



# MDI 2000 and Beyond

# MDI Strategic Direction - 2000 and beyond

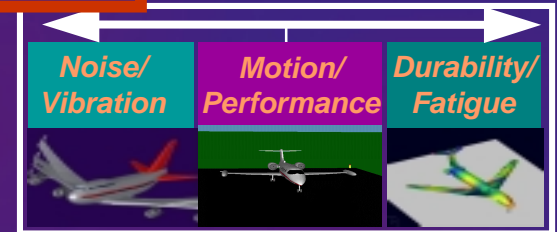
Mechanical  
Dynamics

High Value  
Virtual Prototyping Solutions

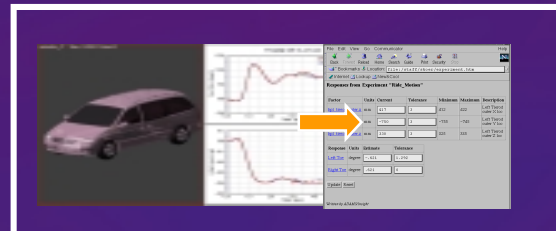


Concept Design Customer

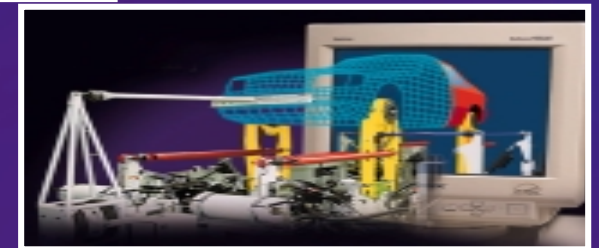
Expanded Virtual Prototyping  
Application Areas



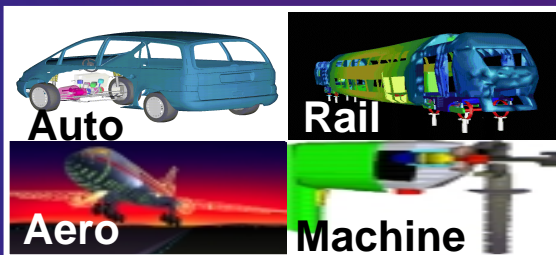
Web-based  
Functional Collaboration



Integrated Virtual  
and Physical Testing



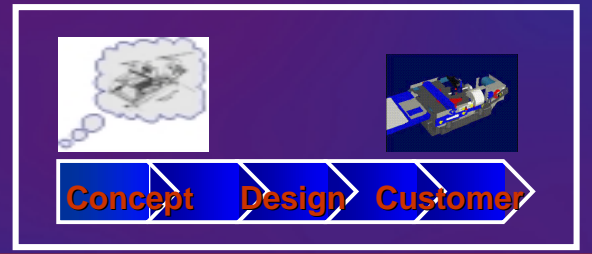
Industry-specific  
Solutions



ADAMS

# MDI Strategic Direction - 2000 and beyond

Mechanical  
Dynamics  
High Value  
Virtual Prototyping Solutions



- Processes to drive customer value
- Architecture to support innovation



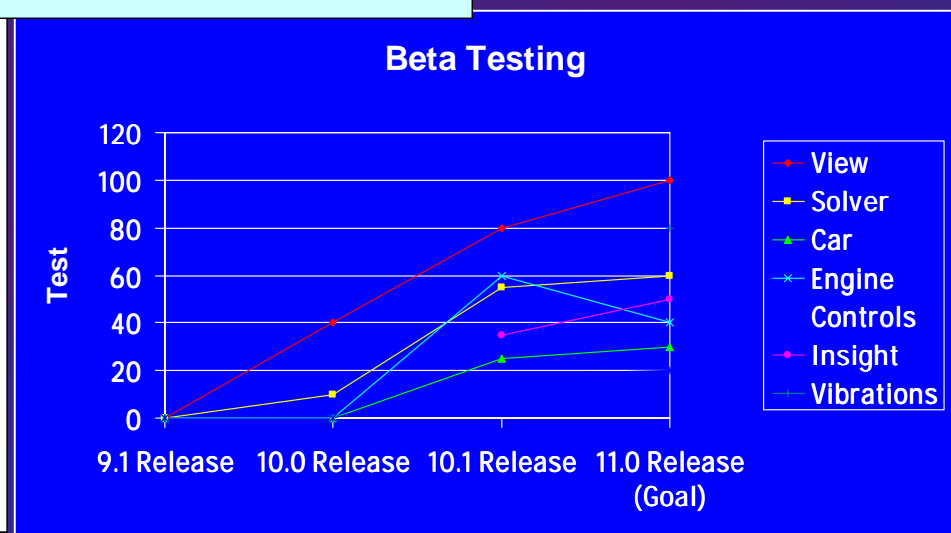
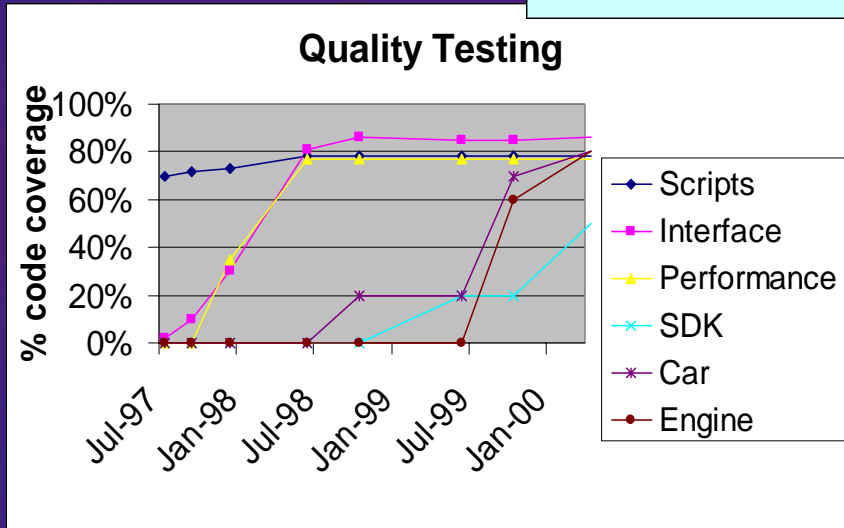
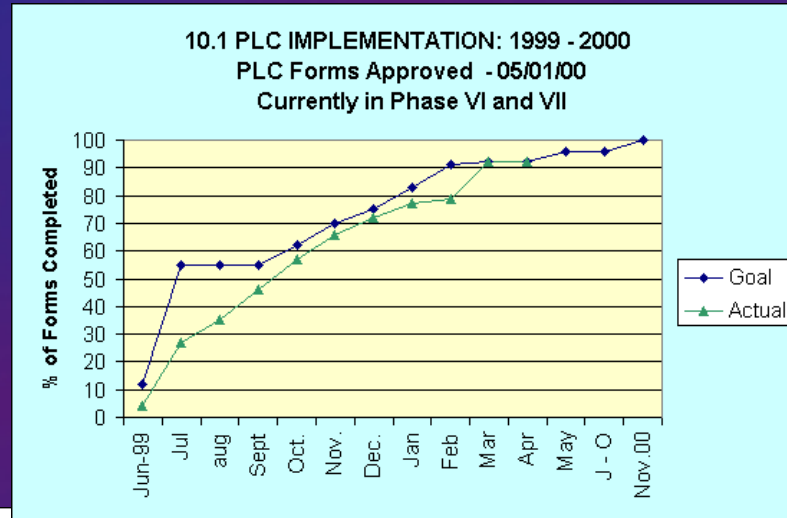
# Delivering High Value Solutions



