OPTIMIZATION OF OVERALL EQUIPMENT EFFECTIVENESS IN MACHINERY MANUFACTURING INDUSTRY

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ABSTRACT

The basic lean tools are implemented irrespective of the industry to enhance the productivity of the firm for a long term. The manufacturing industries go through various changes and are necessary to implement changes periodically. The productivity of the firm is a cumulative result of machine and man power involved in the process. Thus, planning and establishing changes on either side is dispensable for a productive firm. The analysis of the implemented technique with regular inspection along with employee involvement is needed to be seen for future enhancement in any industry.

Keywords: Overall equipment effectiveness, 5S, benchmark, availability, performance, and bottleneck areas.

1. INTRODUCTION

One of India's industries that is expanding the quickest is the automobile industry. The key growth engine for the Indian automobile industry is the rise in demand for automobiles and other vehicles, which is fueled by rising income levels. The development of the vehicle industry has also been aided by the advent of flexible repayment plans and custom financing options. All businesses and endeavours engaged in the production of motor vehicles fall under the umbrella term "automotive industry," which also includes the majority of their parts, such as bodywork and engines, but excludes tyres, batteries, and gasoline. Over 8 million employment are supported directly by the sector (OEMs, suppliers, and dealers), and as many as 30 million more are supported by it along the value chain. The industry contributes 6.4 percentage to GDP and over 35 percentage to manufacturing GDP.

2. REVIEW OF LITERATURE

Akash Mistry and Vivek Deshpande (2020): “Improvement in OEE in Ball Manufacturing Industry: A case study”. The study was conducted in ball manufacturing plant in NH-141 machine from the past record and found the OEE to be 60 percent. The basic tools such as 5S,TPM are implemented in the company and losses are calculated. So, overall equipment efficiency improved to 83% by reducing the setup time to 17 minutes.

Rajan Pio Massimo fabbri et al., (2019): “OEE optimization of an assembly line through lean and TPM methodologies”. The study was conducted in a battery manufacturing industry to calculate the equipment effectiveness in a machine line by using total productive maintenance. The tools are implemented effectively for suitable areas and thus eliminated problems at its root through gemba walk and OEE has been improved from 48 percent to 70 percent.

Farooq Umer et al., (2017): “OEE and Counter measures: A Case Study of a Manufacturing Unit”. The study conducted in wafer biscuit manufacturing plant where OEE is calculated and countermeasures were initiated such as planned downtime management, management routines like 5S in the organization. It has resulted in increase percentage level in planned downtime to 50.10 percent, root causes percentage to 48.49 and 59.57% for 5S workplace organization.

Shekhar sahu et al., (2015): “5s Transfusion to overall equipment effectiveness (OEE) enhancing manufacturing productivity”. The study conducted to prove the the relationship of OEE with 5S. In the studies that have been evaluated, an analysis has been done and hypothesis is framed to prove the relationship in the industry performance. The implementation of 5Japenese technique has been proved to increase productivity through conceptual mapping.

Sivaselvam and Gajendran (2014): “Improvement of Overall Equipment Effectiveness in a Plastic Injection Moulding Industry”. The study conducted in plastic manufacturing industry to find the bottleneck machines in the industry. The overall equipment efficiency of the plant was calculated for all the machineries and six big losses were observed and classified. The downtime found to be higher than every other component measured. Effective TPM measures were advised to implement for further improvements in the plant continuously.

3. RESEARCH GAP

This study has been done in the area of overall equipment efficiency in relation with 5S methodology. The industry either adapts calculation of OEE to determine the productivity of the organization (or) committed to follow 5S methodology throughout the desired plant. Even it has implemented both the techniques to increase the overall performance of the organization, industries fail to review the technique adapted to implement in the organization for the ever changing workspace and fails to adapt without major losses to the organization. The existing gap adapting and reviewing has been discussed in the research for an diesel machinery manufacturing industry.

4. OBJECTIVES

The primary objective of the study is:

1. To identify the OEE and increase productivity: in diesel machinery manufacturing industry.

The secondary objective of the study was to:

1. Examine the six big losses in the manufacturing processes.
2. Classify the losses and evaluate availability, performance efficiency and quality products of the machinery.
3. Identify the bottle neck areas to improve productivity of the firm.
4. Assessing 5S and suggest areas for further improvement.

5. RESEARCH METHODOLOGY

The main goal of the suggested research is to identify the variables that are still impacting the firm's productivity after implementing 5S and the sources of those variables. The relevant data for the research was collected using a qualitative approach in order to meet the study's objectives. The study proposal's technique is depicted in figure1.

