2015 International Forum on DFMA
Boothroyd Dewhurst

Tying it all together: Lean, TCO, DFMA, VAVE, Supply Chain & Operations

June 3, 2015

John Biagioni
President

Introductions

John Biagioni – President, Dynisco

- BA Economics (URI), MS Operations and Information Technology (WPI)
- Started as a machinist trainee, currently a President, been everything in between…
- Hold (3) patents on sensing design
- Been Doing DFMA since URI in the early 90's by hand…

Matt Miles – DFMA and VAVE Engineering Manager, Dynisco

- BS Mechanical Engineering Technology (RIT)
- 16+ in Engineering from supplier quality, to CI lead to R&D to value engineer
- Hold (3) patents on sensing design
- Been Doing DFMA for 9 years, still waiting for someone to listen….

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- Hold (3) patents on sensing design
- Certified Associate Value Specialist (AVS – VAVE)

Introductions

Kevin Dailida – Sr. Director, Supply Chain and Operations, Dynisco

- BS Aerospace Engineering (Hofstra), MS Mfg Engineering and Management (WPI)
- 22+ years of Engineering and Mfg experience covering NPD, process engineering, Lean manufacturing and supply chain between…
- Responsible for product procurement, manufacturing and distribution covering the US, Europe and Asia
- Late bloomer to DFMA. Once of these days, he'll actually get it…

Agenda

- “Take Aways” from Presentations and Discussions
  - Should Costs (Clean Sheeting)
  - Competitive Benchmarking and VOC
  - DFMA Sooner vs. Later
- Dynisco’s Journey
- The Technical
  - TCO
  - Supply Chain Strategy
  - Tying it All Together
- Results

What is “Clean Sheeting” or “Should Costing”?

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- A systematic process of breaking down the cost components of a product including raw material, transportation, direct labor, indirect labor, scrap, productivity enhancing technologies, overhead, energy, regulations, other relevant components, etc.
- Building these components into a simple, quantitative model that can be used to understand the magnitude of costs and how they can be reduced
- That information can be used to better negotiate or leverage your spend with suppliers
- Clean Sheet is a transparent collaboration of data sharing between suppliers to customer
- Should Cost is using estimates on the data to come to a “Should Cost” build up price – Cost transparency does not exist

BDI captures should costs. Populating user definable material libraries and templates creates a TCO tool.

Clean Sheet Example

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ASSUMPTIONS WORKSHEET (PAGE 2)

fill pinks
check greens

		Total Cost	**$35.10**
Input Fields		**Calculated Costs**	
Item	Assumption	Item	Calculation
Material handling labor			
Desired max WiP level (hours)	2.20 hours	Total material handling work content	1 seconds/unit
Safety stock level (hours)	.20 hours	Number of material handlers required	0.02
Number of delivery points	1		
Time required per delivery (seconds)	120 seconds		
Shipping labor			
Time between truck arrivals	8.0 hours	Total shipping work content	14 seconds/unit
Number of load cycles per truck	48	Number of shipping laborers required	0.22
Time required per loading cycle (seconds)	120 seconds		
Receiving labor			
Time between truck departures	8.0 hours	Total receiving work content	14 seconds/unit
Number of unload cycles per truck	48	Number of receiving laborers required	0.22
Time required per unloading cycle (seconds)	120 seconds		
Quality control labor			
Time between QC checks	1.0 hours	Total QC check work content	7 seconds/unit
Number of stations requiring QC checks	2	Number of QC personnel required	0.11
Time required per check (seconds)	180 seconds		
MRO costs			
Maintenance personnel/shift	1.0		
Scrap costs			
Defective material rate (%)	0.05%	Defective materials cost per month	$421/month
First-time yield rate	99.00%	Defective materials cost per year	$5,054
Rework time required per defective unit	0.10 hours	Number of reworkers required per shift	0.05
Materials cost			
		Total material/component costs	$25.39
Fixed asset assumptions			
Plant floor space lease rate per year	$7.00		
Floor space required	25,000 sq ft	Total equipment costs	$825,000
Dunnage	$200,000	Equipment expense per year	$117,857
Useful life for equipment and dunnage	7 years	Dunnage expense per year	$28,571
Total tooling costs	$50,000	Tooling expense per year	$7,143
Useful life for equipment tooling	7.0 years		

