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

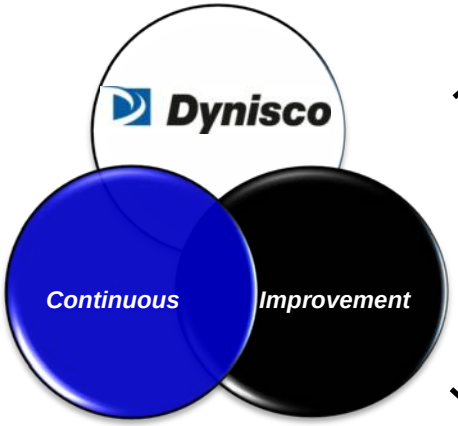
- DFMA Implementation
  - Roadmap
  - Culture Change
  - Product Development Process
- DFMA Application
  - Example Analysis

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
    - 1 DFMA Lead
    - 2 Lean Leads
    - 1 CI Technician
    - 3 Consultants for DFMA & Lean

Continuous Improvement Activities



New Products & Design

- Design for Assembly
- Design for Manufacture
- Value Analysis / Value Engineering

Operations Process

- Value Stream Mapping
- Line Layout
- Pull / Flow
- Standard Work

Business Processes

- Goal Deployment
- Product Development Process
- QMS / ISO

Utilize multiple tools & techniques to drive business results

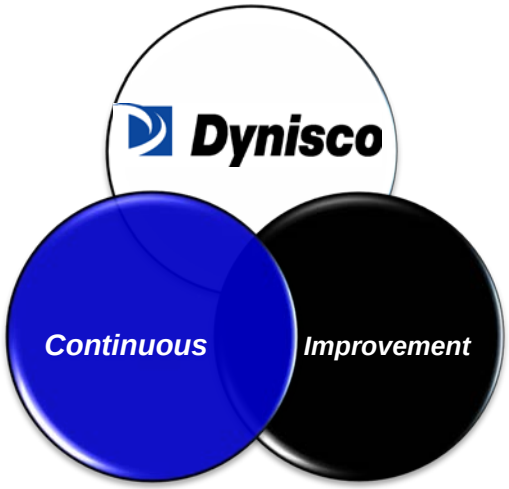
DFMA Roadmap

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

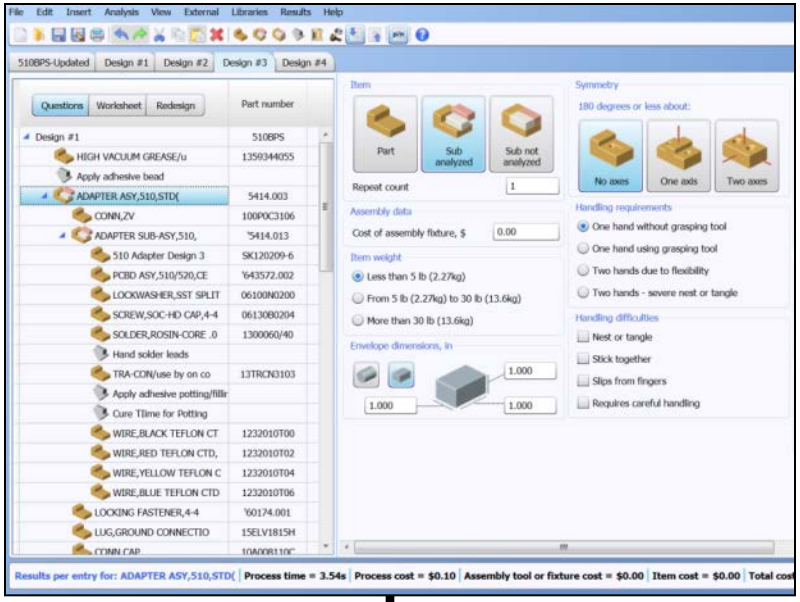
DFMA Training Plan

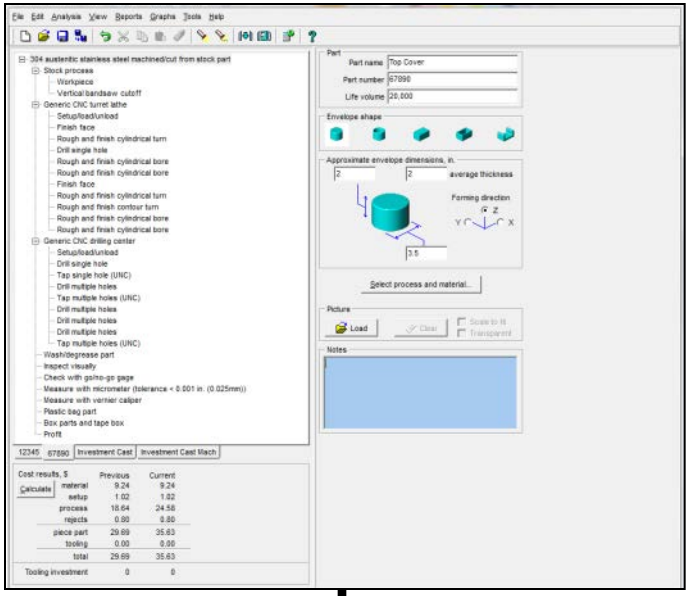
- Core software training
- Monthly user's group meeting
- Advanced training
- Recommended practices
- User's guide booklet

User's Group Meetings

Dynisco

Monthly Webinar





- Design Reviews
- DFA
- Importing BOM's
- Minimum Part Criteria
- Entry Info
- Reports/Graphs
- Machined Castings
- Sheet Metal Parts
- Weldments
- DFM
- 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

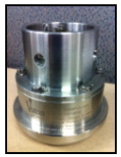
2/3 Day Events

Competitive Benchmarking

Dynisco

4 Dynisco/Viatran Products

7 Competitor Products








Description	Units	Dynisco/Viatran #1	Dynisco/Viatran #2	Dynisco/Viatran #3	Dynisco/Viatran #4	Competitor #1	Competitor #2	Competitor #3	Competitor #4	Competitor #5	Competitor #6	Competitor #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				118	91	101	105	114
Component Count	#	85	102	62				63	58	66	59	62
Theoretical Minimum Part Count	#	22	23	21				25	15	31	20	23
Theoretical Assembly Time	Min.	16	21	17				18	27	21	18	18
Total Cost		Baseline	1%	21%	72%	-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%			%	-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			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

DFA Data

DFM Data

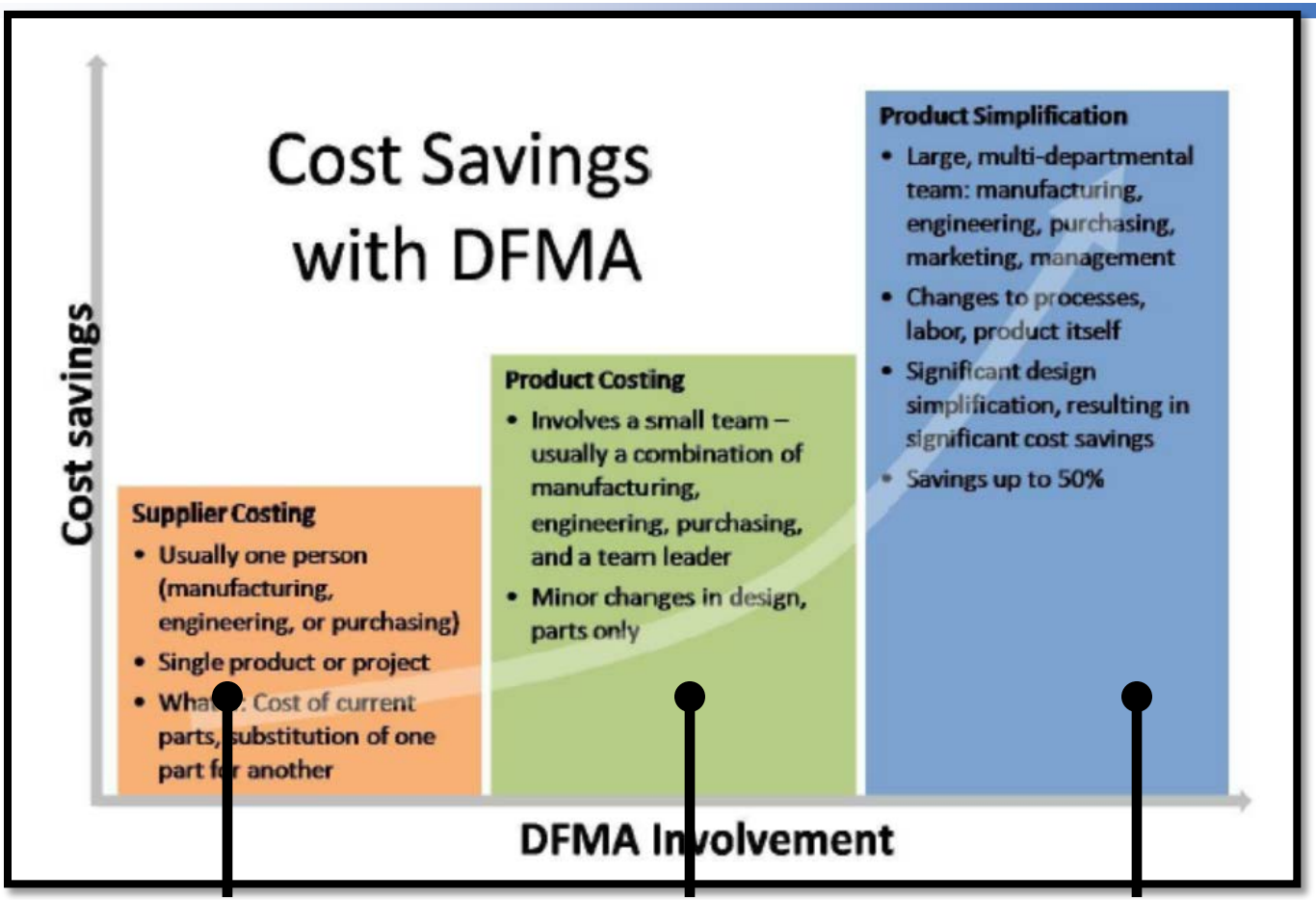
Product Teardown
Generate Bill of Material
DFA Analysis

