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Optimization and improvement of OEE (Overall Equipment Effectiveness) of CNC turning the machine

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ABSTRACT

This study explores the optimization and improvement of OEE (Overall Equipment Effectiveness) of a CNC (Computer Numeric Control) turning machine. The main purpose in increasing OEE is to improve the productivity and production with minimum losses. During the research, our main objective was to reduce the losses to increase OEE. As OEE depends upon three factors i.e. availability, quality, and performance rate so quality rate being top notch the main objective was to focus on availability and performance rate. In our research, OEE is increased by reducing the losses and by reducing the cycle time/product.

Keywords: *Availability rate, quality rate, performance rate, OEE.*

1. INTRODUCTION

The Overall Equipment Effectiveness (OEE) of a machine is a Key Performance Indicator (KPI) that indicates the equipment's overall operational performance and its origins from Total Productive Maintenance which was introduced by Seiichi Nakajima. The basic idea behind this was to improve the production and productivity by increasing OEE, which was done by reducing losses and increasing cycle time. OEE is basically the product of availability quality and performance rate and by increasing any one factor at a time OEE can be increased. If the OEE of a machine is equal to or greater than 85 percent than it is considered as world-class OEE.

2. PROCEDURE

OEE is calculated by the product of these three factors as shown below

O.E.E = Availability rate * Performance rate * Quality rate * 100

$$(1)\quad \text{Availability (A)} = \frac{\text{Loading time (LT)} - \text{Down time (DT)}}{\text{Loading time (LT)}} \times 100 \Longrightarrow (a)$$

(2) Performance rate = Speed operating rate (SOR) *Net operating rate (NOR) *100

- Speed operating rate (SOR) = $\frac{\text{Standard cycle time}}{\text{Actual cycle time}} \times 100$ ⇨ **(b)**

- Net operating rate (NOR) = $\frac{\text{Actual cycle time * produced amount}}{\text{Operating time}}$ ⇨ **(c)**

(3) Quality rate = $\frac{\text{Produced amount – (number of defect)}}{\text{Produced amount}}$ ⇨ **(d)**

(Rejected and Rework are the number of defects)

3. CALCULATION AND RESULT

Calculation for all months is shown in the tables

Loading time (LT) per day = 1-2-3-4

Where, 1= 24 hours * 60 Minutes = 1440 Minutes

2 = 3 * 30 Minutes (lunch)= 90 Minutes

3 = 3 * 30 (tea break, shift changeover)

4= Planned down time =54 Minutes

(No material + No operator + power tripping)

= 1440 -(90+90+54)

= 1440-234

So Loading time = 1206

Down (Time DT) per day = 155 minutes (Electrical break down + Mechanical breakdown +Tool change + set up time +start up loss + inspection time)

No putting all the values in formulas of availability, quality and performance rate

We get the following data

- Availability = $\frac{1206 - 155}{1206} = 0.87$ (from formula (a))

= 0.87 * 100

=87%

Month	Loading Time (LT)	B/D (Min.)	Setup (Min.)	Tool Change (Min.)	Start Up Loss (Min.)	Inspection Time (Min.)	Down time (DT) (Min.)	Availability LT-DT = (--------) LT
Jan-18	1206	80	0	0	0	0	155	0.87
Feb-18	1206	70	0	0	0	0	145	0.87
Mar-18	1206	45	0	0	0	0	120	0.90
Apr-18	1206	25	0	0	0	0	100	0.91

Performance rate

If standard cycle time is 1 minute

Actual cycle time is 1 minute

Then

$$SOR = \frac{1}{1} = 1 \quad \text{(from formula (b))}$$

Net operating rate (NOR)

$$= \frac{1 * 1020}{1051} \quad \text{(from formula (c))}$$

$$= 0.97$$

Operating time = Loading time – Down time

= 1206-155=1051 minutes

Table of performance rate data

	STD. CYCLE TIME	ACT. CYCLE TIME	SOR	Processed amout in Nos.	Operating time (Loading time –Down time) (1206- X)	NOR
Jan	1	1	1	1010	1206-155 =1051	0.96
Feb	1	1	1	1032	1206-145 =1061	0.97
Mar	1	1	1	1068	1206-120=1086	0.98
Apr	1	1	1	1098	1206-100=1106	0.99

$$\text{QUALITY RATE} = \frac{1120-10}{1120} = 0.99 \quad \textbf{(from formula (d))}$$

