NA Regional Summit 2008 NAFEMS
2020 Vision of Engineering Analysis and Simulation
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Product Performance Simulation in the Year 2020

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Products Are More Than They Used to Be – Simulation Tools Must Meet the Challenge

1988

2008

Key Issues

- Which of today's business drivers will have the greatest influence on the product development priorities and processes moving forward?
- Which business behaviors and which technology trends will have the greatest impact on the future of product performance simulation?
- What lessons have we learned since the 1980s?
- What scenarios are most likely in the year 2020 and priorities will produce the best future?

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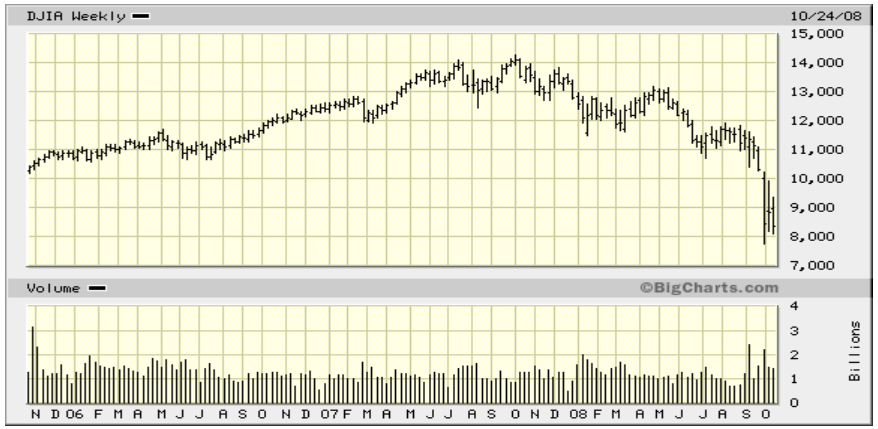
Key Factors impacting Business Priorities and Practices Through 2020

- Economic
- Environmental
- Demographic
- Emerging business models

Economic Stress Will Stimulate Innovation in Product Development and Simulation Use

