

DESIGNER

DYNAMIC

ADAMS

# Virtual Prototyping *Coming of Age*



Robert R. Ryan

*President*

*Mechanical Dynamics, Inc.*

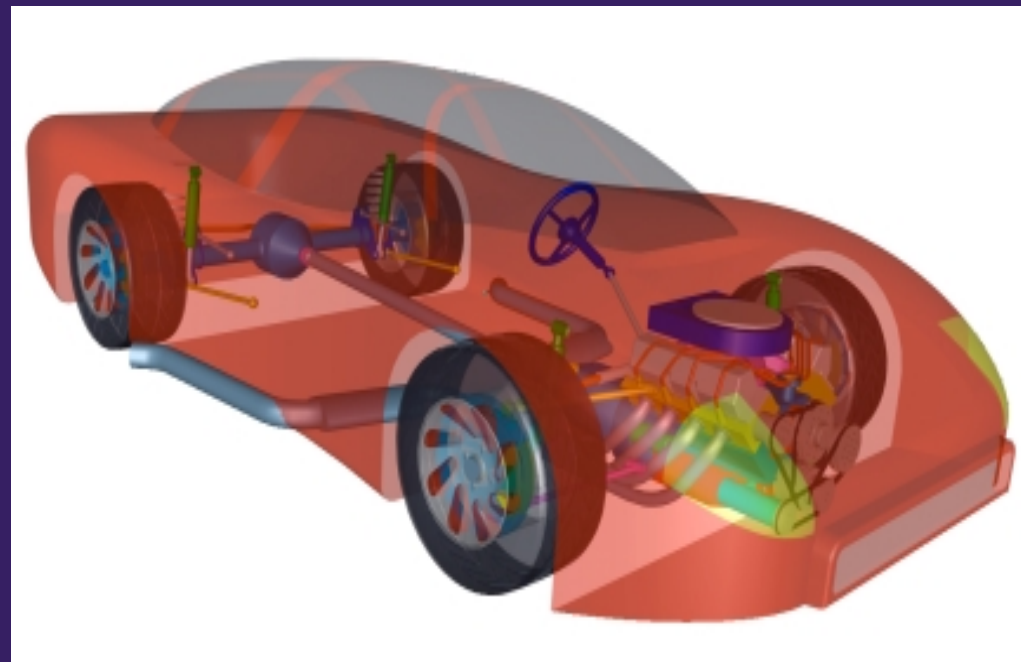


*European ADAMS User Conference 2001*



# Dramatic Change

- Virtual Prototypes have become Platforms for Collaboration



# Meeting the Challenge





# Innovation

- “Rapid Prototyping is the Cornerstone of the Innovative Enterprise.”



Tom Peters, author of  
*In Search of Excellence*



# Innovation

- “Virtual Prototypes are a way of thinking out loud. You want the right people to think out loud with you.”

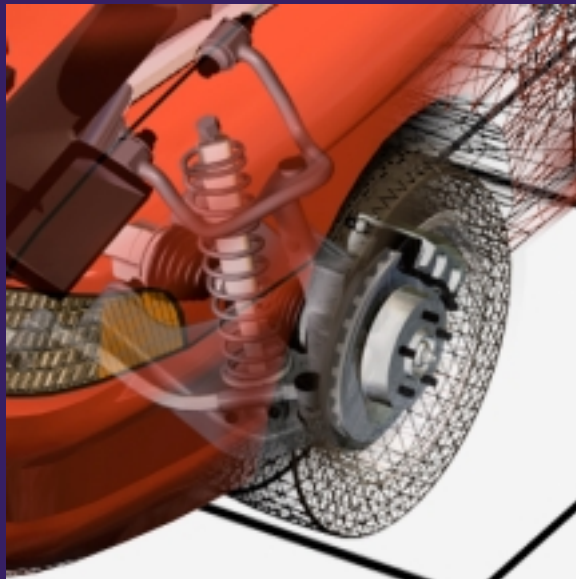


Paul MacCready, designer of award-winning, human-powered Gossamer Condor aircraft



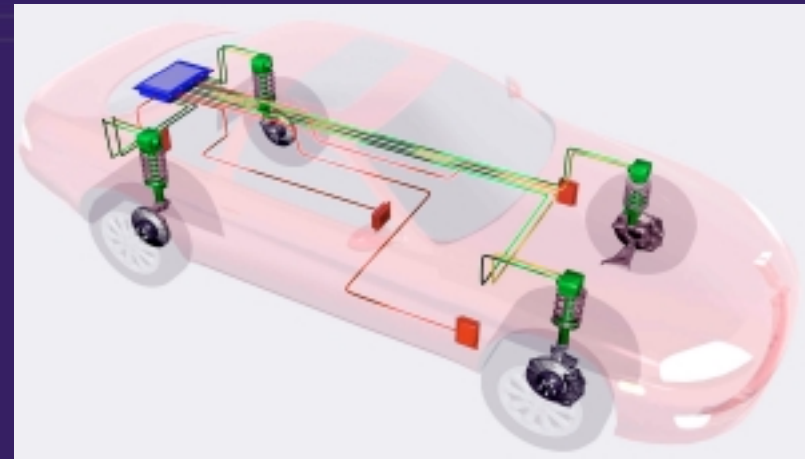
# Innovation

- “Iterate,  
Innovate,  
or Evaporate”



Michael Schrage, *Serious Play*

“The prototype becomes the vocabulary of the innovation, and each successive prototype enlarges that vocabulary and deepens both designer and customer understanding. . . They're a medium of expression.”

