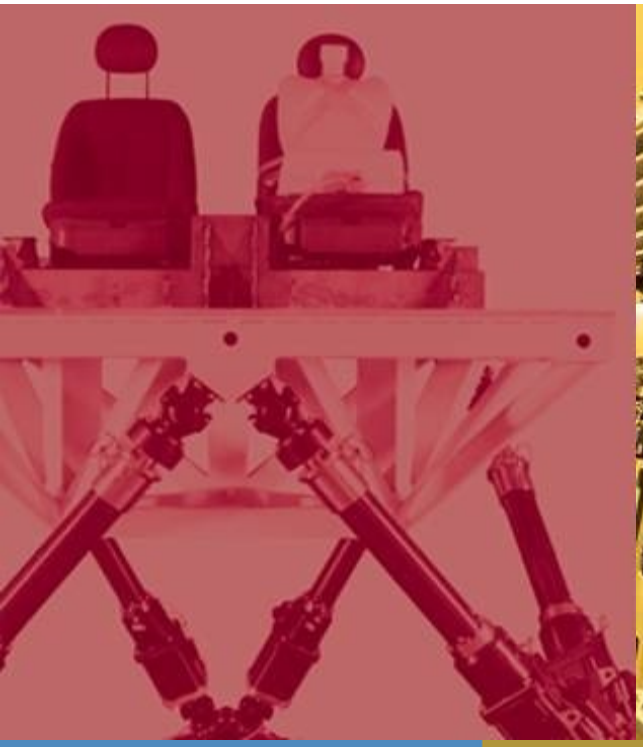
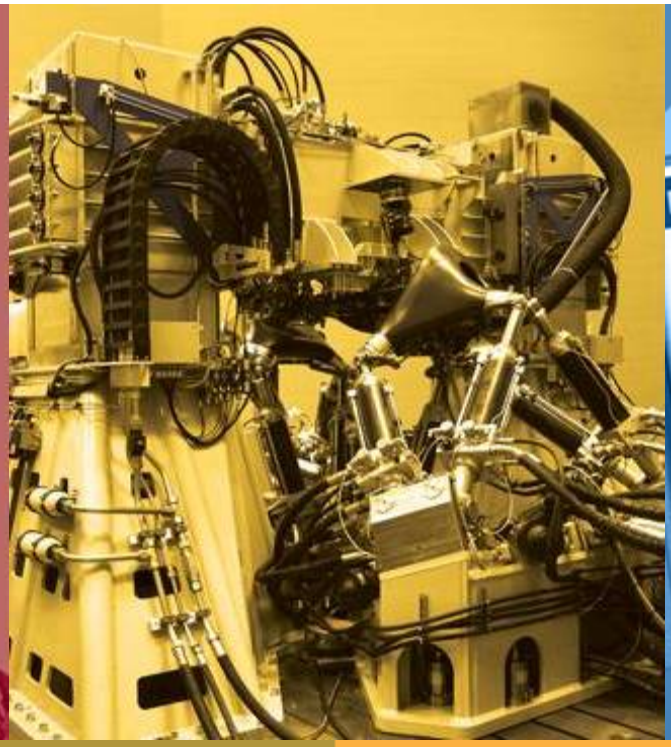
DRIVING SIMULATORS
that improve design and reduce cost and time to market

Test Expo Stuttgart, 12 June 2012





Agenda

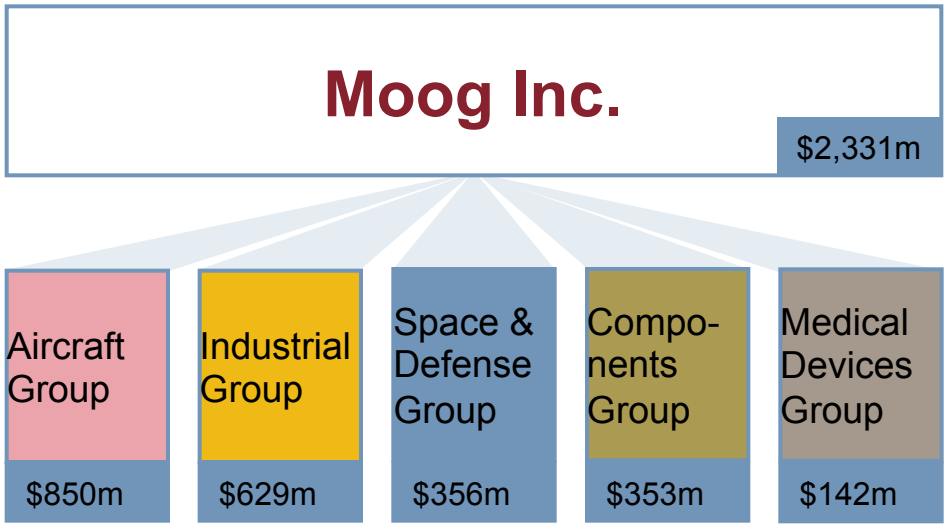
- Driving simulator advantages
- How does it work?
- Different purposes
- Required fidelity
- Motion system
- Use of vehicle dynamics driving simulators during vehicle development
- Conclusions