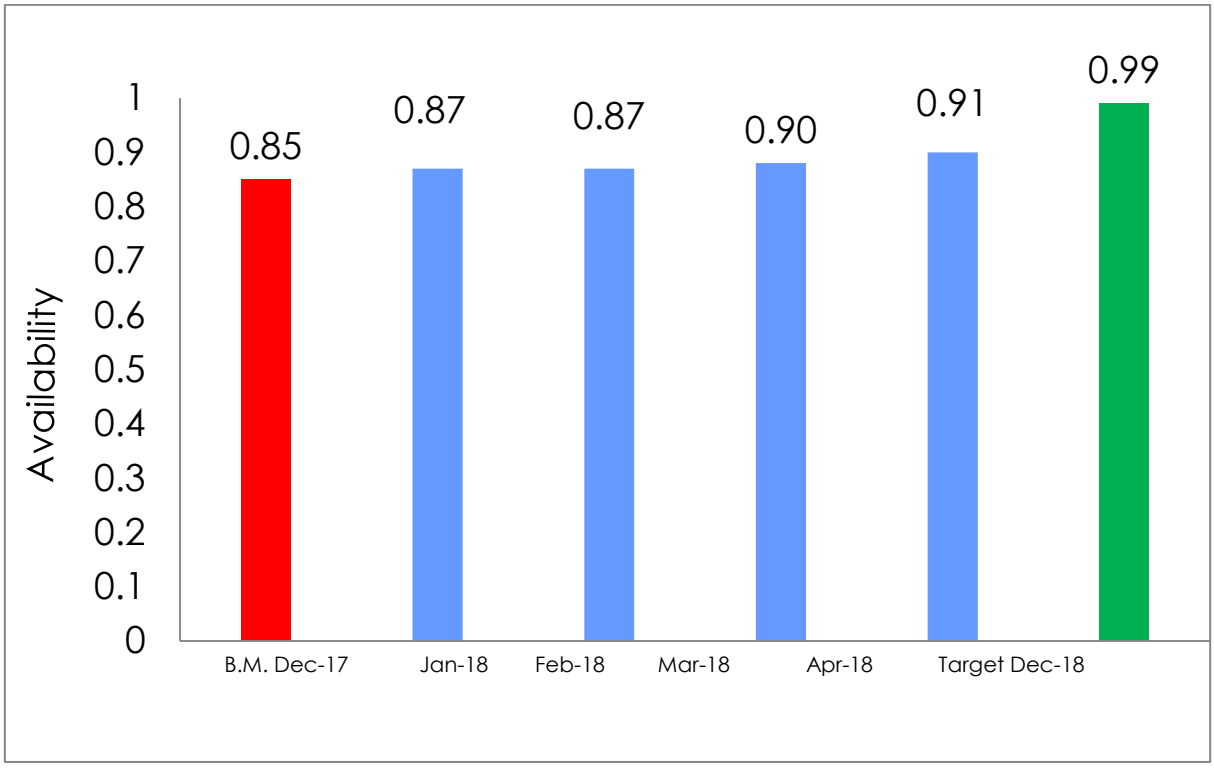
Quality rate = 99 % (0.99 *100)

	Processed Amount	Rejection	Rework	Rejection & Rework	Rate of Quality Product
Jan	1010	10	0	10	0.99
Feb	1032	7	1	8	0.99
Mar	1068	9	0	9	0.99
Apr	1098	9	0	9	0.99

