Boeing Tool Condition

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Background

Boeing performs approximately 45,000 pullout procedures each year. On average, each pullout goes through 45 minutes of rework. Each year, Boeing will spend up to 30,000 hours on rework alone for the worst case. This rework consists of strenuous hammer strikes to adjust the pullout size and shape so that the duct can be welded flush with its mating counterpart. Rework is not only time demanding but is also physically demanding for mechanics.

Problem

- Pullout punches wear out over time
- No system to track the usage of each tool
- No system to verify the dimensions of each tool
- Pullouts created are often out of tolerance
- Additional rework is required

Goal

The goal of this project is to develop a system to verify if pullout punches are within tolerance, and to determine when to replace the pullout punches.

Ranking Alternatives

(A) How accurate the alternative is?
(B) How soon the alternative can be put to place?
(C) How quick the alternative is to use?
(D) How user-friendly the alternative is?

Tool Database Work Order Form

- Tool ID
- Work Order Number
- # Cycles for Work Order

Andon Signals

Andon signals appear after Tool ID has been entered. Allows mechanics to quickly identify status of a tool.

- Green: Tool is in good condition
- Yellow: Scan is rejected before use
- Red: Tool is out of tolerance

Check Tool Info

Runs a query to check additional info of requested tool. Shows:

- Description
- Tool Status
- Total Usage (# Cycles)
- Upper Limit
- % Life Util
- % Life Scan
- Date Issued
- Date Last Used

Save Record

Saves data inputted into the Work Order Entry Form. Error messages pop up if the tool's status is either "Scan Required" or "Do Not Use".

Previous Records

Shows a summary of all the previous work orders.

Solution

Tool Utilization System

The Tool Utilization System is a predictive solution to the pullout punches' tolerance problems. It includes a Microsoft Access database where work orders, scan orders, tool information, and operation information are stored. The purpose of the database is to track the utilization of each tool as they are used to create parts and provide feedback signifying a tool's current status. This database will be available locally on the computers at the work stations, and will require the use of a barcode scanner for easier inputs.

3D Scanning System

Once the Tool Utilization System requests a Scan, the following steps must be taken to check the dimensions of the pullout punch:

1. Take the punch to ATOS scanner and scan the top portion of the punch and export a STL file.
2. Import the STL file into Ansys Spaceclaim or other scan to CAD program and project the object onto a plane perpendicular to the hole in the punch.
3. Use the built in measuring tool to measure every arc along the projected outline. Calculate the diameter from the circumference.
4. Once the diameter is calculated it will be compared with the tolerances given for each punch. If the punch is within tolerance the measurements must be recorded and the punch recirculated. If it is out of tolerance, update the system and throw the punch away.

Functional Diagram

Cost-Benefit Analysis

Current Performance:

<table>
<thead>
<tr>
<th>Current</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Pullouts Performed</td>
<td>45417</td>
</tr>
<tr>
<td>All Pullout Or Pipe Defects</td>
<td>1177</td>
</tr>
<tr>
<td>Pullouts Unacceptable</td>
<td>432</td>
</tr>
<tr>
<td>Pullout Tool Connection Failures</td>
<td>20</td>
</tr>
</tbody>
</table>

Potential: Achieve a “good” level of rework of 3,784 hours. Cost of rework now greatly outweighs the cost of buying new tools. System can be leveraged to track pullout tool connection failures.

Implementation and Future Work

The next phase of this project is for Boeing to begin the project plan we developed. The phases of that are below:

- Full mockup and demonstration
- Handover all related documents and project plan for future implementation

Handoff Period

- Begin Project
  - Boeing will design project using their data and personnel
  - Follow recommended project development plan

- Beta Testing
  - Walk through processes and trial runs on production floor
  - Training will be necessary
  - Some tools might need to be immediately replaced

- Transition to 3D scanning at scheduled rate
  - Important to know how much wear occurs per use

Acknowledgements

This project could not have been completed without the support and guidance from James, Tim, Bryan, Angela, Patty and Boeing.