DRM ASSOCIATES CAPABILITIES: DESIGN FOR SERVICEABILITY

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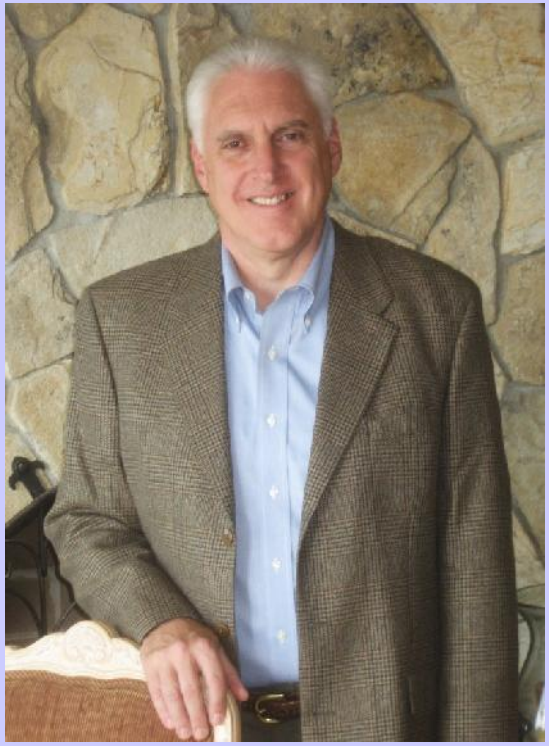
DRM ASSOCIATES

- Firm with recognized expertise in new product development & core focus on value
- Kenneth Crow is the firm's principal consultant
- Ten highly-experienced consultants
- Extensive client list - Fortune 500 and international
- Led consortium to identify 270 best practices
- Extensive training experience and materials - conducted over 200 workshops

For further information on DRM Associates, see www.npd-solutions.com

KENNETH CROW



- 35+ years consulting in product development & manufacturing
  - Former Director, Manufacturing Consulting, Ernst & Young
  - President, DRM Associates
- Recognized expert in product development, design to cost, design for manufacturability and design for serviceability
- Certified New Product Development Professional
- Frequent international speaker and author
- Former President & Director of the Society of Concurrent Product Development

DFS PAPERS & RESOURCES

Expertise demonstrated by papers & resources we have produced:

- Design for Serviceability
- Design for Serviceability/Maintainability Evaluation
- Design for Manufacturability White Paper
- Design to Cost White Paper
- Design for the Product Lifecycle White Paper
- Design for the Environment White Paper
- Mistake-Proofing By Design White Paper

PARTIAL CLIENT LIST

The following is a list of our Design for Serviceability (DFS) clients

- Acushnet
- ASM
- B. Braun Medical
- Carestream
- General Dynamics
- Hewlett Packard Scitex
- Hewlett Packard Specialty Printing Systems
- Medrad
- MKS Instruments

REPRESENTATIVE EXPERIENCE

General Dynamics Land Systems We reviewed the products, customer maintenance environment, and development process of this heavy equipment manufacturer. We developed and conducted customized workshops on Design for Serviceability/Maintainability. We facilitated analysis of some of their maintenance procedures to identify opportunities for improving maintainability. We recommended process steps and practices to better address maintainability and serviceability in their development process.

B. Braun and Acushnet These companies designed specialized equipment for the manufacture of their products. We reviewed this equipment and the maintenance requirements and developed customized design for serviceability/maintainability training for the equipment designers and maintainers. We also recommended process steps to improve their equipment design and development process.

REPRESENTATIVE EXPERIENCE

ASM This European semiconductor equipment wanted to increase their focus on design for serviceability. We reviewed their equipment products, their customer's serviceability requirements, their development process, and their organization. We developed two customized DFS programs and have conducted multiple DFS workshops for their personnel world-wide. We recommended process steps and practices to better address serviceability in their development process.

Hewlett Packard We provided consulting and training to six HP business units. This included Design for Serviceability training for at their Scitex and Specialty Printing Systems business units in Europe and the US. We reviewed their industrial printing products, service environment and development process and developed customized workshops. We also recommended DFS process steps and practices to improve their development process.

