

Outline of Presentation

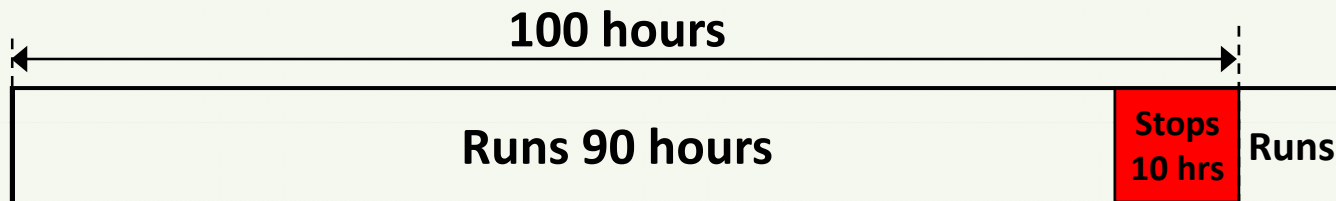
Overall Equipment Effectiveness / OEE – The most misused and abused indicator

1. Development of OEE (Overall Equipment Effectiveness)
2. Where has it gone wrong?
3. What is the real purpose of OEE?
4. If we shouldn't benchmark OEE, what should it be used for?
5. Key Learnings

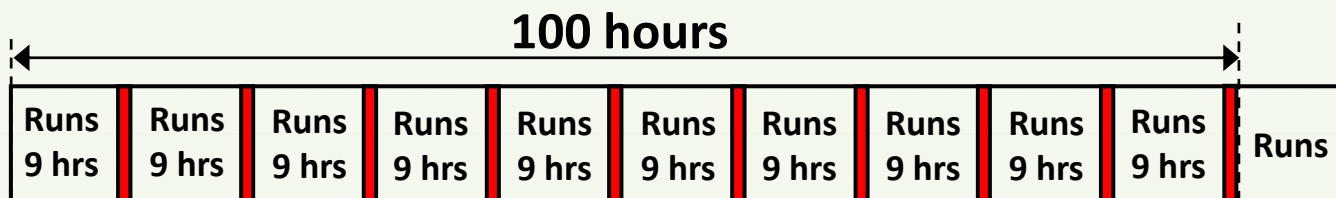
Development of OEE (Overall Equipment Effectiveness)

Limitations of Downtime as a Measure

Situation 1: 10 hour breakdown every 90 hours



Situation 2: 1 hour breakdown every 9 hours



Situation 1

Availability: 90%

Downtime: 10%

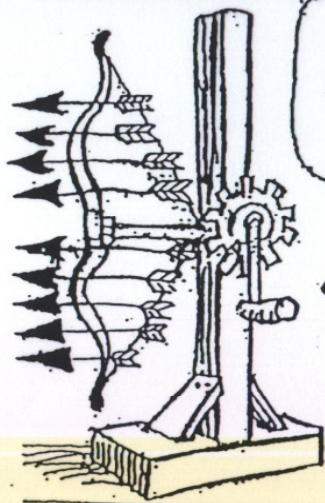
Situation 2

Availability: 90%

Downtime: 10%

Which situation will produce the most output?

WIZARD OF ID



I'VE DONE IT, SIRE... THIS
CROSSBOW WILL SHOOT EIGHT ARROWS
IN TWO SECONDS!

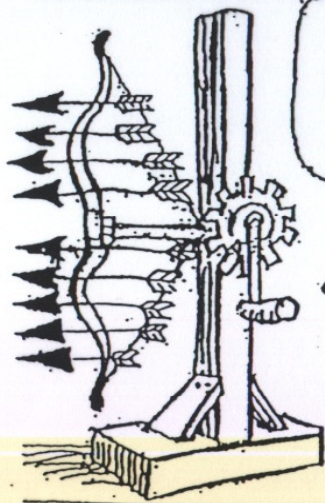
AT LAST!
THE ULTIMATE
WEAPON!



