Industry Perspective

on Modeling & Simulation Tools/Issues

NDIA National Defense Industry Association

5th Simulation-Based Acquisition/Advanced Systems Engineering Environment Conference; Role of Simulation and Advanced Engineering Environments in the Transformation of the Military, 6/24-6/27/02

D.H. BROWN ASSOCIATES, INC.™

Don Brown, Chairman, dhbrown@dhbrown.com

DCV Design Creation & Validation
Collaborative Research Program

Outline -

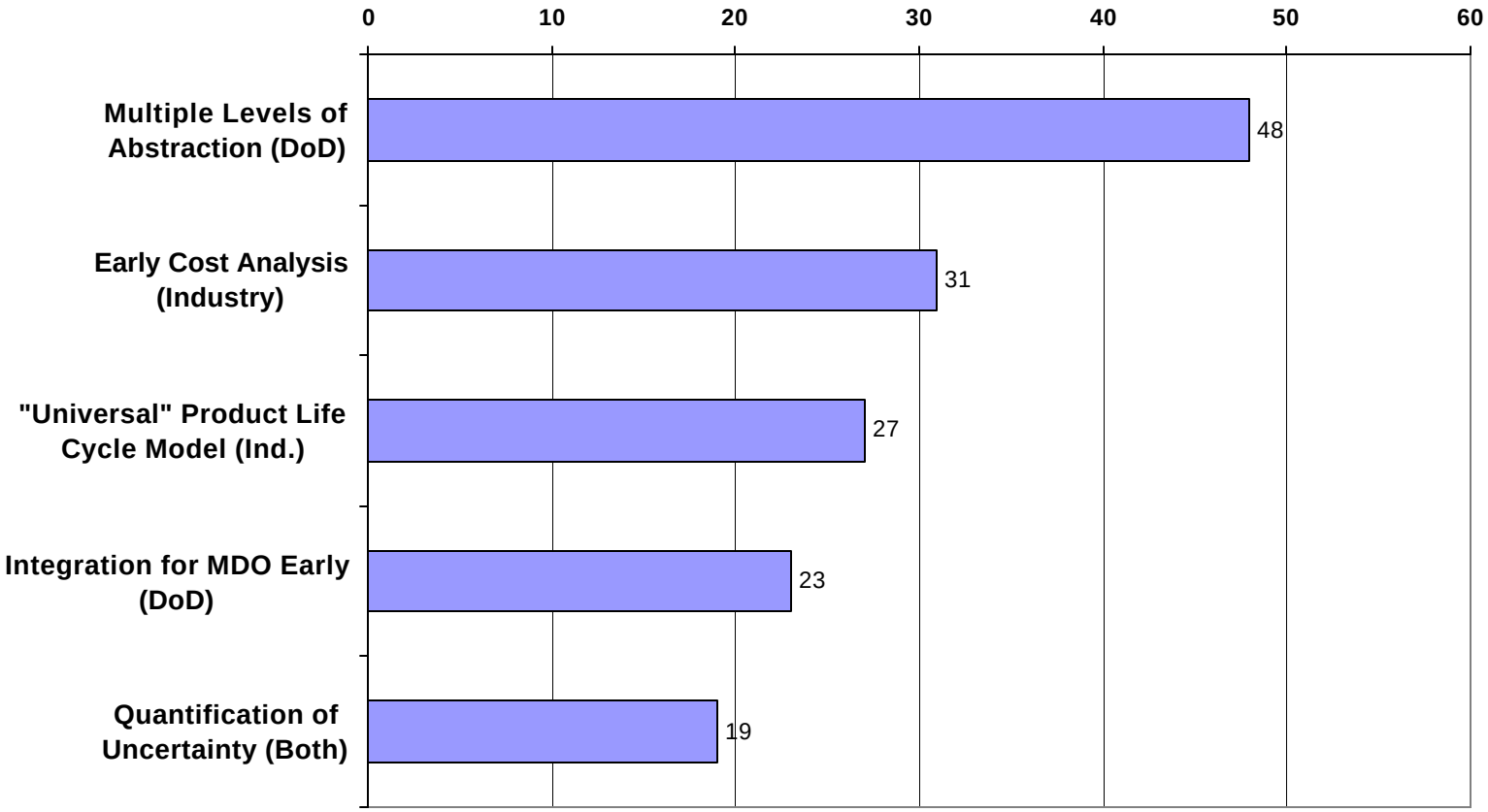
- DHBA Collaborative Research Programs
- DoD, Industry & Commerce - Critical Issues & Lessons
- Up Front CAE/Super Designer
  - Dramatic Evolution from Modest Beginning
  - Intensity of Concerns Escalated
  - Most Impact in Breadth
- Up Front X?
  - Broken Business Model? No.
  - Fundamental Transformation, Retooling Supply Chain in Industry