REPRESENTATIVE EXPERIENCE

Carestream, Medrad and Illumina We reviewed the products, maintenance requirements, operating environment, and development process of these three diagnostic and medical equipment manufacturers. We developed and conducted customized workshops on Design for Serviceability/Maintainability. We facilitated analysis of some of their maintenance procedures to identify opportunities for improving maintainability. We also recommended process steps and practices to better address maintainability and serviceability in their development process.

DESIGN FOR SERVICEABILITY SERVICES

Design for Serviceability Process Assessment

- Assess the current development process

Training

- Conduct Design for Serviceability/Maintainability Workshop

Design for Serviceability Implementation

- Assist defining the Design for Serviceability/Maintainability process, establishing tools and data, creating metrics, and deploying initiative to the enterprise or business unit

Design for Serviceability Project Facilitation

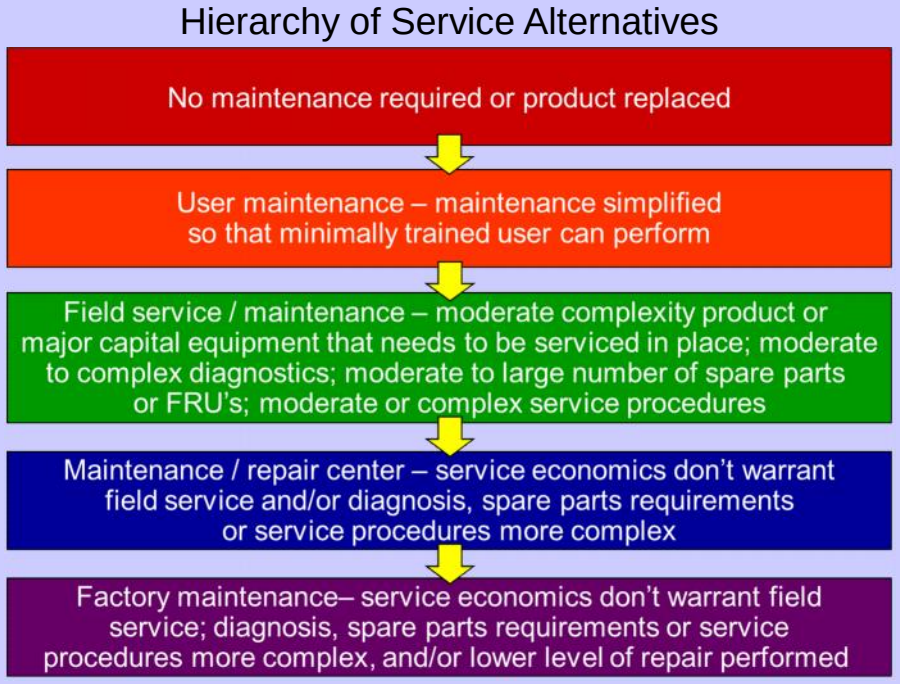
- Facilitate project teams establish a serviceability / maintainability strategy and project plan, facilitate DFS reviews, & measure DFS results

DFS WORKSHOP AGENDA

- Introduction
- Design for Serviceability Strategy and Planning
- Enhancing Reliability & Durability
- Diagnosibility
- Design for Serviceability Principles
  - Preparation
  - Disassembly
  - Clean, Repair, Adjust or Replace
  - Re-assembly
  - Test and Verification
- Addressing DFS in the Development Process
- Workshop Exercise