10-7

PARKER

WIZARD OF ID



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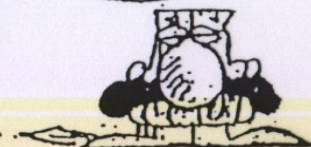
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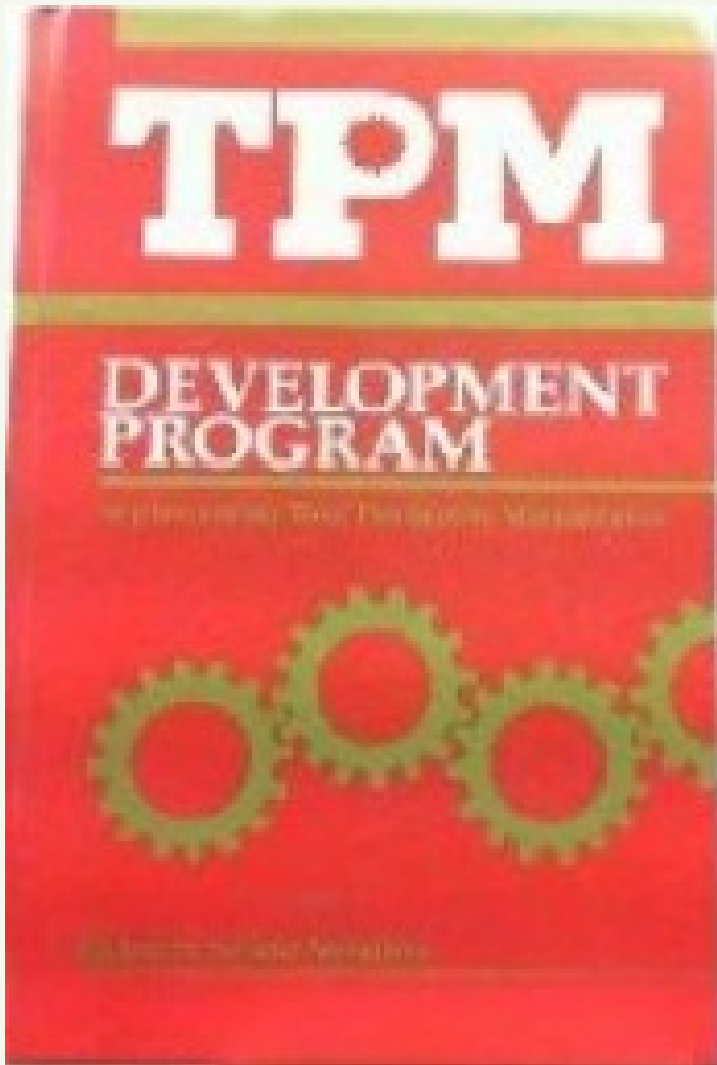
10-7
PARKER



... THE
TROUBLE IS,
IT TAKES
THIRTY
MINUTES TO
RELOAD



History of Overall Equipment Effectiveness



TPM Development Program

Seiichi Nakajima - Head of JIPM

Published in English in 1989

This was translated from the Japanese book **TPM Tenkai** published in 1982 by the Japan Institute of Plant Maintenance (JIPM)

Nakajima's Approach

Nakajima wrote: Effectiveness can be measured using the formula:

