



### Improvement of overall equipment effectiveness in cnc machine

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#### Abstract

In an era of global manufacturing, a company must flexible to change its strategies when new markets are explored and when demand changes frequently. With the intense in market completion, manufacturing companies are accepting the customer orders even for small batch sizes. In order to achieve the target for varying customer needs with small batch quantities, it is becoming a great challenge to get optimal utilisation of the resources available within the company. In a job shop though the resources seem to be utilized completely within the available time, there are huge losses in terms of time which affect the overall productivity of the resources. The purpose of the project is to identify these losses by measuring the OEE in a job shop & improve the productivity time by using lean techniques such as SMED, TQM & 5S.

**Keywords:** OEE, SMED, lean manufacturing, overall effectiveness.

#### I.Introduction

OEE is a productivity improvement tool developed by Seiichi Nakajima in the 1960's to identify how effectively machines are being utilised. OEE is a performance indicator and their result is categorised into three different parameters i.e. Availability, Performance and Quality. OEE is a tool for benchmarking with world class OEE and then optimizing the efficiency of machine. OEE conveys how well our manufacturing facilities are performed relative to its full load capacity during the planned production time.

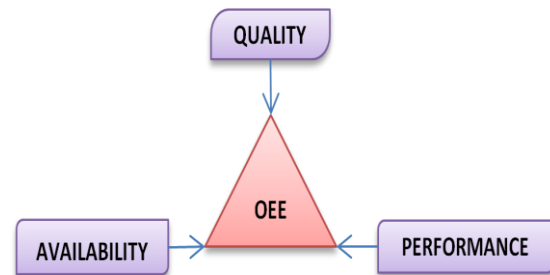


Fig.1 OEE process

**Availability:** This metric describes how actually the machine is available for production. Availability accounts with down time losses. Down time are those events which can be stop planned production for a particular time. For e.g.:- machine is stop due to overheating, tool not available, voltage trip suddenly, coolant supply stopped due to technical fault, job change over time.

$$\text{Availability} = \frac{\text{Actual operating time}}{\text{Planned production time}}$$

**Performance:** It accounts for speed losses. Performance metric tells how fast and effectively the operator carries out the job as soon as possible within the budget hours. It identifies and focuses on those factors which cause delay in production and speed reductions some of the causes are (Improper casting, miss fed, operator Inefficiency, and machine vibrations.)

$$\text{Performance rate (PR)} = \frac{\text{Budgeted allotted time}}{\text{Actual operating time}}$$

**Quality:** Quality metric accounts for quality losses i.e. good product among all fabricated product. In this case study we consider rework time as one of a parameter for quality. After completion of job due to machine and operator Inefficiency rework is carried out for dimensional accuracy of the job. This quality metric shows how well the operator carried out the process for producing a job. This metric shows quality of machine as well as operator skill to run the machine effectively. Quality losses are due to scrap, rework, incorrect, dimension, incorrect sequence of operation, in process damage.

$$\text{Quality Rate (QR)} = \frac{\text{Actual time to turn out job}}{\text{Actual time} + \text{Rework time}}$$

Over all Equipment Effectiveness (OEE):-

OEE is the product of these three metrics i.e. Availability, Performance, Quality.

$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality}$$

### Six Big losses:

1. Breakdown loss
2. Setup and adjustment loss
3. Small stops loss
4. Reduced speed loss
5. Production start up reject loss
6. Production Rejection loss

### II.Methodology

This case study is carried out at Aeropact Precision Machining Pvt. Ltd. Situated in Perundurai sipcot, Tamil nadu. Methodology which is adopted for the study is direct observation of machines. Here both primary as well as secondary data is being gathered for the case analysis. After several visits and direct observation of machines and analysing previous machine utilisation record problem is identified that machine is not working up to its full load production capacity. So

management wants to implement productivity improvement tool. So for this brief literature study is carried out and finally OEE tool is selected to carry out the study. This sub part is machined on CNC Table type Turning and milling machine. The budgeted hour given by planning department is 30 hours for completion of job and this data is being carefully analysed according to the literature. And finally the result is obtained in terms of OEE percentage.

This case study is carried out step by step these steps are shown below in flow diagram.

