DELL
Technologies
DFMA®
at
DELL EMC
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Agenda

- Introduction to Dell Technologies and Dell EMC
- DFX at Dell EMC
- DFMA® Deployment at Dell EMC
- DFMA® Applications at Dell EMC
- DFMA® Examples
- Summary

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Dell Technologies

- Largest private technology company
  - ~140,000 employees
  - 180+ countries globally
- Address the markets for scale-out architecture, converged infrastructure and private cloud computing
- Collective force of innovative capabilities trusted to provide technology solutions and services that accelerate digital transformation

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Dell EMC

- Dell EMC, is a member of Dell Technologies unique family of businesses
  - 70,000+ employees
  - 80+ locations globally
- Dell EMC provides solutions that help modernize, automate and transform data centers with industry-leading servers, storage, cloud computing and converged infrastructure technology

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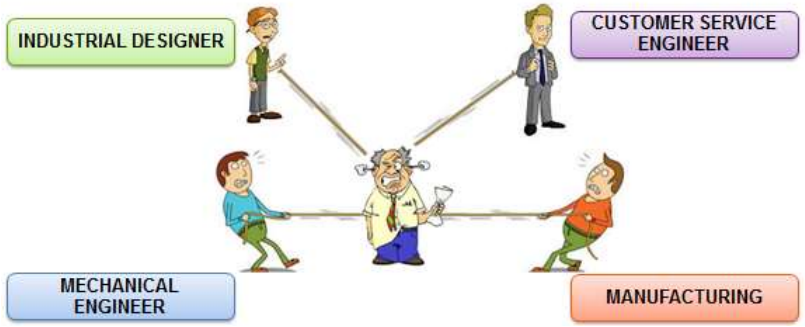
DFX at Dell EMC

The DFX Team

- Part of Dell manufacturing
- Focused on Dell EMC products
- Team of 3 Manufacturing Engineers
- Influence role working closely with Dell EMC cross-functional teams

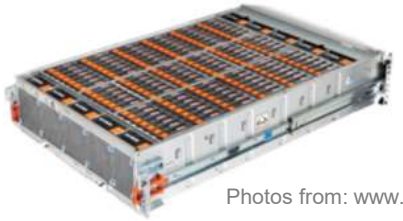


Our Mission

- Help ensure cost, quality and cycle-time targets are achieved

Our Focus

- Custom platform designs
- System integration
- Off-the-shelf platforms



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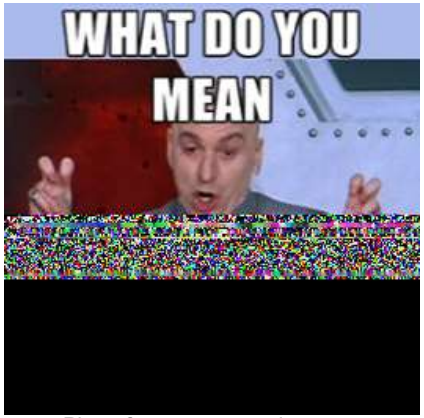
Why DFMA®?

- **More Effective Influence Model**
  - Design improvement proposals supported with accurate cost estimates
  - Quantitative, cost based, design options