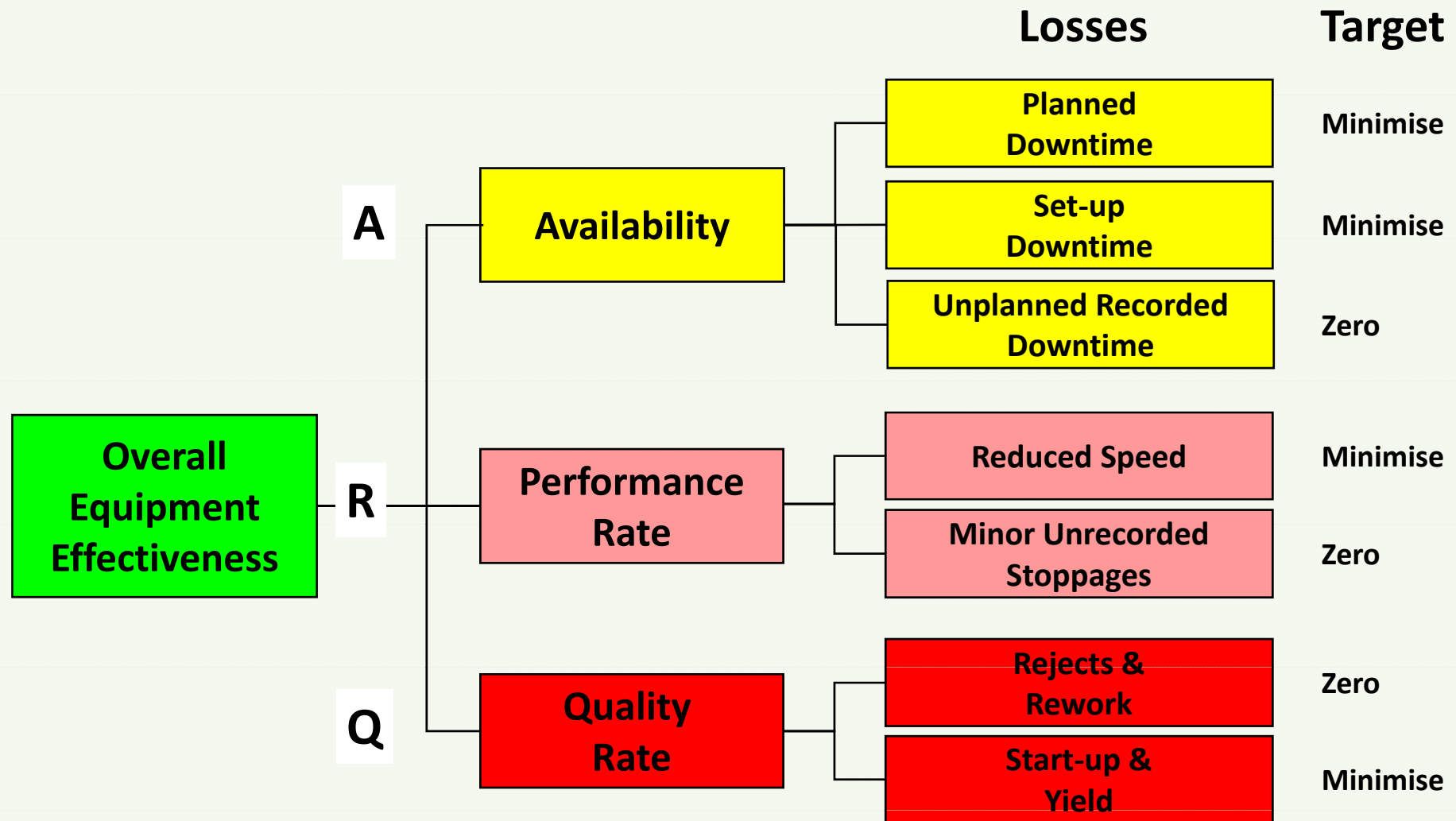
Overall Equipment Effectiveness (OEE) =

Availability x Performance rate x Quality rate

With the losses impacting on Overall Equipment Effectiveness listed as:

Availability	Performance rate	Quality rate
<ul style="list-style-type: none">• Breakdown losses• Setup and adjustment losses• Others	<ul style="list-style-type: none">• Idling and minor stoppage losses• Reduced speed losses	<ul style="list-style-type: none">• Quality defect and rework losses• Start-up losses

Overall Equipment Effectiveness Model



Calculating Overall Equipment Effectiveness using the Equations approach

$$\text{OEE} = \% \text{ Availability} \times \% \text{ Rate} \times \% \text{ Quality}$$

$$\text{Availability} = \frac{\text{Required Production Time} - \text{All Recorded Downtime}}{\text{Required Production Time}}$$

where All Recorded Downtime = Planned Downtime + Set-up Downtime + Unplanned Recorded Downtime

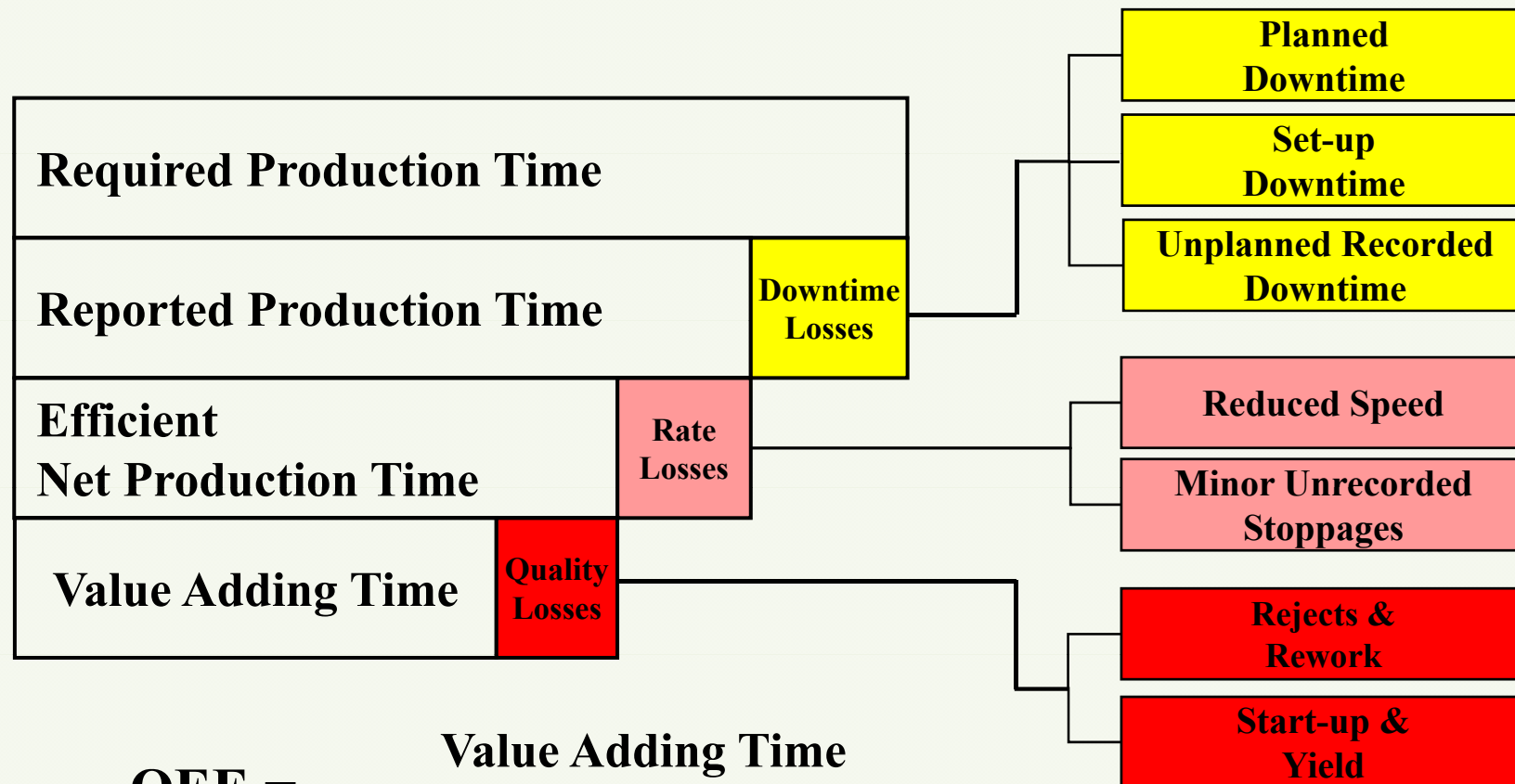
$$\text{Rate} = \frac{\text{Actual Speed}}{\text{Ideal Speed}} \times \frac{\text{Processed Amount}}{\text{Reported Production Time} \times \text{Actual Speed}}$$

