Overall Equipment Effectiveness (OEE) Technique of Lean Manufacturing: An Application in Mechanical Company

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Abstract: This paper covers the Overall Equipment Effectiveness (OEE) technique used for the evaluation of effectiveness of manufacturing industry. Overall Equipment Effectiveness calculates for the finding out machine efficiency. OEE helps to reduce the losses of any type of machine in industry and effectively improving the efficiency of that machine. OEE find out the measure losses which occur and reduces it. It gives the actual data of efficiency of machine. OEE is high means efficiency is high. OEE helps to increase the production rate of industry. This paper highlight problem come in the daily OEE sheet and reducing the losses of the no load, no operator and setting time. By using OEE graph, sheet and data we can minimizes non value added activity and value added activity. In this paper there is relation between the all parameter of OEE i.e. Availability, Quality and Productivity (Labor efficiency). OEE find the root cause of the losses which occur while machining. OEE is important tool of lean manufacturing to measure the effectiveness of equipment. OEE is not only improving efficiency of machine but also give better utilization of resources.

Index Terms: **Overall Equipment Effectiveness (OEE), Availability, Quality, Productivity, Efficiency, Losses.**

I. INTRODUCTION

Overall Equipment Effectiveness (OEE) is tool of lean manufacturing used for finding the efficiency of the machine in mechanical company. OEE increases the production rate on company with better utilization of the resources. OEE helps to increases efficiency of machine as well as quality of product [2]. OEE is important tool of lean manufacturing which monitor to utilize all resources with their maximum output capacity [1]. Overall Equipment Effectiveness is depends on the three parameter which are availability, quality and productivity. Productivity is basically of machine efficiency. To find out the machine is under utilization or over utilization OEE is used. OEE gives data that which machine is having worst efficiency among all machines in a company [7].

The world class standard measure OEE is 85% which was stated by Frost and Sullivan in 2005, with their parameter availability 90%, productivity 95% and quality 99% [4]. In this paper we see the all the performance data of all machines i.e. VMC and CNC of mechanical industry by measuring OEE. The productivity (labor efficiency) is should not be below than 65% for machine. It means that machine is under utilization [5]. There are so many factors are responsible for OEE i.e. no load, no operator, setting time and machine breakdown. By reducing these all parameter we can increase the utilization of machine which indirectly increases the OEE [3].

II. METHODOLOGY

OEE is the measurement method of industry to move towards to the lean concept. The formula of OEE is given below [2]-

$$OEE = Availability \times Quality \times Productivity$$

$$OEE\ \% = OEE \times 100$$

$$Availability = \frac{\text{Net Available time}}{\text{Planned min.}}$$

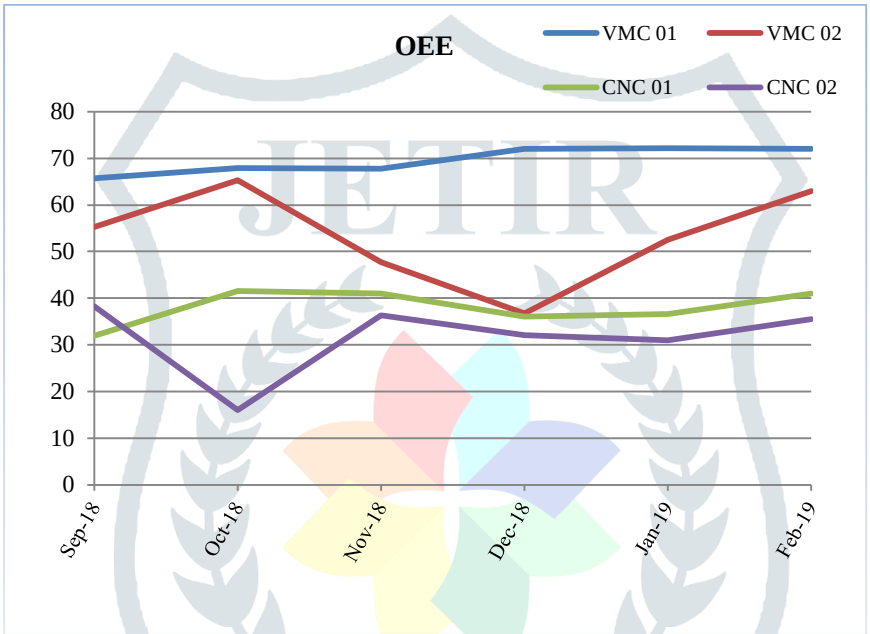
$$Quality = \frac{\text{(Ok Quantity + Casting Rejection Quantity)}}{\text{(Ok Quantity + Casting Rejection + M/c Rejection Quantity)}}.$$

