How to Operate Equipment at Required Effectiveness

Value Chain Competitiveness (VCC)

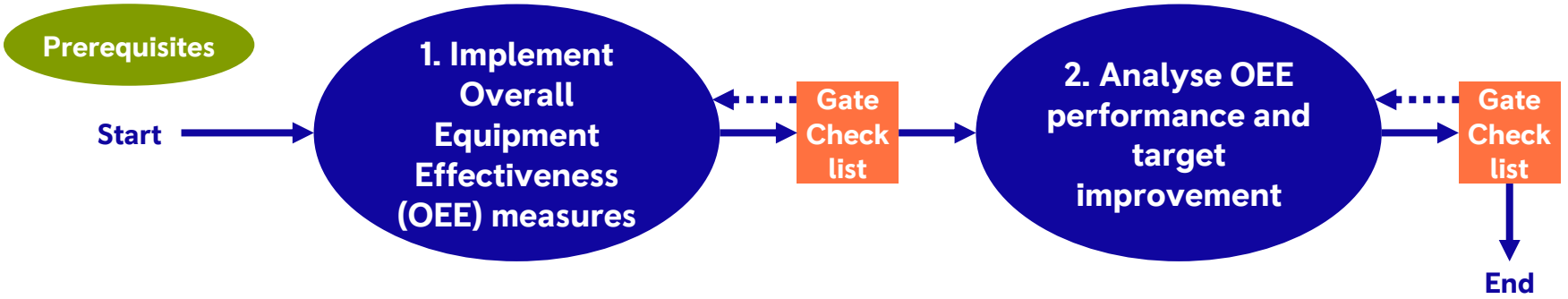
Version: 2

February 2020

How to Operate Equipment at Required Effectiveness

BACK Map NEXT

Scope | Objectives & Principles



Scope

This 'How To' will enable you to:

- Implement Overall Equipment Effectiveness as a measurement and management tool
- Use visual control techniques to manage equipment performance and improvement
- Understand where to focus asset care programmes and maintenance strategy
- Gain equipment ownership at a working level

Objective and Principles

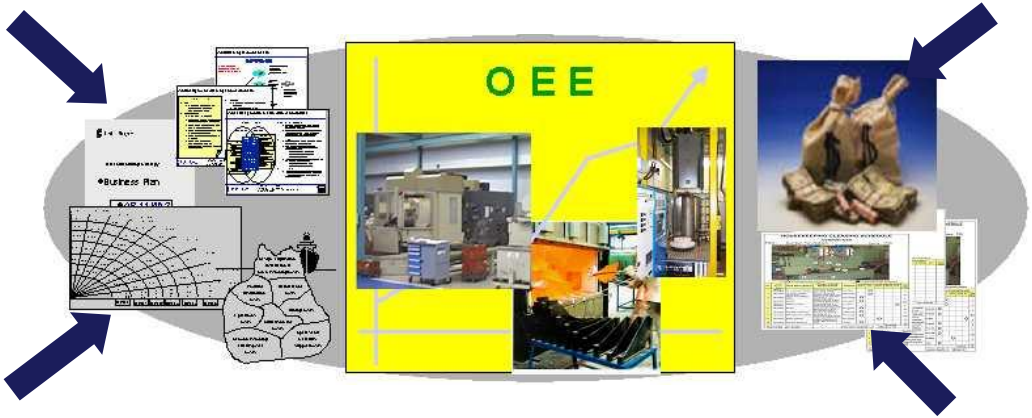
BACK Map NEXT

To ensure equipment can operate at the required effectiveness, in order that:

- The operating cost of equipment can be reduced
- Customer requirements are satisfied
- Return on capital equipment is maximised

1. Understand and analyse current equipment performance

2. Determine the appropriate strategy for the equipment



3. Eliminate equipment losses to improve effectiveness and increase throughput

4. Implement new standard routines to maintain effectiveness

Prerequisites

Knowledge:

- Knowledge of 5S principles
- Appreciation of FMEA techniques
- Knowledge of performance measures and their design and implementation