DHBA Value Proposition

- Origins, research methodology, & differentiation
  - Deep and Detailed Review of Functional Requirements & Capabilities - Operating Systems, Application Software, Web
- Collaborative technology research –
  - Translate needs of strategists and user requirements into architectures and features for implementers
  - Derive industry roadmap and technology footprint
    - what is must have, what is hot, what is risky
  - Mapping business objectives into IT strategies
    - Capabilities assessment culturally vs. technology suitable
- Continuous Monitor for Collaborative Research
  - What should be done? What can be done? What is being done?

DoD Priorities

# of Votes Rating Issue as a Top Concern
Roadmapping Workshop, 23 May 2002
Integrated Manufacturing Technology Initiative (IMTI),

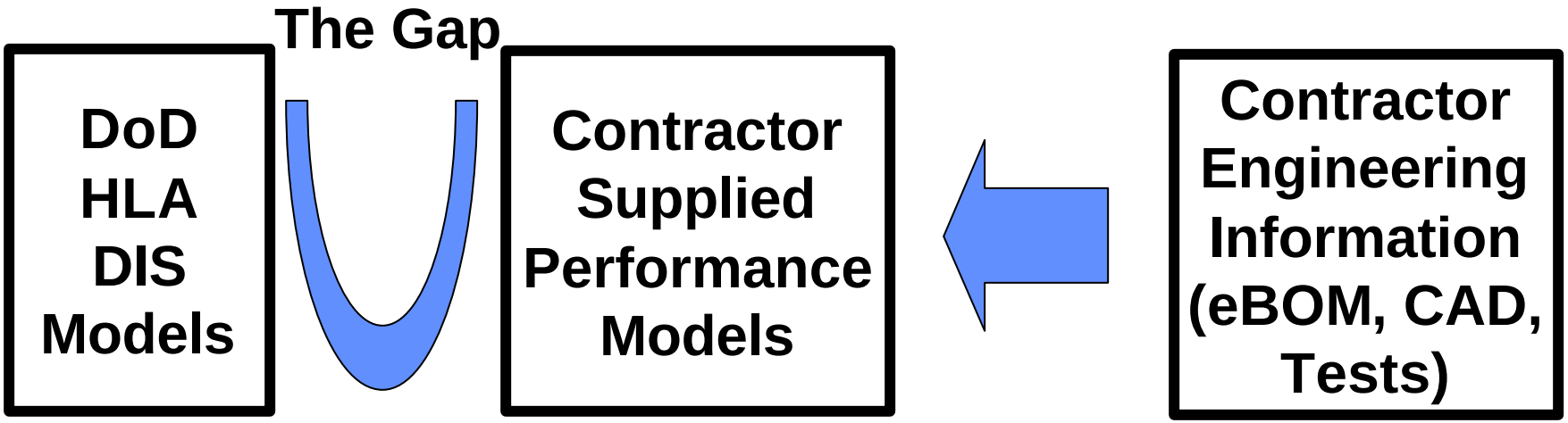


See appendix for supporting detail & reference.

Industry Perspective

What I will not be talking about today:

Data architectures for authoritative system performance models in M&S



DHBA "12-fold Way" and other reports from the Product Definition program are helping manufacturers understand What are the data architectures that can bridge the gap

Up Front CAE/Super Engineer

- Relatively modest scope - retraining, major change
- Up Front Simulation Converging with Test
  - Cultural & Organizational Barriers
  - Capability Assessment: Match Technology & Culture
  - Parallels with Consumer Electronics
- Rapid Expansion in Scope
  - Up Front Mfg., Knowledge Capture & Re-Use, Re-Tooling the Supply Chain
- Escalation of Concerns - Broken Business Model?
  - Driven by competition, accelerated innovation & failures

June 2001

- Major Change for Industry at the Start
  - 1999: Forensic Tool After the Fact
  - Today: Virtual Prototyping rapidly becoming the “Rule, Not Exception” for major companies
    - 2,000 targeted for training this year at GM