Source:McKinsey

Competitive Benchmarking and VOC
DFMA – Sooner vs. Later

- Competitive Benchmarking and VOC
  - VOC is NOT only talking to your own customers. (Your market vs. Available Market)
  - VOC must be a group exercise and include competitive products as a representation of value that customers find in designs other than your own.
- DFMA – Sooner vs. Later
  - What does 62 Parts versus 1 Part mean…
    - Supply Base
    - Capital Investment
    - Labor
    - Support Costs/Overheads…

Think beyond the mechanics of the tool and apply the thought process to a broader business perspective

Dynisco’s Journey – Self Funded and Actualized

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- Lean applied to pilot plants driving incremental savings opportunities
  - Lean expanded to multi-site funding CI roles and the creation of a DFMA hire (Mr. Miles…)
- DFM introduced to Dynisco as a rapid method of effecting a step function drop in pricing moving from commercial negotiators to should cost practitioners
  - DFM focused by pareto on the largest runners with the least amount of open inventory driving quickest ROI
  - DFM successes build driving the need for more resources to work on conversion of the opportunities identified by Matt
- CI rebranded VAVE team and now focused on doing it right the first time with systematic requirement for engagement in the product development process

Lean to DFM to DFMA to VAVE in Product Development
Dynisco to VMAS to ES&C and beyond…(Roper)

What is the Right Formula for Evaluating Your Low-Cost Country Sourcing Options?
“Off-shoring, Near-shoring, Re-Shoring…”

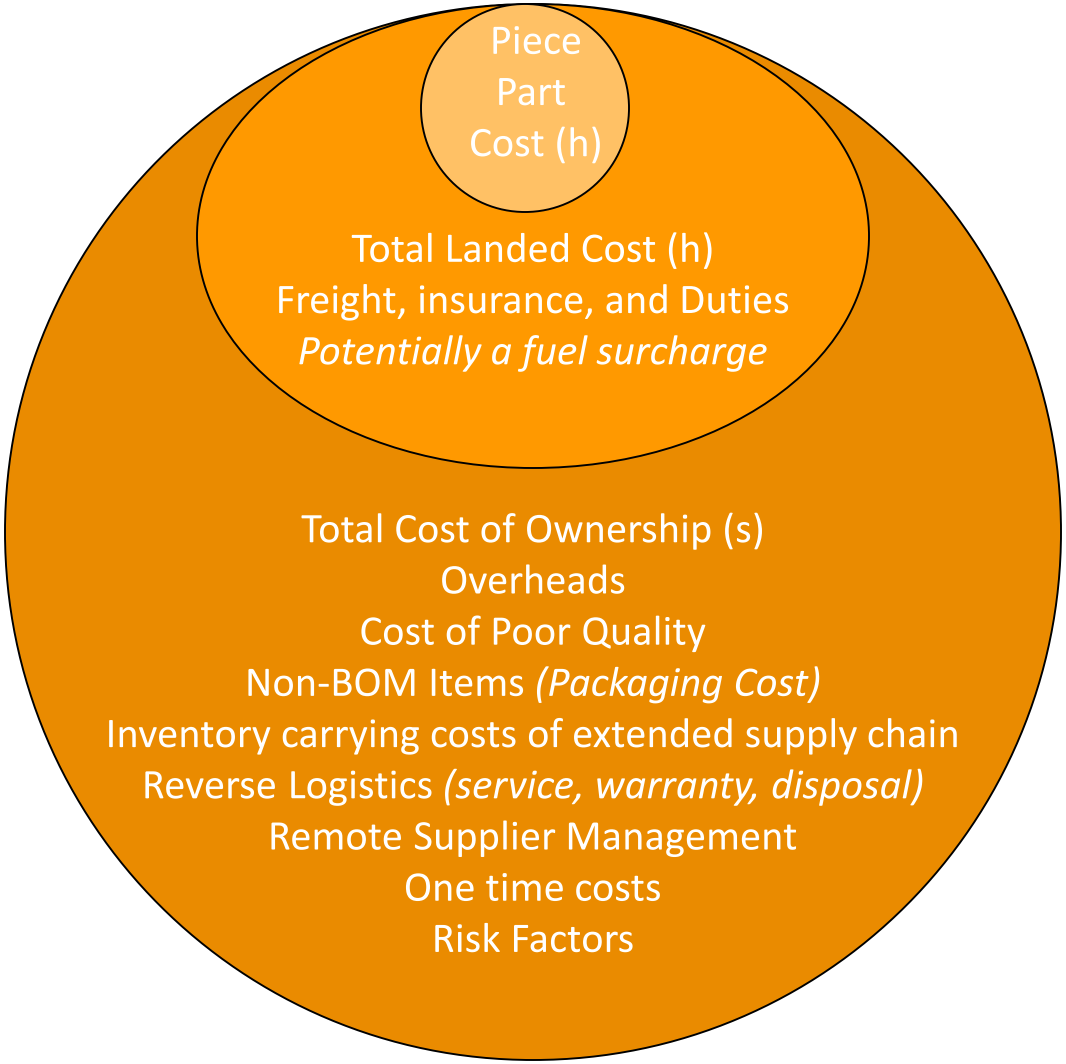
- Break down the cost into **Piece Part**, **Landed Cost** and **Total Cost of Ownership**
- Understand the **Total Cost of Ownership**
- Identify the **Risks** of moving to an LCC
- Calculate the **One Time Costs** and the **Recurring Costs**
- Understand the **True Cost** – “clean sheet” / “should cost” your product.

