Work Study in A Wood Furniture Manufacturing Company

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ABSTRACT

This paper aims to present the problems encountered in a wood manufacturing company, located in Selangor by implementing a work/method study and time measurement. Direct time study was applied for the time measurement. Finishing section consists of sanding process, shellac and drying was chosen for the case study. Pareto chart was used to identify the critical process in the company, namely the sanding process. Standard time for the existing sanding activities was 22.94 minutes. After improvement has been made, the time taken was 16.86 minutes, and hence a 26% reduction in time was achieved. This improvement was done dy designing the more effective tool and workstation. SolidWorks simulation software was used to assist in the design. By eliminating some activities through appropriate designed tool and workstation that in turn reduce the time of movement and space saving, the productivity in the company was subsequently demonstrated to have increased.

Keywords: *Furniture manufacturing company, work study, direct time study, time measurement*

1.0 INTRODUCTION

The purpose of this paper is to identify and investigate the industrial problems encountered in a wood furniture company and propose a solution to the identified problems. Work study is the systematic examination of activities to improve the effective use of human and other material resources. It is also essential for the industry to solve the identified industrial problems within the factories or plants. Meanwhile, the time and motion study has been used and was given a number of different interpretations since their inception in the industrial engineering (IE) world. Others have also suggested that the terms methods engineering, work design or work study should be used instead in place of the motion and time study. However, regardless of the terms used, they are all having the same meaning and purpose with the intention of helping those in the industries to manage and improve the process or work inside their plants or factories. Apart from that, work study can be construed as a generic term that describes techniques, specifically methods of study and work measurement. Both techniques are often used to assist the management personnel to optimize the usage of human and material resources. This also includes the most efficient usage of plant and tools, human effort and the evaluation of human work.

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The main objective is to apply work study in order to achieve a higher productivity under certain circumstances. Therefore, this concept is highly applicable to manual work in terms of simplifying the work methods so that the productivity of the company will be improved.

2.0 LITERATURE REVIEW

Currently, Malaysia stands as the eighth largest furniture exporter globally [1]. Ranked amongst the top 10 largest exporters of furniture in the world, Malaysia exports around 80% of its furniture production. With large markets in US, Japan, Australia, Malaysia has a strong position in the global furniture industry [2, 3]. In order to ensure the success of the production in the long run, the aspect of productivity should be continually on the increase. One of the methods to increase productivity is by implementing good work design and must be supported by equally well-thought policies and regulations [4].

Work design is used widely to strategically arrange, simplify the routine tasks in order to increase productivity [5, 6], job satisfaction and organizational commitment [7]. This includes the industries that can be categorized as small and medium enterprises (SME) in which the owner of the company should have initiatives to motivate their workers through some improvements of work methods [8].

Mishan and Md Tap emphasized that the time study is capable to increase line efficiency through their study in a food manufacturing company [9]. It was done by eliminating and combining the work processes which reduced production time, number of process and space utilization. With the benefits mentioned in the literature, this research was embarked by using the time study methods and time measurement.

3.0 METHODOLOGY

Table 1 shows the methodology of the study. The literature review was carried out based on reading materials found in various related journals, articles, magazine and websites. Then, the search and identification of a company was done to obtain more information on the actual product being produced, organizational chart, objectives and policies of the company. An interview was done with the middle management (engineers in charge) to get further information on the related work processes in detail and its problems, working hours, number of workers and some other useful information. Then, the observation was performed by identifying the detailed activities in the production line and the time taken using the direct time study method.