Education/Careers/Learning

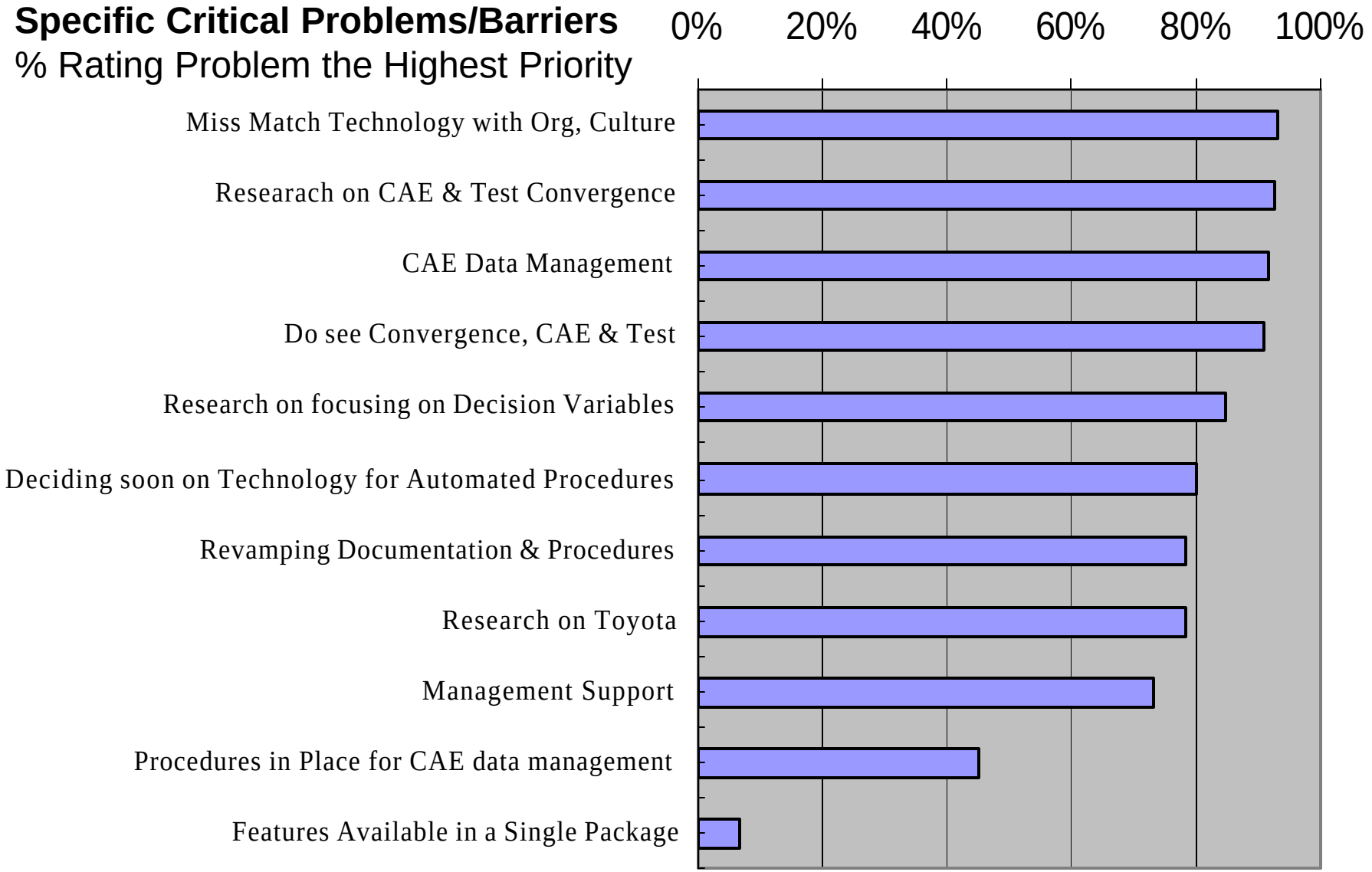
- Simplest Early Formulation - Automotive
  - Need to Upgrade 1000's of Parts Designers with 2 Year Drafting Certificates to Full Fledged Engineers
  - Early and Simplest Formulation: Training & Education
  - Needed full definition of different roles, personality profiles as well as education. Needed much better definition of challenge, and risks for operating managers.
- 2001: 700 "Super Engineers" in Training
  - 500 Design Release Engineers, validation
  - 100 Parts Designers, detail
- Merge roles for "Up Front CAE"

