

DFMA[®]

BOOTHROYD DEWHURST

Concurrent Engineering and DFMA:
The Path to Innovation and Competitiveness

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Improving Product Development Since 1983

The “old” is “new” again



IBM ProPrinter c.1985

- Strict adherence to DFMA[®] principles
 - Cross-functional Dedicated Team Located Off-site
 - Design rules:
 - No screws or other separate fasteners
 - No flexible parts
 - Top-down assembly
- Product & Fully Automated Factory Developed & Launched ~24 months

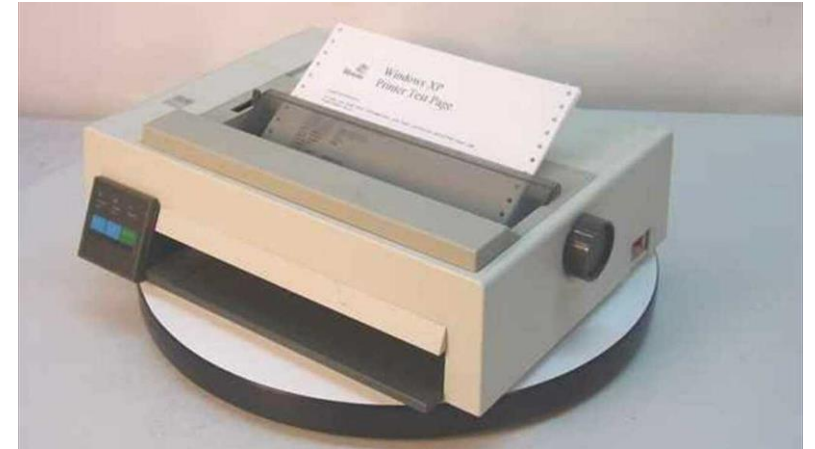


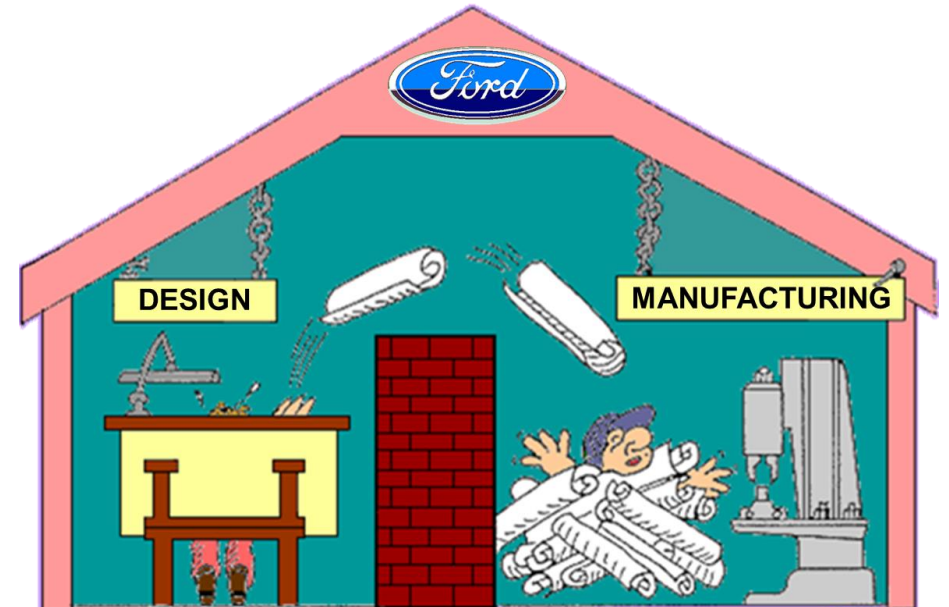
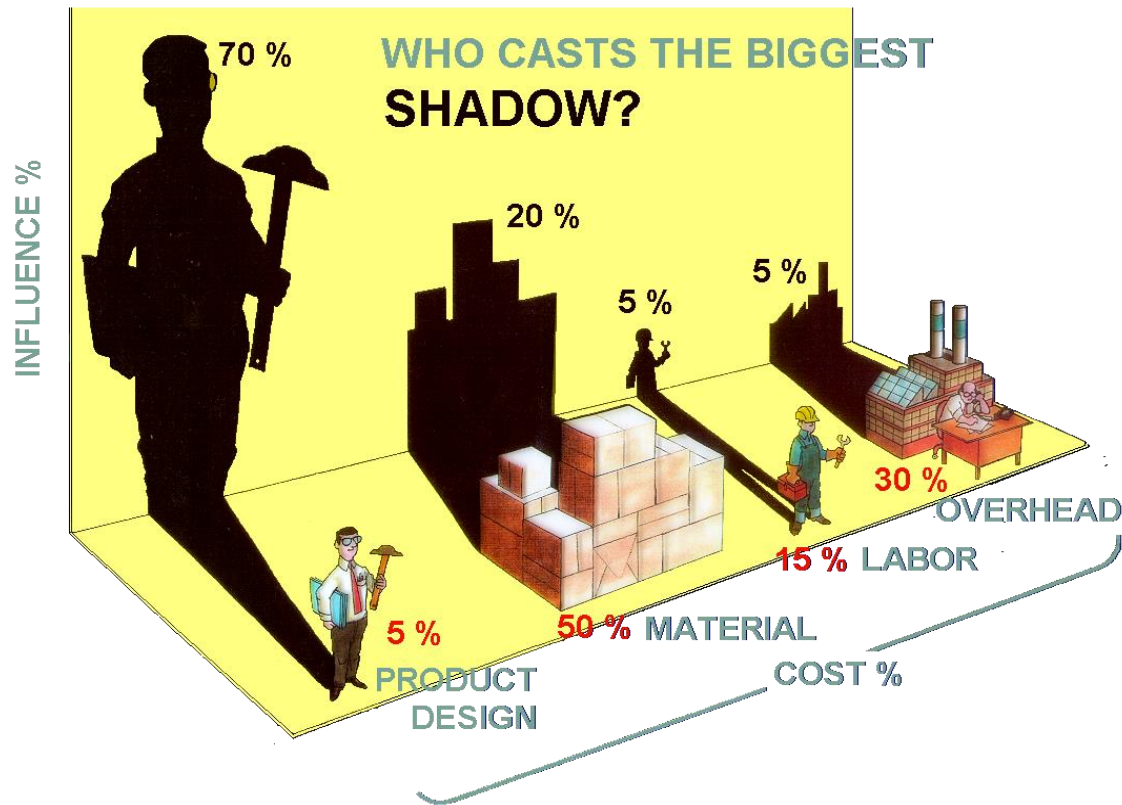
FIG. 10
EPSON MX80
vs. PROPRINTER

