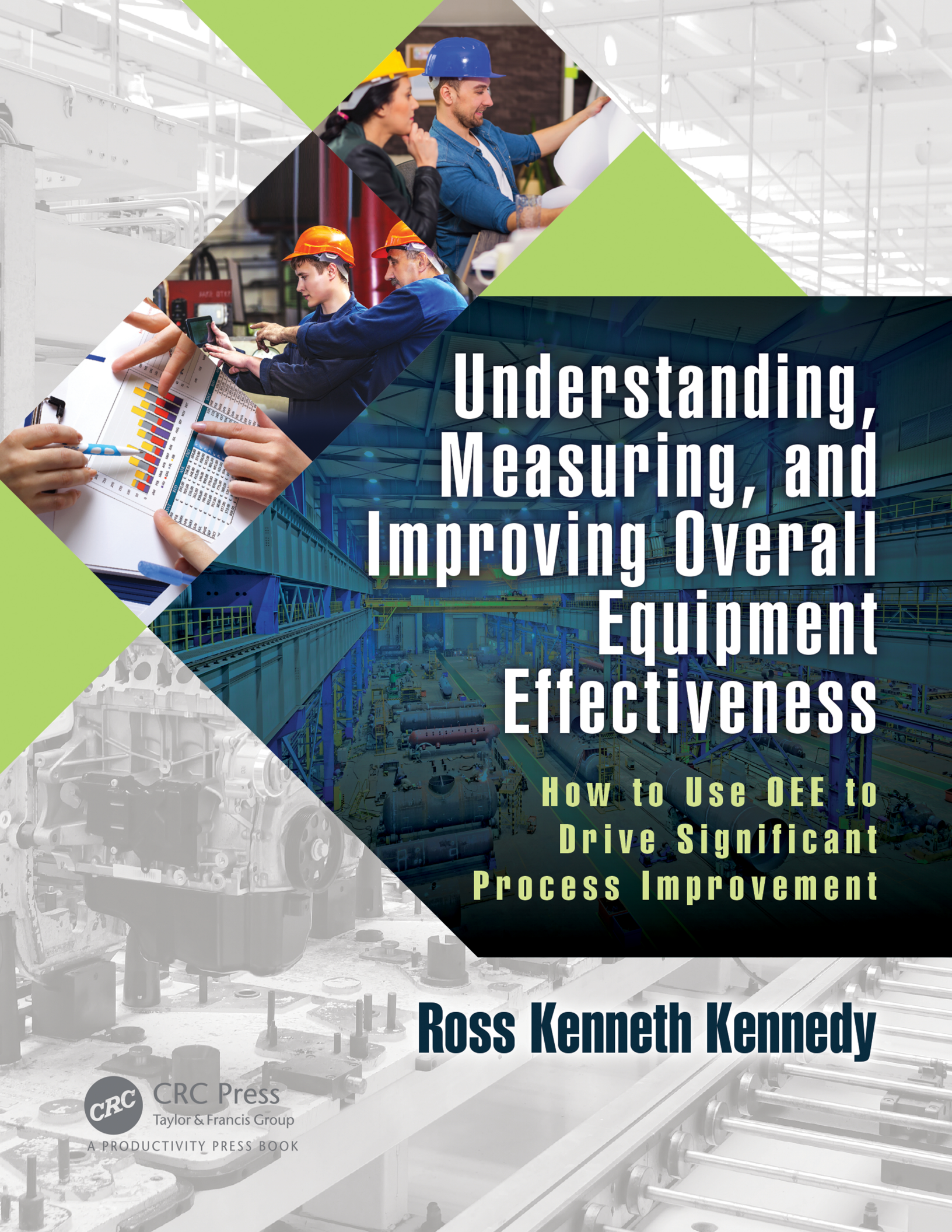

Understanding, Measuring, and Improving Overall Equipment Effectiveness

How to Use OEE to Drive Significant Process Improvement

Ross Kenneth Kennedy

CRC Press
Taylor & Francis Group
A PRODUCTIVITY PRESS BOOK

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Chapter 1

Understanding OEE

The concept of Overall Equipment Effectiveness (OEE) 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.