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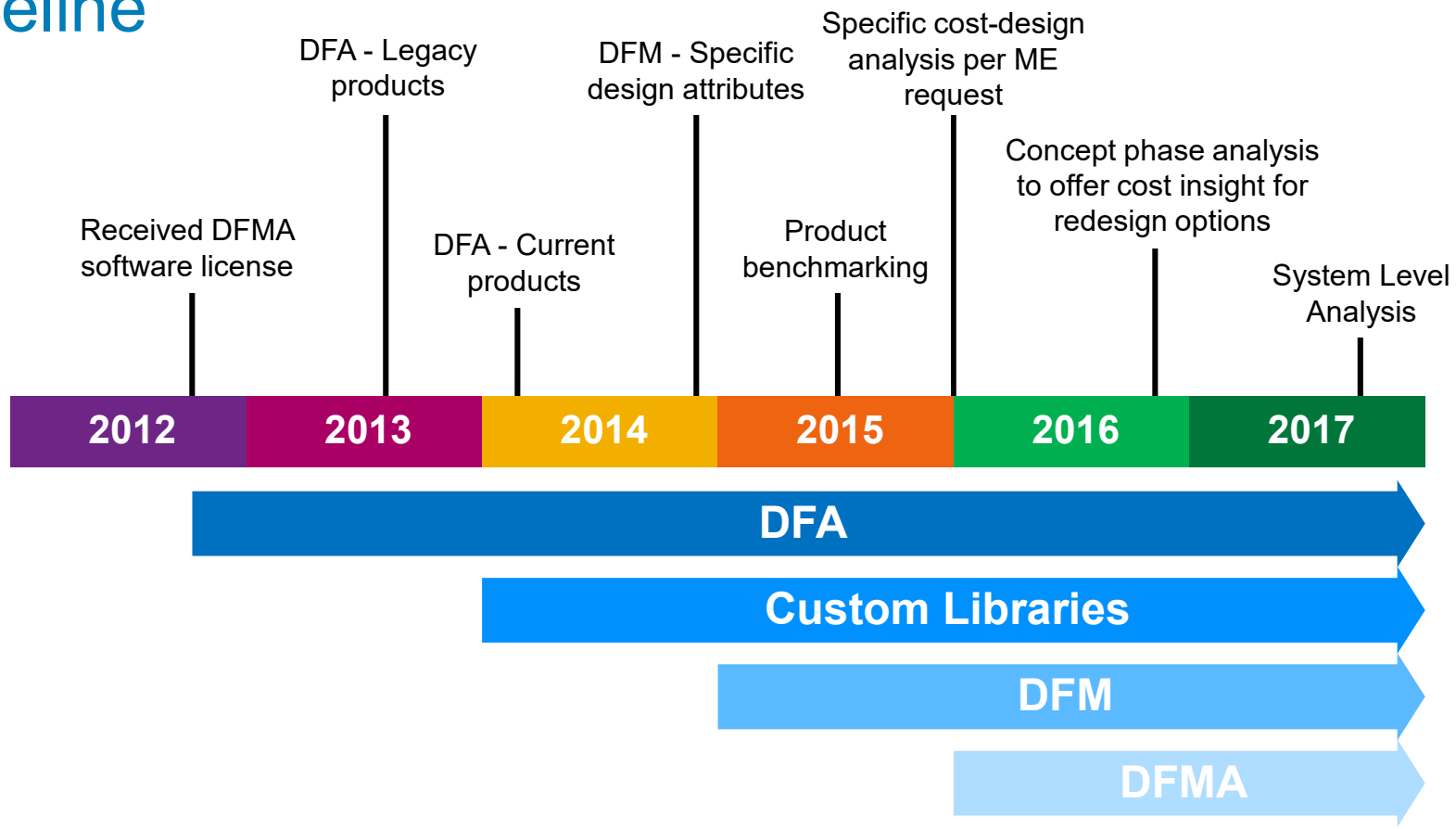
Timeline



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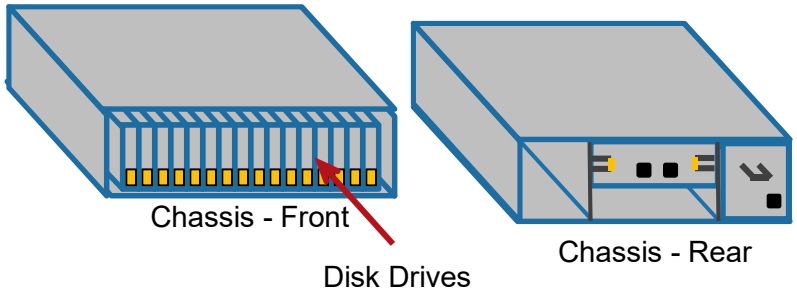
DFMA® Deployment at Dell EMC

