Improving the Efficiency of Rubber Band Cutting in the Rubber Manufacturing Industry

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ABSTRACT

The research study was carried out with the aim of investigating efficiency improvement in rubber manufacturing industry. Most of the Sri Lankan rubber manufacturing factories are concerned with rubber band production for export; hence it is the most profitable export market in rubber. Therefore this research study was done to identify and understand the root causes for production variation and to give favorable solutions to the factory for rubber band. One of the major problems of the most of rubber manufacturing industry is arising at the production department among all the departments of the organization because most of factories are facing low efficiency improvement of the production department. The identified major effect for this less efficiency in production department is rubber band cutting section which is the core area of production department. Because of the delays in rubber band cutting section, quality department is idled and rubber tube production section has to find extra spaces to store their production. Therefore this study was done to identify causes for less efficiency in cutting section and to give solutions for these causes by targeting improving the productivity of production department.

KEYWORDS: Efficiency, Machine Breakdown, Production department, Proper Method, Rubber Manufacturing Industry, Training

INTRODUCTION

Rubber Manufacturing Industry is one of the major export industries which give significant contribution to Sri Lankan economy. Rubber industry has extensive history in Sri Lanka for providing quality rubber products to the world market. And also it gives considerable support to Sri Lanka to reduce unemployment problem especially among less educated and unskilled people. Therefore improving the productivity of the industry helps to improve Sri Lankan economy.

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The organization in which this research was carried out is one of the key players of the Sri Lankan rubber manufacturing industry.

The company makes significant contribution to the Sri Lankan economy by earning foreign currency. The revenue of the company is US $ 4.5m and the annual capacity of company is 3,000MT. It has 3.5 acre facility. The company serves to USA, Canada, UK markets. The company has over 20 year track record in manufacturing and export and it has more capabilities to develop new product lines.

This research was carried to identify the root causes for less efficiency at the finishing department and research went through the process of the rubber band cutting section.

Table 1 below, illustrates that there is no significant improvement of the efficiency of rubber band cutting section. Due to above reason backlog of the section is arising, other sections are idling and most critical problem is that it takes more time to finish the order.

DATE	PRODUCTION EFFICIENCY
06/06/2007	58%
26/06/2007	60%
06/07/2007	52%

Table 1. Production Efficiency of the rubber band cutting section

Research Objectives

The primary objective of the research is to improve the efficiency of the rubber band cutting. With the aim of achieving the objective, the research attempts to identify the root causes for the less efficiency in the cutting operation and suggest solution to eliminate, reduce and control the adverse effect from the causes.

LITERATURE REVIEW

The research is trying to increase the efficiency of rubber industry by reducing or eliminating ineffective time resulting from defects in the material used, inefficient method used by the worker and short comings in management and by setting work norms and standards. As per these are the aims of work measurement Literature Review of the research is based on the work measurement theories.

Work Measurement

Application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance.

Techniques Used for Work Measurement

- Time Study
- Work Sampling
- Predetermined Time Standards
- Analytical Estimating

Time Study

A work measurement technique for recording the time and rates of working, for the elements of a specified job carried out under specified conditions; and for analyzing data so as to obtain the, time necessary for carrying out the job at a defined level of performance.

The statistical variance (□) in the element time measured

The degree of accuracy (a%) required

Statistical confidence level (95.5%) desired

The no. of observations (N) required is calculated from the following expression

(+ or)-} a = 100 {(+ or -) 2(□)/ √N) / Tmean

□ = Sample standard deviation of n repetitive time observations taken from a given work element in a Pilot Study.

(+ or -) a = 100 {(+ or -) 2(□)/ √N) / Tmean
(+ or -) a (Tmean) / 100 = (+ or -) 2(□)/ √N
√N = {(+ or -) 2(□)x 100} / (+ or -) a (Tmean
N = {200(□)/ a (Tmean)} 2

$$N = 100^2 \{4\sigma^2\} / a^2 \{T_{mean}\}^2$$

Performance Rating

Mental comparison of the work study person of the actual rate of performance of an operator under observation, with a preconceived concept of a standard rate of performance. This involves judgment and hence it is controversial.

- Normal performance
- Standard performance

Basic Time for Work Element = Observed (actual) Time * Performance Rating

Westinghouse Method

- The operator is rated on the basis of four factors.
  1. Skill – Proficiency at following a given method
  2. Effort – the will to work
  3. Conditions – Physical environment heat, light, noise, etc.

