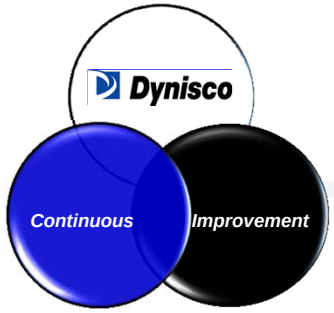

A Dynisco Case Study: From DFMA Implementation Plan to Results

Matthew Miles
DFMA and Value Engineering Manager

Dr. Surinder Sood
Principal Engineer

Joel Neri
Engineering Manager

Agenda

- Dynisco Review
- Hammer Union Product
- Benchmarking
- DFMA Redesign
- Results
- PDP & TCO

2012 DFMA Forum

- DFMA Implementation

  By Matthew Miles

- DFMA in the Product Development Process

  By Kevin Dailida

- Tying it all Together: Lean, TCO, DFx, VAVE and Supply Chain/Operations

  By John Biagioni

Dynisco

Part Count Reduction

Mark III Sten

- 69 to 48 parts
- 1941

Source: The Genius of Design: Blueprints For War, Television Series

Hammer Union 510

Features

- FM, CSA and ATEX Intrinsically Safe
- Hammer Union pressure fitting
- Shock and vibration resistant
- Eight gage sensor design
- Pressure up to 20,000 PSI (1379 bar)

Typical Applications

- Oil well Servicing
  - Cementing
  - Fracturing
  - Acidizing

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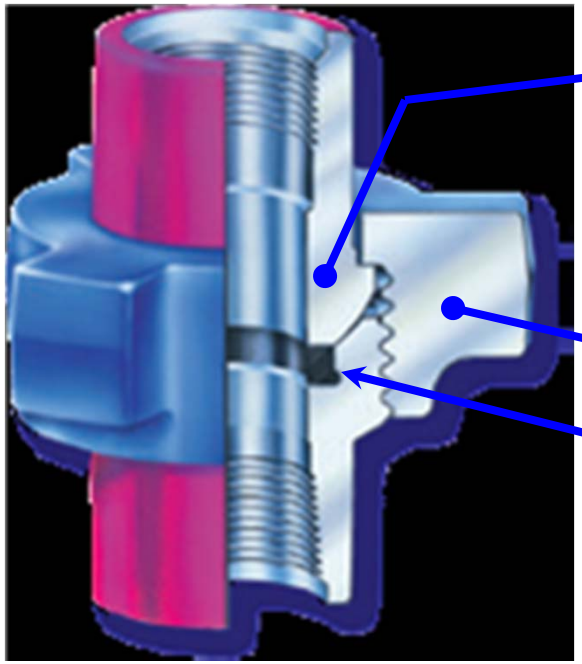
Weco® Fitting



Hammer Union Fitting or Pressure Transducer

Weco® Nut

Seal

Hammer Union Installed

Sledgehammer Impact

Weco® is a registered trademark of FMC Technologies.

Environment

Water

Oil & Gas

Cement

Mud

….and Sledgehammer

“Swings and misses”

Competitive Benchmarking

- 4 Dynisco/Viatran Products
- 7 Competitor Products
- Tear down each unit
- DFA analysis
- DFM “should cost” analyses
- Complete Design analysis

												
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	65	83	184	118	91	101	105	114
Component Count	#	85	102	62	33	39	106	63	58	66	59	62
Theoretical Minimum Part Count	#	22	23	21	15	17	27	25	15	31	20	23
Theoretical Assembly Time	Min.	16	21	17	60	20	41	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%	-34%	27%	19%	-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	2.5" dia. x 2.25" lg. tube	3.50" dia x 2.38" lg	3.25" dia x 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

Strengths **Weaknesses** **Concepts**

Competitive Benchmarking Results

Hammer Union
Pressure Transmitter
510

Our Goals:

- **Improve adapter cleaning, reduce corrosion of connector**
- **Improve Access & Protection for Connector**
- **Eliminate Adapter-to-Sensor Housing Fasteners**
- **Compatibility to Weco® Fitting & Customer Electrical Connector**
- **Repairability**
- **Cost Effective & Simplify Assembly**

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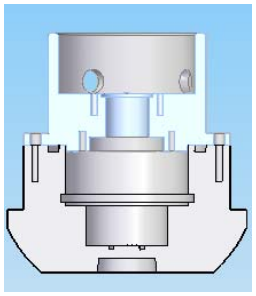
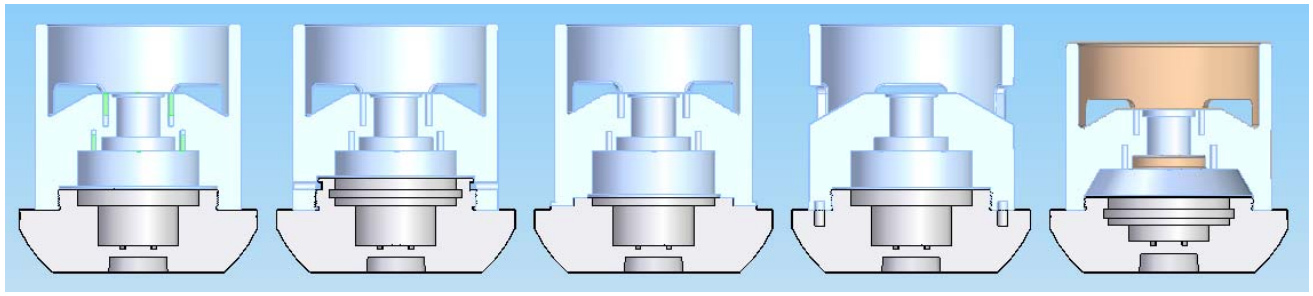
Design Iterations

Round 1 - Concepts



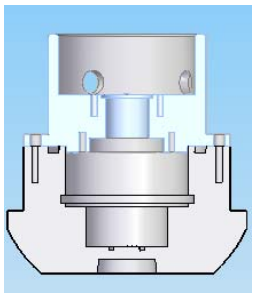
Existing 510 Mechanical Cross-Section



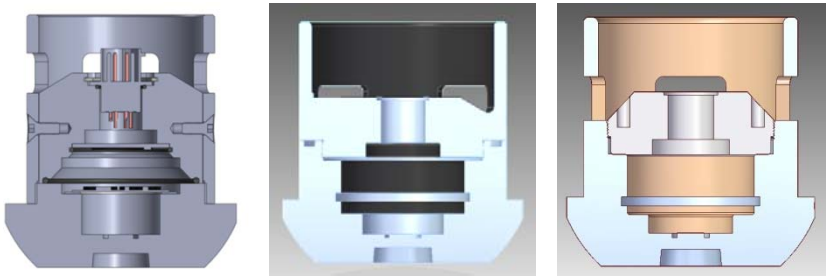
- DFA all assemblies
- DFM all piece parts

Quickly adjust existing 510 DFA & DFM files created during benchmarking

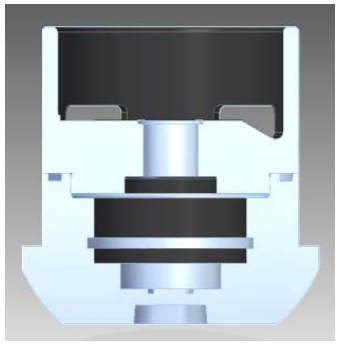
Round 1 Analyses show Design & Cost Targets not achieved



