A Framework for Assessing Management Losses from TPM Perspective

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Abstract

The term "Management Loss", from Total Productive Maintenance or TPM perspective, means the productivity losses in an organization due to delays or impedances caused by human. These include four kinds of losses: losses due to awaiting material, awaiting dolly, awaiting repair and awaiting cleaning. TPM aims to minimize these losses through the proper maintenance schemes. Therefore it is very important to get a proper view of these losses. But human losses are often taken as qualitative losses and their effects are not measured. This study, conducted in an eminent pharmaceutical industry of Bangladesh, presents a structured way of quantifying the management losses under TPM. A way of assessing and comparing the effects of delays was established.

Keywords
Awaiting cleaning, Awaiting dolly, Awaiting material, Awaiting repair, Total Productive Maintenance (TPM), Management loss.

1. Introduction
Total Productive Maintenance or TPM can be proven to be a very effective tool for the improvement of productivity, efficiency of employees and equipments and the overall environment of a company. The prime concern of TPM is more efficient maintenance management, which can only be done through efficient teamwork [1]. That is why, errors and impedances due to human errors are to be minimized or nullified for effective TPM implementation. One of the eight pillars of TPM, Kaizen (the third pillar), pursues efficient equipment, operator, and material and energy utilization. To achieve these goals, 16 major losses have been identified to exist in an organization, of which 5 major losses are the ones that hinder human work efficiency [2]. Among these, the first one is "Management Loss", which is basically the lost productive time due to waiting for materials, carriers, repair or cleaning. In most cases, inefficient management is responsible for these kinds of losses. This study took an insight into these four kinds of management losses. A well reputed pharmaceutical company of Bangladesh already practicing GMP (Good Manufacturing Practice) had taken interest in implementing Total Productive Maintenance in their factory. One of the prime mottos of the company was monitoring of processes for optimization of manufacturing time without compromising on quality. To achieve these goals and apply TPM effectively, it was very important to figure out the delays and impedances in the process flow occurring due to human errors. The four kinds of management losses were measured and their effects were compared in this study. The study [3] was conducted in the tablet section of the pharmaceutical industry.

2. Literature Review
Venkatesh [2] identified sixteen major losses under TPM, of which five were attributed to human productivity losses. Among these five losses, the first one was termed "Management Loss", which occurs due to waiting for something. Various practical studies on TPM have been done, especially in implementing TPM. Researchers have come up with frameworks and roadmaps of implementing TPM in different industries, most of which inevitably emphasize on skill development of workforce. Hussein Naguib [4] proposed a roadmap for TPM implementation in semiconductor industries, in which workforce and workplace development was equally underlined. Operators' skill development was mandatory for autonomous maintenance. Yoon Seng and T. Ramayah [5] proposed a process oriented strategy in implementing TPM in a Malaysian industry, in which identification of losses and causes was vitally important. The reliability of a TPM implemented system has been taken as percentage of planned production time in a technical report by Pekka Katila [6]. Mckone, Schroeder and Cua [7] conducted a study in 97 plants in three different countries and concluded that managerial contextual factors are more important to the execution of

TPM program than the environmental factors. Another UK based study was conducted by Bamber, Sharp and Hides and a roadmap for TPM implementation was presented [8].

3. Management Losses from TPM Perspective

Management losses are waiting losses, such as awaiting material, awaiting dolly, awaiting tools, awaiting instructions, and awaiting repair, which are generated through management problems. The four kinds of management losses existing in the concerned study area were:

- Awaiting material: Losses due to workers waiting for material to arrive.
- Awaiting dolly: Loss of productive time due to waiting for a carrying equipment such as trolley or forklift truck or simply a bucket.
- Awaiting repair: Productive time lost for waiting to repair a part.
- Awaiting cleaning: Productive time lost due to waiting for cleaning of equipments.

4. Analysis of Management Loss

Management loss at the tablet section consisted of losses due to- awaiting material, awaiting repair, awaiting cleaning and awaiting dolly. In the tablet section, various machines were observed at various parts of the production floor. The machines included one fitz mill, two blenders, seven compression machines, one NC compression machine, coating machine, one wet mass mixing machine, one drier one multimill and one compactor machine. To find out the effect of these four types of management losses, different machines and corresponding processes of the tablet section were observed very thoroughly.