Continuous Improvement



# Key Processes





# Product Line Architecture

ADAMS/Insight

ADAMS/Car

ADAMS/Driver

ADAMS/Tire

ADAMS/Engine

ADAMS/Rail

Dynamics

Durability

Vibrations

Test

Virtual Prototype Framework

Hydraulics

Controls

Application Framework - Stand-Alone/ Embedded

Web-based  
Functional Collaboration

Industry-specific  
Solutions

Expanded  
Application Areas

Integrated Virtual  
and Physical Testing

ADAMS





Mechanical  
Dynamics

High Value  
Virtual Prototyping Solutions

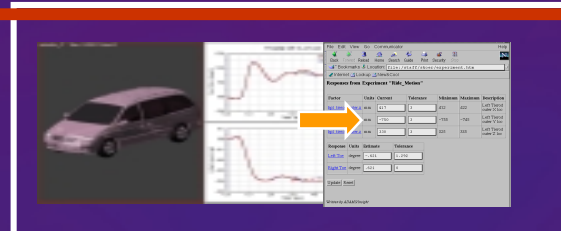
# MDI Strategic Direction - 2000 and beyond



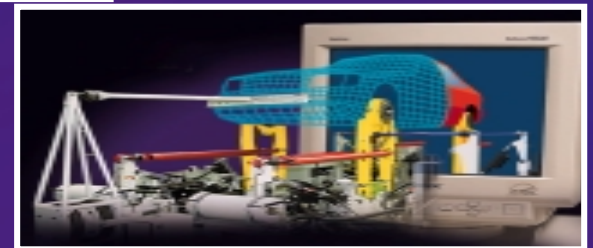
Expanded Virtual Prototyping  
Application Areas



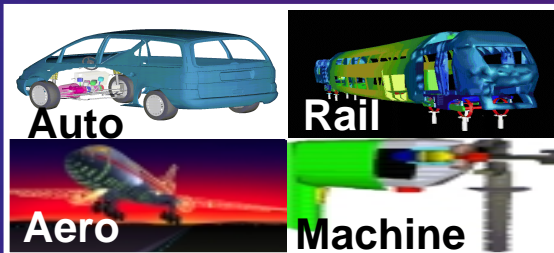
Web-based  
Functional Collaboration



Integrated Virtual  
and Physical Testing



Industry-specific  
Solutions

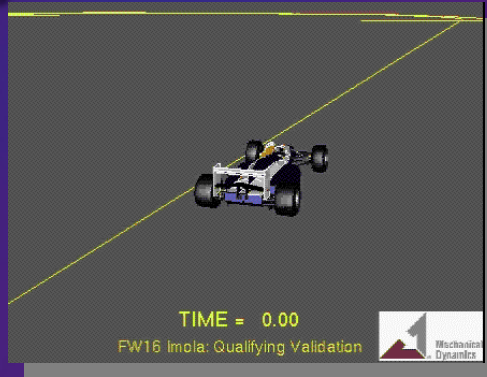


ADAMS

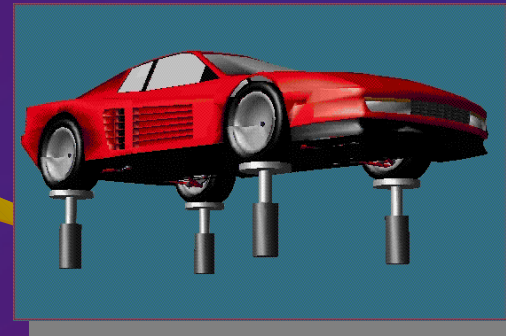


# Expanded Application Areas

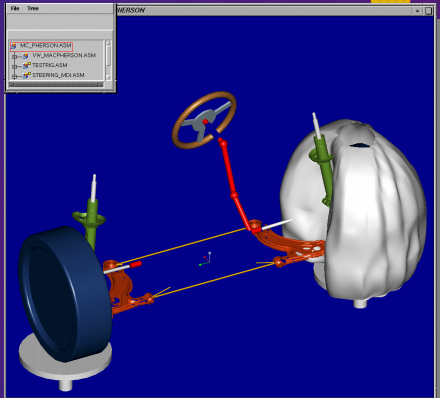
Handling



Durability



Packaging



Vibrations



Controls



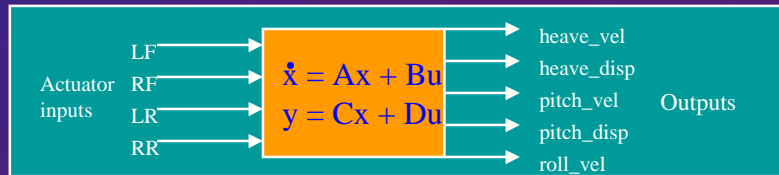
**ADAMS**





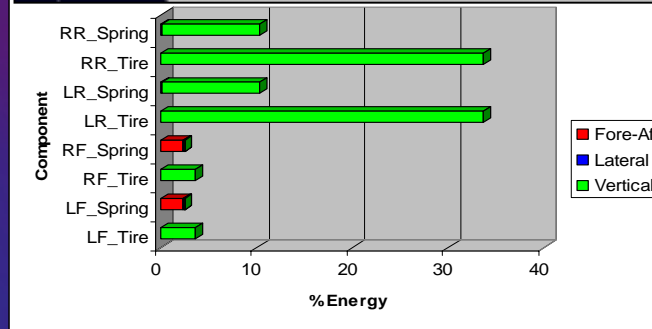
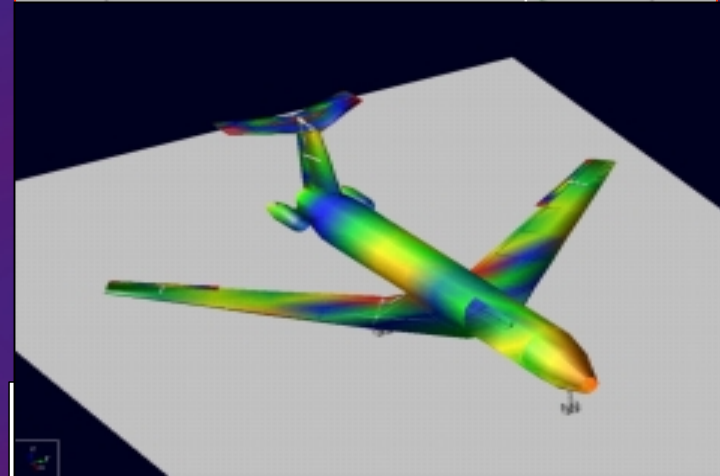
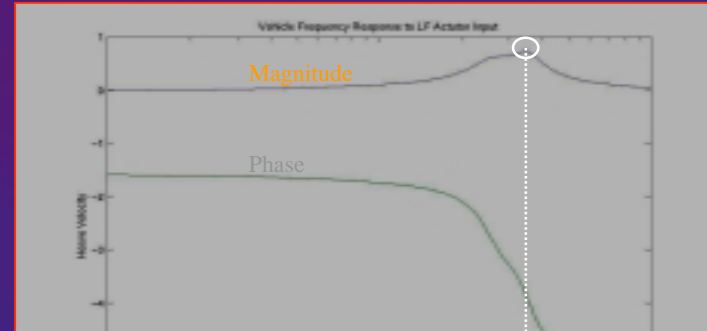
# ADAMS/Vibration