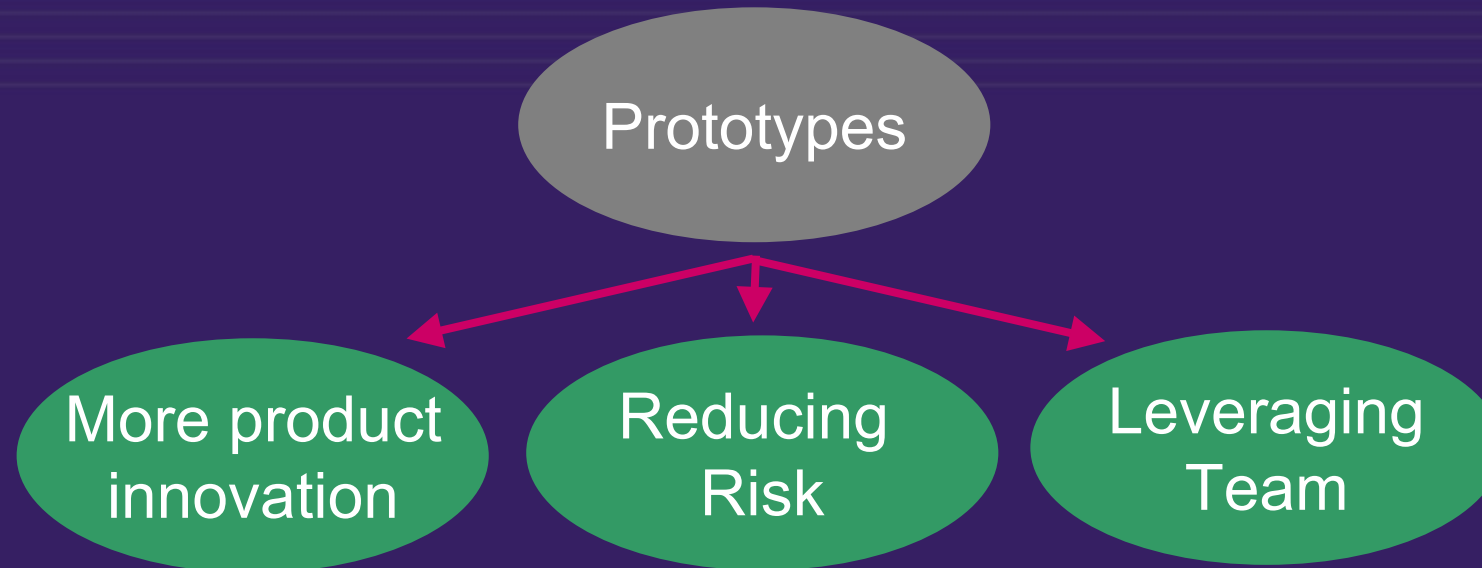


## The Vision:

Virtual Prototyping  
Drives the  
Innovative Design Process



# Business Case



**Physical World**

- Information comes late
- Limited build variations
- No manufacturing effects

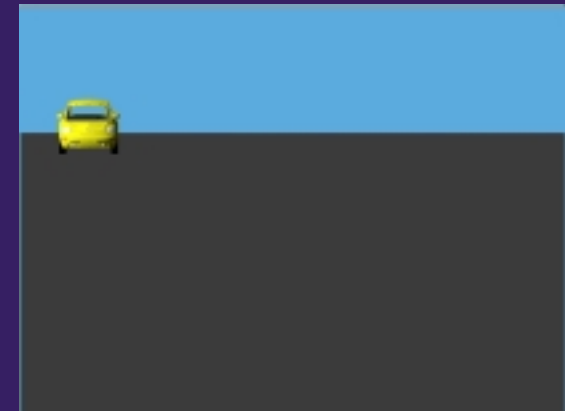
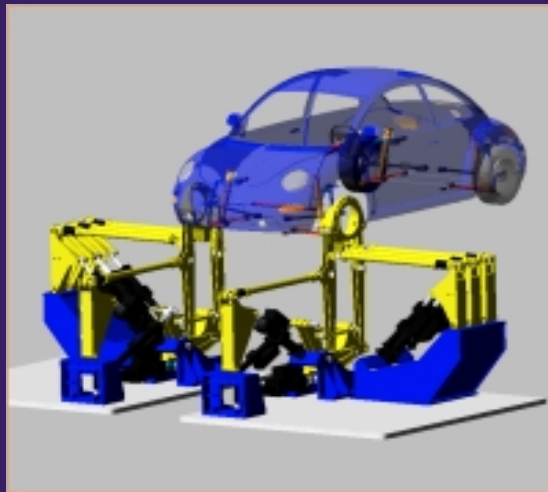
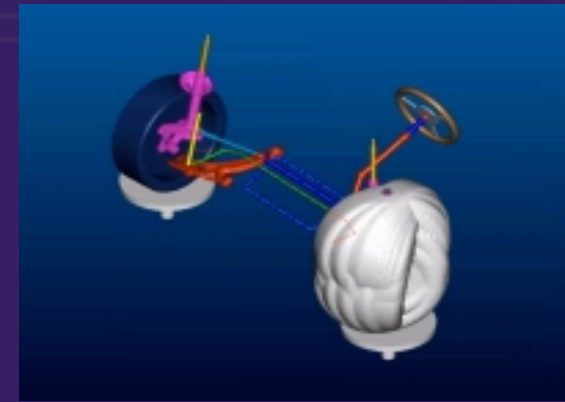


**Virtual World**

- Information up-front
- Validation of all designs
- Warranty feeds process



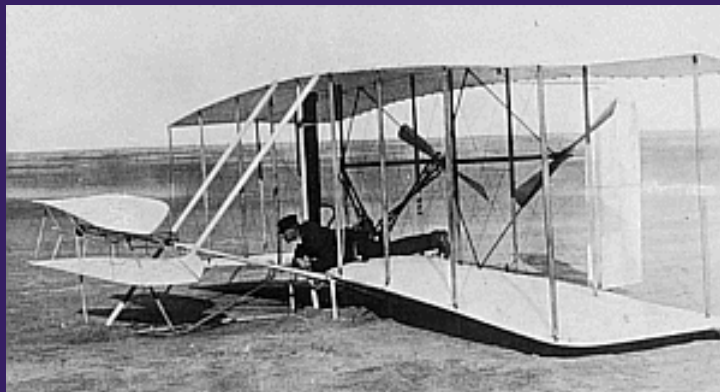
# Functional Virtual Prototyping





# Innovation

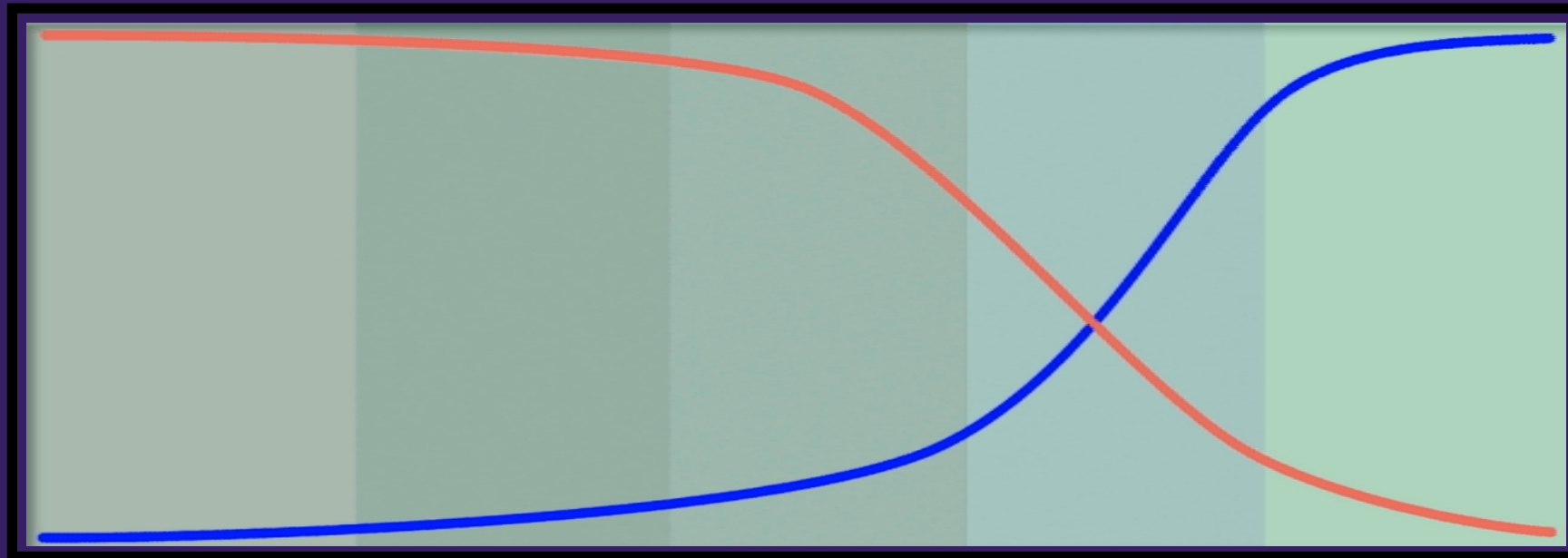
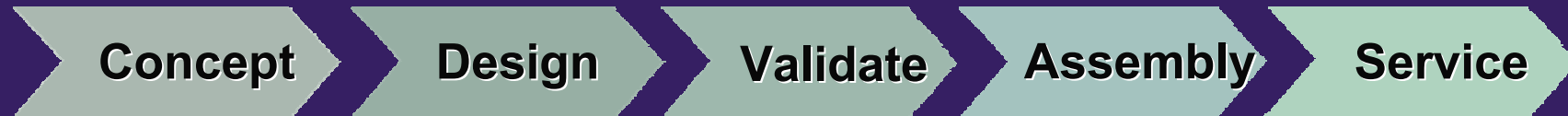
- “Fail Early,  
Fail Often.  
--Frontload your failures!”