4.1 Methodology:

At first, a complete data structure was constructed for arranging the data from different parts of the tablet section was constructed. Data of 12 working days was collected and put in the data structure containing the necessary information about process completion time, lost time and root cause of the loss. A sample of the data structure for two days is shown in Table 1. As can be seen from the sample data, not all the losses occurred at all the sections on a given day. The lost time due to management loss of different kinds varied across different machines. In order to make a comparison of losses, it was important to bring them on a common platform. That is why, all the lost time were converted as percentages of corresponding process completion times.

Table 1: Sample of data structure for analysis of management loss

Day	Type of management loss	Section of occurrence	Time of occurrence	Data	Time lost (min)	Completion time of process (min)	Time lost as percentage of process completion time (%)	Probable reasons
1	*Awaiting material*	Wet mass	8:12 am	8:12-8:19	7	35	20	Morning inertia
		Drier	10: 23 am	10:23-10:27	4	30	13.33	Delay for loading
	Awaiting Dolly	Wet mass to drier	8:58 am	8:58-8:58:30	0.5	2	25	Improper communication
		Fitz Mill to Blender	11:07	11:07-11:07: 26	0.43	3	14.33	Improper communication
		Blender to compression	2:05 pm	2:05-2:05:57	0.95	2.5	38	x
	Awaiting repair	x	x	x	x	x	x	x
	Awaiting cleaning	Blender	2:05 pm	2:05 – 3.30	85	40	212.5	Improper Handling of equipment

The formula used here was:

Time lost as percentage of process completion time (%) = (Time lost / Process completion time) x 100

After that, all the collected data were analyzed to find out the losses. Table 2 summarizes the percentage losses for four kinds of management losses of twelve working days. On the basis of this analysis, comparisons were made among the four types of Management Loss.

Table 2: Analysis of four kinds of management loss

Day	Awaiting Materials (% of process completion time)	Awaiting Dolly (% of process completion time)	Awaiting Repair (% of process completion time)	Awaiting Cleaning (% of process completion time)
1	33.3	77.33	0	212.50
2	10	50	0	148.60
3	176.66	0	0	170
4	86	75.8	0	0
5	344.40	22.33	0	111.11
6	23.33	423	0	306.67
7	28	310	12	15
8	212.70	100	0	327
9	113.80	6	0	160
10	133	458.50	466	108.30
11	6	216.25	0	0
12	371	385.80	0	120
Average loss per day (%)	128.18	166.47	39.83	139.93

4.2 Comparison of four types of Management loss:

Figures 1 to 4 shows a comparative view of the lost process times over the process completion times for four kinds of losses. The losses are taken as percentages of process completion time and therefore, the process completion times are taken as 100%.