Breaking Down The Cost

- Piece Part Cost?
  - *Labor + Overhead + Materials*
- Total Landed Cost?
  - *Commonly, the total cost of a landed shipment—including **purchase price**, **freight**, **insurance**, and **other costs** up to the **port of destination**. In some instances, it may also include the **customs duties** and other taxes levied on the **shipment**. -* www.businessdictionary.com

- Total Cost of Ownership?
  - *Reflects not only the cost of purchase but all aspects in the further use and maintenance of the equipment, device, or system considered.*

Our Model for TCO



<u>Risk Factors</u>

- 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

Risk Factors – Calculating Risk

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Risk Factors	Weight 1-17	% Probability	Risk %
Inflation (general)	4	100%	4.0%
Labor	12	20%	2.4%
Energy/Fuel	11	75%	8.3%
Business Continuity (general)	3	50%	1.5%
Health/Pandemic	13	100%	13.0%
Infrastructure	2	80%	1.6%
Quality (losing the recipe)	17	100%	17.0%
Customer Perception/Acceptance	1	25%	0.3%
Currency	8	100%	8.0%
IP Transfer	15	100%	15.0%
People (general)	5	75%	3.8%
Cultural Differences - Guanxi	6	75%	4.5%
Language Barriers	7	95%	6.7%
Skill/Experience	10	75%	7.5%
Financial & Legal Environment	14	75%	10.5%
Service Level - Flexibility	16	100%	16.0%
Trust – Corruption & Business Practices	9	75%	6.8%
Overall Risk Factor			**7.5%**

LCC Gains at Risk Over Time – Labor Inflation

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Microsoft Excel - wageschina.xls

The Economist Intelligence Unit

CountryData - Annual Time Series

Country/Region		Series Title		Curr	2006	2007	2008	2009	2010
		Fiscal and monetary indi							
		Inflation and wages							
China	CN	Consumer prices (% chan	DCPI		1.40	2.50	2.70	2.80	2.70
China	CN	Consumer price index (av)	LCPI		107.90	110.70	113.60	116.80	120.00
China	CN	Consumer price index (19	CCPI		109.20	112.00	115.00	118.20	121.40
China	CN	Consumer prices (% chan	DCPN		1.40	2.50	2.80	3.00	3.20
China	CN	Producer prices (% chang	DPPI		2.90	3.50	3.00	2.90	2.30
China	CN	Producer price index (av)	LPPI		153.40	158.80	163.50	168.30	172.10
China	CN	Producer price index (199	CPPI		108.60	112.40	115.70	119.10	121.80
China	CN	Average nominal wage ind	CAWI		340.10	391.10	445.80	508.30	582.00
China	CN	Average nominal wages (%	DAWA		15.00	15.00	14.00	14.00	14.50
China	CN	Average real wage index (	CAWR		311.30	349.20	387.70	430.00	479.40
China	CN	Average real wages (% ch	DRWA		13.40	12.20	11.00	10.90	11.50
China	CN	Unit labour cost index (US	CULC		164.10	182.00	196.10	211.30	229.90
China	CN	Unit labour costs (% chan	DULC		7.90	10.90	7.70	7.80	8.80
China	CN	Labour costs per hour	LCHD	US$	1.36	1.63	1.90	2.20	2.56

Legend						
Actuals in Black	China					
Estimates in Blue	$9.71	$11.64	$13.57	$15.71	$18.29	$21.21
Forecasts in Green	USA					
	$18.00	$18.54	$19.10	$19.67	$20.26	$20.87