Round 2 - Concepts



Design Path

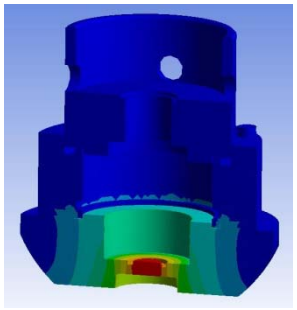


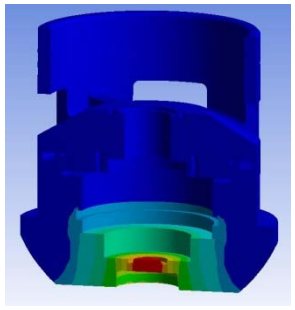
Engineering Toolbox

- Rapid Design Iterations
  - 3D Modeling
  - DFMA
- Rapid Prototyping
- Stress Analysis
  - Hand Calculations
  - FEA
- Best Materials & Processes Selection
- Operations/Assembly

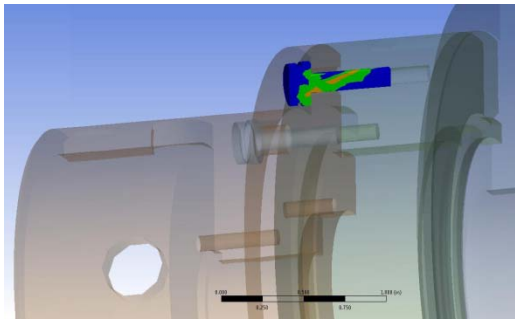
Rapid Proto

Pressure Deformation

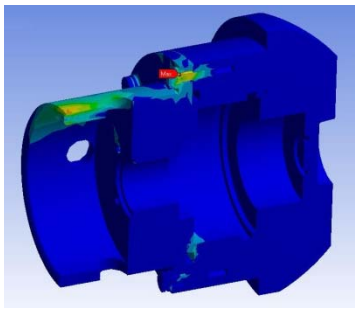


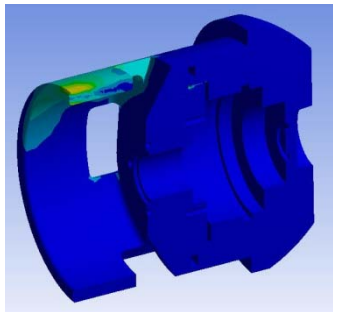


Screw Failure



Design Stress





Quality

- Customer perception:

  “Screws are failing due to sledgehammer strikes to Adapter”

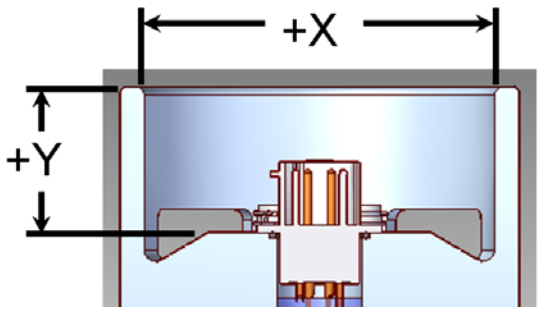
Customer Impact Test Results

- FEA’s supported Customer Test Results: Material deformation before screw failure
- Other failure modes:
  - Electrical Connector: Corrosion, hammer strikes