	No. Assy Operations	Manual Assy Time
EPSON MX80	185	1866
PROPRINTER	32	170

Source: Assembly Engineering 1987

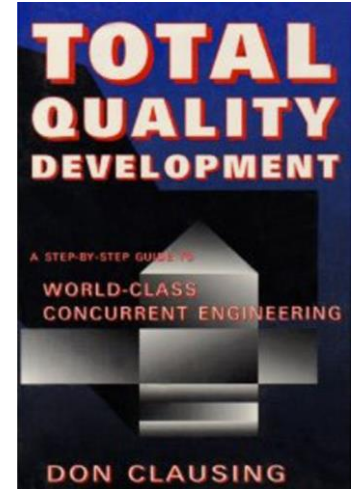
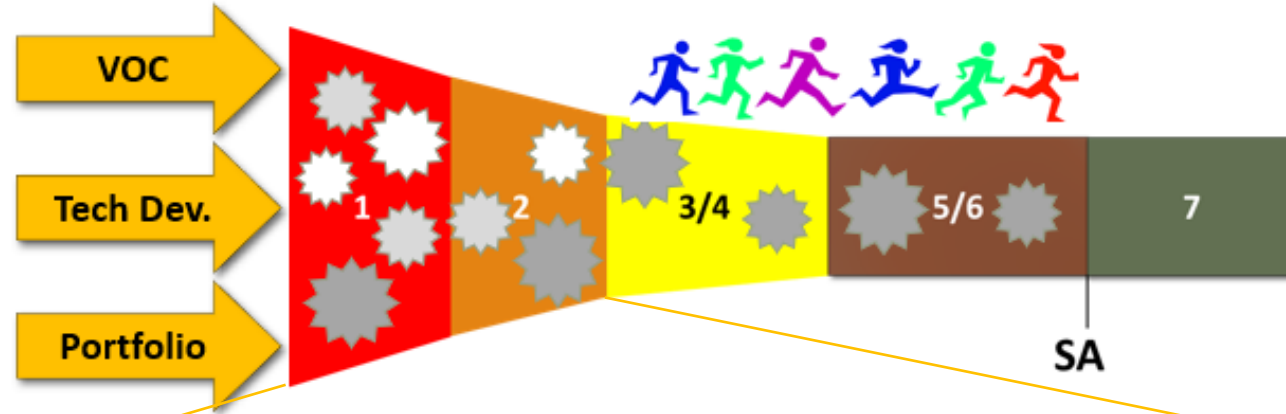
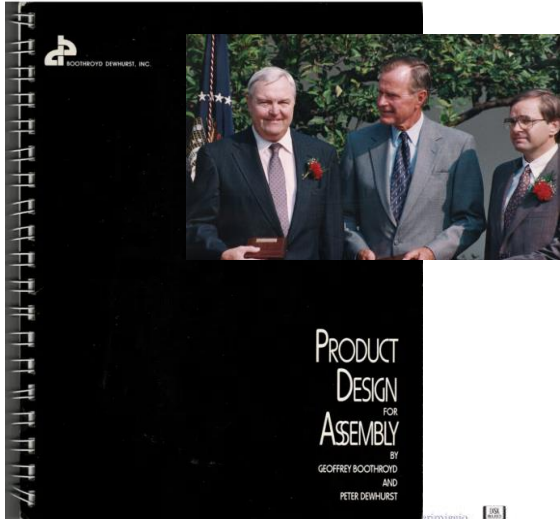
Early 1990's ... DFMA[®] Forum

Historical Way of Doing Business



Source: Ford Motor Company

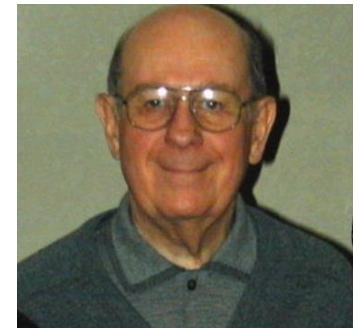
Early-1990's ... Kodak



Engineering Methods for Robust Product Design
Using Taguchi Methods® in Technology and Product Development