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

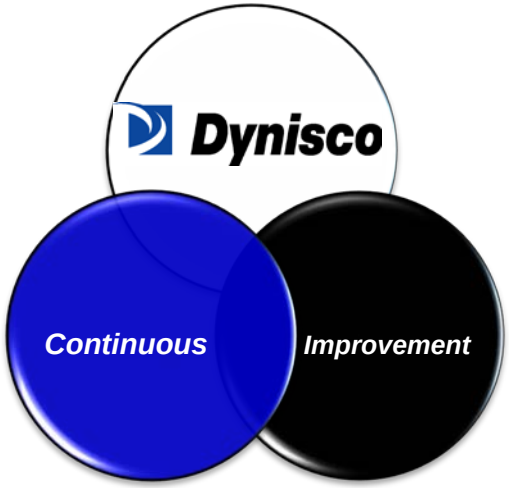


Product Simplification provides the largest opportunity

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

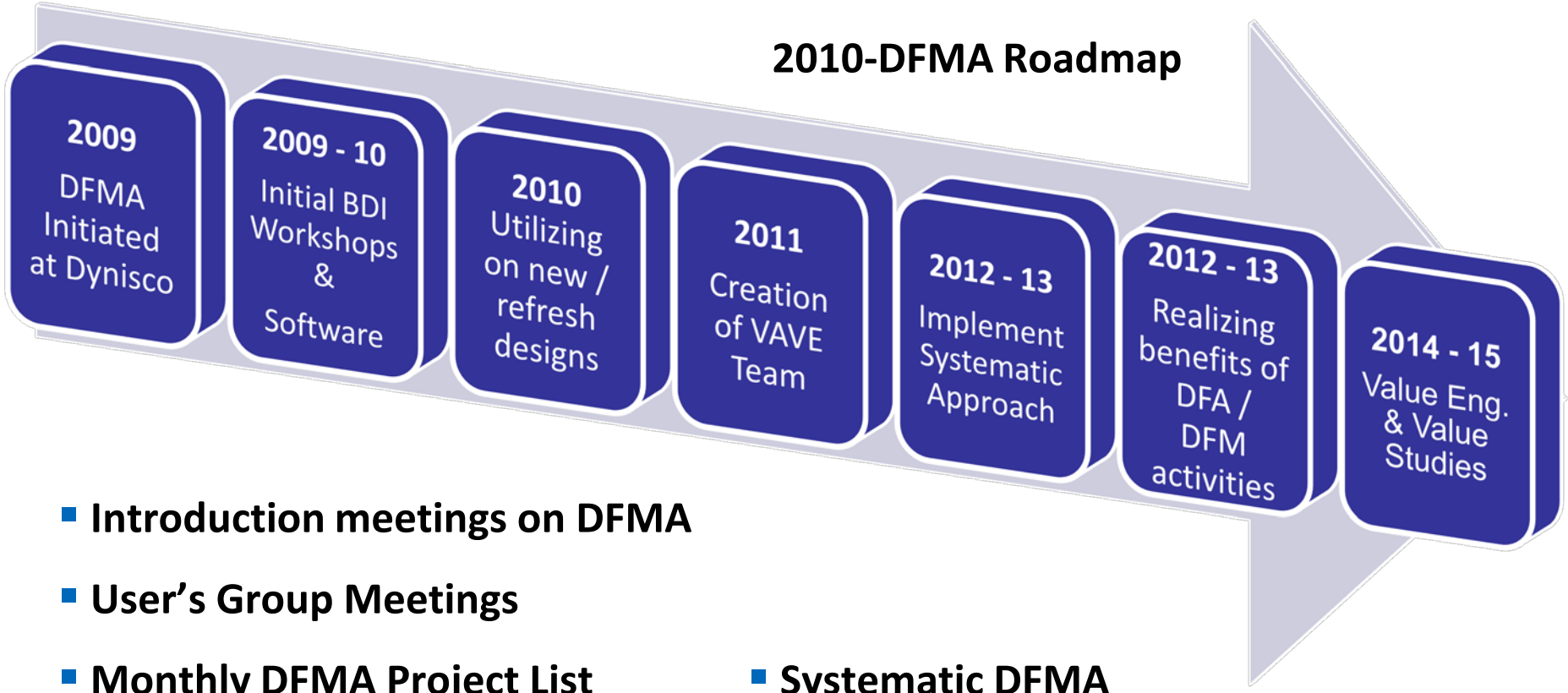
Patience
Vernacular

Dynisco Timeline

2008-Director of CI

2010-DFMA CI Leader

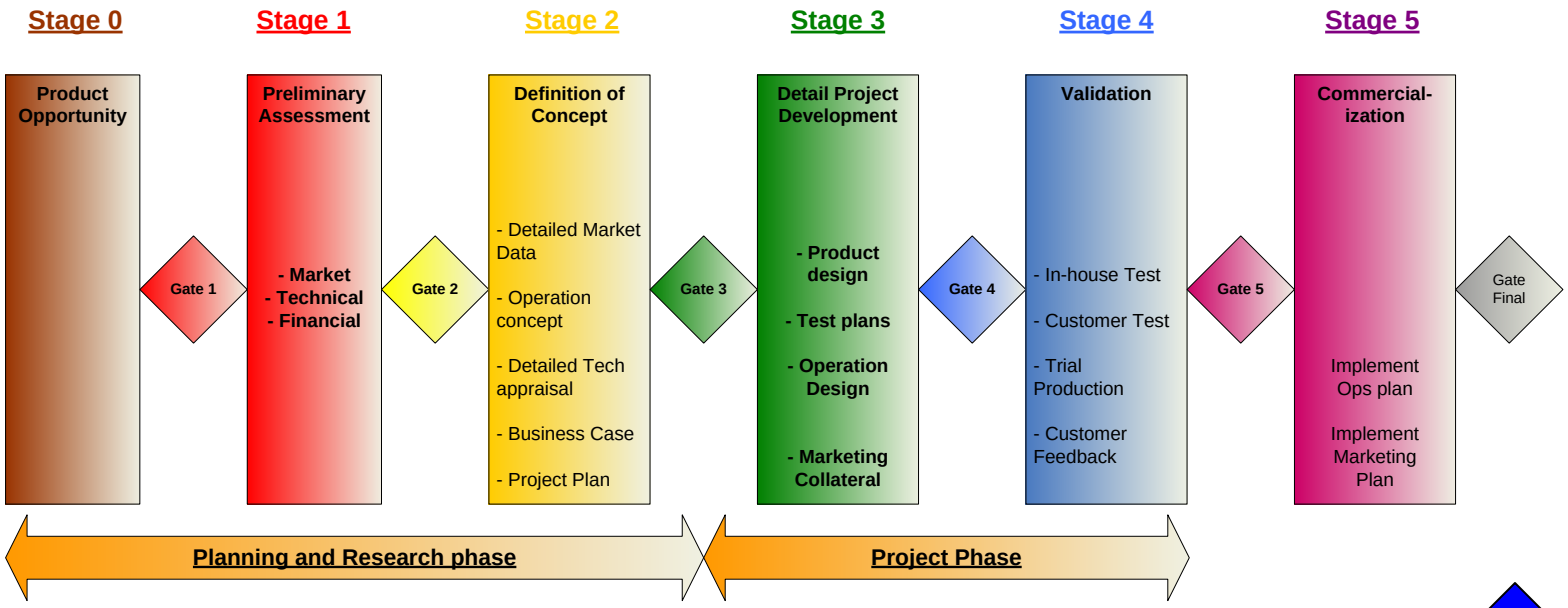
2010-DFMA Roadmap



- **Introduction meetings on DFMA**
- **User's Group Meetings**
- **Monthly DFMA Project List**
- **Recommended Practices Documents / DFMA User's Guide**
- **Systematic DFMA Deployment Workshop**
- **Value Engineering Workshop**

Product Development Process (PDP)

