Understanding the Quality Metrics in PCBA Manufacturing
Uday Bidurukontam, Prototype and NPI Manager

December 01, 2010
• What is Quality?
• Why do we need to measure it?

• Alphabet Soup of Metrics
• Metrics Based on Objectives

• Preventive Approaches
What is Quality?

- Quality could be defined in many different ways
  - Conformance to specifications
  - Initial vs. long term (reliability)
  - Meeting expectations
    - Price, Delivery, Defects, Responsiveness
  - Perception

- One has to understand one’s customer to ensure that the internal definition of quality matches that of the customer’s
  - Often manufacturers contribute to incorrect perception by providing unqualified data
Why Measure Quality?

- If one does not define the objectives clearly, one will end up with the wrong measures.
- In general, quality needs to be measured for the following reasons –
  - To understand if performance meets customer’s express requirements.
  - To understand what areas to focus on to continuously improve because efficiency gains are often related to doing things right the first time.
  - To understand how manufacturing processes may contribute to long term quality (or reliability).
  - To provide a way to compare different products and different manufacturers (or factories).
The Various Measures

- **DPM** – Defects/Defectives per Million Units
- **DPU** – Defects per Unit
- **DPPM** – Defective Parts per Million
- **Yield** – First Pass, Pristine, Process, End-to-End
- **DPMO** – Defects per Million Opportunities
- **CRR** – Customer Return Rate
- **LAR** – Lot Acceptance Rate
- **OMI** – Overall Manufacturing Index
Customer’s Viewpoint

- Often customer is concerned about continuity of supply
  - What is the yield in the customer’s factory or in the field?
  - Are there any component issues?
  - If there is a problem in the field, how easy is it to recall product with precise information?
  - If there is a problem, how well will the supplier react with respect to containment?
  - Are there any hidden yield issues that may affect productivity?
  - Are there any manufacturing issues that may affect long term reliability?
Continuous Improvement

- The ultimate goal is to be able to make processes predictable and to minimize or eliminate rework/repair
- Reducing the opportunities to make defects is a path to achieving this goal
- Often this means making small incremental gains continually
- Understanding the potential defect opportunities and using trending and Pareto analyses will help identify areas to focus on
- Realtime feedback systems will help identify special causes and minimize defects
Reliability

- Often long term reliability is an important factor in design and manufacturing of electronic assemblies.
- Automotive, aerospace, medical etc are common applications that need greater assurances of reliability.
- Cleanliness, minimal rework and repair, ESD and MSD controls, and using higher reliability components together will result in greater reliability from a manufacturing standpoint.
- Process qualification and change control are necessary in ensuring long life and performance of electronic assemblies.
Comparing Quality

- Often customers and managers are interested in comparing quality across product lines, factories, suppliers etc.
- This is an inherently risky proposition – it is very rare that everyone measures quality in the same way – metrics may sound the same but they may be defined entirely differently.
- Use a balanced approach to comparing different products or suppliers.
- Overall Manufacturing Index is a standardized approach as described in IPC-7912A, Appendix B.
Preventive Approaches

- Quality and Reliability begin with design
  - Design for manufacturability (DFM) and testability (DFT) are important to ensure quality and reliability
- Advanced quality planning and safe-launch approaches are early investments to ensure robust manufacturing processes
- Yield estimation will help plan resources and mitigation measures – approach explained in IPC-9261A
- Proper data collection is critical in ensuring the quality metrics are accurate and dependable
Dedicated Prototype Team

Focus on Quality and Delivery Commitment

Right people using innovation and continuous improvement for product enhancement

Ability to flex cell to meet customer order requirements

Single module thru complex mechanical system integration

Capability to work with Engineering documentation

Process controls to transition into production

Total Customer Satisfaction
### SERVICES OFFERED

<table>
<thead>
<tr>
<th>Materials Management</th>
<th>Planning / Configuration</th>
<th>Manufacturing Engineering</th>
<th>Test Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistance with supplier selection including quick-turn PCB houses</td>
<td>Ability to process many different formats of BOM and CAD data</td>
<td>RoHS and Lead-free capabilities</td>
<td>100% AOI Inspection</td>
</tr>
<tr>
<td>Fast-track through receiving process</td>
<td>BOM scrubbing and redline tools for any mid-stream changes</td>
<td>DFM Analysis and Report</td>
<td>Flying Probe, ICT, Functional Test in-house development capabilities</td>
</tr>
<tr>
<td>In-house suppliers to start sourcing against AML information.</td>
<td>5 day turn-around* (1 and 3 day available)</td>
<td>Conformal Coating – acrylic and silicone in-house</td>
<td>All inspection and test data captured in MES</td>
</tr>
<tr>
<td>Ability to work with customer supplied kits</td>
<td></td>
<td>Work instructions generated for each assembly</td>
<td>Design for Testability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>First-article reports and post-build analysis</td>
<td></td>
</tr>
</tbody>
</table>

*From receipt of all materials

**DFM, DFT, AXI and Test Development to be quoted separately**
Jabil Design Services

- **System Architecture**
- **Electrical Engineering**
  - Full Turnkey Product Design
  - Digital, Analog, RF, FPGA, Software / Firmware
- **Mechanical Engineering**
  - Mechanical Design Plastics & Metals, Thermal, ID
  - Quick prototyping in house
- **ECAD PCB Layout**
  - High layer count, controlled Impedances, high density
  - Multiple shifts for shorter cycles
- **Value Engineering Services**
  - Component Engineering, DFx, Cost reductions
  - Product & Manufacturing optimizations
- **Quality Assurance**
  - Product Validation, Safety & Regulatory Compliance
  - Quality Focus throughout the Entire Product Lifecycle
- **NPI Support**
Thank You!