dreaded by the managers and employees in an organization. This undermines one major function of the enterprise that is, innovation.

Exploring for additional facilities in a machine, production use of the extra space available, using smaller cross-section or weight of raw material per component, probing for unknown faculties in an employee, there are some of the ways management can reap higher output from same establishment. In general, over decades, increase in productivity has been achieved by replacement of labor by planning, brawn by brain, and sweat by knowledge.

Productivity can also be substantially increased by changes in product mix, process mix, organizational structure and balance of activities. Proper choice of product and process mix ensures full utilization of available equipment and machinery and avoids overloading of a few machines. Controlling wastage of capitals, assets, power, fuel, materials, skill, supervision, management and time was suggested to increase the productivity (Joglekar, 2003).

Figure 3 shows the production cycle, which is basic to any enterprise. It shows how managers at various levels influence the proper utilization of resources. Clear, progressive and reasonably flexible policies, proper planning and coordination and efficient to sort out on the spot problems to achieve day-to-day targets- these are the hallmarks of productive management working.

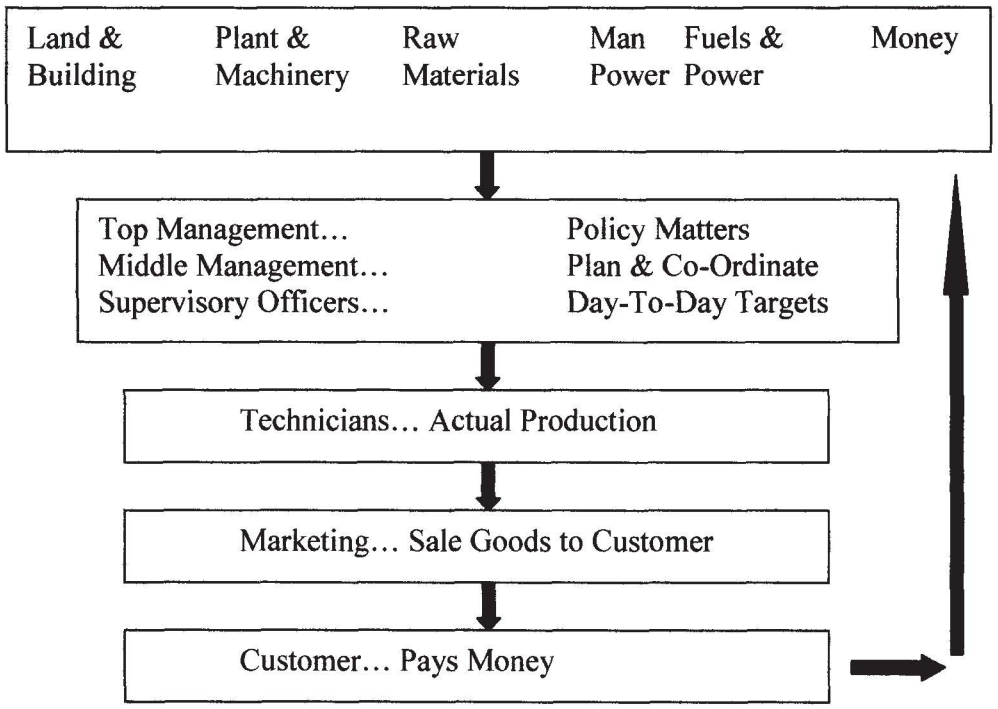



Figure 3: Production Cycle Resources

Sources: http://www.industrialproductsfind.com/content/archive/General/Management/MG280120024.jsp

An International timber Trade Organization (ITTO) pre-project 'Upgrading Production Efficiency in Furniture Manufacturing' was initiated in April 1997 with the aim of reviewing the current status of the furniture industry in Myanmar. The pre-project was designed with two major activity components: (1) the hiring of consultants to analyze the existing production system,

production procedure, quality control and the marketing of both present and potential export items; and (2) a tour by the Myanmar Timber Enterprise (MTE) project team to Malaysia and Thailand to study marketing and production methods. The consultants' recommendations to MTE include the marketing of items from lesser-used species, the implementation of inventory control, the use of precise cross-cutting in timber processing to minimize waste, and the realignment of factory production lines to enhance productivity (U Myint and Ma, 2003)

The work performed in the army ration packing operation, a division of the Department of Administrative Services at Botany, was very repetitive and individual production targets were in place. The layout and workstations were not ergonomically designed and placed strain on the blue-collar workers who were mainly recent migrants. There was very minimal communication between management and the workers over the years. Workers' compensation costs, increased time for inspection tasks, excessive down time due to sickness absences and the use of short interval breaks were contributing to productivity losses. Defective stock was increasingly being tolerated, resulting in additional repetitive sorting work and the workers bearing the responsibility for quality (Lusted, 1995).