Dynisco



Original Process

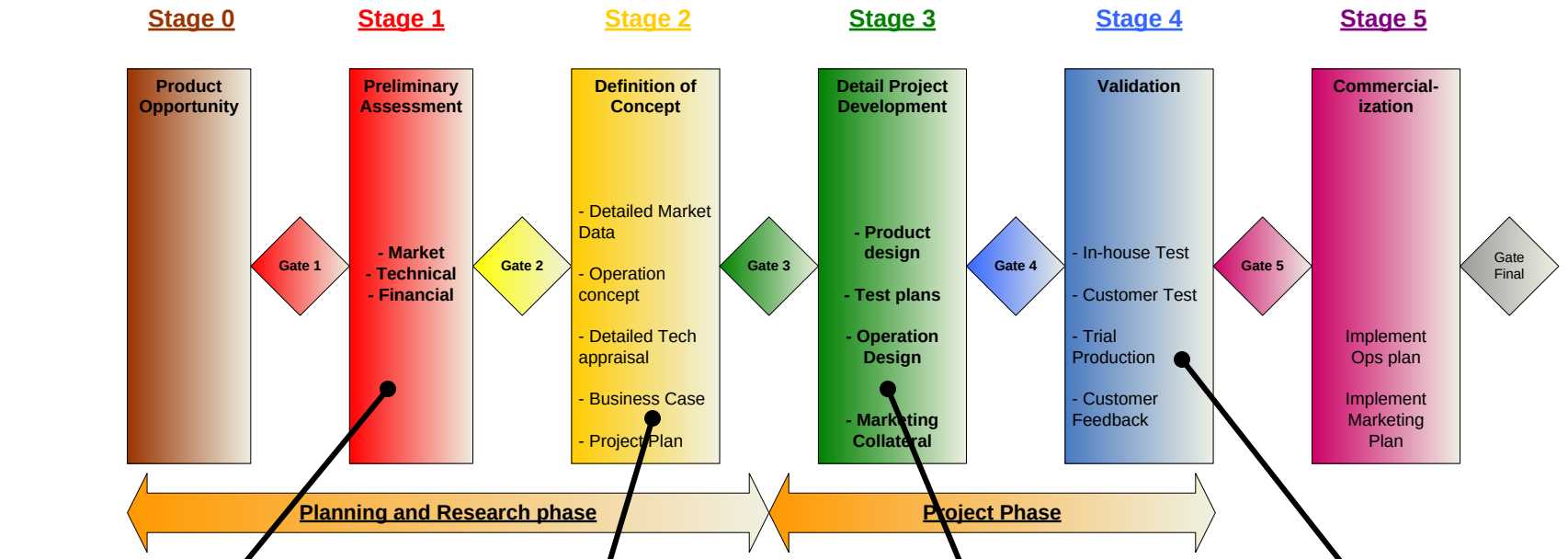
DFM Report

Process Improvement & Cost Reduction

Decouple Function and Part Count Early

DFMA Metrics in Revised PDP

Dynisco



Baseline DFMA Analysis
Generate DFA / Pareto analysis for existing internal and/or competitor product.

- DFA Index
- Total Part Count
- Total Cost - DFM
- Total Assembly Time
- Paretos

Set Targets
Review baseline data and establish cost targets based on NPV/GM requirements.

- Functional Targets
- DFA Index
- Total Part Count
- Total Cost - DFM
- Total Assembly Time
- Paretos

Product Design
Conduct next level DFA / Pareto analysis.

- Multiple iterations can be under taken.
- Compare DFA / Pareto results to targets.
- DFM analysis on major fabricated / machined components
- Identify best materials & mfg. processes

Final DFMA Review
Review final DFMA results and compare to targets before product launch.

- Functional Targets
- DFA Index
- Total Part Count
- Total Cost
- Total Assembly Time
- Paretos

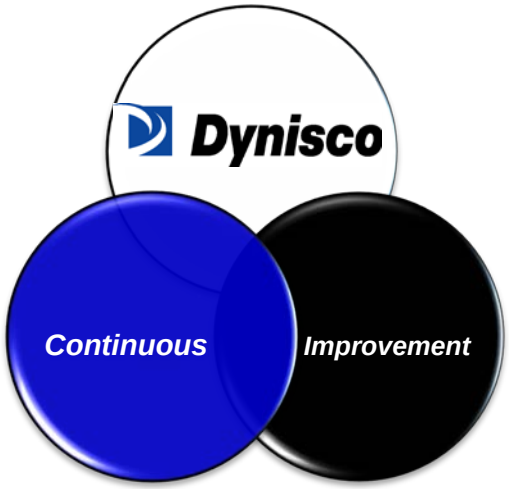
DFMA – Current State

Dynisco

Valves, Material Analysis, and Sensors (VMAS) Group

DJ Instruments

Viatran



ALPHATECHNOLOGIES

amot

HARDY PROCESS SOLUTIONS

DESS
Diesel Engine Safety Solutions

DFMA – Current State

Dynisco

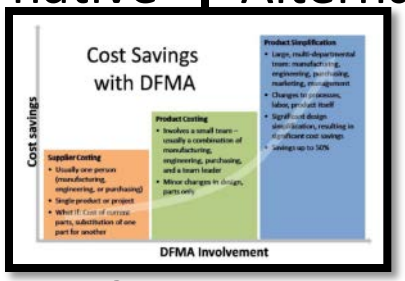
Valves, Material Analysis, and Sensors (VMAS) Group

Questions on DFMA Implementation?

DFMA Application

DFMA and Value Engineering (VE)

DFA	VE Process (origin)	DFM
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



VE Process (refined)

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

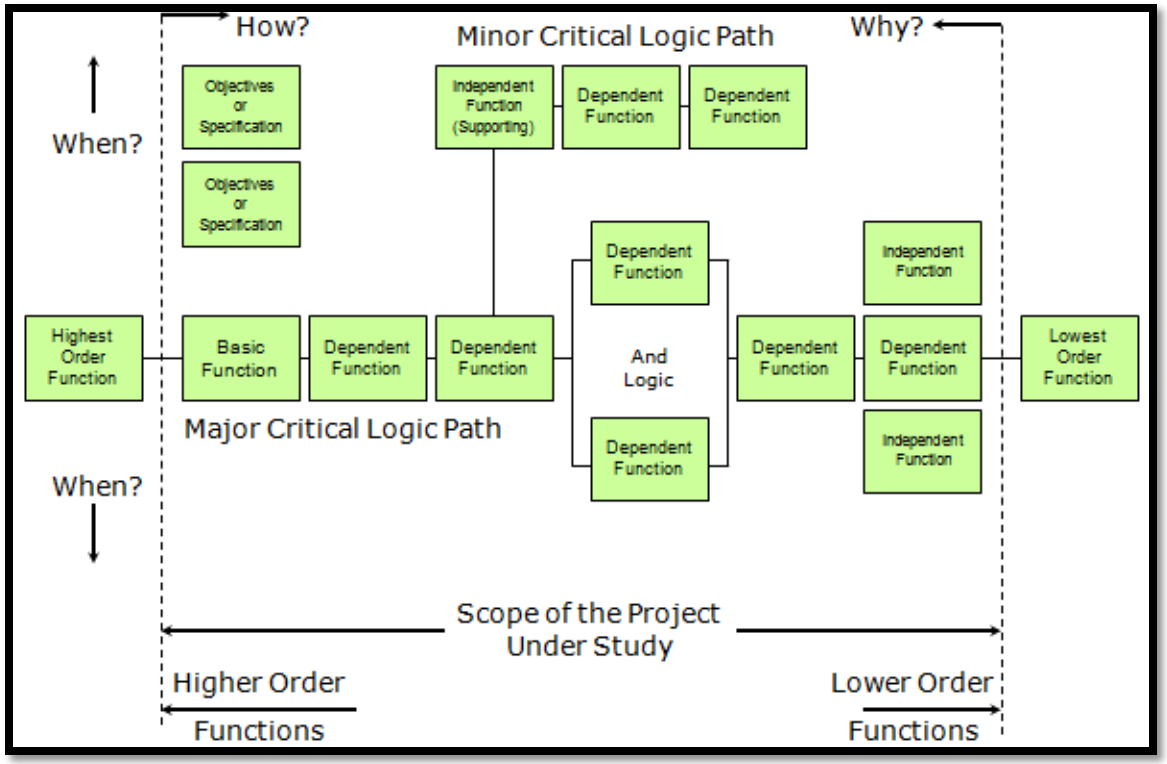
Dynisco

Random Function Identification

- Technique for analyzing the performance of a product
- Active Verb / Measurable Noun
- Use “Transmit Torque”
- Aesthetic “Attract User”

FAST Diagram

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



Value Measurement

Dynisco

$$\text{Value Index} = \frac{\text{\% Importance}}{\text{\% Cost}} \qquad \frac{\text{Function Worth}}{\text{Function Cost}}$$

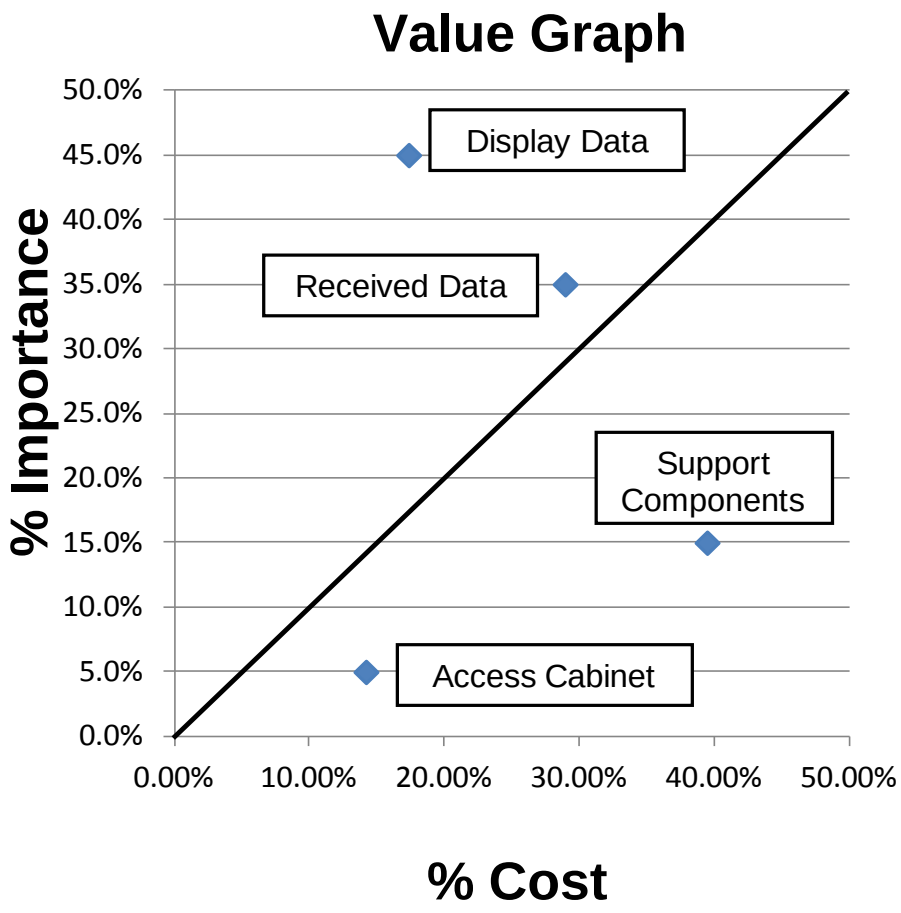
	% Importance	% Cost	Value Index
Display Data	45%	17%	2.59
Received Data	35%	29%	1.21
Support Components	15%	39%	0.38
Access Cabinet	5%	14%	0.35

