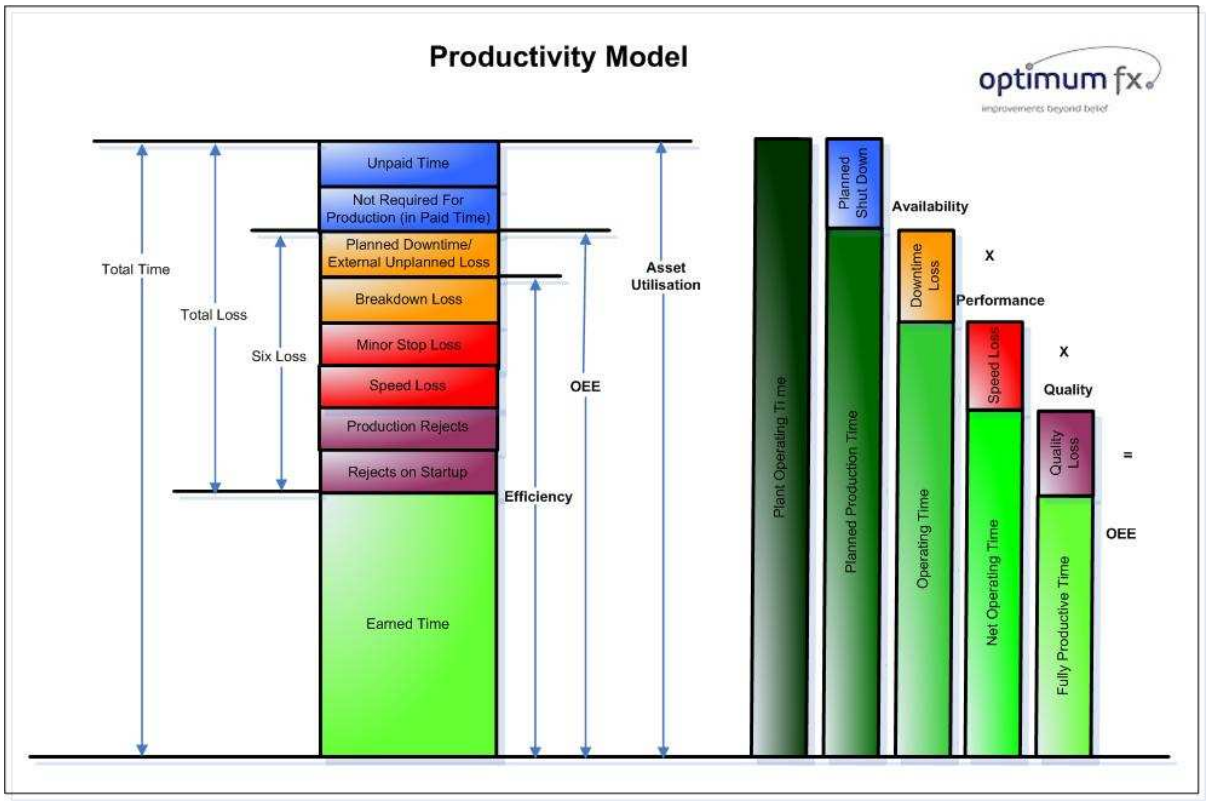
Overall Equipment Effectiveness (OEE) explained

In an ideal environment, all equipment would operate all the time at full capacity producing good quality product. In real life, however, this situation is almost non-existent.

Put simply overall equipment effectiveness (OEE) is a measure of what you actually made over what you could have made in theory over that timeframe. The difference between the ideal (theoretical) and actual situation is due to losses. These losses can be categorised into various metrics that provide you with excellent data to enable you to target that specific area and help you **Improve**.

The three main categories of OEE are Availability, Performance and Quality. By measuring the performance in each of these categories and multiplying the result will give you the OEE figure. These three categories are subdivided into what is known as the 'Six Losses'. The 'Productivity Model' below explains how the various measures fit together.