Industry analysis led way to exploring of things in the auto component industry which is a sub – sector within the industry sector. Purpose of the research is to explore the causes of low productivity in manufacturing unit and to find out how effectively 5S can impact overall equipment efficiency. Problem statement identified in the proposed research was the OEE (overall equipment efficiency) is found to be comparatively lesser than the 85% (world class benchmark value) in the manufacturing sector units even after implementing 5S in the firm. As the overall equipment efficiency defines the productivity and the methods used in the firm.

Objectives were designed in a way forward to look into the factors affecting the performance of the firm, corrective measures to eliminate the causes and its effectiveness over productivity.

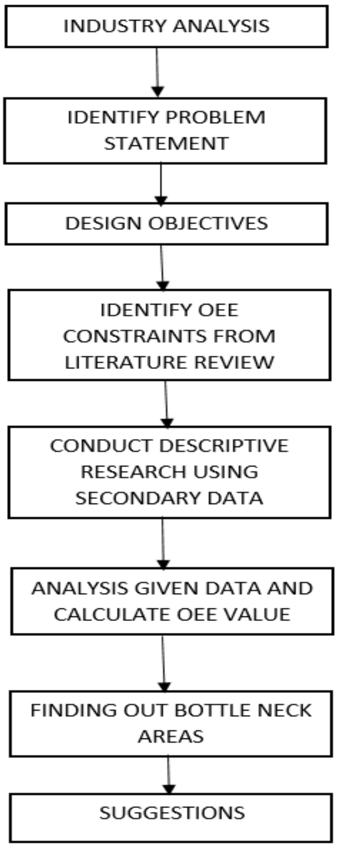
OEE constraint is identified as 85 percent for a manufacturing unit where the downtime, reduced speed and quality losses were deducted from hundred percent. It is the standard value for every manufacturing unit in the world.

Descriptive research is used to state the problems as it exists in the present. It involves facts findings of different kinds. The secondary data is required for the proposed research which is from company records. Analysing the data and taking the necessary information i.e., the losses in the unit and its ratio with each other is interpreted and overall equipment efficiency is calculated.

Findings through the data helped to figure out the areas were modification in the process required, the area to be improved for better productivity and the causes for low overall equipment efficiency.

Suggestions were given to improve the productivity of the firm, certain measures to overcome the present situation and changes to be made for sustaining in the long run in the evolving world.

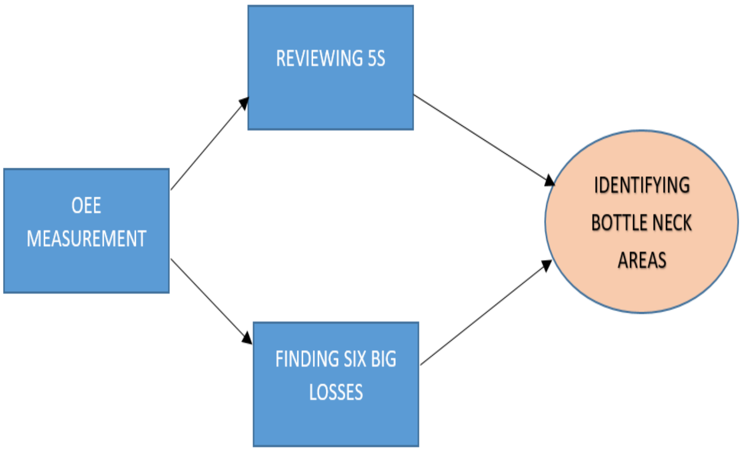
Figure 1
Research Methodology



6. CONCEPTUAL FRAMEWORK

The figure2 represents the framework through which the research has taken place. Some important factors like present overall equipment efficiency, 5S implemented working, figuring the six big losses in the process was considered to find out the bottle neck areas in the process.

Figure2
Conceptual Framework



OEE measurement is a metric based on "best practises" that shows what proportion of production time are actually productive. Here are some examples of OEE benchmarks:
Manufacturing just good components as quickly as possible with no downtime is 100 percent OEE, or flawless production.

For producers of discrete goods, an OEE of 85 percent is regarded as world-class. It is an appropriate long-term objective for many businesses.

A 60 percent OEE is very common for makers of discrete goods, but it shows there is still a lot of potential for improvement.