**ADAMS Model**

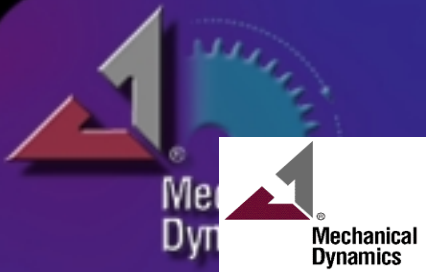


**Vibrations Solver**

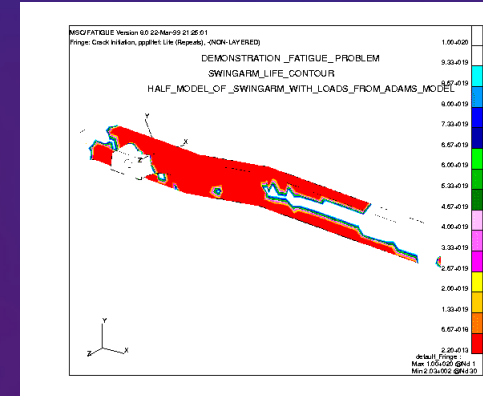
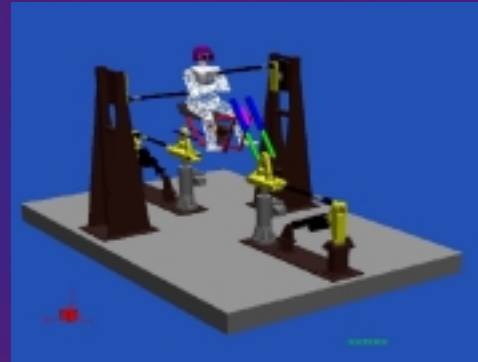
**Forced Vibration**



# Durability Virtual Prototyping



virtual



Environment → Spindle Loads → Component Loads → Fatigue Life

real

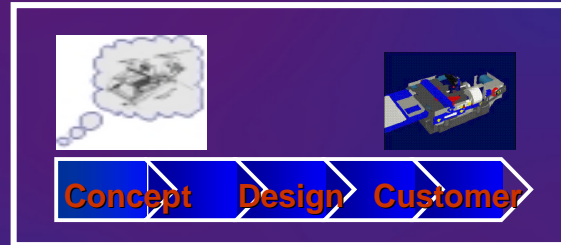




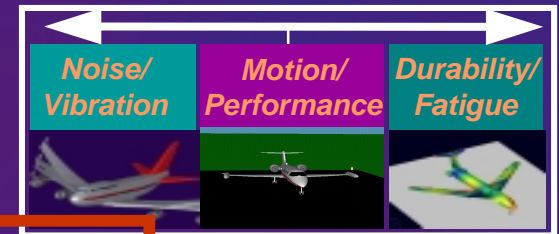
Mechanical  
Dynamics

High Value  
Virtual Prototyping Solutions

# MDI Strategic Direction - 2000 and beyond



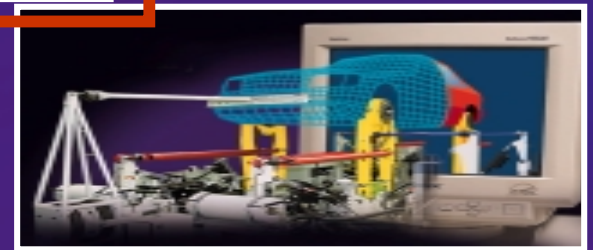
Expanded Virtual Prototyping  
Application Areas



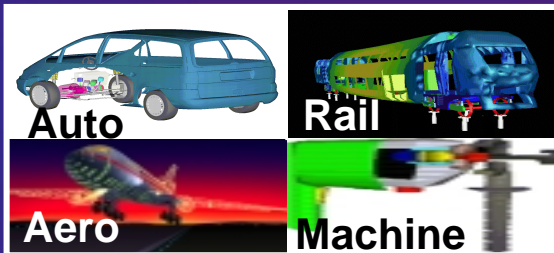
Web-based  
Functional Collaboration

A screenshot of a web-based interface. On the left is a 3D model of a silver car. On the right are two line graphs showing data trends. An orange arrow points from the car model towards the graphs. To the right of the graphs is a control panel with various input fields and buttons.

Integrated Virtual  
and Physical Testing



Industry-specific  
Solutions



**ADAMS**



# Collaborate on Design Decisions

Functional Digital Vehicle



ADAMS/Insight  
Web  
Collaboration

Supply Chain



Platform  
Engineer



Management



Item	Quantity	Description	Unit Price	Total Price
Item 1	100	Part A	1.50	150.00
Item 2	50	Part B	2.00	100.00
Item 3	200	Part C	0.75	150.00
Item 4	10	Part D	10.00	100.00
Item 5	500	Part E	0.20	100.00

Production  
Engineering



Marketing

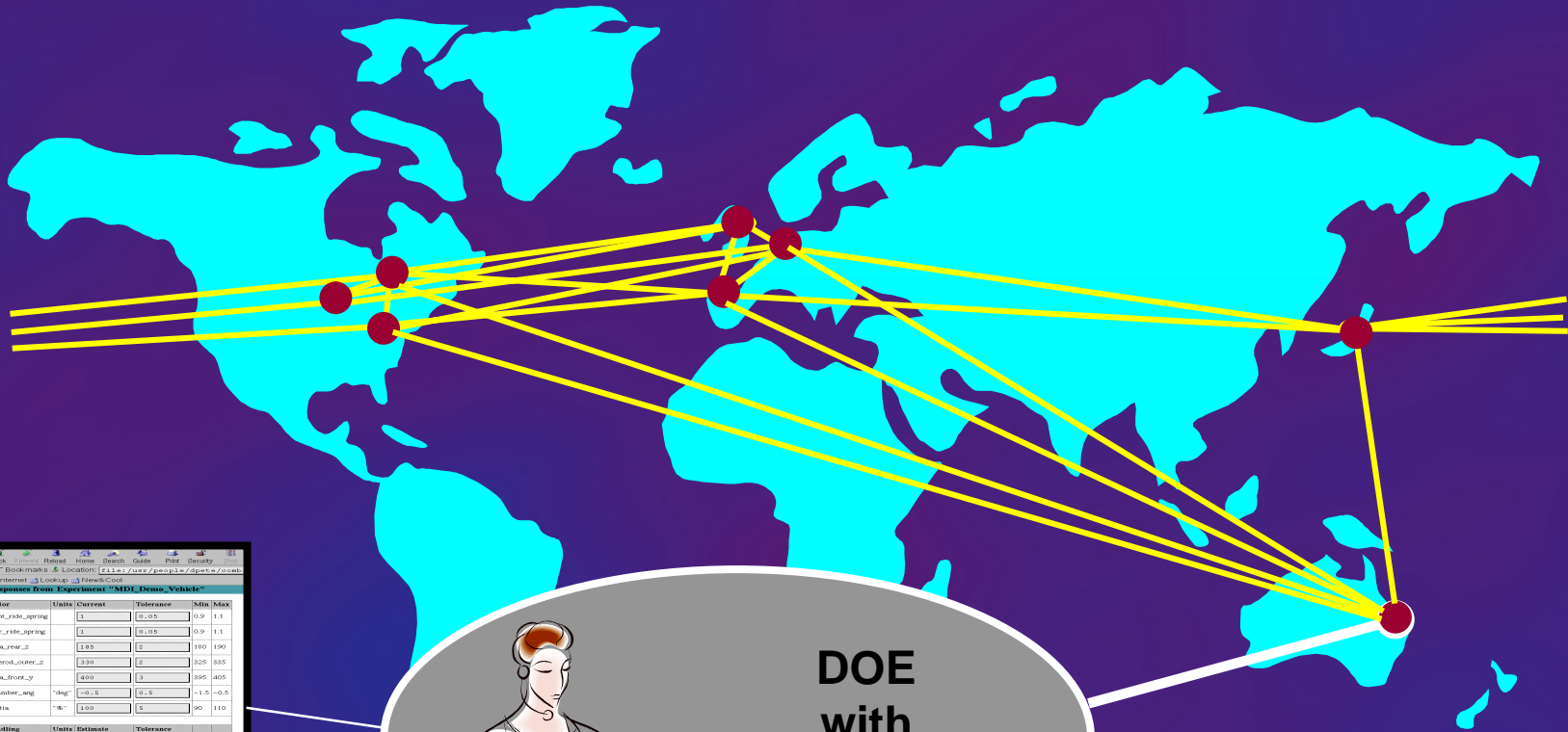


Validating design concepts  
Insight into design alternatives  
Coordinating multiple design regimes  
Arriving at high quality solutions

