Using Standards to Increase Productivity While Fighting Counterfeits

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Outline/Agenda

- Introduction
- Review of Standards
- Case Studies
- Conclusions
- Q & A
Introduction

Purpose

- More secure and productive Supply Chain
- Creates a Digital Build Model©
Overview of Synergy

- **Collecting** Data in a Standardized Way
- **Connecting** The Dots
- **Converting** those patterns into benefits
Standard Data Collection

- Communication: IPC’s CFX
- Data: 1782
- Framework: IPC-2581
Impact Over Product Life
Other Benefit Opportunities

- Reduced Variability
- Increased Yield
- Improved Quality
- Improved Reliability
- Increased Customer Trust
Smart Factory

Enterprise Apps
- Design / ERP / PLM Integration
- Cloud-based Business Intelligence
- Site interoperability

Qualified Data
- MES Apps
  - MES
  - Augmented Reality
- Process Engineering
- Production Plan
- Production Control
  - Electronic Documentation

Demand, Materials
- Active Quality
- Lean Material Management
- Traceability
- Dashboards

Materials, Work-Orders, Flow Control
- Figure: MES Infrastructure

Events, Traceability
- Machine / Line Solutions:
  - Machine Vendor Apps
  - In-House Apps

- Printer
- SPI
- SMT
- AOI
- VI
- Reflow
- Auto Test
- Manual Insertion
- ICT
- Repair
- Assembly
- FCT
- Shipping
IPC 1782

- Four Levels
  - Materials
    - 3σ, 4σ, 6σ, or 9σ
  - Process
    - 3σ, 4σ, 6σ, or 9σ
- Data Fields Defined

<table>
<thead>
<tr>
<th>Material Traceability</th>
<th>Level 1: Basic</th>
<th>Level 2: Standard</th>
<th>Level 3: Advanced</th>
<th>Level 4: Comprehensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1: Part number listed to work-order</td>
<td>M2: Unique material ID listed to work-order</td>
<td>M3: Unique material ID listed to PCBA</td>
<td>M4: Unique material ID listed to reference designator</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process Traceability</th>
<th>Level 1: Basic</th>
<th>Level 2: Standard</th>
<th>Level 3: Advanced</th>
<th>Level 4: Comprehensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1: List significant process exceptions to work-order</td>
<td>P2: List critical process characteristics and exceptions to serialized PCBA</td>
<td>P3: List all key process characteristics and exceptions to serialized PCBA</td>
<td>P4: Capture all available metrics to serialized PCBA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Integrity</th>
<th>3 Sigma</th>
<th>4 Sigma</th>
<th>6 Sigma</th>
<th>9 Sigma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Collection</td>
<td>90 % Manual</td>
<td>70 % Automation</td>
<td>&gt; 90 % Automation</td>
<td>Fully automated</td>
</tr>
<tr>
<td>Reporting Lead Time</td>
<td>48 hours</td>
<td>24 hours</td>
<td>1 shift</td>
<td>Live</td>
</tr>
<tr>
<td>Data Retention Time</td>
<td>Life of product plus 1 year</td>
<td>Life of product plus 3 years</td>
<td>Life of product plus 5 years</td>
<td>Life of product plus 7 years</td>
</tr>
</tbody>
</table>
IPC 2581

Intelligent, Single-File OPEN Standard

PIC-2581 A Single XML File

Systems Company

Manufacturing Partner

Netlist  Artwork  Test
Excel and JPEG  Drill
Assy  BOM  Readme
IPC 2591

Communication Protocol

- Secure (like ATM)
- Encrypted option
- Send and forget (host)
- Point to point (direct)

Defined Language

- Structured topics and messages across all manufacturing elements
- “Build” a model for any type of automation

Data is Encoded using **JSON**
IPC 2591

CFX Topics, Messages & Flow Concept

Information System → Materials → Resource Performance → Production

AMQP

Materials Initialized → Work-Order Created → Work-Orders Scheduled → Material Transport Scheduled → Material State Changed → Material Recipe → Materials Loaded → Unit Arrived → Identifiers Read → Validate Unit → Modify Station Parameter → Work Started → Materials Empty → Action Occurred → Materials Installed → Units Processed → Unit Departed → Tools Used → Readings Recorded → Maintenance Request → Energy Consumed → Log Entry Recorded → Units Packed → Units Shipped

CFX also works seamlessly with The Hermes Standard (SMEMA)
### IPC 2591

**Flow Management:**
- UnitsArrived
- UnitsDeparted
- UnitDisqualified
- WorkCompleted
- WorkStarted

**Recipe Management:**
- GetActiveRecipeRequest
- GetActiveRecipeResponse
- GetRecipeRequest
- GetRecipeResponse
- RecipeActivated
- RecipeModified

**Setup Management:**
- GetRequiredSetupRequest
- GetRequiredSetupResponse
- OperatorActivated
- OperatorDeactivated
IPC 2591

- Hierarchy of Data
  - Matches IPC 1782
  - Smaller Data Size
  - Indexed
  - Down to components (e.g.; ICs, Discretes, Boards, etc.)
Case Study: Paperless Operation

- Background
  - An EMS provider specializing in turnkey manufacturing of high mix, high complexity, and extremely reliable products for the military, avionics, industrial, medical and energy management markets
Case Study: Paperless Operation

Objective

- Increase productivity by going paperless
- Better communication of ECO information to shop floor
- Reduced machine programming times and operator documentation preparation
Case Study: Paperless Operation

■ Outcome

☐ First pass yield increased 9.4% (87.1% to 95.2%)
☐ 90% reduction in documentation time
☐ A 66.8% reduction in defects per unit (0.391 to 0.130)
☐ Machine programming time reduced from 2-3 hours to 30 minutes
Case Study: Regulatory Rmts.

- Background
  - Multi-site contract manufacturer serves highly regulated markets of Medical, Military, and Aerospace
  - Increased demand for high quality, highly complex products delivered ASAP
  - Disparate data sets
Case Study: Regulatory Rmts.

Objective

- Consolidate Data into single system
- Better compliance to FDA’s Title 21 CFR Part 11
- Implement full product and process traceability must be available through a Device History Record (DHR) for recalls
Case Study: Regulatory Rmts.

■ Outcome

□ ROI was realized in just 4 months
□ 5% reduction in defective parts per million
□ 30% reduction in rework time
□ FDA CFR Part 11 supported electronically
□ Deep traceability down to individual reference designators, as well as, early detection of defects
Conclusions

Current Advantages

- Plug & Play
- No Contracts/Fees/Licensing Agreements
- Target Variability
- Counterfeit mitigation
- Process Data itself can be a fingerprint
- Improved Designs
Conclusions

Future Advantages

- Can be expanded beyond SMT
- Differences found in images can be a tag to track components through Supply Chain and mitigate Counterfeits
- Design of Experiments can be done across entire Supply Chain
Thank You!
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■ BIO: Cameron Shearon had the ideas presented here in 1999 and has actively been maturing & implementing them by initiating and Chairing IPC 1782, helping to initiate and scope IPC 2591 among other activities. Cameron is a Principal Engineer at Raytheon’s IDS division, cochair of IPC 1782, and a SMTA Distinguished Speaker. Cameron has given invited speeches at many international events.