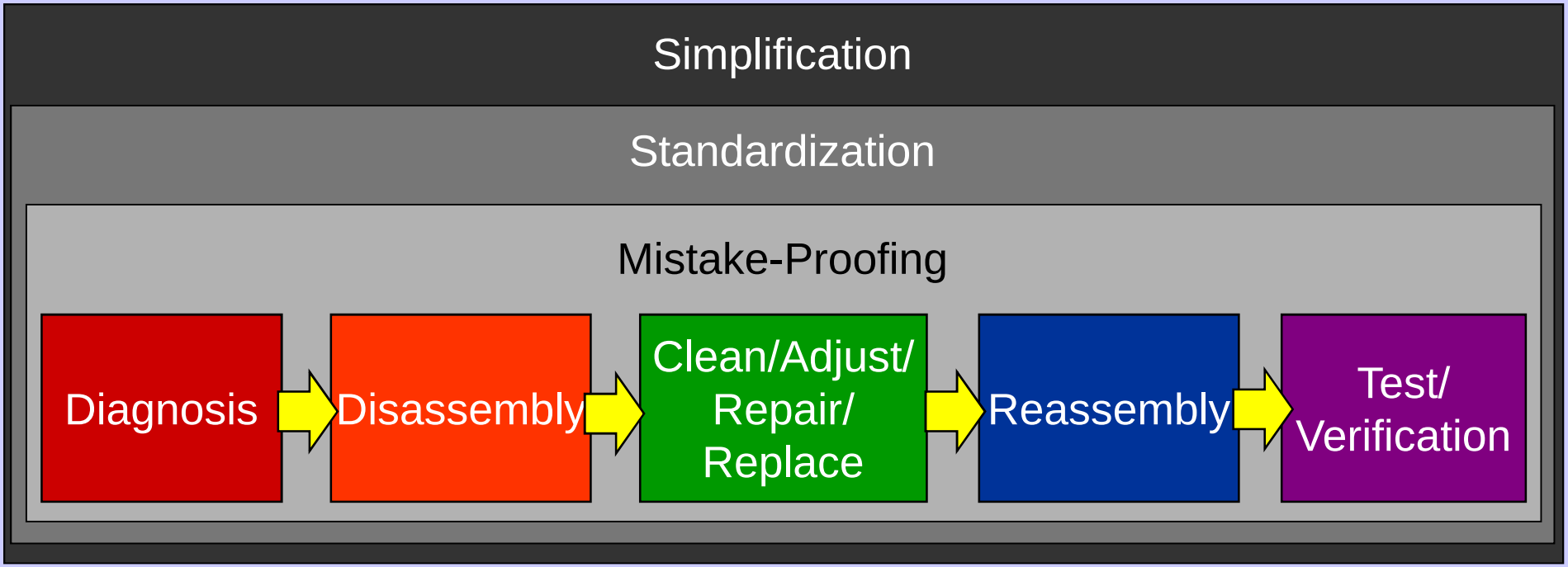
DEVELOP SERVICEABILITY STRATEGY

- Reliability (MTBF) and Maintainability (MTTR) Goals
- Service Provider – Customer, Manufacturer, 3rd Party
- Level of Repair
- Logistics / Spares Inventory
- Warranty
- Response Time

