

2015 International Forum on DFMA Boothroyd Dewhurst

DFMA Implementation and Application: New Product Development Value Engineering

June 3, 2015

Presented by: Matthew Miles DFMA and Value Engineering Manager

Agenda

- DFMA Implementation
 - Roadmap
 - Culture Change
 - Product Development Process
- DFMA Application
 Example Analysis













DFMA Implementation

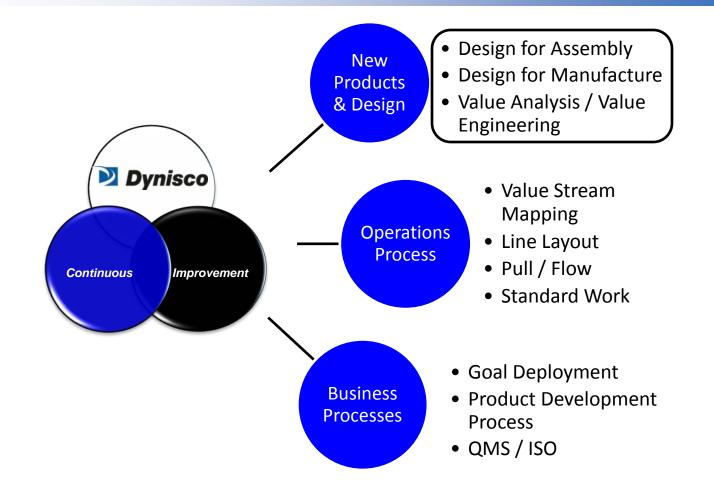
Continuous Improvement (CI)



- Dynisco & Acquisitions Alpha, DJ Instruments, Viatran
 - Matrix organization across the sites
 - VP of Supply Chain & Operations
- CI DFMA & Lean
 - Director of CI, Product & Process Improvement
 - 3 Quality Managers
 - o 1 DFMA Lead
 - 2 Lean Leads
 - o 1 CI Technician
 - 3 Consultants for DFMA & Lean

Continuous Improvement Activities





Utilize multiple tools & techniques to drive business results

DFMA Roadmap



Executive Support

- Launch the DFMA Initiative
- Intro to DFMA at each site

DFMA Support Structure

- Project List
- Resources
- DFMA Files
- File naming convention
- Revision control
- File repository



Application

- New Product Development
- Cost reduction
- Supply Chain
- Competitive Benchmarking

DFMA Training Plan

- Core software training
- Monthly user's group meeting
- Advanced training
- Recommended practices
- User's guide booklet

User's Group Meetings



Monthly Webinar

le Edit Insert Analysis View External				Ein Edi Analysia Xenn Baborta Grapha Jack Hab	
5108PS-Updated Design #1 Design #2 D	Design #3 Design #4			 304 austentic stanless steel machined/cut from stock pa Stock process 	et Part name Top C
Questions Worksheet Redesign	Part number	Item	Symmetry 180 degrees or less about:		Part sumber 6799 Life volume 20.00
✓ Design #1	5108PS *			 Finish face Rough and finish cylindrical term 	
HIGH VACUUM GREASE/u	1359344055		iub not	- Dvill wingle hole	Approximate envelope of
Apply adhesive bead			nalyzed	Rough and finish cylindrical bore Rough and finish cylindrical bore	2
A C ADAPTER ASY, 510, STD(5414.003	Repeat count	1 No axes One axis Two axes	 Finish face Rouch and finish cylindrical turn 	
S CONN.ZV	100P0C3106	Assembly data	Handling requirements	 Rough and finish contour turn Rough and finish cylindrical bore 	4
ADAPTER SUB-ASY,510,	'5414.013	Cost of assembly fixture, \$ 0.0	0 One hand without grasping tool	Rough and finish cylindrical bore	
510 Adapter Design 3	SK120209-6	Rem weight	One hand using grasping tool	Generic ChiC drilling center SetupfoedSunload	
PCBD ASY,510/520,CE	643572.002	 Less than 5 lb (2.27kg) 	Two hands due to flexibility	Drill single hole Tap single hole (UNC)	
LOOKWASHERLSST SPLIT	06100N0200		Two hands - severe nest or tangle	- Drill multiple holes	Select pro
		From 5 lb (2.27kg) to 30 lb (13.6kg)	(1)	- Tap multiple holes (UNC) - Drill multiple holes	Picture
SCREW, SOC-HD CAP, 4-4	0613080204	O More than 30 lb (13.6kg)	Handling difficulties	Dritt multiple trakes	Ge Load
SOLDER, ROSIN-CORE .0	1300060/40	Envelope dimensions, in	Nest or tangle	Tap multiple holes (UNC)	Notes
			Stick together 1.000	- Washidegrease part - Inspect visually	I.
TRA-CON/use by on co	13TRCN3103		Slips from fingers	 Check with going-go gage Measure with micrometer (blerance < 0.001 in: (0.02) 	formation and the second se
Apply adhesive potting/filling	-	1.000	1.000 Requires careful handling	- Measure with vernier calper	
Cure Time for Potting		1.000		- Plastic beg part - Box parts and tape box	
WIRE, BLACK TEFLON CT	1232010T00			- Profit	1
Swire, RED TEFLON CTD,	1232010T02		N	12345 67660 Investment Cast Mach	
Swire, yellow terlon C	1232010T04			Cost results, 5 Previous Current Colonate material 9,24 9,24	
Swire, BLUE TEFLON CTD	1232010T06			setup 1.02 1.02	
Souther the second seco	'60174.001			process 18.64 24.58 rejects 0.90 0.50	
SLUG, GROUND CONNECTIO	15ELV1815H			piece part 29 69 35.63	
CONN CAP	10A008110C	•	M	tooing 0.00 0.00 total 29.69 35.63	
Desi Revie	U	 DFA	Importing BOM's	Machined Castings	
Minimur			Entry Info	Sheet Metal Parts	DFM
Crite	ria	Rep	orts/Graphs		dments