Data:

- Bottleneck equipment
- Process requirements - quality, cost, lead-time, schedule adherence

1. Implement Overall Equipment Effectiveness (OEE) measures

BACK Map NEXT

Overall Equipment Effectiveness is:

- A performance measure that can be used to establish the effectiveness of equipment
- A combination of three important business drivers:
  - Availability
  - Performance
  - Quality
- A data rational measure, it allows us to analyse, identify and target specific improvement activities
- To ensure that equipment is always available and working correctly when it is needed
- Applicable to any piece of equipment, especially on bottleneck / constraint processes

What benefits do you get from improving OEE?

- Improve Quality
- Improve Delivery
- Reduce Costs
- Increase Flow
- Improve equipment beyond intended performance levels
- Increase employee ownership

1. Implement Overall Equipment Effectiveness (OEE) measures

Understand the OEE measure

OEE = **Availability (%)** X **Performance (%)** X **Quality (%)**

OEE begins with Loading Time:- The time for which the machine is available to work once **Planned** Stoppages/Losses have been accounted for

Availability (%)

$$\frac{\text{Loading time} - \text{Downtime Losses}}{\text{Loading time}} \times 100$$

Performance (%)

$$\frac{\text{Operating time} - \text{Speed Losses}}{\text{Operating time}} \times 100$$

Quality (%)

$$\frac{\text{Parts Produced} - \text{Parts Rejected (scrap + rework)}}{\text{Parts Produced}} \times 100$$

OR

$$\frac{\text{Net operating time} - \text{Quality Loss (scrap + rework time)}}{\text{Net operating time}} \times 100$$

Note: The quality ratio can be calculated by either using quantity of parts or equivalent time values

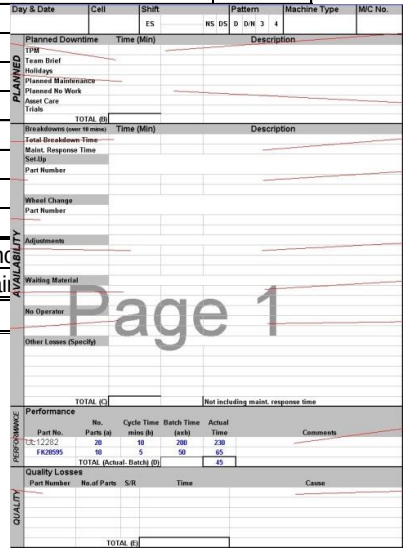
1. Implement Overall Equipment Effectiveness (OEE) measures

Capture the OEE data

1. Data recording must be done by the production team
2. Agree 'rules' for collecting time loss data, eg.
   - Holidays – statutory planned holidays only
   - Planned 'no work' – when equipment is not run, ie. when there are no deliveries required, or trials of new parts/processes/consumables
   - Availability – set standard categories for each loss
     - breakdown over 10 minutes
     - tooling changes (eg. wheel change) additional to set-ups
     - waiting material and resources
   - Performance - where cycle times differ between the equipment and the agreed system cycle time
     - minor stops – any time less than 10 minutes where the cycle stops for the operator to make adjustments
     - speed losses – additional time to complete the cycle due to equipment running slower than planned
   - Quality
     - Scrap – record the time taken to produce any part that is scrapped
     - Rework – record the time taken to rectify the component
3. Design & issue collection sheet
   - Try to design the collection sheet so that data can be captured regularly throughout the working shift.

