Cost-Effective Product Development: Boothroyd Dewhurst DFA Approach to Tractor Cooling Design

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Breaking New Ground
Innovation Sustainability Productivity

Preliminary Draft

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INTRODUCTION

- Design for Assembly (DFA) is a methodology aimed at simplifying the product structure to facilitate easier and faster assembly processes.

- Application of Boothroyd Dewhurst Design for Assembly (DFA) software in the early stages of a cooling package design project for tractors.

When to implement?

At initial stage of design.

What is DFA?

Products designed with ease of assembly in mind.

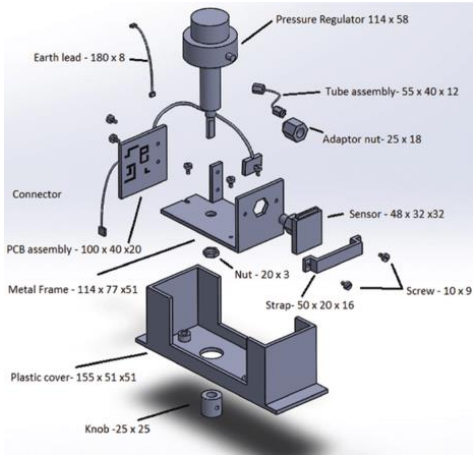
How to do?

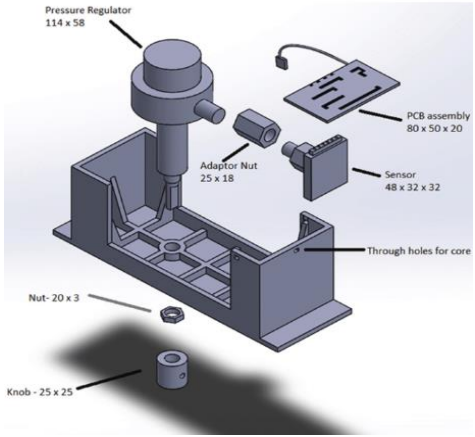
- Simplify the assembly process
- Reduce part count
- Eliminate unnecessary hardware
- Enhance overall manufacturability
- Optimizing design efficiency and cost-effectiveness.

Methodology

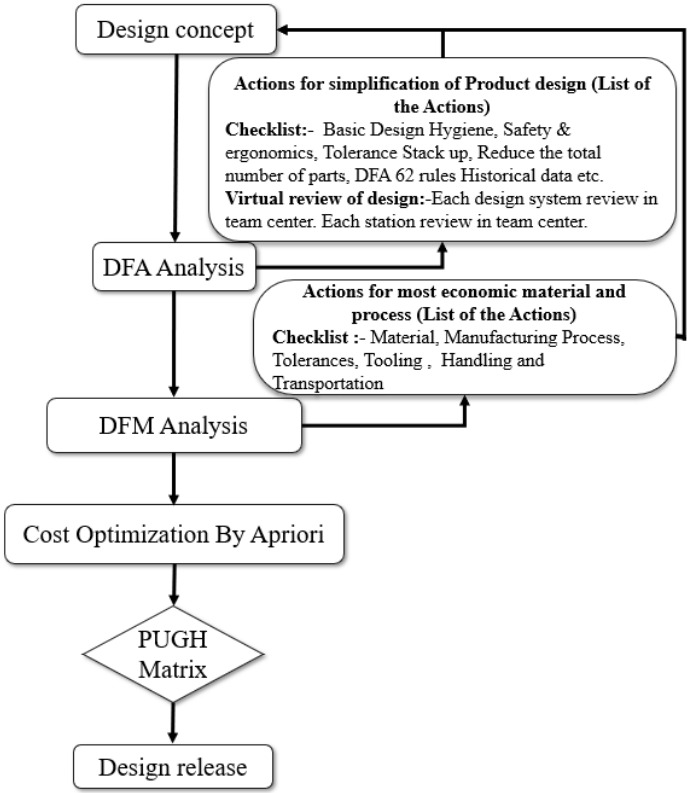
- Challenges facing during initial design phase of cooling package assembly
  - Complex design.
  - High assembly complexity with 352 parts.