45 degree line = Value Line

Value Index > 1 High value

Value Index < 1 Low value

Use Value Indices to create targets



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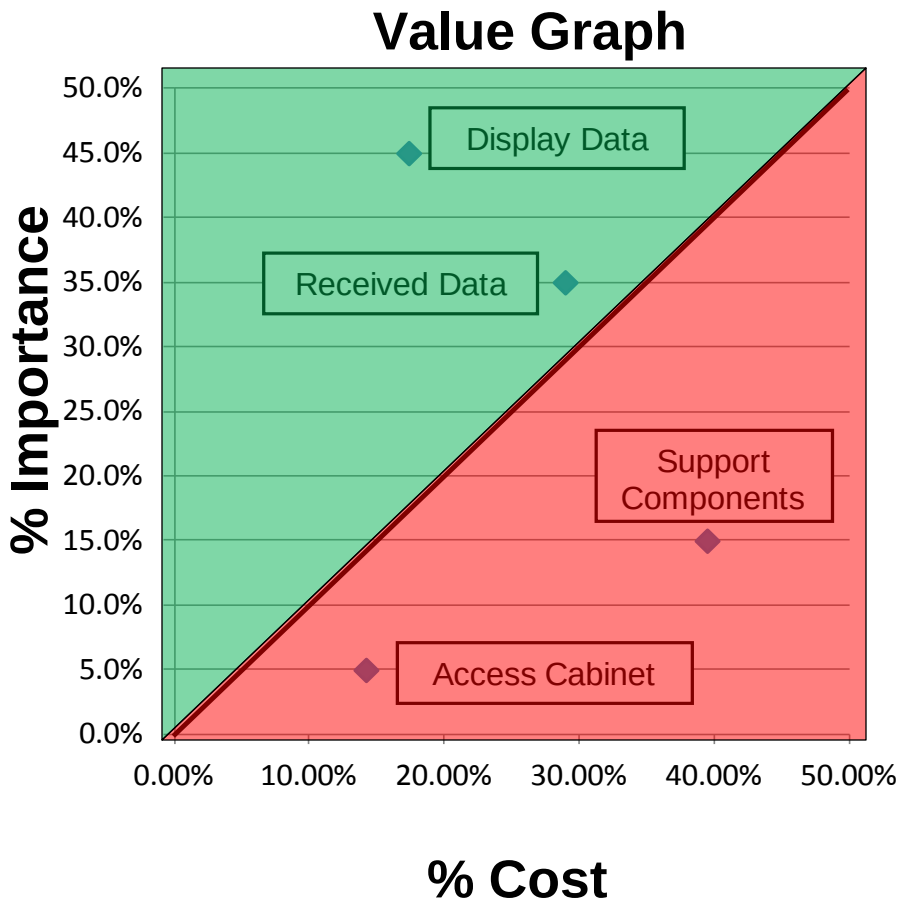


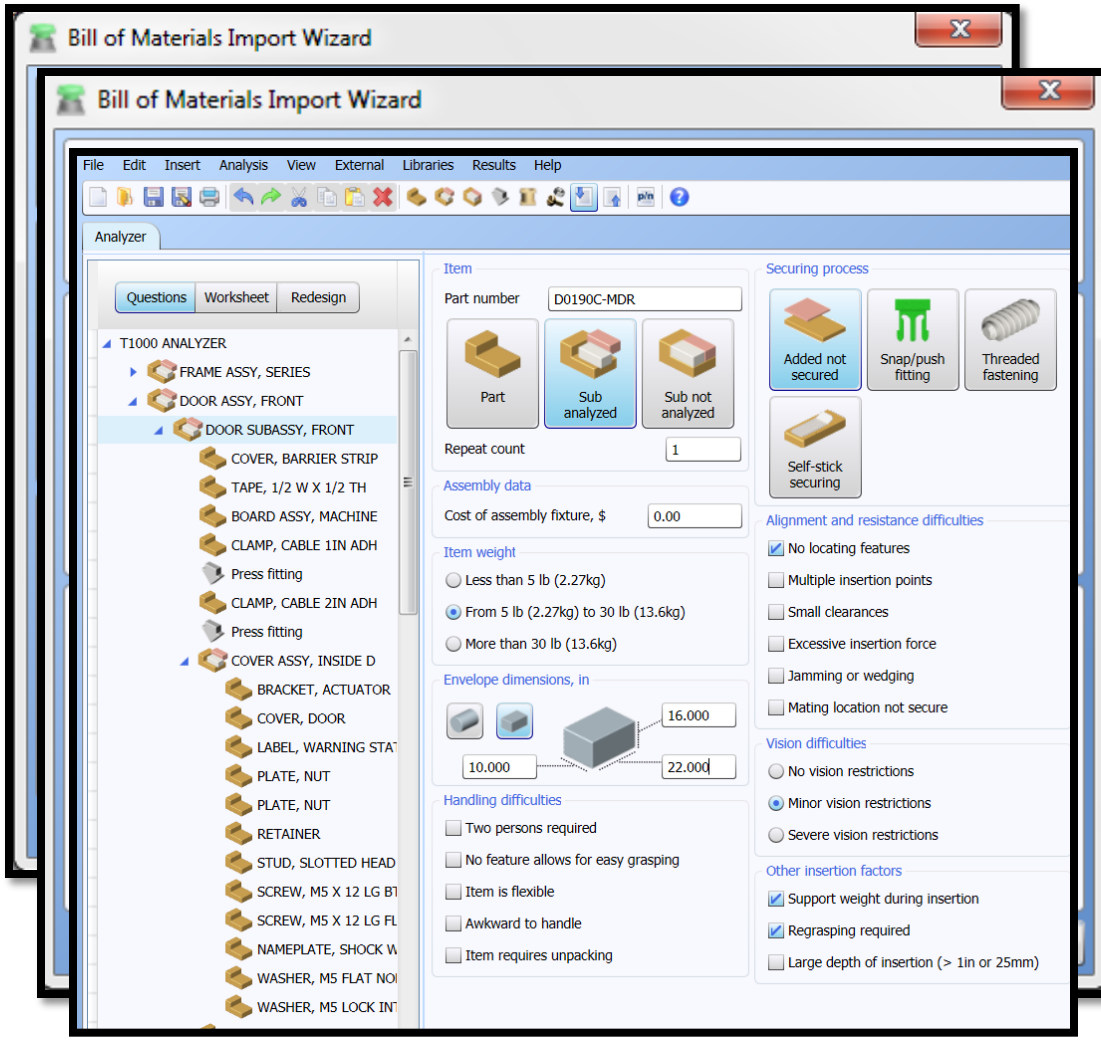
DFA Analysis

Export – from ERP

Import – to DFA

Product BOM

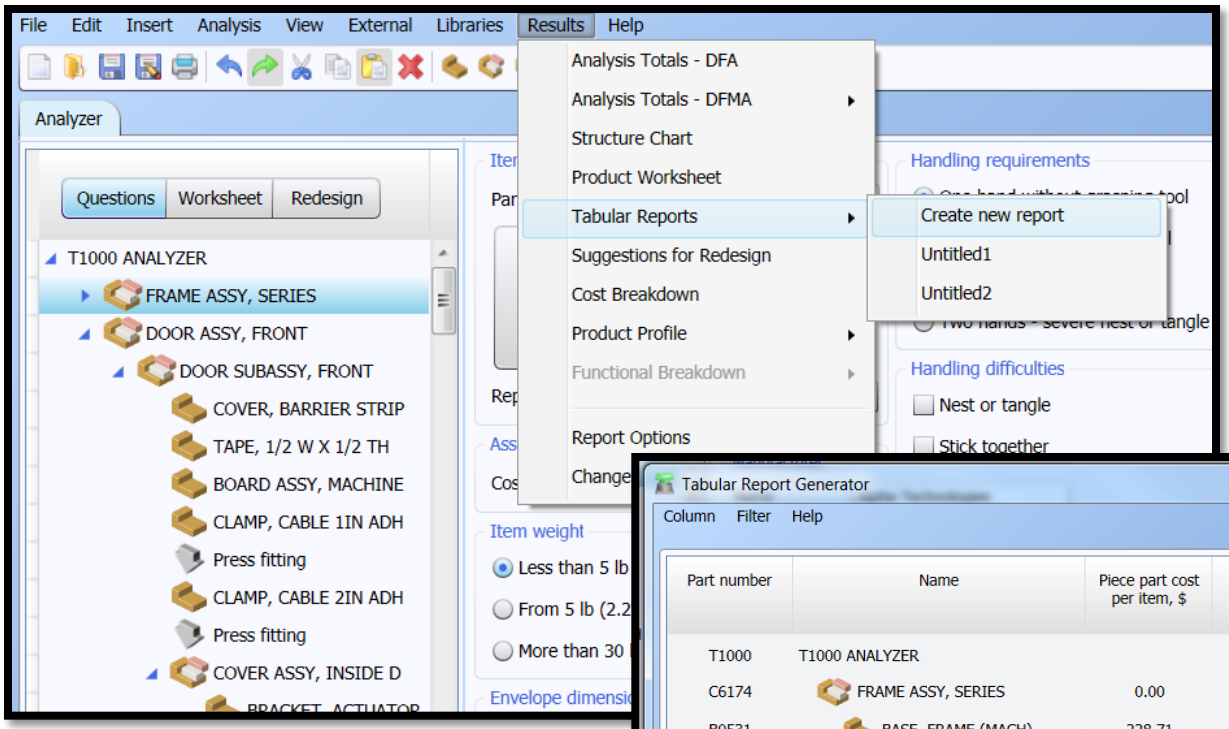
1. Define Product assembly structure
2. Answer DFA questions
3. Generate redesign ideas
4. Categorize ideas and generate concepts
5. Use DFMA to quantify effect of redesigns