Table 1: Methodology

Tasks	**Instruments/tools**
Literature review	Journals, articles, magazines, websites
Find a company for case study and background study	Company's profile, interview
Identify problems	Direct time study, process flow chart
Analysis	*Pareto* chart, process flow chart
Proposed improvement (design)	Morphological chart, PDS, *SolidWorks* simulation software

Upon identifying and selecting the company, the existing process flow chart for the given product was developed as the company did not have any process flow chart. Later, *Pareto* chart was developed to show the critical activities in the factory department (unit) based on the time taken to complete the product part processes. Discussion and observation

were done with the engineers and workers regarding the activities involved in the critical department. For the last step of study, i.e., the final stage, is proposing the engineering design aspect. In order to design the product, the study needs to go through in detail for concept generation, and detail design. Morphological chart, and *SolidWorks* simulation software were used as a tool to assist in designing the product.

4.0 PROBLEMS IDENTIFICATION AND CASE STUDY

The problems were identified by using a time study analysis based on a case study that have been carried out on a wood furniture company. Table 2 illustrates the existing activities and time durations involved for wood processing. The highest processing time is at the finishing section (480.56 min or 8 hours of processing time), followed by the assembly process, packing, boring and cutting.

Figure 1 shows the *Pareto* chart that shows the time taken to perform the task for each section in processing a dozen unit of solid wood plate (product). In the finishing section, the product needs to wait for its turn which is a pre-requisite to the upcoming processes related to sanding and drying and later sanding again and drying (need to perform twice the process of sanding and drying for each solid wood plate).

Table 2: Time study and work study for existing activities in a company (case study)

Chart No: 1 of 1	**Activity**		**Existing**	**Proposed**	**Saving**
Title: Solid Wood Product (Big size table) **Method**: Existing/Proposed **Date**: 26/11/17	Operation Transportation Delay Inspection Storage		6 5 5 2 1		
Location: Meranti Furniture Sdn.Bhd	DISTANCE: 54 m				
ITEM	**UNIT**	**TIME (min)**	**SYMBOL**		**REMARKS**
To cutting section					
Wait to be cut roughly					
Cutting process	12	26.16			
Wait to be cut to size					
Cut to specific size	12	52.12			
To boring section					
Wait to be bored					
Boring process	12	70.15			
To finishing section					
Wait to perform finishing					
Make up the product	12	480.56			
Inspection					
To assembly section					
Wait to be assembled					
Assemble the product	12	220.14			
Inspection					
Pack the product	12	120			
To store section					
Storage					
TOTAL:	12	16.15 h	6	5	5	2	1	

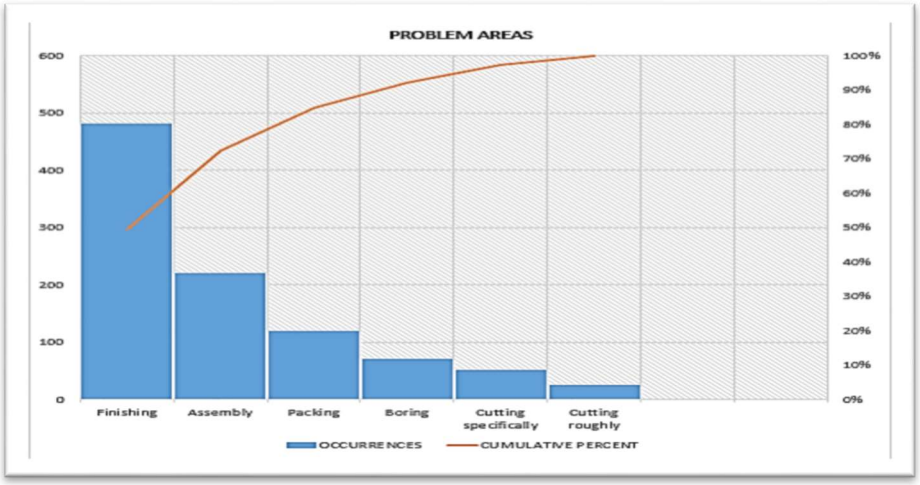

Figure 1: *Pareto* chart of time consuming of each section

In the finishing processes, there were six activities identified: sanding, shellac, lifting, move to another area to dry the solid wood plate, then lifting to the area again for sanding, shellac, for second time and dry to another area. All activities of the finishing processes need to be performed twice. The processes were done by two workers for each solid wood plate work piece. Based on the time cycles as shown in Table 3, the two highest cycle times are the drying followed by the sanding processes.

