What’s your Overall Equipment Effectiveness?

12:30 PM – 1:45 PM

John Sweeney
SpencerMETRICS
Introduction to OEE

“In the Land of the Blind, the One-Eyed Man is King”
Introduction to OEE

What if you had a ‘Tool’ that could help increase manufacturing efficiency 10 - 50%

Profitability would increase 20 – 300% !
Introduction to OEE

OEE Defined

**Overall Equipment Effectiveness (OEE)** is a *quantitative way* of measuring how well a standalone or a flow-line production system operates in making good product relative to what the system could make if it operated perfectly, 100% of the scheduled time *based on specific products and processes*.

OEE is a **Key Performance Indicator (KPI)** used to define the Productivity between Current State and ‘World Class’ *for your system*.

The goal is **Continuous Improvement**
Initial Foundation

“OVERALL EQUIPMENT EFFECTIVENESS:
A Powerful Production/Maintenance Tool for Increased Profits”

Robert C. Hansen, PE., CMRP
Industrial Press, New York, NY 2001

Owner: RC Hansen Consulting, LLC
970-490-1720 cell: 970-481-3145
Initial Foundation

“Total Production Maintenance”
A Guide for the Printing Industry

Kenneth E. Rizzo
GATF Press, 2008
www.printing.org

Win this book!
Drawing at conclusion of today’s seminar.
All methodologies require data to support decision making

Lean 6S, OEE, TEEP, TPM, Takt Time, TQM, Kaizen, Continuous Improvement

Combine Machine Data with Operator Knowledge to prove the case

- **Real-time machine visibility** with OEE metrics on any Machine
- Dashboard for ease of viewing – reduce downtime
- **Connect** production floor to Production Analytics
- Shop Floor to Top Floor
- **Increase Productivity**
- Embrace Manufacturing Efficiency
Initial Foundation

The OEE Industry Standard gives a guideline in order to find ALL potential losses in effectiveness.

An average machine in an average factory runs about 35 to 45% OEE.

So it is losing 55 to 65% capacity!

While - not running

- running at reduced speed
- or producing parts out of spec

It is a matter of definition, What you are not looking for you will not find.

To really reveal the hidden machines in your factory, ALL Losses need to be defined and visualized
Why use OEE?

Productivity Increases of 10-50%

- Reduce Unplanned Downtime
- Reduce Setup and Changeover Times
- Better Management of Resource Allocation, Planning and Scheduling
- Operator Productivity Increases
- Efficiency with Automated Data Collection
- Better Root Cause Analysis
- Improve Quality, Minimize Rejects
- Identify Bottlenecks and Constraints
- Improve On-Time Delivery
- Manage Operations Pre-emptively & Proactively
- Measurably Improve Profitability
Why is OEE so important?

➤ If you were told that your department was running flat out you might reasonably assume that the equipment was running efficiently and effectively.

➤ What if the equipment only ran for 65% of the time?

➤ What if when it ran it ran at 80% of its speed?

➤ What if only 90% of the print are good?

\[
65\% \times 80\% \times 90\% = 47\%
\]

➤ Individually these performance measures seem to indicate an OK piece of equipment, but is it a true picture?

➤ What is having an impact on these performance figures?
## Revenue Calculator

Each one percent improvement could mean $110,880* additional annual revenue! [Learn More](#)

<table>
<thead>
<tr>
<th>Press A/A4 PPM:</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press Operation Hours/Day:</td>
<td>16</td>
</tr>
<tr>
<td>Press Operation Days/Week:</td>
<td>5.5</td>
</tr>
<tr>
<td>Print Sale Price (cents):</td>
<td>35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percent Improvement</th>
<th>Revenue Increase per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 %</td>
<td>$ 110,880</td>
</tr>
<tr>
<td>2 %</td>
<td>$ 221,760</td>
</tr>
<tr>
<td>3 %</td>
<td>$ 332,640</td>
</tr>
<tr>
<td>4 %</td>
<td>$ 443,520</td>
</tr>
<tr>
<td>5 %</td>
<td>$ 554,400</td>
</tr>
</tbody>
</table>

Interactive calculator at: [www.spencermetrics.com](http://www.spencermetrics.com)
How do we use OEE?

- OEE is only a measure, its benefits will be lost if the shortfalls it identifies are not acted upon.

- OEE is a total measure of performance but the data used to produce it must be used to prioritise improvement tasks.

- The purpose of measurement is to identify losses, remove waste and drive improvement.

- OEE should be used to support the Total Productive Maintenance (TPM) approach and the tools it supplies.
What does that mean?

OEE is a Key Performance Indicator (KPI) that can measure the impact of change on a process caused by eliminating process, or equipment losses.