Before OEE, people monitored equipment performance through Availability or Downtime. This was fine until it was realized that you could have the same downtime for the same piece of equipment over different timeframes yet get a 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, Availability will be 90% and Downtime will be 10%. If the same line over another 100 hours had 10 breakdowns of 1 hour duration (total of 10 hours), then Availability would still be 90% and Downtime would be 10% (Figure 1.1).

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 such as scrap or rework. Also, when you start back up again, there is a high probability that there will be a speed loss as you ramp the plant back up to full speed.

Hence, there was a need to create a measure that would reflect all losses that can affect the capacity to produce perfect, or within-specification, output first up. Ideally, the measure could also be used for prioritizing improvement activities while bringing everyone together to improve, as everyone would benefit from its improvement.

This is why OEE was developed. It was the first time you could measure how effective your equipment was at producing good output, recognizing that equipment is only effective if it is available when required, running at the ideal speed, and producing perfect or within-specification output.

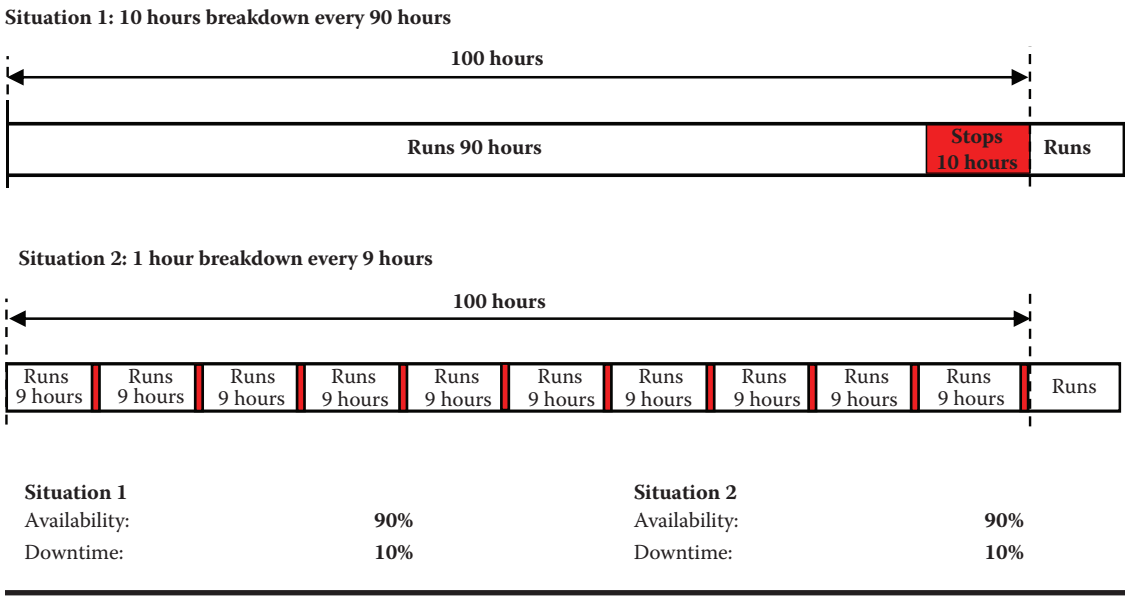

Figure 1.1 Limitations of downtime as a measure.

Nakajima wrote: Effectiveness can be measured using the following formula:

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

with the 6 Big Losses affecting OEE listed as follows:

Availability	*Performance Rate*	*Quality Rate*
• Breakdown losses • Setup and adjustment losses	• Idling and minor stoppage losses • Reduced speed losses	• Quality defect and rework losses • Start-up (yield) losses

In more recent literature, the OEE loss model has been expanded to include a further loss, Planned Downtime under Availability, creating 7 Losses (Figure 1.2).

The aim of the **7 Losses** is to capture all possible losses that could be improved operationally including such **Planned Downtime** as meal breaks, regular maintenance periods, start of shift, toolbox meetings, and so on.

