

Technology Paradigm Shifts Commercial Survival Lessons



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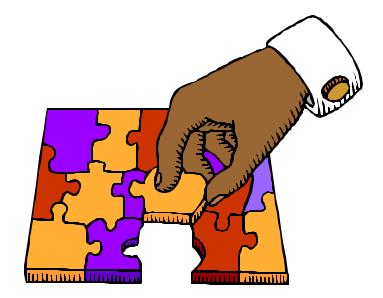
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Drivers in Discrete Manufacturing

- **Paradigm Shift? 3 to 5 years out**
- Disruptive Technology: Biggest Challenge, Risk Organizational
- Modular design
- Simulation's & Physical Testing
 - CAE Data Management/Infrastructure
 - MDO Multi-Disciplinary Optimization, Multi-physics



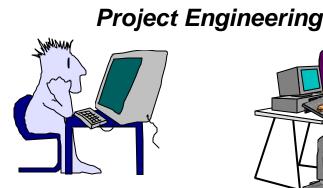


Dramatic Impact

- ***** Up Front Design/or Front End Loading
 - Redefine Skill Sets, Training Roles, Performance Metrics
- Standardization:Design & Manufacturing
- ***** Knowledge Management

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Design and Test



Outline

- Paradigm Shift? Don Brown, DHBA
- Up Front Design/or Front End Loading Don summarizes for Greg Roth, Eaton, Jeff Okrutny, Delphi Automotive Systems
- Simulation & Physical Testing *Jim Crosheck*, *Deere & Company*
- **CAE Data Management/Infrastructure** *Keith Meintjes, General Motors Corporation*
- Standardization Keith
- Modular Design Jim, Keith & Don,
- Knowledge Management
- * MDO Multi-Disciplinary Optimization, Multi-physics



Relevance to you and DoD?

- **Lessons of Paradigm Shifts**
- **SBA Involves a Paradigm Shift**

"Dramatic reductions in complex system acquisition life cycle cost and development schedule cannot be achieved via *incremental systems engineering process and method improvements*. A bold innovative shift is required... The consequences of not achieving a successful systems acquisition *paradigm shift* which can avert the downward spiral of cost overruns and failures are severe and will be amplified as the complexity and magnitude of future systems continues to rise."

The Simulation Based Acquisition Vision Nicholas Karangelen, nkarang@tridsys.com
Trident Skylstems Inc., undated



Tumultuous

- Primary Characteristic?
- Continuous Wave of Change
 - ... Disruptive Technology



The Innovators's Dilemna, When New Technologies Cause Great Firms to Fail, C.M. Christensen, 1997.



\$200 Billion...

IBM... Intel... Microsoft... Compaq... Dell





Seven Dwarves?

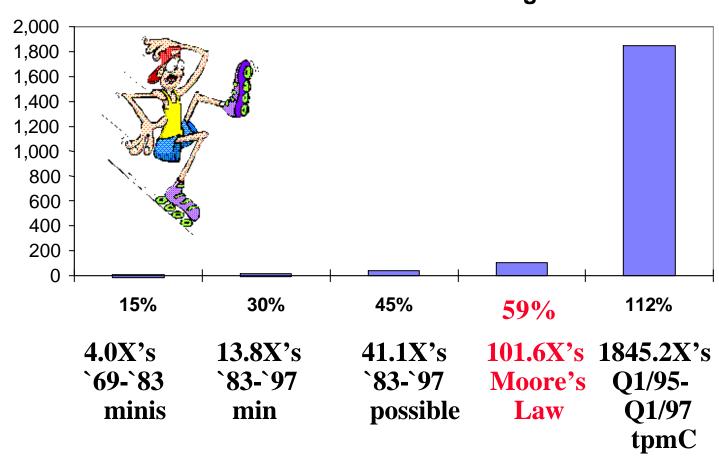
Burroughs...Univac... Control Data... GE... RCA... and who?

Minicomputers?

DEC... Data General... Prime Computer... Wang Labs... Apollo



Cumulative Impact of Compounding Change Over 10 Years



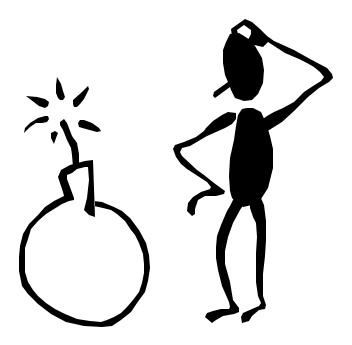


What are those lessons?