Stefan Thomke,  
Harvard Business School



# Up-front Information!



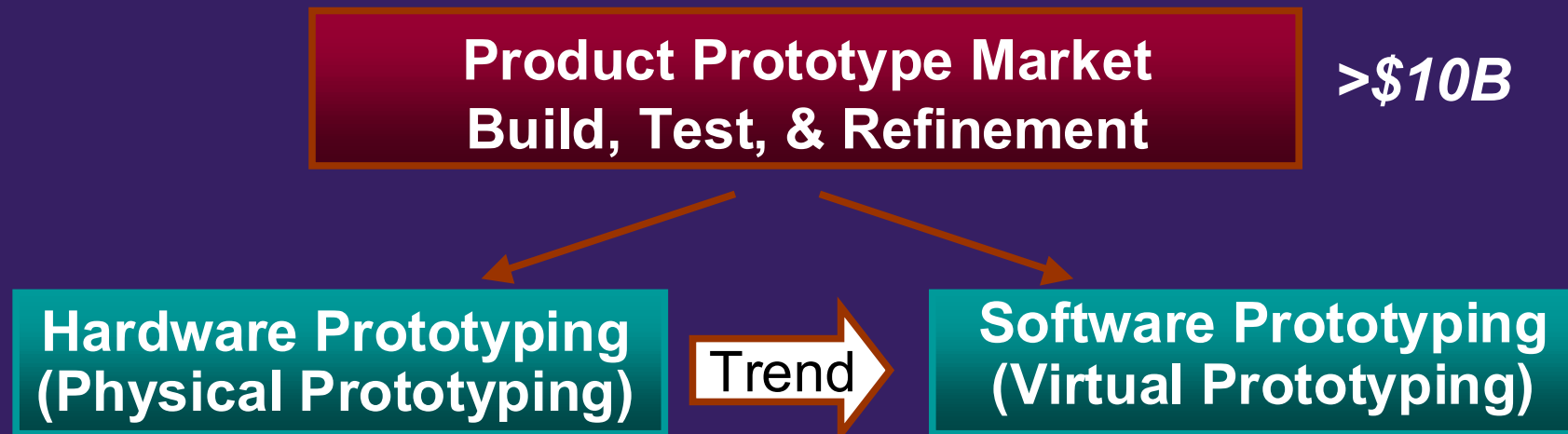
Information

Risk



# Product Prototyping Market

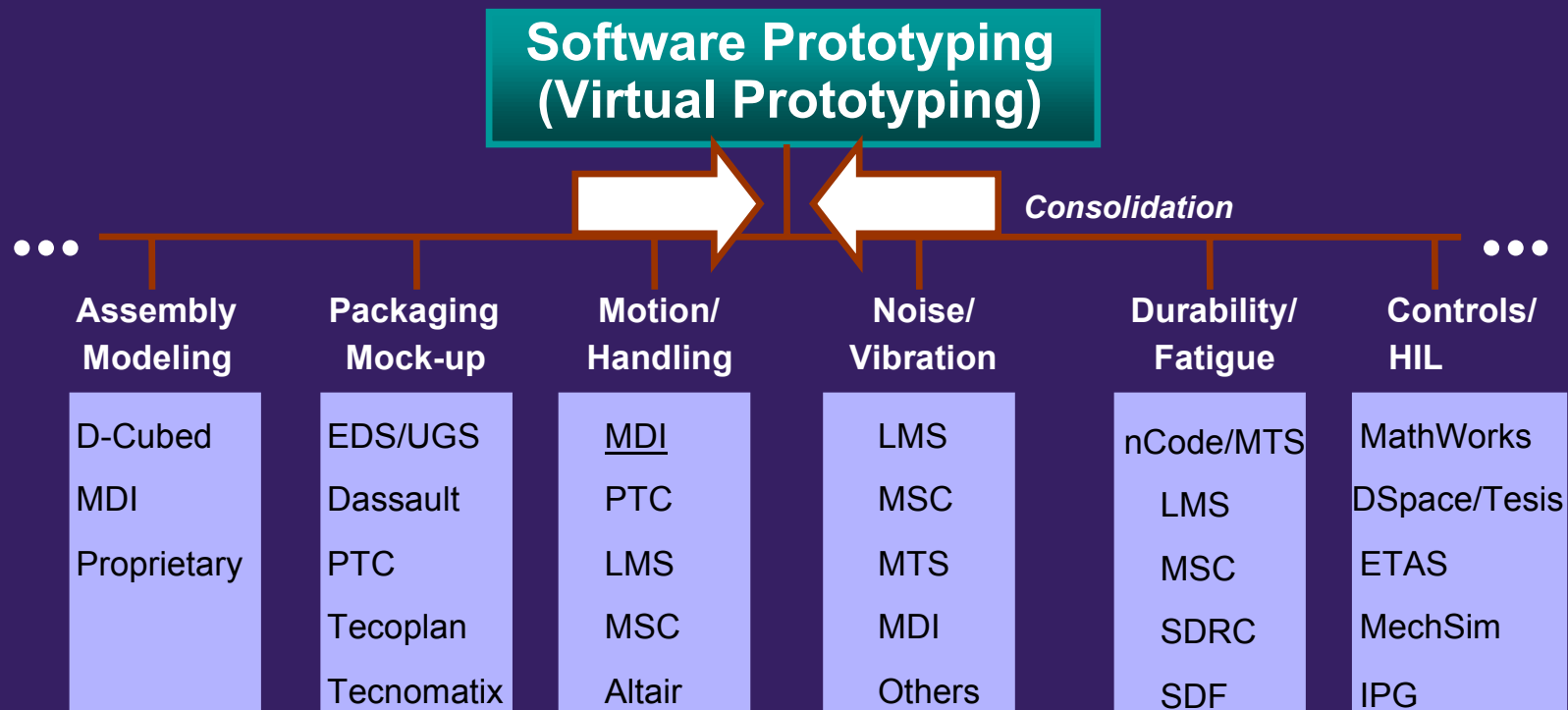
- Market Trend: Shift from Physical to Virtual Prototyping





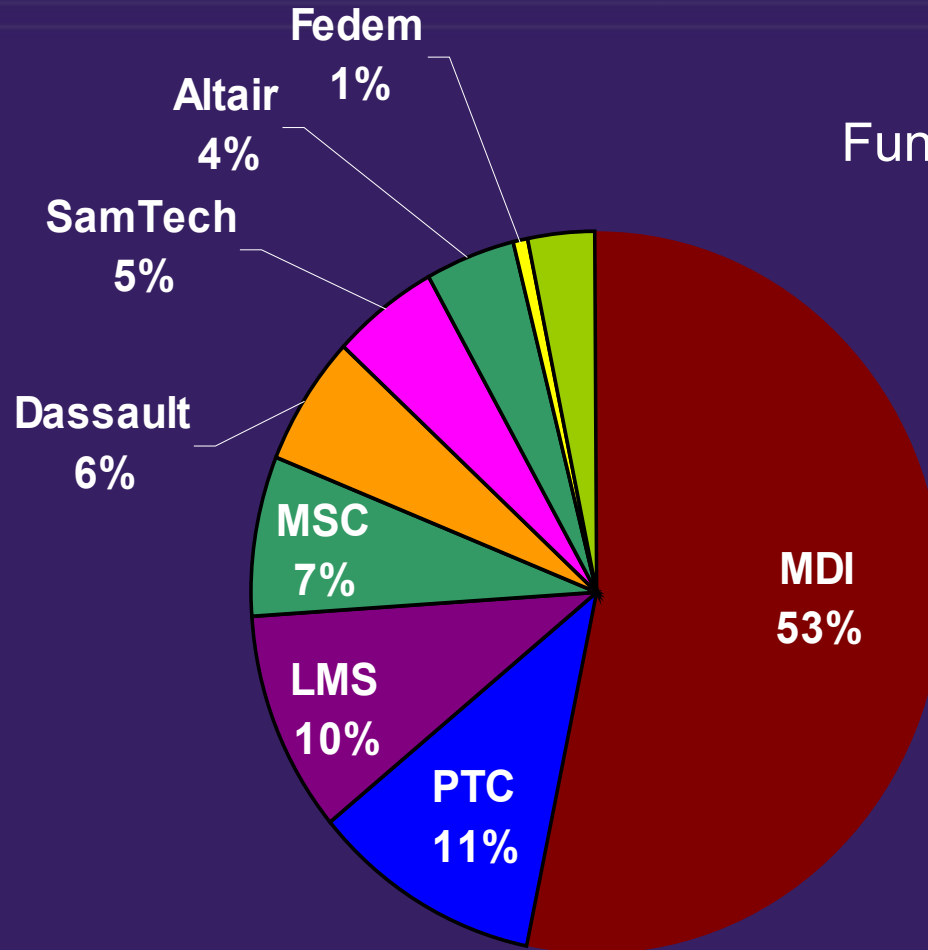
# Product Prototyping Market

- Market Trend: Consolidation among Virtual Prototyping Technology Suppliers





# Market Share



Functional Virtual Prototyping  
Motion Market  
\$112M, 23% Growth

Source:  
Daratech 2001

# MDI Direction



## System-Level Prototype Market Build, Test, & Refinement

Hardware Prototyping  
(Physical Prototyping)