Assembly Fabrications Quick Estimator in DFM

Designing with DFMA



- Cross-functional Teams
 - Engineering (all disciplines)
 - Supply Chain
 - Operations
 - Executive Management
 - Suppliers
- DFA
 - Overhead walk-through of Bill of Material in DFA
- DFM
 - Piece part cost review







2/3 Day Events

Competitive Benchmarking



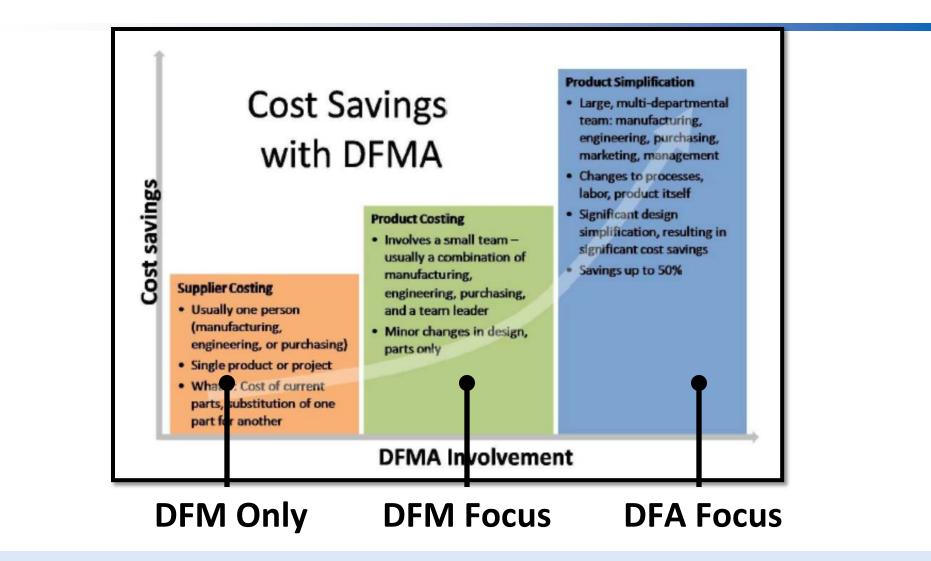
4 Dynisco/Viatran Products					7 Competitor Products							
							A A A A A A A A A A A A A A A A A A A					
.		Dynisco/Viatran	Dynisco/Viatran	Dynisco/Viatran	Dynisco/Viatran	Competitor	Competitor	Competitor	Competitor	Competitor	Competitor	Competitor
Description	Units	#1	#2	#3	#4	#1	#2	#3	#4	#5	#6	#7
DFA Index	%	6.9	7.0	7.2	6.3	4.5	3.6	8.3	3.1	9.1	6.1	7.3
DFA Part Count (Parts & Processes)	#	137	151	134			1	118	91	101	105	114
Component Count	#	85	102	62		A Dat		63	58	66	59	62
Theoretical Minimum Part Count	#	22	23	21		A Dai	d	25	15	31	20	23
Theoretical Assembly Time	Min.	16	21	17				18	27	21	18	18
Total Cost		Baseline	1%	21%	12%	-6%	18%	4%	- 15%	-1%	-22%	-5%
Base Part												
Cost	\$	Baseline	-46%	-5%	43%	-53%	-31%	-62%	-81%	-77%	-79%	-38%
Billet Size	in.	3.75" dia x 2.19" lg	3.75" dia x 1.25" lg	3.00" dia x 2.50" lg	3.00" dia x 1.25" lg	3.75" dia x 1.5" lg	3.75" dia x 2" lg	3.75" dia x 5.50" lg	3.75" dia x 1.25" lg	3.75" dia x 1.50" lg	3.75" dia. x 3.31" lg.	3.75" dia x 1.38" lg
Billet Weight	lbs.	7.4	4.4	5.7	4.0	5.3	6.2	17.6	4.4	5.3	10.3	5.7
Finished Weight	lbs.	3.9	2.0	3.4	2.0	3.2	3.5	7.9	2.6	3.3	5.0	3.0
Adapter												
Cost	\$	Baseline	-3%	55%		1 Dai		-53%	13%	1%	-49%	7%
Billet Size	in.	3.25" dia x 2.25" lg	3.25" dia x 2" lg	3.00" dia x 2.50" lg	יודט	∕I Da [∙]	Ld 3.38" lg	3.00" dia x 2.50" lg. .31" thick wall tube	3.38" dia x 1.62" lg	2.5" dia x 5" lg, .38" thick wall tube	2.75" dia. x 2.75" lg.	2.62" dia x 1.38" lg,
Billet Weight	lbs.	5.4	4.7	4.9	4.7	6.4	7.9	2.7	4.1	3.5	4.6	2.7
Finished Weight	lbs.	1.3	1.1	1.8	1.1	2.2	1.8	1	1.5	1.8	1.9	1.0
Weld		NA	EB	NA	EB	NA	NA	NA	TIG	EB	NA	TIG

Product Teardown Generate Bill of Material DFA Analysis Material Analysis DFM Cost Analysis Total Product Cost Estimated Gross Margin Design Strengths/Weaknesses Voice of the Customer

DFMA software – key tool in the benchmarking process

Three Main Uses of DFMA





Product Simplification provides the largest opportunity

Source: Boothroyd Dewhurst, Inc.