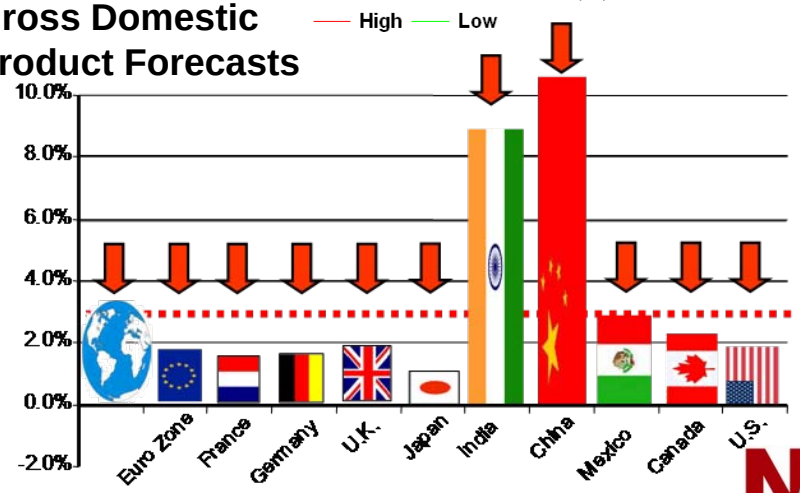
DJIA 10/24/05 to 10/24/08



NYMEX – Crude Oil Futures - Forecasts

Nikkei Index

Gross Domestic Product Forecasts



Demand for Green Warrants More Simulation to Achieve Objectives

Today's Students in the 2020 Workplace Will Want Web 2.0 Look and Feel

Tomorrow's workers

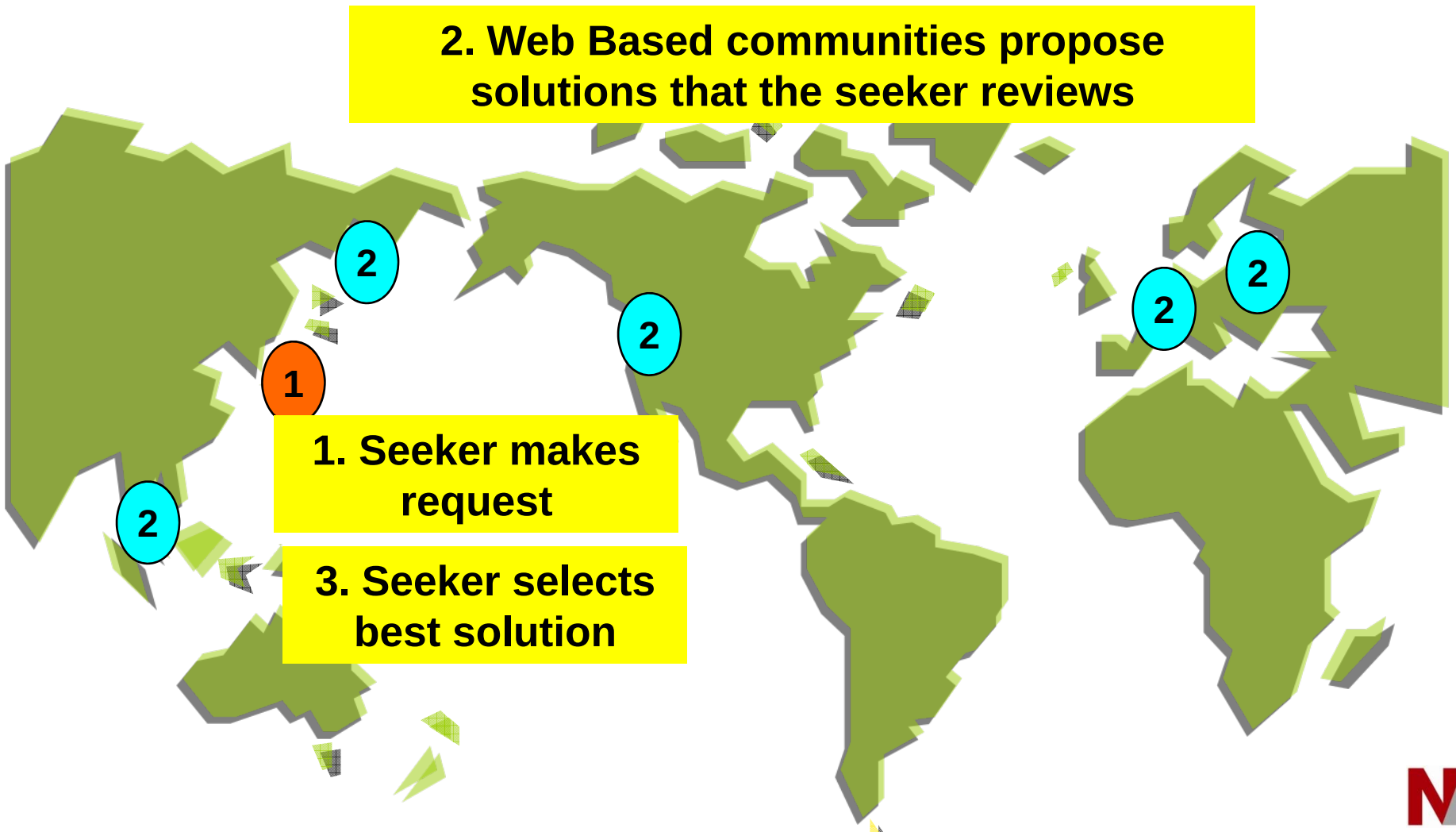




- Want to work in <u>their</u> world or context
- Want continuity between offline/online and all channels
- Expect immediate access to <u>all</u> information
- Want to work in social networks