Responsibility and Accountability for OEE

To understand who should be responsible and accountable for OEE, we have found it helpful to first identify some of the activities that may need to be addressed to eliminate or minimize the losses. For example:

- Detect and Predict Deterioration
- Establish Repair Methods

- Restore Deterioration
- Maintain Operating Standards
- Maintain Basic Equipment Conditions
- Prevent Incorrect Operation
- Prevent Repair Errors
- Improve Design Weaknesses

Then, ask the question: who should be involved in carrying out these activities?

The answer becomes obvious in that OEE Improvement involves all departments including the following: Production, Maintenance, Engineering, Quality, HR/Training, Procurement, and Planning and Scheduling.

However, one department needs to take full ***responsibility*** for the cost-effective performance of their plant and equipment and be ***accountable*** for the OEE.

If we think about our car, it is the way we drive it, the environment we keep it in, the frequency we get it serviced, and, most importantly, the timeliness we respond to any little problems we may encounter that has the biggest impact on the overall running cost and resale value of our car.

Production Plant and Equipment is no different. The way we operate it, the condition we keep it in, the frequency we allow maintenance to do their servicing, and the way we identify and respond to small problems before they become big problems all contribute significantly to the plant performance and the maintenance costs.

That is why the Production department must take full responsibility and accountability for OEE, recognizing they can't achieve best practice without every other department's support.

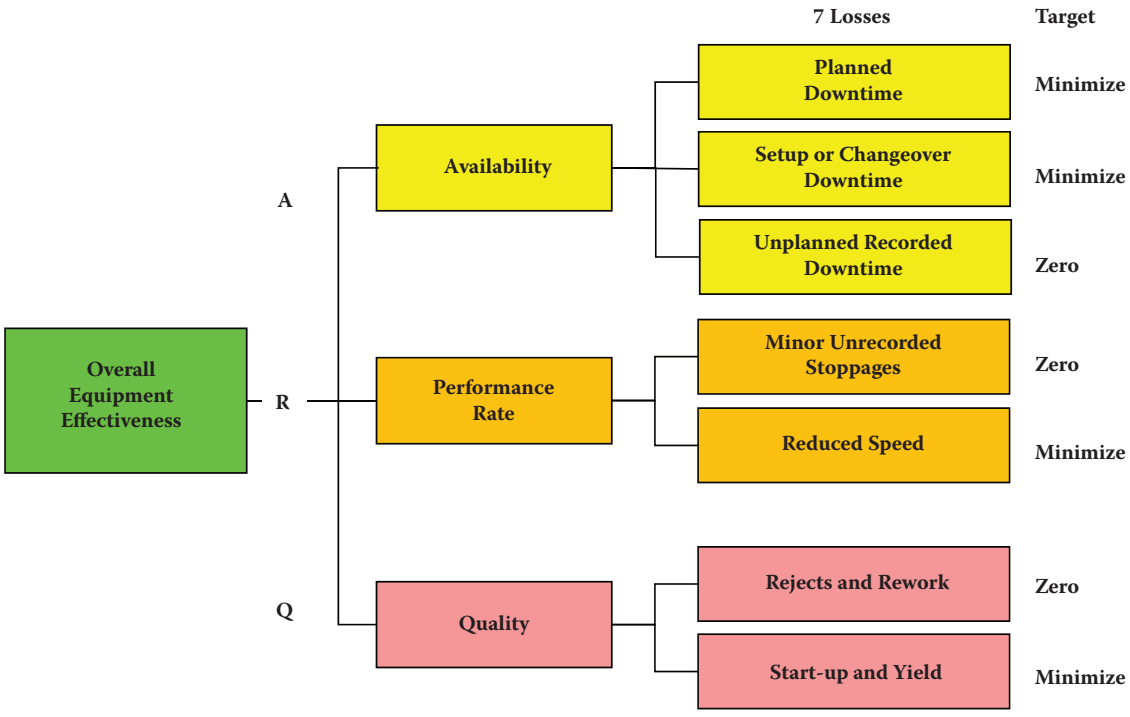

Figure 1.2 OEE Model.