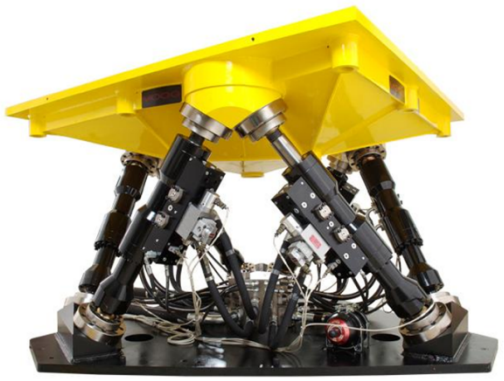
Introduction to Moog

Leading designer, manufacturer, and integrator of precision control components and systems

- Revenue FY11
  $2.33 Billion
- Employees worldwide:
  >10,320

- Simulation and Test within Industrial group
- Largest motion system supplier for simulators in the world with over 500 systems installed





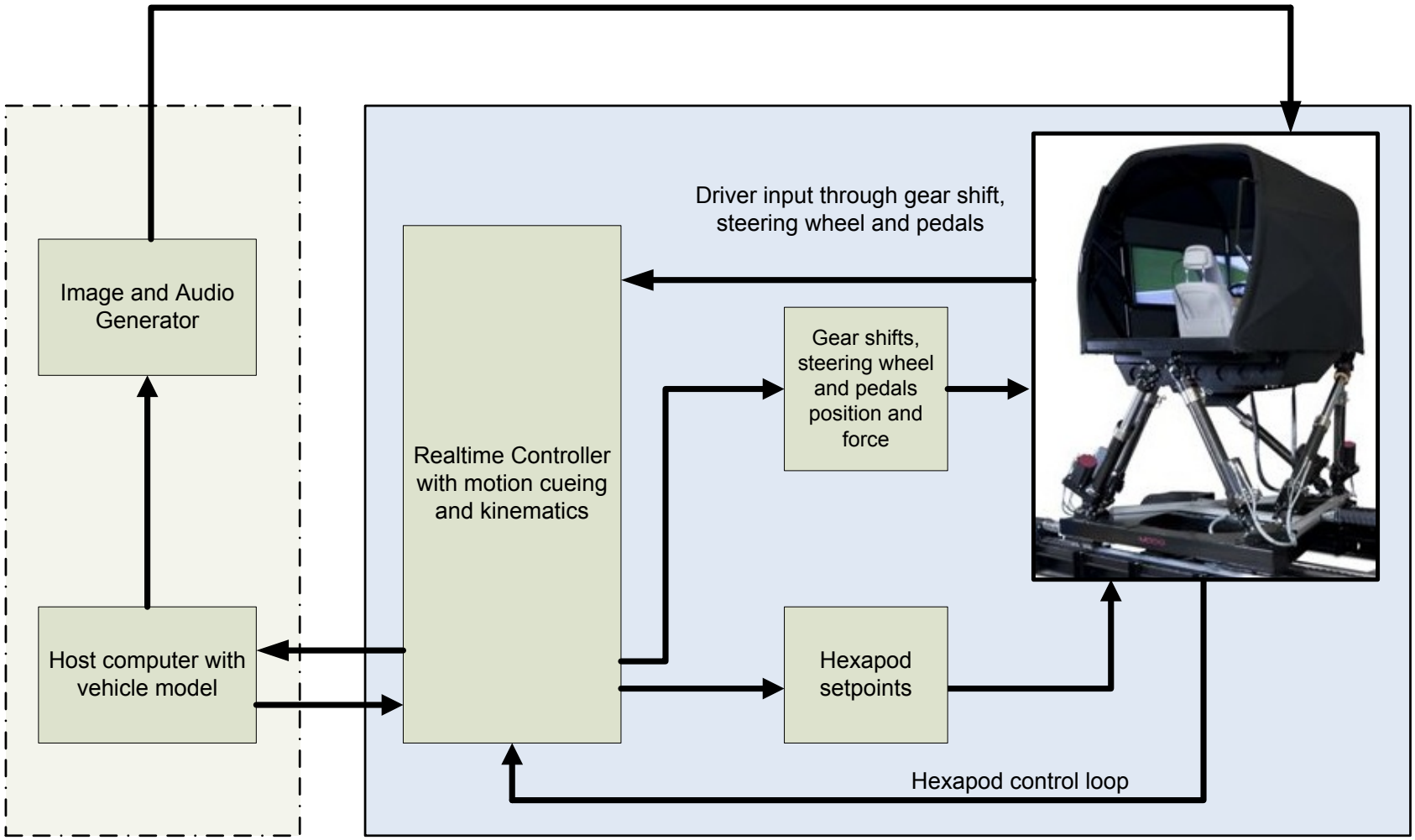
Wouldn't you like….

