TOTAL PRODUCTIVE MAINTENANCE IN RMG SECTOR A CASE: BURLINGTONS LIMITED, BANGLADESH

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INTRODUCTION

Until now the Ready Made Garments industry is considered as "The Engine of Growth" for the economy in Bangladesh in so many ways including development of women and society as a whole. The journey of export oriented Ready Made Garments industry started in the 80s with some favorable policy support from the Government of Bangladesh and preferential treatment of major apparel importing countries of the world through guaranteed share of their market. The entrepreneurs of apparel export of Bangladesh exposed mainly with "low value, low price, low quality products" with the objective of using expensive labor force of the country. But in course of time the structure and direction of world trade in RMG has changed fast. Again the scenario in trade and business is about to change due to globalization and trade liberalities under the world trade organization. It is anticipated that Bangladesh is going to face stiff competition from large number of apparel producing countries notably China, India and Pakistan. It has now become a severe challenge to the economy of Bangladesh as maximum number of garment factories go out of business throwing 10 million direct and indirect workers out of jobs which certainly brings about a socio-economic havoc. It is now essential to bring dynamism in this sector by taking some realistic steps. Such steps can be categorized as improving productivity and standard of workers, development of product design capability, quality improvement, strengthening marketing and promotion ability, improving management skills and techniques, fabric developments, increasing overall equipment efficiency etc.

Burlingtons Limited, a Ready Made Garments industry in Bangladesh, was experiencing low productivity and less profit. The reasons of low productivity and possible means of improvement were then investigated by applying Total Productive Maintenance (TPM). Total Productive Maintenance (TPM) is a maintenance program, which involves a newly defined concept for maintaining plants and equipment. All sections of the factory have been studied to identify and reduce equipment losses to maximize overall equipment efficiency (OEE) by using the techniques of Total Productive Maintenance (TPM). Finally, the most significant losses were indicated and eliminated and the overall equipment efficiency (OEE) was improved. The detail of the study is reported in this paper.

TOTAL PRODUCTIVE MAINTENANCE

TPM brings maintenance into focus as a necessary and vitally important part of the business. Downtime for maintenance is scheduled as a part of the manufacturing day and, in some cases, as an integral part of the manufacturing process. The goal is to hold emergency and unscheduled maintenance to a minimum. The details of this technique are available in Srivasatava[1].

CASE STUDY

Methodology: Firstly, all sections of the garments factory have been pointed out for assessment. It is observed that the goal of all factory improvement activity is to increase productivity by minimizing input and maximizing output. Equipment and machinery are the crucial factors in increasing output. Productivity, quality, cost and delivery, as well as safety, hygiene, environment, and morale are all influenced significantly by equipment conditions.

The goal of maintenance management is to enhance equipment effectiveness and maximize output. It strives to attain and maintain optimal equipment conditions in order to event unexpected breakdowns, speed losses, and quality defects in process. Overall efficiency including economic efficiency is achieved by minimizing the cost of upkeep and maintaining optimal equipment conditions throughout the life of equipment. So the steps that were followed are[2]

a. Identification of major losses.
b. Identification of significant losses by Pareto analysis.
c. Calculation of Overall Equipment Efficiency (OEE).
d. Reduction of losses with analytical techniques.

Steps in introducing TPM in an organization[3]

Stage A – Preparatory stage
- Step1: General announcement by management about TPM introduction in the organization
- Step2: Initial education and propaganda for TPM
- Step3: Setting up TPM and departmental committees
- Step4: Establishing the TPM working system and target
- Step5: A master plan for institutionalizing

Stage B – Introduction Stage
Stage C – Implementation
Stage D – Institutionalizing Stage.