Culture Change



"Guerilla Transformation: Change an Insurgency into a Movement" —Joseph Paris; Chairman, XONITEK Group of Companies



CI Group

- Don't oversell promises
- Don't have grand plan with great fanfare
- Internal Disrupter
- Target Engineering Groups
- Create sense of want with DFMA

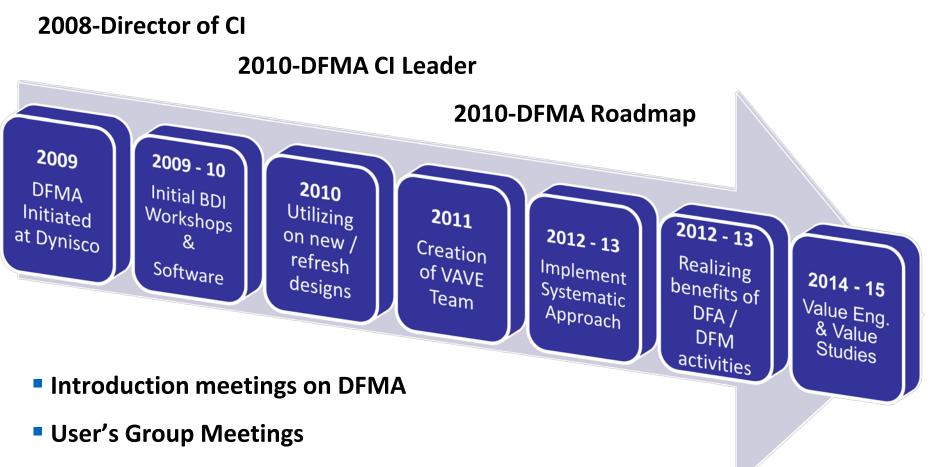
Lessons Learned:

Change takes time Number of projects Small wins

Patience Vernacular

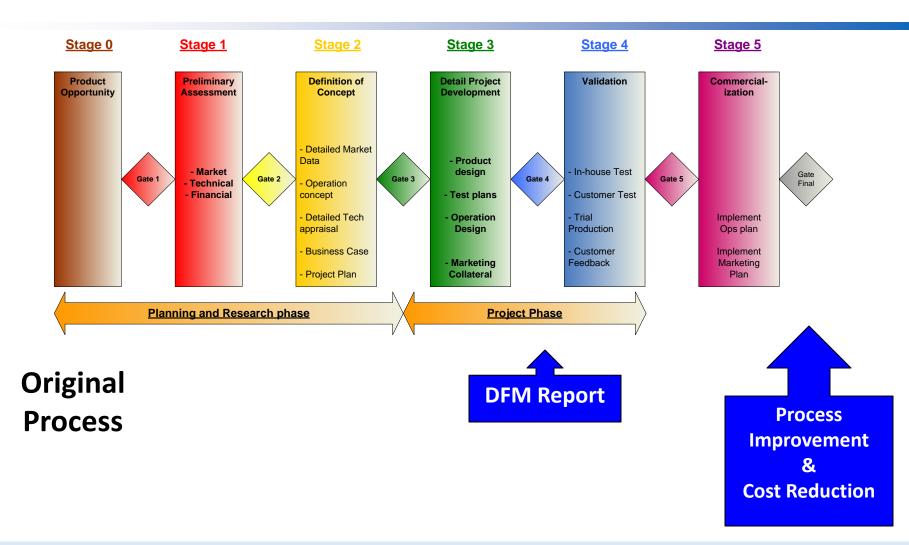
Dynisco Timeline





- Monthly DFMA Project List
- Recommended Practices
 Documents / DFMA User's Guide
- Systematic DFMA
 Deployment Workshop
- Value Engineering Workshop

Product Development Process (PDP)