where Reported Production Time = Required Production Time – All Recorded Downtime

$$\text{Quality} = \frac{\text{Good Output Produced}}{\text{Processed Amount}} \quad (\text{Mass Balance approach})$$

Note: Ideal Speed is measured in Output / Time

Calculating Overall Equipment Effectiveness using the Time Loss approach



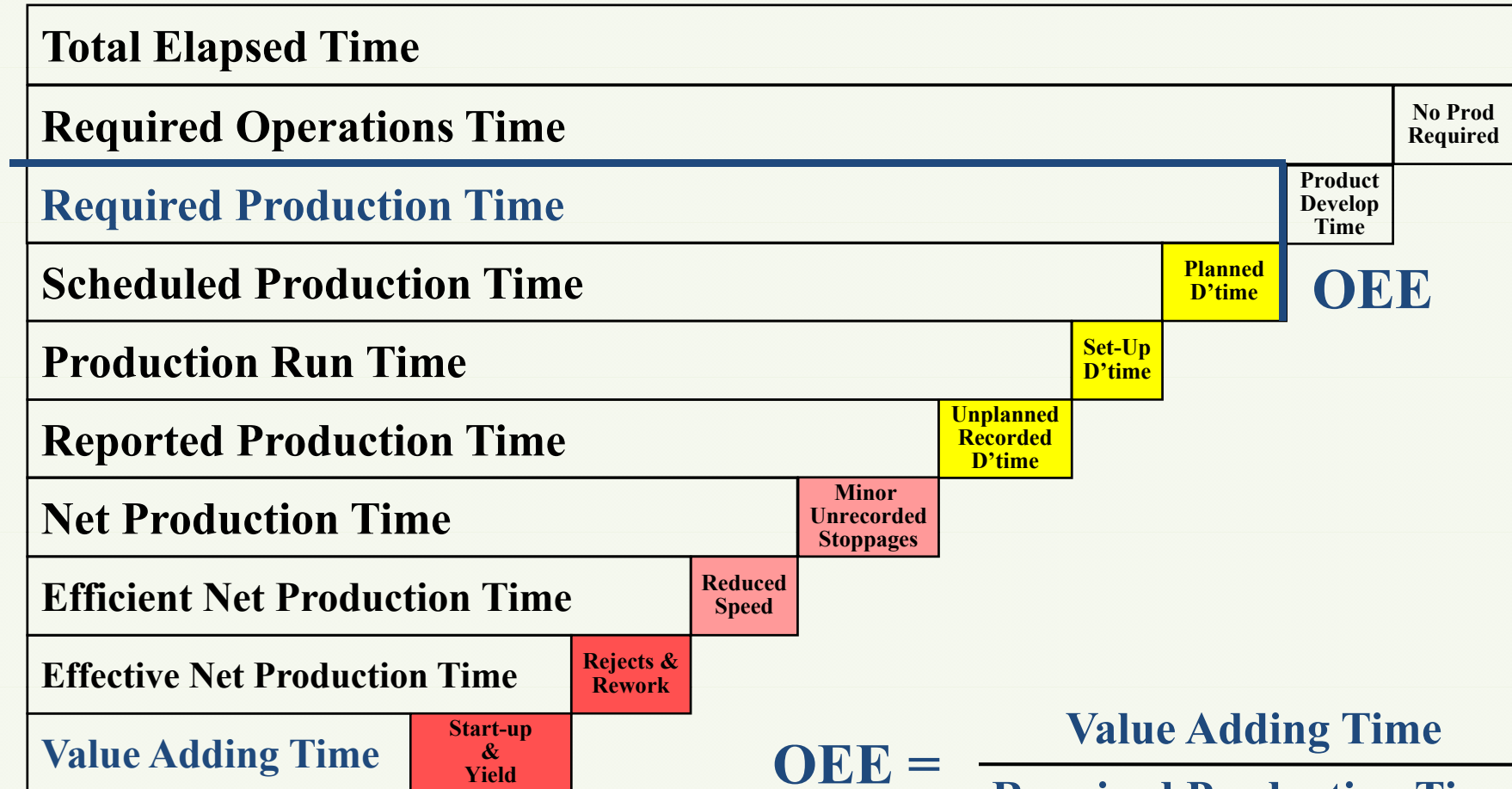
$$OEE = \frac{\text{Value Adding Time}}{\text{Required Production Time}}$$

Where has it gone Wrong?

