ALTIUMLIVE 2018:
THE SECRETS OF A SUCCESSFUL BOARD BUILD
4 BEST PRACTICES FOR DESIGNER/MANUFACTURER COLLABORATION

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Tempo Automation, VP of Product, Cofounder
San Diego
Oct 4-5 2018
Agenda

1. Waterfall Manufacturing
2. Agile Manufacturing
3. Best Practice 1: Design Intent Synchronization
4. Best Practice 2: Quote Optimization
5. Best Practice 3: Manufacturing Synchronization
6. Best Practice 4: Transfer Manufacturing Knowledge
PCB Designer → Gerbers → PCB Manufacturer

Waterfall Manufacturing
Waterfall Manufacturing

PCB Designer -> PCB Manufacturer

Altium
From Waterfall Manufacturing...
...to Agile Manufacturing
How do you achieve Agile Manufacturing?
Radical Transparency!
Transparency during PCB Design
Best Practice 1: Manufacturing Synchronization
# Manufacturing Synchronization Best Practices

<table>
<thead>
<tr>
<th>Planning</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Engage with CM</td>
<td>• Confirm CM supports QC requirements</td>
</tr>
<tr>
<td>• Determine special processes required</td>
<td>• Generate target stackup</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Sourcing</td>
<td></td>
</tr>
<tr>
<td>• Compile for component sensitives</td>
<td>• Check for stock availabilities</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Schematic</td>
<td></td>
</tr>
<tr>
<td>• Include features for testing at CM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Layout</td>
<td></td>
</tr>
<tr>
<td>• Use DRC rules specific to the CM</td>
<td>• Check thermal impacts of manufacturing</td>
</tr>
</tbody>
</table>
Manufacturing Synchronization with Tempo

Capabilities with Cost and Lead Time

**Impedance**
- Uncontrolled, Controlled Dielectric, Controlled Impedance ±10%, Controlled Impedance ±10%

**Traces**

<table>
<thead>
<tr>
<th>Width and Spacing</th>
<th>COST</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; .003&quot;</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>.003&quot;</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>.0025&quot;</td>
<td>$</td>
<td>$</td>
</tr>
</tbody>
</table>

Clearance to board edge (minimum): 0.010"
Transparency during transfer to PCB Build
Best Practice 2: Design Intent Synchronization
### Design Intent Synchronization Best Practices

<table>
<thead>
<tr>
<th>CAD</th>
<th>Gerbers are incomplete, use native CAD or IPC-2581</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOM</td>
<td>Use CM supplied template</td>
</tr>
<tr>
<td></td>
<td>Simulate procurement</td>
</tr>
<tr>
<td></td>
<td>Check for CAD – BOM mismatch</td>
</tr>
<tr>
<td>Stackup</td>
<td>Iterate implementation with manufacturer</td>
</tr>
<tr>
<td>Notes</td>
<td>Confirm receipt and understanding</td>
</tr>
</tbody>
</table>
CAD Validation with Tempo
BOM Validation with Tempo

3246 - Prototype Project 1

VERIFY YOUR BOM

We found 21 parts in your BOM. There are 9 BOM Lines that need to be corrected.

- CAD ACCEPTED
- PROJECT BASICS
- 9 BOM SOURCING ERRORS
- BOARD VISUALIZER
- BOARD PREFERENCES
- GET A QUOTE

<table>
<thead>
<tr>
<th>#</th>
<th>DESIGNATOR</th>
<th>DESCRIPTION</th>
<th>MANUF.</th>
<th>MPN</th>
<th>QTY</th>
<th>SOURCING</th>
<th>EDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>C1</td>
<td>1µ</td>
<td>TDK</td>
<td>CGA3E5K7R105X100AC</td>
<td>1</td>
<td>Sourced by Tempo</td>
<td>UPDATE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I will provide</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Do not assemble</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Use other distributors</td>
<td></td>
</tr>
</tbody>
</table>

ERROR: MPN is out of stock at Digkey and Mouser. Edit the MPN above, replace it with another MPN, or use the Sourcing dropdown menu above to fix.