Table 3: Standard time for existing finishing activities

Element	Average rating	Total observed time (min)	Average observed time (min)	Normal time (min)	Standard time (min)
1 - Lifting to sanding section	102.5	3.81	0.48	0.49	0.578
2 - Sanding process	101.3	51.9	6.49	6.57	7.753
3 - Transport to shellac section	102.5	3.81	0.48	0.49	0.578
4 - Shellac process	100.6	13.24	1.81	1.81	2.136
5 - Transport to drying section	102.5	3.81	0.48	0.49	0.578
6 - Wait until dry	-	75.4	9.59	9.59	11.316
Total standard time					22.939

Table 4: Standard time for proposed design and activities

Element	Average rating	Total observed time (min)	Average observed time (min)	Normal time (min)	Standard time (min)
1 - Lifting plate	102.5	3.01	0.38	0.39	0.449
2 - Sanding	101.3	25.95	3.24	3.282	3.774
3 - Shellac	100.6	21.66	1.81	1.82	2.093
4 - Drying	-	284.57	9.17	9.17	10.546
Total standard time					16.862

The other next three workstations involve the application of shellac to the plate, lifting the plate and transporting the plate. Hence, an IE procedure is suggested here to minimize the movements, space (area) used and energy consumed by the workers. In order to identify

the standard time for the finishing processes, a stop watch was used to record the average time, normal time and finally, the standard time. Observations were done thrice to get the average time.

In summary, the problems were identified as follows:

a. Highest total processing time to perform all the finishing tasks.
b. Difficulty of the work methods - difficult work steps with considerable movements involving manual works and pose some ergonomics problems (bending and repetitive works for 22.939 min). From further identification, it was found that the existing platform was not stable and caused the workers to consume a longer period of time to perform the sanding (polishing) process on the platform. Figure 2 shows the existing workstation for the polishing process.
c. Tools used were not efficient and that the performed tasks required substantial repetitions. Figure 3 illustrates the existing sanding tool used.
d. Inefficient layout design - the limited space and bad working layout design caused longer time to complete the finishing process (Figure 4).

Figure 2: Existing designed platform

Figure 3: Existing sanding tool

5.0 PROPOSED DESIGN AND DISCUSSION

After identifying the problems at the finishing section, the next stage was to suggest for improvements in resolving the problems. The sanding process was first chosen as the process suggested for improvement as this task is indirectly related to other processes such as transporting and drying. In other words, improving the sanding process has a positive impact on transporting and drying processes in terms of improved work methods and time savings. After applying some design steps, a new design of platform was proposed (refer to Figure 6). This in turn leads to an improvement of the existing layout as shown in Figure 4 to a new proposed version as illustrated in Figure 5.

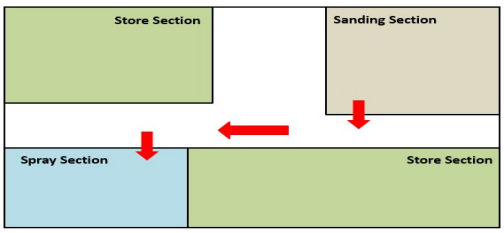

Figure 4: Existing layout of finishing process

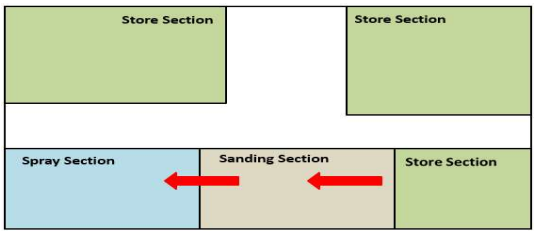

Figure 5: Proposed layout of finishing process

5.1 Working Principle of The Sanding Platform

The general function of this platform as shown in Figure 6 is to hold the solid wood plate (or work piece) and at the same time performing various finishing processes such as sanding (polishing), applying shellac and drying. The plate shall remain on the platform until the finishing process. Firstly, the solid wood plate will be lifted and placed on the platform, then a worker pushes the platform to the sanding section. Here, the work piece

