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Productivity Improvement Through Line Balancing in the Assembly Area of a Lighting Manufacturing Company in the Philippines

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Abstract: ***One of the important aspects of business efficiency is to reduce cycle time and eliminate idle time in the production. Optimum cycle time can be determined using the line balancing techniques. Line balancing supports optimal layout that helps in reducing processing time by eliminating non value added activities. In a lighting manufacturing company in the Philippines, line balancing is used in the assembly line of 25A – 19A of clear household lamps. This is used as a production line technique in every station to have an equal amount of workload and equal cycle time to diminish bottlenecks and reduced idle time. However, the current operation process still cannot meet the standards set by the management. Thus study aims to establish a standard operating procedures for a lighting manufacturing company to achieve a balanced line and improve their rate of efficiency. Time study was used to identify the average cycle time per process and Westing House System was used to determine the standard process time per workstation. Eliminating the idle time and minimizing the number of the workstation can make the number of outputs per task or station balanced and increase their rate of efficiency. After using a simulation application to test the proposed solution to the problem, it is recommended that the company should use simplify and combine task elements that can be merged to improve the efficiency rate in the assembly line.***

Index Terms: Cycle Time, Line Balancing, Productivity Improvement, Time Study, Westing House System

I. INTRODUCTION

Most of the manufacturing companies need a basis for productivity rate and decision making based on the identified areas of improvement in the existing line process. One of the important aspects in improving business efficiency is the cycle time which is defined as the total time it will take to complete a task. Cycle time includes machine or operation time and idle time that affects the rate of production and line balancing and efficiency. Optimum cycle time can be determined using the line balancing techniques. Line balancing can be used as a strategy to capture the internal and external errors in the production area. It also supports having an optimal layout that helps to reduce processing time by eliminating non value added activities. A study was conducted in a lighting manufacturing company that manufactures a wide range of incandescent lamps components both for international/or import and export and domestic markets.

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The production process is vertically integrated, operating 24 hours every day. Aside from its major lamp production lines which are semi-automated, the operation extends to glass bulb blowing and various bulb coating and packaging. The study aims to improve the line efficiency of assembly line of Global Lighting Philippines INC. This study specifically aims to: 1) determine the average process time of each of the workstations of the assembly line; 2) identify the processes that cause bottleneck in the assembly line; 3) identify the best possible solution to improve the efficiency in the assembly line of clear household lamps.

II. MATERIALS AND METHODS

For attainment of the objectives of the study, a descriptive method of research with the preliminary observation as the main source of data was used. The key subject of the research is the line balancing in the production line with respondents directly from the assembly line of a lighting manufacturing company. Since the data collected may be discrete and contain actual numbers, descriptive statistics were used and normal time was used to determine the time required by the operation based on worker's performance rating, standard time to establish standards considering 9% basic and fatigue allowance, takt time to determine the rate at which product needs to be completed, theoretical number of workstation to a balanced line, and percentage of efficiency.

III. RESULTS AND DISCUSSION

The purpose of the study was to improve the line efficiency of the assembly line of 25A -19 clear household lamps, the model light bulbs of Lighting manufacturing company in the Philippines and address the proper solution to it. Based on observation, the recorded time element in the assembly line was measured.

Table 1: Average Process time per Station of 25A -19 clear household lamps assembly line

Process		Task Element	Task Time	Process Time
1	Stemming	Load	0.04	0.64
		Stem	0.55	
		Unload	0.05	
2	Mounting	Load	0.06	0.65
		Mount	0.52	
		Unload	0.07	
3	Sealex	Load	0.05	0.92
		Seal	0.48	
		Unload	0.06	
		Check	0.33	
4	Base cap	Load	0.06	0.40
		Capping	0.30	
		Unload	0.04	
5	Light testing	Load	0.03	0.33
		Light Test	0.28	
		Unload	0.02	

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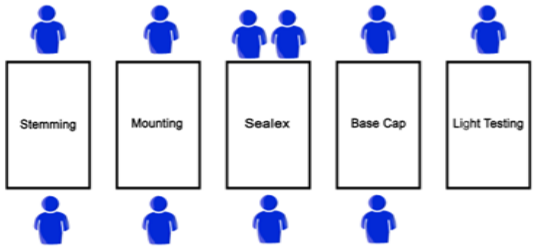

Fig. 1. Current distribution of operators in the assembly line

Figure 1 illustrates the current cell layout of the assembly line.

It consists of five (5) workstations which are all semi-automated such as Station 1 Stemming, Station 2 Mounting, Station 3 Sealex, Station 4 Base capping, and Station 5 Light testing.