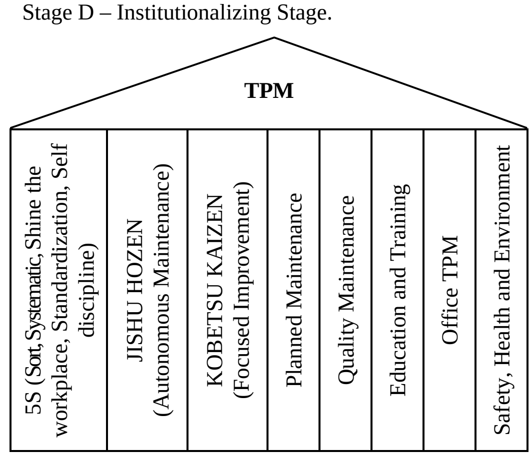

Figure 1: Eight pillars of TPM

TPM stands on 8 pillars[4] as shown in figure 1. Among these, the third pillar KAIZEN is used in this study. This pillar is aimed at reducing losses in the workplace that affect the efficiencies. It is possible to eliminate losses in a systematic method using various Kaizen tools such as: PM analysis, Why - Why analysis, Summary of losses, Kaizen register and Kaizen summary sheet.

As one of the pillars of TPM activities, Kaizen pursues efficient equipment, operator and material and energy utilization. Kaizen activities try to thoroughly eliminate 16 major losses shown in Table 1.

Table 1: Sixteen major losses that occur in a factory

Loss	Category
1. Failure losses-Breakdown loss 2. Setup/adjustment loss 3. Cutting blade loss 4. Minor stoppage 5. Speed loss 6. Start up loss 7. Defect/rework loss 8. Scheduled down time loss	Losses that impede equipment efficiency
1. Management loss 2. Operating motion loss 3. Line organization loss 4. Logistics loss 5. Measurement loss	Loses that impede human work efficiency
1. Energy loss 2. Die, jig and tool breakage loss 3. Yield loss	Loses that impede effective use of production resources

MAXIMIZING OVERALL EQUIPMENT EFFICIENCY

After studying all the sections of the factory, the Sewing section was taken for the Project purpose. There are 4 lines in the Sewing section. The production rate of different lines in Sewing section is considered and seen that Line 5B has the lowest production rate. So, Line 5B is considered for identifying and reducing equipment losses to maximize overall equipment efficiency (OEE) by TPM pillar 3- Kobetsu Kaizen (Focused Improvement).

Identifying losses: To identify losses and equipment efficiency, loss data is collected for several machines for 10 days during operation. These data are presented in Table 2. Based on these data, the following 6 major equipment losses are identified in Line 5B:

I. Breakdowns due to equipment failure
2. Set up and adjustment
3. Idling and minor stoppages
4. Reduced speed
5. Defects in process and rework
6. Reduced yield between machine startup and stable production

Identifying Significant Losses: From these 6 major losses the most significant losses are then identified by PARETO analysis. The data of PARETO analysis is given in Table 3.

Table 3: Pareto Chart for six major losses

Major Losses	Time (min)	% Composition	Cumulative %
Idling and minor stoppages	174	41	41
Set up and adjustment	150	35	76
Breakdown	60	14	90
Defects in process	20	5	95
Reduced speed	14	3	98
Reduced yield	9	2	100
Total	427	100	

Table 2: loss data for several machines (Ten days)

