Industry 4.0 in Glass
Needs a pragmatic approach

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Industry 4.0 is a name for the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing.
Let’s do a bit of “generalizing”

The Glass industry:

- Is conservative
- Is risk averse
- Doesn’t like storing data in the cloud
- Runs furnaces 24/7 for 15 years
- Is mostly a commodity industry
- Has low margins
- Is a tough job

..and yes, you are not like that at all, we know
Let’s blame ourselves a little

Process Control Suppliers:

• Often copy-paste
• Keep on repeating things they did 30 years ago
• Keep on giving you the same PID control
• Keep on asking for more money
• Started using “Windows”
• Keep asking you to pay for upgrades

..and yes, you know that we are not like that at all
Talking about recent innovations?

- Regenerative furnace: 1867
- Pilkington float process: 1957
- Narrow Neck Press and Blow: 1987
- Gorilla glass: 1960

..and yes we all know there were some recent developments…
Step 1: Data Collection

• Enterprise Wide
• From Raw Materials to Warehouse
• All Data Formats
• Real Time
• Sufficient Resolution
• From All Kind of Data Sources
• Automatic and Manual Inputs
• One Virtual Data Space
• Unlimited Storage Capacity

The Owner should set the database standards - not the equipment suppliers
Data Collection

- Batch
- Melting
- Conditioning
- Forming
- Annealing
- Cold-end
- Packaging

TIME SYNCHRONISATION

- Laboratory
- Customer
- Environment

Different Users

Confidential Property of Schneider Electric
How Plant Data is Managed Today

Corporate Data Management, Reporting & Plant Benchmarking

Plant Data Management, Reporting and Line Benchmarking

Unit or Line Data Management and Reporting

Furnace Operators
- Furnace Supp.
- Raw Materials
- Mould Maintenance

Forming Operators
- Quality control

Cold End Operators
- Lab.
- Logistics

Batch Melting Forming
- Quality & Packaging
- Utilities

PLC DCS DCS PLC PLC
How Data Should be Managed

Corporate Data Management, Reporting & Plant Benchmarking

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Unit or Line Data Management and Reporting

Plant Maintenance

Furnace Raw Materials

Mould Maintenance

Quality Control

Lab.

Furnace Operators

Forming Operators

Cold End Operators

Logistics

Advanced Control

Batch

Melting

Forming

Quality & Packaging

Utilities

PLC

DCS

DCS

PLC

Special

PLC

PLC

PLC

Advanced Control

Life Is On

by Schneider Electric
Step 2: What’s in a Name?

- Enterprise Wide Tag-Name Conventions
- Time Synchronized
- Covering All Data Types
  - Batch Data
  - Continuous Process Data
  - Digital Data
  - Images
  - External Data
  - Environmental Data
- Easy to Recognize
- Easy to Learn
- Easy to Manage
- ONE SIZE FITS ALL
## Examples

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOV1TONX</td>
<td>Pull Rate Furnace 1 PV</td>
</tr>
<tr>
<td>FOV1GAW</td>
<td>Flow Gas Furnace 1 SP</td>
</tr>
<tr>
<td>FOV1GAX</td>
<td>Flow Gas Furnace 1 PV</td>
</tr>
<tr>
<td>FOV1LUW</td>
<td>Flow Air Furnace 1 SP</td>
</tr>
<tr>
<td>FOV1LUX</td>
<td>Flow Air Furnace 1 PV</td>
</tr>
<tr>
<td>ZOV1W</td>
<td>Gas/Air Ratio Furnace 1 SP</td>
</tr>
<tr>
<td>QOV1O2X</td>
<td>Percentage O2 Furnace 1 PV</td>
</tr>
<tr>
<td>QOV1O2LX</td>
<td>Percentage O2 Furnace 1 L PV</td>
</tr>
<tr>
<td>TOV1O2LX</td>
<td>Temp. O2 Sensor Furnace 1 L PV</td>
</tr>
<tr>
<td>QOV1O2RX</td>
<td>Percentage O2 Furnace 1 R PV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MST_FRN01CRW_TPPV</td>
<td>Furnace 1, crown temperature, measure</td>
</tr>
<tr>
<td>GRC_FRH51ALC_HTN_MU_TPSPHI</td>
<td>Forehearth 51, alcove heating, Temperature Set Point High Limit for Middle Upper thermocouple</td>
</tr>
<tr>
<td>GRC_FRH51ALC_CLN_MM_TPPV</td>
<td>Forehearth 51, alcove heating, Temperature Measure for Middle Middle thermocouple</td>
</tr>
<tr>
<td>MST_FRN01GAS_FLSP</td>
<td>Furnace 1, Gas flow setpoint</td>
</tr>
<tr>
<td>MST_FRN02NOX_WGCX</td>
<td>Furnace 2, NOx weight emission (calculated)</td>
</tr>
<tr>
<td>MST_LIN11PTM_EFCX</td>
<td>Line 11, Pack to melt, calculated performance indicator</td>
</tr>
<tr>
<td>MST_FRN03NOX_KNT_PMMI</td>
<td>Kentall value for furnace 3 (parameter for Nox calculation, Manual input)</td>
</tr>
<tr>
<td>MST_MCH23MCW_PSPV</td>
<td>Machine 23, Pressure of machine cooling wind,</td>
</tr>
<tr>
<td>RDF_MCH24ATM_TPPV</td>
<td>Atmospheric temperature relative to machine 24</td>
</tr>
<tr>
<td>MST_CMP10_IN01_PSPV</td>
<td>Compressor 10, Pressure measure for indicator 1</td>
</tr>
</tbody>
</table>
Getting the Speed, Resolution, Capacity and Data-Set Right

- Different types of data need to be managed
- Different resolutions
- Different sample rates
- Different events
- Manual data input
- Third party data (weather info)
- Different time scales

- Data needs to be open for all users
Different Users, Different Demands

Production

Management

Quality

Maintenance
Why Analytics are (will become) Important

The Glass Melting Process will Change Dramatically
• Fossil fuel compositions are changing (Hydrogen content )
• Fossil fuel compositions are becoming less stable

Transition from Fossil Fuels Towards All-Electric with Intermediary Steps
• Experienced workforce not available
• Youngsters will use data-driven approaches

Utilities Would Like to be in Control of Power
• More renewable energy on the grid will cause grid instabilities that need to be predicted
• Centralized power generation will become de-centralized power generation

Smart Grid Compatibility

Glass Quality
• Predicting freedom of control without glass impacting glass quality will generate revenues

Melting Efficiency
Separate Right from Wrong

What we have:
• Huge amounts of data
• Different formats
• Time shifts
• Smart analytic tools
• Little or no understanding

What we need:
• Desired result
• Process Knowledge
• Open Mind

What we get:
• Correlations
• Models
• New insights
• Improved process
Example: Melter Energy Household will become more Complex

- Conversion from fossil fuel towards all-electric
- Increased boosting capacity
- Smart grid management
- Natural gas composition fluctuation
- Fossil / electrical energy ratio control
First get the Fundamentals Right

- It eases current challenges for glass makers
- It leads to an innovation economy
- It puts the consumer in the center of all activities
- It even puts humans into the center of production
- It will enable sustainable prosperity
Conclusions

- Better understanding of our processes
- Improved quality and throughput
- Helps adapt our process to the outside world
- Increases flexibility
- Increases attractiveness to new employees
- More energy effective and reduces carbon footprint
QUESTIONS?