$$Productivity = \frac{\text{O/P Time}}{\text{Net Available Time}}.$$

OEE is calculated by these formulae. There is given all monthly data of VMC and CNC machines of six months, which is given below-

M/c No.	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19
VMC 01	65.66	67.86	67.74	72	72.21	72.01
VMC 02	55.21	65.23	47.69	36.80	52.54	63
CNC 01	31.95	41.5	41	36	36.58	40.93
CNC 02	38.19	16.03	36.27	32	31.00	35.51

Table 1: OEE of machines



Graph 1: OEE graph of machines

The above graph is showing the OEE of VMC and CNC machines based on the data shown in table 1. There is a monthly summary sheet of OEE, Which help to monitor the data of various machines in the industry. This summary sheet identifies the losses in terms of idle time. The calculation of summary sheet of OEE month Jan-19 is given below-

MONTH	M/C NAME	VMC-01	VMC-02	CNC-01	CNC-02	T0TAL
Jan-19	Total Setup	5	8	25	30	68
	Total Setup Time(Min)	1000	1490	2430	5430	10350
	Avg. Setting Time(Min)	200	186	97	181	152
	No Operator(Min)	0	450	0	450	900
	No Load(Min)	3040	12980	6840	4980	27840
	M/C Breakdown	0	200	5520	0	5720
	Tooling Problem	150	0	0	0	150
	Other	0	0	0	0	0
	No Power	0	0	0	0	0
	Total Idle Time(Min)	3190	13630	12360	5430	34610
	Net Available Time (Min)	31690	20760	22743	29856	105049
	Output Time(Min)	25905	13230	13418.5	18208	70761.4

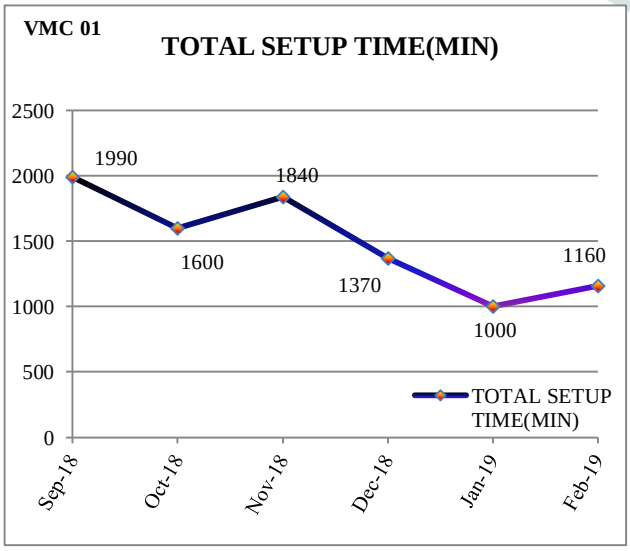
	Total Hrs	432	221	224	303	1179
	Availability	0.89	0.82	0.62	0.51	0.71
	Quality	1.00	1.00	1.00	1.00	1.00
	Labor Efficiency	0.82	0.64	0.59	0.61	0.67
	OEE %	**72.21**	**52.54**	**36.58**	**31.00**	48.08

