Machinery Information

How machines will be represented in the Internet-of-Things

Marketing Track
Exercise I:

Everyone in row 1,3,5,7 ...
Try to exchange your business information with the person behind you in an electronic way!
Introduction

Analysis:

- From what APP did you take the info?
- What communication means (BT, WiFi)?
- What data format (VCF / Picture / QR)?

- To succeed, ALL factors must match
Exercise II:

- Now try to share with everyone in the room!

- Make a new database
- Standardize data
- ...
- Make it an APP
- ... make it common sense
Challenges in our industry

Let's try to map this experience to machines

- How do machines communicate?
- What kind of data?
- Which format?
Definition of Architectural Scenarios
What has been done so far

Multi-Organization Partnership established
What has been done so far

Typical Use Cases defined

- **UC1:** Machine-to-Machine Communication
- **UC2:** Machine-to-Supervisory Communication
- **UC3:** Communication Connectivity

![Diagram of OMI and Communication Connectivity]
What has been done so far

Special Interest Group formed in 2013

- **Mission**
  - The Special Interest Group for Machinery Information ("SIG") seeks to optimize the integration of manufacturing machines with the industrial ecosystem. To this end, the SIG seeks to develop standards for exchange of information between machines, and between machines and supervisory systems.

- **Main Players**
  - Rockwell Automation
  - Bosch Rexroth
  - Cisco
  - (18 members)
  - Omron
  - Schneider Electric
  - Sercos International
  - OPC Foundation
What has been done so far

Foundation of the Machinery SIG

- Work plan is created
- Technical work is started
- Related machine types are defined
- Work started on focused data groups
  - Base machine states
  - Energy
  - Condition Monitoring
What has been done so far

UC2: Definition of Architectural Scenarios
What has been done so far

**UC3: Communication Connectivity**

Definition of optional blended infrastructure for systems using EtherNet/IP and Sercos III

- Same cable
- Common profiles
- Different performance

![Diagram showing the connection between Sercos III Drives, Sercos III I/Os, TCP/IP Devices, EtherNet/IP Drives, and EtherNet/IP I/Os with Sercos telegrams, TCP/IP/UDP messages, and CIP messages.]
What the SIG is working on now

Reviewing existing standards

- ISA S95 / S88
- IEC TR 62794
- OMAC / PackML
- MT Connect
- Others

Looking for similarities

Building a flexible, expandable approach
What the SIG is working on now

Typical consumers of data

- SCADA
- LIMS
- Scheduler
- Energy Mgt.
- Asset Mgt.
- Line Control
- Condition Monitoring
- Recipe Mgt.
- Audit trail
- Alarming
- ...
What the SIG is working on now

Types of information

Machine related

- Base machine states
- Energy
- Condition monitoring

Process related

- Build profiles
- Recipes
- Schedules
“A day in the life of machinery data”

Jeff Smith

American Axle Manufacturing
ENTERPRISE LAYER

• Quality Information System
• Factory Information System (FIS)
• Provide Assembly Status to Packout & Shipping
• Reporting

PLANT FLOOR – AGGREGATE LAYER

• Deliver Build Direction to Stations
• Store Build Results to Quality Systems
• Real-time Process Validation
• Identify Assemblies in station
• Provide FIS Data (OEE, Blocked, Starved, etc.)

PLANT FLOOR – STATION LAYER

• Build the Assembly
• Provide Build Results for devices not capable of Listen Only Connections (from Aggregate layer)
A 30,000 foot view of the world from the Aggregate Layer (SCADA)
# TYPE “C” MACHINE – Defined Process

