ENGINEERING CHANGE NOTICE
COST IMPROVEMENTS

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PRESENTATION
AGENDA

- Engineering Change Overview
- Change Process
- Automating Change Detection
- Intuitive Reporting
- Cost of Changes
- Summary
ENGINEERING CHANGE LEXICON

**Engineering Change**
(synonymous)

- (EC) Engineering Change
- (ECN) Engineering Change Notice
- (ECO) Engineering Change Order
- (CO) Change Order

**Change Request**
(synonymous)

- Engineering Change Request
- Change Request

- (ECP) Engineering Change Proposal
- (ECB) Engineering Change Board¹
- (TTP) Transition to Production²

¹ Approval authority for issuing ECN
² The process that brings a change or new product into production on the shop floor
## Engineering Change Terms

<table>
<thead>
<tr>
<th>Engineering Change Process</th>
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</thead>
<tbody>
<tr>
<td>Starts when ECR is created</td>
<td></td>
</tr>
<tr>
<td>“Scoper” is assigned to determine justification and the scope of the request</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>ECN “Scoper” (title may vary)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A person who identifies all things affected by an ECR</td>
<td></td>
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<tr>
<td>Plans all aspects of the request change and presents to ECB</td>
<td></td>
</tr>
<tr>
<td>After approval, initiates and supports TTP to incorporate the ECN</td>
<td></td>
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</tbody>
</table>
## Engineering Change Terms

<table>
<thead>
<tr>
<th>Change Incorporation</th>
<th>The process of scoping and planning and executing an ECN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change Review Board</td>
<td>Management positions that authorize a change to be incorporated</td>
</tr>
<tr>
<td></td>
<td>May include Logistics, Tech data, others as required and determined by the ECN “Scoper”</td>
</tr>
</tbody>
</table>
REASONS FOR CHANGE
Including, but not limited to

Design Mistake (Form, Fit, Function)
- Requirements incorrect or changed
- Material Specification incorrect or unavailable
- Design error not caught until testing

TTP Mistake
- MBOM Definition
- Material not available
- Work Instruction error
- Tool design error

Safety
- End user safety issue
- Manufacturing production process issue
TYPES OF CHANGES
How will the change effect the product

Add
Delete
Modify
Hanging Paper is the process of defining and approving a change, but not incorporating it into the documentation. Instead, defining the product definition as “This Drawing/Model plus this unincorporated but approved change”.

CHANGE SCOPING PROCESS

Scoper determines:

Change justified?

Scope of Change

Where is changed item?
- Where is it used
- Assembly association

Affect on materials
- Disposition of Materials
  - Use as is
    - Determine cut in date/line number of change
  - Modify
    - Plan for modifications
    - Cut in date/line number of change
  - Scrap
    - Plan for new material
    - Cut in date/line number of change

Manufacturing process change
- Change due to end user safety
  - Changes to process ASAP
  - Changes implemented ASAP
  - Field replacement/update need to be defined & incorporated ASAP

Continued…
**CHANGE SCOPING PROCESS**

Engineer determines:

- Leads the TDP through normal production
- Modifies MBOM, Request MRP for change
- Work with Configuration Management to update TDP
- Develops approved ECN
- Send work orders to Tool Design & CNC programming
- Work with:
  - Quality Control
  - Procurement/Buyers
  - Suppliers
  - Other departments

If approved:

- Plans all actions required to TTP
- Prepares ECP for ECB Review
- Submits the ECP and TTP plan to the ECB

**ENGINEERING CHANGE NOTICE – COST IMPROVEMENTS**
**CHANGE PROCESS**

Anyone can initiate a change request:

- CR is logged into system
- Scoper determines initial justification
- If good, completes scope analysis.
- All changes are compiled into ECP for ECB review

**ECN Scope Analysis**

**Change Proposal**

**ECB**

- Rejected
- Approved

**ECN Created**

**TTP** All Changes
TYPICAL CHANGE PROCESS

How will the change effect the product

• Anyone can start the change process
ENGINEERING CHANGE PROPOSAL

Move lug from outside body to inside body
ENGINEERING CHANGE ORDER / NOTICE
DIFFERENCES REPORTING
Including Attributes & Metadata

<table>
<thead>
<tr>
<th>Name</th>
<th>V5R26-TBM-MBD-R00</th>
<th>V5R26-TBM-MBD-R01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part number</td>
<td>V5R26-TBM-MBD-R00</td>
<td>V5R26-TBM-MBD-R01</td>
</tr>
<tr>
<td>Revision</td>
<td>00</td>
<td>01</td>
</tr>
</tbody>
</table>
Unintended changes will also be discovered while using V&V routines to check that the change was completed as defined. Strict modeling practices need to be followed in order to achieve a change report that only includes the changes that were defined as needed.

Sloppy design work caused the 3D annotations to move.
COST OF CHANGE

The cost of change is less expensive within the early Product Lifecycle, prior to Initial Release and Production Start.

After Production Start, incorporating changes can be extremely costly.

Goal: *Improve cost and process control to prevent disaster.*
COST IMPACTORS (CONT’D)

- People
  - Scoper
  - Designer
  - Manufacturing Planner
  - CNC Programmer
  - Machinist
  - Weld/Fabricators
  - Quality
  - Purchasing
  - Packaging
  - Safety
  - Etc.

- Time
- Hardware/Software
  - Tools
  - Materials
- Schedules

Customers have shared that engineering changes can cost $xx,xxx ~ $x,xxx,xxx from scrap/re-work from poorly documented changes.
Cost Impactors

Manual vs. Automated

- **Time & accuracy** to *record* changes
  - Disconnect between drawings and models
  - Limited spacing for documentation
  - Ambiguous markings
  - Completion of recording

- **Time & accuracy** to *interpret* changes
  - Ambiguous markings
  - Incomplete detail
  - Unintended omissions of changes
  - Unintended additional impacted changes
BENEFITS TO AUTOMATED DETECTION & REPORTING

- Detections are automated
  - No omissions
- Unintended changes captured
- Interpretation is intuitive
  - 3D & math is Multi-cultural/lingual
- Quality of communication
  - Improved relationships:
    - Design-Manufacturing
    - OEM-Supplier
- Time-to-market improves
- Cost improves

Business Value

- Quality
- Cost
- Reliability
- Time
QUESTIONS?

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