ADAMS



# Global Access to Virtual Prototype



Responses from Experiment: M13\_Demo\_Vehicle

Factor	Units	Current	Tolerance	Min	Max
Front_ride_spring		1	10.05	0.9	1.1
Rear_ride_spring		1	10.05	0.9	1.1
C_spr_spr_2		180	12	180	190
L_spr_spr_2		330	12	325	335
C_spr_spr_3		400	13	395	405
C_spr_spr_4	deg	-0.9	10.5	-1.5	-0.5
Inertia	"kg"	100	15	80	110

Heading	Units	Estimate	Tolerance
Ride_Ride		4.2313	1.1391e-01
Underside		7.9553	3.1196e-01
View_Ride		1.4770e+02	1.5092

Ride	Units	Estimate	Tolerance
Ride_west		0.0706e+01	4.0812e-02
Ride_pitch		7.7226e+01	5.2867e-02

Durability	Units	Estimate	Tolerance
Life A		1.8947	3.3117e-01
Life B		0.2024e+01	9.0740

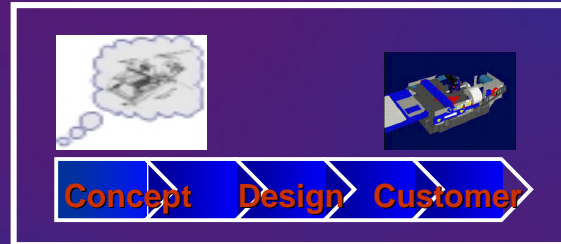
**DOE with  
ADAMS/Insight**



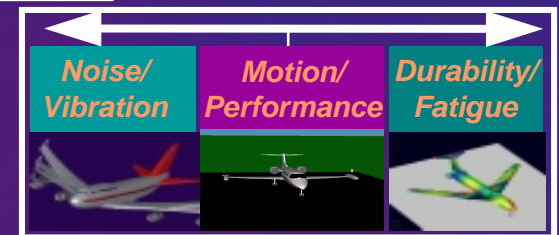


# MDI Strategic Direction - 2000 and beyond

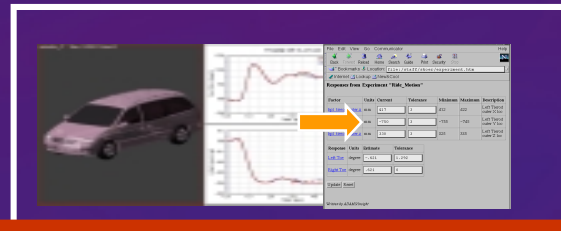
High Value  
Virtual Prototyping Solutions



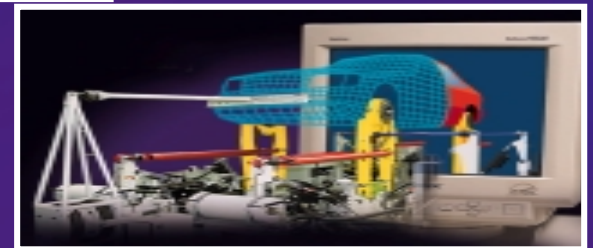
Expanded Virtual Prototyping  
Application Areas