Cultural & Organizational Barriers

- Impatience with techie issues, especially IT, worried about more important issues
  - 40+Participants, 10+ Companies
  - Key players rated as 9's or 10's in importance - Top Management, or Program Managers
  - What do you think they rated IT?
- Emphasis on cultural barriers, and organizational constraints … ROI & Maturity Issues … Match those concerns!
  - Need to Match Organizational Capabilities and Benefits
  - Assess Maturity & Then Technology

Specific Critical Problems/Barriers

% Rating Problem the Highest Priority



Parallel - Consumer Electronics

- Keen Sensitivity of the Failure of Technology to Fulfill Expectations
  - PLM - Product Lifecycle Management
- Maturity Assessments - Process to Match Technology to Organizational Strengths & Weaknesses
  - Assess Organizational Convergence or Agreement on Objectives, the Definition of Objectives, and Approaches
  - Assess Expectations for Technology to Resolved the Priorities, and Implementation Successes or Failures
- 27 Individuals, 17 Companies Worldwide

Methodology - Maturity Assessment

- Another Evolution of the Approach for Requirements Analysis for Software
  - Reconcile, Explain, Translate complexity across expert domains
- Turn tacit understanding into explicit statements, verbalize implicit knowledge
  - People often do not know the depth of their expertise & experience
- Very Similar Approach - define organizational & cultural barriers rather than technical barriers

Expansion in Scope

- Surface: Career/training issues for automotive
  - Design Engineer will hold responsibility for design detailing, engineering approaches and concepts, and analytical verification - all three roles.
- But …. Very Fundamental:
  - Virtual Prototyping replacing test, target - physical testing should be done only to confirm simulation
  - Convergence of Simulation/Engineering & Testing

Up Front Manufacturing?

- Mfg. Engineering faces similar pressures
  - Convergence of Manufacturing, Mfg. Engineers must participate up front, face same career upgrade pressures
  - Gating factor to drive Time-To-Market < months
- Context Explodes… Very Broad
  - Warranties, TTM: Time to Market, Retool Supply Chain
  - Fundamental redefinition of roles and responsibilities

Current Status: Up Front Manufacturing

- Major European Automotive OEM
  - Case study documentation: “The Collaborative Dimension in Virtual Factory Planning”
  - IndustriePlanung Fischer AG (iPF)
  - Total Factory Design
- Update on U.S. - Teleconference Open to All
  - Date - tbd
  - Manufacturing Process Management, or MPM
  - Tecnomatix Technologies developed MPM with BMW, Airbus, and other partners. MPM enables manufacturers to digitally model, simulate and manage all manufacturing processes and resources related to a complete solution of how to manufacture a product.

Intensified Concerns:

- Failures
  - Far too long to deliver recognizable value…
    … Deliver a focused solution, not a framework
  - Targeted ROI, Series of Phased Stages
- Training and Education? Culture & Org. Barriers?
- Real Underlying Issue - International Competition
- Accelerated Technological Innovation

