Realizing Smart Manufacturing for Electronics
Digitalization in Electronics
“Digital is the main reason just over half of the companies on the Fortune 500 have disappeared since the year 2000.”

Pierre Nanterme CEO Accenture

Electronics Industry: New possibilities, new pressures

Electronics innovations drive new opportunities

Compute

Connected

Digital

Source: Siemens Analysis and VLSI Research, 2018

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The electronics revolution is accelerating
ELECTRONICS INNOVATIONS DRIVE NEW MARKETS

**AUTONOMOUS**
- ADAS
- Safety systems

**SMART AND CONNECTED**
- Smart Cities/Homes
- Industrial IoT
- Connected health
- Smart Products

**AUGMENTED & VIRTUAL REALITY**
- Manufacturing
- Military/Defense
- Sales & Marketing
- Recreational

**By 2030, 50% of automotive costs will be electronics-based**
— Statista

**The global IoT market will grow from $157B in 2016 to $457B by 2020, attaining a compound annual growth rate (CAGR) of 28.5%**
— GrowthEnabler Analysis

**Total spending on AR/VR products will hit $215 billion 2021, achieving a compound annual growth rate (CAGR) of 113.2% along the way.**
— IDC
A unifying connectivity fabric for society

Like electricity, you will just expect it everywhere

Source: Qualcomm
Trends in Electronics Industry

Customized and personal products are on the rise.

Disruptive pull of electronics in mature industries.

Customer experience is essential to growth.

Devices are getting smaller and smarter.
Implications of being unprepared

Those unprepared share common characteristics:

- Poor integration of electronics with mechanical across product development and manufacturing
- Inefficient design processes, data incompatibilities, data mismanagement leads to extensive error-prone manual intervention
- Heavy dependence on backend verification and physical prototyping that compromises product reliability and increases cost

Inefficient cross-domain collaboration

Data incompatibilities

Manual manufacturing handoff

Reliance on physical prototyping

BRINGING MORE CAPABLE PRODUCTS TO MARKET FASTER REQUIRES MULTI-DISCIPLINE STRATEGIC INITIATIVES
Smart Manufacturing for Electronics
Modern manufacturing introduces new challenges

DELIVERING
LOT SIZE ONE

OPTIMIZING
MATERIAL USAGE

MAKING
DATA USEFUL

<table>
<thead>
<tr>
<th>COST OF SELECTED PARTS</th>
<th></th>
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<tbody>
<tr>
<td>Display</td>
<td>$45</td>
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<tr>
<td>Memory</td>
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<tr>
<td>Communications</td>
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<td>Processor</td>
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<td>Mechanical</td>
<td>30</td>
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<tr>
<td>Other</td>
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<tr>
<td><strong>TOTAL PARTS</strong></td>
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<tr>
<td>Labor</td>
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<td><strong>TOTAL</strong></td>
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<tr>
<td><strong>U.S. RETAIL PRICE</strong></td>
<td><strong>$649</strong></td>
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</table>
Typical customer scenario (based on customer input):
Mechanical and Electronics Assembly planning and execution in disconnected environments

- Test plan not in sync with assembly plan and product changes
- Difficult to assess quality of the entire product
- No single traceability record

- Low material turnover
- High scrap rate
- Low predictability

- Different machine interfaces
- Work instructions are not up-to-date

- Product data is complex, outdated, hard to access
- No standardization across sites

- Outdated legacy information systems
- Multiple interfaces to maintain
Breaking down the silos: delivering an integrated solution for Electronics Manufacturing
Continuous improvement with the Digital Twin

Digital Twin Product

Virtual product

Verification

Specification

Digital Twin Production

Virtual production

Validation

Commissioning

Digital Twin Performance

Real production

Automation

Ideal delivery

Real product

Insights from performance with MindSphere

Continuous improvement

Collaboration platform: Teamcenter

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Maintaining a Digital Thread with Open, Intelligent data exchange formats

**Digital Twin Product**
- Design
- ODB++
- Layout tool agnostic

**Digital Twin Production**
- DFM Hand-off
- Process Engineering
- ODB++
- Machine-agnostic

**Digital Twin Performance**
- Production
- Box-Build
- OML/OPC-UA
- OPM

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Breaking down the silos: Delivering an integrated solution for Electronics Manufacturing

- Right-first-time production
- Consolidated, collaborative digitalization platform
- Fast, scalable, global NPI
- Optimized production plans
- Improved performance, utilization, material turnover
- Continuous improvement; Intelligent decision making

Teamcenter (+Teamcenter Manufacturing) → Camstar Electronics Suite

Design Verification → Manufacturing Planning → Process Engineering → Production Scheduling → Production Execution → Manufacturing Analytics

Manufacturing Planning
- Fast, scalable, global NPI

Process Engineering
- Optimized production plans

Production Scheduling
- Improved performance, utilization, material turnover

Production Execution
- Continuous improvement; Intelligent decision making

Manufacturing Analytics
- Design Verification

Teamcenter (+Teamcenter Manufacturing)
- Right-first-time production
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Camstar Electronics Suite
- Fast, scalable, global NPI
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The vision by 2025
A radical change for manufacturers

- Design Anywhere – Build Everywhere
- Touchless Factory
- Cloud based analytics and apps
- 5G Connectivity
- Machine-to-Machine connectivity
- Flexible Electronics
- Feedback loop from Manufacturing to Design
- Autonomous material handling
- Smart Product
- Embedded components
- Flexible Electronics