Time loss Data

Reason	Time
Planned maintenance	500
Trials	100
Set ups & adjust	1498
Breakdowns	981
No material	
No operator	
Awtg tooling	
Awtg inspection	
Speed losses	
Rework	
Scrap	
Other -	
TOTAL LOST mins (not inc	
Mins left after Planned mai	



1. Implement Overall Equipment Effectiveness (OEE) measures

Understanding the impact of loss on available operating time

Total time

Loading time | Planned Downtime

Operating time | Downtime Losses

Net operating time | Speed Losses

Valuable Operating time | Quality Losses

Plant Operating Time

Total shift time planned = shift working hours x number of shifts plus overtime worked

Loss Category

- Breaks
- Planned maintenance
- No work

- Breakdowns
- Set-up & adjustment
- Waiting materials / tooling

- Minor stoppages
- Reduced speed/ idling

- Quality defects & rework
- Reduced yield

OEE Loss Category

Availability (%)

$$\frac{\text{Loading time - Downtime Losses}}{\text{Loading time}} \times 100$$

Performance (%)

$$\frac{\text{Operating time - Speed Losses}}{\text{Operating time}} \times 100$$

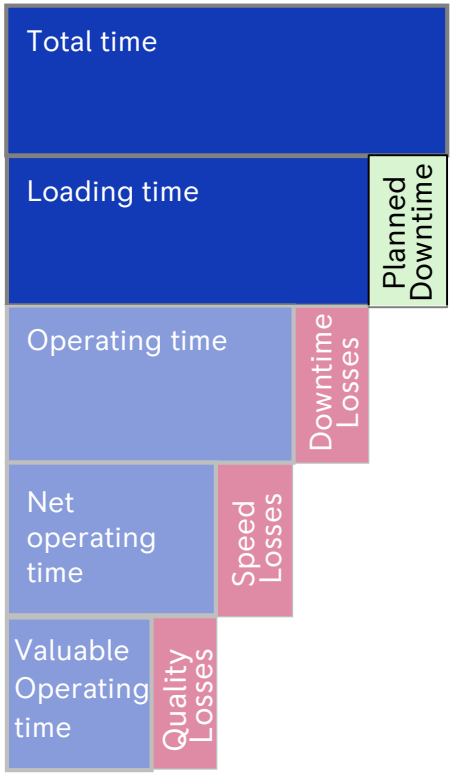
Quality (%)

$$\frac{\text{Net operating time - Quality Losses}}{\text{Net operating time}} \times 100$$

1. Implement Overall Equipment Effectiveness (OEE) measures

BACK Map NEXT

Calculate the Loading Time



1st Calculate **Loading Time** by deducting **Planned Downtime** from Total Time

Planned downtime

Breaks

Lunch and tea breaks where equipment is not operated e.g. Team briefs, start of shift & shift change overs

Planned

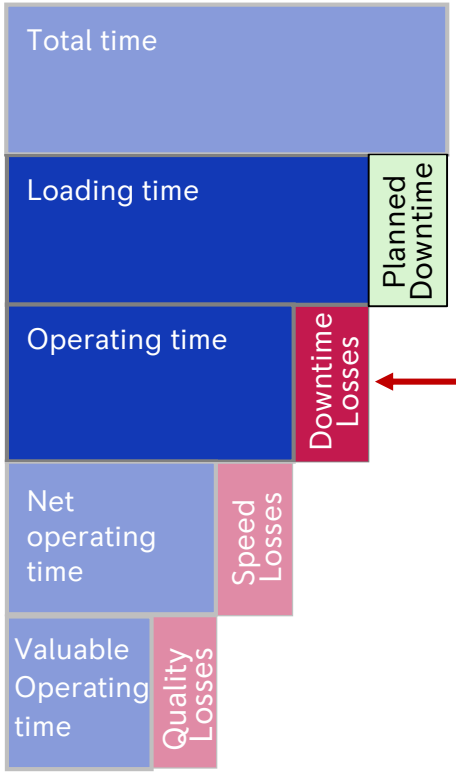
Scheduled time f or checks and maintenance; whether daily, monthly or on a usage basis

No Work

This is defined as time when there is no requirement on the schedule for the equipment to run. By running the equipment, inventory would be increased, which is undesirable. This is different to 'waiting' which is when there is a requirement to run, but due to a lack of resources (operators tools, jigs, information) equipment is not able to run

1. Implement Overall Equipment Effectiveness (OEE) measures

Calculate Availability% using Downtime Losses



Availability percentage: $\frac{\text{Loading time} - \text{Downtime Losses}}{\text{Operating time}} \times 100$