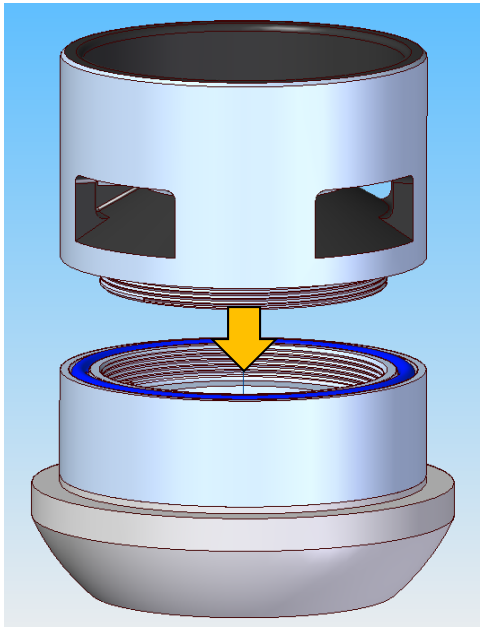
6-Pin Connector

New Design

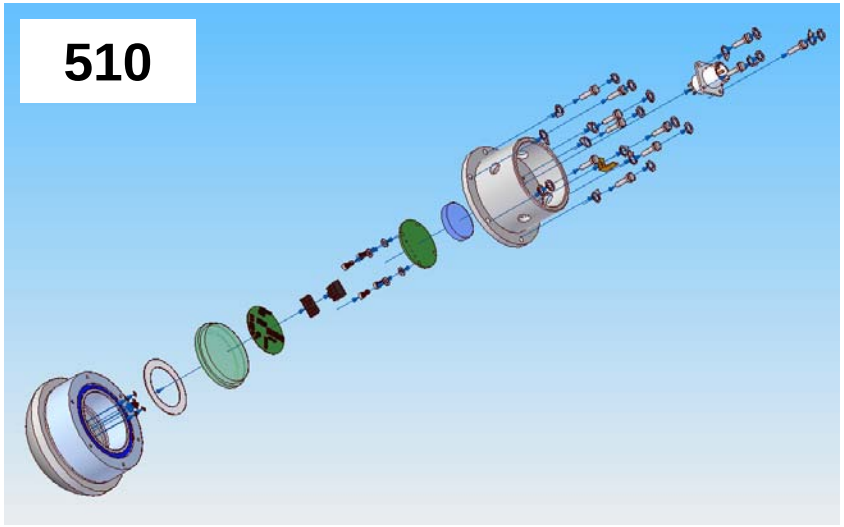
Hammer Union Pressure Transmitter 511

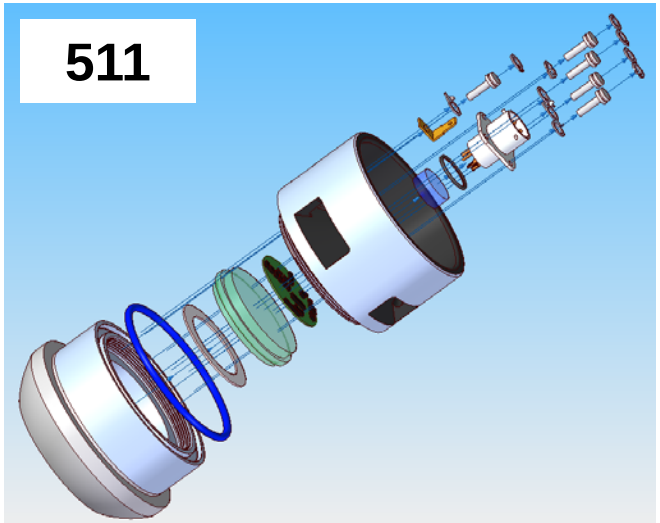


- Investment Cast Adapter
  - Near Net-Shape = Reduced Machining
  - Raw material/Finished Part
    - 510 4.7 lbs / 1.1 lbs
    - 511 2.9 lbs / 2.0 lbs
- Debris Egress Windows
  - Windows/sloped surface provide easier cleaning
- Repairability
  - Adapter screws to housing
- Improved Connector Protection & Access
  - Increased X & Y dimensions