Day	Machine name	Losses	Time (min)
1	Single needle	Idling & Minor stoppage (Needle break & Bobbin case)	3+3 = 6
	Single needle	Reduced speed	4
	Overlock	Idling & Minor stoppage (False stitch)	8
	Overlock	Set up & adjustment	20
2	Overlock	Idling & Minor stoppage (False stitch)	10
	Single needle	Idling & Minor stoppage (Needle break & Bobbin case)	3+7+4 +4 = 18
	Single needle	Reduced yield	5
	Two needle	Breakdown	30
3	Overlock	Set up & adjustment	20
	Single needle	Idling & Minor stoppage (Needle break, Bobbin case & others)	13+4+3 = 20
4	Single needle	Idling & Minor stoppage (Needle break & Bobbin case)	6+4 = 10
	Two needle	Set up & adjustment	30
	Overlock	Reduced speed	4
	Single needle	Defects in process	10
5	Single needle	Idling & Minor stoppage (Needle break & Bobbin case)	13
6	Overlock	Set up & adjustment	20
	Single needle	Idling & Minor stoppage (Needle break , Bobbin case & others)	12+5+3 = 20
7	Overlock	Idling & Minor stoppage (False stitch)	10
	Single needle	Idling & Minor stoppage (Needle break & Bobbin case)	7+3+4 +4 = 18
	Single needle	Reduced yield	4
	Two needle	Breakdown	30
8	Single needle	Idling & Minor stoppage (Needle break & Bobbin case)	6+4 = 10
	Two needle	Set up & adjustment	35
	Overlock	Reduced speed	6
	Single needle	Defects in process	10
9	Single needle	Idling & Minor stoppage (Needle break & Bobbin case)	8+5 = 13
10	Single needle	Idling & Minor stoppage	3+4+3 = 10
	Overlock	Idling & Minor stoppage	8
	Overlock	Set up & adjustment	25

It is seen that the most significant sources of OEE loss are Minor Stoppages and Set up and adjustment.

Calculation of OEE: The calculations for Overall Equipment Efficiency (OEE) of the machines having losses are given in Table 4.

Table 4: Calculation for Overall Equipment Efficiency

A	Running time per day=60 min*8hrs=480 min
B	Down time per day= 20 min
C	Loading time per day=A-B=480-20=460 min
D	Stoppage losses per day= 174 min/10 days = 17.4 min = 18 min
E	Operating time per day=C-D= 460-18 = 442 min
F	Out put per day=70 pcs/hr * 8 hrs = 560 pcs
G	Rate of quality products= (Processed amounts – Defect amount)/Processed amount*100= (560-15)/560*100 = 97.32%
H	Ideal cycle time = 30 sec = 0.5 min
I	Actual cycle time = 35 sec = 0.58 min
J	Actual processing time = I*F = 0.58*640 = 325 min
K	Operating speed rate = H/I*100 = (30/35)*100 = 85.71%
L	Net operating rate = J/E*100 = (325/442) *100 = 73.52 %
M	Availability = (E/C)*100 = (442/460)*100 = 96.08%
N	Performance efficiency = K*L*100 = 0.8571 * .7352 * 100 = 63.01%
Overall Equipment Efficiency = M*N*G*100 = .9608 * .6301 * .9732 * 100 = 58.92% = 59 %	

Now, the target is to increase the OEE from 59% by minimizing the losses.

Minimizing the Losses: The basic analytical techniques used in TPM for improvement are:

- WWBLA (Why Why Because Logical Analysis)
- P-M analysis
- Why-Why analysis
- Fault tree analysis
- Failure Mode Effect analysis
- Pareto analysis
- SPC etc.

Table 5: Major Causes of Idling and Minor stoppages

Major Causes	Time (min)	% Composition	Cumulative %
Needle Break	81	47	47
Bobbin Case	56	32	79
False Stitch	28	16	95
Others	9	5	100
Total	174	100	

Here, WWBLA is used. WWBLA technique is a worksheet which identifies the root causes of a problem. In this technique, each major problem is considered separately and a worksheet is prepared. For each major problem, a cause is identified and called it *first factor for problem*. Then it is verified whether it can be divided into further root causes. If it is possible, then it is marked as G. Here, G stands for Go. Then a *second factor for problem* is identified and verified. In this way, a third, fourth problems are identified. If it is not possible to identify further, then verification is marked as NG (Stand for No Go). Finally, countermeasures are identified for each root causes of the problem.

Now, from Pareto analysis, it is seen that the two significant losses (Idling &Minor Stoppages and Set up and adjustment) comprise of about 68% of total loss. So, it needs to eliminate these losses first to increase the OEE. The main cause of the most significant loss *i.e.* Idling & Minor Stoppages, is due to Needle breaking in the machines. It can be easily observed from the Pareto analysis given in Table 5. It is seen that the main cause of idling and minor stoppage is needle breaking. Now, WWBLA technique is used for identifying the countermeasures to reduce the problem of needle breaking. The WWBLA worksheet is given in Table 6.