Downtime Losses

Breakdowns

Breakdown of equipment for more than 10 minutes

Setup and adjustment

The time taken when changing a machine or process over from the last good product of the previous run, to the first good product of the new run

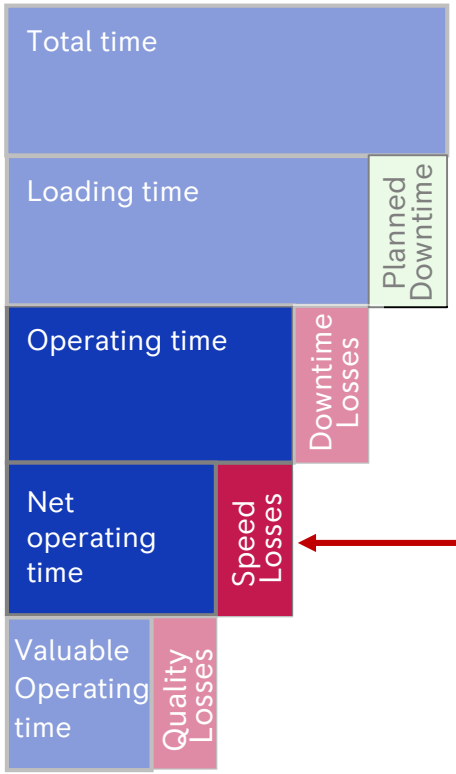
Waiting

If a piece of equipment is not running due to waiting, searching for tools, equipment, information etc.

1. Implement Overall Equipment Effectiveness (OEE) measures

BACK Map NEXT

Calculate Performance% using Speed Losses



Performance percentage: $\frac{\text{Operating time} - \text{Speed Losses}}{\text{Operating time}} \times 100$

Performance (Speed) Losses

Minor stoppage losses

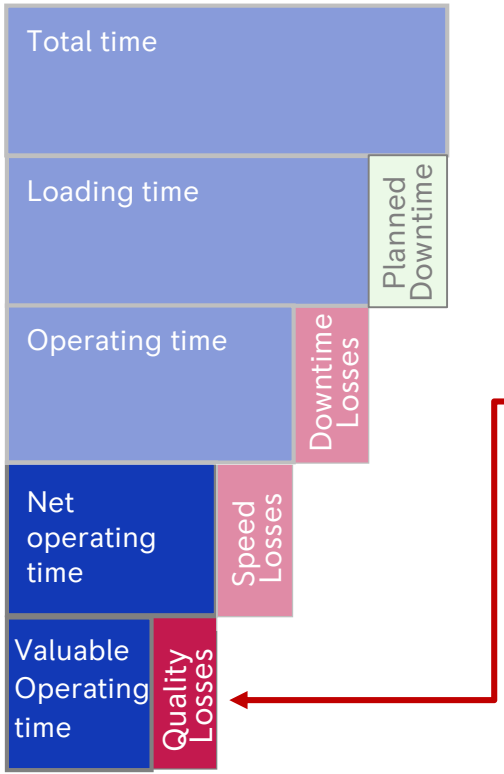
A short interruption in the running of the equipment (<10 mins)

Reduced speed losses

The difference between the time it should take to complete a batch of work, and the actual time taken

1. Implement Overall Equipment Effectiveness (OEE) measures

Calculate Quality% using Quality Losses



$$\text{Quality percentage:} \quad \frac{\text{Parts Produced} - \text{Parts Rejected (scrap + rework)}}{\text{Parts Produced}} \times 100$$

OR

$$\frac{\text{Net operating time} - \text{Quality Losses (scrap + rework times)}}{\text{Net operating time}} \times 100$$

Quality Losses

Quality defects and rework

Time or components lost due to rework or scrap because they do not meet the quality standard

Yield losses

Time or components lost during the start-up and for shutdown of the equipment

Components or output lost during the operation of the equipment, eg. leaks

1. Implement Overall Equipment Effectiveness (OEE) measures

Calculate the OEE%

Availability (%)

