Improving Overall Equipment Effectiveness (OEE)

Evaluating equipment’s ability to perform well at the lowest overall cost is a real challenge in manufacturing plants. More data than ever before is available; capturing and analyzing the right data can be more difficult.

Today’s Agenda
1) Introduction to OEE
2) Review Ways of Improving OEE
3) Customer Benefits
Application Resource Center

- Provides field application support for technology products
  Focus on Simocode, safety, Sirius networks, Softstarters standards (Synergy / ICP), and FastBus

- Application and solution approach to customer needs
  Develops repeatable solution based upon applications and value fit. Develops configurators, how-to tools

- Leads CP social media Ambassador Program
  Online awareness and promotion of CP through SN, in collaboration with other DF businesses

- Drives Controls Technical community knowledge swaps
  Manages team of 25 channel, and xBU technical community which support CP in the market

- Increase revenue and community within Synergy program
  Own the control panel Shift from Synergy signage to revenue growth

- Territory aligned to pursue high value conversions
  Regionally aligned to support field and pursue high value conversion accounts
Introduction to OEE

Overall Equipment Effectiveness (OEE) is a measurement of performance for industrial equipment.

It is based on 3 major components: 
Availability, Performance and Quality

\[ \text{OEE} = A \times P \times Q \]
Availability – A percentage measurement based on how much time a machine is “available” to run production versus a fixed period of time

\[
\text{Availability} = \frac{\text{Available time}}{\text{Fixed Period}} = \frac{6 \text{ hours}}{8 \text{ hour shift}} = 75\%
\]
Performance – A percentage measurement based on the actual production rate versus a fixed maximum production rate.

Productivity = \frac{\text{Product produced}}{\text{Max. Product}} = \frac{80 \text{ units/hr.}}{100 \text{ units/hr.}} = 80\%
Introduction to OEE

**Quality** – A percentage measurement based on good parts versus total parts produced

\[
\text{Quality} = \frac{\text{Good produced}}{\text{Total produced}} = \frac{90 \text{ units}}{100 \text{ units}} = 90\%
\]
Introduction to OEE

IDA – A simple methodology for driving improvement of OEE.
It stands for: Information, Decision and Action…drive Results

I  X  D  X  A  =  R
Barriers to Improving OEE

- Improved trigger mechanism to record data
- Corp HQ
- Raw Data vs. Knowledge
- Plant Floor
- Barriers

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Digital Factory Division
Introduction to OEE

Let’s Focus on the Data Trigger

Availability = \( \frac{\text{Available time}}{\text{Fixed Period}} = \frac{6 \text{ hours}}{8 \text{ hour shift}} = 75\% \)

2 Hours of Downtime

(How do you improve this)
Introduction to OEE

Does this “Availability” measurement tell the whole story?
Improving OEE

The First Step in improving “Availability” is by improving “Accountability”. (Identifying Who does What and When)

How Do We Currently Do This?

1) Key Switch
2) Password
3) Paper Log
Improving OEE

The First Step in Improving Availability is by Improving Accountability. *(Identifying Who does What and When)*

How Can We Do This Better?

RFID Key Switch
Improving OEE

RFID Key Switch

Basic Characteristics

1) Common 22mm pilot device size
2) Communicates to any PLC/DCS via IO-Link
3) Keys are read only
4) Unique shape provides protection against tampering or duplication
5) Easily attaches to a key ring
6) Unique Hex code ID is assigned at the factory
### Improving OEE

Every key has a unique hex code ID assigned at the factory.

Similar to a MAC ID to Ethernet products.

<table>
<thead>
<tr>
<th>Key #</th>
<th>Unique ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>04 D7 C8 18 04</td>
</tr>
<tr>
<td>2</td>
<td>04 9A 45 1A 04</td>
</tr>
<tr>
<td>3</td>
<td>C1 F5 C8 18 04</td>
</tr>
<tr>
<td>4</td>
<td>40 D9 C8 18 04</td>
</tr>
</tbody>
</table>
### Improving OEE

- PLC matches ID code from the RFID key to previously stored values to identify owner.