William Y. Fowlkes
Clyde M. Creveling

Foreword by George M. C. Fisher
Engineering Process Improvement Series

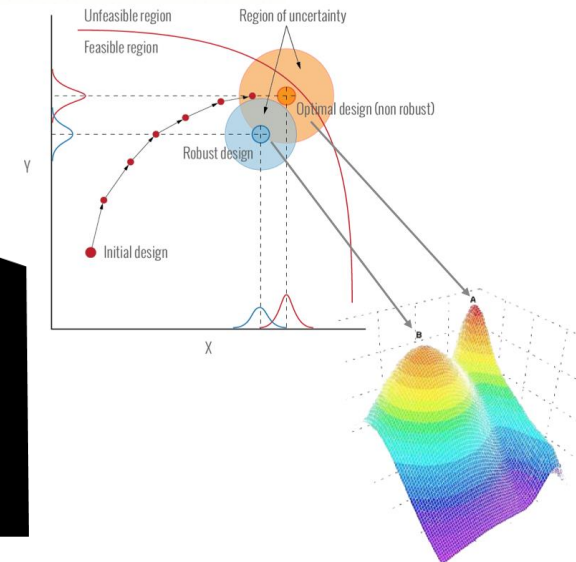


Key Principles

- Co-located Cross-Functional Teams
- Voice of the Customer ... Collected, Analyzed, and Deployed
- Engineering Best Practices
 - DFMA[®] Product Simplification & Costing ... Innovative Design Options
 - Set-Based Concurrent Engineering
 - Statistical Methods
- Data-Driven Decisions

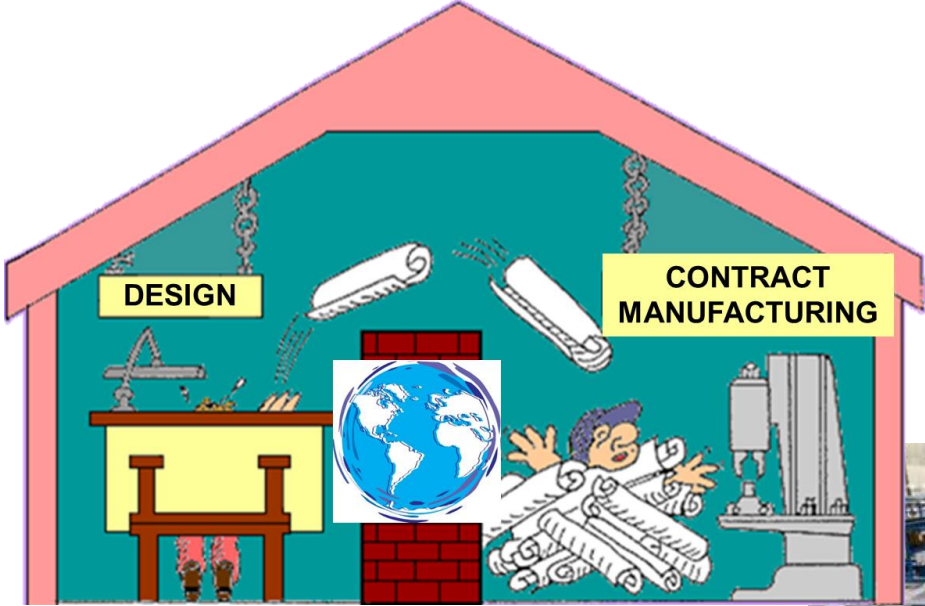


DON'T DESIGN FROM HABIT.