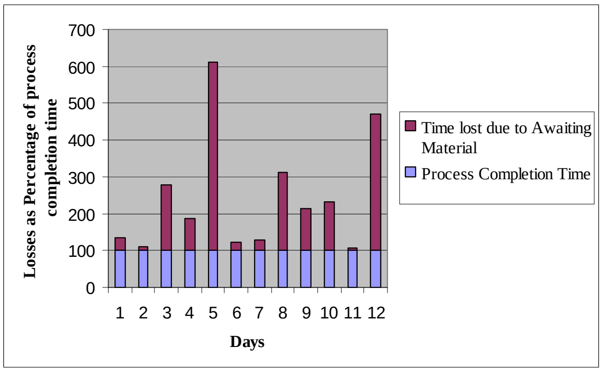

Figure 1: Comparative view of losses due to awaiting material

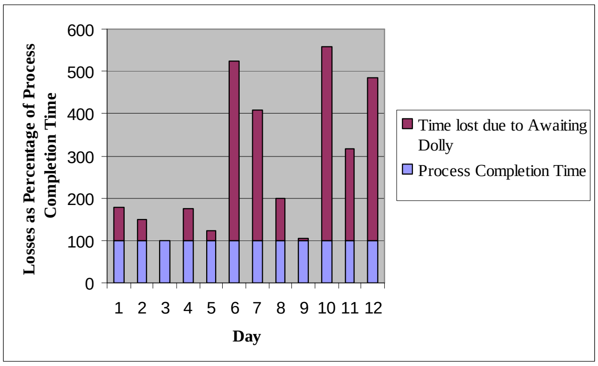

Figure 2: Comparative view of losses due to awaiting dolly

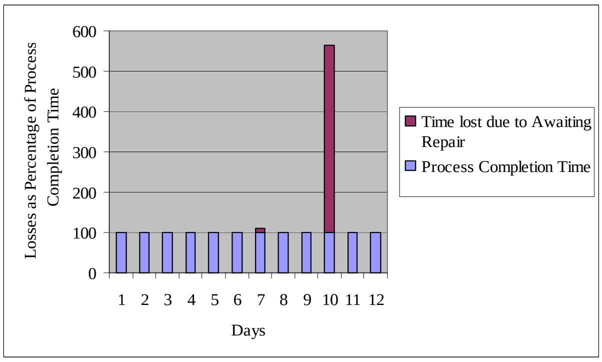

Figure 3: Comparative view of losses due to awaiting repair

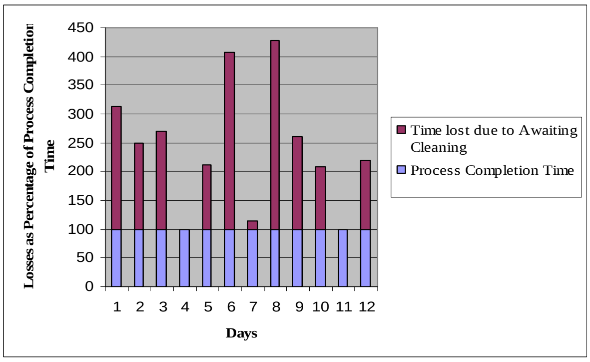

Figure 4: Comparative view of losses due to awaiting cleaning

In each of the figures, the process completion time is taken as 100%, denoted by the bottom portion of the bars each day. The upper portions of the bars represent the losses that occurred in comparison to process completion time, and a visual comparison can me made from the figures. For example, in figure 1, on day 4, the loss due to awaiting materials was equal to the process completion time, while on days 1,2,6,7and 11, the lost time was less than the process completion time. On the other hand, on day 5, the lost time due to awaiting material was 5 times of process completion time. Comparison of four types of Management Losses was made according to the following criteria:

a) Average percentage of lost process time b) Median value and c) Variability

Table 3: Comparison of losses on the basis of mean, median and variability

Criteria	Awaiting Material	Awaiting Dolly	Awaiting Repair	Awaiting Cleaning
Average % of lost process time	142.07	**166.47**	39.83	139.93
Median	96.14	86.86	**239**	119.94
Standard Deviation	157.74	**173.02**	134.25	107.21

* Highest values are bolded.

Awaiting Dolly is the highest hindrance in terms of average lost time, as is evident from table 3. Awaiting dolly also has the highest standard deviation. If we consider the median value to be representative of the lost time, then Awaiting repair would have the highest value, which means that time lost due to awaiting repair has the highest median value. It is actually quite obvious, since repairing takes much more time than most other activities. It can be said from here that, Awaiting Dolly is the most important management loss related to human impedance that affects the process completion time the most.

4.3 Root Cause Analysis

The root causes for Awaiting Material loss are shown in table 4. Seven kinds of causes were identified, of which the most frequent cause was waiting for material to be released from QC (Quality Checking). Table 5 shows the causes for Awaiting Dolly loss. Three causes were identified. Of them, improper communication was observed to exist most of the time. Table 6 shows the causes for Awaiting Repair loss. 2 of such occurrences existed, with different assignable causes. Table 7 shows the causes for Awaiting Cleaning loss. Seven causes existed, of which pre and post- lunch inertia was the most prominent.