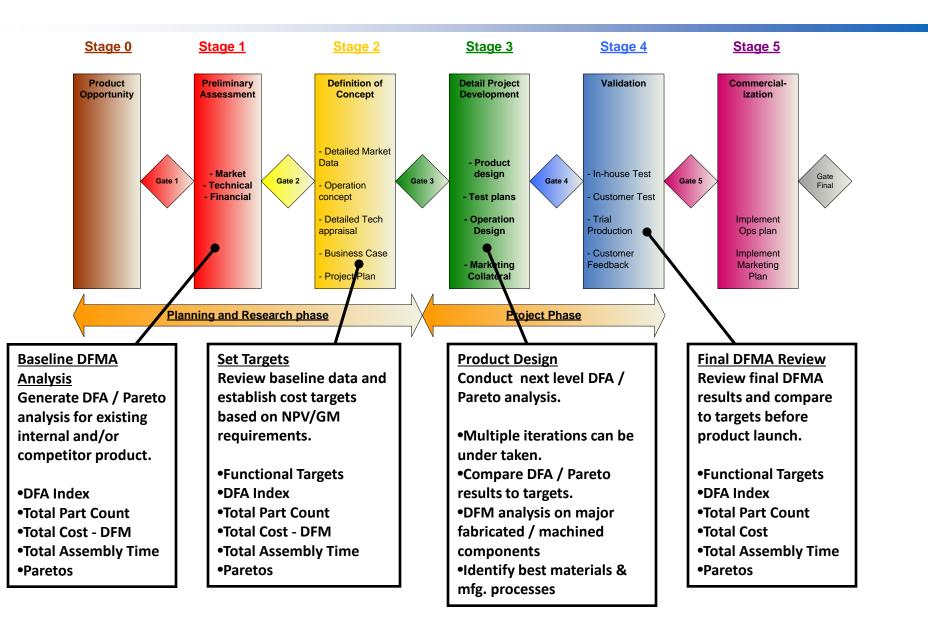


🔰 Dynisco

Decouple Function and Part Count Early

DFMA Metrics in Revised PDP

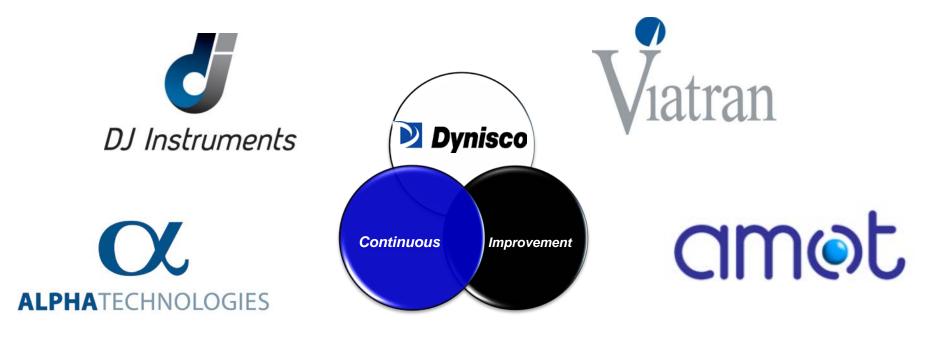




DFMA – Current State



Valves, Material Analysis, and Sensors (VMAS) Group







DFMA – Current State



Valves, Material Analysis, and Sensors (VMAS) Group









Questions on DFMA Implementation?



DFMA Application

DFMA and Value Engineering (VE)



<u>DFA</u>	<u>VE Process (origin)</u>	<u>DFM</u>
Baseline analysis	1.What is it?	Part Design
Total product cost	2.What does it cost?	Should-cost
Min. Part Criteria	3.What does/must it do?	Part Design
Redesign	4.What else would do the job?	Mat'l & Processes
Redesign total cost	5.What would that alternative cost?	Alternative cost Network 100 Participation of the second
<u>VE Process (refir</u>	need)	jan hang pa thi dingay

Function Analysis – "Heart" of VE, analyze performance of a product

FAST Diagram – Classification of entire system of functions

Value Index – Measure the value of the function within the product

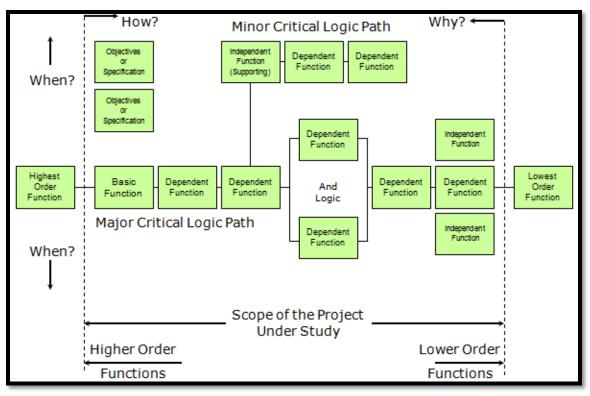
Function Analysis / FAST Diagram

Random Function Identification

- Technique for analyzing the performance of a product
- Active Verb / Measurable Noun

FAST Diagram

- Use a questioning logic to classify an entire system of functions
- Critical Logic Path
- Highest Order Function



Use

Aesthetic

Dynisco

"Transmit Torque"

"Attract User"

Value Measurement



Value Index = $\frac{\%$ ImportanceFunction Worth% CostFunction Cost

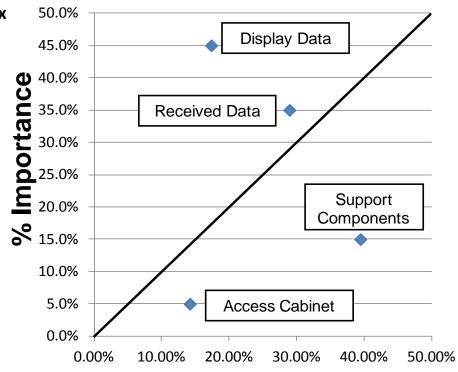
	% Importance	% Cost	Value Index
Display Data	45%	17%	2.59
Received Data	35%	29%	1.21
Support Components	15%	39%	0.38
Access Cabinet	5%	14%	0.35

