

Arab Academy for Science and Technology and Maritime Transport



Maintenance Planning–ME542

Key Performance Indicators

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Introduction

Key Performance Indicators

*“It is not possible to manage what you cannot control
and you cannot control what you cannot measure!”
(Peter Drucker)*

Performance measurement is a fundamental principle of management. The measurement of performance is important because it identifies current performance gaps between current and desired performance and provides indication of progress towards closing the gaps.

The performance data for a certain plant is given below

Calculate:

- 1. OEE
- 2. TEEP
- 3. NEE
- 4. A
- 5. MTBM
- 6. MTTM
- 7. MTBF
- 8. MTTR
- 9. Ut

Production Data			Maintenance Data		
Production rate	(ton/hr)	8	Annual total time	(hr)	8760
Total time	(hr/day)	24	Annual operating time	(hr)	5520
Average downtime	(hr/day)	4	Annual PM downtime	(hr)	1240
Average available time	(hr/day)	20	Annual CM downtime	(hr)	410
Average standby time	(hr/day)	3	Annual number of PM	(--)	12
Average used time	(hr/day)	17	Annual number of failures	(--)	5
Average target quantity	(ton/day)	136	Annual PM spare parts	(1000\$)	149
Average actual quantity	(ton/day)	105	Annual CM spare parts	(1000\$)	130
Average sound quantity	(ton/day)	98	Annual PM effort	(man.hr)	720
Average defect quantity	(ton/day)	7	Annual CM effort	(man.hr)	210

Production

Maintenance

Production

1. OEE Overall Equipment Effectiveness
2. TEEP Total Effective Equipment Productivity
3. NEE Net Equipment Effectiveness

Maintenance

4. A Availability
5. MTBM Mean Time Between Maintenance
6. MTTM Mean Time To Maintenance
7. MTBF Mean Time Between Failures
8. MTTR Mean Time To Repair
9. Ut Utilization

Solution:

▶ Production Indicators:

1. OEE :

$$OEE = A * P * Q$$

Quality rate

Performance efficiency

Availability

$$Q = \frac{\text{sound quantity}}{\text{actual quantity}}$$

$$P = \frac{\text{actual quantity}}{\text{target quantity}}$$

$$A = \frac{\text{total time} - \text{total downtime}}{\text{total time}}$$

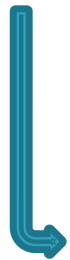
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Solution:

▶ Production Indicators:

2. TEEP :

$$\text{TEEP} = U * \text{OEE}$$



Used time ratio



Overall Equipment Effectiveness

$$U = \frac{\text{used time}}{\text{available time}} = \frac{\text{available time} - \text{standby time}}{\text{available time}}$$

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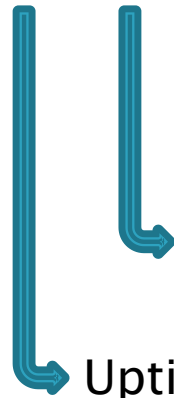
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Average defect quantity	(ton/day)	7	Annual CM effort	(man.hr) 210

► Production Indicators:

3. NEE :

$$NEE = U_p * P * Q$$



Quality rate

$$Q = \frac{\text{sound quantity}}{\text{actual quantity}}$$

Performance efficiency

$$P = \frac{\text{actual quantity}}{\text{target quantity}}$$

Uptime ratio

$$U_p = \frac{\text{uptime (productive time)}}{\text{average time (operating time)}} \rightarrow \frac{\text{sound quantity}}{\text{production rate}}$$

Solution:

▶ Maintenance Indicators:

4. **A** :

$$A = \frac{\text{total time} - \text{total downtime}}{\text{total time}}$$



Availability

Production Data			Maintenance Data		
Production rate	(ton/hr)	8	Annual total time	(hr)	8760
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Average defect quantity	(ton/day)	7	Annual CM effort	(man.hr)	210

Solution:

▶ Maintenance Indicators:

5. **MTBM** :

$$MTBM = \frac{\textit{operating time}}{\textit{number of PM}}$$



Mean Time Between Maintenance

Production Data			Maintenance Data		
Production rate	(ton/hr)	8	Annual total time	(hr)	8760
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Average defect quantity	(ton/day)	7	Annual CM effort	(man.hr)	210

Solution:

▶ Maintenance Indicators:

6. **MTTM** :

$$MTTM = \frac{PM \text{ downtime}}{\text{number of PM}}$$



Mean Time To Maintenance

Production Data			Maintenance Data		
Production rate	(ton/hr)	8	Annual total time	(hr)	8760
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Average downtime	(hr/day)	4	Annual PM downtime	(hr)	1240
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Average defect quantity	(ton/day)	7	Annual CM effort	(man.hr)	210

Solution:

▶ Maintenance Indicators:

7. **MTBF** :

$$MTBF = \frac{\text{operating time}}{\text{number of CM}}$$



Mean Time Between Failures

Production Data			Maintenance Data		
Production rate	(ton/hr)	8	Annual total time	(hr)	8760
Total time	(hr/day)	24	Annual operating time	(hr)	5520
Average downtime	(hr/day)	4	Annual PM downtime	(hr)	1240
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Solution:

▶ Maintenance Indicators:

8. **MTTR** :

$$MTTR = \frac{CM \text{ downtime}}{\text{number of CM}}$$



Mean Time To Repair

Production Data			Maintenance Data	
Production rate	(ton/hr)	8	Annual total time	(hr) 8760
Total time	(hr/day)	24	Annual operating time	(hr) 5520
Average downtime	(hr/day)	4	Annual PM downtime	(hr) 1240
Average available time	(hr/day)	20	Annual CM downtime	(hr) 410
Average standby time	(hr/day)	3	Annual number of PM	(--) 12
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Average sound quantity	(ton/day)	98	Annual PM effort	(man.hr) 720
Average defect quantity	(ton/day)	7	Annual CM effort	(man.hr) 210

Solution:

▶ Maintenance Indicators:

9. **Ut** :

$$U_t = \frac{\text{operating time}}{\text{available time}}$$



Equipment utilization

$$U_t = \frac{\text{CM effort} + \text{PM effort}}{\text{total effort}}$$



Worker utilization

Production Data			Maintenance Data		
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Thank you 😊