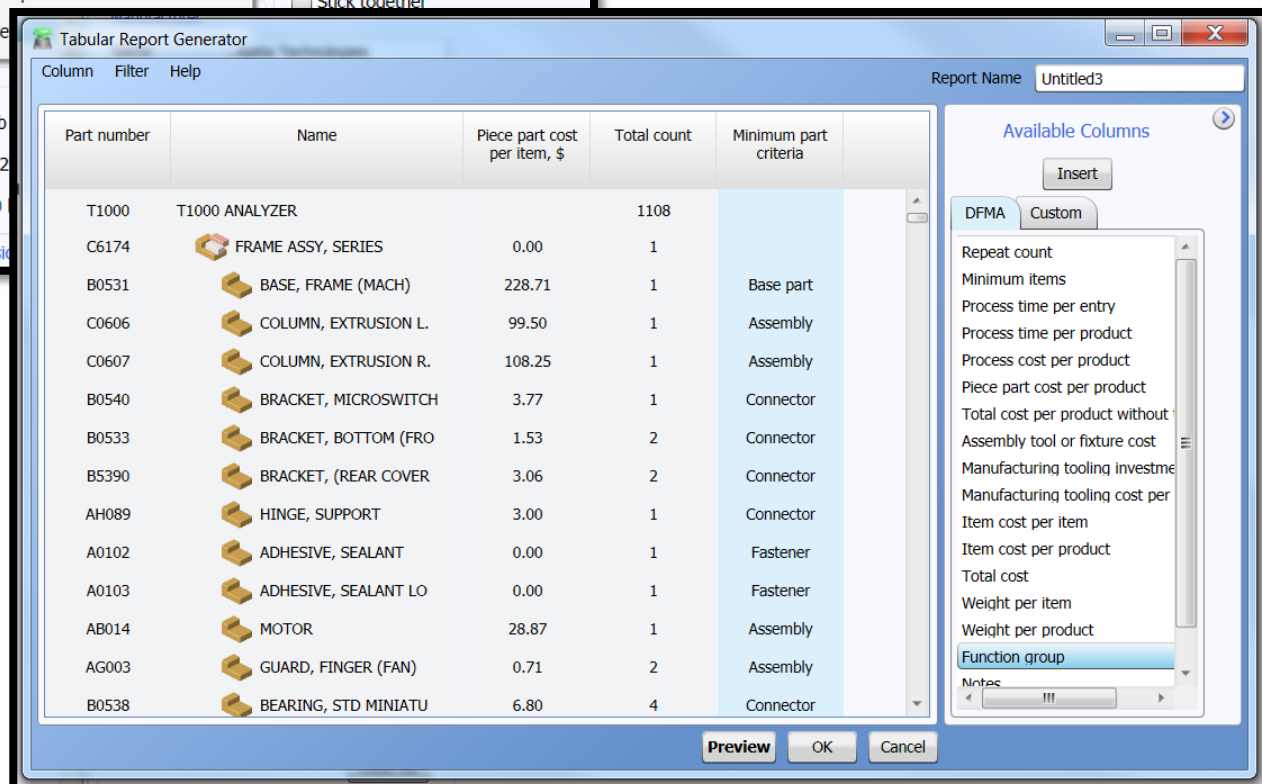


Source: Boothroyd Dewhurst, Inc.