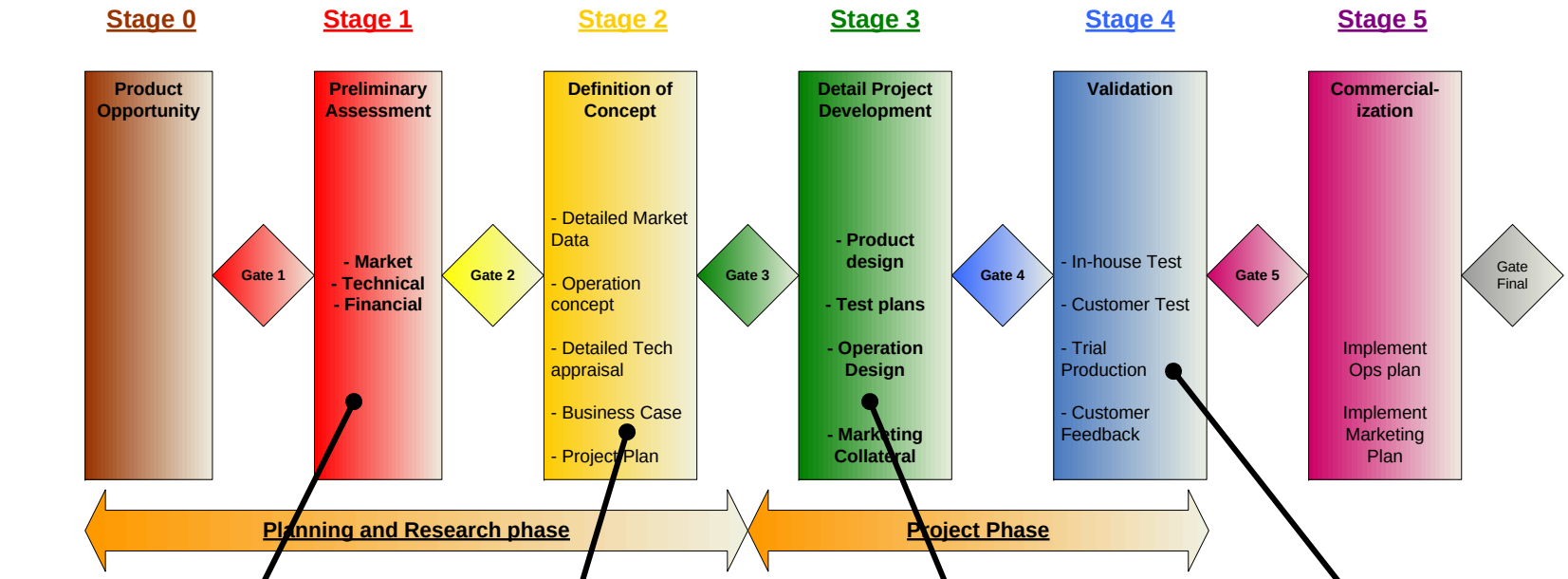
New Design – Part Count Reduction





	510	**511**
▪ DFA Index	7.0	**9.6**
▪ Part Count	102	**66**
▪ Fasteners	82	**46**
▪ PCBD	2	**1**
▪ Assembly Time	**25% reduction**	