Risk: Local optimization

***** Driver: Modularization of Design Critical

Driver: Simulation and Test Critical



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Local Optimization

- No Guarantees
 - Past success
 - Size
- Limited Predictability Random Chance Greater Than Most Like to Admit
- Getting Real Recognition, Understanding Tough, Action?
 - The Art of the Long View, Peter Schwartz





Recommendations

- ***** #1: Get Change Agents
 - Skunkworks, Venture Capitalists
 - Established Leaders May not Lead the Breakout
 - IBM brought in an outsider... Boeing moves it's HQ
- ***** #2: Monitor Closely
 - Driver: Modularization of Design Critical
 - Driver: Simulation and Test Critical



Push, and Measure Progress in:

- Modular Design
- Simulation & Physical Testing
- **CAE Data Management/Infrastructure**
- * MDO Multi-Disciplinary Optimization, Multi-physics
- **Up Front Design/or Front End Loading**
- Standardization
- ***** Knowledge Management
- **Objective:** Stay One Jump Ahead of the Next Guy
 - Not Optimization, Not "Best Practices"



Principles of Modular Design - Computer Systems

- **Create Nested, Regular, Hierarchical Structures In a Complex System**
 - Design Rules Critical! Design Rules of System/360 the first standards battle in the computer industry
- **Define Independent Components Within an Integrated Architecture**
 - Decentralization of Control, Continuous Innovation at Module Level
 - Multiplies Options at Module Level
- **Establish and Maintain Rigorous Partitions of Design Information into Hidden and Visible Subsets**
- **❖** Invest in Clean Interfaces and "Good" Module Tests
 - Design evolution can only proceed as fast as good simulation and testing enhances confidence, and insures quality

Design Rules Volume 1 The Power of ModularityCarliss Y. Baldwin & Kim B. Clark
MIT Press, 2000

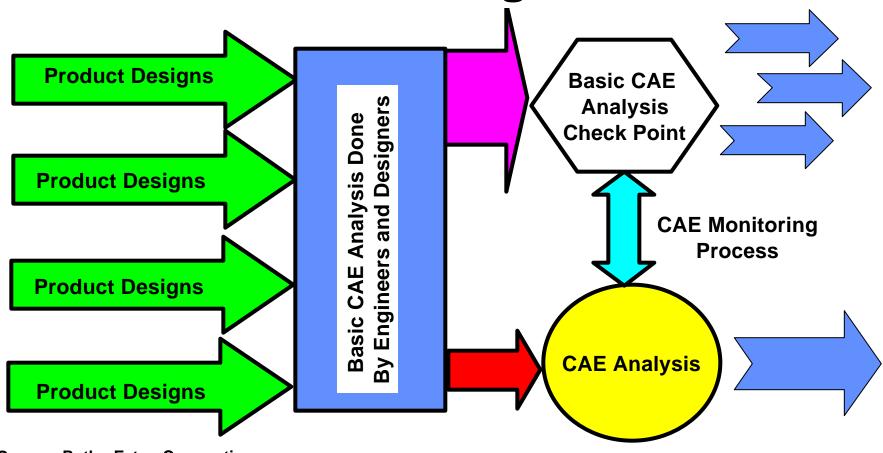


Up Front Design/or Front End Loading

- Optimization Engine/Design Discovery
 - Driven by WEB, Accelerated Innovation
 - Hundreds of simulations search all design alternatives
- Design Criteria Entire Product Life,
 - Warranty costs, even maintenance schedules
- **Templates of well-defined, well understood** frequently repeated analyses
 - Automated model creation and knowledge-based data interpretation
- Monitored and managed by CAE experts



Achieving Economy of Scale for CAE in the Design Process



Gregory Roth - Eaton Corporation http://www.ANSYS.com/action/white_papers/early_analysis.htm paul.bemis@ansys.com







Paradigm Shift?

- Redefine Skill Sets
- **Redefine Roles**
- **Redefine Performance Metrics**

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Design and Test



Background: Point of View

- Since 1969 Computer Systems/Software
- Since '84: D. H. Brown Associates:
 - Collaborative Research Subscription Programs
 - Software & Systems: Requirements Analysis,
 - Discrete Manufacturing: Software & Systems, Process, Business Metrics







❖ Jim Crosheck, Sr. Staff Engineer, Deere & Company

- selection of electronic tools the product development process
- leading the analytic support of the integrated test and analysis
- re-joined Deere & Company in 1999 after spending 11 years as Vice-President, Engineering Services, at CADSI, now LMS/CADSI, where he led their consulting activity in multibody dynamics applications.
- Prior to CADSI, Jim spent 15 years at the Deere & Company