will be polished to get a smooth surface. A new sanding tool has been suggested to perform the sanding (polishing) process. By using this platform, it would be easier for the workers to change the appropriate face of the solid wood plate without having to rotate it by 360 degrees. The worker has to only change the position of the work piece from the left to right platform. After the sanding process, the work piece will remain on the platform for the application of shellac. The last process is drying in which the platform will be pushed to dry under the direct sun.

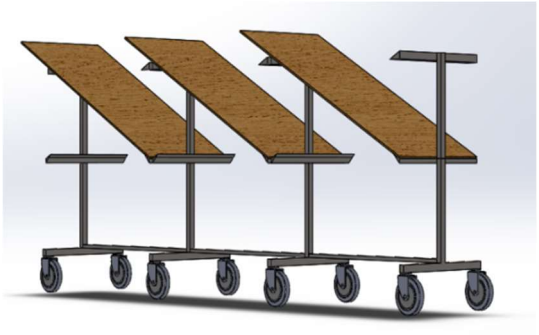

Figure 6: New platform design

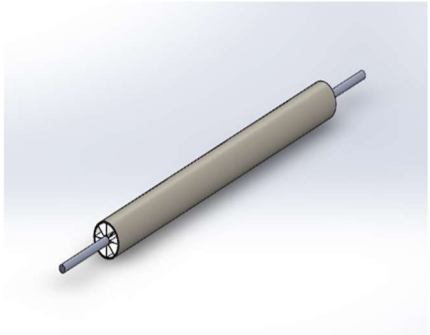

Figure 7: Proposed sanding tool

5.2 Working principle of The Sanding Tool

The general function of the sanding (polishing) tool as shown in Figure 7 is to reduce the repetitive sanding process due to the small surface of sand paper and was done manually. By incorporating a toy rotary mechanism in the proposed design, the process time for the polishing process was reduced from 6.49 to 3.24 min, which is a 50% reduction (the details are not explained here due to some limitations). The new method makes it easier for the worker to handle compared to the existing tool.

5.3 Time Analysis Before and After The Proposed Solution

As shown in Table 3, the existing finishing process took about 23 min while the proposed workstation with the new designed tools took only about 17 min (refer to Table 4 for more details). The process flow chart can be seen in Table 5.

Table 5: Process flow chart after improvements

Chart No: 1 of 1	**Activity**	**Existing**	**Proposed**	**Saving**
Title: Finishing Process Method: Existing/ Proposed	Operation Transportation Delay Inspection Storage		●	
Date:	DISTANCE:			

ITEM	**NO**	**TIME (min)**	**SYMBOL**					**REMARKS**
			●	→	D	▬	▼	
Lifting solid wood to the sanding section	1	0.38		■				
Ready to be sanding	2				■			
Sanding the solid wood plate	3	3.24	■					
Shellac the solid wood plate	5	1.81	■					
Waiting for plate to dry	6	9.17			■			
TOTAL:			2	1	2			

6.0 CONCLUSION

From this study, the total standard time to perform the task has been reduced to about 26.5% time compared to the existing standard time. Besides, all the work processes have become more efficient by using the proposed platform and sanding tool. However, there are some issues and challenges faced by the wood furniture industry that need to be further addressed resolved. One of the issues is the shortage of workers in the company that will lead to a decrease of productivity in this industry sector. It is expected that better working styles or methods will help to counter this issues and lead to good productivity. In summary, the identified and the proposed designs for improvements if implemented in the wood furniture company may help to improve the working methods and productivity.

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