For manufacturing businesses that are just beginning to monitor and enhance their manufacturing performance, 40 percent OEE is by no means unusual.

Reviewing 5Smakes things easier for improving the place for great extend of use without holding back in performance of workers involved in production. Constant review and documentation of the practices followed in the firm helps us to track the performance of the implemented technique. Changing the environment according to easy access to the tools by changing places and extra storage places near the machinery makes process smoother without any damages neither to man nor machine & product.

Finding six big losses comes under planned& unplanned downtime losses, idling & minor stoppages, slow downs, defective parts were noted and time lost in these process were calculated from the planned productive time. The causes for these losses are identified.
Identifying bottle neck areas are more important to eliminate its effects on productivity. More idle time of the machines due to tool fixture change, breakdowns and unplanned downtimes frequency weren't reduced with any measures.

7. ANALYSIS

Table 1
Days to Monthly Conversion

	WORKING DAYS	LUNCH (MINS / DAY)	PRODUCTS(PER DAY)	DEFECTS	NON-DEFECTIVE PARTS
DAYS	480mi*3 =1140min	30	45		

MONTHLY	26 days	780	1170	15	1155

CYCLE TIME= 2hours40minutes

A day has three shifts of 8 hours each and the total number of working days in an month is 26 days, where remaining are working off. Each day has 30 minutes of planned lunch break, 45 produced products and were converted into minutes. The theoretical cycle time for a product is calculated as two hours and forty minutes. The total number of working days, lunch time (in minutes), products produced (in units), defective items produced (in units) and non defective parts produced (in units) for a month is calculated and shown in table 1.

8. INTERPRETATION

Table 2
Value of Losses in June Month

Values	
Sum of speed losses	16200
Sum of quality	15
Sum of planned downtime	10902
Sum of unplanned downtime	45321

The data gathered are used to calculate and classify the losses. It helps to identify the losses ratioin the processes.Table 2 represents the total amount of time (in minutes) classified as planned and unplanned downtimes, sum of speed losses and sum of quality losses, out of the total available time in June month.

Figure3
Comparison of Losses in June Month

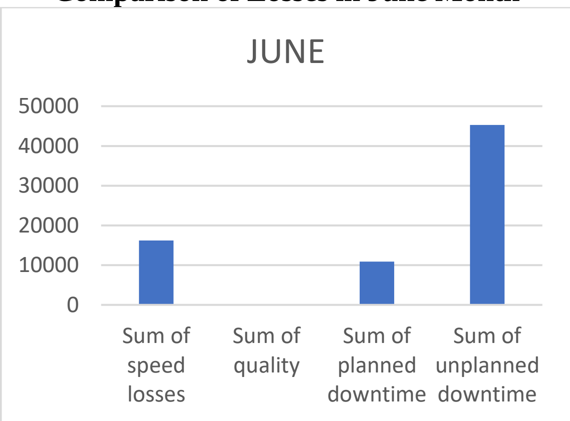


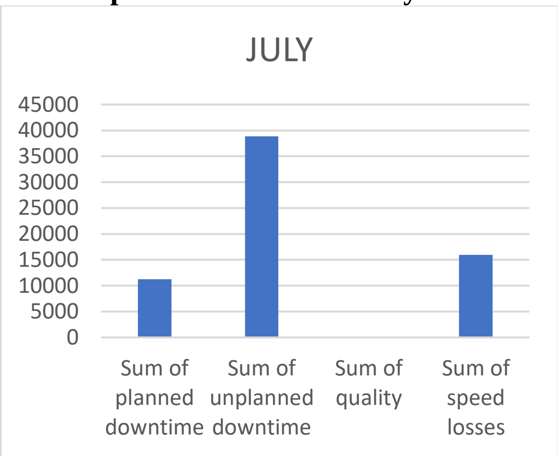
Figure 3 shows that unplanned downtime loss is higher than any other losses and more specifically it is four times higher than that of the planned downtime.

Table 3
Value of Losses in July Month

Values	
Sum of planned downtime	11280
Sum of unplanned downtime	38850
Sum of quality	10
Sum of speed losses	15971

Table 3 represents the total amount of time (in minutes) classified as planned and unplanned downtimes, sum of quality losses and sum of speed losses, out of the total available time in July month. Figure 4 shows that unplanned downtime loss is higher than any other losses and more specifically it is three times higher than that of the planned downtime. While comparing tables 2 and 3, the unplanned downtime has been lowered in July month were the planned downtime has been increased in July month. Also with decreasing the values of speed losses and quality losses in July month with comparison of June month.