![Image of PLC and RFID system]

#### RFID Key Number[1]
<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEX Code[1]</td>
<td>Byte</td>
<td>16#C3</td>
</tr>
<tr>
<td>HEX Code[2]</td>
<td>Byte</td>
<td>16#EC</td>
</tr>
<tr>
<td>HEX Code[3]</td>
<td>Byte</td>
<td>16#01</td>
</tr>
<tr>
<td>HEX Code[4]</td>
<td>Byte</td>
<td>16#1A</td>
</tr>
<tr>
<td>Prize Number</td>
<td>Byte</td>
<td>1</td>
</tr>
<tr>
<td>Winner Name</td>
<td>String</td>
<td>'John Burns'</td>
</tr>
<tr>
<td>Winner Phone</td>
<td>String</td>
<td>'678 575 3086'</td>
</tr>
</tbody>
</table>

#### RFID Key Number[2]
<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEX Code[1]</td>
<td>Byte</td>
<td>16#42</td>
</tr>
<tr>
<td>HEX Code[2]</td>
<td>Byte</td>
<td>16#FB</td>
</tr>
<tr>
<td>HEX Code[3]</td>
<td>Byte</td>
<td>16#01</td>
</tr>
<tr>
<td>HEX Code[4]</td>
<td>Byte</td>
<td>16#1A</td>
</tr>
<tr>
<td>Prize Number</td>
<td>Byte</td>
<td>2</td>
</tr>
<tr>
<td>Winner Name</td>
<td>String</td>
<td>''</td>
</tr>
<tr>
<td>Winner Phone</td>
<td>String</td>
<td>''</td>
</tr>
</tbody>
</table>

#### RFID Key Number[3] (Red Highlighted)

![Image of highlighted RFID key number]
Improving OEE

- PLC records date, time and action every time a key is inserted or removed
## Improving OEE

### Action

Operator inserts key at start of shift

Operator removes key and requests maintenance

Maintenance inserts key and begins maintenance

Maintenance removes key and completes maintenance

### What is Recorded in the System

<table>
<thead>
<tr>
<th>Who</th>
<th>What</th>
<th>When</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>Start of Shift</td>
<td>8:00 am</td>
</tr>
<tr>
<td>04</td>
<td>Maint. Req.</td>
<td>9:00 am</td>
</tr>
<tr>
<td>C1</td>
<td>Maint. Started</td>
<td>10:45 am</td>
</tr>
<tr>
<td>C1</td>
<td>Maint. Completed</td>
<td>11:00 am</td>
</tr>
</tbody>
</table>
Improving Availability

Now “Availability” measurement tells a more accurate story?
Improving OEE

Solution – Raw Data vs. Knowledge

WinCC

- WinCC HMI software displays recorded events

<table>
<thead>
<tr>
<th>Date and Time</th>
<th>Reason</th>
<th>Employee ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/31/2002 10:59:59 AM</td>
<td>0000000000000000</td>
<td>00</td>
</tr>
<tr>
<td>12/31/2002 10:59:59 AM</td>
<td>0000000000000000</td>
<td>00</td>
</tr>
<tr>
<td>12/31/2002 10:59:59 AM</td>
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<td>0000000000000000</td>
<td>00</td>
</tr>
</tbody>
</table>
Improving OEE

Solution – Raw Data vs. Knowledge

WinCC Performance Monitor Analyzes the Data

- The WinCC Performance Monitor offers reliable analyses on:
  - OEE - Overall Equipment Effectiveness
  - MTBF - Mean Time Between Failures
  - MRT - Mean Repair Time
  - and further Key Performance Indicators (KPI).
  - The production equipment can be defined individually depending on the specific plant.
Improving OEE

Solution – Raw Data vs. Knowledge

MindApps
- Use apps from Siemens, partners or develop own apps
- Gain asset transparency and analytical insights
- Subscription based pricing model

MindSphere
- Open interface for development of customer specific apps
- Various cloud infrastructures: SAP, AtoS, Microsoft Azure offered as public, private or on-premise (planned)

MindConnect
- Open standards for connectivity, e.g., OPC UA
- Plug & play connection of Siemens and 3rd party products
- Secure and encrypted data communication
Improving OEE

Solution – Raw Data vs. Knowledge

**PLC/DCS**

**PROFINET**

**OPC**

**Field Asset – SIMOCODE**

**MindConnect Nano**

**Internet Router**

Optional: Proxy

**MindSphere** - Siemens Cloud for Industry

Internet

Production / Machine Network

Corporate / Office Network with route to the internet

… or direct internet access, e.g. via a DSL modem
MindSphere – the cloud-based, open IoT operating system

Solution – Raw Data vs. Knowledge

MindApps
Data analytics applications to increase uptime, optimize energy efficiency and enhance cyber security.