OEE is used to measure the performance of equipment and the process.
What does that mean?

Organizations that train and strategically use the OEE Tools and methods presented in the modules have a clear roadmap to quickly achieve “Top Quartile” competitive advantage in the Printing Industry.

‘Top Quartile’ Winning Teams have common best practices:

- Detailed Measurement of their performance
- Constantly improving their ‘Best Ever’ performance
- Synergizing every player’s contribution – OPERATOR KNOWLEDGE
- Effectively Communicating new ideas or conditions
- Being the Provider of Choice re: Price and Delivery
How do I measure OEE?

Overall Equipment Effectiveness

OEE % = Availability x Performance x Quality

Shows each press output as a percentage of maximum capacity
Example: 65% x 80% x 90% = 47%

Availability %
Percentage of scheduled time that the operation is actually operating.
Availability % = Run Time / Scheduled Time

Performance %
Speed at which the Press runs as a percentage of its designed speed or ideal cycle time. *Reality vs. advertised “Feeds and Speeds”.*
Performance % = (Parts Made x Standard) / Run Time

Quality %
Good Units produced as a percentage of the Total Units Started.
Quality % = Good Units / Units Started
## OEE Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Sub-Metric 1</th>
<th>Sub-Metric 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Productivity</strong></td>
<td>Good Output Time</td>
<td>Loading Time less Delays</td>
</tr>
<tr>
<td><strong>OEE Top</strong></td>
<td>Good Output Time</td>
<td>Loading Time (Work Load)</td>
</tr>
<tr>
<td><strong>Utilization</strong></td>
<td>Good Output Time</td>
<td>Sum of All Shift Times</td>
</tr>
<tr>
<td><strong>AVAILABILITY</strong></td>
<td>Total Output Actual Time</td>
<td>Loading Time (Work Load)</td>
</tr>
<tr>
<td><strong>QUALITY</strong></td>
<td>Good Output</td>
<td>Total Output</td>
</tr>
<tr>
<td><strong>PERFORMANCE</strong></td>
<td>Good Output @Rate</td>
<td>Good Output Actual Time</td>
</tr>
<tr>
<td><strong>OEE</strong></td>
<td>Good Output @Rate</td>
<td>Loading Time (Work Load)</td>
</tr>
<tr>
<td><strong>OEE Solitaire</strong></td>
<td>Good Output @Rate</td>
<td>Loading Time less Delays</td>
</tr>
<tr>
<td><strong>TEEP: Net Utilization</strong></td>
<td>Good Output @Rate</td>
<td>Selected Measurement Duration 24/7</td>
</tr>
<tr>
<td><strong>Operations Effectiveness</strong></td>
<td>Good Output @Rate</td>
<td>W&amp;R</td>
</tr>
<tr>
<td><strong>Asset Utilization</strong></td>
<td>Total Output Actual Time</td>
<td>Sum of All Shift Times</td>
</tr>
<tr>
<td><strong>Capacity Utilization</strong></td>
<td>Loading Time (Work Load)</td>
<td>Selected Measurement Duration 24/7</td>
</tr>
</tbody>
</table>
It's about Time!

Selected Measurement Duration 24/7

Sum of All Shift Times

Loading Time (Work Load)

Loading Time less Delays

Total Output Actual Time

Good Output Actual Time

Good Output @Rated Speed

Performance Loss

Waste & Rework

Service, Repair, Break/Jam, Maintenance, Quality Control, Consumables, Setup

Delays

No Work

No Shifts

Applying OEE to Production Print
Make data available to all
Pareto Analysis is a data graphing analysis based on the Pareto principle which focuses on identifying the 20% of sources that result in 80% of the problems.
Six Big Losses – What Are They?

**Six Big Losses**

1. Breakdowns
2. Setup / adjustment
3. Idling / minor stoppages
4. Speed
5. Defects in process and rework
6. Start up losses

The time lost due to key equipment breaking down or deterioration which causes the production to be stopped for more than 10 min.
Six Big Losses – What Are They?

**Six Big Losses**

1. Breakdowns
2. Setup / adjustment
3. Idling / minor stoppages
4. Speed
5. Defects in process and rework
6. Start up losses

The time lost through “product change over and adjustment” to the point where the production of the new product is completely satisfactory. “Makeready”
Six Big Losses – What Are They?

**Six Big Losses**

1. Breakdowns
2. Setup / adjustment
3. Idling / minor stoppages
4. Speed
5. Defects in process and rework
6. Start up losses

- **Breakdowns**: The time lost through key equipment being stopped for less than 10 min.
- **Setup / adjustment**: Time lost during the standard cycle when the equipment is not adding value.
- **Idling / minor stoppages**: The time lost through key equipment being stopped for less than 10 min.
- **Speed**: Time lost during the standard cycle when the equipment is not adding value.
Six Big Losses – What Are They?