- 45 degree line = Value Line
- Value Index > 1 High value

Value Index < 1 Low value



Use Value Indices to create targets



Value Graph

% Cost

Value Measurement



% Importance Value Index =

% Cost

Function Worth Function Cost

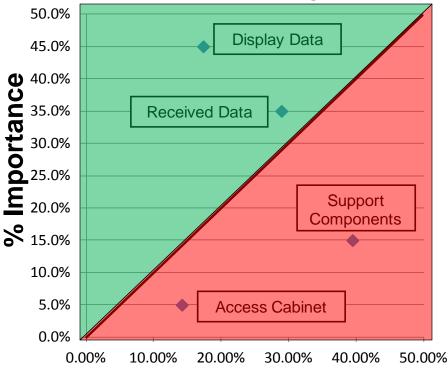
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- 45 degree line = Value Line
- Value Index > 1 High value

Value Index < 1 Low value



Use Value Indices to create targets



Value Graph

% Cost

DFA Analysis

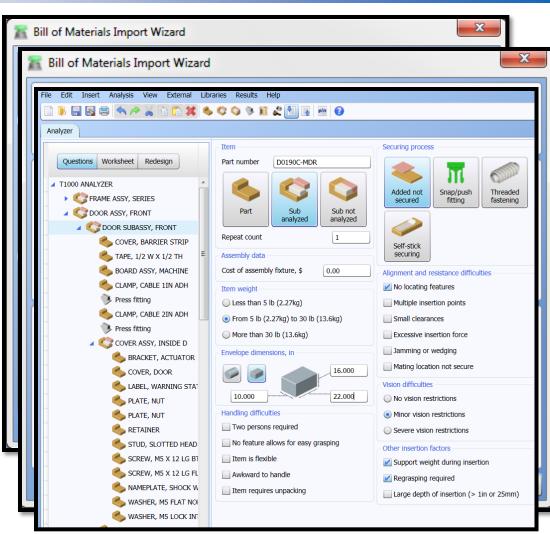


Export – from ERP

Import – to DFA

Product BOM

- 1. Define Product assembly structure
- 2. Answer DFA questions
- 3. Generate redesign ideas
- 4. Categorize ideas and generate concepts
- 5. Use DFMA to quantify effect of redesigns



Source: Boothroyd Dewhurst, Inc.