Software Prototyping  
(Virtual Prototyping)

Assembly  
Modeling

Packaging/  
Mock-up

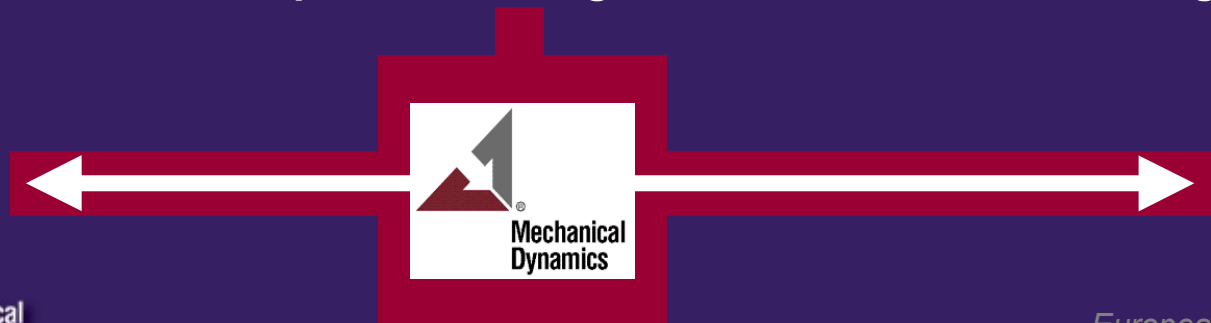
Motion/  
Handling

Noise/  
Vibration

Durability/  
Fatigue

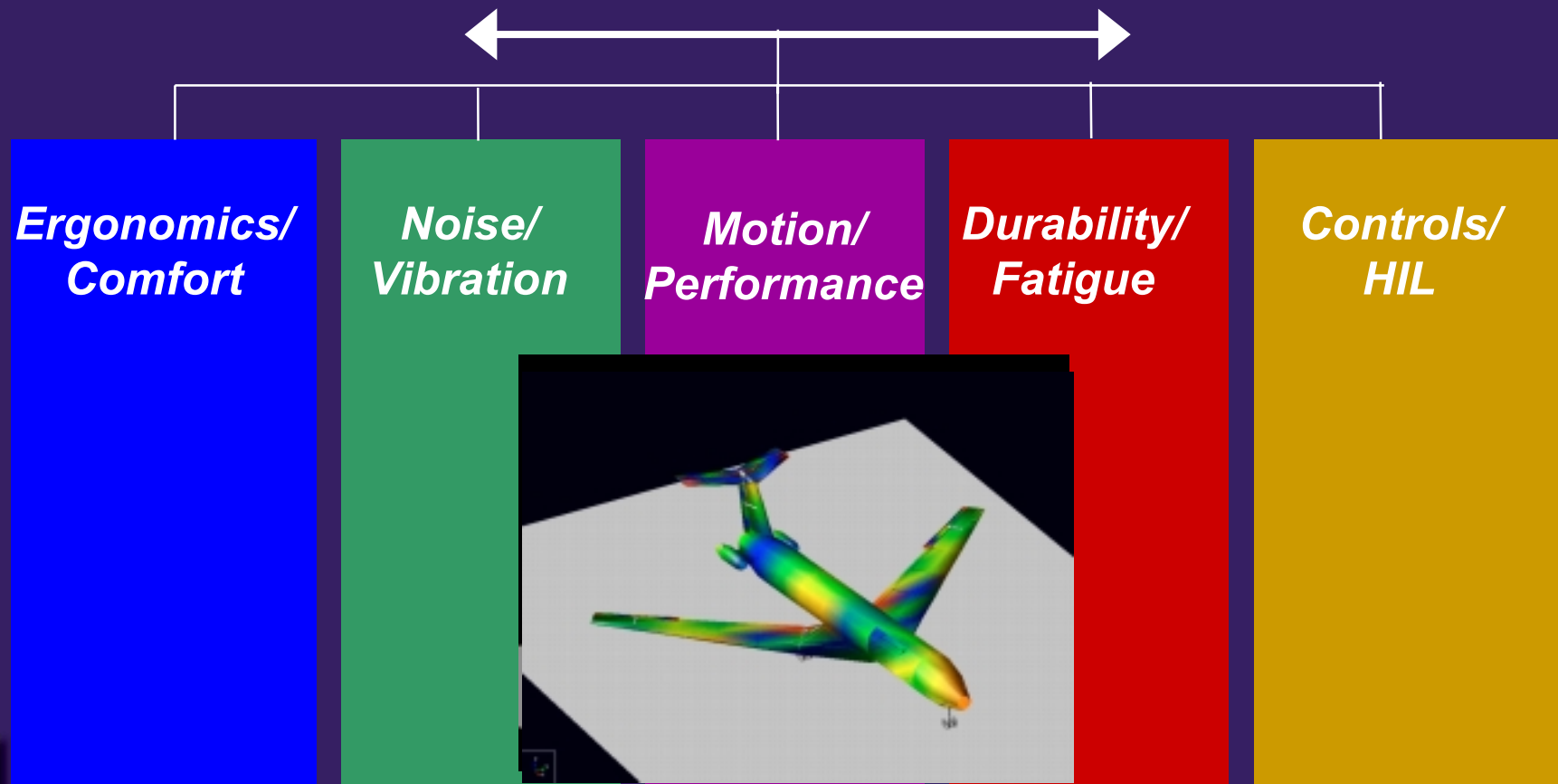
Controls/  
HIL

...