Many of the quality and Occupational Health and Safety (OHS) problems were found to be related to the customer's requirements and specifications.

However, the customer was unaware of the nature and extent of the problems that these demands were imposing on the packing line workers.

Ergonomics management tool can be used to reduce loss related to health safety and productivity. It can also be used when implementing quality standards. The participatory approach ensures the commitment of the employees to the implementation of solutions (Lusted *et al.*, 1995).

Human resources are considered the most important asset of an organization, but very few organizations are able to fully harness its potential. A human resource system is defined "... as a set of distinct but interrelated activities, functions, and processes that are directed at attracting, developing, and maintaining (or disposing of) a firm's human resources." (Lado and Wilson, 1994).

Traditionally, management of this system has gained more attention from service organizations than from manufacturing organizations. However, to enhance operational performance, effectively managing this system is equally important in both types of organizations. Needless to say, sophisticated technologies and innovation manufacturing practices alone can do very little to enhance operational performance unless the requisite human resource management (HRM) practices are in place to form a consistent socio-technical system (Ahmad and Schroedar, 2003).

Flexible work assignment has great potential to increase productivity. When bottlenecks develop, for example, downstream operations may halt for lack of materials. A flexible worker can prevent this by moving in and increasing capacity temporarily, thereby avoiding work stoppage. Several "negative side effects" that occur in systems that rely on worker flexibility, effects that may partially or totally offset the advantages were identified (Schultz *et al.*, 2003). Research has shown that performance feedback and work interruptions are factors that may explain some of these effects. Schultz *et al.* (2003) showed that productivity loss due to these behavioral effects could be significant, in both the statistical and managerial sense of the work. Work sharing is designed to avoid productivity loss caused by bottlenecks.

Cellular manufacturing emphasize smaller inventory and smaller footprints for the production lines. This brings workers closer together and improves sight lines, which may improve performance feedback and increase the exchange of knowledge among workers. Schultz *et al.* (2003) suggests that this yields productivity benefits, and that those benefits may be further enhanced by additional performance feedback.

Manufacturing flexibility, a critical dimension of value chain flexibility, is the ability to produce a variety of products in the quantities that customers demand while maintaining high performance. Zhang *et al.* (2003) organized

literature on manufacturing flexibility and classifies it according to competence and capability theory. A framework to explore the relationships among flexible competence (machine, labor, material handling and routing flexibility), flexible capability (volume flexibility and mix flexibility), and customer satisfaction was described. Volume flexibility is the ability to produce the quantities required while mix flexibility is the ability to produce a variety of products required. The result indicates strong, positive, and direct relationships between flexible manufacturing competence and volume flexibility and between flexible manufacturing competence and mix flexibility. Volume flexibility and mix flexibility have strong, positive, and direct relationships with customer satisfaction.

A frequent raised question is what kind of influence a characteristic of the production system exerts on business performance. Phillips *et al.* (1983) examined the effect of product quality on business performance and cost, supporting the idea that focusing on one specific competitive edge for the business can help in reaching competitiveness. De Meyer and Ferdows (1990) analyzed the connection between production programs and production performance. They concluded that it is not enough to implement several production programs, a well-developed portfolio, or in other words, existing concept behind is necessary to get high-production performance. Ahmed *et al.* (1996) have reached a similar conclusion. Beaumont and Schroeder (1997) have looked at the connection between technology and performance. Their results

were not obvious, some technology affects business performance positively, but others did not affect it or even had a negative effect on the performance. These studies support the idea that the existence of a strategic view in manufacturing is necessary in order to reach business success.