Table 2: Process time in each workstation at the assembly line of 25A -19 clear household lamps

	Process	Takt Time	Process Time
1	Stemming	0.96	0.64
2	Mounting	0.96	0.65
3	Sealex	0.96	0.92
4	Base cap	0.96	0.40
5	Light testing	0.96	0.33

Table 2 indicates the recorded time for each station in the assembly line of 25A – 19 clear household lamps. The results show that sealex which is Station 3 takes the longest time as it takes 0.92 minutes to finish the job.

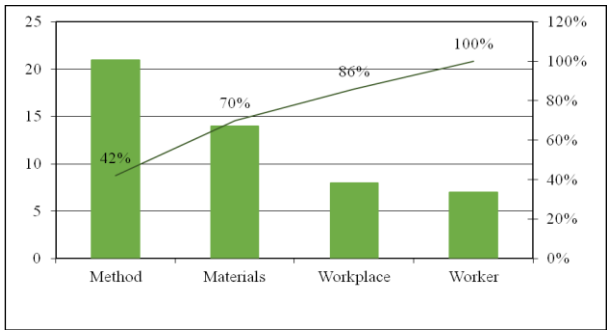

Figure 2. Pareto Chart: Factors affecting unbalanced and inefficient line

The above figure shows the instances of breakdown that affects the efficiency of the assembly line as perceived by the twenty – two (22) out of fifty (50) respondents. Pareto diagram was used to classify the factors that significantly cause delays in the production. Among the given factors, it was the method that greatly affects the low line efficiency.

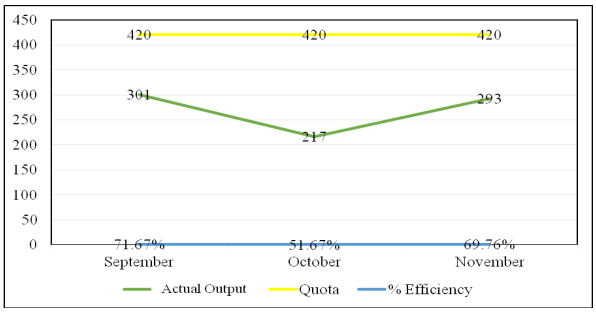

Figure 3 - Efficiency Rate of 25A – 19 of clear household lamps assembly line for three months

The above figure shows the efficiency rate of the clear household lamps assembly line for a span of three (3) months, September, October, and November 2016. This shows that the customer requirement or the standard output of 420 units of clear household lamps were not met by the assembly line.

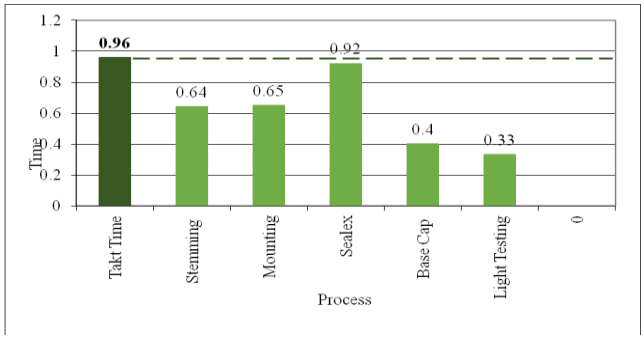

Figure 4. The current line balancing of 25A -19 clear household lamps in the assembly line

The above graph summarizes the computed takt time for 29A – 19 clear household lamps per shift. In order to meet the standard output, the level of the process time must not exceed and be too low with respect to the computed takt time.

Also from the above illustration, it can be clearly seen that the line is not balanced. Several stations take too much time while some task requires only lesser time to complete the entire operation. An unbalanced line makes the efficiency rate low and not efficient. Time study was used to determine the standard time and to establish a standard operating procedure. Operators' ergonomic factors in establishing the standard cycle time for them to be more productive were also considered.

IV. CONCLUSION & RECOMMENDATIONS

In view of the above findings, the following conclusions were drawn:

1. Using time study, bottleneck in production happened in Station 3 Sealex that caused bottleneck, thus decreasing the efficiency rate.
2. Idle time and machine breakdown affect the efficiency and productivity of the assembly line.
3. The current method used in the assembly line significantly affects the line efficiency and their productivity.
4. Line balancing is an effective way to eliminate the idle time, minimize the number of workstations and its workers and increase the rate of efficiency in an assembly line.

The researchers recommend the following for future actions:

1. The company must follow the proposed flowchart to increase the rate of efficiency and improved its productivity output.
2. Productivity improvement through savings in time per piece should be computed in terms of peso equivalent to convince the management that the necessary line balancing must be implemented.
3. Further study on another model of lighting bulb and its assembly line should be conducted to compare its results with the computed cycle time.

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