1. Not including the right losses

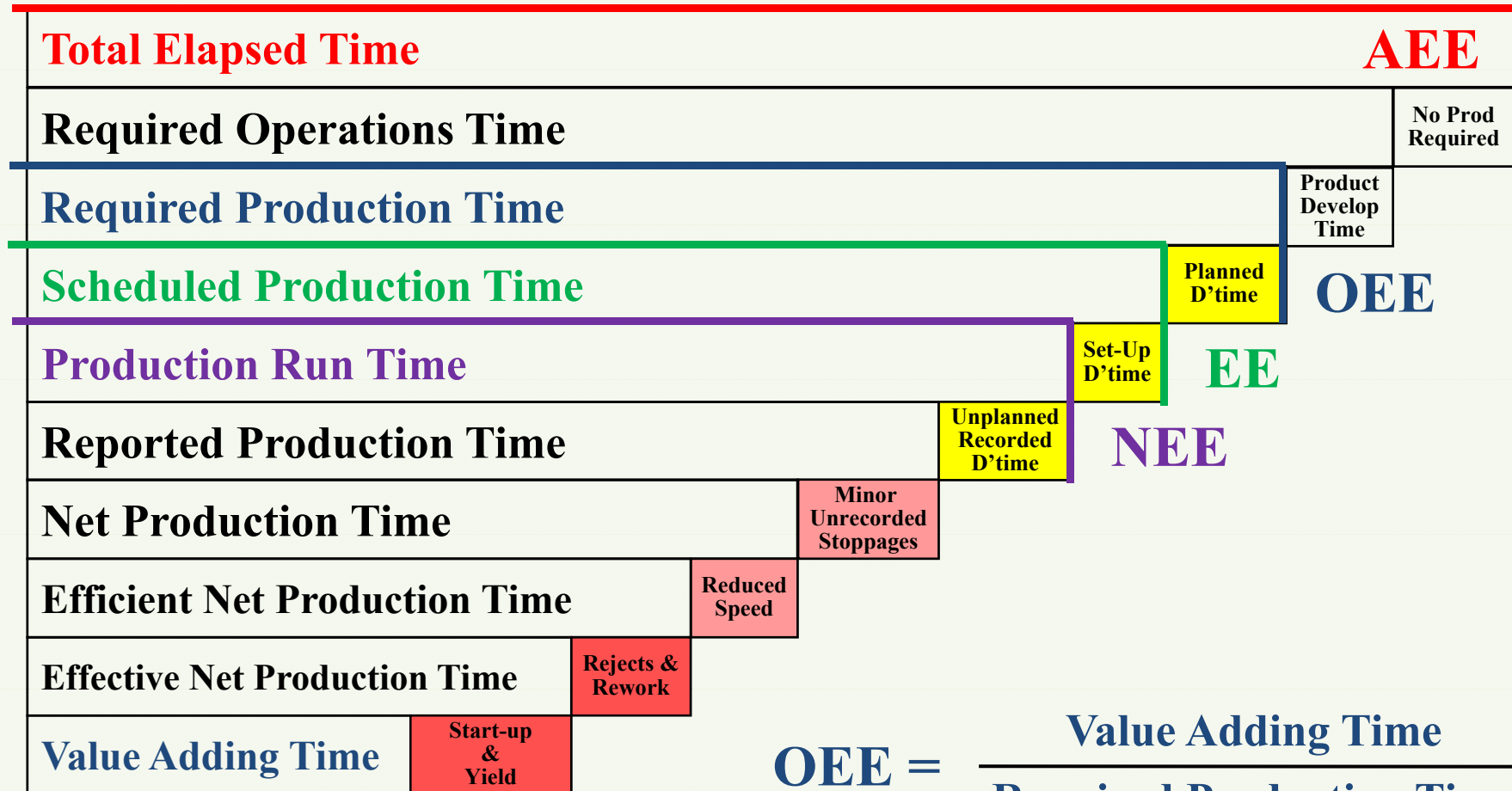
*The need for an Equipment Loss Model
that clearly outlines what losses will be
included in OEE*

Creating your Equipment Loss Model



$$OEE = \frac{\text{Value Adding Time}}{\text{Required Production Time}}$$

Creating your Equipment Loss Model



Where has it gone Wrong?

2. Having a soft definition for Speed Loss

Nakajima explained speed loss by stating:

‘Bring actual operation speed up to design speed; then make improvement to surpass design speed’. He then goes on to refer to ideal speed.

Rather than identifying the true ideal (or theoretical) speed of a line, a lot of companies, and consultants to that matter, use standard or budgeted speed for their calculations rather than recognising *the aim of OEE is to assist sites to achieve world class performance rather than support average or standard performance.*

Example Ideal Speed Definitions

1. Original Equipment Manufacturer's *Design Constraint* Speed which we define as the maximum speed that the equipment could run at due to the limitations of its design. (This is quite different from Manufacturers recommended speed which is often slower); or
2. Sampled speed *measured over a short period of time (eg 10 minutes)*, achievable with best operator, best feed, best environmental conditions and best equipment conditions without “red lining” the equipment; or
3. Upper Control Limit of the daily or weekly run chart of the actual equipment speed over at least 15 points with any special causes removed.