# Extending Virtual Prototyping Scope





# MDI Virtual Prototyping Solutions



## Productivity Tools

Professional Series – ADAMS

Design Series – Dynamic Designer

OEM Series – Private Branding



## Implementation Services

Benchmarking & Needs Assessment

Phased Implementation Programs

Education, Training, & Support



## Collaboration Environments

Web Portal – Data & Templates

Partner Program

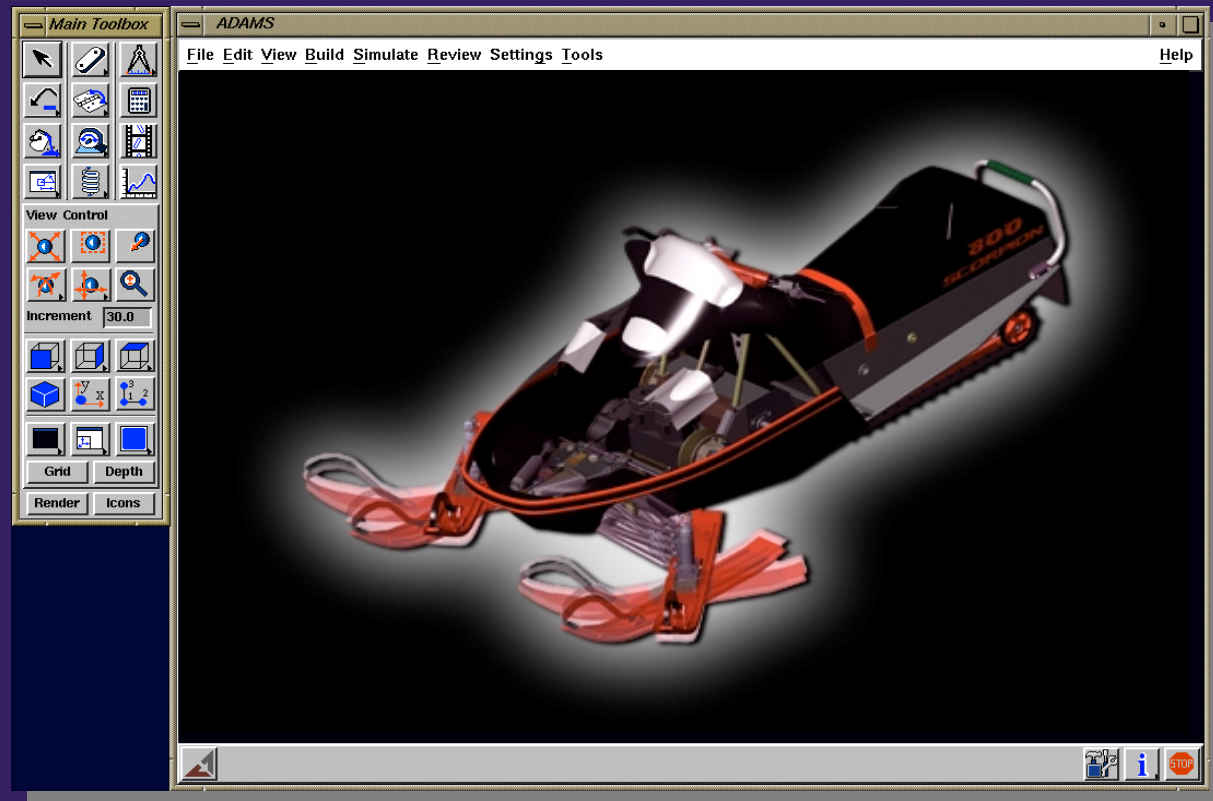
Consortia, Forums, Conferences,



# Functional Virtual Prototyping



- Build
- Test
- Review
- Improve



# Build, Test, Review, Improve



System

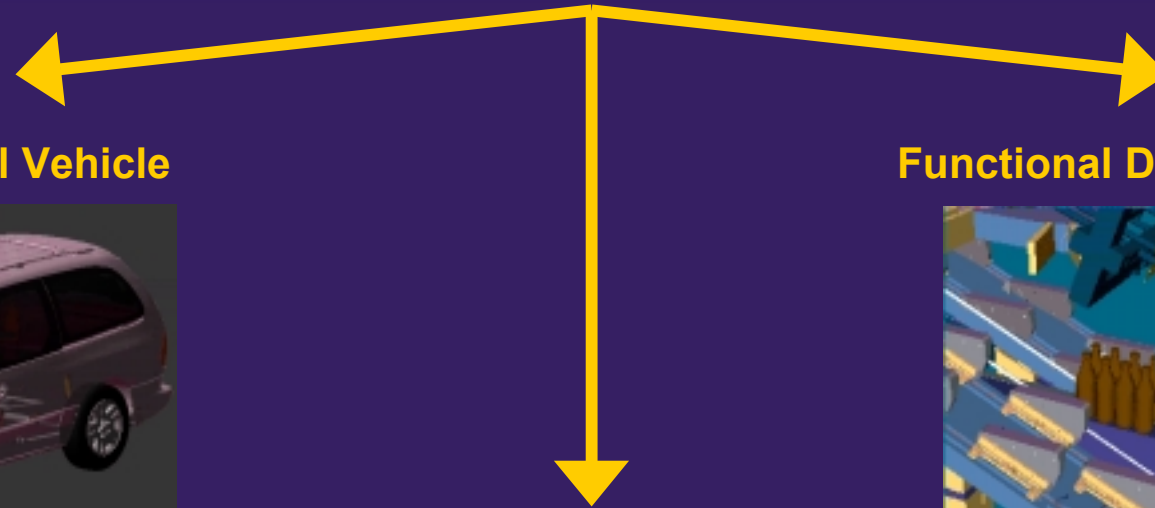
Subsystems

Components





# Functional Digital Prototype



## Functional Digital Vehicle



## Functional Digital Machine

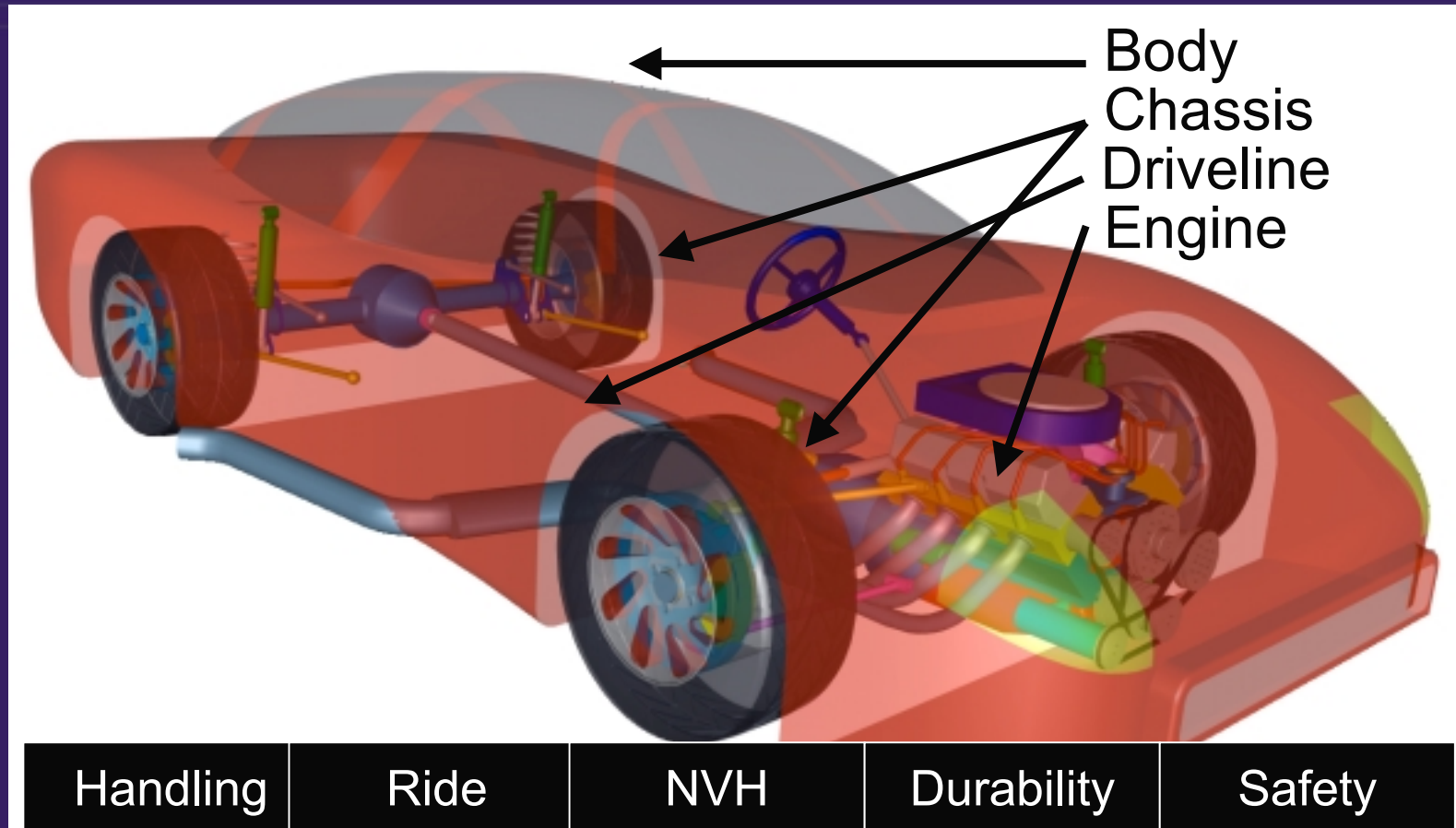


## Functional Digital Airplane





# Functional Digital Car





# Functional Digital Car Dramatic Success!

- Adopted by over 200 organizations worldwide

Chassis, Engine, Driveline, Full Vehicle Simulation Solutions

OEMs	Suppliers	Tire Providers	Racing	Experts
Toyota Volkswagen Fiat Nissan Volvo Navistar Audi : : :	Delphi Visteon Bosch Dana TRW ArvinMeritor Magnetti : : :	Michelin Bridgestone Goodyear Pirelli Continental : : :	Ferrari Williams Honda Penske Newman-Haas Benneton : : :	FEV Lotus Ricardo AVL : : :