## OP20 Parking Brake (LH & RH) & Axle Shaft (LH & RH) Install (All Part Types)

<table>
<thead>
<tr>
<th>Station Controller</th>
<th>SCADA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pallet transfers into station</td>
<td></td>
</tr>
<tr>
<td>2. Pallet is detected in position</td>
<td>SCADA PLC : Read RFID tag for SERIAL_NUM AB RIFD</td>
</tr>
<tr>
<td>3. FIS Start-of-Cycle</td>
<td>Query Database: Determine if OK_ToBuild and Get Build directions/limits (5RF-RF022)</td>
</tr>
<tr>
<td>4. Wait for Confirmation / Status</td>
<td>RETURN: OK/NOK to Build &amp; Build Directions/Limits</td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
<tr>
<td>6. K2XX Assemblies</td>
<td></td>
</tr>
<tr>
<td>7. Obtain Parking Brakes and bolts from dunnage</td>
<td></td>
</tr>
<tr>
<td>8. Install Parking Brakes to Axle (LH &amp; RH)</td>
<td></td>
</tr>
<tr>
<td>9. Hand Start Parking Brake Bolts (Qty 4 / side)</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
</tr>
<tr>
<td>11. Nissan 61L Assemblies</td>
<td></td>
</tr>
<tr>
<td>12. Obtain Shaft Sub-assemblies from rack</td>
<td></td>
</tr>
<tr>
<td>13. Install Shaft Sub-assemblies to Axle (LH &amp; RH)</td>
<td></td>
</tr>
<tr>
<td>14. Hand Start Shaft Sub-assemblies Bolts (Qty 4 / side)</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td></td>
</tr>
<tr>
<td>16. Operators Scan Labels (LH &amp; RH) - verify readability and contents</td>
<td>SCADA PLC : Read RFID tag for SERIAL_NUM AB RIFD</td>
</tr>
<tr>
<td>17. Wait for Confirmation / Status</td>
<td>Query Database: Determine if OK_ToBuild and Get Build directions/limits (5RF-RF022)</td>
</tr>
<tr>
<td>18.</td>
<td>RETURN: Validation Result</td>
</tr>
<tr>
<td>19. Operators confirm all bolts are in place - swipe pallet release(s)</td>
<td></td>
</tr>
<tr>
<td>20. End of Cycle</td>
<td>SCADA PLC : Send Build Data to Database</td>
</tr>
<tr>
<td>21. Wait for Confirmation / Status</td>
<td>Query Database: Send Build Data to Database</td>
</tr>
<tr>
<td>22. FIS End-of-Cycle</td>
<td>RETURN: Confirm successful transaction, Overall Accept/Reject &amp; OK_ToRelease</td>
</tr>
<tr>
<td>23. Release the Pallet to the Next Station</td>
<td></td>
</tr>
</tbody>
</table>

## SCADA

<table>
<thead>
<tr>
<th>Station Controller</th>
<th>SCADA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SERIAL NUM</td>
<td>n/a</td>
</tr>
<tr>
<td>2. PART_NUM</td>
<td>1</td>
</tr>
<tr>
<td>3. OP_STATUS</td>
<td>n/a</td>
</tr>
<tr>
<td>4. REJECT_CODE</td>
<td>n/a</td>
</tr>
<tr>
<td>5. AXLE_TYPE</td>
<td>TARG PROC 104 Axle.Type</td>
</tr>
<tr>
<td>6. DIFF_TYPE</td>
<td>TARG PROC 101 Axle.DiffType</td>
</tr>
<tr>
<td>7. GEAR_RATIO</td>
<td>TARG PROC 120 Axle.GearRatio</td>
</tr>
<tr>
<td>8. LH_SHAFT_PART_NUM</td>
<td>TEXT VAL 1085 BuildData.AxleShaftPNum_LH</td>
</tr>
<tr>
<td>9. LH_SHAFT_SERIAL_NUM</td>
<td>n/a</td>
</tr>
<tr>
<td>10. RH_SHAFT_PART_NUM</td>
<td>TEXT VAL 1086 BuildData.AxleShaftPNum_RH</td>
</tr>
<tr>
<td>11. RH_SHAFT_SERIAL_NUM</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**Note:** Currently there is no SCADA data collected for the K2XX axles.
TYPES “A” OR “B” MACHINE “OFF THE SHELF”

OP20 Parking Brake (LH & RH) & Axle Shaft (LH & RH) Install (All Part Types)

STATION CONTROLLER

1. Pallet transfers into station
2. Pallet is detected in position
3. FIS Start-of-Cycle
4. Wait for Confirmation / Status
5. AB RFID
6. K2XX Assemblies
7. Obtain Parking Brakes and bolts from dunnage
8. Install Parking Brakes to Axle (LH & RH)
9. Hand Start Parking Brake Bolts (Qty 4 / side)
10. K2XX Assemblies
11. Obtain Shaft Sub-assemblies from rack
12. Install Shaft Sub-assemblies to Axle (LH & RH)
13. Hand Start Shaft Sub-assemblies Bolts (Qty 4 / side)
14. Operators Scan Labels (LH & RH) - verify readability and contents
15. Wait for Confirmation / Status
16. Cognex
17. Operators confirm all bolts are in place - swipe pallet release(s)
18. End of Cycle
19. SCADA RETURN:  Validation Result
20. Release the Pallet to the Next Station