Where has it gone Wrong?

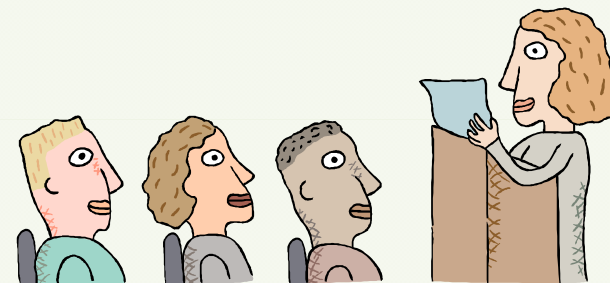
2. Having a soft definition for Speed Loss (cont)

The key learning about Speed or Rate Loss for the OEE calculation has been:

Do not confuse ideal speed (designed to assist improvement) with rate used for costing or scheduling.



Ask the Audience

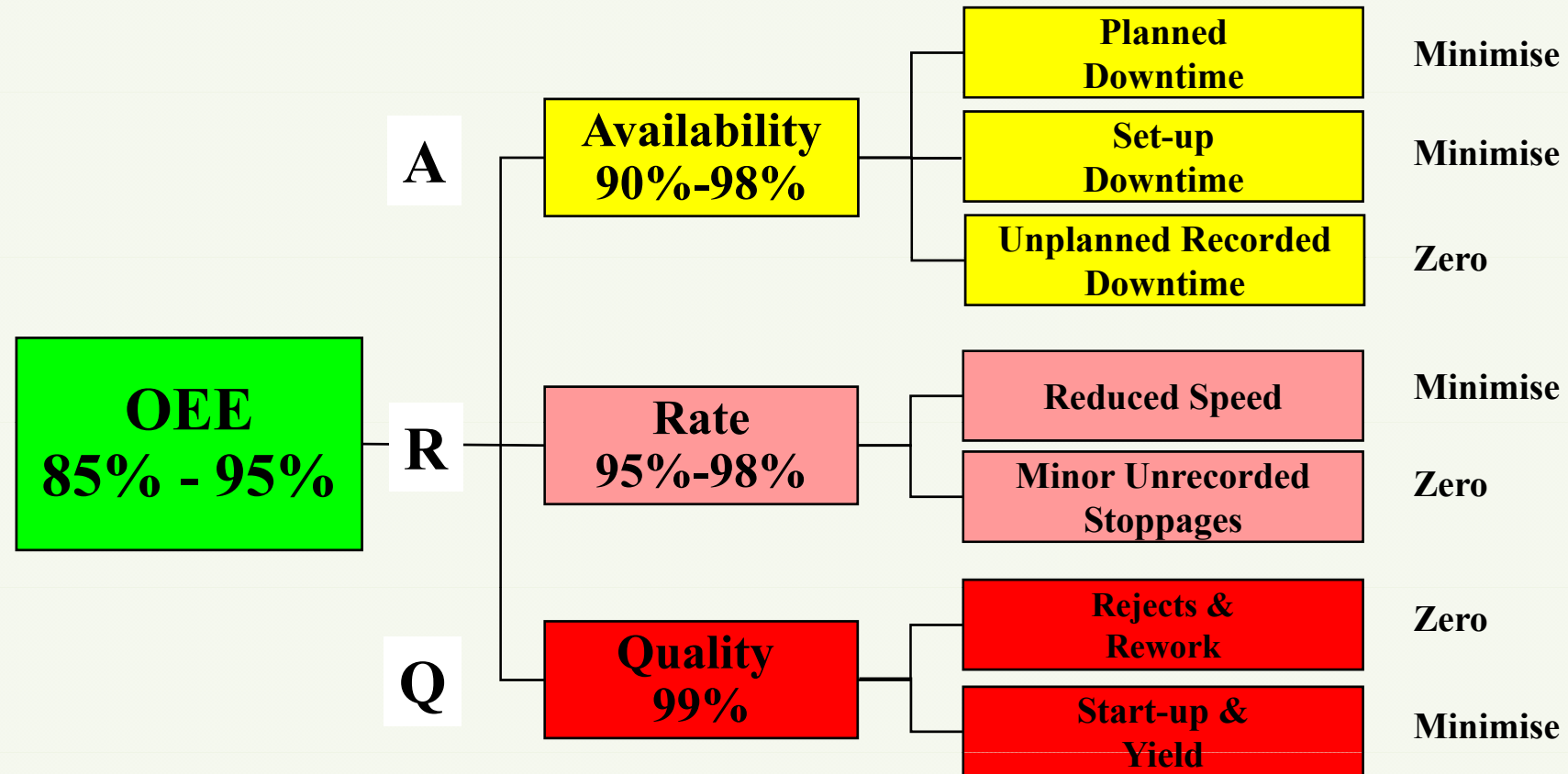


Where has it gone Wrong?

3. Setting arbitrary targets for OEE

How best do we determine what is OEE Best Practice?

What is OEE Best Practice?