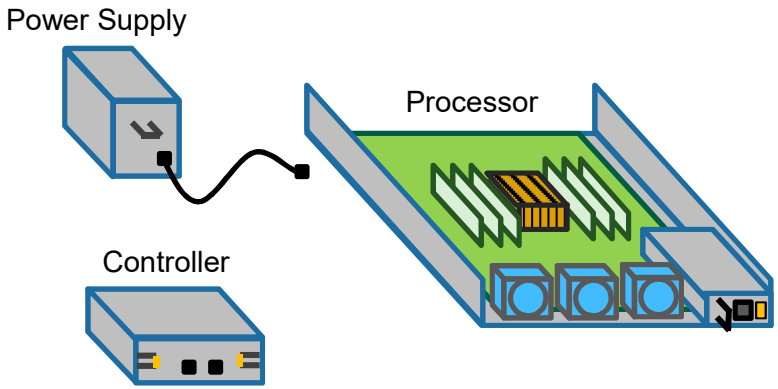
1. Detailed BOM analysis
   Time consuming

2. High level integration analysis
   Not enough detail

3. High level integration analysis
   High level functional component analysis
   Good balance

4. High level integration analysis
   High level functional component analysis
   Detailed analysis of key areas
   More effective





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DFMA® Applications at Dell EMC

- **Early Design Team Support**
  - **Design simplification and best practices**
- Benchmarking
  - Product benchmarking and trend analysis
- Design Improvement
  - Cost-optimization analysis

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Early Design Team Support

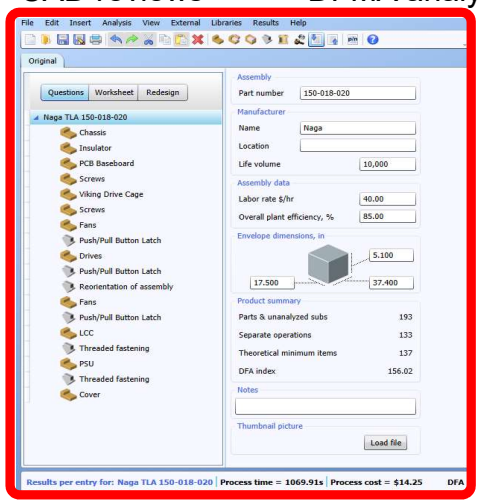
Concept & Design Phase → **Prototype phase** → **Implementation and Validation** → **Production**

DFMA Analysis
CAD reviews

Hands-on DFX review
DFMA analysis (if required)

DFX findings
Implement improvements
Validation

Feedback for future designs



Triton Proto Issue List							
Issue No.	Issue Status	Hardware Description	OPT #	Issue	Photo?	Notes	Submitter
1	Open	Chassis-Rail Mounting		Side mount to rack rails not desired. You must remove fan to mount.	Y	Issue raised at DFX Review 11/22/13. **UPDATE(12/5/13) Larry F:** NPTF status	Jim Buckley
2	Open	BBU tray		Label location for BBU tray is not defined	Y	Issue raised at DFX Review 11/22/13. **UPDATE(12/5/13) Larry F:** To extend bottom frame outward for label space. OPEN status.	Jim Buckley
3	Open	Airwave		Fan insertion not keyed. Can insert fully the wrong way	Y	Issue raised at DFX Review 11/22/13. **UPDATE(12/5/13) Larry F:** Will add feature to key. OPEN status.	Jim Buckley
4	Open	Airwave		Fan label not easy to scan; it is upside down	Y	Issue raised at DFX Review 11/22/13. **UPDATE(12/5/13) Jim B:** Will verify BOM on where/when the Airwave is scanned. OPEN status.	Jim Buckley
5	Open	Labels		Need labels on all locations (SLiCs, Fans, PSs, etc) NOT EMBOSSED (unless absolutely necessary)		Issue raised at DFX Review 11/22/13. **UPDATE(12/5/13) Larry F:** Will verify on next DFX review. OPEN status.	Dan Hewitt
6	New	BBU Tray		Need customer facing surface large enough to place FRU label (barcode SN & PN)		Issue raised at DFX Review 11/22/13. **UPDATE(12/5/13) Larry F:** Duplicate of issue # 2.	Van J.
7	New	Battery Module		Label are up-side-down in Triton	Y	Issue raised at DFX Review 11/26/13. **UPDATE(12/5/13) Larry F:** NPTF status	Jeff Moore
8	New	SP Tray-Fan area		Check that slot behind 2nd fan will pass USB cable		Issue raised at DFX Review 11/26/13. **UPDATE(12/5/13) Larry F:** Will veryfy on next DFX review. TBV status.	Jeff Moore
9	New	SP Tray-Fan area		Could we locate USB connector at far left of fan?	Y	Issue raised at DFX Review 11/26/13. **UPDATE(12/5/13) Larry F:** NPTF status	Jeff Moore
10	New	Mounting Rails		Will the Triton use the same mounting rails as Megatron?		Issue raised through email 12/3/13. **UPDATE(12/5/13) Larry F:** No, they are different. New bezel, new rails, new clips. CLOSED status.	Ben Conroy