DFMA Metrics in Revised Dynisco PDP



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

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

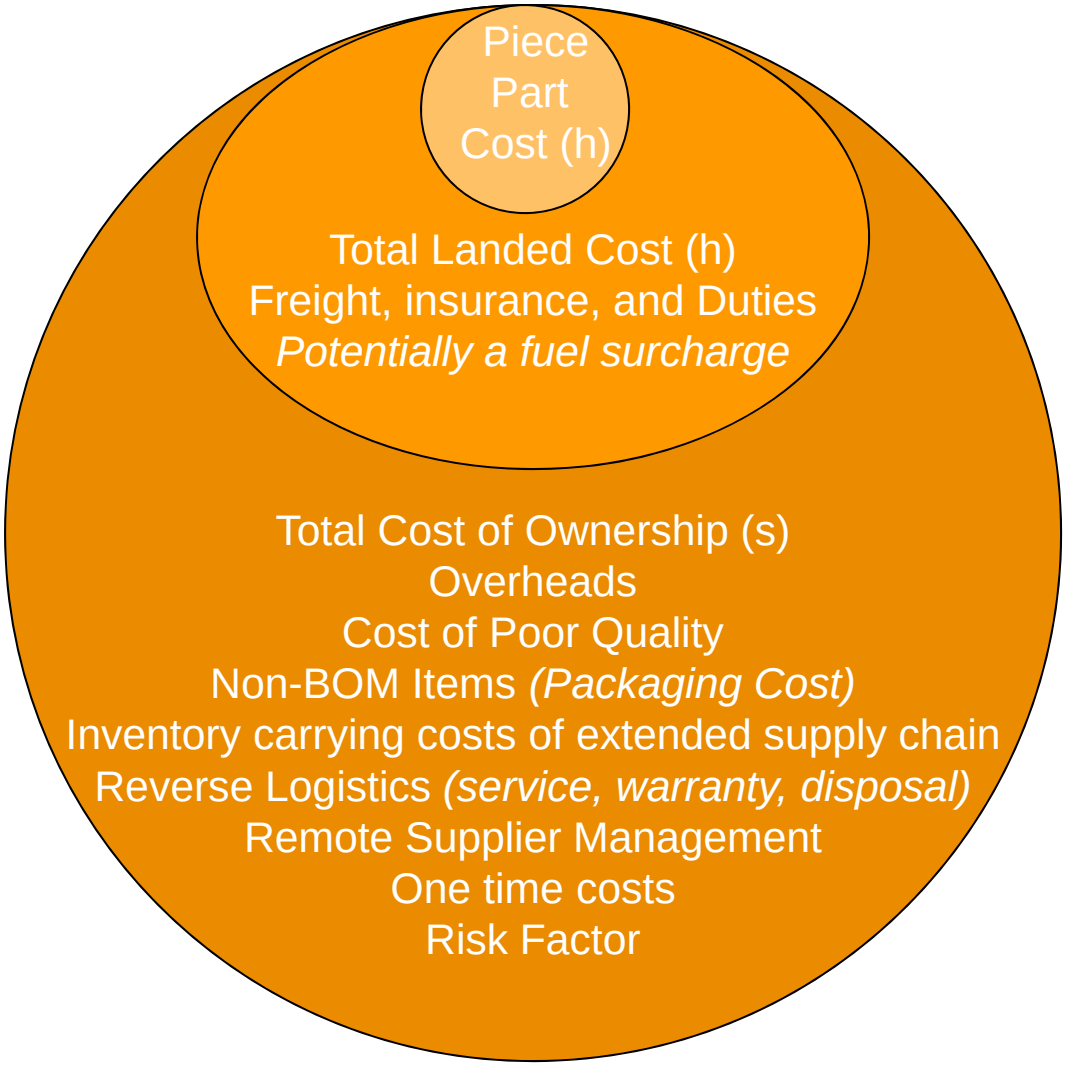
Product Design
Conduct next level DFA / Pareto analysis.

- 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

Total Cost of Ownership (TCO)



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Risk Factors

- Inflation
  - Labor
  - Energy/Fuel
- Business Continuity
  - Health/Pandemic
  - Infrastructure
- Quality (losing the recipe)
- Customer Perception/Acceptance
- Currency
- IP Transfer
- People
  - Cultural Differences - Guanxi
  - Language Barriers
  - Skill/Experience
  - Turnover
- Financial & Legal Environment
- Service Level - Flexibility
- Trust – Corruption & Business Practices