- Used DFA Boothroyd integrating with following
  - DFA flowchart
  - DFA levers.





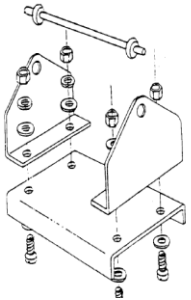
DFAM Flow chart



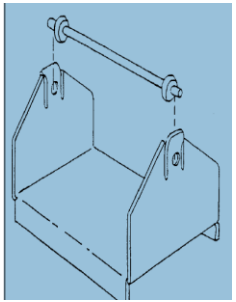
Examples

Assembly Hygiene

Ergonomics



Part count



Risk to damage

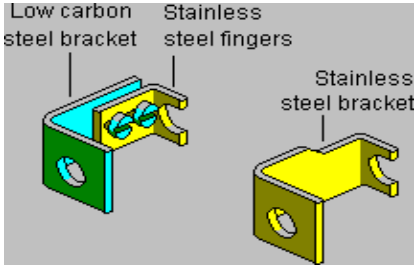
DFA Levers

DFA check levers for the designer to make the design as cost effective and robust design.

- Less the Number of Parts
- Standardization- Carryover Parts, Standard Parts
- Modular Design
- Multifunctionality- Combining Function
- Poka-Yoke-Error Proofing
- Self-Guiding/Adjusting- minimize Assy instructions.
- Minimize Handlings
- Avoid Fasteners
- Use Affordable and Standard Material
- Use Available Process Capabilities
- Limit Tolerance – avoid overspecification.
- Design For Ease for Fabrication
- Complete Compliance – in Drawings and ASSY sheet.

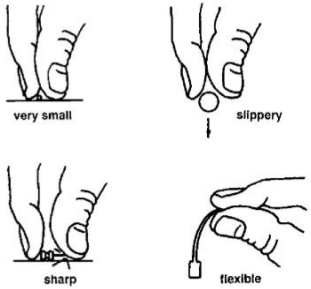
Examples

Standard parts and process



Part commonization

Use standard tooling and tools

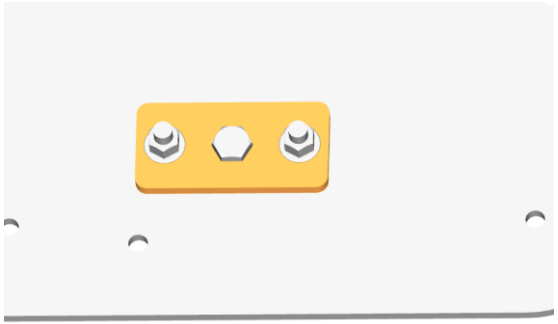


Handling difficulties

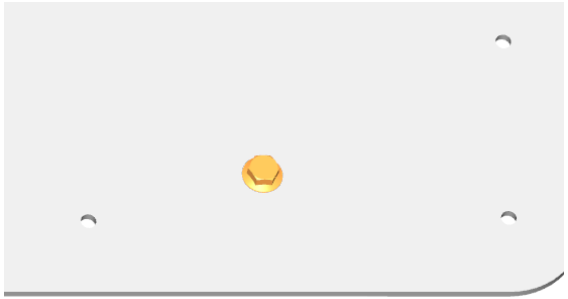
Examples of strategic modifications:

Case 1:

Before

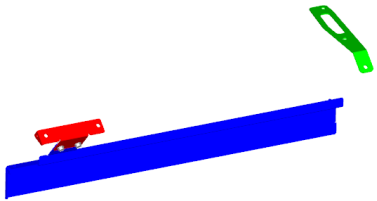


After



- Removed the bracket by modifying the design to get better tool access bolt (2 parts and 8 hardware removed).

