SMART Manufacturing: Corning's Journey

Michelle Pastel

July 2016

“Next Industrial Revolution”

US: Smart Manufacturing
Europe: Industry 4.0
China: Made in China 2025
India: Make in India

Right Data, Right People, Right Time, Right Decisions
Corning’s Story…

- Corning’s strategic approach is deeply rooted in innovation of products and processes

- Our sales are enabled by producing quality products with the attributes our customers want at the right price

- Our profitability comes in part from supply chain management and manufacturing excellence

Corning is a world class manufacturer of specialty materials,… …SMART Manufacturing will help us continue our legacy
All of us deeply depend on Data…

… and Information Technology Systems…

… to Deliver our Objectives for Business Success

Smart Manufacturing is Redefining All of the Above
Today…
Think of Manufacturing Systems as a Puzzle

Each piece can exist and function independently

But the real impact can’t be seen until all the pieces are connected
The Puzzle can be logically grouped by Functionality

**Product & Process Data Tracking**
- **Detailed Data supporting what happened**
  - Environmental/Qualification
  - Product Design
  - Lab Testing
  - Product & Process Data

**Enterprise Resource Planning (ERP)**
- **Financial Control of what we buy and sell**
  - Order Management
  - Inventory
  - Planning
  - Procurement
  - Ware Tracking
  - Downtime Tracking

**Product Management System**
- **Rules for what we make & how**
  - Experiments
  - Quality Systems
  - Process Documentation
  - Product Management
  - Defect Collection
  - Maintenance Management

**Manufacturing Execution Systems (MES)**
- **What to do & What Happened**
Once assembled...Integrated Manufacturing Systems of Today

- Product/Process Data Collection and Analysis
- Lab Testing
- Product Design
- Environmental/Qualification

- Product Management System
  - Quality Systems Documents
  - Process Documents
  - Experiment Tracking
  - Specifications
  - Material
  - Products
  - Bill of Materials
  - Routings
  - Product Documents

- Enterprise Resource Planning - ERP
  - Order Management
  - Procurement
  - Inventory Management
  - Planning
  - Human Resources
  - Time Tracking

- Manufacturing Execution System - MES
  - Mfg Scheduling
  - Ware Tracking
  - Defect Collection
  - Downtime Tracking
  - Maintenance Management

- Product & Process Data Tracking

Janisch, Jefferson 2012
But Today’s Information Systems Aren’t Seamlessly Connected from Plant-to-Plant Across the Supply Chain

Minimal Supply Chain Data Sharing

1st Factory
“Corning”

2nd Factory
“Contract”

3rd Factory
“Customer”

Finished Product
Smart Manufacturing

Corning’s SMART Manufacturing (SM) is the concept of combining multiple capabilities (Integrating Measurements, Controls, Computing Platforms, Modeling and Analytics) to improve process/product development, manufacturing performance, and reduce manufacturing cost within a plant and across the supply chain.

Smart Manufacturing Leadership Collation (SMLC) is a national coalition to promote, standardize and enable SMART Manufacturing. Corning- member since 2011.

DOE’s Clean Energy on Smart Manufacturing Innovation Institute (CESMII) is a public-private partnership to advance SM and Clean Energy creating competitive US manufacturing. The SMLC awarded the Institute June 2016.
Corning’s SMART Manufacturing

**Right Data*, Right People, Right Time, Right Decisions**

### Typical IMS

- **Cyber Security**
  - Quality
  - Energy
  - Maint.
  - Supply Chain
  - Ops

- **Data Analysis**

- **Databases & Data Systems**
  - Equipment
  - PI
  - MES
  - Test Data
  - Many other devices

### SMART Mfg

- State of the art **Cyber Security**
- **Cloud** computing platform
- Access to **Data Analysis** and real-time **Predictive Modeling**
- **Advanced Controls**, sensors and data protocols
- New data **Visualization** tools
- Infrastructure to enable improvements in **Mfg.**
- **Reduce costs** by changing mfg system suppliers’ biz model
## Corning’s SMART Manufacturing Shared Objectives: Q1=100%

### Multi-directorate Team: AE, MPE, EIG, MCS, APM

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<th>Objective</th>
<th>Score</th>
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Total Weighted Score: 100.0%
Corning’s Successful Execution of SM: Requires Commitment to a Common Vision & Shared Goals

Keys to Success:
• **Partnerships across Corning**
• **Collaboration amongst multi-disciplinary people**

Business Functions
- Biz Unit
- Mfg Plant
- Supply Chain

Initiatives / Programs
- Corp Prog
- Biz Prog
- Qual Prog

SM Technologies
- Advanced Sensors
- Process Control
- Modeling & Analytics
- Platform*

SM Project Manager led Team

Technical / Domain Expertise
- IMS
- Model
- Stats
- Cntrl
- Meas
- Proc

*Cloud technology with state-of-the-art Security
We know what we measure…

… We manage what we know
Leveraging Smart Manufacturing’s Cloud Technology to “Couple” Decoupled Processes

- Process instrumentation is critical in coupled process, but especially so in a decoupled process
- Identify and implement process controls based on quality requirements and process variability
- Improve fundamental understanding, monitoring, & control within a plant and from plant-to-plant
**Draft-Not Complete**

**Systems Architecture: Prototype SM Tech**

**Evaluating Cloud Based Technologies to Address**: Industry data requirements, Multi-location mfg plans; Large data sets for advanced analytics; and Design for future functionality.

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**SM Framework Managed Analytics – Hadoop + Others (Tableau, JMP, Custom, etc.)**

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**Glass Data** → **Process 1 Setup** → **Process Step 1** → **Lab Tests** → **Process 2 Setup** → **Process Step 2** → **Final Inspection**

- IQA
- Recipe and Process Data DB
- LIMS
- Recipe and Process Data
- Inspection Data - DB

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**SM Framework Database - Hadoop**

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**Workflow Managed Analytics**
**SM Summary:** Learn by Doing ↔ Plan Through Experience; Consult; Analyze Opportunities for More Near-Term Impact

**Smart Manufacturing is**
- Underway in Corning
- Supports collaboration across multiple divisions
- Impacts a corporate priority program
- Generating pull
- Establishing foundational systems, knowledge, and protocols
- Extending our capabilities and competitive advantage while reducing cost
- Partnering with the SMLC to accelerate learning, collaborate, go faster, and spend less

*Right Data*, *Right People*, *Right Time*, *Right Decisions*
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<th>Name</th>
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<td>Tom Capek</td>
<td>Jeff Ahrens</td>
<td>SGP Operations Team</td>
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