OEE Calculation

OEE Category	Calculation
Availability	Operating time / Planned production time
Performance	Net operating time / Operating time
Quality	Fully productive time/ Net operating time

OEE = Availability X Performance X Quality

Six Loss and counter measures

One of the major goals in TPM or OEE improvement programs is to reduce or eliminate the Six Losses. It allows us to accurately pinpoint the area of focus that will improve the efficiency of the equipment. The following table explains the Six Losses and how they can be addressed:

Six loss category	OEE measure	Reason for Loss	Countermeasures
Planned downtime or external unplanned event	Availability	• Changeovers • Asset care • Planned Maintenance • Material shortages • Labour shortages	• SMED – quick changeover techniques • Benchmarking • Planned downtime log and matrix
Breakdowns	Availability	• Equipment failure >5mins • Major component failure • Unplanned maintenance	• Asset care or preventative maintenance • Lubrication • Root cause analysis • Electrical thermographs or vibration analysis
Minor stops	Performance	• Equipment failure <5mins • Fallen product • Obstruction • blockages	• Targeted reduction of MTBF • High speed cameras • Tick sheets for further analysis • OEM audit and servicing
Speed loss	Performance	• Running lower than rated speed • Untrained operator not able to run at nominal speed • Machine idling	• Optimising line control • Training and awareness of line balance theory
Production rejects	Quality	• Product out of specification • Damaged product • scrap	• Error proofing • Six Sigma • Targeted analysis of reject area to analyse cause
Rejects on start up	Quality	• Product out of specification at start of run • Scrap created before nominal running after changeover • Damaged product after planned maintenance activity	• Precision settings • Ensure machine availability on start up • Complete all checks before start up

Six loss Calculation

Six loss category	Calculation
Planned downtime or external unplanned event	Planned downtime / Total production time
Breakdowns (>5mins)	Major fault time / Total production time
Minor stops (<5mins)	Minor fault time / Total production time
Speed loss	(Output / Ave speedxTotal production time) – (Output / Rated speedxTotal production time)
Production rejects	Rejects in prod / Actual speedxTotal production time
Rejects on start up	Rejects on start up / Actual speedxTotal production time

OEE and Six Loss Analysis Calculation Example

In a 480 minute shift :-
On a machine rated at 100 products output per minute
Maximum output = 480 mins x 100 units = 48000 units

Shift info:	Output (Good Production)	= 32000 units
	Speed	= 98 units per minute
	Planned downtime	= 82 mins
	Bottleneck loss due to B/down	= 30 mins
	Rejects (in process)	= 1255 in 8 hr shift

Output (OEE) = 32000 / 48000 = 66.66%
480mins x 66.67% = 320 mins
Total Loss = 160 mins

Six Loss Calculations:

Speed loss
Max theoretical units possible at actual speed = 98 x 480 = 47040
= (32000/47040) – (32000/48000) =
68.03% - 66.67% = 1.36%
480 x 1.36% = 6.53 mins / 480 = (1.36%)

Planned downtime = 82 mins / 480 = (17.08%)

Breakdown = 30 mins / 480 = (6.25%)

Rejects = 1255 / 98 (actual running speed) = 12.81 mins / 480 = (2.67%)

Minor stops = 480-320-6.53-82-30-12.81 = 28.66 mins / 480 = (5.97%)

Total loss = 160 mins = (33.33%)

OEE Calculations:
(Time in mins)

Production time = 480 Time less availability loss = 368 Time less performance loss = 333

Availability Loss		Performance Loss		Quality Loss	
Planned downtime	=82	Speed loss	=6.53	Rejects on start up	=0
Breakdowns	=30	Minor stops (<5mins)	=28.66	Rejects in process	=12.81
Total	*=112*	*Total*	*=35.19*	*Total*	*=12.81*

Availability (368/480) = 77% Performance (333/368) = 90% Quality (320/333) = 96%

OEE = 0.77x0.9x0.96 = 66.7%