Best practice is dependent on the nature of your business and equipment

Setting OEE Best Practice Targets

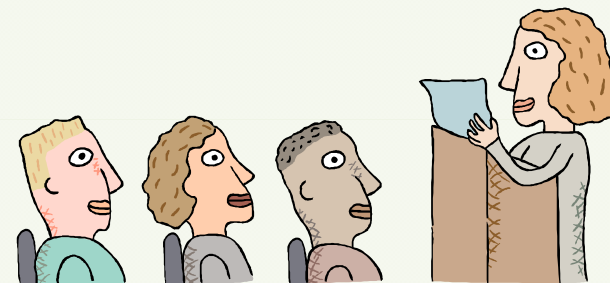
OEE Best Practice Targets should be established for each separate production line or machine based on business requirements, then backed up with documented assumptions

Planned Downtime	Minimise – eg List Assumptions = 8%
Set-up Downtime	Minimise – eg List Assumptions = 7%
Unplanned Recorded Downtime	Zero – eg < 2%
Reduced Speed	Minimise – eg List Assumptions = 2%
Minor Unrecorded Stoppages	Zero – eg List Assumptions = 0%
Rejects & Rework	Zero – eg List Assumptions = 0%
Start-up & Yield	Minimise – eg List Assumptions = 1%

Total 20% Losses: Target OEE = 80%



Ask the Audience

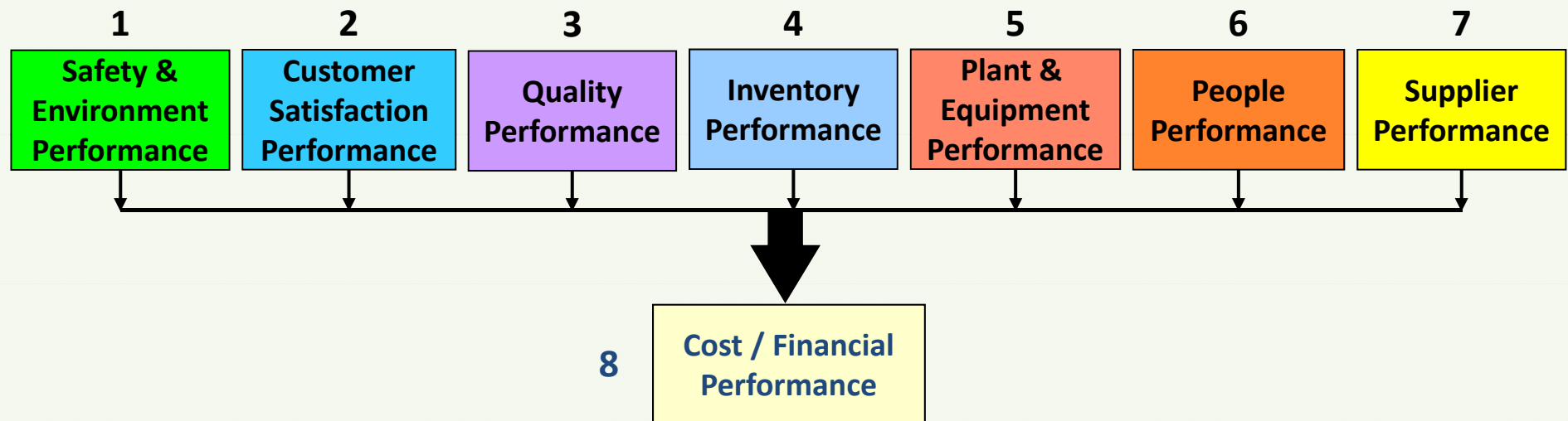


What is the real purpose of OEE?

OEE was developed as a 'driver' for improvement, not as a performance measure to be compared or benchmarked between equipment and sites.