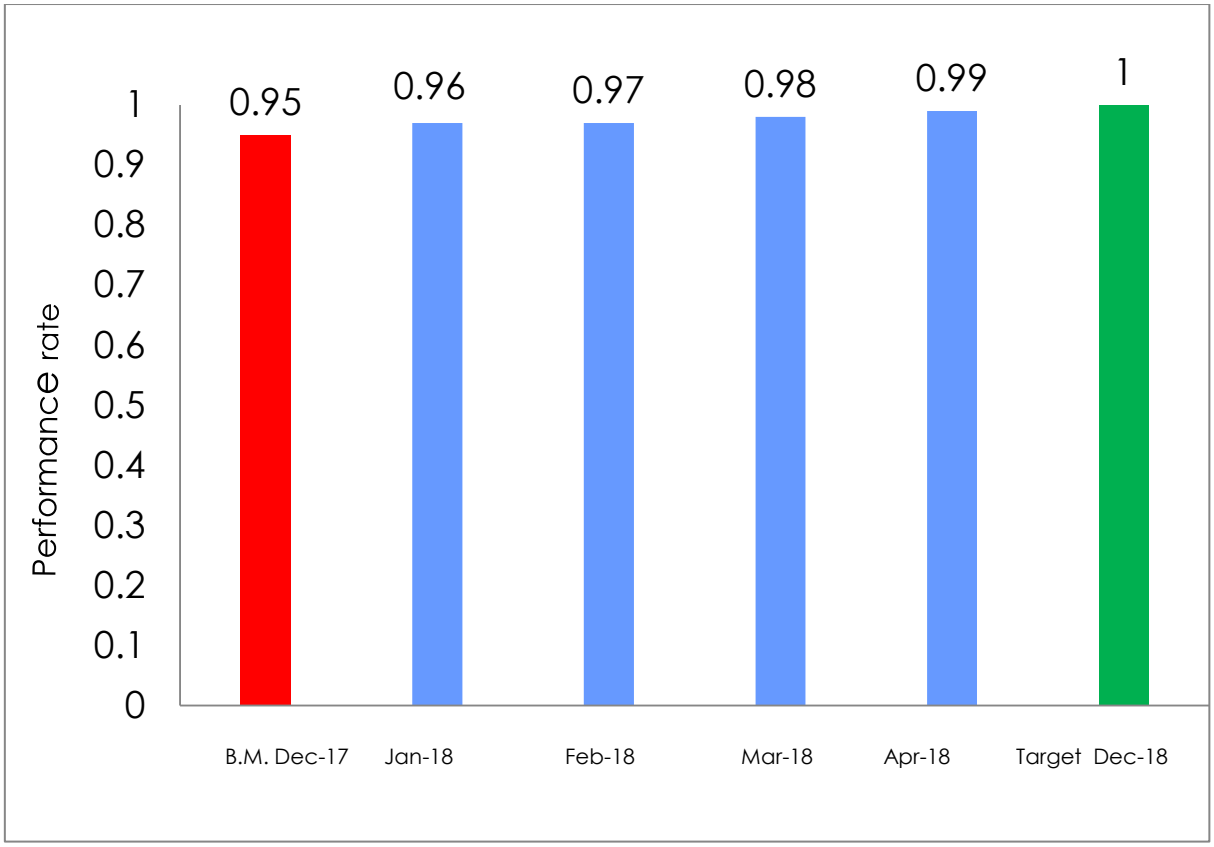
OEE= 0.87*0.96*0.99*100

= 82.64 %

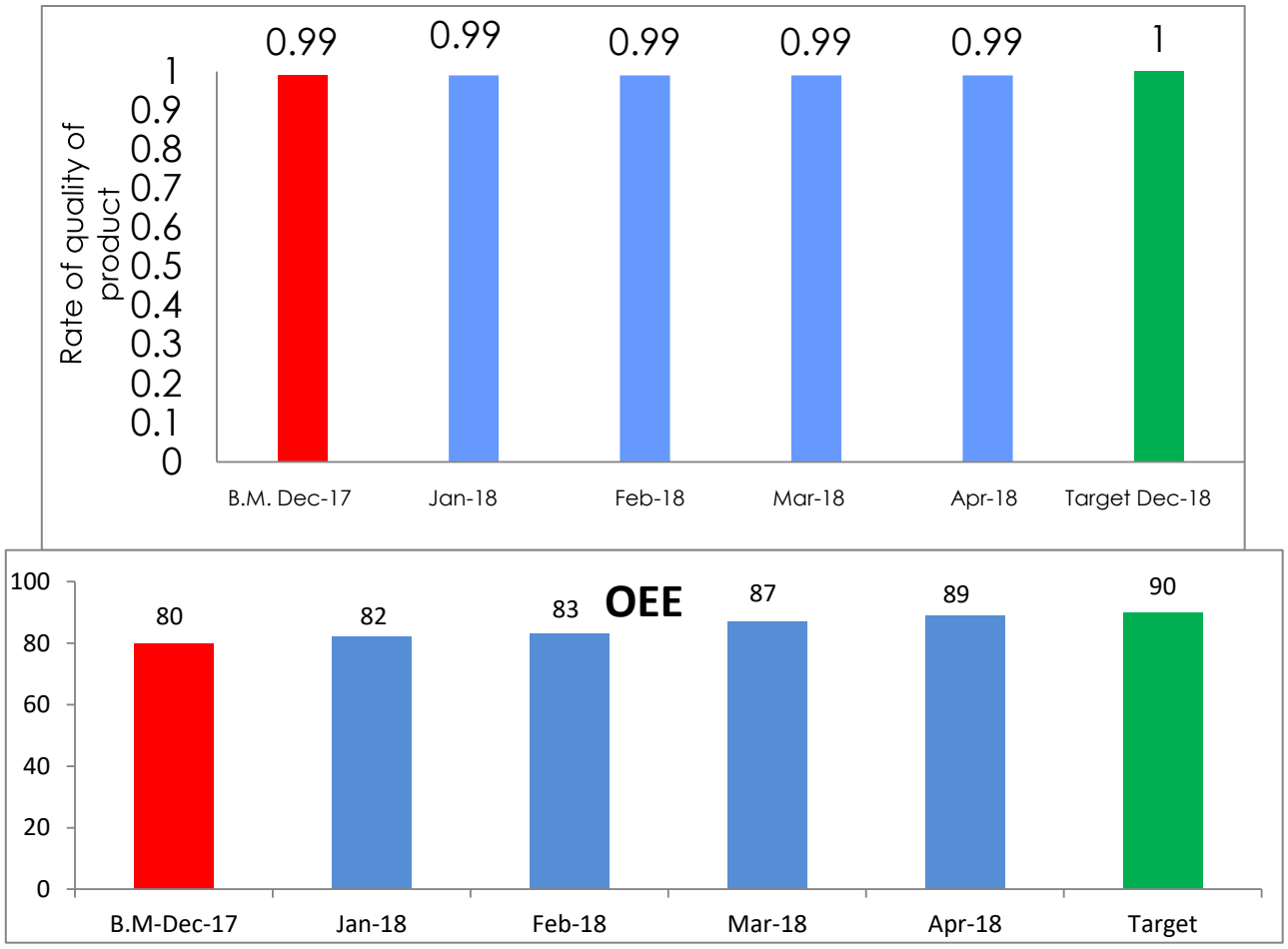
The result we got after reducing the losses are shown on the bar graph



Availability rate bar graph



Performance rate bar graph



The data shows the improvement of OEE over the past four months on the basis of reducing the downtime as one factor is reduced at a time to increase OEE.

OEE can also be increased by reducing start-up loss tool adjustment loss or reducing cycle time etc but we took downtime into our consideration to reduce OEE.

4. CONCLUSION

The aim of improving the OEE is to increase the production rate for better productivity, which was done by reducing the downtime of the machine while maintaining the minimum time allowed for the machine to work effectively.

The OEE of production line improved resulting in the improvement of delivery time.

Overall Equipment Effectiveness is used all over the world to increase the production rate or productivity and it is very effective also, so it is considered as an important factor in any industry.

5. REFERENCES

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