Figure 4
Comparison of Losses in July Month



OEE calculation (in minutes):
A = (T / P) * 100
Where, T = operating time (P – D),
P = planned operating time,
D = downtime
E = (C * N / T) * 100
Where, C = theoretical cycle time,
N = processed amount
R = (N – Q / N) * 100
Where, N = processed amount,
Q = defective products
Planned operating time = 262080 (both months)

A. June month (in minutes):

Operating time = 205857
Downtime = 56223
A = (205857 / 262080) * 100 = 78.6%
E = (160*1170 / 205857) * 100 = 90.94%
R = (1170-15 / 1170) * 100 = 98.72%
OEE = A * E * R = 70.56%
The planned operating time is calculated for 26 days (in minutes) of June month.

Figure 5
Cumulative Value of Losses in June Month

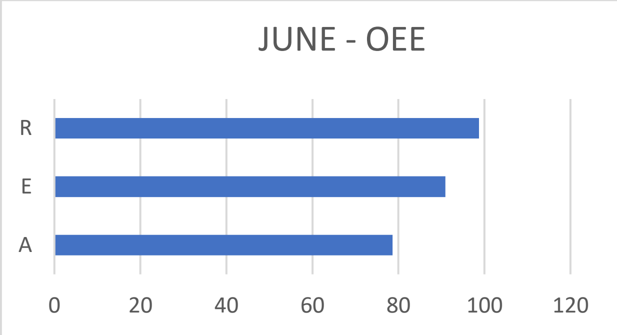


Figure 5 shows the availability (78.6%), productivity efficiency (90.94%) and quality losses (98.72%) of June month which is comparatively lesser than the world class values of 90%, 95%, 99% respectively.

B. July month (in minutes):

Operating time = 211950
Downtime = 50130
A = (211950 / 262080) * 100 = 80.9%
E = (160*1170 / 211950) * 100 = 88.32%
R = (1170-10 / 1170) * 100 = 99.15%
OEE = A * E * R = 70.84%
The planned operating time is calculated for 26 days (in minutes) of July month.

Figure6
Cumulative Value of Losses in July Month

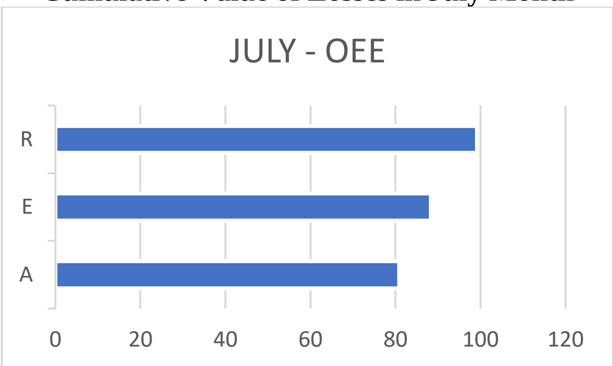


Figure 6 shows the availability (80.9%), productivity efficiency (88.32%) and quality losses (99.15%) of July month which is comparatively lesser than the world class values of 90% (A), 95% (E) respectively.

Figure 7
Comparison of obtained OEE with World Class Benchmark

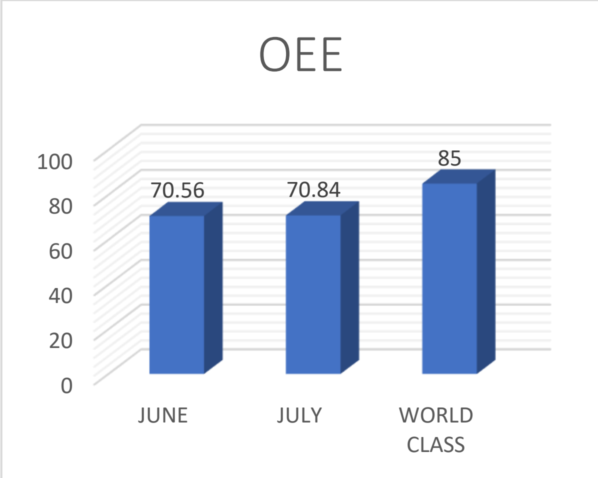
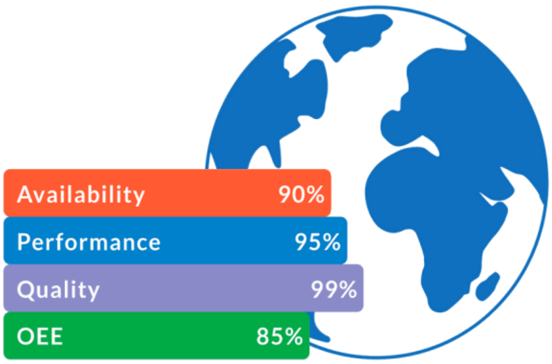