Web-based  
Functional Collaboration



Integrated Virtual  
and Physical Testing



Industry-specific  
Solutions



**ADAMS**





# Empirical Dynamics Model (EDM)



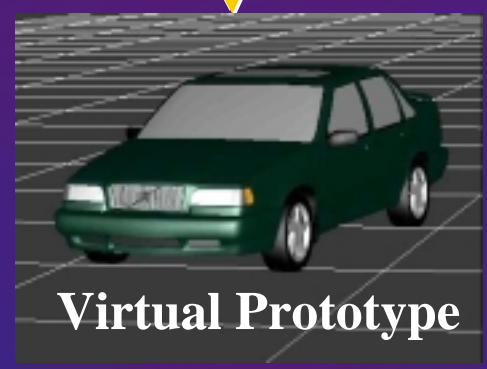
Elastomers



Shock Absorbers



Tires



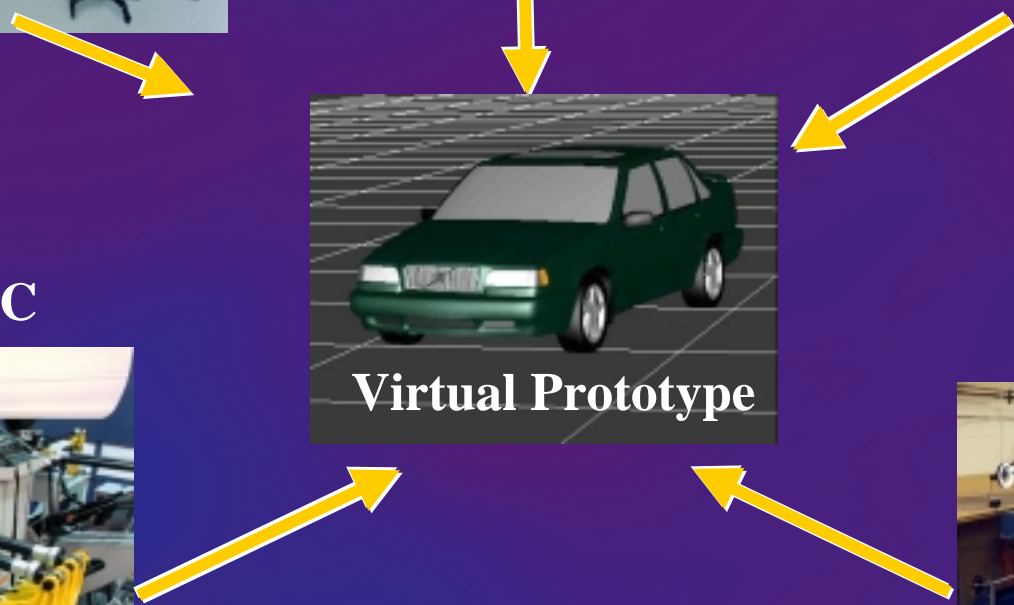
Virtual Prototype



Dynamic K&C



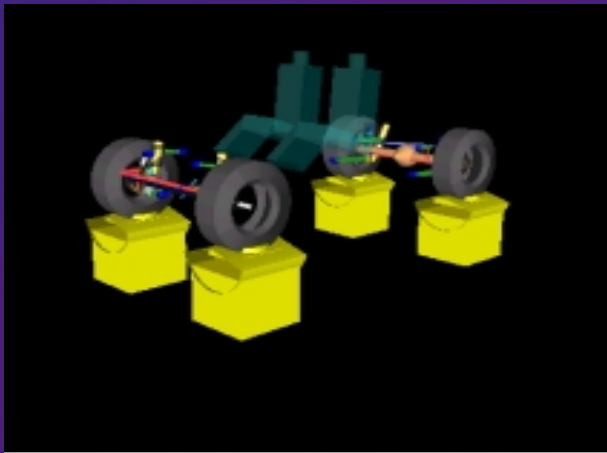
K&C





# Virtual Test Lab (VTL)

Virtual Testing



**ADAMS**  
Virtual Test Machine



**Physical Test**  
Machine





Mechanical  
Dynamics

High Value  
Virtual Prototyping Solutions

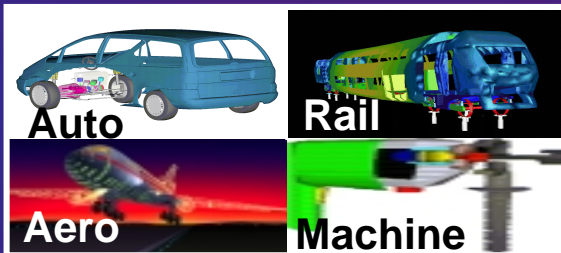
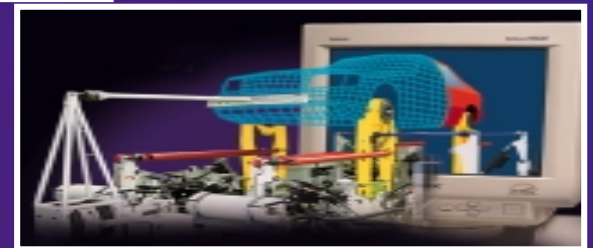
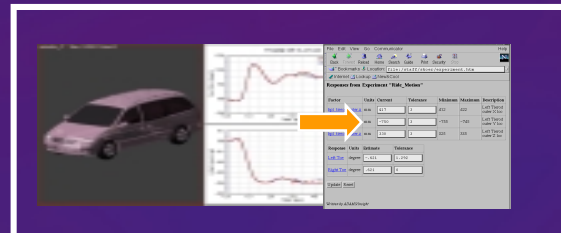
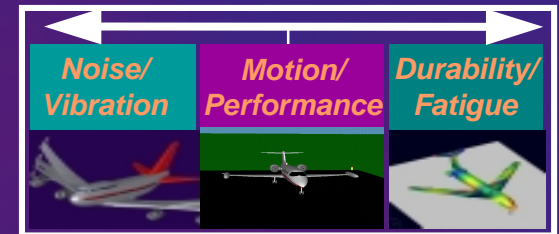
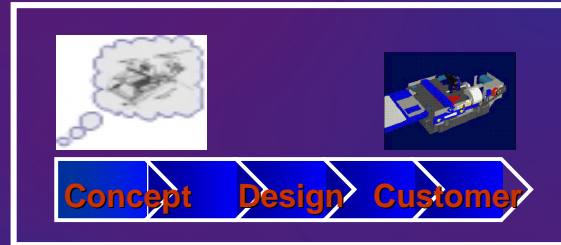
Expanded Virtual Prototyping  
Application Areas

Web-based  
Functional Collaboration

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Industry-specific  
Solutions

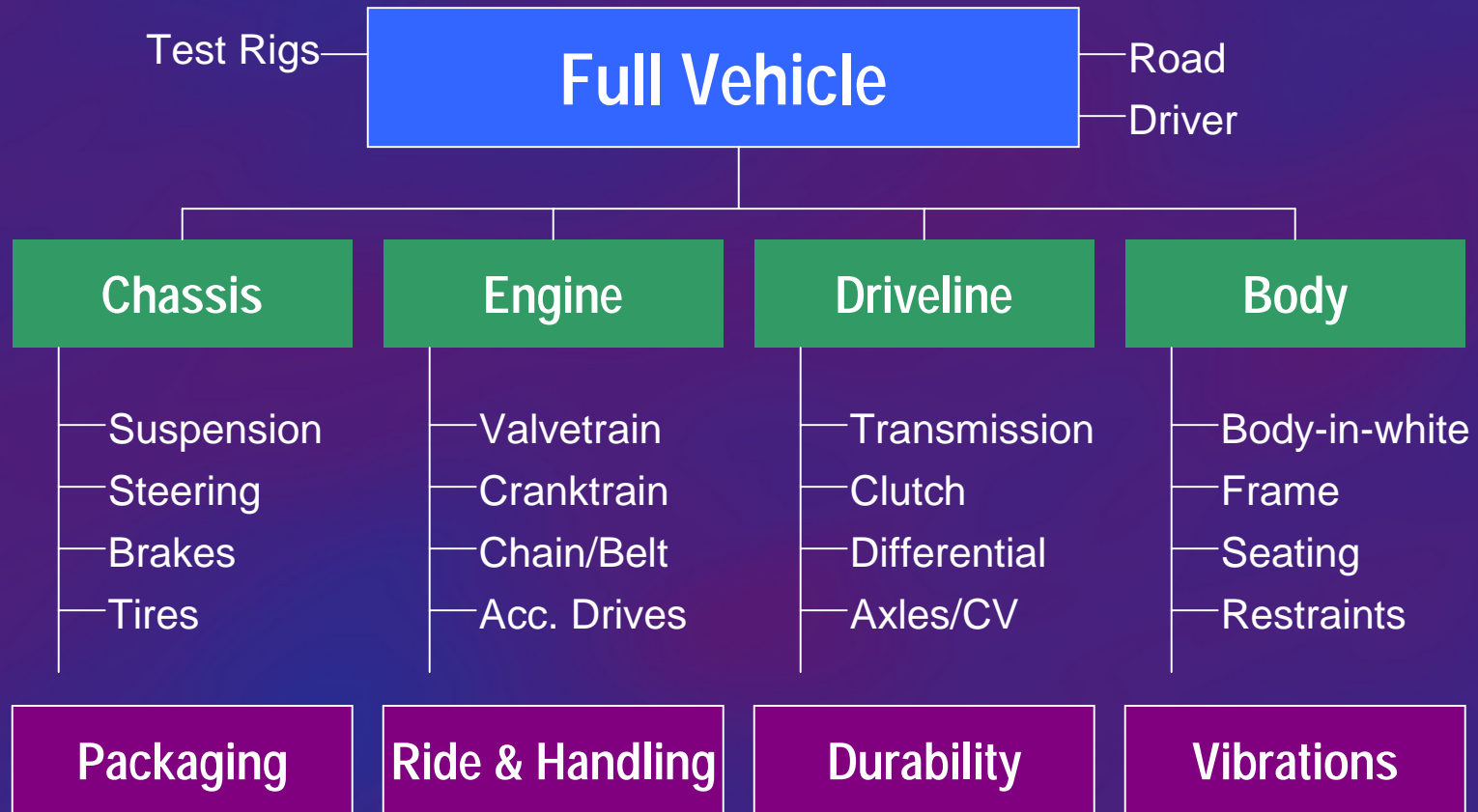
# MDI Strategic Direction - 2000 and beyond