4. Consistency – Degree absence of variation in performance time

(1 + Sum of grades of a normal worker) * Actual time = Basic element time

Allowances

Basic time computed by the application of performance rating is increased; by the addition of allowances in order to compensate for

- Fatigue (need for resting)'
- Personal needs (visits to toilet, canteen etc.) and Contingencies arising during work (EX: getting instructions, cleaning machines etc.)

Standard Minute

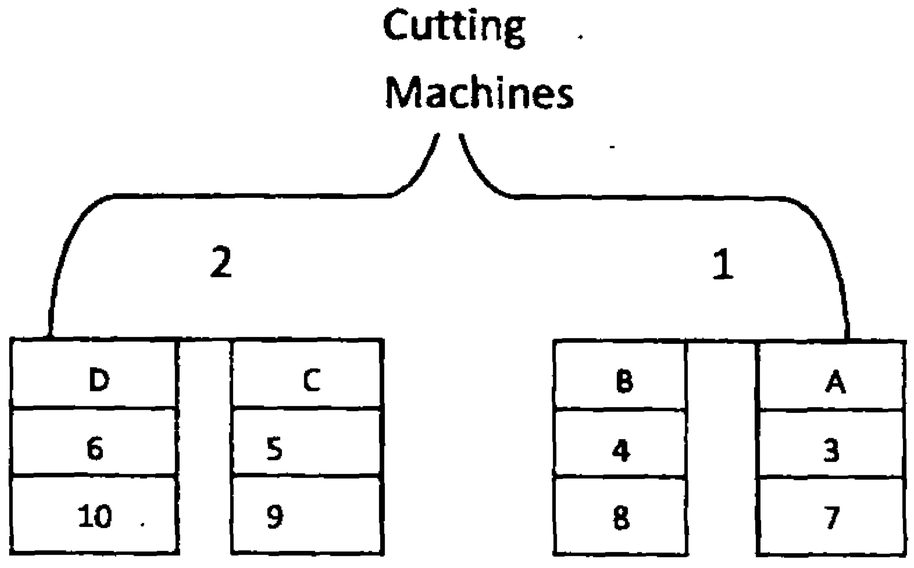
This represents the work output in one minute if the work output in one minute if the work is performed by a worker at the standard rate. It is a measure of work content but not a measure of time. Any two jobs can be measured on the common scale of standard minute irrespective of their nature. This makes it possible to define a measure of labor efficiency and gives a basis for designing a fair basis for remunerating manual work by the application of rational basis for the calculation of piece rates and wages.

RESEARCH METHODOLOGY

Research design is the science of planning procedures for conducting studies so as to get the most valid findings. The first step in research design is to identify a research problem. The purpose of this research is to improve the efficiency by finding the root causes for less efficiency and provide solutions to improve efficiency. Therefore this research is an applied research. Since this is an inductive research, general inferences are induced from particular instances (Hussey, 1997). The primary data collecting techniques includes individual observation, interviews and secondary data collection methods includes company reports Primary data collection was carried out during month.

DATA COLLECTION & ANALYZING

Below figure 1 illustrates the layout of the cutting section of rubber bands.



1, 2 – Rubber tube storage bars
3, 4, 5, 6 – Rubber bands collecting boxes
7, 8, 9, 10 – Rubber bands storage boxes

Figure 1. Cutting Process Layout

Cutting Process

1. Get the tubes form the bars and feed them to the machine.
2. Cutting

Below Table 2 illustrates the Standard Minute Value (SMV) of the first step of the cutting process.

No	Operation		(min)
1	Get the tubes (3nos.) from the bars and feed them to the machine	Basic Time	0.13
		Allowance	0.02
		SMV	0.15

Table 2. Element - Feed the tubes to machine

Below Table 3 illustrates the machine wise standard minute values for whole cutting process.

No	Operation		A	B	C	D
1	Get the tubes and cut the rubber bands (for 1 kg)	Basic Time	0.74	0.7	0.68	0.75
		Allowance	0.11	0.1	0.1	0.11
		SMV	0.85	0.80	0.78	0.86

Table 3. Machine-vise SMV's for whole cutting process

Below Table 4 illustrates the breakdown of the rates of allowances which are used to calculate the standard minute values.

	Type of allowances	Rate
A	Relaxation allowance	8%
B	Cleaning allowance	3%
C	Setting-up allowance	2%
D	Reject allowance	2%

Table 4. Allowances

Below table 5 and figure 2 shows the existing situation and the achievable situation of the rubber band cutting section.