CountryData Notes	
Country/Region	Forecast Date
China	1/25/2007

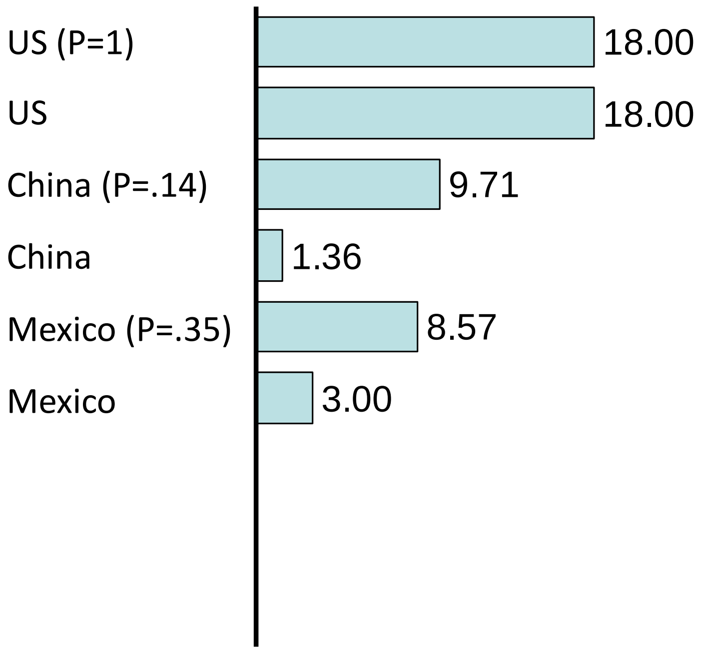
5 Yr Inflection Pt

wageschina

Ready NUM

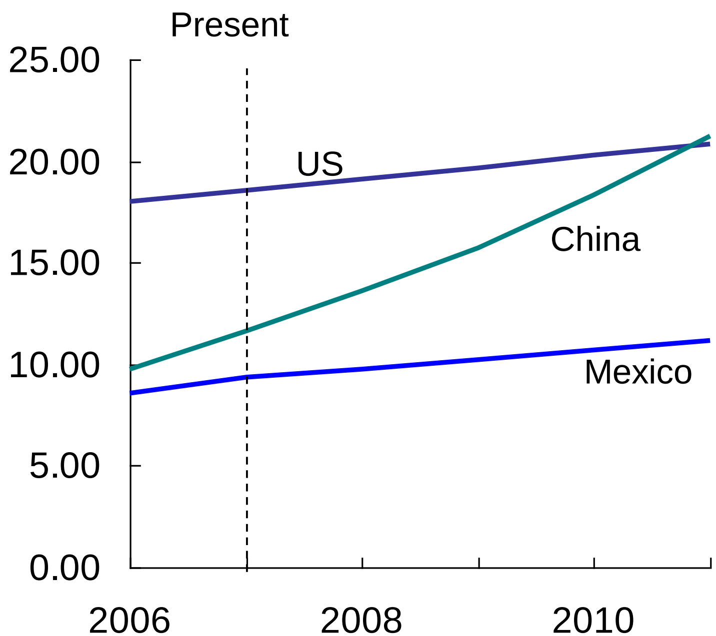
Labor Rate Comparison, Inflationary Trends and Impact of Productivity on Labor Rates

Manufacturing hourly wage, 2007 US $



Mexico's effective labor rate is lower versus China due to productivity

Manufacturing hourly wage US $



Impact of inflation on productivity indexed wages highlight risks associated with savings derived from "low cost labor"

Source: The Economist Intelligence Unit, 2007

LCC Gains at Risk Over Time – Currency Devaluation

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Year Over Year
Decline of the buying power of the USD in LCG and the EU

	Riggit (MYR)		Yuan (CNY)		Peso (MXN)		Euro (EUR)	
2005	3.7886		8.2033		10.9048		0.8045	
2006	3.6783	3.00%	7.9819	2.77%	10.9155	-0.10%	0.7970	0.94%
2007	3.4471	6.71%	7.6172	4.79%	10.9366	-0.19%	0.7308	9.06%
2008	3.2321	6.65%	7.0289	8.37%	10.5404	3.76%	0.6513	12.21%
		16.36%		15.93%		3.47%		22.21%