ADAMS



# Functional Digital Vehicle







# Functional Digital Airplane



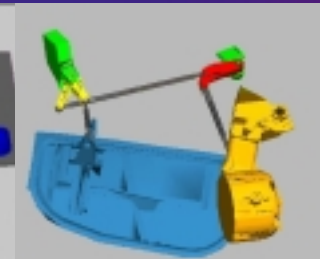
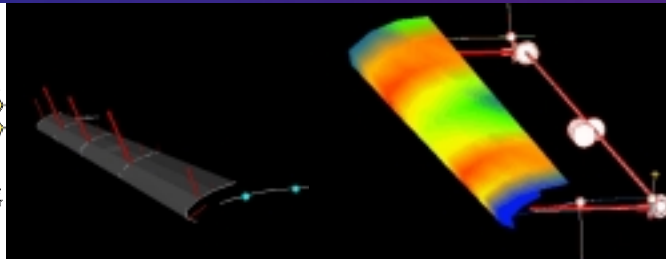
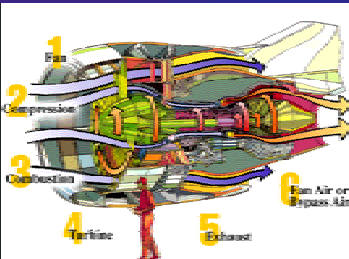
**Undercarriage**

**Engine**

**Flight Controls**

**Mechanisms**

**Devices**





# ADAMS 10.1

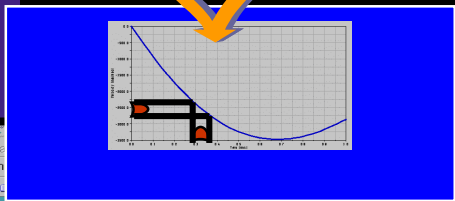
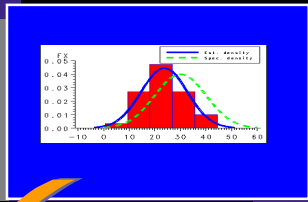
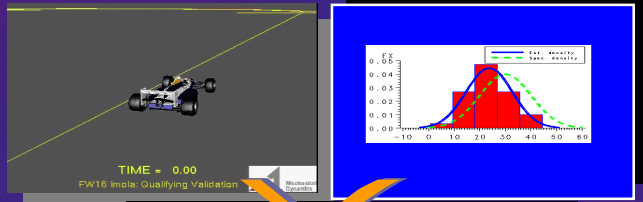
First Customer Ship - April 2000

- 
- Web-Based Functional Collaboration
  - ADAMS/Engine Timing Mechanism module
  - Continue quality improvement





# ADAMS/Insight Facilitates Web Collaboration



## ■ ADAMS/Insight

- ◆ Separate key vs. insignificant design parameters
- ◆ Understand the impact of design decisions on a broad range of customer requirements
- ◆ Manufacturing variations can be considered up front to improve design robustness
- ◆ Collaborate on design specifications across engineering enterprise

Responses from Experiment: MDI\_demo\_vehicle

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
f_lca_rear_z		185	2	180	190
f_tierod_outer_z		330	2	325	335
f_lca_front_y		400	3	395	405
f_camber_ang	"deg"	-0.5	0.5	-1.5	-0.5
inertia	"%"	100	5	90	110

Handling	Units	Estimate	Tolerance
Roll_Rate		4.2312	1.3587e-0
Understeer		2.9553	3.1996e-0
Yaw_Rate		1.4776e+02	1.5998

Ride	Units	Estimate	Tolerance
Ride_vert		8.0796e-0	4.0813e-02
Ride_Pitch		7.7226e-0	5.3867e-02

Durability	Units	Estimate	Tolerance
Life A		1.8917	1.5117e-01
Life B		6.2021e+0	9.9748

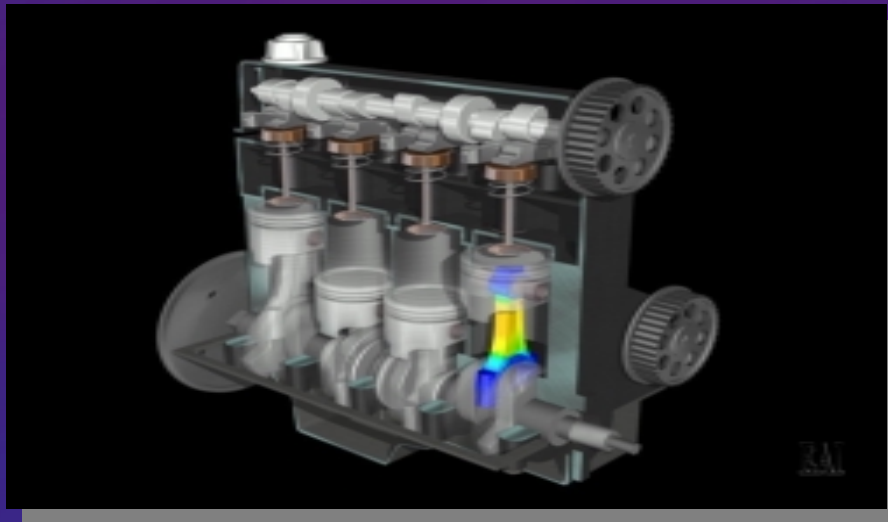
Factor	From	To	Effect	Effect %
f_tierod_outer_z	325	335	-6.09	4.14
f_lca_rear_z	180	190	-2.405	1.63
Rear_ride_spring	0.9	1.1	-2.191	1.49
Front_ride_spring	0.9	1.1	1.782	-1.21
f_camber_ang	-1.5	-0.5	-1.027	0.70
f_lca_front_y	395	405	-0.3709	0.25



# ADAMS/Engine 10.1

## ■ Major Capabilities

- ◆ Timing mechanism module – roller & bushing chains





# ADAMS/Rail 10.1

- **Major enhancements:**
  - ◆ Transition to ADAMS/Car architecture
  - ◆ Wheel-rail profile preprocessor
  - ◆ Irregular track modeling
  - ◆ Medyna contact element support





# ADAMS 11.0

First Customer Ship – November 2000

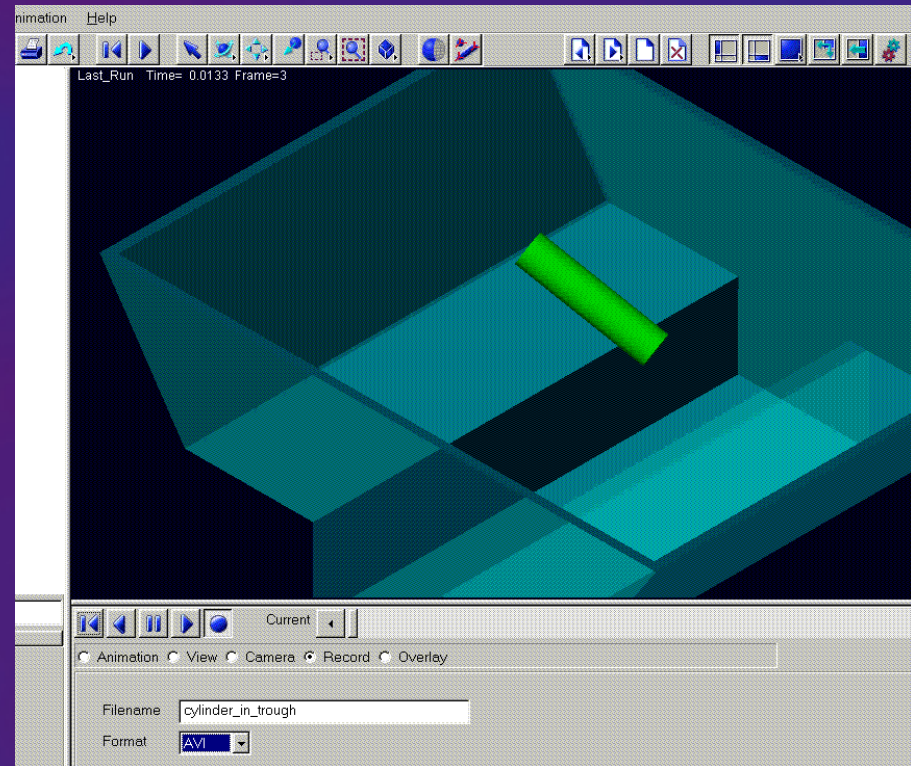
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- **General 3D contact**
- **Expand ADAMS in vibrations and durability**
- **Extend Functional Digital Car**