Last Quarter Century

Historical Way of Doing Business



Recent Manf Trends

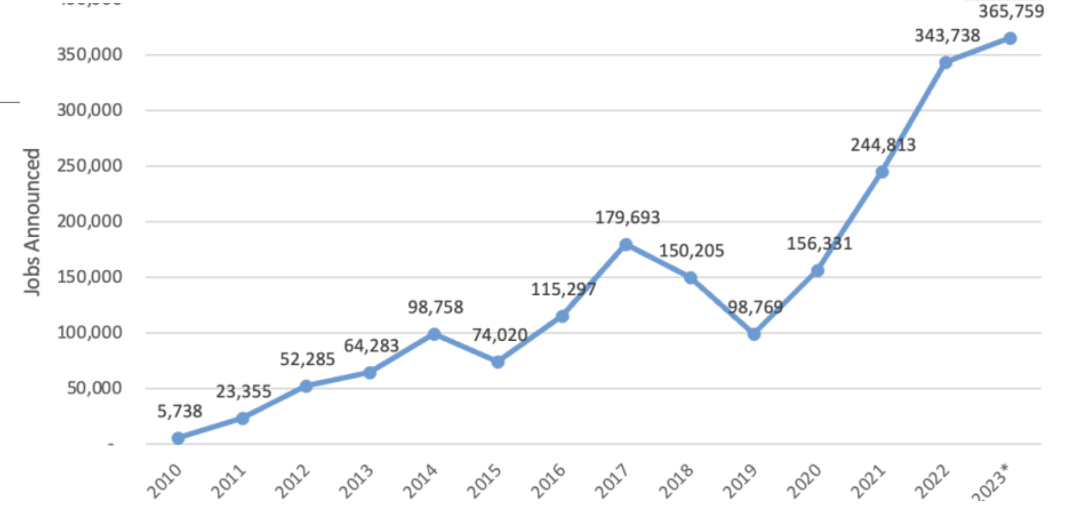


1H 2023 Report

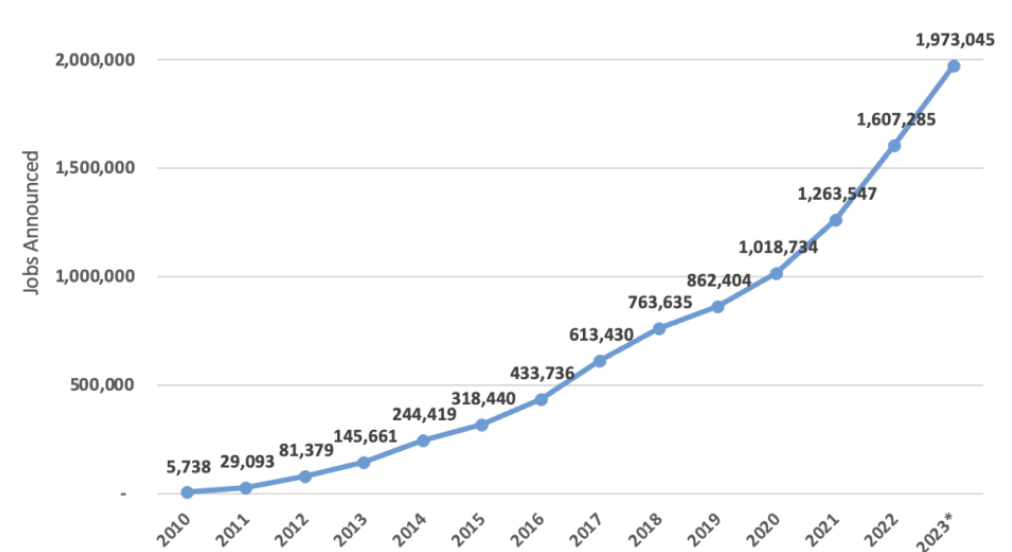
Exhibit 3 | 2023 Projected, Announcements by Industry, Reshoring + FDI

Rank	Industry	Jobs	Cases	Avg. Jobs/case	% of Total Jobs
1	Electrical Equipment, Appliances & Components	148,948	344	433	41%
2	Computer & Electronic Products	84,484	288	294	23%
3	Chemicals	49,795	285	174	14%
4	Transportation Equipment	41,704	140	297	11%
5	Machinery	12,428	132	94	3%
6	Plastic & Rubber Products	6,405	50	129	2%
7	Primary Metal Products	4,830	69	70	1%

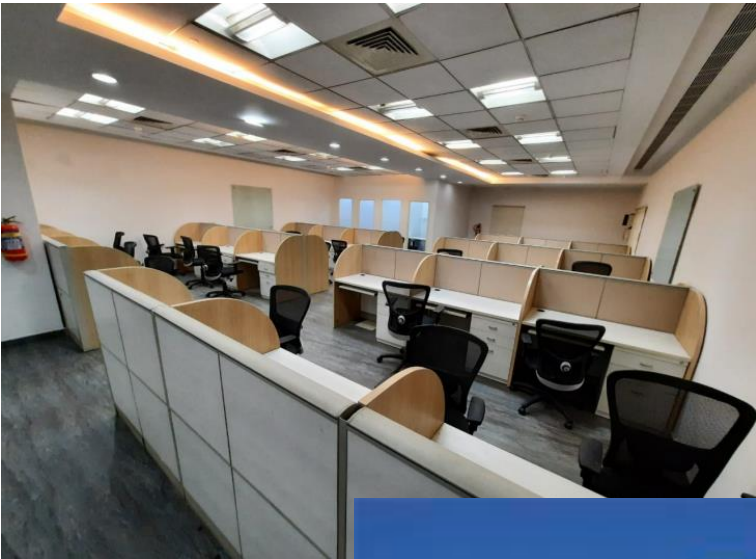
Reshoring + FDI Job Announcements by Year, 2010 - 2023 Projected