DFA Analysis

Dynisco

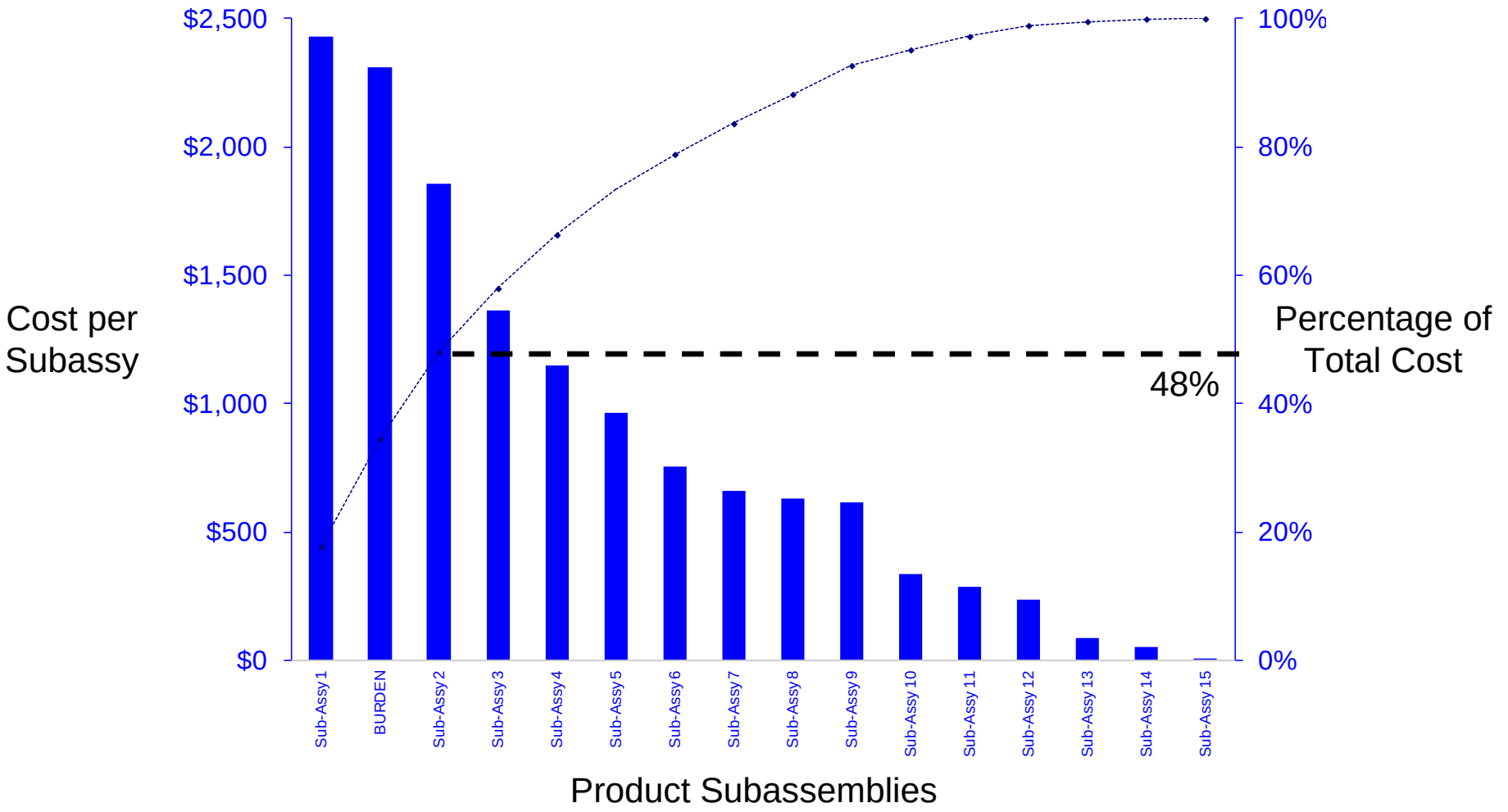




Export – from DFA

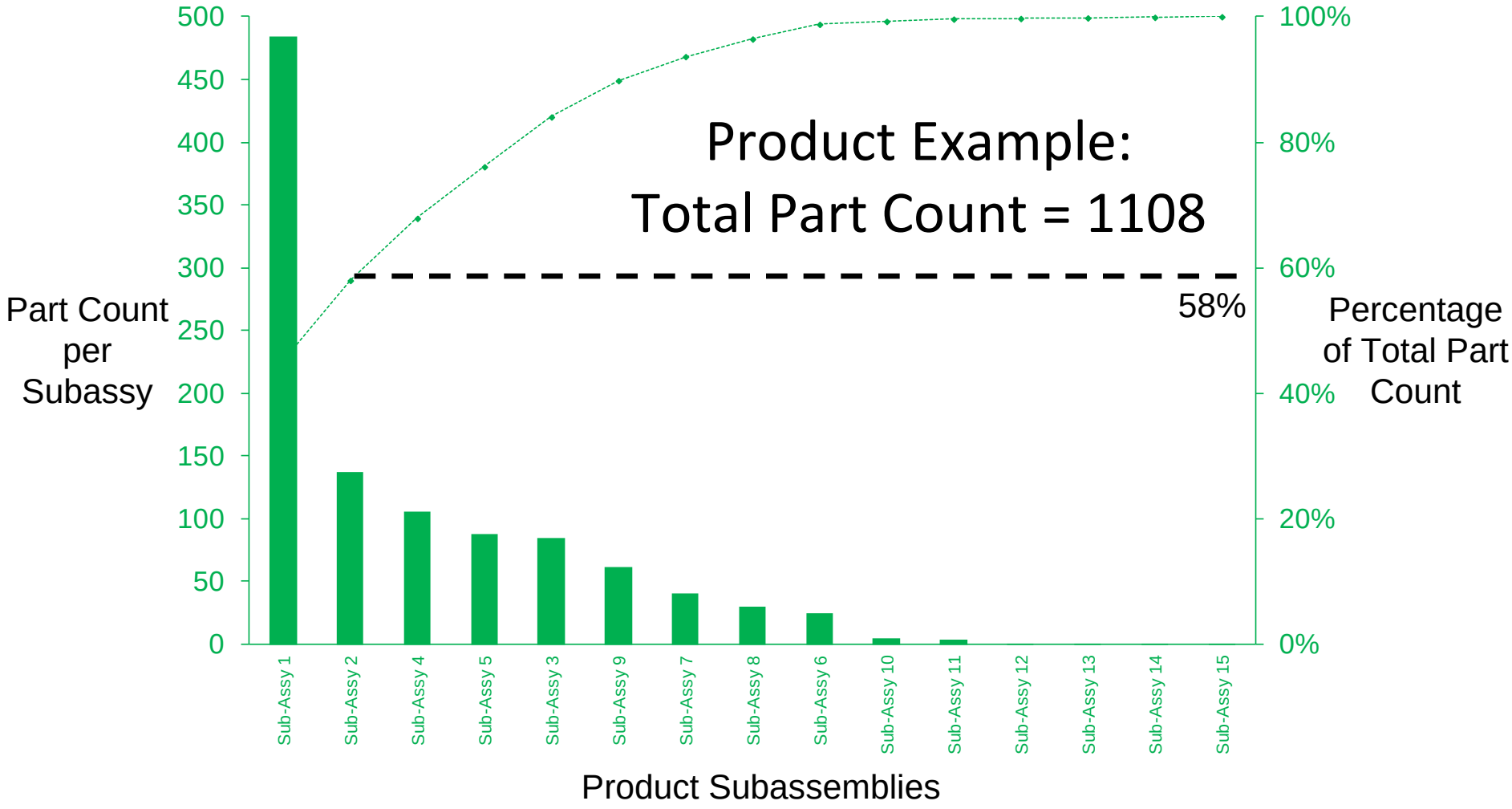
Import – to Excel

DFA – Cost by Subassembly



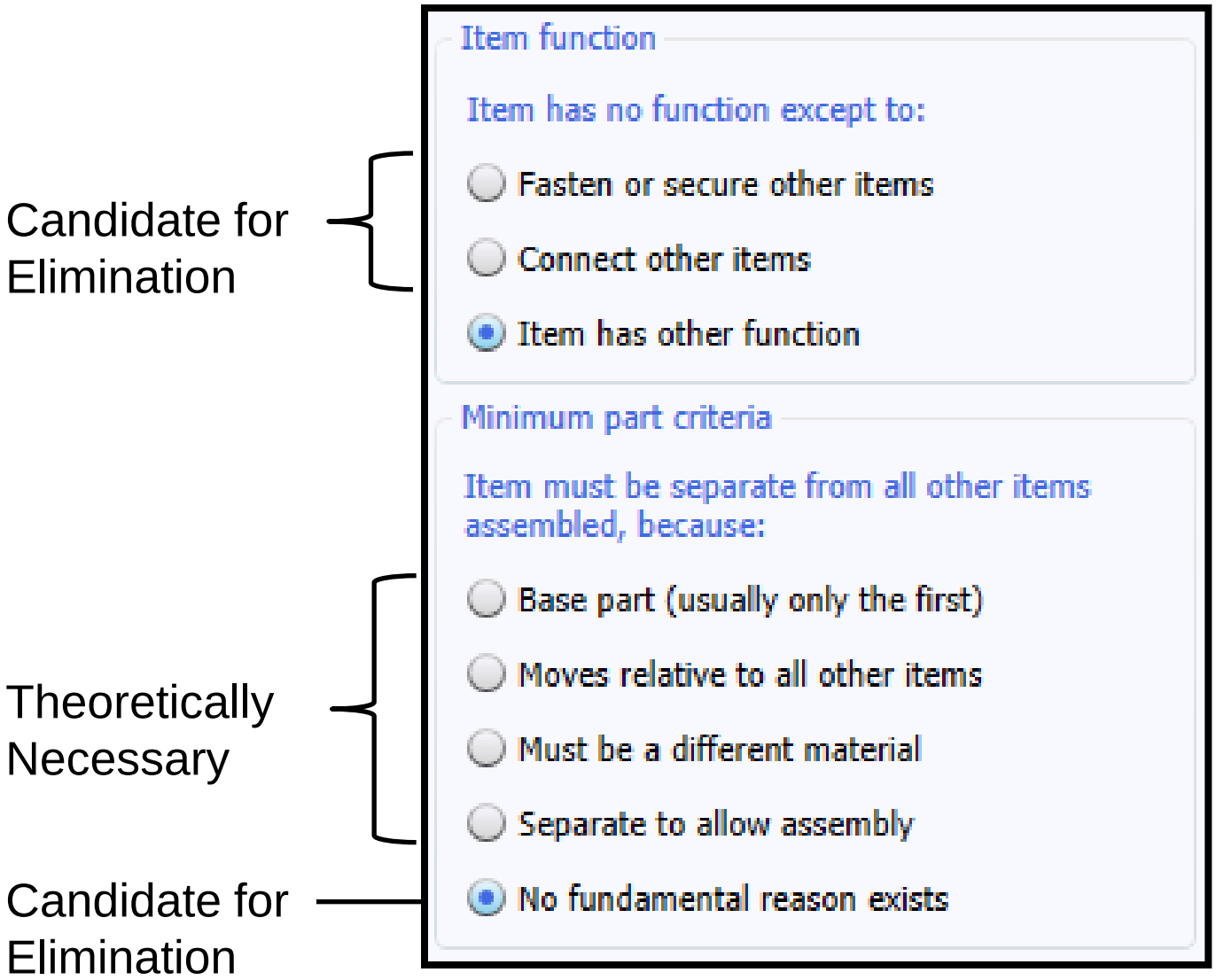
Identify where the cost is in the product (Subassemblies 1 & 2)

DFA – Part Count by Subassembly



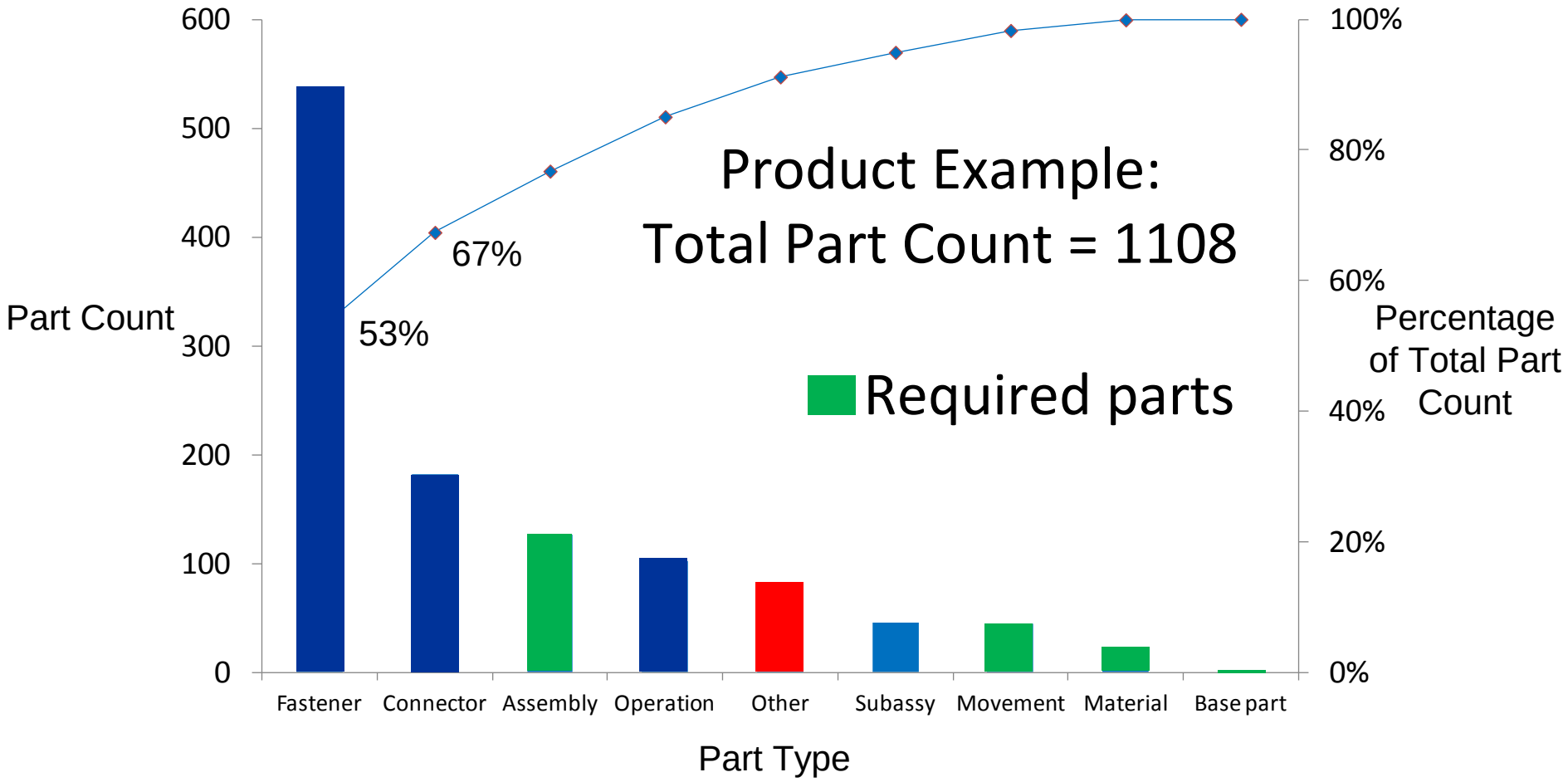
Subassemblies 1 & 2 – Highest costs and highest part count

DFA – Minimum Part Criteria



Source: Boothroyd Dewhurst, Inc.