| 6 | D1, D3     |             |        | ES20 | 2   | Sourced by Tempo | UPDATE |
|   |            |            |        |     |     | Select to consign this part. |     |

ERROR: Could not find this exact MPN at Digkey or Mouser. Edit the MPN above, replace it with another MPN, or use the Sourcing dropdown menu above to fix.

| 7 | D2, D4     |             |        | P63MBH0AT3G | 2   | Sourced by Tempo | UPDATE |
|   |            |            |        |     |     | Select to consign this part. |     |

ERROR: Could not find this exact MPN at Digkey or Mouser. Edit the MPN above, replace it with another MPN, or use the Sourcing dropdown menu above to fix.
Best Practice 3: Quote Optimization
## Price Optimization Best Practices

### Components
- Use Approved Parts List (AVL) to allow crosses
- Request component level price breakdown

### Fab
- Ask pricing implications for board parameters
- Maximize boards per panel

### Assembly
- TH placements 5x > SMT
- Leadless 8x > SMT
## Lead Time Optimization Best Practices

| Components | • Use Approved Parts List (AVL)  
            | • Secure low stock component early |
|------------|---------------------------------|
| Fab        | • Minimize materials that not stocked  
            | • Choose via type to minimize lamination cycles |
| Assembly   | • Minimize number of through hole parts  
            | • Minimize special operations (press fit etc.) |
### Quote Optimization with Tempo

#### Fabrication
- Fabrication Base Cost: 1 day  $863.46
  - 3.94in x 2.36in
  - 2 Layers
  - Quantity: 20
- Surface Finish: HASL Lead-free: 1 day  $737.46
- Solder Mask Color: Red: 1 day  $2700

#### Assembly
- Assembly Base Cost: 1 day  $1923.67
  - Placement Count: 32
  - Through Hole Placement Count: 2
- Components: 21 BOM Lines:
  - Tempo Sourced Parts: 19
  - Third Party Sourced Parts: 0
  - Consigned Parts: 2
  - Do Not Assemble Parts: 0 (no charge)
- Components Cost: 21 BOM Lines:  $814.84

#### Shipping & Packaging
- Shipping & Packaging: same day  $99.70

#### Buffer
- Buffer: 1 day  --

#### Total
- Total: 3 days  $3701.67

#### Price / unit
- Price / unit: 20 x $185.08

#### Sales Tax
- Sales Tax: $333.15

#### Total (incl. tax)
- Total (incl. tax): $4034.82

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Estimated delivery:
- Tuesday, Mar. 13 2018

Order 20 boards now

View DFM feedback

hide details
Transparency during transfer from PCB Build
Best Practice 4: Learn from each Build
## Knowledge Transfer Best Practices

| Files          | • As built production files  
                  | • Design recommendations     |
|----------------|-------------------------------|
| Programs       | • Reflow profile              
                  | • Machine programs           |
| Diagnostics    | • Production log              
                  | • QA records                 |
Knowledge Transfer with Tempo

**Traveler Traceability**

- Paste first article (side 1, top)
  - bianca completed Mon 3:15 pm, 01/08/18
- QA - Paste first article (side 1, top)
  - somalen completed Mon 4:33 pm, 01/08/18
- PnP first article (side 1, top)
  - peter completed Mon 9:09 pm, 01/08/18
- QA - PnP first article (side 1, top)
  - garvin62
- Reflow first article (side 1, top)
- QA - Reflow first article (side 1, top)
- Paste and inspect all boards (side 1, top)
- PnP all boards (side 1, top)
  - jessica
- Inspection of all boards pre-reflow (side 1, top)

**Production Log**

<table>
<thead>
<tr>
<th>Component - Orientation/polarity</th>
<th>QA defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>QA - PnP first article (side 1)</td>
<td>3602-001</td>
</tr>
<tr>
<td>3602-001</td>
<td>J302</td>
</tr>
</tbody>
</table>

**AOI and X-Ray Image**
Agile PCBA Manufacturing

PCB Designer

PCB Design

PCB Build

PCB Testing

PCB Manufacturer
THANK YOU!

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