Cumulative Jobs Announced, Reshoring + FDI, 2010-2023 Projected



Recent Design Trends



Product Development is a Team Sport

- Co-located/Interconnected Cross-functional Teams
 - Design/Engineering
 - Manufacturing/Process/Ops
 - Assemblers/Skilled Trades
 - Field Service
 - Quality/Reliability
 - Procurement/Supply Chain
 - Suppliers
 - Marketing
 - Industrial Design
- Committed Strategic Supplier Relationships
- Facilitator Led DFMA[®] Events... Internal Subject Matter Experts
- Benchmarking: Analyze Competitive Products & Other Functionally Similar Assemblies
- Data-driven Design Decisions



Recent Case Study – Capstone Green Energy

- 3-day DFMA[®] Implementation Workshop
- 5 “cross-functional” teams
- Results:
 - Significant Design Simplification
... Cost, Quality, Serviceability, etc.
 - Improved Sense of “Team”
 - Morale Boost

“Seeing the excitement in our employees as they realized they had a powerful tool in their hands and that they could make real change, not only reduced our material and assembly costs but created a positive impact on the quality and reliability of our advanced microturbine clean technology.”

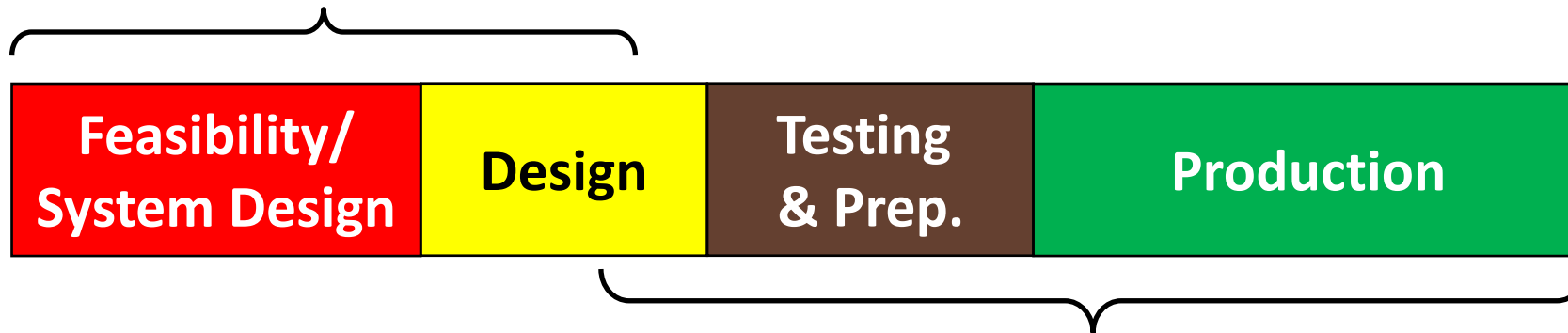
Vince Canino, President & CEO



The “old” is “new” again

Concurrent Engineering and DFMA[®] – Product Simplification & Costing

Cross-functional teams innovating, problem solving, learning, breaking “design by habit”, making data-driven decisions



*“Lean” the design before
you “Lean” the process*

DFMA[®] – Supplier Costing

Should & could costing for economical, predictable value streams