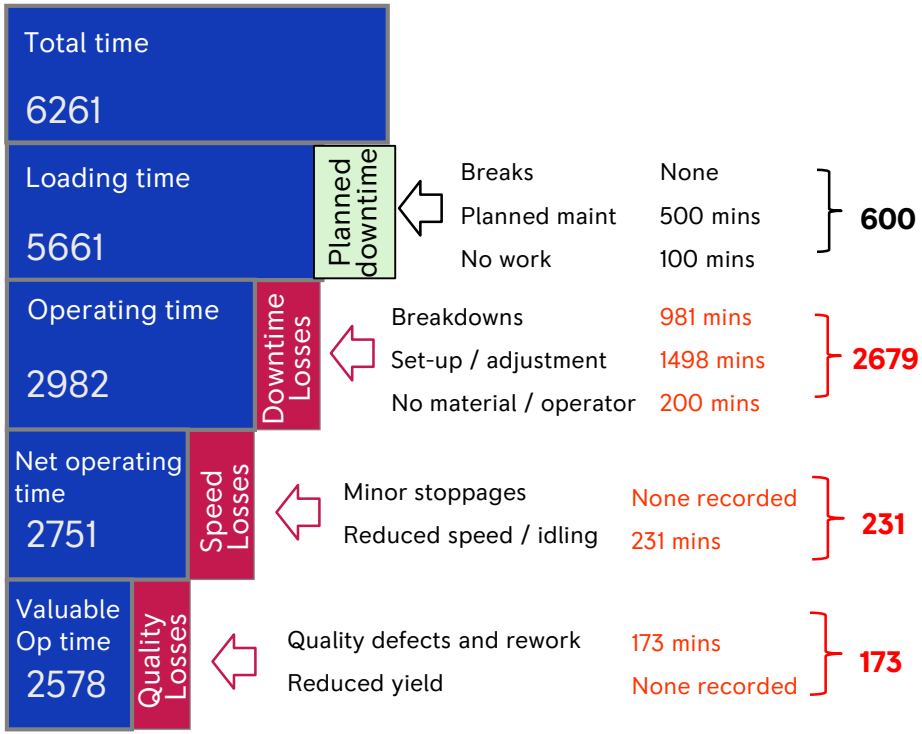
$$\frac{5661 - 2679}{5661} \times 100 = 52\%$$

Performance (%)

$$\frac{2982 - 231}{298\ 2} \times 100 = 92\%$$

Quality (%)

$$\frac{2751 - 173}{2751} \times 100 = 94\%$$



Therefore OEE% = 0.52 x 0.92 x 0.94 x 100 = 45%

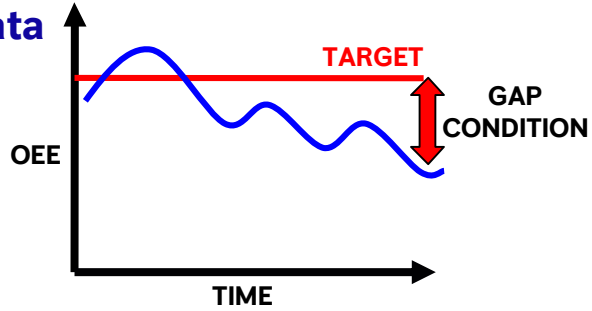
Gate checklist 1: Implement Overall Equipment Effectiveness (OEE) measures

- ☑ Overall equipment effectiveness (OEE) is understood by the team
- ☑ OEE measures have been implemented on key equipment and processes
- ☑ OEE visual management is at the point of equipment / process
- ☑ The team can identify which three business drivers to focus on – Availability / Performance / Quality

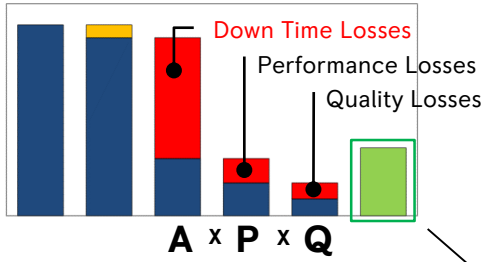
2. Analyse OEE performance and target improvement