- MindApp Fleet-manager
- OEM App
- Mobile Plant Dashboard
- Production Confirmation
- Build your own Dashboard
- Analytics App
- Manufacturing Sustainability
- Augmented Quality Mgmt. Worker
- Defect Reporting

Siemens products and systems or 3rd party products and systems

Siemens
Atos Apps
3rd Party Apps
### Improving OEE

#### Solution – Raw Data vs. Knowledge

<table>
<thead>
<tr>
<th>Mobile Plant Dashboard</th>
<th>Production confirmation app</th>
<th>Manufacturing sustainability app</th>
<th>Quality management worker app</th>
<th>App “Maintenance Planner”</th>
<th>Manufacturing intelligence app</th>
</tr>
</thead>
<tbody>
<tr>
<td>An app summarizing all relevant production/plant information, e.g. on a tablet or smart phone</td>
<td>Can read all different kinds of bar-, QR-, ddmc-,... codes via the camera of the device and capture manual data inputs from a keyboard AND change values in a database via a generic adaptable web service (production status, production steps, amount produced,...)</td>
<td>Manufacturing intelligence app focusing on sustainability KPIs (KWh/h, CO2,...). Can be added to manufacturing intelligence app. The user shall be able to drill through the plants down to the machine in a hierarchical tree view (show the plants on google maps &gt; show the lines in a plant plan &gt; show the machines in a line plan &gt; machine). (Optional: Location based viewing of the nearest machine via iBeacon,...) Besides the Machine view there should also be an order and a product view on sustainability KPIs</td>
<td>Focusing on supporting the QM worker by showing data (KPIs, MES, ERP, PLM, CM) which is crucial for his/her work (to have insight into the production and product – this way he/she is able to find production/product issues that have an impact on quality)</td>
<td>Service technician will be informed via the app about the new maintenance job. Technicians will receive the relevant information (location, time, first information about the problem,...). Arriving at the place to be technicians could identify the machine to be checked. After successful completion of the maintenance job, the technician can provide immediate feedback via app (Maintenance job is done)</td>
<td>Show order/production status and production KPIs (CIE,...). The user shall be able to drill through the plants down to the machine in a hierarchical tree view (show the plants on google maps &gt; show the lines in a plant plan &gt; show the machines in a line plan &gt; machine). (Optional: Location based viewing of the nearest machine via iBeacon,...) Besides the Machine view there should also be an order and a product view on manufacturing KPIs</td>
</tr>
</tbody>
</table>

1) To be developed & to be matched with Siemens MindApp development roadmap.
RFID Keys

1) New keys can easily be assigned by a supervisor
2) Lost keys can be identified if ever used again
3) Multiple Keys can be assigned to a single owner
4) Unique shape provides protection against tampering or duplication
Benefits

WinCC & Performance Monitor

- Makes it possible to show the weak points of the production and to derive suitable optimization potential.
- Flexible – Individual calculation of plant specific performance indicators within SIMATIC WinCC
- Recognizing performance indicators within the content e.g. quality per vendor
- Analyzing of the performance indicators and displaying them as bar- or Gantt – diagram or as a table also using the Web
- Viewing everything at any time – Target–group oriented analysis reports
- Expandable– Adding of performance indicators within existing plants without any loss of production
Benefits

MindSphere – Cloud Based Solution

Customer focus: System integrators, machine manufacturers
First industry-specific applications: automotive, F&B, aerospace

- Performance Management APP
- Energy Management PRO APP
- SIMATIC System Diagnostic APP
- Alarm and Event Management APP
- Shift Calendar APP

Connectivity

- Optimized engineering packages for integrated configuration

Planned for TIA Portal V15 and following TIA Portal versions
Benefits

Siemens Solution is Scalable:

Machine

Production Line
Benefits

Siemens Solution is Scalable:

Entire Plant
Benefits

Siemens Can Provide a Complete Solution:

Controls + Automation + HMI/SCADA
Thank You

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