Table 4: Causes of awaiting material

Cause	Number of Occurrence	Percentage of Occurrence (%)
Morning inertia	3	17.64
Delay for loading	2	11.76
Delay of previous process	3	17.64
Waiting for release from QC	4	23.52
Attaching document	1	5.9
Hot water not ready	2	11.76
Improper communication	2	11.76
Total	17	100

Table 5: Causes of awaiting dolly

Cause	Number of Occurrence	Percentage of Occurrence (%)
Improper communication	12	52.17
Dolly was not free	4	17.39
Worker was not free	7	30.43
Total	23	100

Table 6: Causes of awaiting repair

Cause	Number of Occurrence	Percentage of Occurrence (%)
Improper setup of machine	1	50
Lubricant oil got mixed with material	1	50
Total	2	100

Table 7: Causes of awaiting cleaning

Cause	Number of Occurrence	Percentage of Occurrence (%)
Improper handling of equipment	1	7.14
Unloading before cleaning	1	7.14
Material was stuck	1	7.14
Morning inertia	3	21.42
Pre and Post- lunch inertia	4	28.57
Cleaner unavailable	3	21.42
Waiting for appropriate worker	1	7.14
Total	14	100

Management losses of different kinds also differed in their causes. Awaiting repair was a kind of loss for which special assignable causes were likely to exist, because repair is only needed when something actually goes wrong. For the other losses, the most common cause was morning inertia or pre and post lunch inertia. Also, for awaiting material, checking material quality was the phenomenon that led to such delay most of the time. Improper communication was also a vital cause for losses, especially awaiting dolly.

5. Conclusion

This study attempted to look into the management losses due to human interventions. A comparative study among the four kinds of management losses was presented. It has been evident from the study that the largest amount of loss occurred due to awaiting dolly. This is the kind of human impedance that hampered production time by almost 67%. i.e., 67% extra time was required due to the fact that carrier dolly was not available. Also, according to this study, variability of lost production time occurred most in case of awaiting dolly. Therefore, among the four kinds of TPM management losses, awaiting dolly was the kind that affects productive time the most, the underlying reason for which, in most of the cases, was improper communication and lack of coordination among workers. The effect of such losses on process completion time was the main concern of the study, future scopes may lie in exploring further effects on other aspects of production, such as production scheduling, maintenance, safety and environment. Apart from these four types of management losses, other kinds of human impedances may exist in other kinds of production systems. This study may be used as a framework that will hopefully be successful in determining and comparing other kinds of human hindrances to production pace.

6. References

1. Hasin, A. A., 2007, Quality Control and Management, 1st Edition, Bangladesh Business Solutions, Dhaka.
2. Venkatesh, J., 2007, An Introduction to Total Productive Maintenance, The Plant Maintenance Resource Center.
3. Proma, F. A. and Yesmin, T., 2007, “Measurement of Human Losses and Risk Assessment: Case study of a Pharmaceutical Company”, B. Sc Engineering Project, Department of Industrial and Production Engineering, BUET, Dhaka.
4. Naguib, H., “A Roadmap for the Implementation of Total Productive Maintenance (TPM) in a Semiconductor Manufacturing Operations”, 1993, Proceedings of IEEE/ SEMI International Semiconductor Manufacturing Science Symposium, pp. 89-97.
5. Seng, O. Y., Jantan, M., and Ramayah, T., 2005, “Implementing total productive maintenance (TPM) in Malaysian manufacturing organization: An operational strategy study”, The ICFAI Journal of Operations Management**,** vol. 4, no. 2, pp. 53-62.
6. Katila, P., 2000, Applying Total Productive Maintenance- TPM Principles in the flexible Manufacturing Systems, Technical Report, Lulea University of Technology.
7. McKone, K. E., Schroeder, R. G. and Cua, K. O., 1999, “Total productive maintenance: a contextual view”, Journal of Operations Management, vol. 17, pp. 123-144.
8. Bamber, C. J., Sharp, J. M. and Hides, M. T., 1999, “Factors affecting successful implementation of total productive maintenance: A UK manufacturing case study perspective”, Journal of Quality in Maintenance Engineering, vol. 5, no. 3, pp. 162-181.