# 3D Contact

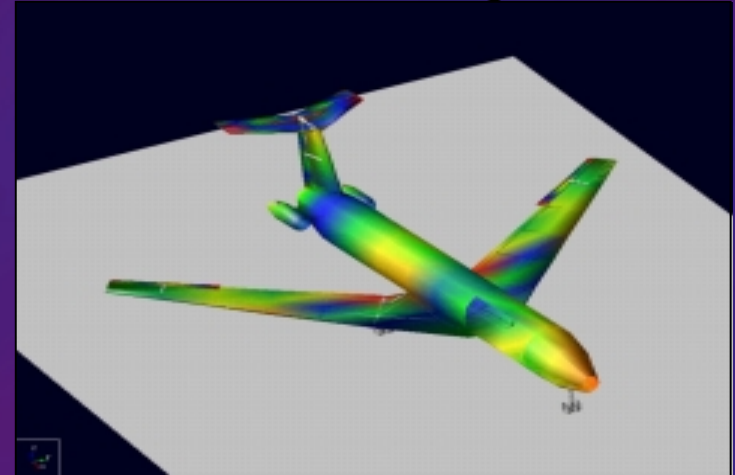
- Precise contact detection using Parasolids geometry engine
- Multiple point contact capability
- Contact force graphics
- Available in ADAMS/View and ADAMS/Solver





# ADAMS/Vibration - Durability

- Re-use your ADAMS model for extended test disciplines
- Major Vibration Capabilities:
  - ◆ Forced Vibration Animation
  - ◆ Forced Vibration Plotting
  - ◆ Modal Participation
  - ◆ Transfer function analysis
- Major Durability capabilities:
  - ◆ Support of MTS rpc file to exchange data with MTS test equipment
  - ◆ Support of nCode dac file to exchange data with nCode fatigue analysis software