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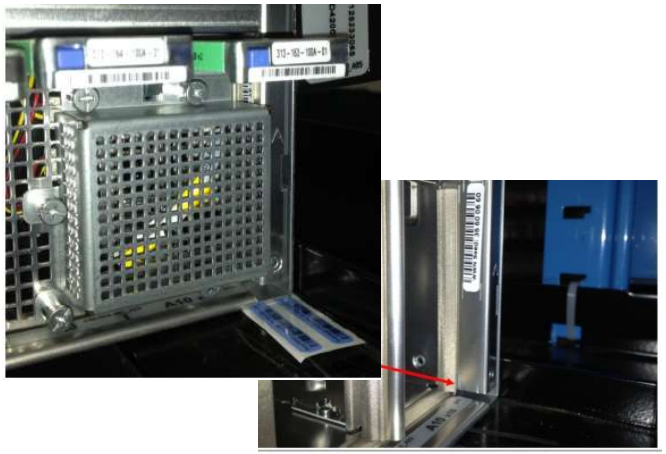
Design Simplification and Best Practices

Concerns & Suggestions

- Interferences
- Complexity
- EMI shielding
- Poke Yoke/keying
- Tool-less securing
- Reduce screw count
- Simplify design
- Accessibility/visibility



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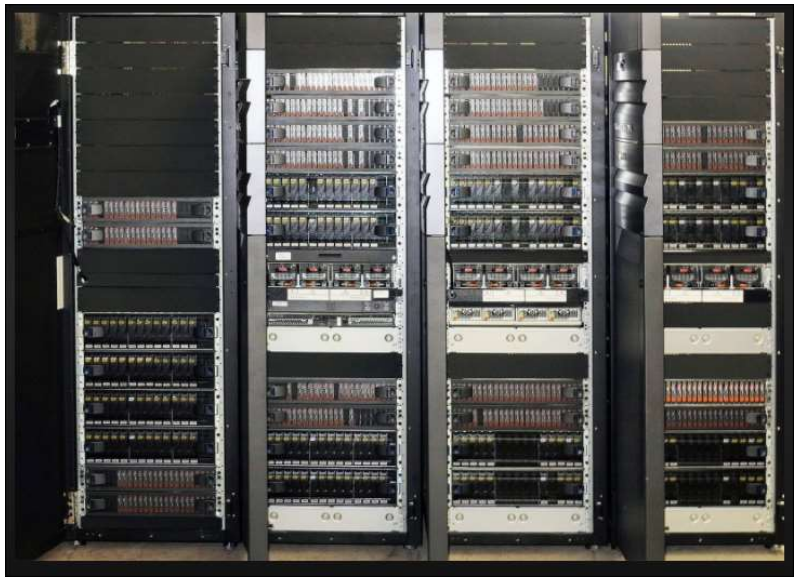
DFMA® Applications at Dell EMC

- Early Design Team Support
  - Design simplification and best practices
- **Product Benchmarking**
  - **Benchmarking and trend analysis**
- Design Improvement
  - Cost-optimization analysis