Update – The Euro has dropped 18.7% on average over the last five months versus the US dollar year over year (from 1.37 to 1.11)

Creating a Model

Total Cost of Ownership

The Elements

- Factors
  - Volume
  - Lead Time
- Piece Part
  - Labor
    - Build Hours to complete the assembly
    - Labor rate
  - Material
- TLC (Total Landed Cost)
  - Transportation
- TCO (Total Cost of Ownership)
  - COPQ (Cost of Poor Quality)
  - Profit
  - Additional recurring costs
  - Inventory Carrying Costs
  - Risks
- Other Costs
  - One Time/Transition Cost
    - Idled resources / Assets *(have you created an impaired asset?)*

One Time Costs

- Documenting the process
- Separation / severance cost
- Inventory
  - Carrying cost increase as a lead time de-coupler
  - One time build up
- Cost of Poor Quality (initial yields)
- Cost in transplanting processes, equipment and infrastructure to new geographies
  - Capital Investments
  - Travel & Expenses for staff
  - Freight & duties
  - Productivity impact during transfer phase

Recurring Costs

- Change in harmonization codes
- Travel & Expense – Support
- In Country Infrastructure Costs
- Extended Inventory Pipeline (Inventory as de-coupler)
  - Have you localized?
  - Customer within same region the build?

Worksheet

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ITEM	FACTOR	Current	LCC 1	LCC 2	Definition
1	Yearly Volume				The Yearly Sold Quantity
2	Lead Time (wks)				Lead Time in Weeks
	Piece Part				
3	Labor				Calculate: 4 x 5
4	Rate				The Hourly Labor Rate
5	Build Hours				Number of Hours To Build One Unit
6	Material				Total Material Cost
7	Total Piece Part				Calculate: 3 + 6
	TLC				
8	Transportation (per unit)				Total Transportation Cost
	TCO				
9	COPQ %				Percentage of Labor, Materials and Transportation
10	COPQ $				Calculate: (7 + 8) x 9
11	Profit %				Percentage of Labor, Materials, Transportation and COPQ
12	Profit $				Calculate: (7 + 8 + 10) x 11
13	Additional Recurring Cost				Total additional cost including support, travel, etc.
14	Additional Recurring Cost / Units				Calculate: 13 / 1
15	Inventory Carrying Cost %				Percentage of additional inventory
16	Inventory Carrying Cost (per unit) $				Calculate: (((7 + 8 + 10 + 12) x 15) / 52 weeks) x 2
17	Risk %				Percentage of risk
18	Risk (per unit) $				Calculate: (7 + 8 + 10 + 12 + 14 + 16) x 17
19	TCO Unit Amount				Calculate: 7 + 8 + 10 + 12 + 14 + 16 + 18
20	TCO Annualized Amount				Calculate: 1 x 19
	Savings/Loss (units)				
21	Net savings/loss (per unit)				Calculate: 'Current' 19 - 'LCC 1' 19
22	Net savings/loss (annualized)				Calculate: 'Current' 20 - 'LCC 1' 20
	Additional Costs				
23	One Time Cost/Transition (per piece)				Calculate: 1 / 24
24	One Time Cost/Transition				One time transition and set up costs
	Savings/Loss Overall				
25	Net savings/loss (annualized)				Calculate: 21 - 23
26	Net savings/loss (per unit)				Calculate: 22 - 24

Example of a product that should stay in the USA
Start up too high & customer base in USA