Manufacturing

Cloud based analytics and apps

5G Connectivity

Feedback loop from Manufacturing to Design

Flexible Electronics

Autonomous material handling

Smart Product

Embedded components
Introducing Camstar Electronics Suite
The MOM evolution towards Smart Manufacturing

**Stand-alone MES**
- Focus on vertical integration
- Rich set of Industry-specific OOTB functionalities
- Real-time data acquisition

**2 '00s Monolithic MOM**
- From execution to a broader coverage of manufacturing disciplines
- Scalable solutions, extensibility and code-less configuration
- Data synchronization and contextualization

**3 Today MOM for Smart Manufacturing**
- Focus on collaboration through horizontal integration
- Cloud-ready technologies
- Orchestration based on principles of Artificial Intelligence
- Augmented data contextualization through IoT

Digital Enterprise & Industry 4.0

Improved manufacturing execution

Manufacturing digitalization
Camstar Electronics Suite - Overview

LEVEL 0

LEVEL 1

LEVEL 2

LEVEL 3
MES

LEVEL 4
ENTERPRISE

OML
Data Exchange

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Seamless NPI integration with PLM

• Seamless flow of product and production data from PLM to manufacturing execution
• One solution for all manufacturing engineering tasks, including Data preparation, Manufacturability and Testability analysis, SMT programming, Test Programming, Stencil design, and work instructions for Manual assembly and inspection
• Visual BOP definition and enrichment through a full set of out-of-the-box (OOTB) manufacturing capabilities
• Automatic machine library generation and DFA leveraging Valor Parts Library (VPL)

Faster product innovation  Effective change management  Reduced errors
Advanced and detailed planning and scheduling

- Import production orders from ERP and integrated PCB, mechanical and box-build plans and schedules
- Optimize SMT grouping for minimized change-over and setup time
- Compare production alternatives and optimize schedules
- Run what-if analysis and analyze the impact of unexpected events and decision taken

Real-time planning and scheduling

Manufacturing efficiency

Global visibility
Plug&play shop floor connectivity

- Robust, real-time data acquisition and control of SMT Production and Test machines
- Live dashboards displaying machine performance, utilization and quality
- Built-in material / process verification and interlock
- Normalized data available through Open Manufacturing Language (OML)

User-friendly plant model configuration
Real-time monitoring dashboard
One production client for SMT and box-build execution

- Streamlined and guided manufacturing processes and traceability
- Bill of Material, PCB and Box visualization and interactions
- Smart scanning, auto recognition and minimized actions for operators
- User-friendly Electronics Work Instructions (EWI), detailed shop-floor documentation, in-process quality tests

Manage shop-floor complexity

Improved shop-floor efficiency

Reduce training and maintenance costs
One production client for SMT and box-build test

- Guided inspections and graphical defect logging
- Display of defects from automated manufacturing operations
- Guided repair actions and support
- PLM integration for Closed-loop feedbacks from production to product development and engineering

Efficient defects repair

Improved quality

Closed-loop feedbacks
Advanced Material Management

- Manage material handling across the factory, including registration, storing, picking, verification and traceability
- Just-in-time KANBAN material management – Driven by IoT devices
- Autonomous material logistics management
- Bridge ERP-view of work orders and shop floor view of WIP in real-time

Reduced inventory and waste
Improve performance
Empower ERP investment
Configurable big-data reporting and manufacturing analytics

- Out-of-the-box reports focused on Electronics Manufacturing quality, traceability, utilization, materials, environmental data and more
- OEE, SPC, FPY, trends and alarms, Root-cause analysis
- Scalable on-premise big-data solution
- Support for multi-site enterprises
CAMSTAR Electronics Suite

1. Streamlined NPI processes and change management
2. Optimized production plans and schedules
3. Flexible configuration, out-of-the-box production enforcement, end-to-end traceability and real-time material management
4. Direct shop-floor connectivity, real-time data acquisition and performance analysis
5. Closed-Loop Manufacturing for efficient and continuous improvements
6. Big Data Analytics and intuitive enterprise manufacturing intelligence

for both…

PCB

BOX-BUILD
Case study: Siemens Fürth
Siemens Fürth case study
Before

LEVEL 4
ENTERPRISE

LEVEL 3
MES

LEVEL 2

LEVEL 1

LEVEL 0

NX
TeamCenter R4.2
SAP R71

Zuken CR5000

Diplan

Preactor

Valor Process Preparation

Unicam eMES

ISA-95
Siemens Fürth case study
After – Camstar Electronics Suite

LEVEL 4
ENTERPRISE

LEVEL 3
MES

LEVEL 2

LEVEL 1

LEVEL 0

NX
Xpedition

TeamCenter R4.2

SAP AXP

Camstar Scheduling
Valor Material Management
Valor Manufacturing Analytics

Valor Process Preparation
Camstar Electronics Services

Camstar Enterprise Platform

IoT Data Acquisition

ISA-95

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Siemens PLM Software
“The migration to the Camstar Electronics Suite introduced a layer of value that we could not have achieved with a disconnected set of tools through custom integration”

“The inclusion of Valor IoT data acquisition in the suite has drastically simplified the deployment of the solution across our assembly lines”

“Today we have a true one-stop-shop solution for managing Electronics Manufacturing that covers all process areas, as well as material flow and integration with PLM and ERP”

Hermann Kraus
Manufacturing Manager
Siemens Fürth
Smart Manufacturing
An enterprise strategy – not only a matter of technology

Driven by inspired executives, realized by experts

Think big – Start focused – Scale fast

Re-think financial and strategic targets

Enabled by innovative partners
Thank you