New Collaborative Business Models Will Change Simulation Use and Sharing



Business IT Megatrends Will Change the Shape of Simulation Software Vendors

People and IT

The schism is here

Nature of work

Diminishing
Automation returns

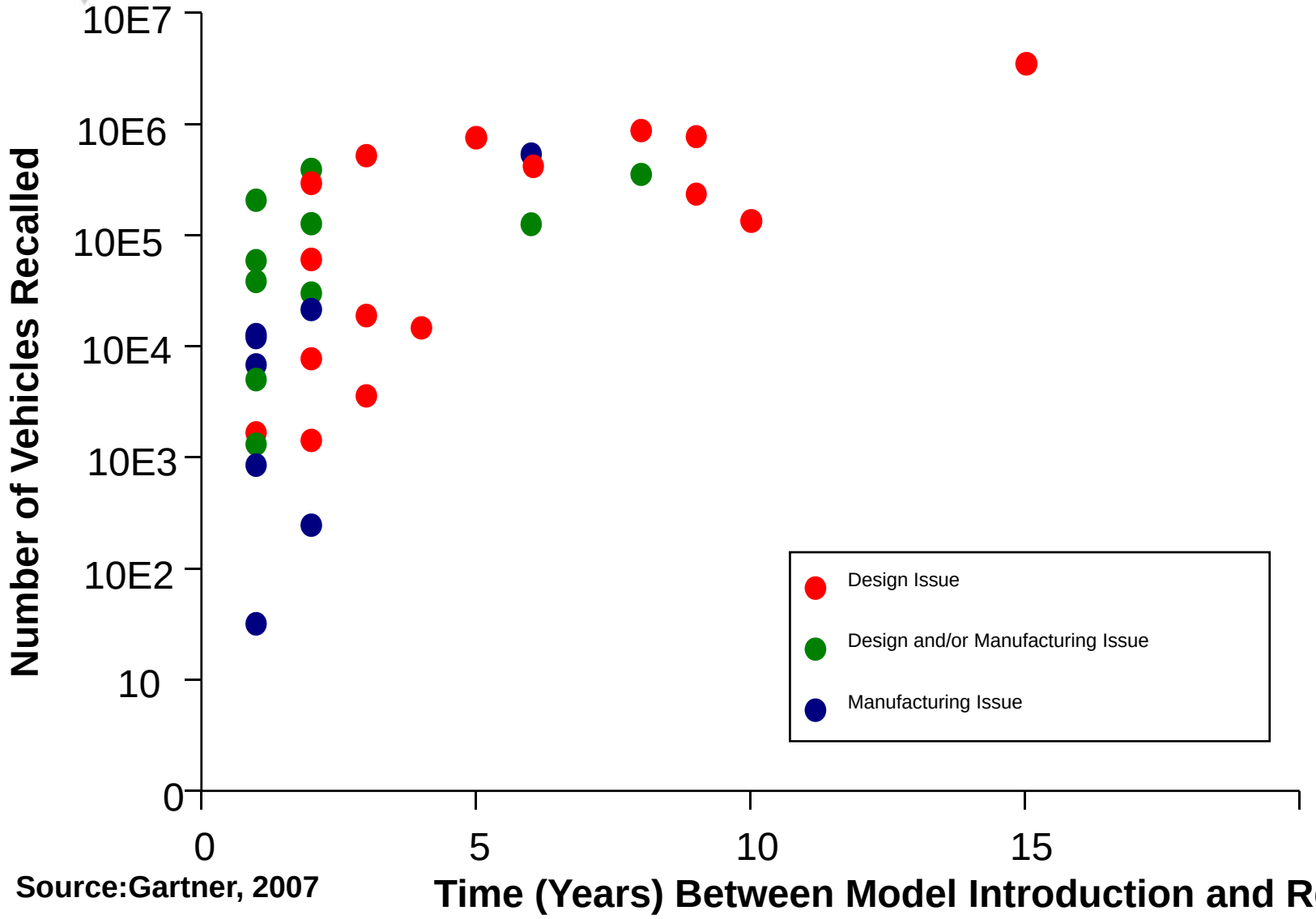
Nature of business

Ecosystems, not enterprises

Technology markets

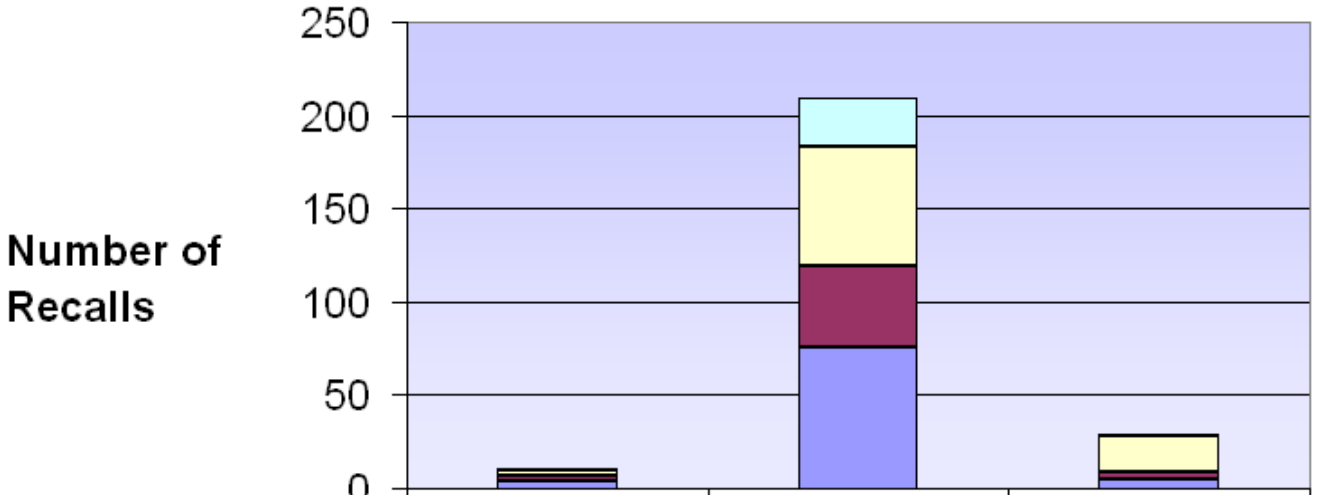
New business models, buying centers, channels

Analysis of Major Automotive Recalls: 2005-2007 Suggests Lifecycle Simulation Priorities



Source:Gartner, 2007

Root Causes of Medical Device Recalls Reveal Need for Broader Simulation Scope



	Class 1	Class 2	Class 3
Software	1	26	1
Manufacturing related	3	64	19
DFM-related or manufacturing	3	43	4
Design related	4	76	5

Recall Class

Source: FDA website

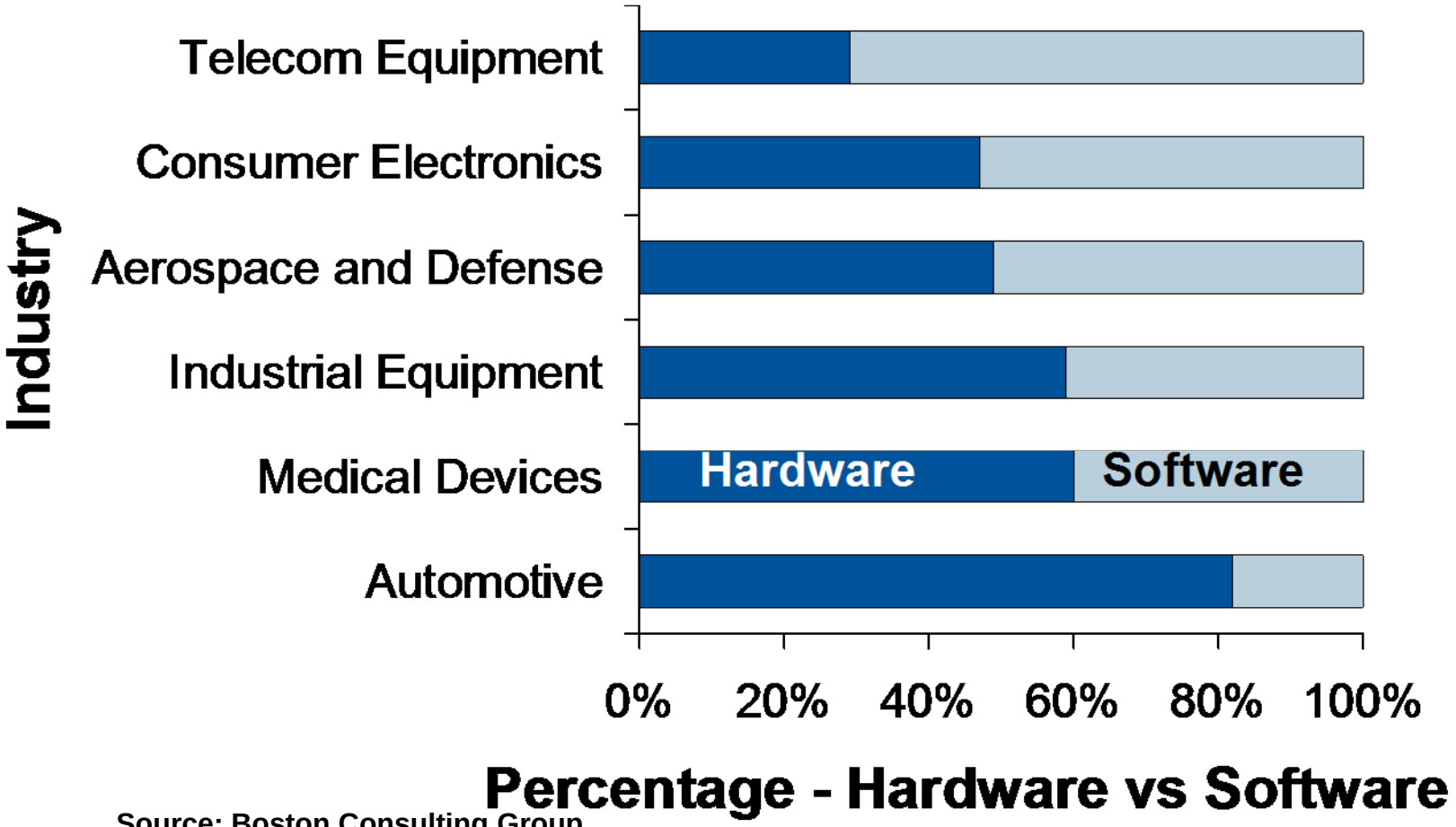
(See http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfTopic/medicaldevicesafety/recalls.cfm

http://www.fda.gov/opacom/7alerts.html)

Top Aerospace and Defense Priorities Confirm Expanding Role of Simulation

1. Capturing/Retaining/Cultivating A&D knowledge-base and innovative skills with re-use
2. Harmonizing views of data across engineering, manufacturing, MRO, and customer documentation
3. Streamlining new product introduction processes
4. **Enhancing virtual prototyping and simulation support**
5. **Enhancing systems engineering and mechatronics support**
6. **Deepening understanding of composite material behavior**
7. Richer global support for collaboration including simultaneous role-based views of product content
8. Continuous improvement of requirements management support
9. Continuous improvement of quality management
10. Continuously streamlining regulatory compliance and governance

Growing Mechatronics in Products Reflect Greater Need for Systems-Level Simulation



Source: Boston Consulting Group

Courtesy: Siemens PLM

Processors on Wheels!