ITEM	FACTOR	Current	Mexico	China	
1	**Yearly Volume**	100000	100000	100000	The Yearly Sold Quantity
2	**Lead Time (wks)**	0.2	2	11	Lead Time in Weeks
	Piece Part				
3	**Labor**	$ 54.00	$ 16.00	$ 12.00	Calculate: 4 x 5
4	**Rate**	$ 18.00	$ 4.00	$ 3.00	The Hourly Labor Rate
5	**Build Hours**	3.00	4.00	4.00	Number of Hours To Build One Unit
6	**Material**	$ 150.00	$ 150.00	$ 150.00	Total Material Cost
7	**Total Piece Part**	$ 204.00	$ 166.00	$ 162.00	Calculate: 3 + 6
	TLC				
8	**Transportation (per unit)**	$ -	$ 6.00	$ 18.00	Total Transportation Cost
	TCO				
9	**COPQ %**	1%	10%	10%	Percentage of Labor, Materials and Transportation
10	**COPQ $**	$ 2.04	$ 17.20	$ 18.00	Calculate: (7 + 8) x 9
11	**Profit %**	10%	10%	10%	Percentage of Labor, Materials, Transportation and COPQ
12	**Profit $**	$ 20.60	$ 18.92	$ 19.80	Calculate: (7 + 8 + 10) x 11
13	**Additional Recurring Cost**	$ -	$ 8,000.00	$ 50,000.00	Total unique additional cost including support, travel, etc.
14	**Additional Recurring Cost / Units**	$ -	$ 0.08	$ 0.50	Calculate: 13 / 1
15	**Inventory Carrying Cost %**	10%	10%	10%	Percentage of additional inventory
16	**Inventory Carrying Cost (per unit) $**	$ 0.09	$ 0.80	$ 4.61	Calculate: (((7 + 8 + 10 + 12) x 15) / 52 weeks) x 2
17	**Risk %**	1.0%	7.5%	7.5%	Percentage of risk
18	**Risk (per unit) $**	$ 2.27	$ 15.68	$ 16.72	Calculate: (7 + 8 + 10 + 12 + 14 + 16) x 17
19	**TCO Unit Amount**	$ 229.00	$ 224.68	$ 239.63	Calculate: 7 + 8 + 10 + 12 + 14 + 16 + 18
20	**TCO Annualized Amount**	$ 22,899,848.25	$ 22,467,549.62	$ 23,962,535.58	Calculate: 1 x 19
	Savings/Loss (units)				
21	**Net savings/loss (per unit)**		$ 4.32	$ (10.63)	Calculate: 'Current' 19 - 'Mexico' 19
22	**Net savings/loss (annualized)**		$ 432,298.63	$ (1,062,687.33)	Calculate: 'Current' 20 - 'Mexico' 20
	Additional Costs				
23	**One Time Cost/Transition (per piece)**		$ 10.00	$ 10.00	Calculate: 1 / 24
24	**One Time Cost/Transition**		$ 1,000,000.00	$ 1,000,000.00	One time transition and set up costs
	Savings/Loss Overall				
25	**Net savings/loss (annualized)**		$ (5.68)	$ (20.63)	Calculate: 21 - 23
26	**Net savings/loss (per unit)**		$ (567,701.37)	$ (2,062,687.33)	Calculate: 22 - 24

Formulas

Labor	Calculate: Rate x Build Hours
Total Piece Part	Calculate: Labor + Material
Profit $	Calculate: (Total Piece Part + Transportation (per unit) + COPQ $) x Profit %
Additional Recurring Cost / Units	Calculate: Additional Recurring Cost / Yearly Volume
Inventory Carrying Cost (per unit) $	Calculate: (((Total Piece Part + Transportation (per unit) + COPQ $ + Profit $) x Inventory Carrying Cost %) / 52 weeks) x Lead Time (wks)
Risk (per unit) $	Calculate: (Total Piece Part + Transportation (per unit) + COPQ $ + Profit $ + Additional Recurring Cost / Units + Inventory Carrying Cost (per unit) $) x Risk %
TCO Unit Amount	Calculate: Total Piece Part + Transportation (per unit) + COPQ $ + Profit $ + Additional Recurring Cost / Units + Inventory Carrying Cost (per unit) $ + Risk (per unit) $
TCO Annualized Amount	Calculate: Yearly Volume x TCO Unit Amount
One Time Cost/Transition (per piece)	Calculate: Yearly Volume / One Time Cost/Transition

Preliminary Steps Before Making Your Sourcing Decision

- Create **standardized work** practices that document remaining labor content so it can be more easily transferred if required
- **Lean** the process out – labor accounts for 7-12% of the part cost (less for TLC & TCO)
- Focus on **"Clean Sheeting" / "Should Costing"** designs to determine what the absolute lowest cost will be based on index pricing
- **Spaghetti Map** the complete supply and demand chain from cradle to grave
- Focus on **redesigning product lines (DFx)** based on customer order winners (price and speed of delivery are big ones now)

Supply Chain and Operations Strategy

Match our operational and supply chain capabilities in support of the Business Segment Strategies of growth, new product introductions, integration of 3rd party products, repeatability and speed of delivery.

- Short term, Lean all of our facilities helping to determine the proper course for plant and product rationalizations while providing increased inventory turns, increased productivity and decreased square footage requirements in 15 months from kick off.