# Functional Digital Aircraft

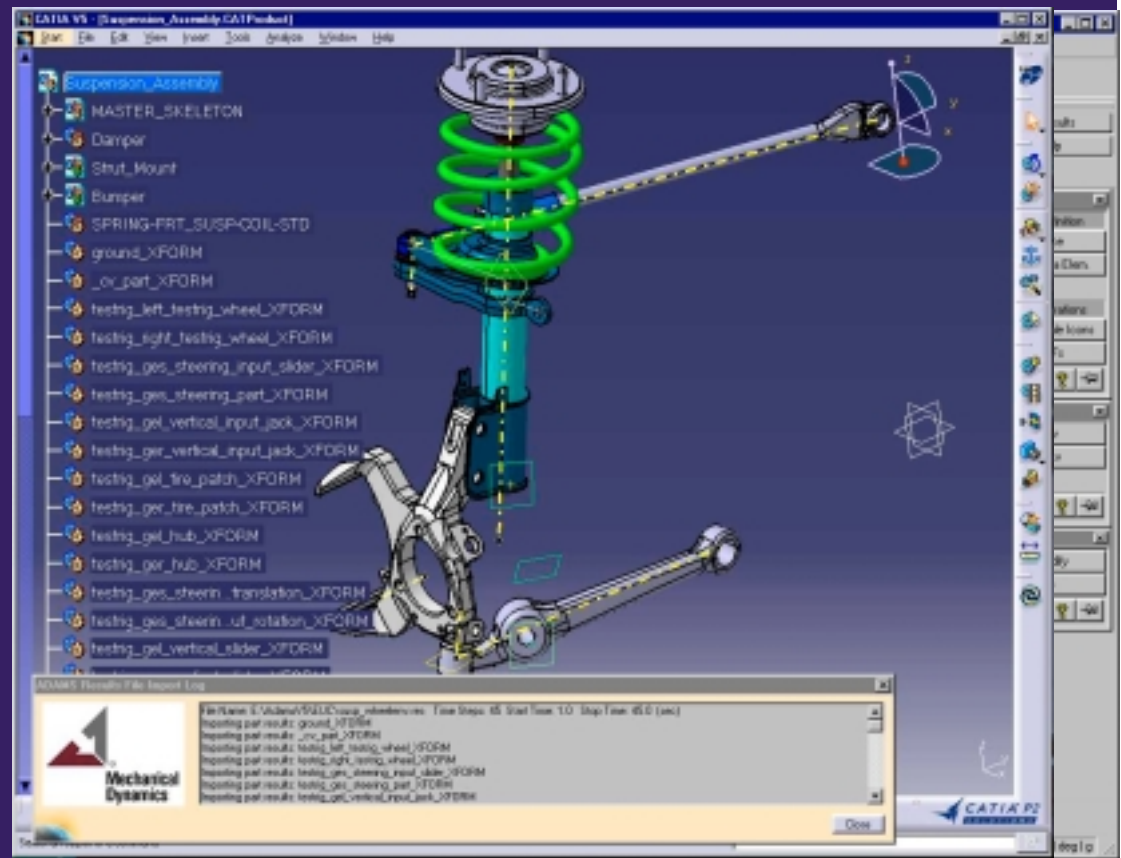


**Mechanical  
Dynamics**

# CAD-Embedded Functional Simulation

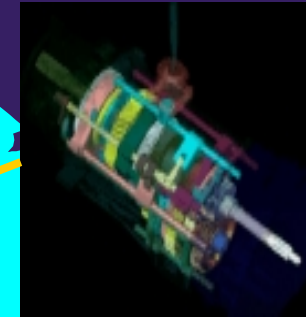
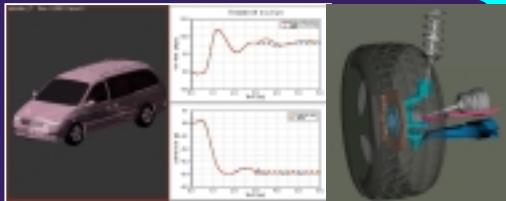


- AutoCAD MDT
- SolidWorks
- Solid Edge
- SolidDesigner
- Unigraphics
- I-DEAS
- Pro/ENGINEER
- CATIA V4 and V5

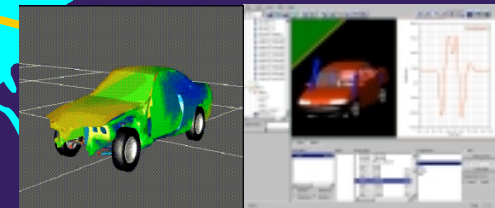
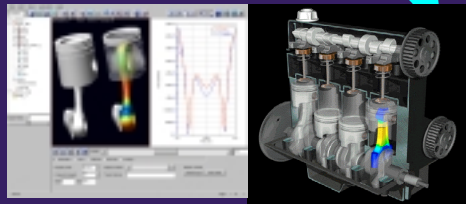




# Vision Enterprise Prototyping

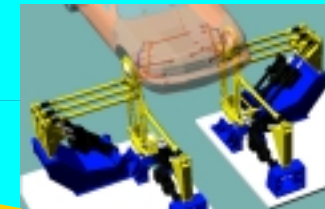
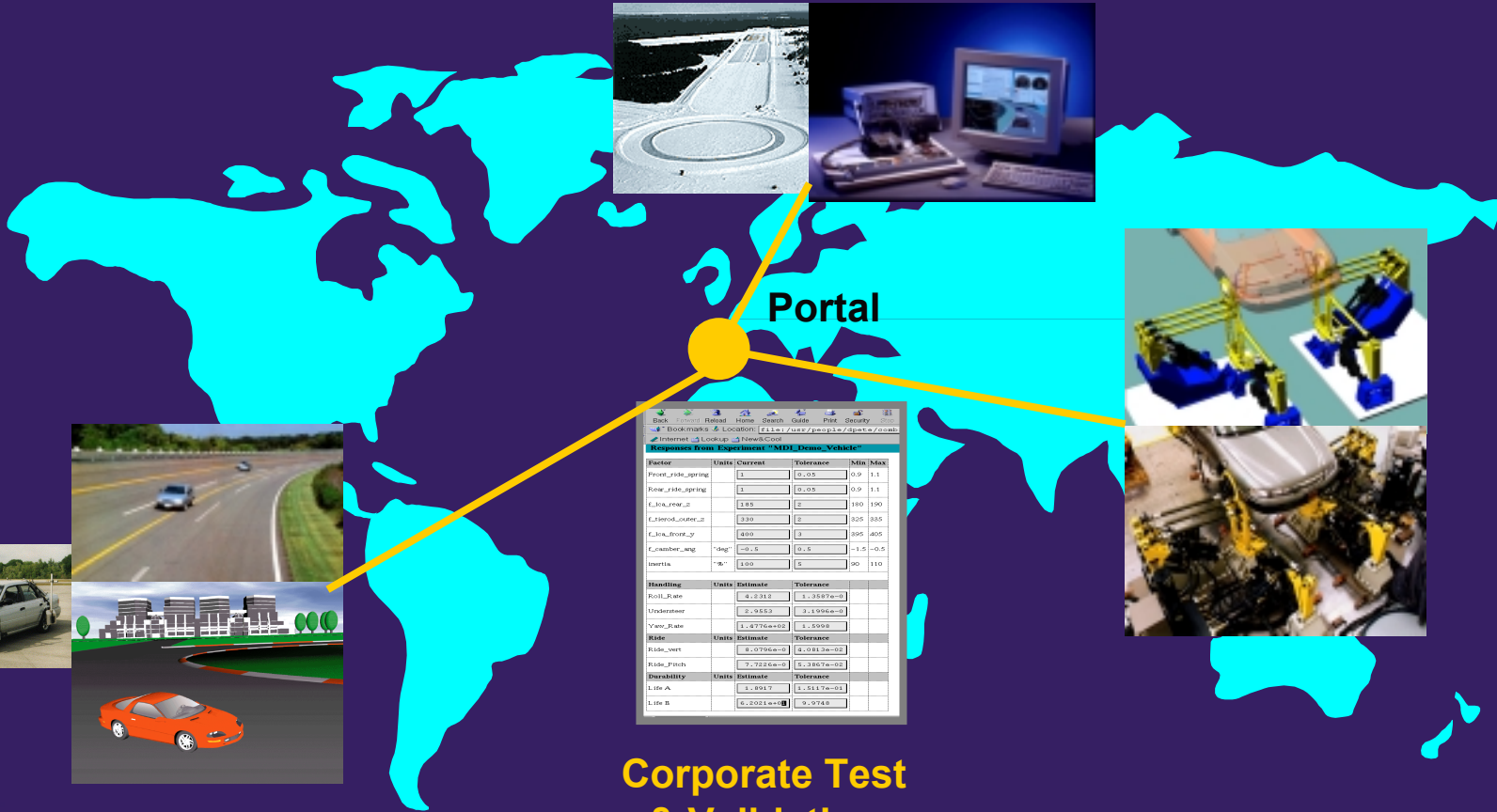