Table 2: Summary sheet of Jan-2019

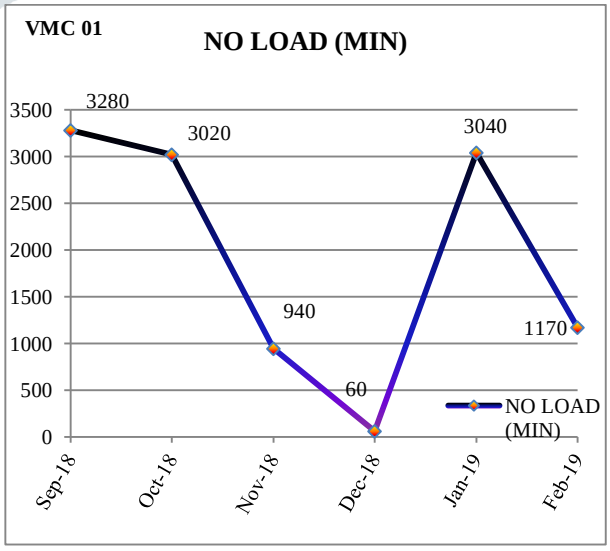
(VMC 01) / MONTH →	**Sep-18**	**Oct-18**	**Nov-18**	**Dec-18**	**Jan-19**	**Feb-19**
Total Setup	10	9	7	5	5	5
Total Setup Time(Min)	1990	1600	1840	1370	1000	1160
Avg. Setting Time(Min)	199	178	263	274	200	232
No Operator (Min)	900	1020	1830	2250	0	690
No Load (Min)	3280	3020	940	60	3040	1170
M/C Breakdown	0	0	0	0	0	0
Tooling Problem	0	0	0	60	150	240
Other	1380	300	0	0	0	1380
No Power	255.00	420	410	0	0	0
Total Idle Time(Min)	5815	4760	3180	2370	3190	3480
Net Available Time (Min)	29575	28440	30868	25240	31690	31240
Output Time(Min)	24500	23471	24400	21245	25905	26045
Availability	0.79	0.82	0.86	0.90	0.89	0.88
Quality	1.00	1.00	1.00	1.00	1.00	1.00
Labor Efficiency	0.83	0.83	0.79	0.80	0.82	0.82
OEE %	**65.66**	**67.86**	**67.74**	**72.00**	**72.21**	**72.01**

Table 3: Six month data of VMC 01

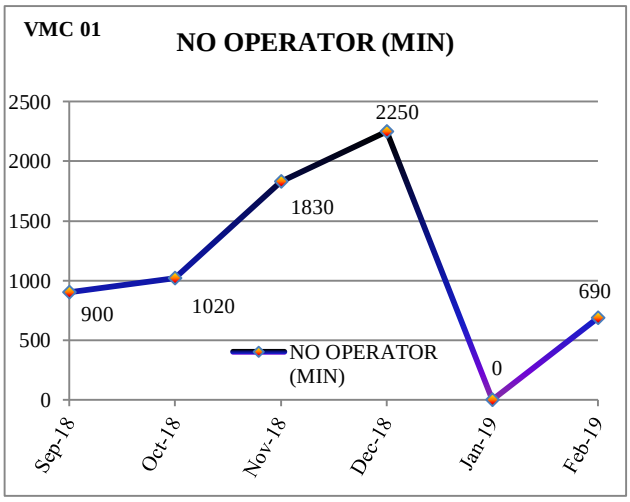
The above table is of VMC 01 data of six months. This data helps to find the losses of that particular machine. This data used for the better utilization of machine. By analyzing the nature of graph we can find the root cause of losses. OEE is increased with the reduction of losses. The graphs of losses based on data in table 3 are given below-



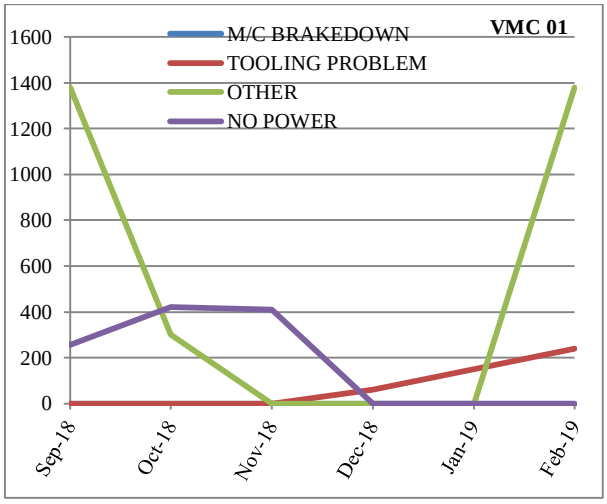
Graph 2: Total setup time (min)