Six Big Losses

1. Breakdowns
2. Setup / adjustment
3. Idling / minor stoppages
4. Speed
5. Defects in process and rework
6. Start up losses

The time lost through key equipment not producing parts at its optimum rate.
Six Big Losses – What Are They?

1. Breakdowns

2. Setup / adjustment

3. Idling / minor stoppages

4. Speed

5. Defects in process and rework

6. Start up losses

The time lost through key equipment not producing parts that meet the specified quality standard.

The time lost through key equipment being utilised to rework sub-standard parts.
Six Big Losses – What Are They?

Six Big Losses

1. Breakdowns
2. Setup / adjustment
3. Idling / minor stoppages
4. Speed
5. Defects in process and rework
6. Start up losses

The time lost through key equipment not producing parts to the specified quality standard, following start up and before the equipment achieves controllable production conditions.
OEE Overview

OEE (Overall Equipment Effectiveness) is the measure of:

the amount of good product produced compared to the amount of product that could have been produced if the manufacturing system operated perfectly for its entire scheduled time.

Total Effective Equipment Performance (TEEP) is the measure of the amount of good product produced compared to the amount of product that could have been produced if the manufacturing system operated perfectly for the total time (calendar time) over the time period under consideration.

24 x 7 x 365 = 100 asset utilization
How to collect data for OEE

Key Points:

- OEE is a measure of the equipment or process, **not the operators**.
- KISS! Keep it simple.
- Ensure the process of measuring and applying OEE **involves the people who use the equipment. OPERATOR KNOWLEDGE**
- Make data collection second nature not a hindrance.
- Integrate Automatic and manual data collection.

- Obtain the data on fixed frequency.
- Snap shot vs continuous.
- Units of time (1 min, 10 mins, 30 mins, etc.).
- Regular communication of results.
- Response to trends, peaks and troughs.
# How to collect data for OEE

## Example: Three Hourly Data Sheet

<table>
<thead>
<tr>
<th>Machine No.</th>
<th>No. operators</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Day / Night</th>
<th>Date</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hour of the Day</strong></td>
<td><strong>Tape No.</strong></td>
<td><strong>Programme change</strong></td>
<td><strong>nc test</strong></td>
<td><strong>place</strong></td>
<td><strong>problem</strong></td>
<td><strong>place</strong></td>
<td><strong>specific</strong></td>
<td><strong>cause</strong></td>
</tr>
<tr>
<td>7-8</td>
<td></td>
<td></td>
<td></td>
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<td>8-9</td>
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<td>9-10</td>
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<td>10-11</td>
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<td>11-12</td>
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<tr>
<td>1-2</td>
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<td>2-3</td>
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<td>3-4</td>
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<td>4-5</td>
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<tr>
<td>5-6</td>
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<td>6-7</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Hand Over Notes:
# How to collect data for OEE

## Availability

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planned Down Time</td>
<td>(in minutes)</td>
<td></td>
</tr>
<tr>
<td>Net Available Time</td>
<td>(in minutes)</td>
<td></td>
</tr>
<tr>
<td>Non planned stoppages</td>
<td>(in minutes)</td>
<td></td>
</tr>
<tr>
<td>Operating Time</td>
<td>(in minutes)</td>
<td></td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( F = \frac{E}{C} )</td>
<td></td>
</tr>
</tbody>
</table>

## Productivity

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>(in units)</td>
<td></td>
</tr>
<tr>
<td>Standard Cycle time</td>
<td>(mins/unit)</td>
<td></td>
</tr>
<tr>
<td><strong>Productivity</strong></td>
<td>( I = \frac{(H \times G)}{E} )</td>
<td></td>
</tr>
</tbody>
</table>

## Quality

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defect Quantity</td>
<td>(in units)</td>
<td></td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td>( K = \frac{(G - J)}{G} )</td>
<td></td>
</tr>
</tbody>
</table>
"Following the computer and the Internet, every machine tool will become a node on the network creating greater efficiency."

The technology is here today, the tools are readily available and cost effective.
CONNECT™
Automatic Data Collection
Enhanced with Operator Knowledge

Measure
Analyze
Improve

spencerMETRICS LLC
A SPENCER ASSOCIATES GROUP COMPANY
member of the spencerLAB family—serving the industry for over 27 years
Combine Data & Operator Knowledge

![Image of a product tracking interface]
Actionable Information!