Longer term develop Regional Manufacturing/Distribution Centers (RMDCs) utilizing <u>processes and products that incorporate postponement theory</u> providing the <u>greatest flexibility against demand variation</u> while providing the lowest TCO, the lowest inventory carrying cost and the quickest speed of delivery.

End Results of Strategy

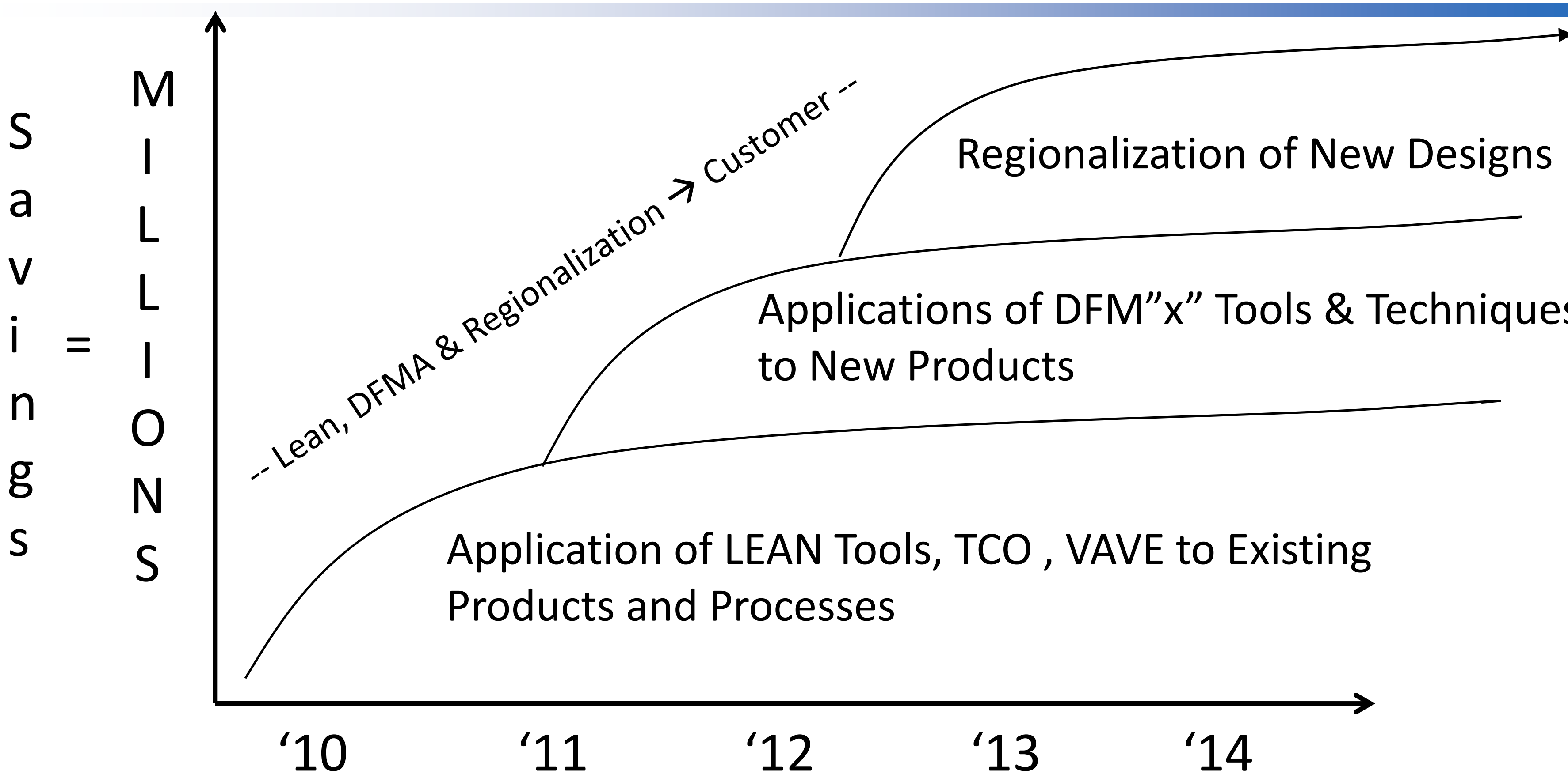
- RMDCs located close to our core customer markets ensuring speed of delivery requirements are met
- Core Manufacturing locations located near Engineering, Sales and Marketing resources allowing for quick NPI roll outs
- Fully utilized Low Cost Country manufacturing center to RMDC
- A robust, flexible and agile Operational Organization that has replicated processes in multiple regions ensuring continuity of supply