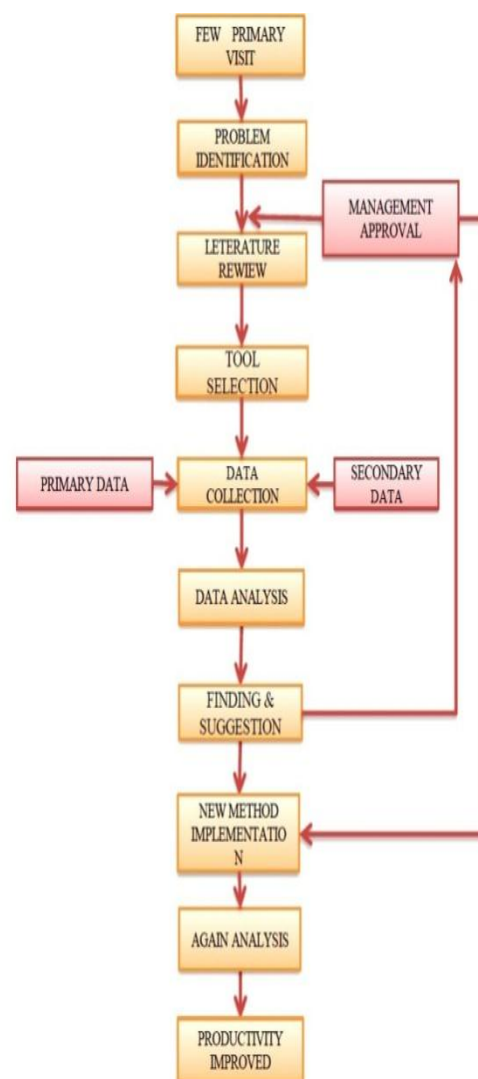


Fig.2, Process flow diagram

## Present OEE Calculation

OVERALL EQUIPMENT EFFECTIVENESS WORKSHEET						
Job Title : Adaptor union					<b>OEE</b>	
Machine : Tsugami CNC Turning and Milling machine						
Date : 02.03.2017						
OEE DATA						
Number of shifts:	7					
Shift Duration :	8 Hrs 30 Min shift (8am to 4.30pm, 4.30pm to 1am )					
Shift length :	510	Minute per Shift				
Short Breaks:	7	Breaks@	10	MIN EACH	70	Minute
Meal Break :	7	Breaks@	30	MIN EACH	210	Minute
Down Time:	75	Minute		Scheduled maintenance:	0	Minute
Change Over Time :	75	Minute		Housekeeping of m/c	0	Minute
Rework Time duration:	135	Minute		Total time	280	Minute
Planned Production Time:	3290	Minute				
Operating time :	3570	Minute				
Actual completion time :	3435	Minute				
Budgeted time for job :	1800	Minute				
Actual operating time:	1830	Minute				
OEE CALCULATIONS						
OEE FACTORS	CALCULATION				OEE	OEE %
Availability:	Actual Operating time/planned production time				0.556	55.6 %
Performance:	Budget time/ actual completion time of job				0.524	52.4 %
Quality:	Actual Min/(Rework Min + Actual Min)				0.989	98.9 %
Overall OEE:	Availability × Performance × Quality				0.288	28.8%

Table 1, Present OEE Calculation

### III. Finding and Suggestions

After the analysis of present situation we found that CNC Table type Turning and milling machine is working much below the world class OEE i.e. 28% OEE compare to 85% world class OEE so there is a scope of improvement.

After carefully analysis and discussion with shop floor Incharge and management we find some feasible suggestions for improvement of OEE.

These suggestions are as follows:-

- 1- During observation we found that housekeeping of machine is carried out during machining hours which accounts for 60 minute delay. So if housekeeping of machine is carried out during lunch time and in break time then delay can be reduced to 50 minute compare to previous 60 minute delay.
- 2- During observation Tool and Tool insert unavailability is a huge problem it usually takes huge time to find the tools from

Other machines so during this period machine is ideal. We can reduce this delay if company deployed experience manpower in Tool crib room so he will ensure the availability of Tool and Tool insert for all machines. This will largely reduce the unplanned down time. Approximately 60 minute for this machine during the machining of bottom balancer frame.

- 3- Planning department must ensure the provision of operation process sheet (OPS) so the operator will easily understand the sequence of operation. And drawing should be provided before the job load. So operator can study and make program for that particular job in their ideal time. This step reduces 60 minute delay for the bottom balancer frame during the study of CNC machine i.e. CNC table type turning & milling machine.

## Improved OEE Calculation

OVERALL EQUIPMENT EFFECTIVENESS WORKSHEET						
Job Title : Adaptor union					<b>OEE</b>	
Machine : Tsugami CNC Turning and Milling machine						
Date : 02.03.2017						
OEE DATA						
Number of shifts:	7					
Shift Duration :	8 Hrs 30 Min shift (8am to 4.30pm, 4.30pm to 1am )					
Shift length :	510	Minute per Shift				
Short Breaks:	7	<a href="#">Breaks@</a>	10	MIN EACH	70	Minute
Meal Break :	7	<a href="#">Breaks@</a>	30	MIN EACH	210	Minute
Down Time:	65	Minute		Scheduled maintenance:	0	Minute
Change Over Time :	60	Minute		Housekeeping of m/c	0	Minute
Rework Time duration:	90	Minute		Total time	280	Minute
Planned Production Time:	3290	Minute				
Operating time :	3570	Minute				
Actual completion time :	3250	Minute				
Budgeted time for job :	1800	Minute				
Actual operating time:	2060	Minute				
OEE CALCULATIONS						
OEE FACTORS	CALCULATION				OEE	OEE %
Availability:	Actual Operating time/planned production time				0.626	62.6 %
Performance:	Budget time/ actual completion time of job				0.553	55.3 %
Quality:	Actual Min/(Rework Min + Actual Min)				0.973	987.3 %
Overall OEE:	Availability × Performance × Quality				0.333	33.3%

**Table 2. Improved OEE Calculation**

## Result

	PRESENT	IMPROVED	WORLD CLASS
Availability	0.55	0.62	0.90
Performance	0.52	0.55	0.95
Quality	0.98	0.97	0.99
OEE	0.28	0.33	0.85

**Table 3. Result**

## IV. Conclusion

At last I conclude that CNC Table type turning and milling machine was continuously running before the case study but company production schedule delayed for every time. So after implementation of Overall Equipment Effectiveness (OEE) cycle time for machining decreased from 57 hours to 52 hours. Saving of

5 hours it means by using OEE performance and productivity is improved up to a certain level. As we know that measurement of performance is important, because it identifies current performance gaps between current and desired performance and provides indication of progress towards closing the gap. So by using OEE we can reduce this gap up to a certain level.

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