STATION CONTROLLER

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Type</th>
<th>Usage</th>
<th>Param ID#</th>
<th>Destination Tagnames</th>
<th>Source Tagname</th>
<th>Char ID#</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERIAL NUM</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td>SCADA PLC: Read RFID tag for SERIAL_NUM</td>
<td></td>
</tr>
<tr>
<td>PART_NUM</td>
<td>1</td>
<td>Comm.PNum</td>
<td>1</td>
<td>Process.Dem.Rej</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OP_STATUS</td>
<td>-</td>
<td>n/a</td>
<td></td>
<td></td>
<td>Process.Dem.Rej</td>
<td>n/a</td>
</tr>
<tr>
<td>REJECT_CODE</td>
<td>-</td>
<td>n/a</td>
<td></td>
<td></td>
<td>Process.Dem.Rej</td>
<td>54</td>
</tr>
<tr>
<td>AXLE TYPE</td>
<td>10</td>
<td>TARG</td>
<td>PROC 104</td>
<td>Axle.Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIFF_TYPE</td>
<td>2</td>
<td>TARG</td>
<td>PROC 101</td>
<td>Axle.Diff.Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEAR_RATIO</td>
<td>-</td>
<td>TARG</td>
<td>PROC 120</td>
<td>Axle.GearRatio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LH SHAFT PART_NUM</td>
<td>TEXT</td>
<td>VAL</td>
<td>1085</td>
<td>BuildData.AxleShaftPNum.LH</td>
<td></td>
<td>1085</td>
</tr>
<tr>
<td>LH SHAFT SERIAL_NUM</td>
<td>-</td>
<td></td>
<td></td>
<td>BuildData.AxleShaftSerialOutString</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RH SHAFT PART_NUM</td>
<td>TEXT</td>
<td>VAL</td>
<td>1086</td>
<td>BuildData.AxleShaftPNum.RH</td>
<td></td>
<td>1086</td>
</tr>
<tr>
<td>RH SHAFT SERIAL_NUM</td>
<td>-</td>
<td></td>
<td></td>
<td>BuildData.AxleShaftSerialOutString</td>
<td></td>
<td>1084</td>
</tr>
</tbody>
</table>

Note: Currently there is no SCADA data collected for the K2XX axles

SCADA RETURN:  Validation Result
Parse Part (PN) and Serial number (SN), Enable validation
SCADA PLC: Read RFID tag for SERIAL_NUM
Query Database:  Determine if OK_ToBuild and Get Build directions/limits
RETURN: OK/NOK to Build & Build Directions/Limits

SCADA RETURN: Confirm successful transaction, Overall Accept/Reject & OK_ToRelease
Query Database:  Send Build Data to Database
Note: Currently there is no SCADA data collected for the K2XX axles

TYPES “A” OR “B” MACHINE “OFF THE SHELF”

OP20 Parking Brake (LH & RH) & Axle Shaft (LH & RH) Install (All Part Types)
$1,000,000 Question
Partner Update

OPC Foundation: Tom Burke
OPC Foundation: Who We Are

Community:
• The OPC Foundation is the world’s leading community for interoperability solutions based on OPC specifications that deliver universal connectivity.

Collaboration:
• The mission of this community is to advance the development, adoption and certification of OPC based products through global collaborations.

Compliance:
• The OPC Foundation is the official source for the OPC Certification Program, ensuring that OPC products plug-and-play in real-world application.
# Board of Directors

<table>
<thead>
<tr>
<th>Dr. Grant Wilson (Chairman)</th>
<th>• Emerson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dave Eisner</td>
<td>• Honeywell</td>
</tr>
<tr>
<td>Russ Agrusa</td>
<td>• ICONICS</td>
</tr>
<tr>
<td>Thomas Burke</td>
<td>• OPC Foundation</td>
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<td>Juergen Weinhofer</td>
<td>• Rockwell</td>
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<tr>
<td>Thomas Hahn</td>
<td>• Siemens</td>
</tr>
<tr>
<td>Nobuaki Konishi</td>
<td>• Yokogawa</td>
</tr>
</tbody>
</table>
2013 Membership by Region

- Europe: 210, 47%
- North America: 126, 29%
- China: 37,8%
- Japan: 29,7%
- Rest of World: 41,9%
President Summary

OPC Technology Adoption is Accelerating
Centralized Global Marketing
OPC Certification Program Recognition
IEC Standardization
New Market Opportunities
Collaboration & Partnerships
Continuous Improvement Process
Sercos International: Peter Lutz

sercos
the automation bus
Sercos: working together for open systems

ODVA (since Nov. 2006)
Adoption of CIP Safety as the safety protocol for Sercos

FDT (since Nov. 2008)
Standardize the interface between field devices and engineering tools

OSADL (since April 2009)
Cooperation in the field of Open Source Software

Machinery Initiative (since April 2011)
Optimization of Machine Integration (OMI)

CIP Safety on Sercos Specification
Sercos Annex to the FDT specification
Integration of Sercos driver in mainline Linux
Improve the machine integration
Machinery Initiative: Use Cases

Typical Use Cases defined

- **UC1:** Machine-to-Machine Communication
- **UC2:** Machine-to-Supervisory Communication
- **UC3:** Communication Connectivity
SIG priorities and next steps

- Define a clear and pragmatic description of different aspects of common machine information.
- Provide coherent syntax and semantics for a flexible, modular and expandable model that allows easy implementation on new and existing machines to simplify and standardize the access of machine information.
- Create common objects with data structure
- Map them to CIP and OPC UA
- Maintain the cooperation with Sercos International