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Product Benchmarking

	Product A	Product B	Product C
U size	**4**	**5**	**2**
Parts & unanalyzed subs	**25**	**99**	**11**
Separate Operations	**29**	**27**	**5**
TMNP	**25**	**55**	**11**
DFA Index (%)	**24.26**	**73.32**	**49.3**
Process Time (mins)	**20.88**	**15.22**	**4.51**
Process Cost	**$16.77**	**$12.07**	**$3.54**
Entries (incl. repeats)			
Meet min. part criteria	**25**	**55**	**11**
Cadidates for Elimination	**0**	**44**	**0**
# of Fasteners	**0**	**26**	**0**
# of C.F.E NOT fasteners	0	18	0
Analyzed Subs	**0**	**1**	**0**
Separate Operations	**29**	**27**	**5**
Total Entries	**54**	**127**	**16**
Labor Time (mins)			
Meet min. part criteria	**19.66**	**6.47**	**4.25**
Cadidates for Elimination	**0.00**	**7.09**	**0**
# of Fastners	0.00	4.19	0.00
# of C.F.E NOT fasteners	0.00	2.90	0.00
Analyzed Subs	**0.00**	**0.20**	**0.00**
Separate Operations	**1.22**	**1.46**	**0.26**
Total Assembly Time	**20.88**	**15.22**	**4.51**
total time (verification)	*20.88*	*15.22*	*4.51*

"Per U" calculations	Product A	Product B	Product C
Meet min. part criteria per U	6	11	6
Candidates for Elimination per U	0	9	0
# of Fastners per U	0	5	0
# of C.F.E NOT fasteners per U	0	4	0
Analyzed Subs per U	0	0	0
Separate Operations per U	7	5	3
Total Entries per U	14	25	8
total entries (verification)	14	25	8
Assembly Time For:			
Meet min. part criteria per U	4.92	1.29	2.13
Candidates for Elimination per U	0.00	1.42	0.00
# of Fasteners per U	0.00	0.84	0.00
# of C.F.E NOT fasteners per U	0.00	0.58	0.00
Analyzed Subs per U	0.00	0.04	0.00
Separate Operations per U	0.31	0.29	0.13
Total Assembly Time per U	5.22	3.04	2.26
total time (verification)	*5.22*	*3.04*	*2.26*
Cost Data:			
$ spent assembling parts	$1.94	$1.05	$1.22
$ spent assembling all C.F.E	$0.00	$0.84	$0.00
$ Spent assembling fasteners	$0.00	$0.49	$0.00
$ spent assembling C.F.E NOT fasteners	$0.00	$0.34	$0.00
$ spent on sub assemblies	$0.00	$0.02	$0.00
$ Spent completing assembly operations	$2.25	$0.51	$0.55
Total Cost Per U	$4.19	$2.41	$1.77
total cost (verification)	*$4.19*	*$2.41*	*$1.77*

DFMA® Applications at Dell EMC

- Early Design Team Support
  - Design simplification and best practices
- Benchmarking
  - Product benchmarking and trend analysis
- **Design Improvement**
  - **Cost-optimization analysis**