Twin Drivers in Automotive

- Now - Economic pressures

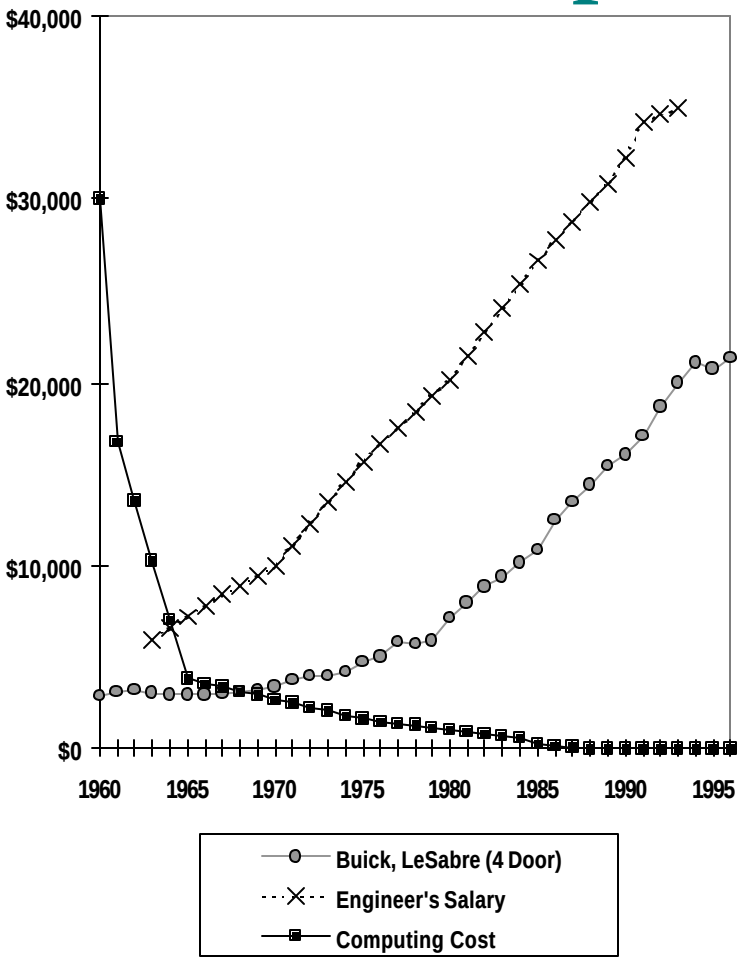
Pressures Much More Dramatic

- Worldwide Competition
  - Japan - Evolution of the Black Box Parts Supplier System
    - *Machine that Changed the World* - 1990
    - Toyota - Development work split - assembler & supplier
  - Define Context - Toyota - 1996 In U.S. Supply Chain
    - Evaluation of 39 U.S. Suppliers: Major lead established by Toyota with the same suppliers.
    - *Collaborative Advantage*, Jeff Liker, good study of Toyota U.S. and Chrysler

Accelerated Innovation: Radical Impact

- Relative Production Costs - Steve Rohde, GM

	1960	2001
Computing	$30,000	$.02
Buick LeSabre	$3,000	$25,000
Engineer's Salary	$6,000	$35,000



Broken Business Model in Automotive?

- Detroit Pitches by Dr. David Cole
  - President, Center for Automotive Research
- Crisis genre of the journalism: *Creative Destruction* and *Innovator's Dilemma* hit lists of best sellers
- Teleconference June 13th - CD Available to Research partners
  - Maryann Keller
  - "Car Guy", & Top Financial Analyst with Institutional Investors

Toyota Advantage Historically

- Knowledge Capture/Re-use
  - Toyota - Long evident in design
  - Equally important on the supply chain, focus on critical tradeoffs, abstraction which allows the flexibility for a supplier to optimize on his contribution

"Toyota is able to generate competitive advantages through knowledge sharing in its extended enterprise even when it uses the identical suppliers as its competitors."
Jeff Dyer

- Supplier Relationships
  - Download design, test & validation, and supply

"Toyota's inputs to black box parts suppliers (a few pages of specification documents with rough sketches) were much simpler than those of Nissan (a roll of fairly detailed specification drawings)… Nissan…consumed more in-house engineering resources and … put more restrictions on supplier efforts…"
Takahiro Fujimoto