Case 2:

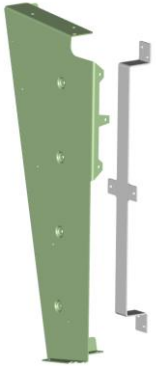


- 3 parts communized into 1 part, which providing the same function (2 parts and 4 hardware removed).

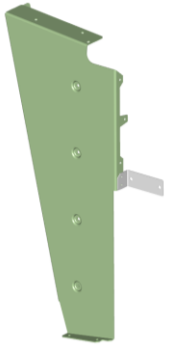
Examples of strategic modifications:

Case 3:

Before

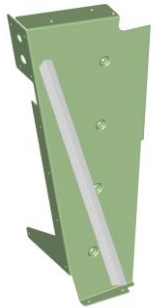


After



- A large bracket, which is used to hold tubes is removed with simple small bracket.

Case 4:



- Hardware reduction using welding (16 hardware removed).

Results

Part Count Reduction

- Total 58 parts got reduced.
- 30 fasteners were removed

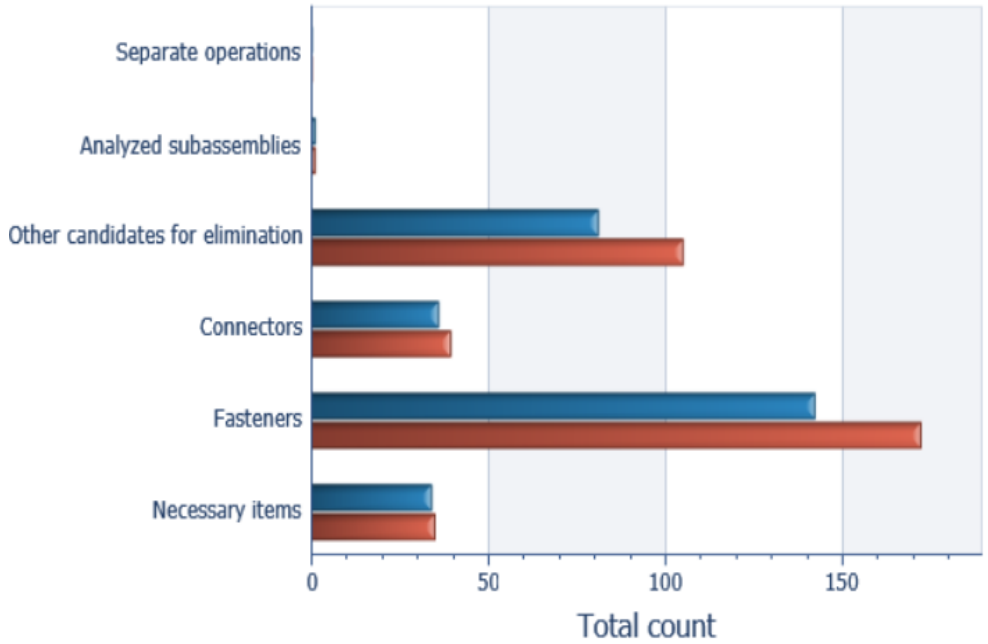


Fig. Difference of total count between Baseline and Modified designs

Process time reduction

- 824.55 s assembly process time saved.
- Maximum time saved by removing the fasteners