Table 6: Why Why Because Logical Analysis (WWBLA) worksheet

Problem	1st Factor for problem	Verification	2nd Factor for problem	Verification	3rd Factor for problem	Verification	Countermeasures
Needle Breaking	1. Needle nib hits the needle plate	G	1.1 Needle plate becomes down	G	1.1.1 Needle plate is not positioned properly	NG	1.1.1 Needle plate should be positioned properly at the beginning of operation
	2. Needle nib falls within the rotary hook	G	2.1 Rotary hook is displaced 2.2 Needle-hook timing is not maintained properly	NG NG			2.1 Rotary hook should be positioned by screw tightening 2.2 Rotary hook should be replaced by a new one
	3. Pressure guide is displaced	G	3.1 Pressure guide becomes loose	NG			3.1 Pressure guide should be tightened properly
	4. Needle safety guide is displaced	G	4.1 Needle safety guide becomes loose	NG			4.1 Needle safety guide should be tightened properly
	5. Needle quality is low	NG					5. Good quality of needle should be bought and used

Due to the countermeasures found in the WWBLA, the stoppage loss per day reduced to 11 minutes from 18 minutes and consequently output per day increased to 600 pcs. Thus, the OEE is increased which is shown Table 7.

Table 7: Revised calculations for OEE after reducing stoppage loss.

A	Running time per day=60 min*8hrs=480 min
B	Down time per day= 20 min
C	Loading time per day=A-B=480-20=460 min
D	**Stoppage losses per day = 110 min/10 days = 11 min** (as the time losses for needle break is eliminated, the stoppage losses time becomes 174 min-64 min of needle break = 110 min)
E	Operating time per day=C-D=460-11 = 449 min
F	Out put per day=**75 pcs/hr** * 8 hrs = **600 pcs**
G	Rate of quality products= (Processed amounts – Defect amount)/Processed amount*100= (600-10)/600*100 = 98.33%
H	Idle cycle time = 30 sec
I	Actual cycle time = 34 sec = 0.57 min
J	Actual processing time = I*F = 0.57 min * 600 pcs = 342 min
K	Operating speed rate = H/I*100 = (30/34)*100 = 88.24%
L	Net operating rate = J/E*100 = (342/449) *100 = 76.17 %
M	Availability = (E/C)*100 = (449/460)*100 = 97.60%
N	Performance efficiency = K*L*100 = .8824 * .7617 * 100 = 67.21%
Overall Equipment Efficiency = M*N*G*100 = .9760 * .6721 * .9833 * 100 = 64.50% = 65 %	

RESULTS AND RECOMMENDATIONS

It is shown that the two significant causes of losses in the study area are Minor Stoppages and Set up and adjustment. Of these two losses, the most significant loss Minor Stoppages is considered for reducing and thereby maximizing equipment efficiency. There are many causes of minor stoppages but here only the main cause Needle breaking is considered and solved by the analytical technique WWBLA.

By reducing only a singly kind of loss, the Overall Equipment Efficiency (OEE) is increased to 65% from 59%. It can be said that by reducing only one root cause of the problem the OEE is increased to 65%. So by reducing the entire root causes of significant losses, the OEE can be increased as high as to 85% or even more which is a standard for Japanese industries.

CONCLUSION

From the study, it is found that the concept of Total Productive Maintenance can be applied to a Bangladeshi garments factory successfully. In today’s highly competitive market, TPM may be one of the tools that stand between success and total failure for some companies.

In this research work, it has been found that OEE has increased to 65% from 59% while a single problem was considered and analyzed by only one tool of TPM (WWBLA). Here, it can also be mentioned that only one cause of the mentioned single problem has been considered. Thus from this research work it can be expected that the OEE could be increased to a very high level by implementing TPM to an industry.

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