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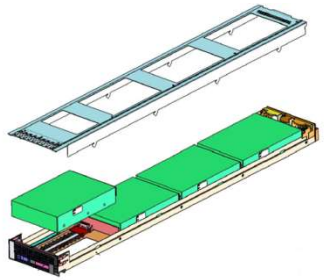
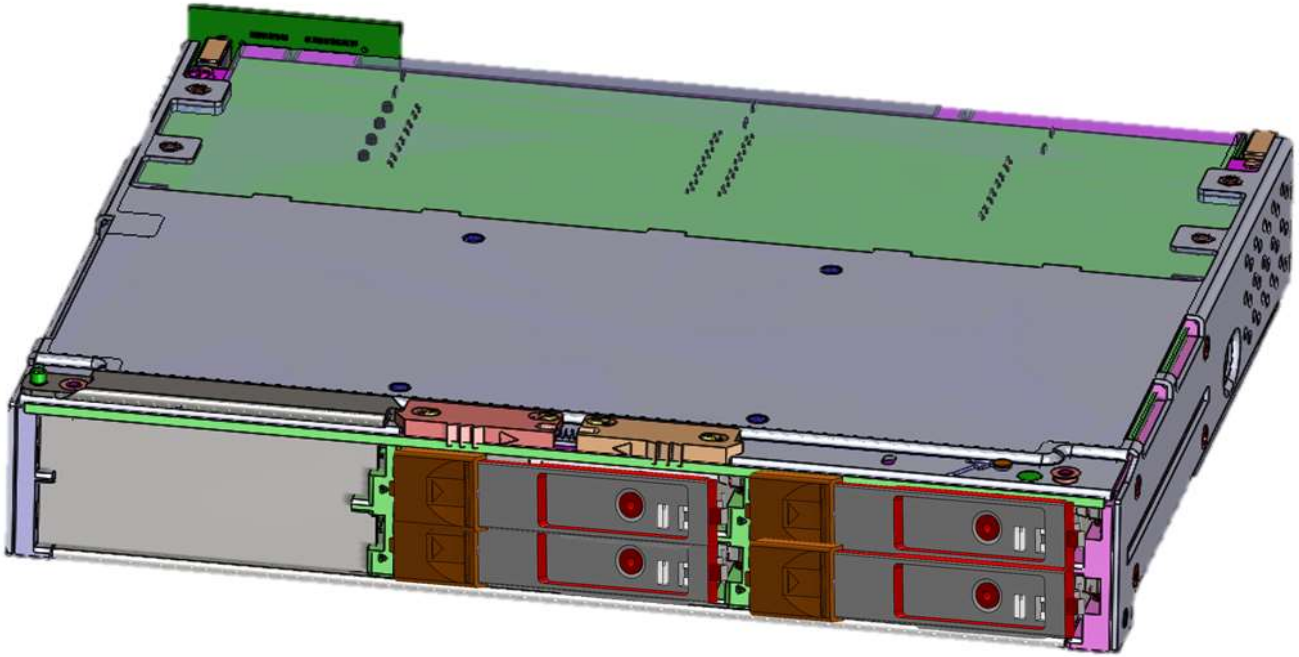
Filler Material DFM Example

	2MM MODIFIED ABS PLASTICS	0.5MM SS	0.5 PRE-PLATE STEEL	0.8 PRE-PLATE STEEL
PER PRODUCT COSTS, $				
Assembly process	0.22	1.10	1.10	1.10
Manufacturing piece part	1.72	4.95	1.80	2.38
Total cost w/o tooling	1.94	6.05	2.90	3.48
Total tooling cost	1.23	0.96	0.96	0.96
Total cost	**3.17**	**7.01**	**3.87**	**4.44**
TOTAL TOOLING INVESTMENT, $				
Assembly tools & fixtures	0	0	0	0
Manufacturing tooling	122,880	96,411	96,411	96,448
Total investment	122,880	96,411	96,411	96,448
PRODUCTION LIFE DATA & WEIGHT				
Life volume	100,000	100,000	100,000	100,000
Total production life cost, $	316,637	701,461	386,705	444,378
Total weight, lb	0.75	0.10	0.10	0.16