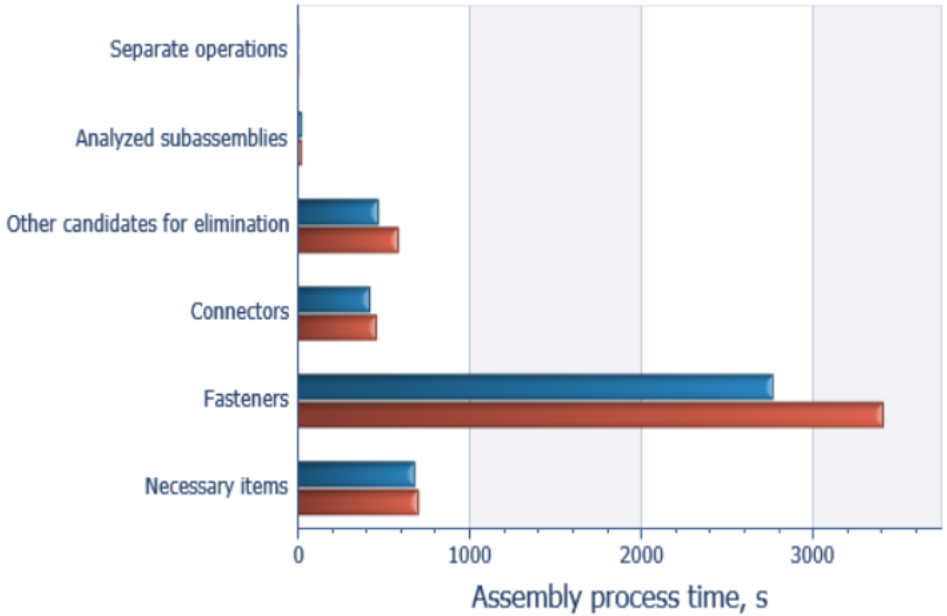


Fig. Difference of Assembly process time between Baseline and Modified designs

Overall cost reduction

- Overall 1.2 % cost reduced as compared baseline design
- Material and process cost reduction made a significant impact on annual cooling package cost

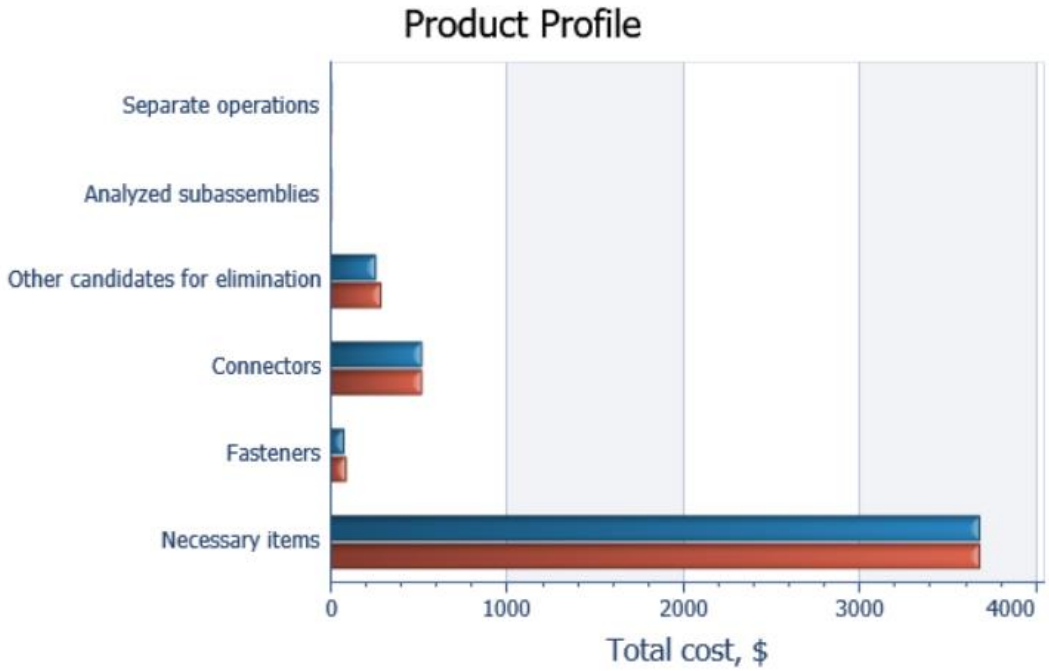


Fig. Difference of Total cost between Baseline and Modified designs

Conclusions

Utilizing the Boothroyd Dewhurst software, the design team was able to make a significant impact on the manufacturability, cost and complexity of cooling package design.

- Parts reduced from 352 to 294
- 824.55 s of assembly process time saved
- DFA index increased from 9.93 to 11.48
- 1.2% cost saved

Backup