Source: John Biagioni
Dynisco, Franklin, MA

Total Cost of Ownership (TCO) – Part from China

Dynisco

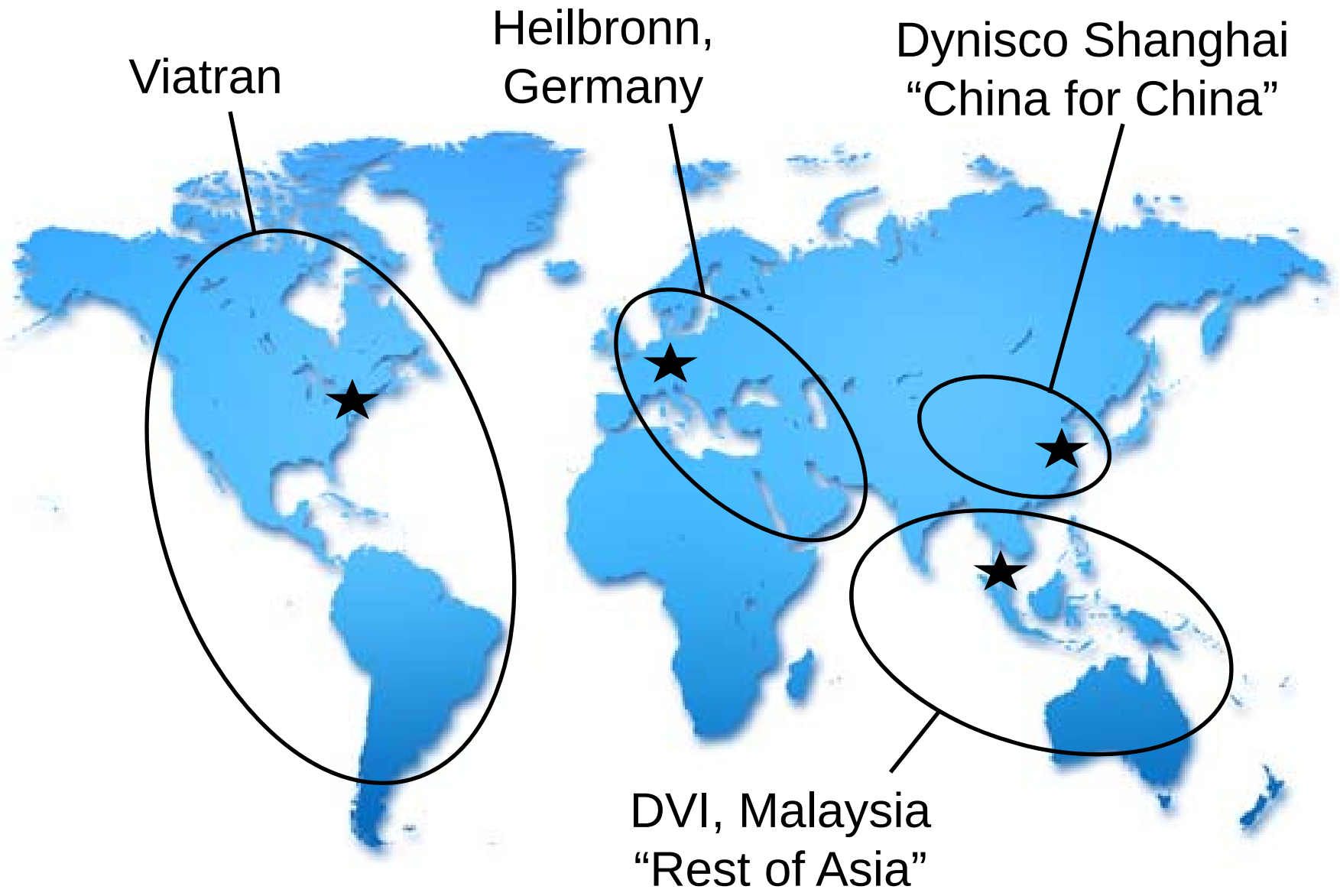
Value Stream Map

1. China to Dynisco
2. Dynisco to Viatran
3. Viatran to Welder
4. Welder to Machine Shop
5. Machine Shop to Viatran

TCO Analysis = **$22/unit**

Dynisco

Regional Manufacturing and Distribution



Summary

DFMA Implementation Plan

Benchmarking **DFMA** **TCO** **Lean**

Revised Product Development Process

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"the greatest improvements arise from simplification of the product by reducing the number of separate parts"

Thank you!

Questions?