Courtesy of Siemens PLM

- 10 million lines of code
- 50 ECUs
- 30,000 calibration parameters
- 4-7 vehicle BUS systems
- 3 kilometers of wiring

Key Issues

- Which factors today will have the greatest influence on the ongoing development of simulation software?
- Which business dynamics, and which technology trends will have the greatest impact on the future of product performance simulation?
- What lessons have we learned since the 1980s?
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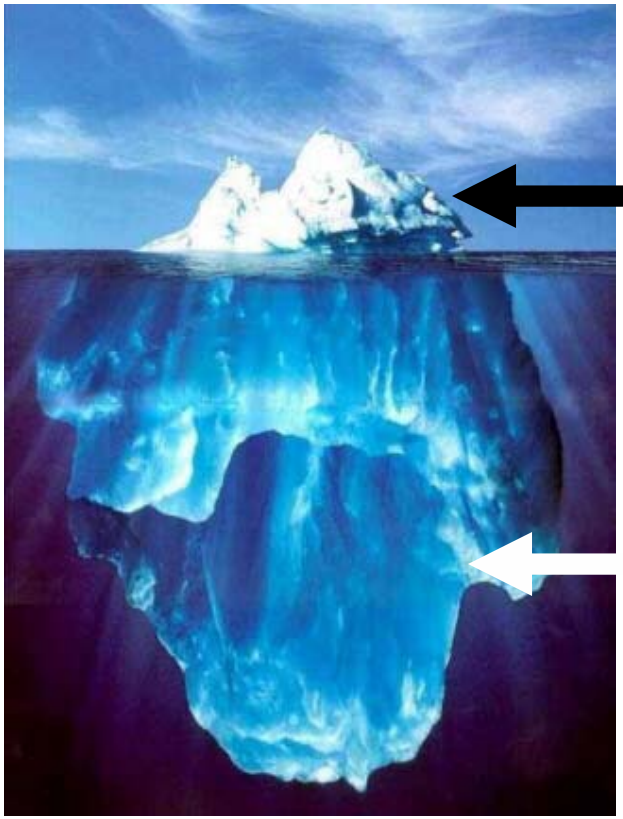
Product Development SW Historically Not Visible to Senior Executives



Visible IT

- ERP
- Customer Relationship Mgmt.
- Sarbanes-Oxley

Invisible IT

- Engineering and Design
- Manufacturing Operations
- Quality Assurance
- Environmental compliance
- Process control

Emerging Business Priorities of CIOs Suggest Greater Attention to PLM, R&D

To what extent will each of the following be a top priority for you in 2008?	2008	2007	2006
Improving business processes	1	1	1
Attracting and retaining new customers	2	3	3
Creating new products or services (innovation)	3	10	9
Expanding into new markets or geographies	4	9	**
Reducing enterprise costs	5	2	2
Improving enterprise workforce effectiveness.	6	4	**
Expanding current customer relationships	7	*	*
Increasing the use of information/analytics	8	7	6
Targeting customers and markets more effectively	9	*	*
Acquiring new companies and capabilities (M&A, etc)	10	*	*

Source: Gartner, 2008

Survey of 1498 CIOs

Hardware Performance Trends – Not a Barrier to Simulation Advances

Year	Month	$/GFLOPS	Comments
1961		$1.1 trillion	(=US$1,100 per FLOPS); with 1 billion IBM 1620 units @ $64,000 each and a multiplication operation taking 17.7ms
1984		$15,000,000	Cray X-MP
1997		$30,000	with two 16-Pentium-Pro–processor Beowulf cluster computers
2000	April	$1,000	Bunyip, Australian National University. First sub-US$1/MFlop and Gordon Bell Prize 2000
2000	May	$640	KLAT2, University of Kentucky
2003	August	$82	KASY0, University of Kentucky
2006	February	$1	ATI PC add-in graphics card (X1900 architecture) — these figures are disputed as they refer to highly parallelized GPU power
2007	March	$0.42	in Ambric AM2045
2007	October	$0.20	Available with the cheapest retail Sony PS3 console, at US$400, that runs at a claimed 2 teraFLOPS; these figures represent the processing power of the GPU. The seven CPUs run collectively at a lower 218 GFLOPS