Drive Latch DFMA Example



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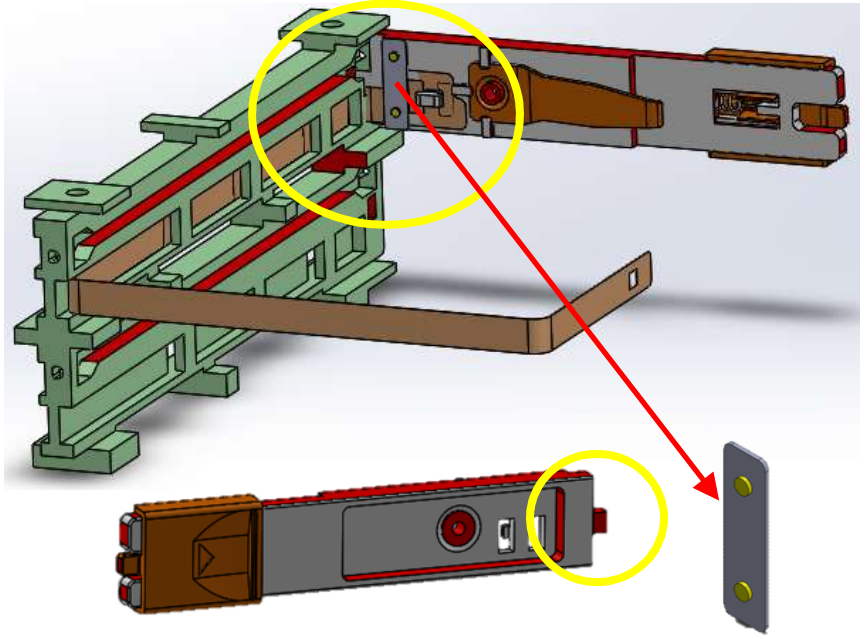
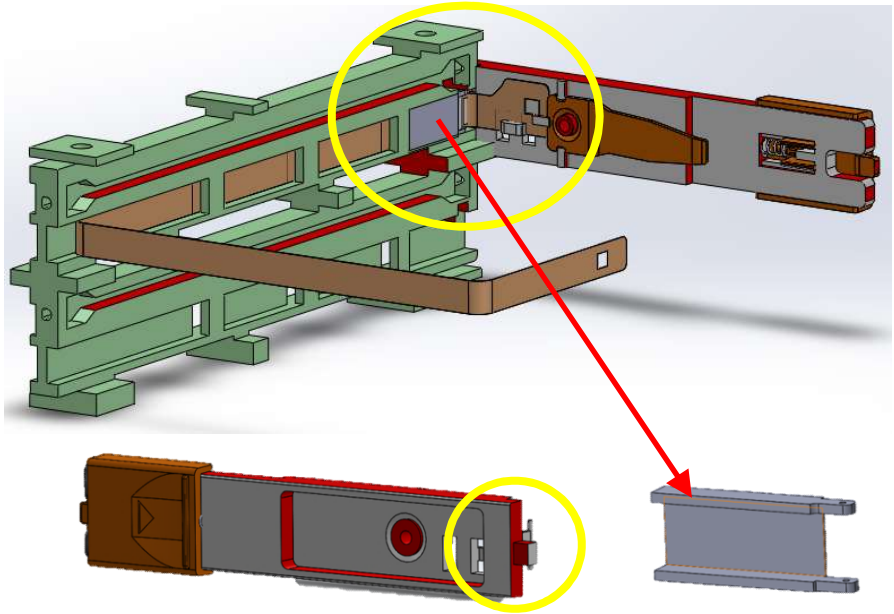
Drive Latch DFMA Example

Current Design
Strap with dangling handle



Proposed Redesign
Strap with hinged handle



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Drive Latch DFMA Example

Current Design	Piece Part Cost	Assy Process Cost
Divider	$0.38	$0.16
Strap	N/A	$0.10
Handle	$0.62	$0.40
Strap Clamp	$0.05	$0.18
Sub-Total	$1.05	$0.84
TOTAL	$1.89	

Proposed Redesign	Piece Part Cost	Assy Process Cost
Modified Divider	$0.37	$0.16
Strap	N/A	$0.10
Modified Handle	$0.63	$0.34
Strap Support	$0.09	$0.02
Sub-Total	$0.80	$0.91
TOTAL	$1.71	

Latches per Assembly	Total Savings per Assembly	Assemblies in Product	Total Savings per Product
4	$0.72	23	$16.56