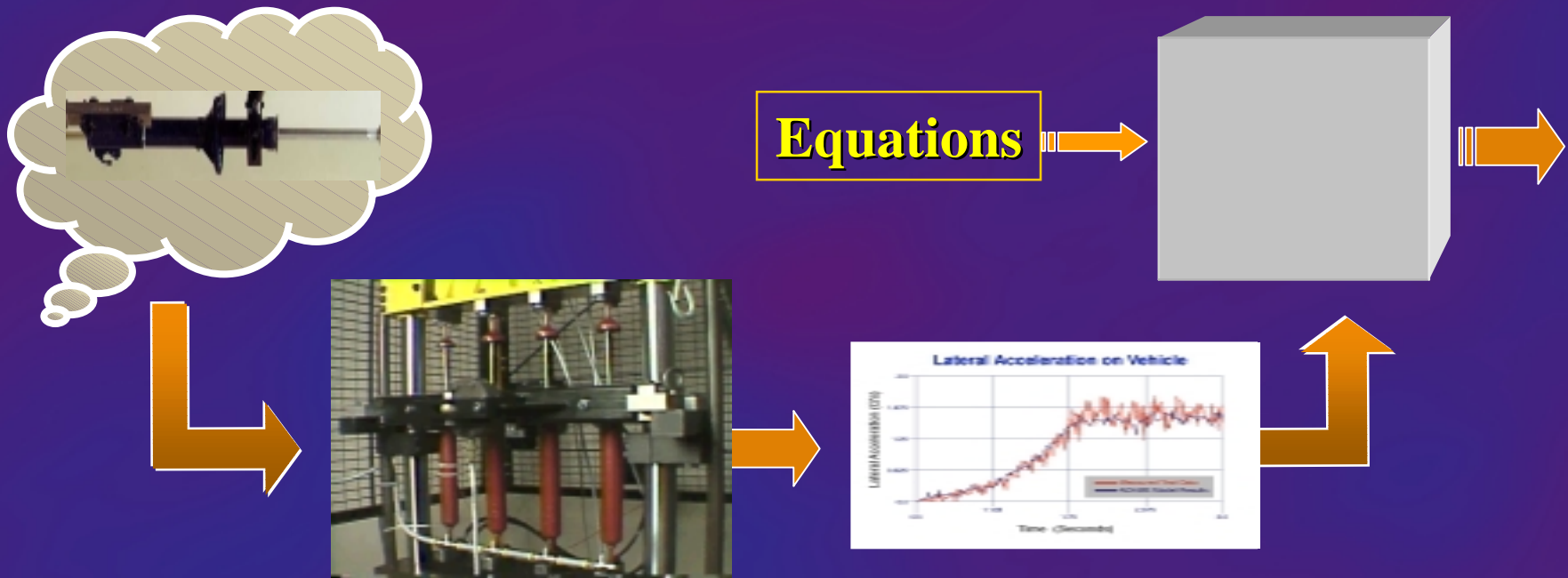




# Test Integration for 11.0

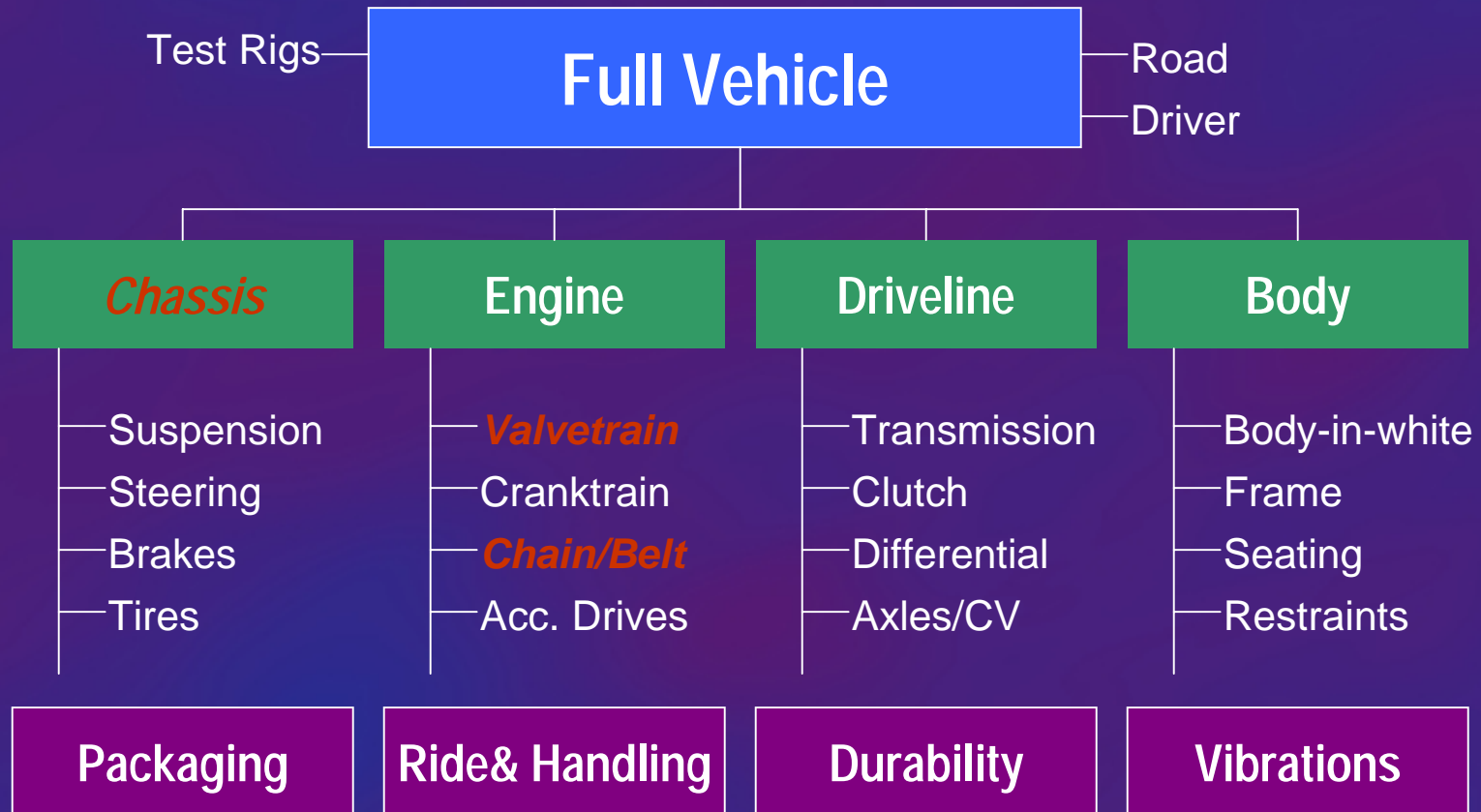
## ■ Support of EDM

- ◆ ADAMS/View, ADAMS/Car, ADAMS/Pre



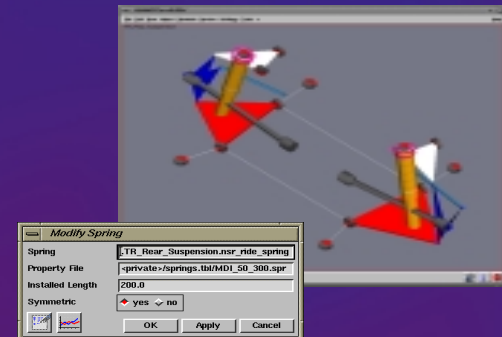


# Functional Digital Vehicle





# ADAMS/Car 11.0



## ■ Major enhancements

- ◆ Parametric flexible twist beam and other simple components
- ◆ Fully transition all events to Driving Machine
- ◆ ADAMS/Hydraulics integration
- ◆ EDM integration
- ◆ Improved software quality testing



# ADAMS/Pre 11.0



## ■ Major enhancements

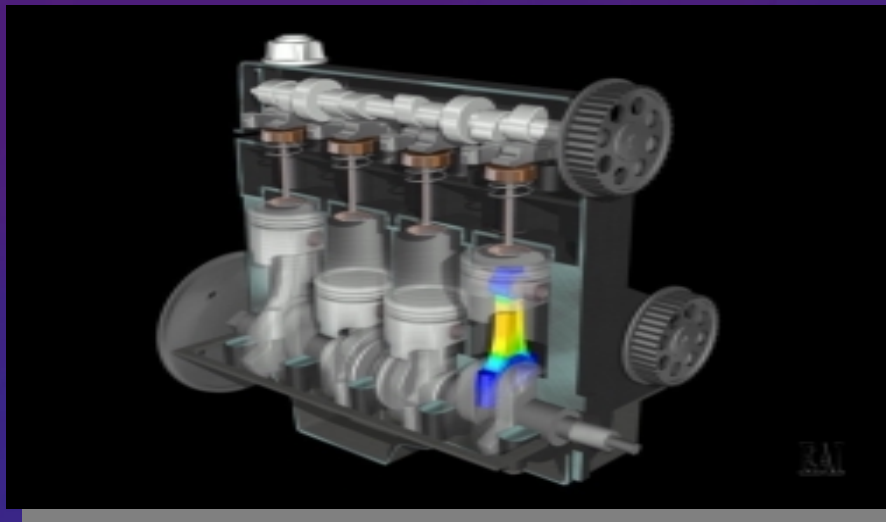
- ◆ Fully transition all events to Driving Machine
- ◆ ADAMS/Hydraulics integration
- ◆ EDM integration
- ◆ New suspension templates



# ADAMS/Engine 11.0

## ■ Major Capabilities

- ◆ Tooth belt extension to timing mechanism module
- ◆ Simple gear extension to ADAMS/Engine package

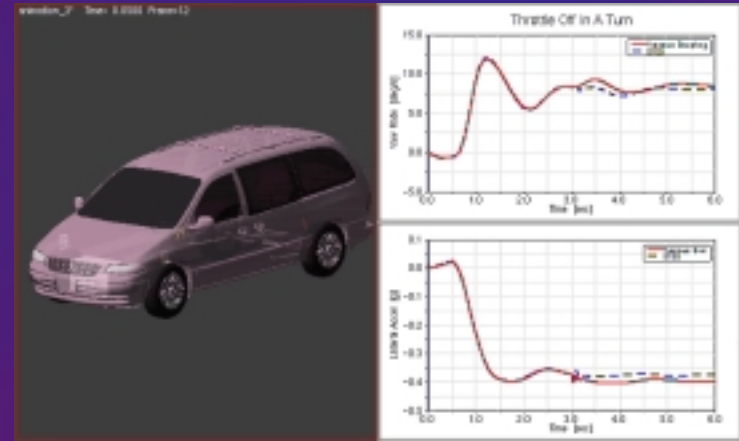




# High Value Solutions

## ■ ADAMS/Full Simulation

- ◆ Improved software performance for large models
  - Dynamically linked libraries
  - Quickview – graphics performance
- ◆ Enhancements based on user feedback
  - Move panel
  - Bitmap on curve
  - Page header/footer
  - Minimal names
- ◆ Improved software quality



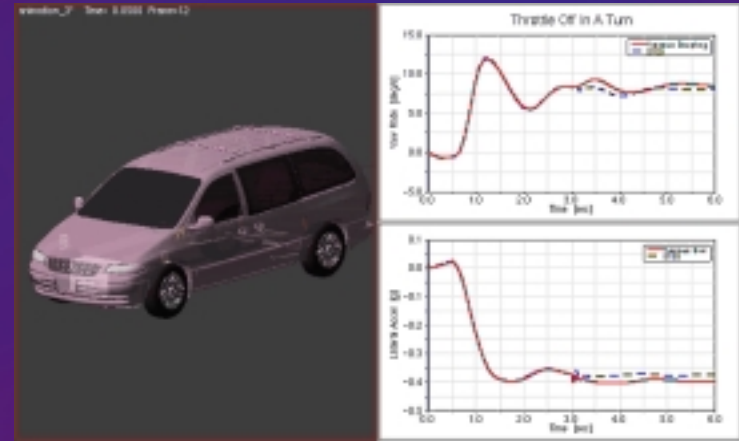




# High Value Solutions

## ■ ADAMS/Solver

- ◆ Solver robustness
  - Fixed-step integrator
  - Static solver enhancements
- ◆ C++ solver
  - Continue drive towards multi-tier web based architecture
  - Primary solver for ADAMS/Vibrations





# ADAMS 10.1

First Customer Ship - April 2000

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# ADAMS 11.0

First Customer Ship – November 2000

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