DFA Analysis

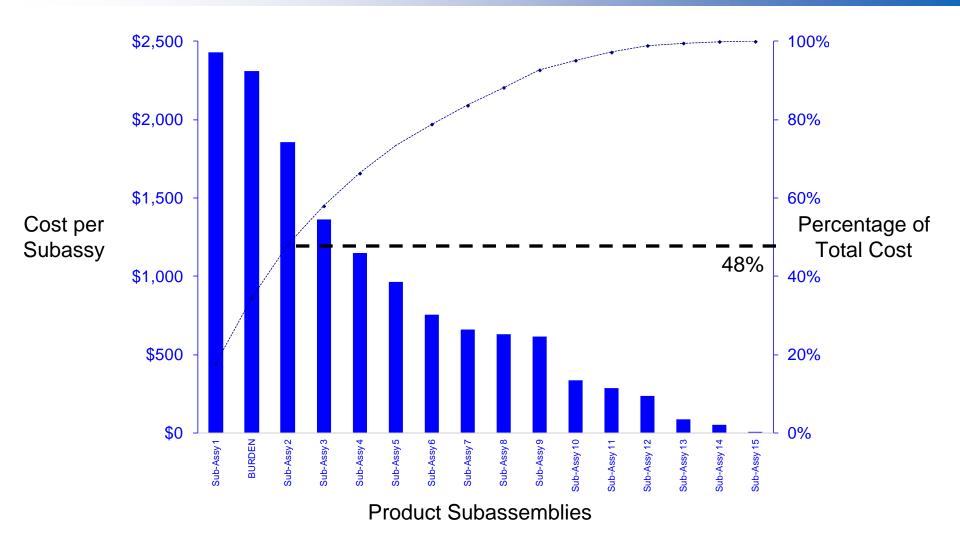


File Edit Insert Analysis View External Libr	raries	Results Help)						
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	_	Analysis	Totals - DFMA	•					
Analyzer		Structure	e Chart						
	Iter	Product	Worksheet	Handling requirement					
Questions Worksheet Redesign	Par	Tabular I	Reports	Create new report					
T1000 ANALYZER		Suggesti	ons for Redesign	Untitled1					
FRAME ASSY, SERIES		Cost Brea	akdown	Untitled2					
DOOR ASSY, FRONT		Product I	Profile		r e nest or t angle				
A CODOR SUBASSY, FRONT		Function	al Breakdown	Handling difficulties					
COVER, BARRIER STRIP	Rep			Nest or tangle					
📥 TAPE, 1/2 W X 1/2 TH	Ass	Report O	ptions	Stick together					
BOARD ASSY, MACHINE	Cos	Change	Tabular Repor	t Generator					
CLAMP, CABLE 1IN ADH	Item	n weight	Column Filter	Help				R	eport Name Untitled3
Press fitting	οL	Less than 5 lb	Determine.		Diagonal and	Total count	Malana and		Available Columns
CLAMP, CABLE 2IN ADH	OF	From 5 lb (2.2	Part number	Name	Piece part cost per item, \$	Total count	Minimum part criteria		
Press fitting		More than 30 l	T1000	T1000 ANALYZER		1108		~	Insert
∠ 🥸 COVER ASSY, INSIDE D	Ľ		C6174	FRAME ASSY, SERIES	0.00	1			DFMA Custom
	Enve	elope dimensio	B0531	BASE, FRAME (MACH)	228.71	1	Base part		Repeat count Alinimum items
			C0606	COLUMN, EXTRUSION L.	99.50	1	Assembly		Process time per entry
			C0607	COLUMN, EXTRUSION R.	108.25	1	Assembly		Process time per product Process cost per product
			B0540	BRACKET, MICROSWITCH	3.77	1	Connector		Piece part cost per product
Export – from	D	ן אזי	B0533	BRACKET, BOTTOM (FRO	1.53	2	Connector		Total cost per product without
•			B5390	BRACKET, (REAR COVER	3.06	2	Connector		Assembly tool or fixture cost Manufacturing tooling investme
–		. I	AH089	HINGE, SUPPORT	3.00	1	Connector		Manufacturing tooling cost per
Import – to Ex	<ce< th=""><td>el I</td><td>A0102</td><td>ADHESIVE, SEALANT</td><td>0.00</td><td>1</td><td>Fastener</td><td></td><td>Item cost per item Item cost per product</td></ce<>	el I	A0102	ADHESIVE, SEALANT	0.00	1	Fastener		Item cost per item Item cost per product
			A0102	ADHESIVE, SEALANT LO	0.00	1	Fastener		Total cost
			A0103 AB014	MOTOR	28.87	1	Assembly		Weight per item
			AG003	GUARD, FINGER (FAN)	0.71	2	Assembly		Weight per product Function group
			B0538	BEARING, STD MINIATU	6.80	4	Connector		Notes
			00000		0.00		_		
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DFA – Cost by Subassembly

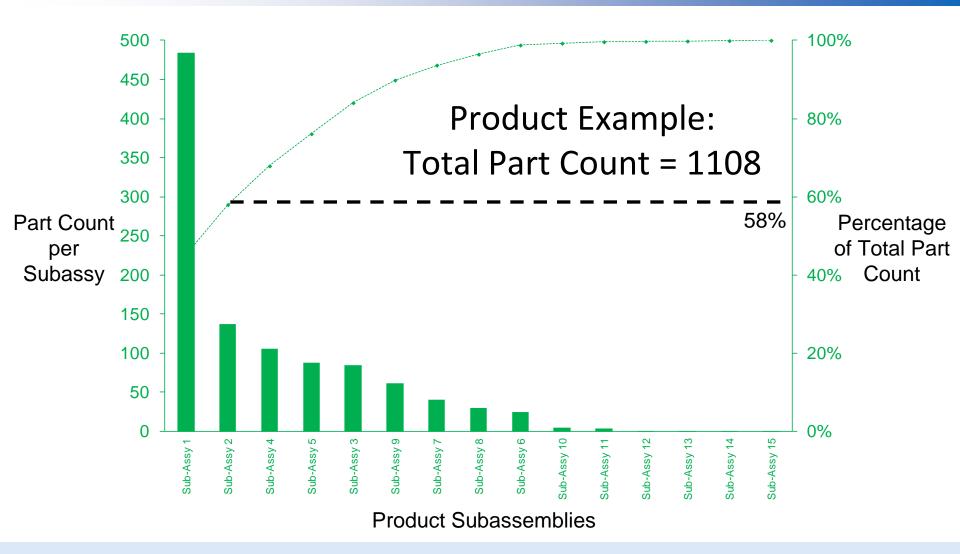




Identify where the cost is in the product (Subassemblies 1 & 2)

