

Collaborative Engineering

Maintainability (Design for Service)



- Product Service – Need
- Design for Maintainability
- Instruments for Service
- Service Ergonomics

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Product Maintenance or Service

Maintenance / Service needed for:

- ✓ Regular preventive maintenance
- ✓ Malfunction diagnosis
- ✓ Part repair or replacement



STEPS

Fault Diagnosis

Product
Dis-assembly

Repair or
Replacement

Parts requiring service:

- ✓ Parts with long life
- ✓ Parts subject to wear

Poor service leads to:

- Non-availability of product
- Higher costs of use / warranty
- Unhappy customers

Product Design for Maintainability

Goal: Design a product to reduce the **need** for service, and the **time** for service when required.

Design guidelines:

1. Provide quick and easy access to parts needing service
2. Design for ease of removal and replacement of a part



Product Design for Maintainability

Goal: Design a product to reduce the **need** for service, and the **time** for service when required.

Design guidelines:

3. Combine parts requiring frequent service into a module
4. Use standard or common replacement parts



Product Design for Maintainability

Goal: Design a product to reduce the **need** for service, and the **time** for service when required.

Design guidelines:

5. Provide self-test indicators for isolating faults
6. Eliminate or reduce the need for adjustments
7. Mistake-proof fasteners, electrical connectors



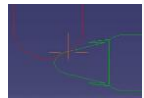
"Nah, it can't just be that the plug's out. That would be too simple and inexpensive."

Tooling for Product Service

Goal: Design the tooling and plan for easy maintenance along with product design.

Guidelines:

- Can the tools reach the location?
- Ensure tools do not collide or damage the product
- Plan for correct procedure and sequence of steps



Service Ergonomics

Goal: Design the product and service instruments to ensure safe and comfortable maintenance procedures.

Guidelines:

- Ensure reachability : RULA
- Check space constraints
- Forces within ergonomic limits
- Time for dis-assembly, overhauling
- Prevent unsafe / hazardous conditions
- Time for arming / disarming



Service Documentation

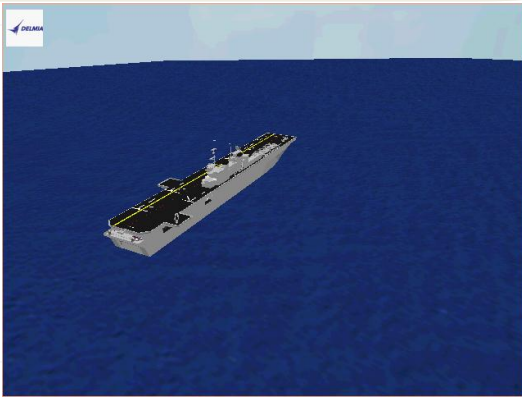
Goal: Ensure documentation facilitates training and on-the-job referencing.

Guidelines:

- Should be self-explanatory
- Quick and easy reference
- Enable e-service
- Video animations best



DFS – Example – Jet Engine Change



SUMMARY

- Design the product for ease of maintenance along with necessary tools and documentation
- Minimize the need for maintenance
- Ensure ergonomic & safe maintenance
- Validate by 3D simulation