Date	Actual Output per hour	Earning minutes per hour	Exis. Prod. Effi.	*Achievable Production Efficiency
06/06/	168.57	138.23	58%	93%
07/06/	169.44	138.94	58%	93%
08/06/	151.24	124.02	52%	83%
11/06/	147.62	121.05	50%	81%
12/06/	118.89	97.49	41%	65%
13/06	142.86	117.15	49%	79%
15/06/	119.44	97.91	41%	66%
16/06/	135.56	111.16	46%	75%
18/06/	145.56	119.36	50%	80%
21/06/	141.67	116.17	48%	78%
22/06/	142.22	116.62	49%	78%
26/06/	176.11	144.41	60%	97%
28/06/	104.76	85.90	36%	58%
03/07/	133.33	109.33	46%	73%
05/07/	95.22	78.08	40%	64%
06/07/	124.19	101.84	52%	83%

* If machine breakdown times are eliminated.

Table 5. Efficiencies

When consider existed situation, there is a huge difference between current output and target output according to the calculations.

According to the SMV's the actual output must be 196.8 Kg per hour.

Figure 2 illustrates the output differentiation of current situation and correct situation.

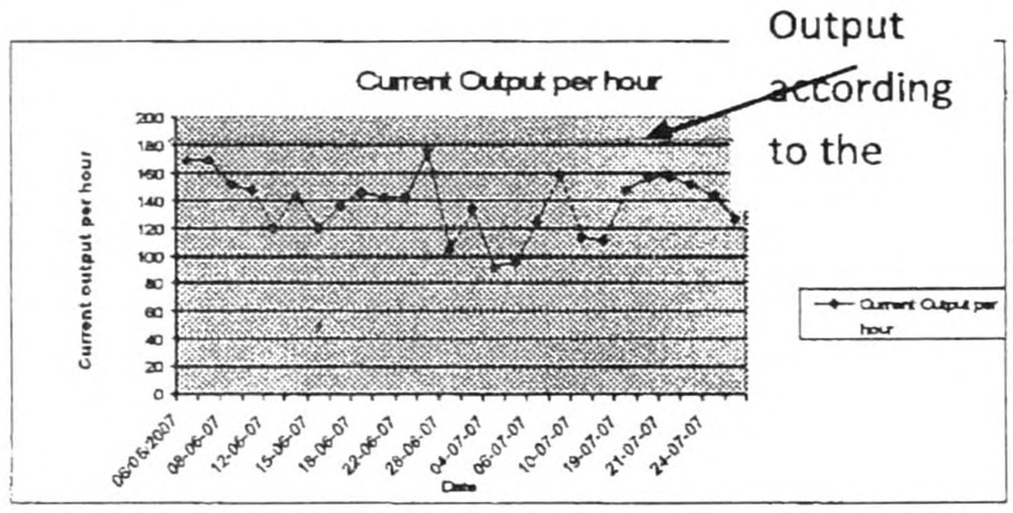


Figure 2. Output Variation

Reasons for above variation

- Machine Breakdowns
  - Machine Breakdown time is 38% from the total working time
  - The time taken to start the repair (after the breakdown is identified). 56%
  - The time taken from starting of the repair to finish and handover the machine. 44%
- Other reasons (e.g. changing of blades, overhaul of machine, etc)
  - Due to jamming of rubber tubes while feeding.
  - Due to stopping of the machines for sharpening for blades.
  - Due to breaking of the belt (attached to the two feeding rollers).

Most of the times, operators get more time to feed the tubes to machine than the SMV

Lengths of the tubes that are being used in the same cutting operation

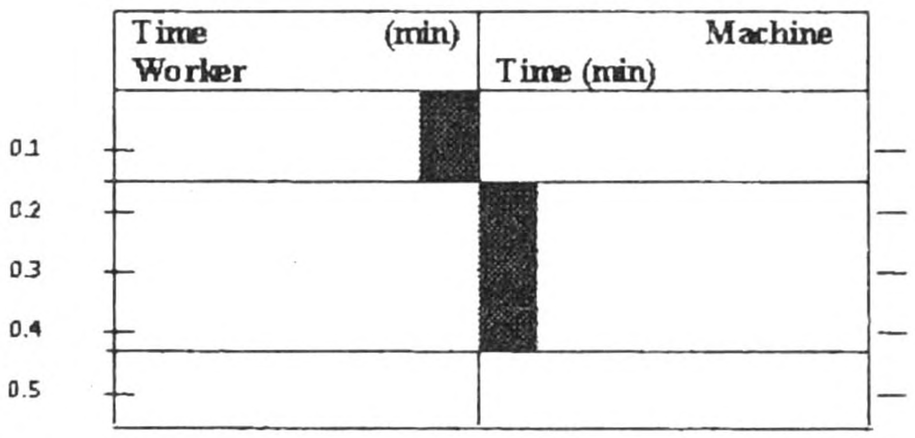
Output differences due to the current working methods (explained below in Table 7 and Table 8)