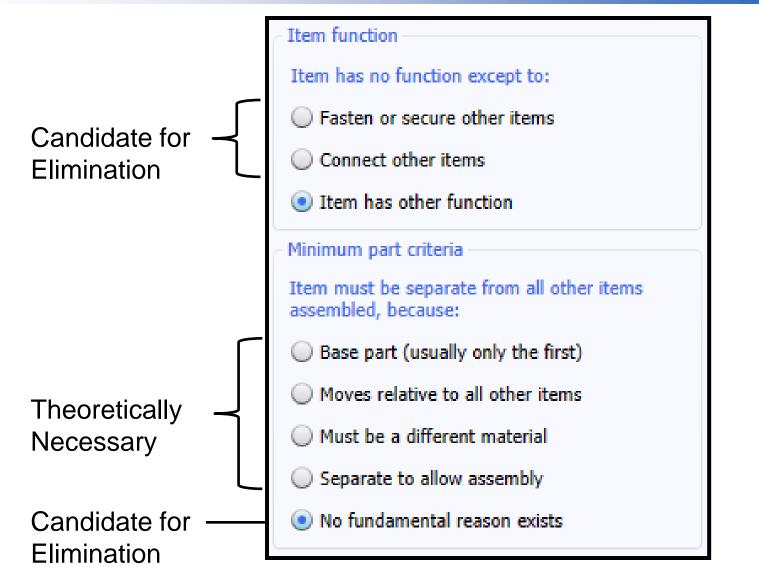
DFA – Part Count by Subassembly





Subassemblies 1 & 2 – Highest costs and highest part count

DFA – Minimum Part Criteria

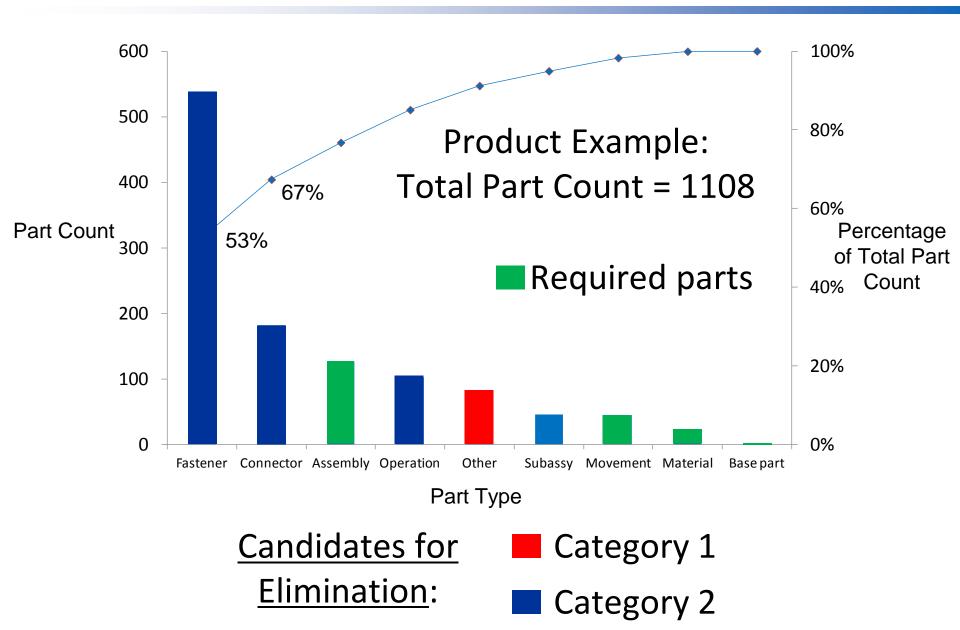


Source: Boothroyd Dewhurst, Inc.

🔰 Dynisco

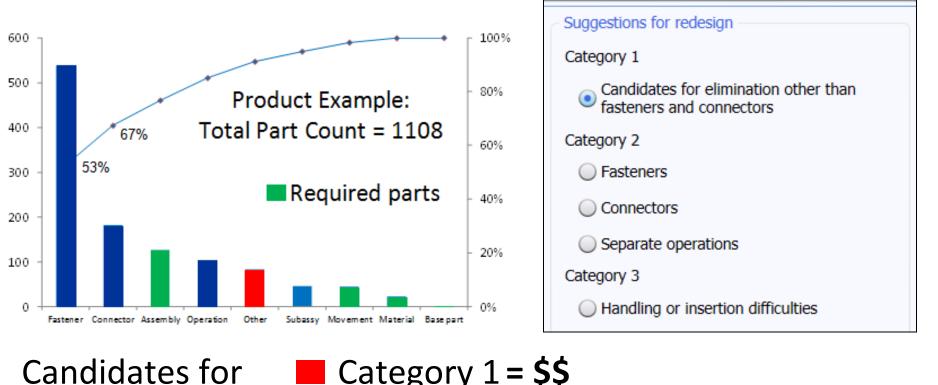
DFA – Part Count by Min. Part Criteria





DFA – Part Count by Min. Part Criteria



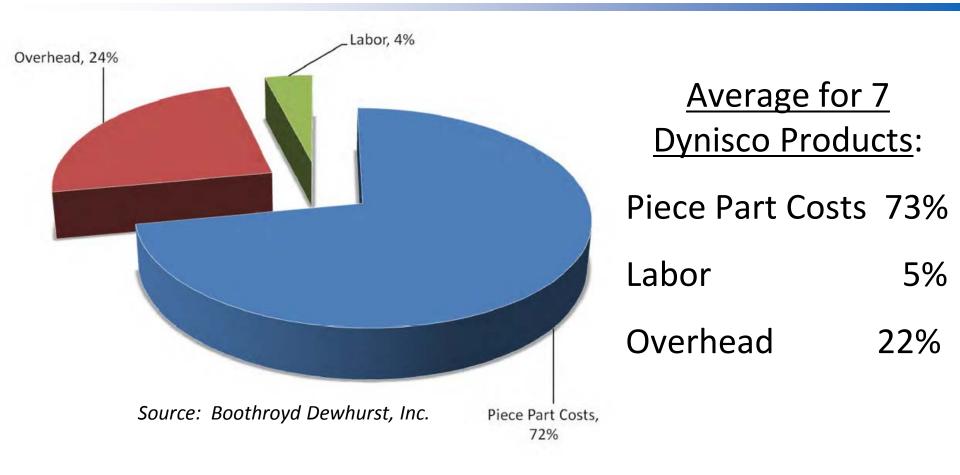


Elimination:

Category 1 = \$\$
Category 2

Target the candidates for elimination by numerical category to maximize part and cost reduction