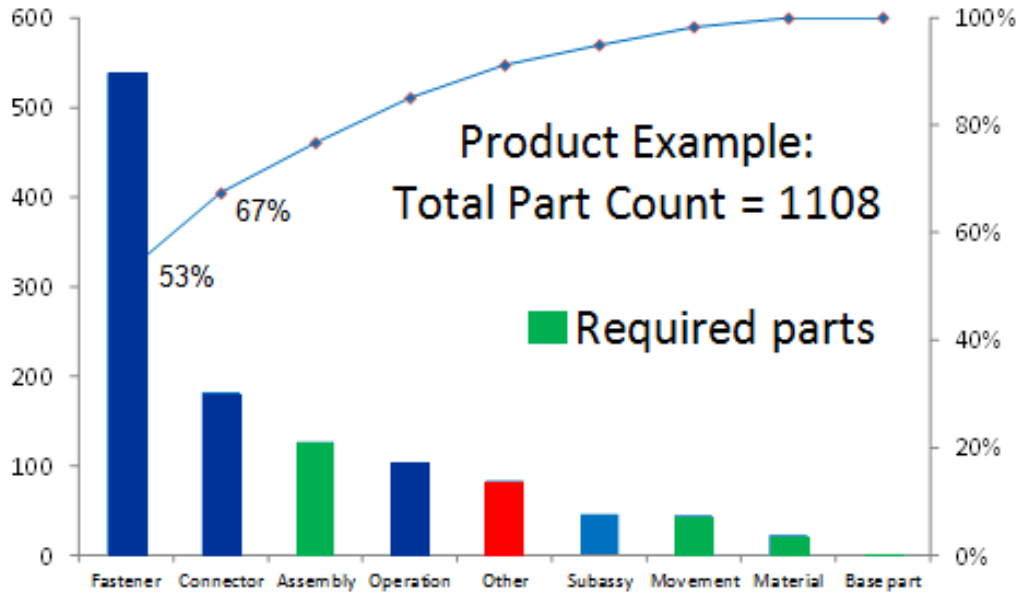
DFA – Part Count by Min. Part Criteria

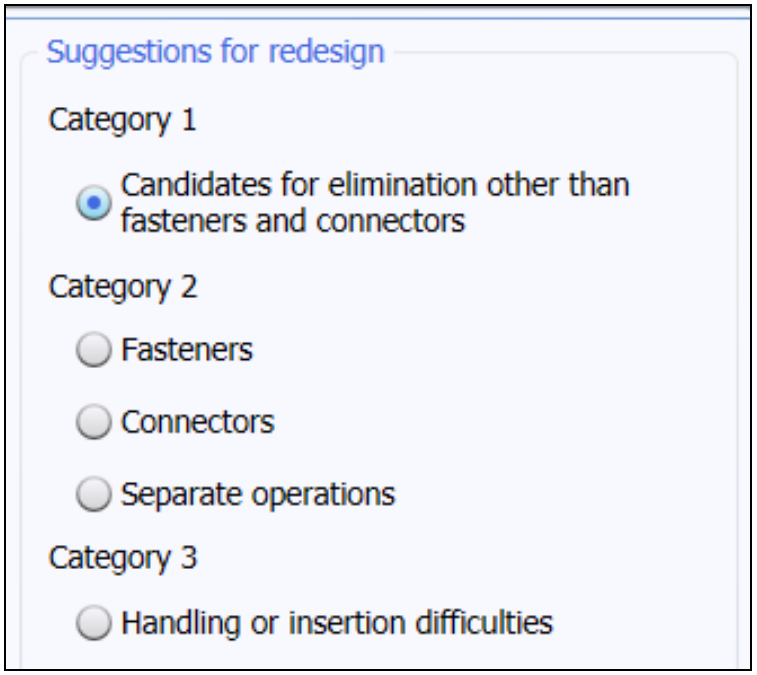


Candidates for Elimination:

- Category 1
- Category 2

DFA – Part Count by Min. Part Criteria



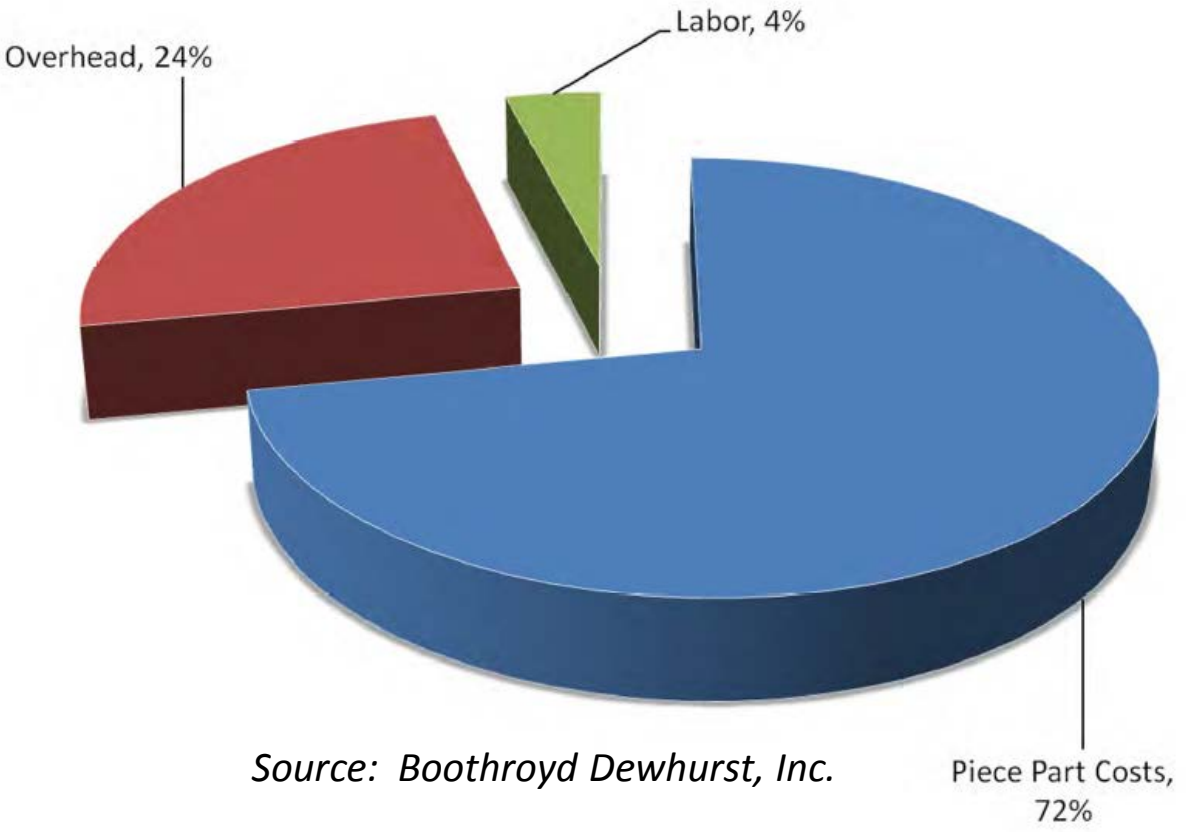


Candidates for Elimination:

- Category 1 = **$$**
- Category 2

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

Typical Product Cost Breakdown



Source: Boothroyd Dewhurst, Inc.