Data compiled from Wikipedia

Changing Nature of Products Will Mean Shifts in Simulation Priorities

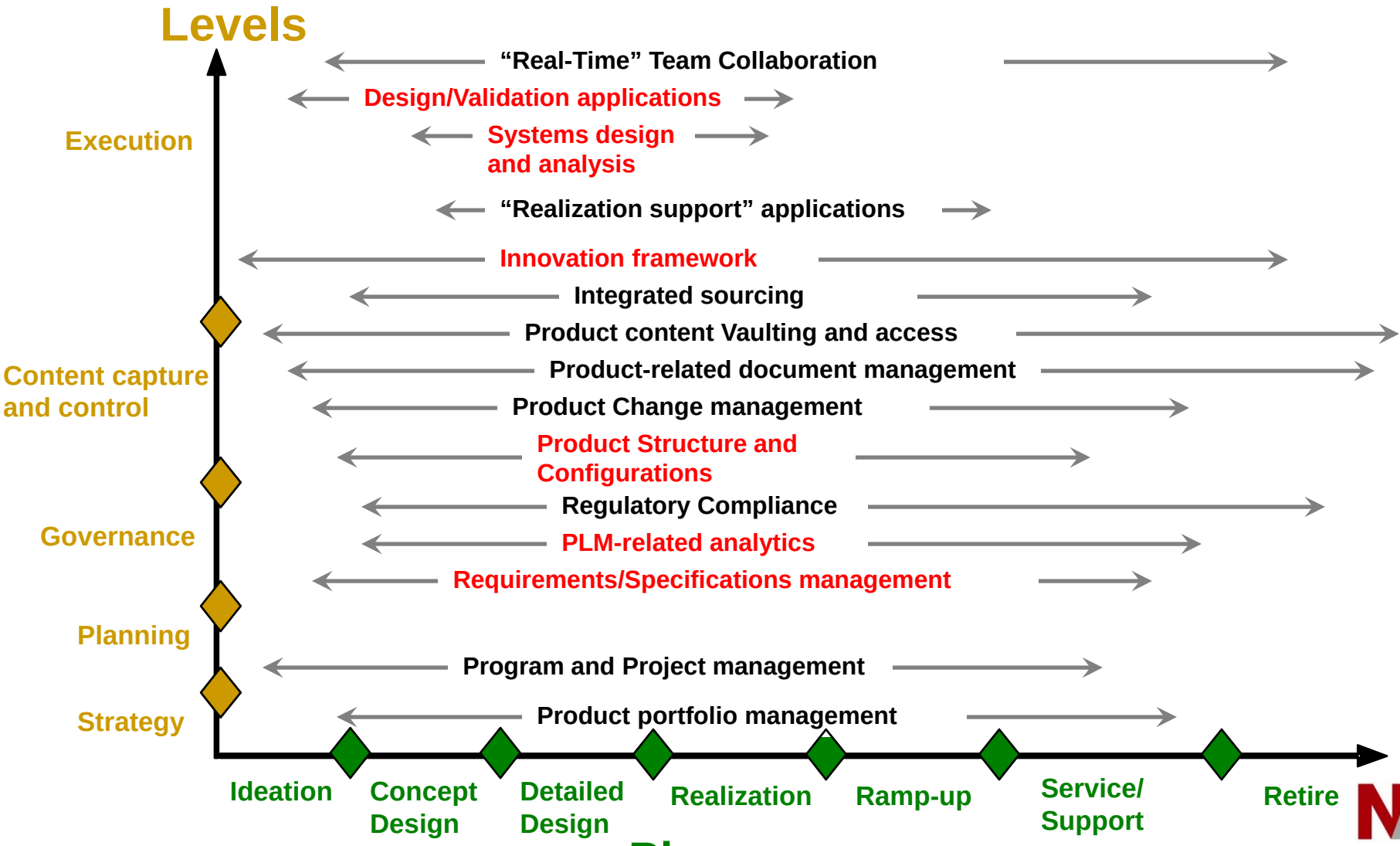
Contributions to Revenue

Year	2003	2015	2020
Software	4%	15%	20%
Electronics	16%	25%	30%
Hardware	80%	60%	50%

Source: McKinsey, 2006

Courtesy, Siemens PLM

PLM Vendors Absorb Product Performance Simulation Capabilities into PLM Portfolios



Twelve Most Influential Technology Trends Shaping Product Performance Simulation

- Stochastic simulation
- Complexity analysis
- Systems simulation
- Multiphysics simulation
- Advances in materials modeling
- Analytics for CAE
- MEMS and nanotechnology simulation
- Further advances in error estimation and control
- Simulation/test data management
- Business Intelligence and analytics for simulation data
- Multi-sensory feedback
- Further advances in model creation from CAD data
- Adapt gaming technology

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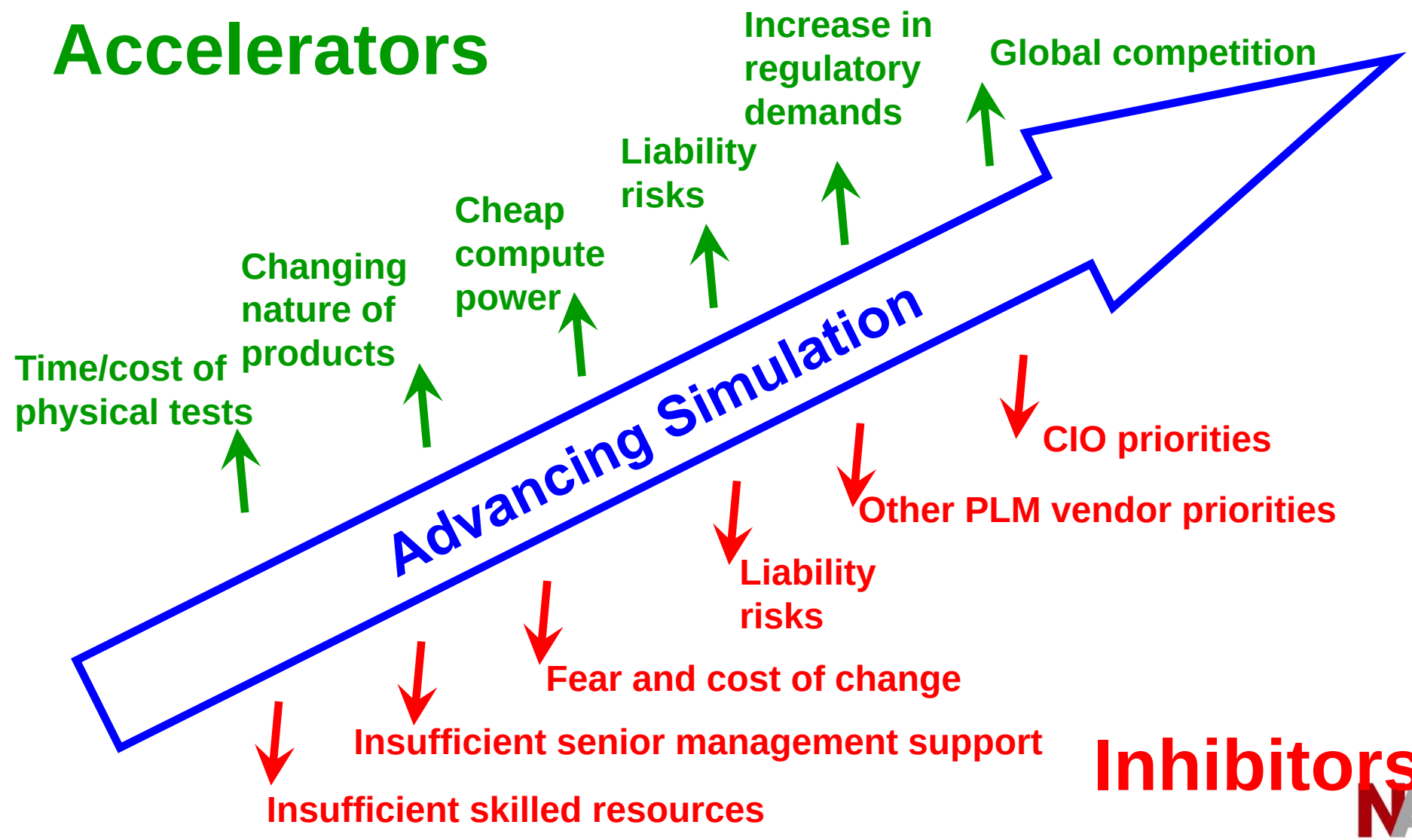
Predictions from the 1980s vs. Today's Realities