Portal



Corporate  
Prototype Build  
Process

# Vision Enterprise Prototyping



Portal

Factor	Units	Current	Tolerance	Min	Max
Front_ride_spring		1	(0.05)	0.9	1.1
Rear_ride_spring		1	(0.05)	0.9	1.1
c_kn_rear_2		185	(2)	180	190
c_tired_outer_2		330	(2)	325	335
c_kn_front_2		400	(3)	395	405
c_camber_ang	"deg"	-0.5	(0.5)	-1.5	-0.5
inertia	"g"	100	(5)	95	110

Handling	Units	Estimate	Tolerance
Roll_Rate		0.2312	1.3587e-01
Understeer		2.9553	3.1996e-01
Yaw_Rate		1.4776e+02	1.5990

Ride	Units	Estimate	Tolerance
Ride_went		0.0786e+2	0.0112e+02
Ride_push		0.0222e+2	0.0076e+02

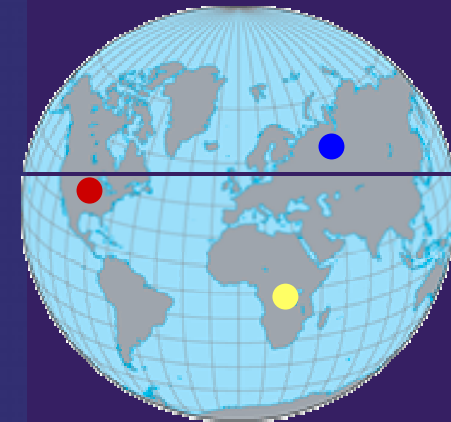
  

Disability	Units	Estimate	Tolerance
Life A		1.8917	1.0117e-01
Life B		0.2021e+01	0.0740

Corporate Test  
& Validation  
Process



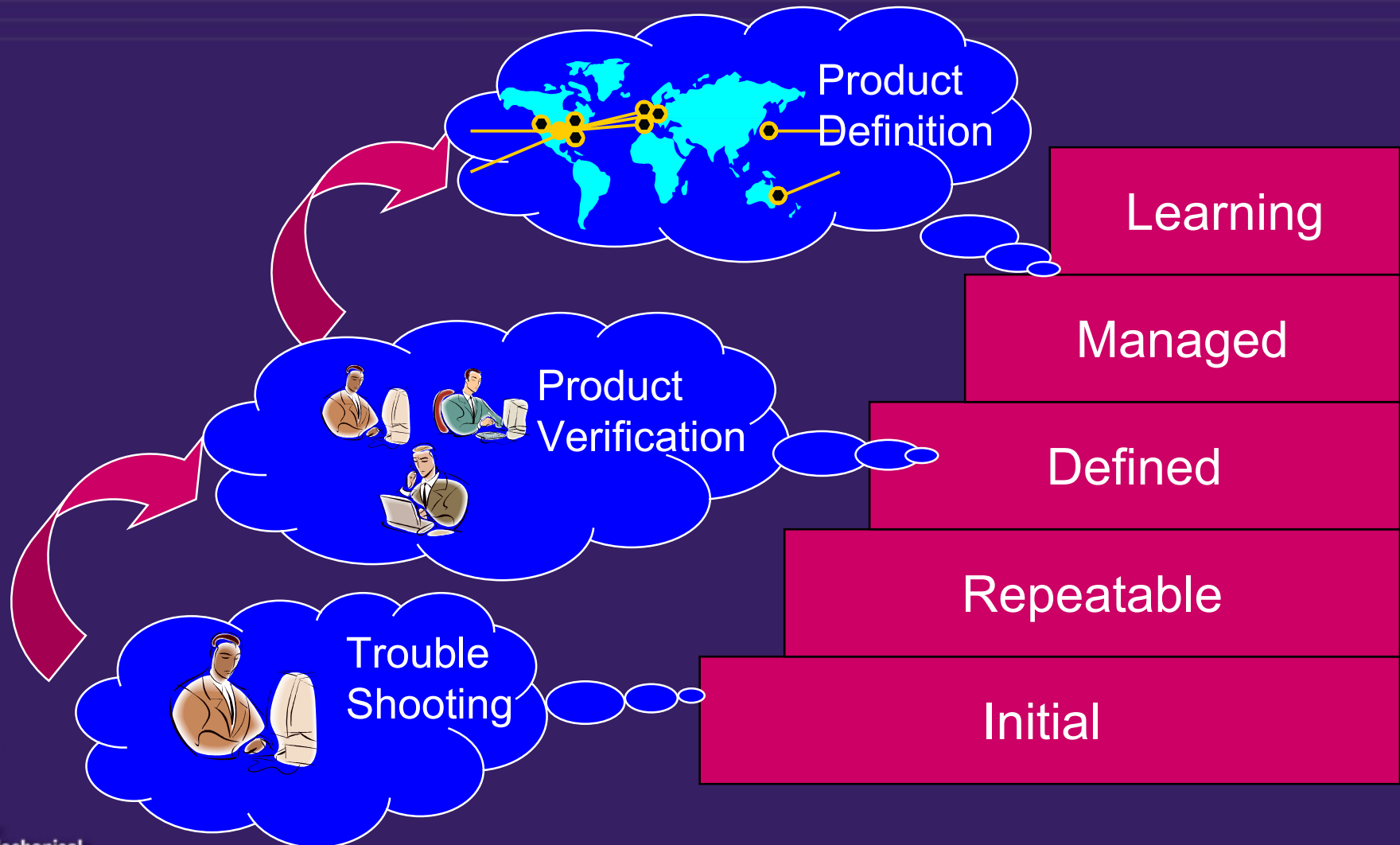
# Virtual Prototyping Across The Global Enterprise





# Implementation is Key!

## - Virtual Prototyping Maturity Model -





# Already There?

- “Virtual Prototype Builds” on Development Project Charts?
- Target Setting with Virtual Prototypes?
- Supplier Models in Virtual Builds?
- Functional Virtual Design Reviews?
- Six Sigma Simulation Process?