All organizations driven by ***Lean techniques***

All sourcing decisions leverage the ***TCO model***

All NPD utilizing DFx

Tying it All Together

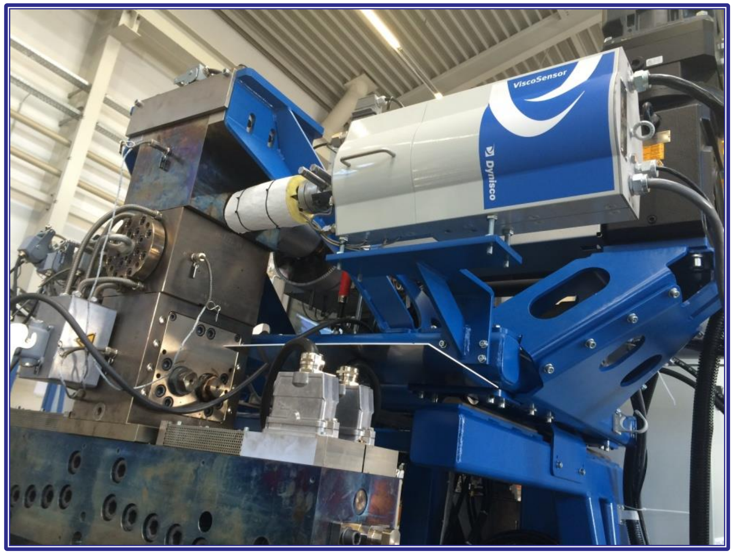


Working across all disciplines will drive value beyond a simple cost reduction/design and drive customer intimacy

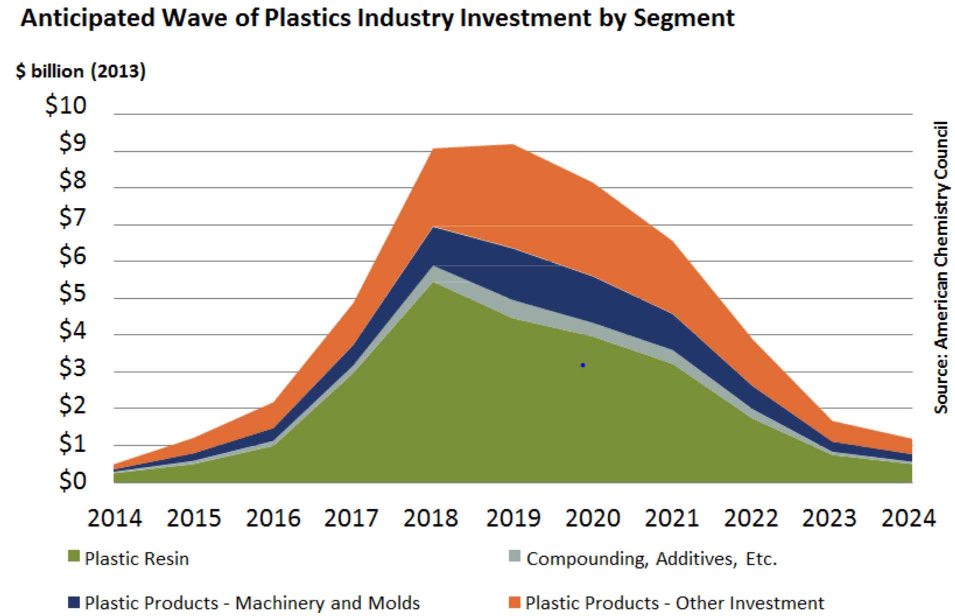
Examples of Success – Burst Plugs

- Historical supplier had issues
- Price, Quality, Delivery
- Hard to quote, non-standards displayed completely erratic behavior
- Used BDI Tool to develop 8 models based upon (4) major features/attributes
  - Thread type, lot size, retention mechanism, length
  - 750 DFM calculations vs. Supplier Quotes (Configurations & lot size combinations)
- Business up 20% yr/yr for the last (2) years
- Cost and Price lower
- Quotes developed instantly from DFMA models

Example of Success – Visco & eRCU



- From Red to Blue Oceans
- Driving cost down, while increasing value
- Expanded available markets 10x as of today, 1000x by 2020
- DFMA provided the insight to go forward



Thank you!

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Questions?