Figure 7 shows the comparison of OEE calculated in the firm of June and July month with World class benchmark value of 85% and it means that there are rooms for improvement in productivity in a more sustaining manner. Figure 8 shows the world class values of A, E, R and Overall Equipment Efficiency which determines the huge gap difference between them. It shows that there is an Availability loss which more than Performance efficiency losses, when compared the obtained values (in figure 5 &6) with figure 8.

Figure 8
World Class Values



9. FINDINGS

The study found that issues including availability, performance effectiveness, subpar quality, and general organisational equipment efficiency all contributed to losses.

Table 4
Findings from the study

LOSSES(%)	WORLD CLASS	JUNEMONTH	JULY MONTH
AVAILABILITY	90	78.6	80.9
PERFORMANCE	95	90.94	88.32

QUALITY	99	98.72	99.15
OEE	85	70.56	70.84

The table 4 shows the cumulative findings from the study. The comparison of all the losses which were found from the organization is compared with the world class benchmark values accepted across every industry.

- The availability values having a big gap differences in each month, which contributes availability loss and thus affects the performance of the organization towards the targeted value.
- The qualities of products have been more than the world class value of 99 percent.
- The whole cumulative value of availability and performance has produced OEE values of 70%, which are much lower than the global average of 85%.
- The availability of the machine for the desired task is low in the organization.

The company has adopted and is using the 5S technique:

- The workers except one or two, none were wearing ear plugs which were recommended to eliminate the work noises as it is a heavy machinery manufacturing organization. Due to changing workspace requirements has resulted in adherence effect in maintenance of the tools in the workplace.
- Their no space allocated for placing the tools which helps to set the machine parts inside the cabin for operation. This resulted in placing of tools above in the machine door which breaks the door lock (or) placing tools in pockets (or) on the working pathway which leads to missing of tools.
- Their no shadow boards (or) separate place allocated for placing the tools (or) not providing proper dresses for placing the tools.
- The damaged tools crossed over the estimated tool breakage (300) levels than two times (750). By considering the working and functioning of the machineries for longer period of time, tool breakage estimation will be made in every manufacturing industry. The estimation makes the firm to order the tools in prior to replace the tools whenever necessary. But due no changes in the 5S implementation over years, tools breakages were seen more because of insufficient space management and no updation in the process.

10. SUGGESTIONS

Certain suggestions that will help in increasing productivity and are as follows:

- Reline the sorting near the machine (or) space in between the machinery, to avoid damage in the machinery door.
- Align the tools fixture in the centre portion of the hall, so that every operator can access it easily.
- Make available number of fixtures and tools for the existing machines, instead of keeping in storage rooms.
- Scheduling of materials to every machine can be reviewed to increase the overall productivity.
- Unavailability of operator affects the productivity which is next to no loads.
- Monthly maintenance can be carried out in last couple of days in a week, instead of doing it in mid of the week.
- Strictly following safety measures like usage of earbuds by employees, to eradicate noise from the machineries.
- Avoiding unnecessary motion in search of tools can reduce the unplanned downtime.
- Usage of shadow boards by workers to sort the tools near (or) beneath the workplace and can be used to find out tools when it is missing.
- Keeping the standards can lead to adaptation of 7s in the organization.

11. CONCLUSION

From the literature review, it can be concluded that overall equipment efficiency and 5S methodology are used as a perfect technique to measure and increase the productivity irrespective of the industry. The calculation of overall equipment efficiency states the condition of productivity in the organization, the losses occurring in the process stages and counter measures to overcome the losses. The Japanese 5S technique used to check the workplace for proper working and to sort the workspace with more employee involvement results in targeted productivity. It have find out the reason behind the performance of the organization. It realizes the reviewing of the implemented technique in any organization is inevitable for sustaining performance of the organization which is running towards a long term goal. The organization which implements any technique for study the readiness level of accepting the changes in the organization process. Even though it implemented sometimes following up seems to be impossible in level and results in decrease in the productivity. Thus, continuous reviewing of the implemented technique helps any organization for adopting to any kind of changes for future trends.

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