9.5% Cost Reduction

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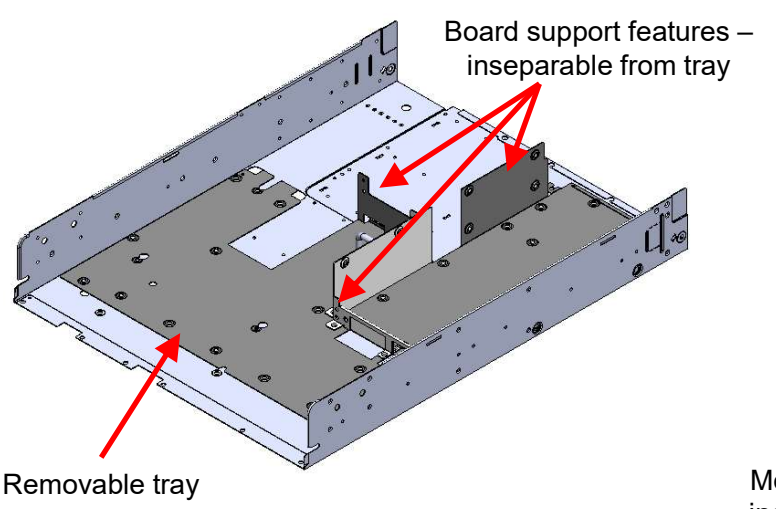
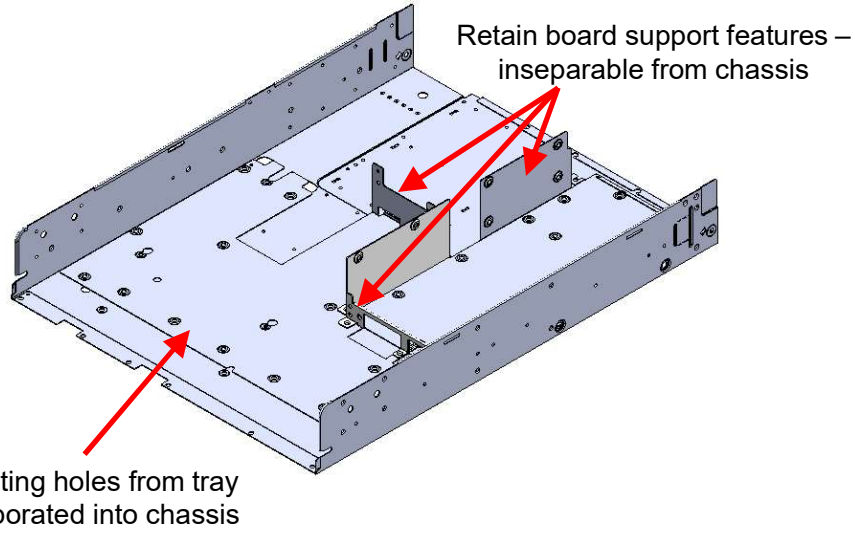
Chassis Redesign DFMA Example

Current Design
Chassis with removable tray to support multiple PCB's



Proposed Redesign
Eliminate the removable tray & incorporate tray features into the chassis.



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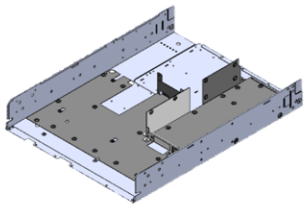
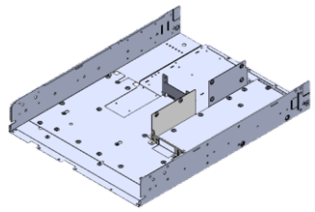
Chassis Redesign DFMA Example



Current Design (w/ Tray)	Piece Part Cost
Base Chassis	$5.25
Removable Tray	$4.06
Board Support	$1.08
Total	**$10.39**

Proposed Redesign (No Tray)	Piece Part Cost
Chassis w/ Tray Features	$5.25
Removable Tray	$0.00
Updated Board Support	$1.30
Total	**$6.55**



	Process Time	Process Cost	Piece Part Cost	Total Cost
Current Design (w/ Tray)	1.97 mins	$1.55	$10.39	$11.94
Re-Design (No Tray)	1.55 mins	$1.22	$6.55	$7.77
SAVINGS	**0.42 mins**	**$0.33**	**$3.84**	**$4.17**

35% Cost Reduction

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How is this different than the traditional approach taken by supplier engineers?

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DFX Engineering Model
Relative Costing
Negotiate with Design Team
Improve Design
Assembly Focused
Primarily DFA

Supplier Engineering Model
Should Costing
Negotiate with Suppliers
Lower Cost
Part Focused
Primarily DFM

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Benefits of DFMA® at Dell EMC

- Make compelling design recommendations using quantitative data
- Help identify possible areas of design/cost improvements
  - Material
  - Process
  - Relative Costing
  - Product Simplification

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- Systematic analysis gives a thorough understanding of the design
- Analyze designs early, even without a CAD model
- DFMA® is easily customizable to fit the needs of our industry/process
  - Libraries
  - Materials
  - Operations
  - Tools/machines
  - Labor rates

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What's Next?

DFMA Strategy

- Increased Collaboration
  - Further engagement with Supplier and Industrial Design Engineering
- DFMA Training
  - DFX Advocates
- Improved DFMA Capabilities
  - Libraries of standard parts and fasteners
  - System level DFA analysis

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Thank You

Questions?