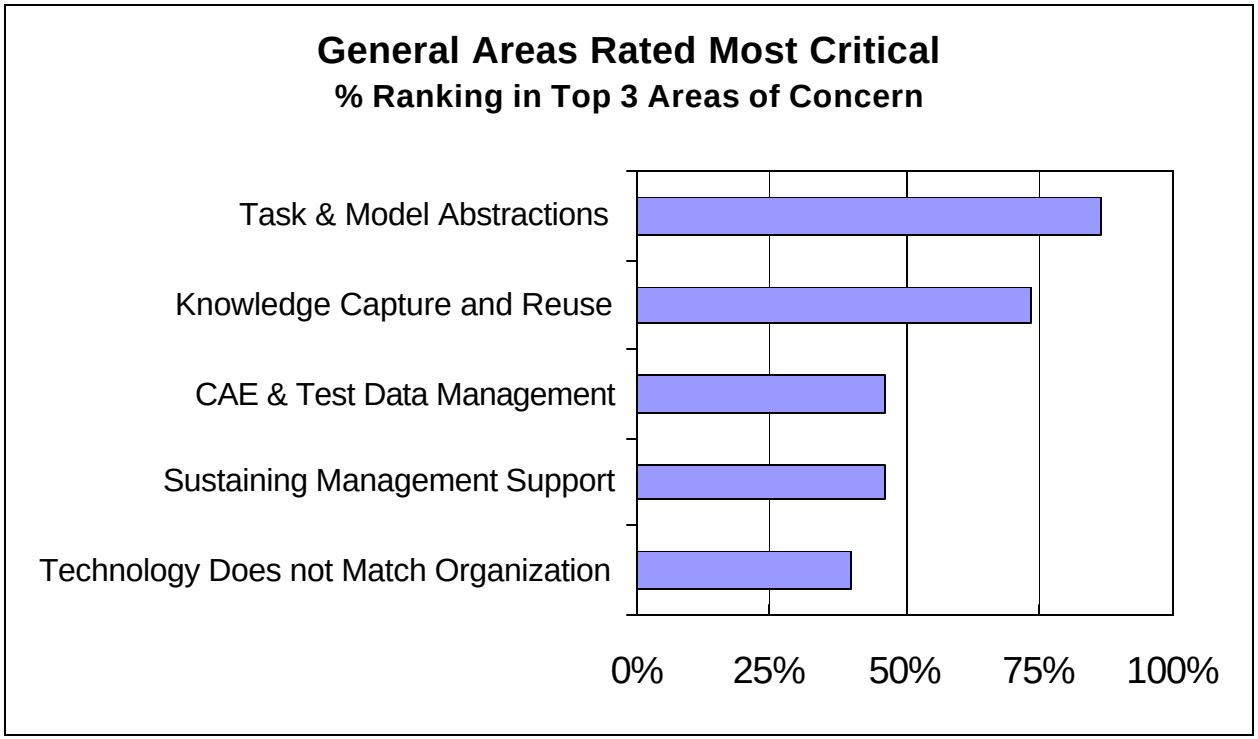
Industry Perspective

Re-Tool Supply Chain

- U.S. OEMs In Crisis
  - Crisis Management crucial in forcing change
- Technical trends reinforce business pressures
  - Up Front X, Modular Design, Warranty Issues, Time to Market
  - MUST re-partition responsibilities across supply chain
- U.S. OEMs - Narrowed, maybe eliminated, Japanese lead
  - Toyota - In Japan - Lags Nissan!!! Say what?
  - Incredible pressure to control & emphasize costs
  - Economic pressures shift balances in supply chain
  - Technological innovation - leveling impact

Critical Issues: “Design Advisors”

- Knowledge Capture & Re-use
- Distinct from Current Problems/Barriers
  - Technology miss match - not recognized as systematic



Industry Perspective

Moving Fast, Urgency - Not 2015 Target

- Happening Right Now, Today
- See June 10th issue, Automotive
- Expansion in Scope
  - Convergence Simulation & Test
  - Up Front Mfg., Up Front X, Warranties, Time-To-Market
  - Design Advisors/Templates/Knowledge Capture & Reuse
- Escalation in Concerns
  - Questioning the Business Model
  - Retooling the Supply Chain