Average for 7 Dynisco Products:

Piece Part Costs	73%
Labor	5%
Overhead	22%

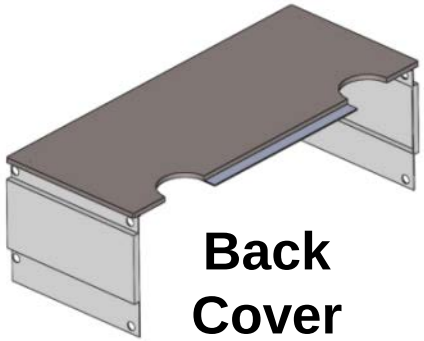
Total cost of parts represents the largest opportunity for cost reduction

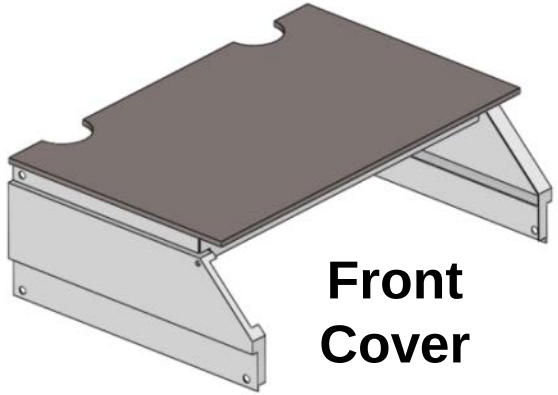
Example

Laboratory Capillary Rheometer (LCR)

- Measures plastic material flow & deformation properties under high force, high shear rate, and elevated temperatures

Cover Assemblies:

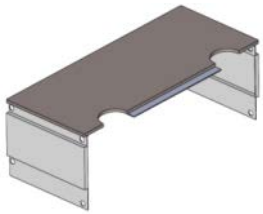


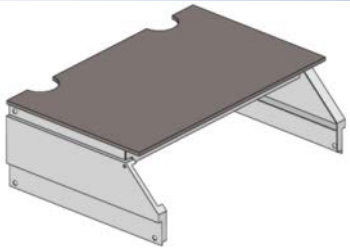


Function / FAST / Value Index exercise results:

Enhance Style (aesthetic)	1.3
Protect Components (use)	.50

Example

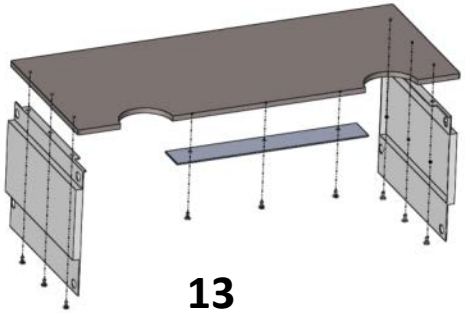


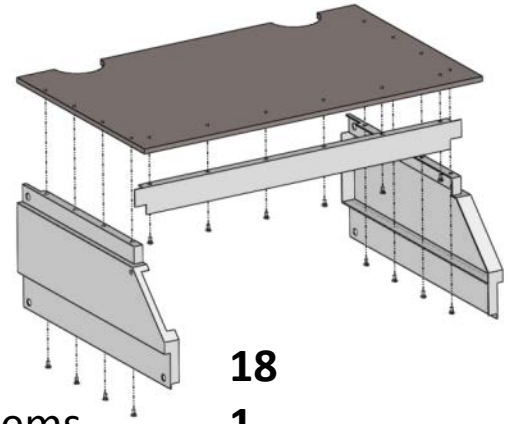


Value Index

Enhance Style	1.3
Protect Components	.50

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





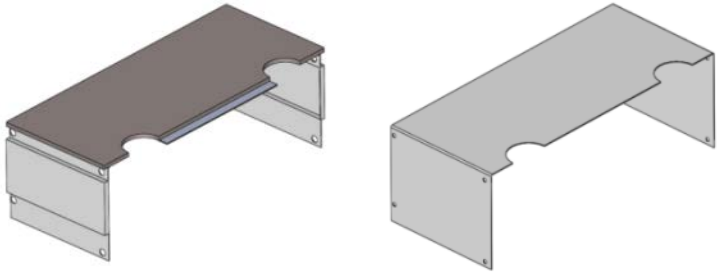
DFA - Back

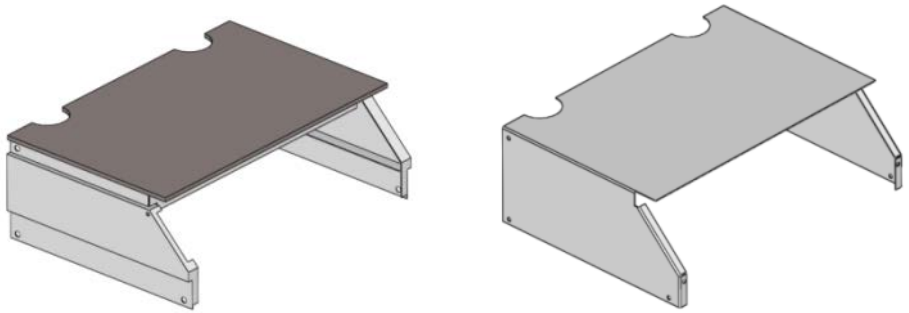
Total Part Count	**13**
Theoretical Min Items	**1**
DFA Index	**3.1**
DFA Labor Time	**187s**
Time Study	**203s**
Labor Cost	**$2.59**
Item Cost	**$138**
Total Cost	**$141**
DFM 'should-cost'	**$70**

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**
Item Cost	**$193**
Total Cost	**$197**
DFM 'should-cost'	**$104**

Example





DFM - Back

Total Cost	**$141**
DFM ‘should-cost’	**$70**

<u>1-Piece Cover</u>

Steel, Painted	**$39**
Aluminum	**$39**
Aluminum, Painted	**$46**
Stainless Steel	**$77**

DFM - Front

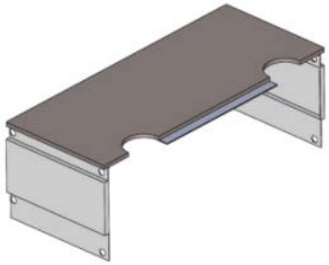
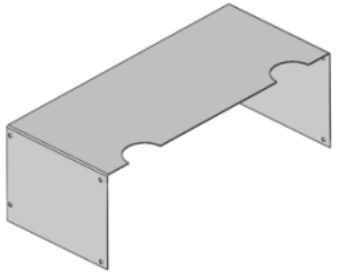
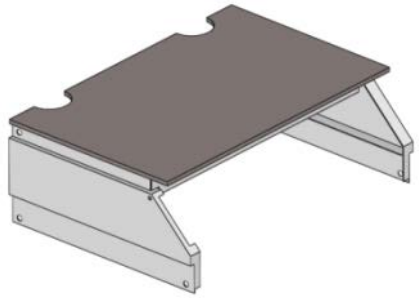
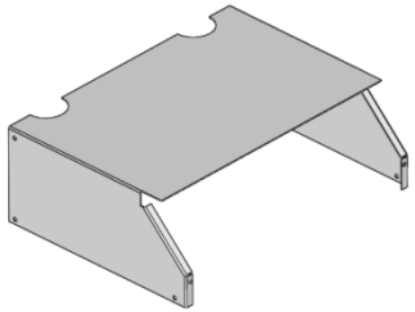
Total Cost	**$197**
DFM ‘should-cost’	**$104**

<u>1-Piece Cover</u>

Steel, Painted	**$54**
Aluminum	**$55**
Aluminum, Painted	**$65**
Stainless Steel	**$108**

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

Example

Enhance Style 1.3

Protect Components .50

DFA - Back		Redesign
Total Part Count	**13**	**1**
Theoretical Min Items	**1**	**1**
DFA Index	**3.1**	**53.9**
DFA Labor Time	**187s**	**0**
Time Study	**203s**	**0**
Labor Cost	**$2.59**	**0**
Item Cost	**$138**	**$39**
Total Cost	**$141**	**$39**
DFM 'should-cost'	**$70**	

DFA - Front		Redesign
Total Part Count	**18**	**1**
Theoretical Min Items	**1**	**1**
DFA Index	**2.2**	**53.9**
DFA Labor Time	**258s**	**0**
Time Study	**278s**	**0**
Labor Cost	**$3.58**	**0**
Item Cost	**$193**	**$54**
Total Cost	**$197**	**$54**
DFM 'should-cost'	**$104**	

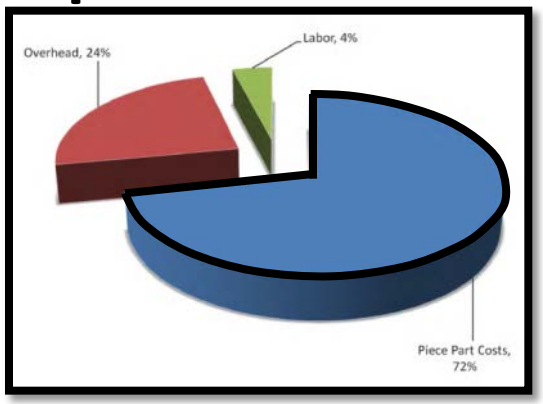
Data based decision

Everyday Tools

Dynisco

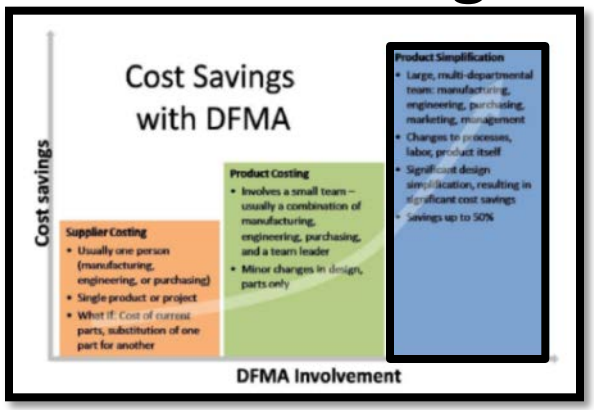
DFA	VE Process	DFM
Baseline analysis	1.What is it?	Part Design
Total product cost	2.What does it cost?	Should-cost
Min. Part Criteria	3.What does/must it do?	Part Design
Redesign	4.What else would do the job?	Mat'l & Processes
Redesign total cost	5.What would that alternative cost?	Alternative cost

Product Simplification



Function FAST Value Index

Part & Tooling Costing



Questions on DFMA Application?