1980s Prediction	Today's Reality
Supercomputers will be available on the desktop	Fulfilled in terms of 1980s supercomputers
Dramatic reduction in physical testing	Reductions in select industries for select purposes
The mainstream of designers perform analysis	Only 1 out of every 10 CAD seats is sold for this purpose
Rapid growth of automated design through optimization	Actual use is niche
High fidelity multi-physics will be broadly adopted	Multi-physics use is relatively narrow and selective
Simulation will proactively guide a significant percentage of design	Largely unfulfilled given scope and urgency of design decisions

Lessons Learned

- C-level executives in most manufacturing industries are less educated about CAE than we previously thought
- The CAE community is risk-averse and slow to change
- The CAE community, users and R&D professionals, need to learn more and think more “integratively” about product lifecycle demands
- The strategic importance of CAE in large enterprise-PLM vendors gets diminished due to overarching business demands
- CAE technologies succeed commercially when users perceive they will streamline existing processes and not require substantial change
- Manufacturers adopt advanced simulation technologies when the cost and time for physical testing is significantly higher than computing resources and expertise
- Manufacturers typically behave more tactically than strategically, making the investments to address urgent situations

Accelerators and Inhibitors Shaping the 2020 Landscape



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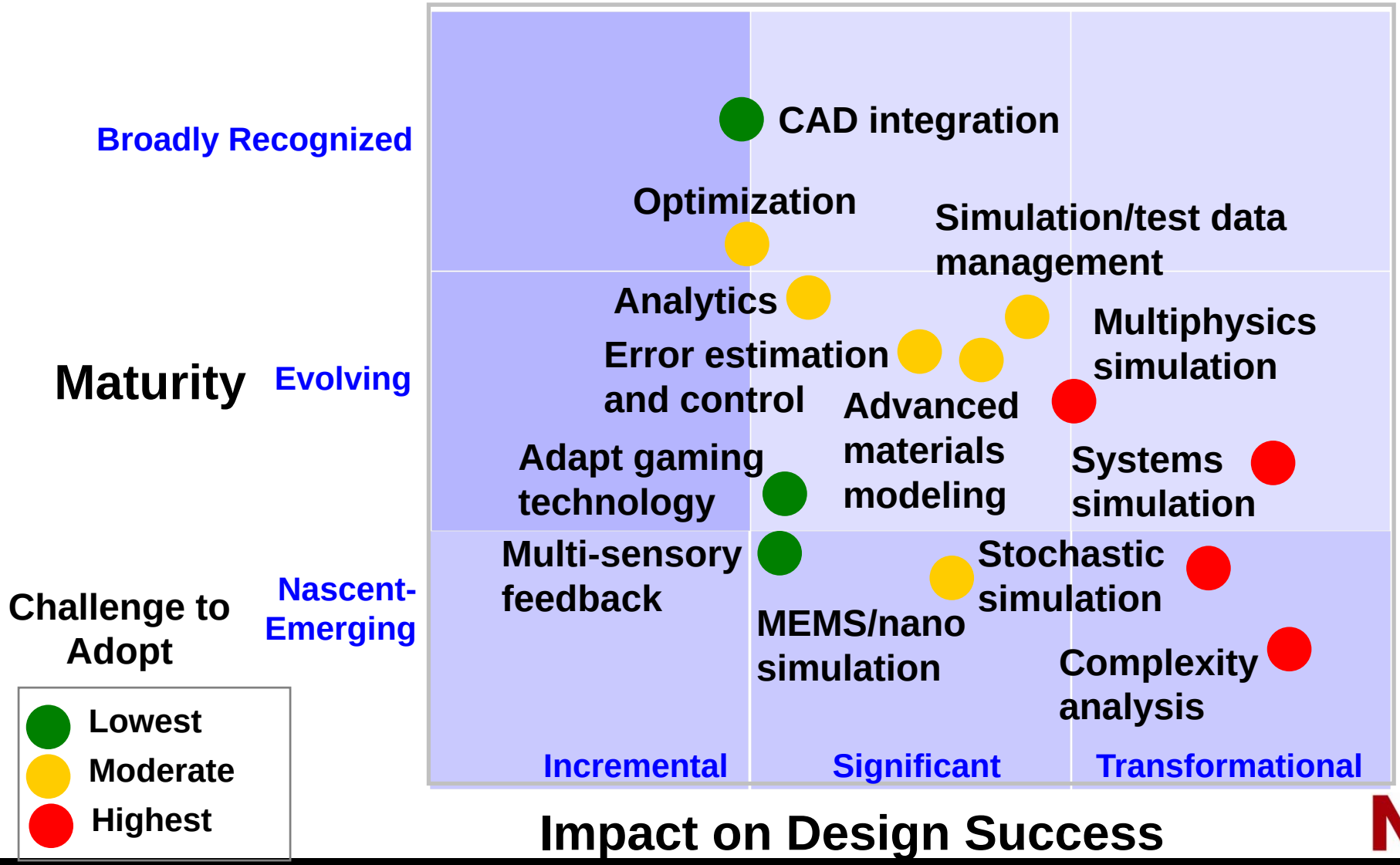
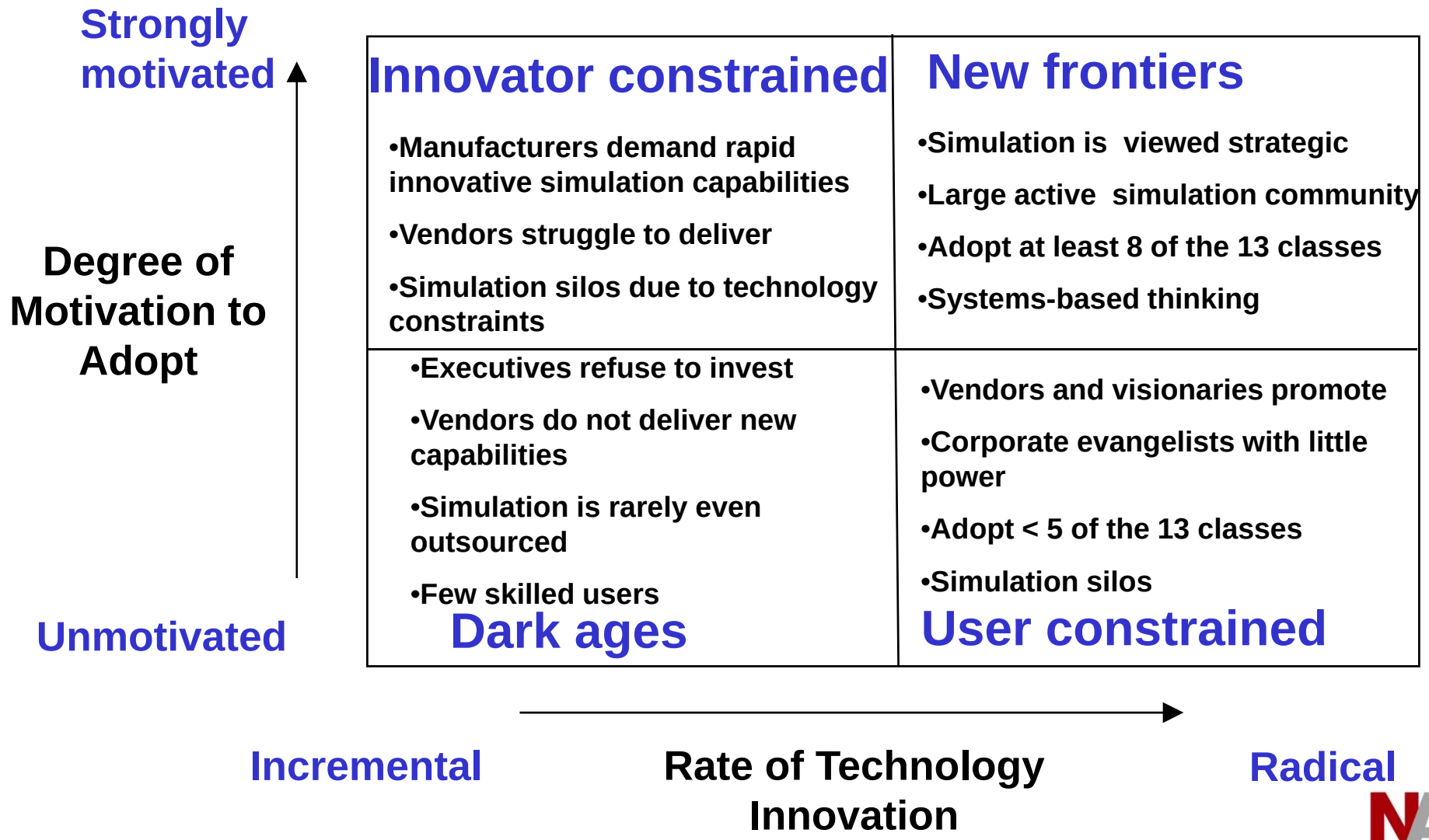
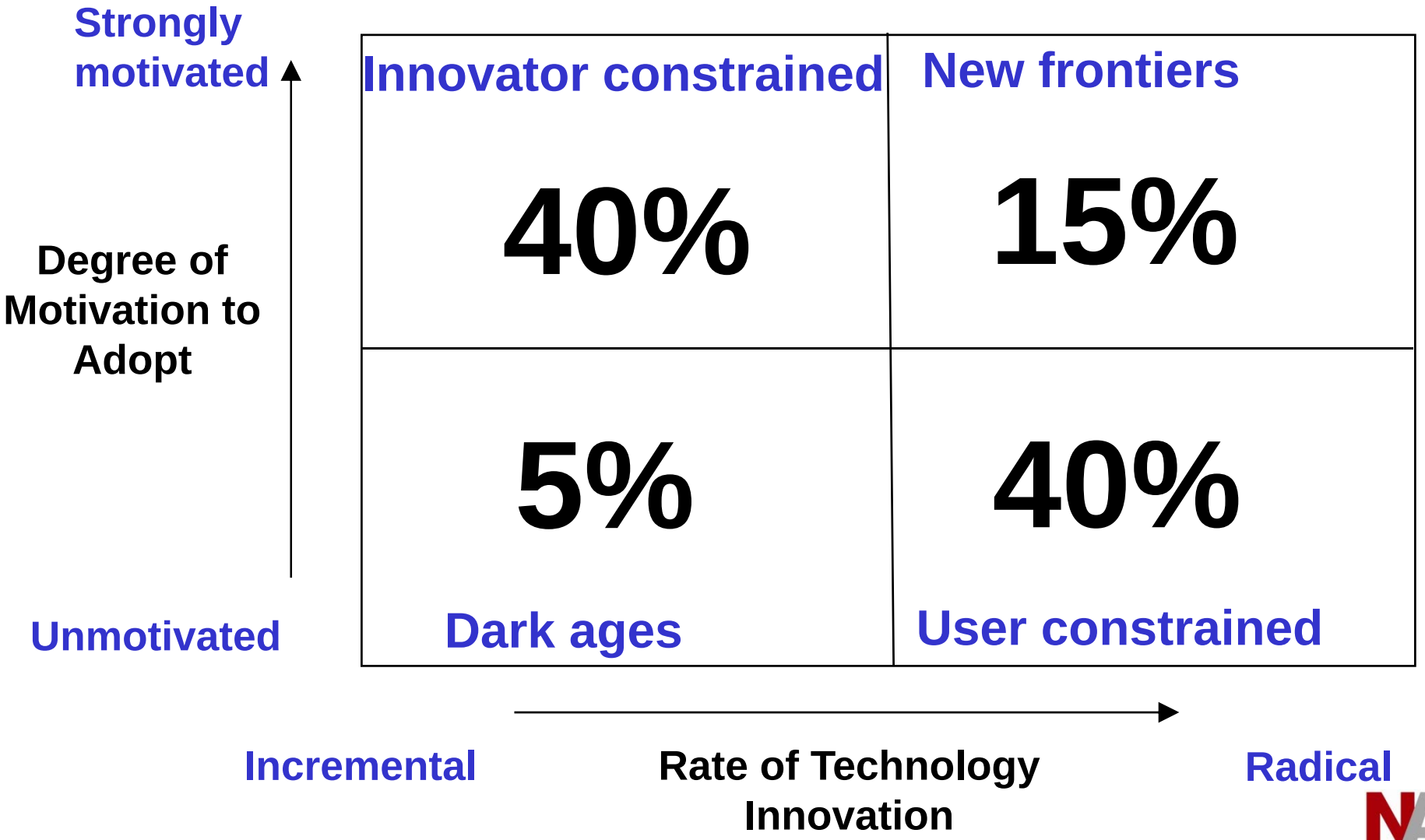
The Application Classes with the Greatest Value in 2020 Are Toughest to Adopt