Drama

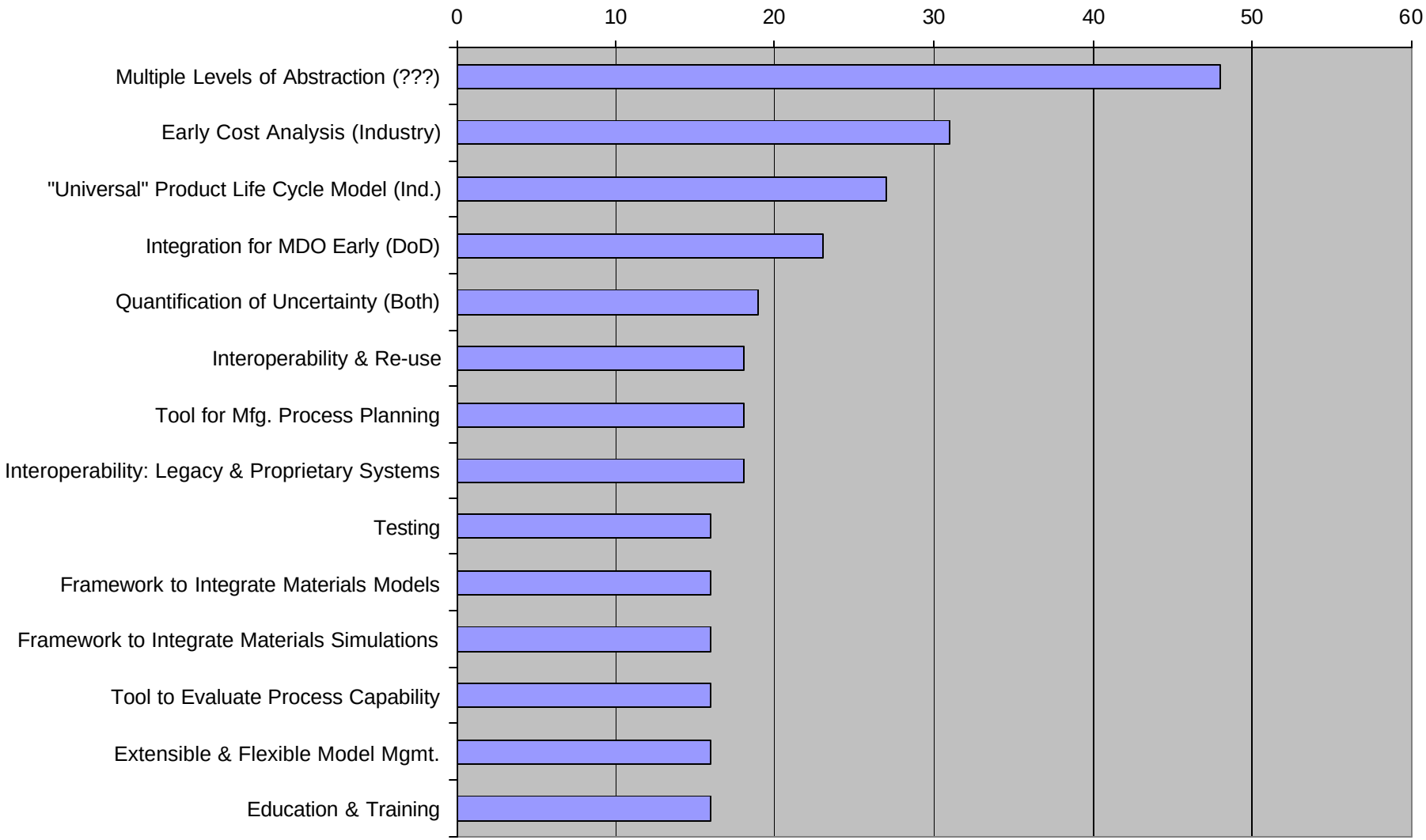
Full Context of Super Designer Magnifies the Challenge, Raises the Urgency for Action, and Reduces the Time Available for Achieving Effective Results.

Note! Only One Element of a Wide Range of Challenges. Necessity of moving on multiple fronts.

Appendix - “DoD Critical Issues”

- Source: Modeling & Simulation for Affordable Manufacturing Technology, Roadmapping Workshop, Compiled Workshop Notes, 23 May 2002
- Integrated Manufacturing Technology Initiative (IMTI), Richard Neal, IMTI@mail.imti21.org, imti1@msn.com

DoD Priorities
% of Participants Rating Issue as One of Their Top Concerns



DoD Categories - Defined

- Develop techniques to support the automated generation of models at various levels of abstraction
- Complete awareness of cost factors, supporting decision making early and throughout the design and manufacturing lifecycle
- Develop and deliver a scaleable, comprehensive product life-cycle model with enabling architecture and data structures tailorable to all sectors and integratable across all levels of the supply chain
- Establish seamless integration of modeling systems to enable multi-discipline optimization delivering impact early in the design process
- Establish rigorous mathematical models to analyze uncertainty, and provide validation and certification in M&S including the quantification of uncertainty in models
- Develop object-driven data schema from which models are generated, assuring interoperability and reuse (includes common feature sets)
- Create a tool to produce a process plan for manufacturing operations
- Develop a solution to solve the interoperability problem of new, legacy and proprietary systems and models
- Develop systems that maximize the effectiveness of testing through the use of performance models realizing “surprise free” product performance
- Develop an interoperable framework for the integration of materials, material processing and manufacturing models
- Develop interoperable models for the integration of materials, material processing and manufacturing simulations
- Create a tool to evaluate process capability to determine producibility of features, resource capabilities, and process repeatability
- Establish extensible process and guidance for flexible, ongoing conceptual model management
- Establish an efficient means to educate and train all stakeholders on the fundamental concepts, capabilities and limitations of M&S, so they are able to critically and effectively apply M&S infrastructure to solve problems and contribute to the growth of corporate M&S knowledge and capability