[Graphical representation of productivity metrics with various data points and KPIs, including:
- Productivity: 72.5%
- OEE (Top): 69.5%
- Utilization: 69.0%
- Availability: 70.6%
- Quality: 98.5%
- Performance: 99.4%
- OEE: 69.1%
- OEE Solitaire: 72.1%
- NetUtilization (TEEP): 49.2%
- Operations Effectiveness: 69.7%
- Asset Utilization: 50.3%
- Capacity Utilization: 71.2%
]
Actionable Information!

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OEE (Top) Utilization</td>
<td>72.5%</td>
</tr>
<tr>
<td>Availability</td>
<td>70.6%</td>
</tr>
<tr>
<td>Quality</td>
<td>98.5%</td>
</tr>
<tr>
<td>Performance</td>
<td>99.4%</td>
</tr>
<tr>
<td>OEE Solitaire</td>
<td>69.1%</td>
</tr>
<tr>
<td>NetUtilization (TEEP)</td>
<td>49.2%</td>
</tr>
<tr>
<td>Operations Effectiveness</td>
<td>69.7%</td>
</tr>
<tr>
<td>Asset Utilization</td>
<td>50.3%</td>
</tr>
<tr>
<td>Capacity Utilization</td>
<td>71.2%</td>
</tr>
</tbody>
</table>

Diagrams showing various performance metrics and categories.
Learning to ‘see’ OEE

- As a Strategic Tool and a Monitoring Tool NOT BIG BROTHER
- As a Reliability metric and a Business metric
- As a leading metric and a lagging metric
- Using OEE as a ‘fair’ benchmarking metric
- Quantify the value of each OEE factor
Lean Thinking

Lean Thinking Management System Model

The Lean Management System Model reflects graphically, the integration of **Hoshin Kanri** (Strategic Deployment), **Deming’s PDCA Wheel** (plan–do–check–act) four-step model for carrying out change with the **Toyota Way 2001** principles (Continuous Improvement and Respect for people), and how the lean management system is driven by customer requirements and level of satisfaction.

The Lean Thinking Management System is used to implement the 5 Elements of Lean Thinking.
The Deming Cycle

...Data based problem solving

Typical PDCA:
Plan quickly
  • Address Symptoms
Do immediately
  • Jump to conclusions
Check roughly
Act pretty much the way you did before

High Velocity Organization PDCA:
Plan deeply
  • Discuss actual situation and target with everyone affected
  • Really understand/model the problem and its root cause
Do many quick experiments
  • Validate your thinking
Check implications carefully
Act systematically
  • Update and deploy standards and checklist disciplines
Current Condition – What's your OEE?

… What do we already know?

Specific, detailed, quantitative, concise

- Tables, graphs, histograms, value-stream maps, diagrams
- Highlight exactly where problem occurs
- Baseline to compare to metrics after countermeasures are applied

Engage everyone affected by or causing symptoms

Build Consensus on what is

- Symptoms / Undesirable Effects everyone can see
- Foundation of authority to experiment with countermeasures

Update as understanding improves
Goal – Next Target Condition

...Model what we expect

What baseline change is wanted

- What does “ideal” look like?
- What does the organization need?
- What is Realistically attainable target condition?

Mentor ensures that the owner has both

Plausible Hypothesis

- Based on best available model/understanding of how the system works/could work

Consensus among stakeholders

- Target is attainable and desirable.

Update as root cause and countermeasures developed
Root Cause

...Model Cause & Effect

Identify underlying problem(s) causing symptoms
  ➔ Root cause is typically faulty thinking or assumptions
Addressing the root cause(s) improves all levels of symptoms/
undesirable effects/visible damage.

Build consensus among stakeholders
  ➔ Broad agreement on Cause & Effect network
  ➔ Reflect best current knowledge about how things work

Some techniques:
  ➔ Fishbone Diagram
  ➔ 5 Whys
  ➔ Histograms
  ➔ Pareto Analysis
  ➔ Root Cause Analysis
Root Cause Analysis

The causal or contributing factors that, if corrected, would prevent recurrence of the identified problem.

The “true” reason that contributed to the creation of a problem, defect or non-conformance.

But this is only what we see on the surface

our habits and work procedures

What is happening under the surface?

what is causing our habits and work procedures

A root cause is a blind spot beyond our reach

they are hidden deep down, they feed into or create many of the causes that we see under the surface

How deep are you willing or able to dig?
Compare different presses locations timeframes shifts operators
OEE Overview

OEE for Leadership

OEE Value Stream Analysis as a Strategic Tool

Where?
When?
What?
Why?

WHO is your CI Manager?
Resources

www.spencermetrics.com
Revenue Calculator
SpencerMetrics CONNECT
White Papers

www.ci.printing.org
CI (Continuous Improvement) Conference
Milwaukee, April 10-13
Thank you!

Q & A

Book Drawing!