Graph 3: No load (min)



Graph 4: No operator (min)



Graph 5: Losses in min

These graphs are clearly indicated the all parameters which are affect the efficiency of particular machine. After the analyzing these graphs we reduce the all parameter as well as losses. It ultimately results in the increased in OEE. Graphical method is easy to identify the problems. The main losses are no load, no operator, setup-time, machine breakdown, tooling problem, no power and other.

III. CONCLUSION

Overall Equipment Effectiveness (OEE) is the important tool of Lean Manufacturing. OEE gives exact efficiency of the machines. The real scenario finds with the help of OEE data. The improvement of the efficiency it depends on the actual machine condition. To use the optimum utilization of work machines OEE plays a vital role. Lean manufacturing is widely necessary for the growth of the industry is all areas. To increase the OEE it's necessary to reduce the losses like no load, no operator, and setup time reduction. Setup time reduction can be possible by converting the interior action in to the exterior action. As soon as the losses are reduced there is improvement in the OEE. Overall Equipment Effectiveness is the intrinsic element for the good quality and better productivity to industry. OEE does not monitor the equipment, but show the status of equipment to take corrective action for better improvement.

REFERENCES

[1] Richard Hedman, Mukund Subramaniyan, Analysis of critical factors for automatic measurement of OEE, CIRP-CMS 2016.
[2] A. J. DE Ron, J. E. Rooda, OEE and equipment effectiveness: an evaluation, International journal of production research, vol. 44, No. 23,1 Dec.2006.
[3] S. R. Vijaykumar, Improvement of overall equipment effectiveness (OEE) in injection moulding process industry, IOSR journal of mechanical and civil engineering, 2014.
[4] Nikunj A Patel, Dilbag Mondloe, Study optimization of productivity through overall equipment effectiveness (OEE) method – A review, International journal of advance engineering and research development, vol. 3, March 2016.
[5] A. P. Puvanasvaran, C. Z. Mei, Overall equipment efficiency improvement using time study in an aerospace industry, Procedia engineering 68, 2013.
[6] S. F. Fam, N. Ismail, Lean manufacturing and overall equipment efficiency (OEE) in paper manufacturing and paper products industry, Journal of advance manufacturing technology, Dec-2017.
[7] Ranteshwar Singh, Dhaval B Shah, Overall equipment effectiveness (OEE) calculation – Automation through hardware and software development, Procedia engineering 51, 2013.
[8] Amit Kumar Gupta, OEE improvement by TPM implementation: A case study, International journal of IT, engineering and applied sciences research, vol. 1 Oct.-2012.
[9] Marin Mainea, Ion Caciula, A method to optimize the overall equipment effectiveness, Management and control of production logistics, Sep.-2010.
[10] Faraz Ali, Improvement of OEE by measuring and analysis of machine speed, total stoppages and implementation of visual display board, Journal of electronics and communication engineering research, vol. 2, 2015.
[11] Gisela Lanza, Johannes Stoll, Measuring global production effectiveness, Procedia CIRP 7, 2013.
[12] Anand S Relkar, Optimizing and analyzing overall equipment effectiveness (OEE) through design of experiments (DOE), Procedia engineering 38, 2012.
[13] Chandrajit P Ahire, Correlating failure mode effect analysis (FMEA) and overall equipment effectiveness (OEE), Procedia engineering 38, 2012.
[14] Shekhar Sahu, Lakhan Patidar, 5S transfusion to overall equipment effectiveness (OEE) for enhancing manufacturing productivity, International journal of engineering and technology, vol. 2, Oct-2015.