Analyse & understand the OEE data

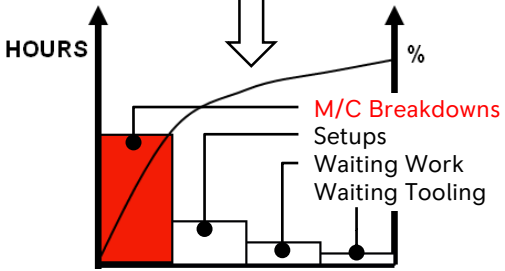
Level 1 - Analyse OEE trend data. Define "Gap condition"



Level 2 – Breakdown the gap to understand the highest contributing factors.



Level 3 – Pareto each of the losses.



Setting The Target

It is important to consider load.

Comparing load against Valuable Operating Time (Available capacity) will help to establish OEE targets.

2. Analyse OEE performance and target improvement

Target the area for improvement and select appropriate tools / techniques

Planned Maintenance
Asset Care

Set-Ups
Set-Up Reduction

No Material
Visual Management

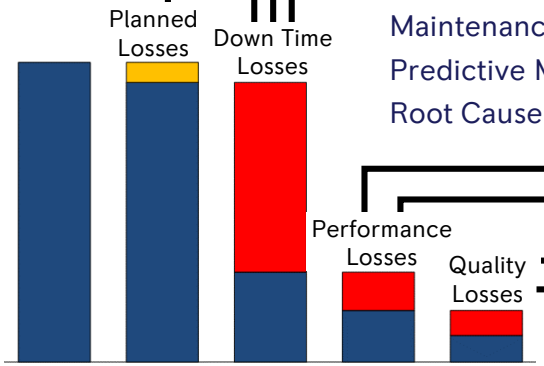
Breakdowns
Asset Care
Maintenance Strategy
Predictive Maintenance
Root Cause Analysis

Minor Losses
Asset Care

Speed Loss
Asset Care
Standardisation
Visual Management

Start-Up Losses
Asset Care
Set-Up Reduction

Yield Losses
Practical Problem Solving
Gauge R&R
Autonomation (Jidoka)
Right First Time



2. Analyse OEE performance and target improvement

Plan the improvement activities

- Setting a quantifiable target for improvement enables the gap condition to be monitored
- Detailed plans will contain activity steps and timelines

Improvement Technique

Loss Category	Plant Care	Maintenance Strategy	Set-up Reduction	Guage Calibration	Jidoka	Predictive Maintenance	Visual Management	Baseline Performance	Improvement Initiative	Target	Owner
Breakdown Loss	■	■				■		4.5 hrs/wk	Implement steps 1 to 4 of plant care	2 hrs/wk	A.Smith
No Material Loss							■	0.5 hrs/wk	Install visual kanban with stores	0 hrs/wk	D.Jones
Set-up Loss			■					1.5 hrs/set	Hold SMED workshop in Week 32	30 mins/set	P.Fellows
Minor Loss	■							N/A		N/A	
Speed Loss	■					■	■	N/A		N/A	
Start-up Loss	■		■					N/A		N/A	
Yield Loss	■			■	■		■	15%	Investigate improved cutting tools on Milacron	3%	M.Milton

Gate checklist 2: Analyse OEE performance and target improvement

BACK Map

- ☑ OEE is analysed and the Pareto of loss types is understood
- ☑ OEE improvement targets have been set
- ☑ Improvement techniques have been selected
- ☑ Improvement activity plans are in place

Version control sheet

Version	Change description	Who	When
1	VCC version first release of ‘How to Operate Equipment at Required Effectiveness’ – refresh of launch workshop materials (Mar ‘19) using R-R branded template as ‘Non-Confidential’ hosted on R-R.com website.	Andy Hodgkinson	Dec ‘19
2	DGP logo added to title page & copyright updated.	Andy Hodgkinson	Feb ‘20