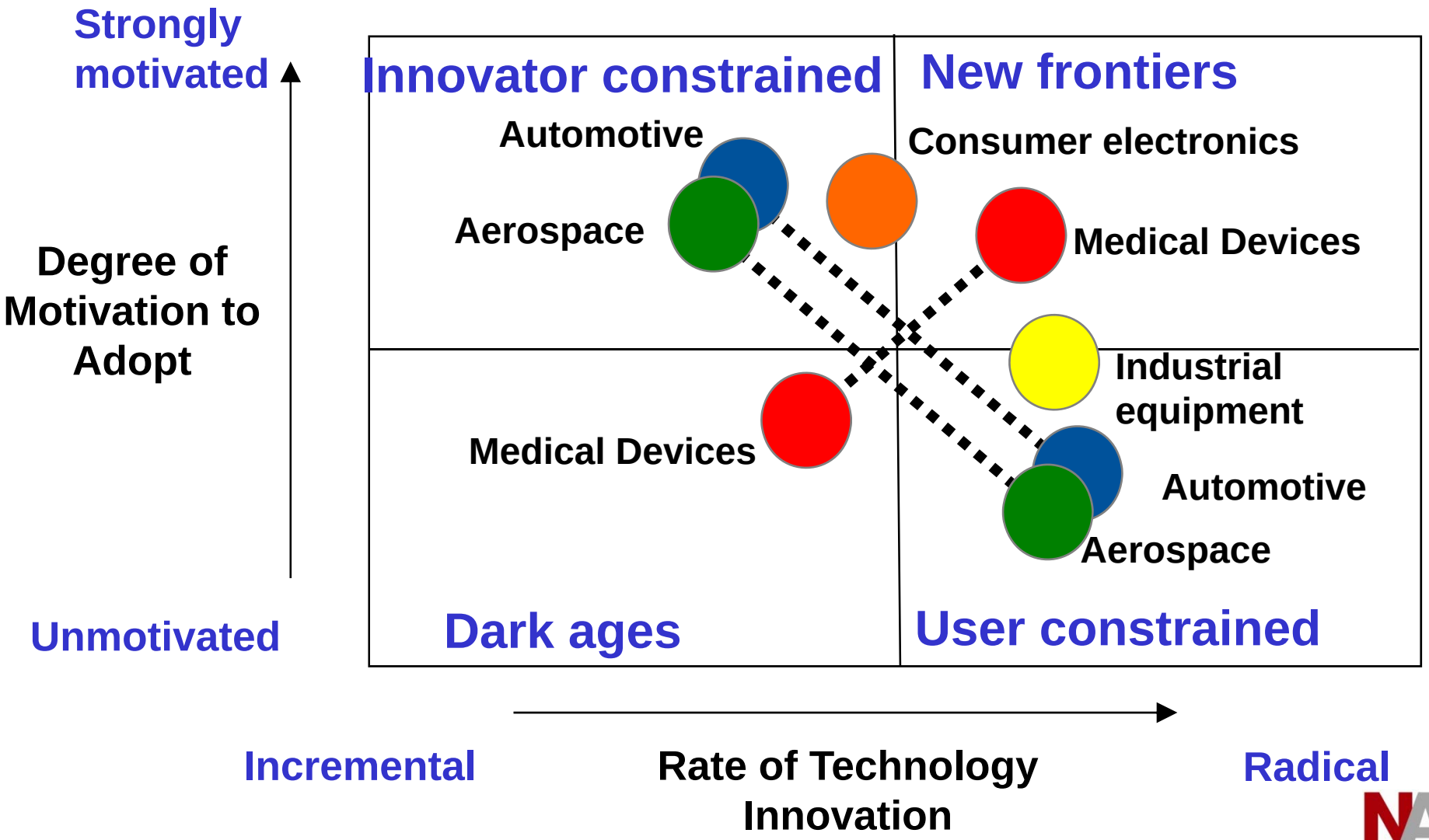
Product Performance Simulation in 2020: Potential Scenarios



Product Performance Simulation in 2020: Most Likely Scenarios



Product Performance Simulation in 2020 Vary by Manufacturing Vertical



Conclusions and Recommendations

- Emerging classes of products will require “systems-centric” simulation capabilities by 2020. Today’s mainstream CAE tools will not provide the competitive advantage
  - Manufacturers should be investing in best of class transformational tools today to cultivate the core competencies
- C-level executives, particularly CIOs, will be more involved in PLM and product development activities by 2020 because they are pressured to add more value to the business
  - They have views and values inconsistent with product development culture. Be prepared to listen, patiently educate, and address their preferences for IT homogeneity and risk management
- Improving the odds of a “New frontiers” reality by 2020 depends on executive support
  - This requires ROI analysis of a simulation-based IT strategy communicated in business language