# Mechanical Dynamics, Inc.

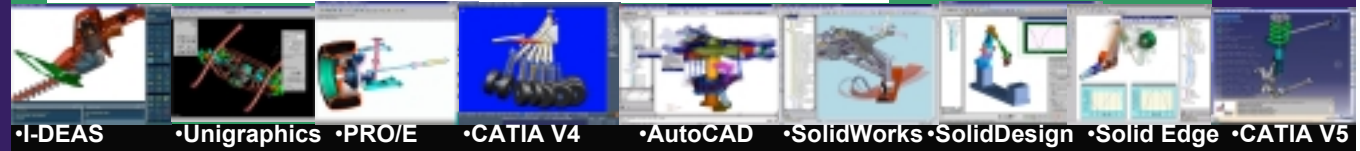
## Product Evolution



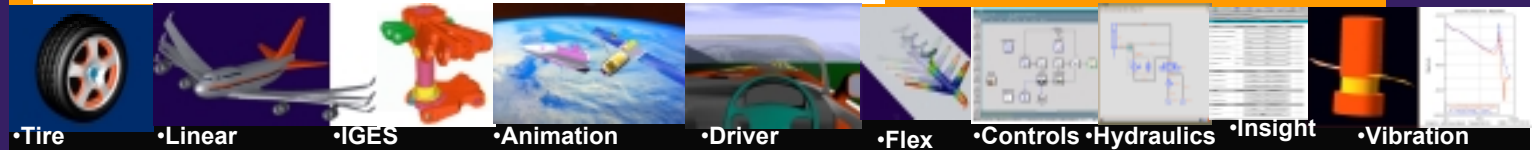
### Application-Specific Products



### Embedded Functional Virtual Prototyping



### Functional Virtual Prototyping Extensions



### Functional Virtual Prototyping Foundation

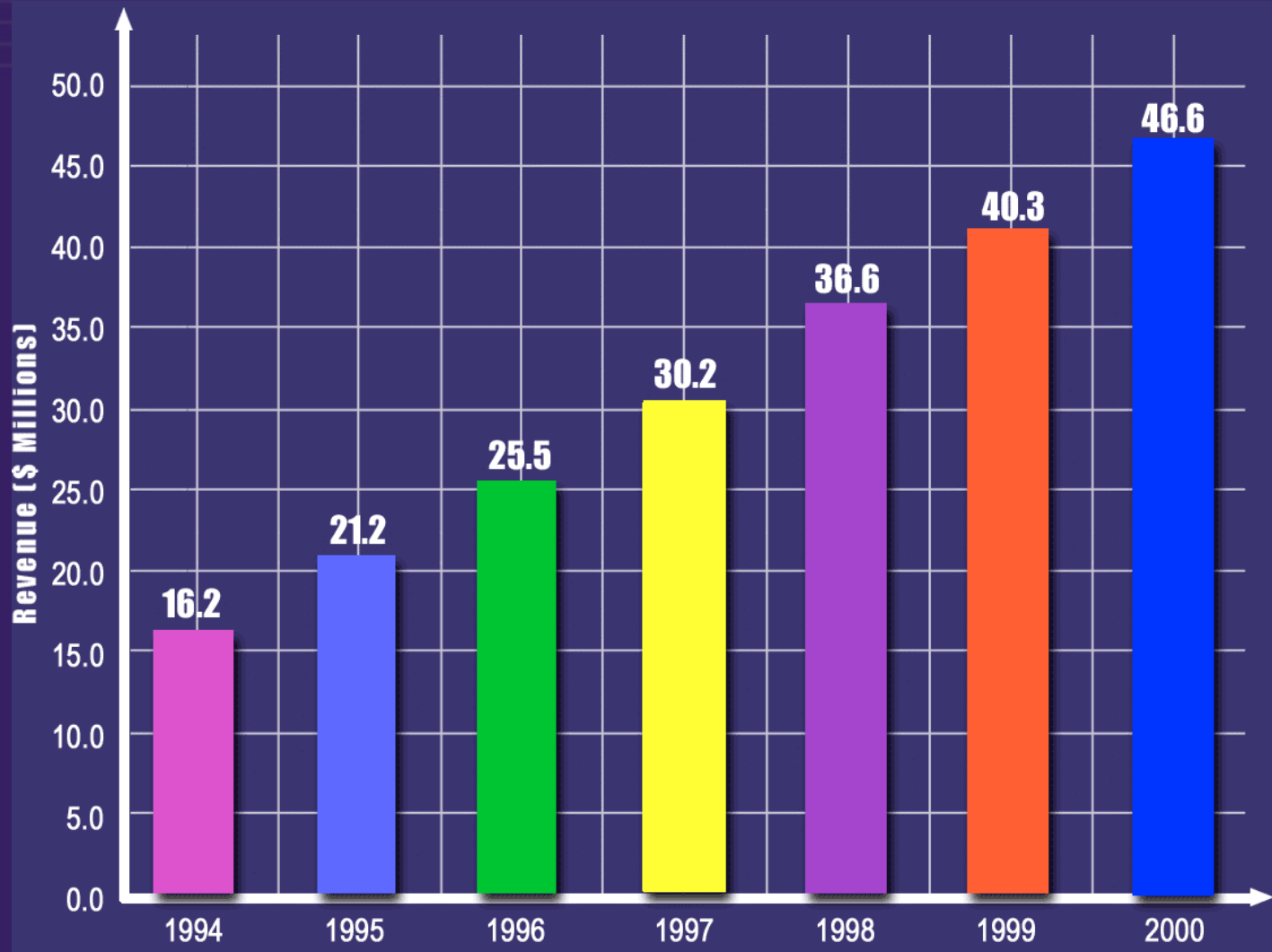
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•ADAMS 6.0	•ADAMS 7.0	•ADAMS 8.1	•ADAMS 9.0.1	•ADAMS 9.2	•ADAMS 11.0	
•ADAMS 5.2.1	•ADAMS 7.1	•ADAMS 8.2	•ADAMS 9.0.2	•ADAMS 10.0	•ADAMS 11.0.1	

1991   1992   1993   1994   1995   1996   1997   1998   1999   2000   2001



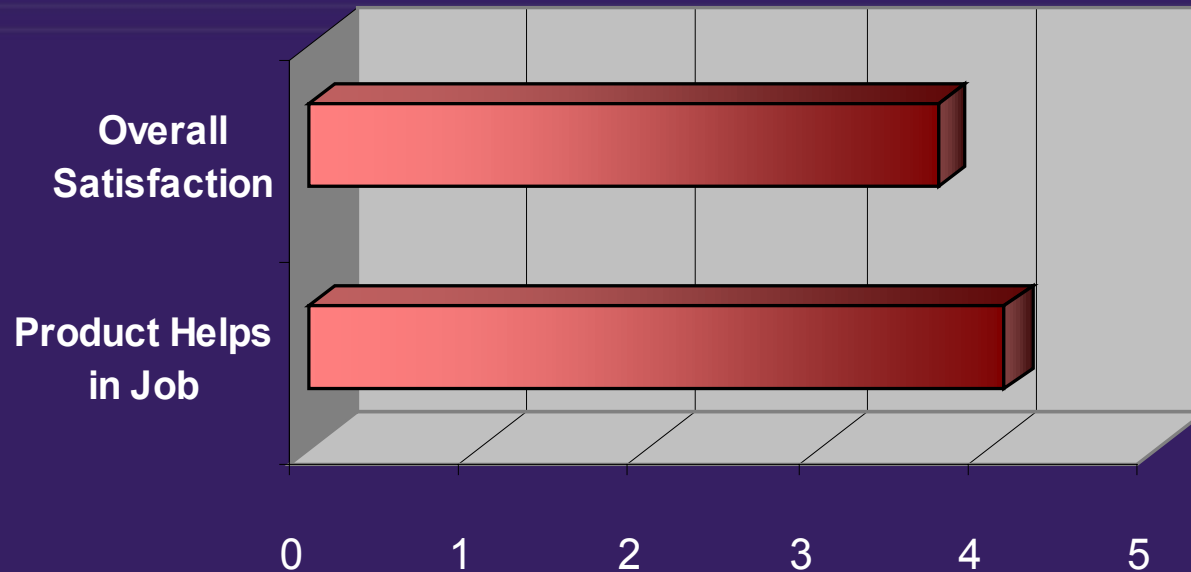


# MDI Growth





# Customer Satisfaction



## *Would Recommend Doing Business with MDI*







**To Our Valued Clients**

**Thank You!**