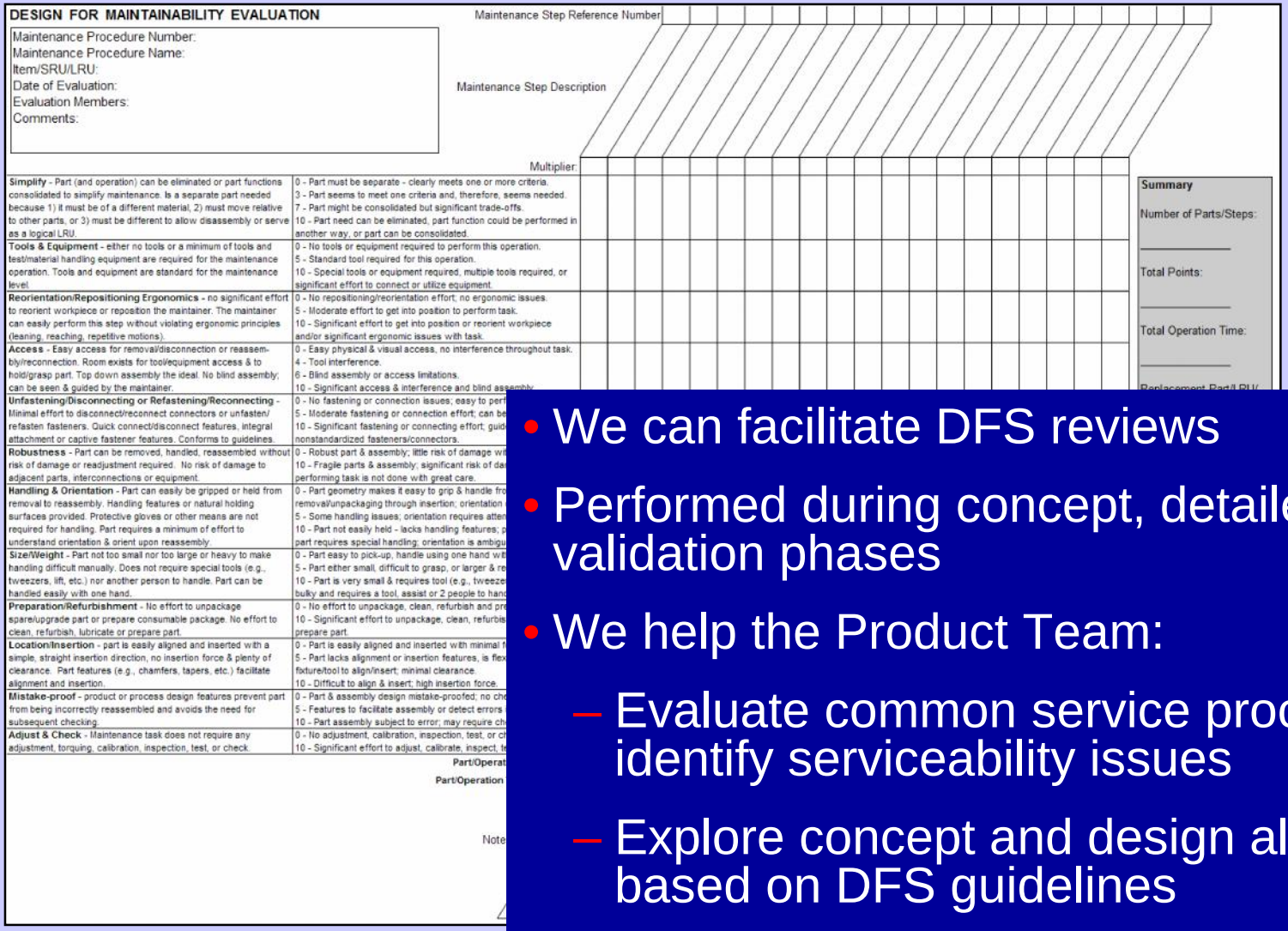


SERVICE PROCESS

Design for Serviceability / Maintainability training, guidelines, and evaluation organized by general service process step



ASSESS SERVICEABILITY



DESIGN FOR MAINTAINABILITY EVALUATION

Maintenance Procedure Number:
Maintenance Procedure Name:
Item/SRU/LRU:
Date of Evaluation:
Evaluation Members:
Comments:

Maintenance Step Reference Number

Maintenance Step Description

Multiplier:

Simplify - Part (and operation) can be eliminated or part functions consolidated to simplify maintenance. Is a separate part needed because 1) it must be of a different material; 2) must move relative to other parts, or 3) must be different to allow disassembly or serve as a logical LRU.	0 - Part must be separate - clearly meets one or more criteria. 3 - Part seems to meet one criteria and, therefore, seems needed. 7 - Part might be consolidated but significant trade-offs. 10 - Part need can be eliminated, part function could be performed in another way, or part can be consolidated.
Tools & Equipment - either no tools or a minimum of tools and test/material handling equipment are required for the maintenance operation. Tools and equipment are standard for the maintenance level.	0 - No tools or equipment required to perform this operation. 5 - Standard tool required for this operation. 10 - Special tools or equipment required, multiple tools required, or significant effort to connect or utilize equipment.
Reorientation/Repositioning Ergonomics - no significant effort to reorient workpiece or reposition the maintainer. The maintainer can easily perform this step without violating ergonomic principles (leaning, reaching, repetitive motions).	0 - No repositioning/reorientation effort; no ergonomic issues. 5 - Moderate effort to get into position to perform task. 10 - Significant effort to get into position or reorient workpiece and/or significant ergonomic issues with task.
Access - Easy access for removal/disconnection or reassembly/reconnection. Room exists for tool/equipment access & to hold/grasp part. Top down assembly the ideal. No blind assembly; can be seen & guided by the maintainer.	0 - Easy physical & visual access, no interference throughout task. 4 - Tool interference. 6 - Blind assembly or access limitations. 10 - Significant access & interference and blind assembly
Unfastening/Disconnecting or Refastening/Reconnecting - Minimal effort to disconnect/reconnect connectors or unfasten/refasten fasteners. Quick connect/disconnect features, integral attachment or captive fastener features. Conforms to guidelines.	0 - No fastening or connection issues; easy to perf 5 - Moderate fastening or connection effort; can be 10 - Significant fastening or connecting effort; guid nonstandardized fasteners/connectors.
Robustness - Part can be removed, handled, reassembled without risk of damage or readjustment required. No risk of damage to adjacent parts, interconnections or equipment.	0 - Robust part & assembly; little risk of damage wi 10 - Fragile parts & assembly; significant risk of da performing task is not done with great care.
Handling & Orientation - Part can easily be gripped or held from removal to reassembly. Handling features or natural holding surfaces provided. Protective gloves or other means are not required for handling. Part requires a minimum of effort to understand orientation & orient upon reassembly.	0 - Part geometry makes it easy to grip & handle fro removal/unpackaging through insertion; orientation 5 - Some handling issues; orientation requires atten 10 - Part not easily held - lacks handling features; p part requires special handling; orientation is ambigu
Size/Weight - Part not too small nor too large or heavy to make handling difficult manually. Does not require special tools (e.g., tweezers, lift, etc.) nor another person to handle. Part can be handled easily with one hand.	0 - Part easy to pick-up, handle using one hand wit 5 - Part either small, difficult to grasp, or larger & re 10 - Part is very small & requires tool (e.g., tweeze bulky and requires a tool, assist or 2 people to hand
Preparation/Refurbishment - No effort to unpackage spare/upgrade part or prepare consumable package. No effort to clean, refurbish, lubricate or prepare part.	0 - No effort to unpackage, clean, refurbish and pr 10 - Significant effort to unpackage, clean, refurbis prepare part.
Location/Insertion - part is easily aligned and inserted with a simple, straight insertion direction, no insertion force & plenty of clearance. Part features (e.g., chamfers, tapers, etc.) facilitate alignment and insertion.	0 - Part is easily aligned and inserted with minimal f 5 - Part lacks alignment or insertion features, is flex fixture/tool to align/insert; minimal clearance. 10 - Difficult to align & insert; high insertion force.
Mistake-proof - product or process design features prevent part from being incorrectly reassembled and avoids the need for subsequent checking.	0 - Part & assembly design mistake-proofed; no ch 5 - Features to facilitate assembly or detect errors 10 - Part assembly subject to error; may require ch
Adjust & Check - Maintenance task does not require any adjustment, torquing, calibration, inspection, test, or check.	0 - No adjustment, calibration, inspection, test, or ch 10 - Significant effort to adjust, calibrate, inspect, te

Part/Operat

Part/Operation

Note

Summary

Number of Parts/Steps:

Total Points:

Total Operation Time:

Replacement Rad/LRU

- We can facilitate DFS reviews
- Performed during concept, detailed design for validation phases
- We help the Product Team:
  - Evaluate common service procedures and identify serviceability issues
  - Explore concept and design alternatives based on DFS guidelines
  - Consider alternatives to improve serviceability / maintainability

WHAT DISTINGUISHES OUR TRAINING

- We spend time prior to the workshop to understand your products and processes and to customize the workshop which makes the workshop more relevant
- We focus on the principles of DFS as well as the development of a service strategy
- Our workshop is illustrated with hundreds of examples to illustrate the principles
- The final workshop exercise uses a manual evaluation methodology to analyze service procedures on one or more of products. This reinforces understanding of the principles and makes them more relevant to participants.
- We also cover steps to take to better address serviceability in your development process

WHY DRM ASSOCIATES

- Significant experience in applying DFS to many industries and types of products and equipment
- Solid expertise in DFS for electronics & mechanical products
- Customized training related to your products and business environment
- Extensive DFS training materials with practical examples and exercises
- Tools to kick-start the DFS process with a DFS Assessment methodology