Below Table 7 illustrates the time taken for cutting process with the current method.

Work Study

Multiple Activity Chart				
Chart No. 1 Sheet No. 1 of	Summary			
Product :		Present	Proposed	Saving
	Cycle Time	(min)		
Drawing No. :	Worker	0.42		
Process : Cutting Rubber bands	Machine	0.42		
	Working			
	Worker	0.15		
	Machine	0.27		
Machine(s) : Speed :	Idle Time			
	Worker	0.27		
	Machine	0.15		
	Utilization			
Operative : Clock No. :	Worker	36%		
Charted By : Date :	Machine	64%		

Table 6. Multiple Activity Chart for

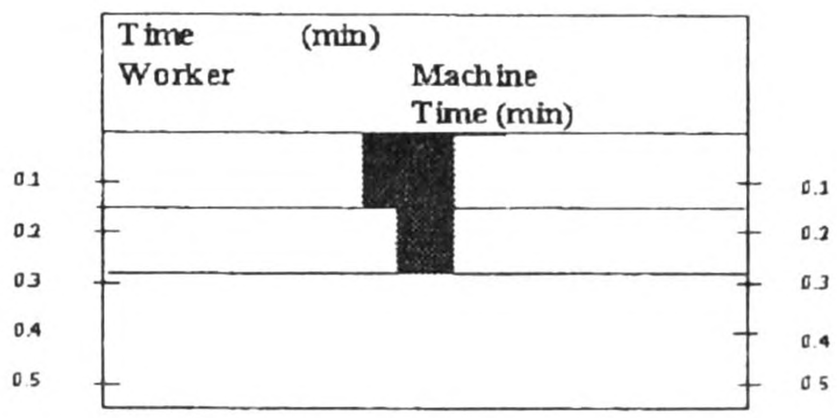


Machine 3 as per the existed method

As per the current method, to cut one rubber tube it takes 0.42 minutes.

Multiple Activity Chart				
Chart No. 1 Sheet No. 1 of 1	Summary			
Product :		Present	Proposed	Saving
	Cycle Time	(min)	(min)	(min)
Drawing No. :	Worker	0.42	0.27	0.15
Process : Cutting Rubber bands	Machine	0.42	0.27	0.15
	Working			
	Worker	0.15	0.15	-
	Machine	0.27	0.27	-
Machine(s) : Speed :	Idle Time			
	Worker	0.27	0.12	0.15
	Machine	0.15	-	0.15
	Utilization			
Operative : Clock No. :	Worker	36%	56%	20%
Charted By : Date :	Machine	64%	100%	36%

Table 7. Multiple Activity Chart for Machine 3 as per the proposed method



Above Table 8 illustrates the time taken for cutting process with the proposed method.

As per the proposed method, to cut one rubber tube it takes 0.27 minutes.

RESULTS AND DISCUSSION

Train the operators to follow the proper method to feed the tubes to machines.

- Drag the tubes to the revolving bar of the machine and feed them to the machine.

Train the helpers to put the tubes to the bars (between the 2 machines) by considering the length of them.

- Keep the small tubes separately.

Train the operators to follow improved methods (proposed above in Table 8)

Need to assign one mechanic for repair urgent breakdowns. Need to follow proper preventive maintenance system for cutting machines.

CONCLUSION

The main goal is this research is to improve the efficiency of the rubber band cutting in the rubber manufacturing industry. Whilst doing the research it was founded, that efficiency was declining due to many reasons such as machine breakdown, less training, improper methods. According to this research efficiency can enhance by introducing proper method, giving proper training to workers, introducing preventive maintenance system and assigning full time mechanic for rubber band cutting area.

REFERENCES

BOOKS

- Ralph M Barnes, (1990), *Motion & Time Study Design & Measurement*, John Wiley & Sons

OTHER NOTES

- Provided by the company (Company profile)