Key Success Factors for Operations

'Cause' Key Success Factors



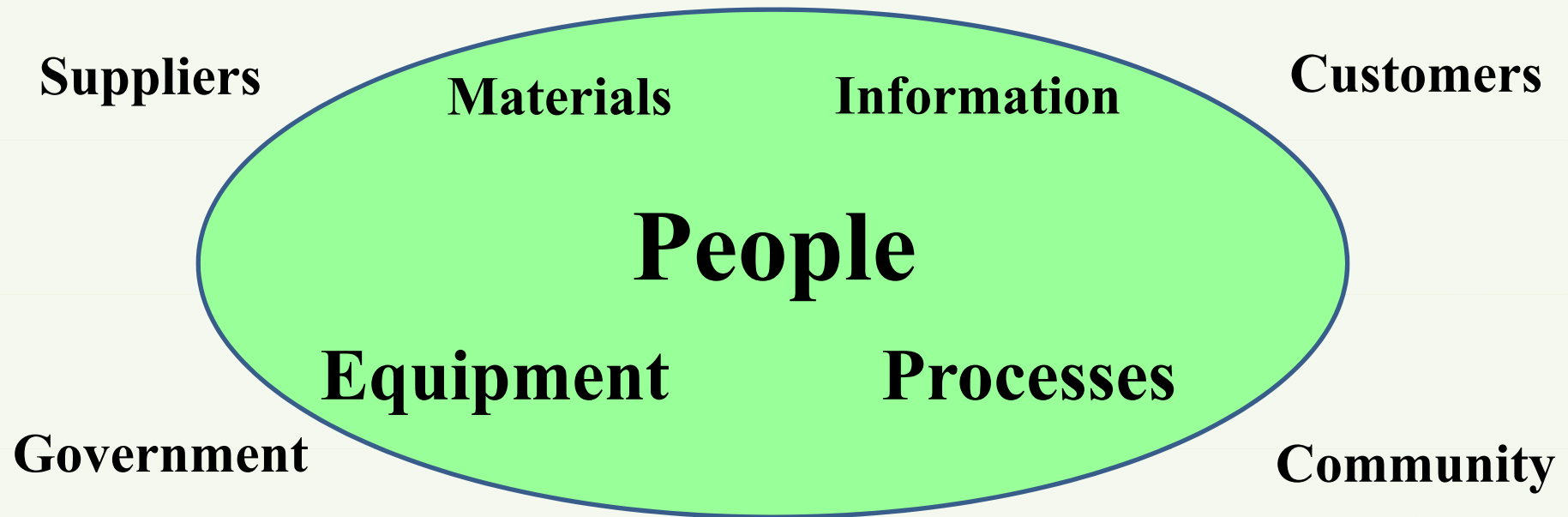
'Effect' Key Success Factor

- Order is important
- Performance measures should be grouped under the appropriate Key Success Factor
- Goal Alignment occurs when all measures at all levels are linked to a Key Success Factor

Approaches to improve Operations

- 1. Technology & Automation Improvement**
- 2. Project & Event Improvement**
- 3. On-going Improvement focused on developing all people to enhance their Practices & Behaviors**

What is Operations Excellence



Equipment Focused (TPM)



Overall Equipment Effectiveness
(Losses)

Correlates to Good Output

Process Focused (Lean)



Lead Time Reduction
(Wastes)

Correlates to Inventory Levels

What is the real purpose of OEE?

OEE was developed as a 'driver' for improvement, not as a performance measure to be compared or benchmarked between equipment and sites.

It was also developed to provide everyone a simple indicator to monitor the amount of on-going formal improvement time that can be allocated each week to support TPM focused Production Area Based Team improvement activities.

If OEE improves by 10% then you should be able to produce 10% more good output within the same time, or produce the same amount of good output in 10% less time.

The Challenge of Productivity and OEE



Technical vs People Related OEE Losses



Key Learnings

- OEE is a powerful improvement tool if used correctly.
- Too often misguided managers go looking for the simple measure that they can focus-on so that they can compare performance.

However in reality there is no one measure that tells the full story

- A suite of performance measures which are aligned to your site's Key Success Factors are required to capture all opportunities for improvement in an operation.
- To support the improvement of your suite of performance measures we have found OEE (plant & equipment focus) and Lead Time Reduction (process focus) are the drivers to improve, not measures to be compared.

OEE: the most Misused and Abused Indicator

by Ross Kennedy – President, CTPM Australasia

The concept of Overall Equipment Effectiveness was first written about in 1989 from a book called TPM Development Program – Implementing Total Productive Maintenance edited by Seiichi Nakajima from the Japan Institute of Plant Maintenance. This was translated from the Japanese book TPM tenkai published in 1982.

Prior to Overall Equipment Effectiveness, people monitored equipment performance through Availability or Downtime. This was fine until it was realised that you could have the same downtime for the same piece of equipment over different timeframes yet get different output.

For example, if a line's performance is measured over 100 hours and during this time it has one breakdown for 10 hours, the Availability will be 90% and Downtime 10%. If the same line over another 100 hours had 10 breakdowns of one hour duration (total of 10 hours), then the Availability would still be 90% and Downtime 10%.

However when comparing output, in the majority of cases the first situation of only one breakdown will produce significantly more output than the situation of 10 breakdowns. The logic is quite simple. Every time your plant stops unexpectedly there is a high probability you will have some form of quality loss from restarting to first time quality, purging, or the material being processed again will need to be reworked to complete it or be scrapped. Also when you start back up again, there is a high probability there will be a speed loss as you ramp the plant back up to full speed.

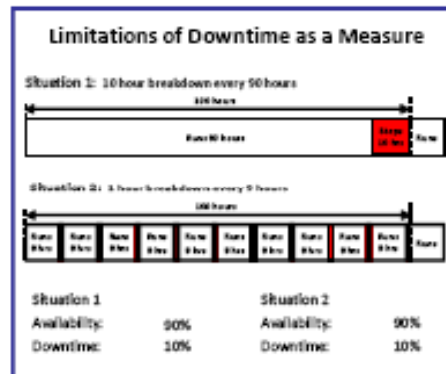
This is why OEE was developed. It was the first time you could measure how effective your equipment was at producing good output with minimum losses.

Nakajima wrote: Effectiveness can be measured using the formula:

$$\text{Overall Equipment Effectiveness} = \text{Availability} \times \text{Performance rate} \times \text{Quality rate}$$

With the losses impacting on Overall Equipment Effectiveness listed as:

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Question Time