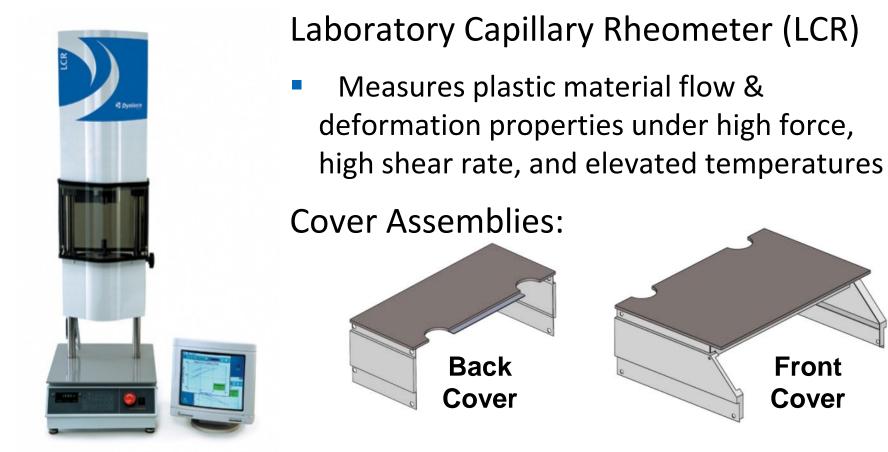
Typical Product Cost Breakdown



🔰 Dynisco

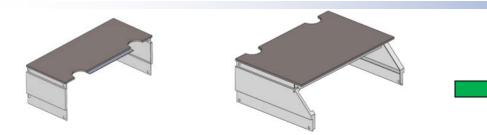
Total cost of parts represents the largest opportunity for cost reduction





Function / FAST / Value Index exercise results:Enhance Style (aesthetic)1.3Protect Components (use).50





Value Index	
Enhance Style	1.3
Protect Components	.50

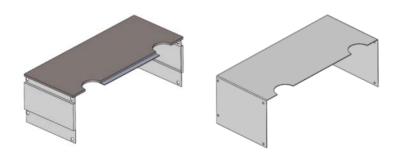
Importance of styling and cover costs, directly impact the value indices

DFA	-	Back

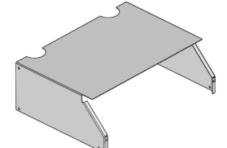
Total Part Count	13
Theoretical Min Items	1
DFA Index	3.1
DFA Labor Time	187s
Time Study	203s
Labor Cost	\$2.59
Item Cost	<u>\$138</u>
Total Cost	\$141
DFM 'should-cost'	\$70

DFA - Front 🦳 🚺	•
Total Part Count	18
Theoretical Min Items	1
DFA Index	2.2
DFA Labor Time	258s
Time Study	278s
Labor Cost	\$3.58
tem Cost	<u>\$193</u>
Total Cost	\$197
DFM 'should-cost'	\$104





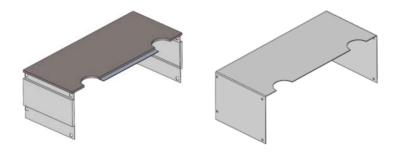


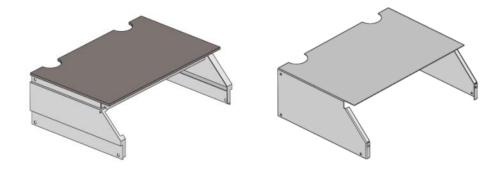


DFM - Back		DFM - Front	
Total Cost	\$141	Total Cost	\$197
DFM 'should-cost'	\$70	DFM 'should-cost'	\$104
<u>1-Piece Cover</u>		<u>1-Piece Cover</u>	
Steel, Painted	\$39	Steel, Painted	\$54
Aluminum	\$39	Aluminum	\$55
Aluminum, Painted	\$46	Aluminum, Painted	\$65
Stainless Steel	\$77	Stainless Steel	\$108

What else would do the job? What does that alternative cost?







Enhance Style 1.3

Protect Components .50

DFA - Back Redesign		DFA - Front	R	Redesign	
Total Part Count	13	1	Total Part Count	18	1
Theoretical Min Items	1	1	Theoretical Min Items	1	1
DFA Index	3.1	53.9	DFA Index	2.2	53.9
DFA Labor Time	187s	0	DFA Labor Time	258 s	0
Time Study	203s	0	Time Study	278s	0
Labor Cost	\$2.59	0	Labor Cost	\$3.58	0
Item Cost	\$138	<u>\$39</u>	Item Cost	\$193	<u>\$54</u>
Total Cost	\$141	\$39	Total Cost	\$197	\$54
DFM 'should-cost'	\$70		DFM 'should-cost'	\$104	

Data based decision

Everyday Tools



DFA

Baseline analysis

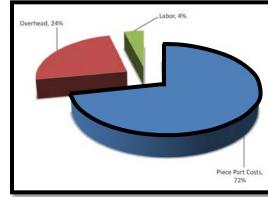
Total product cost

Min. Part Criteria

Redesign

Redesign total cost

Product Simplification



VE Process DFM Part Design 1.What is it? 2.What does it cost? Should-cost 3.What does/must it do? Part Design 4. What else would do the job? Mat'l & Processes 5. What would that alternative Alternative cost cost? **Function** Part & Tooling Costing FAST Value Index

Cost Savings with DFMA		Product Simplification • Large, multi-departmental team: manufacturing, engineering, parchasing, marketing, management • Changes to processins, Taboo, product itself
Supplier Cotting • Usually one person (manufacturing, engineering, or partbasing) • Single product or project • Whott If: Cost of current parts, substitution of one parts a nother	Product Costing	Significant design single location, resulting in significant cost swings Savings up to 50%
	DFMA Involveme	ent



Questions on DFMA Application?