"Thanks to the driving simulator we are able to reduce the number of prototype tires to 2-3" (Tire manufacturer)

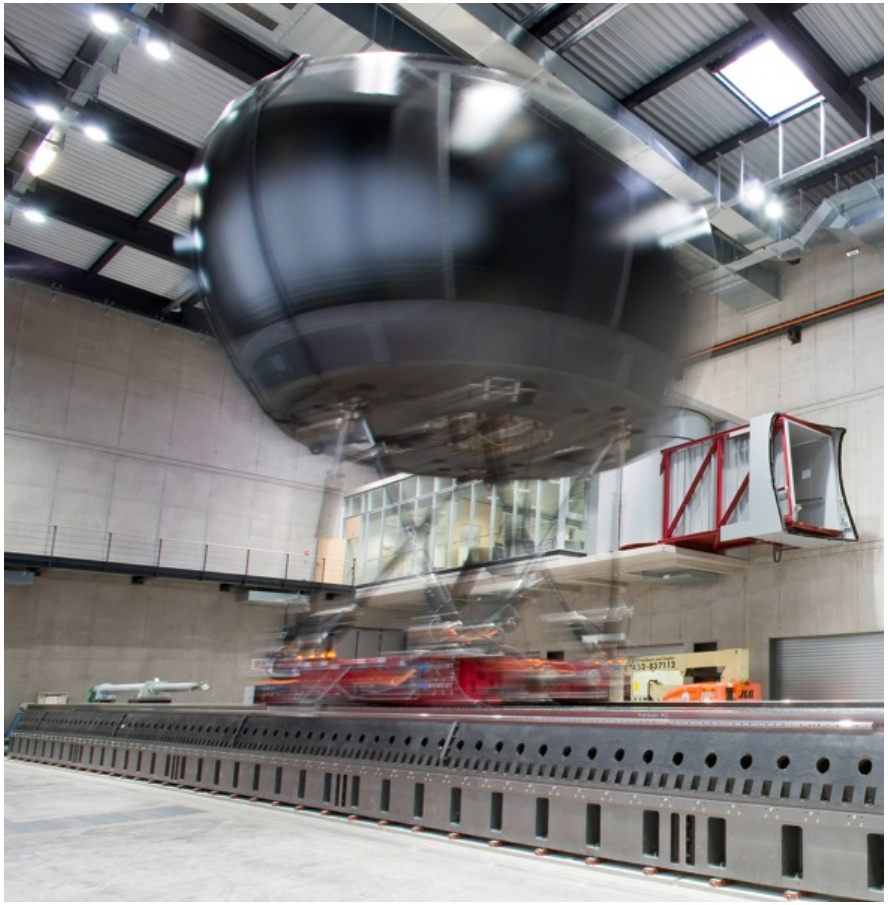
"The adjustments done in the driving simulator allow us to drive the first training laps with optimal settings" (Racecar manufacturer)

"In the driving simulator, we are able to optimize specific driving experience (sportive, classic,..) much quicker than on the test track" (Car manufacturer)

How does a driving simulator work?



Driving simulator evolution

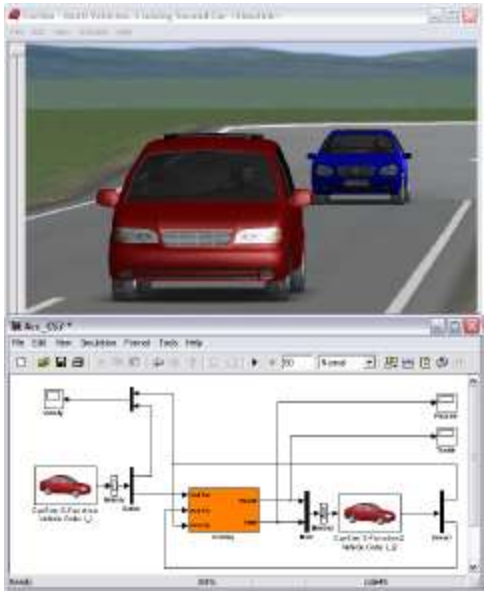


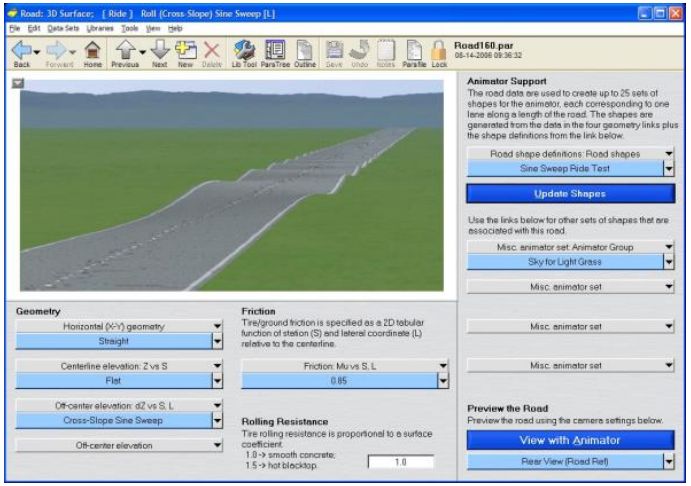
Due to:

- CAE tools/vehicle models
- Computer performance
- Image generation,

driving simulators have evolved from training to development tool

Driving Simulator fidelity factors



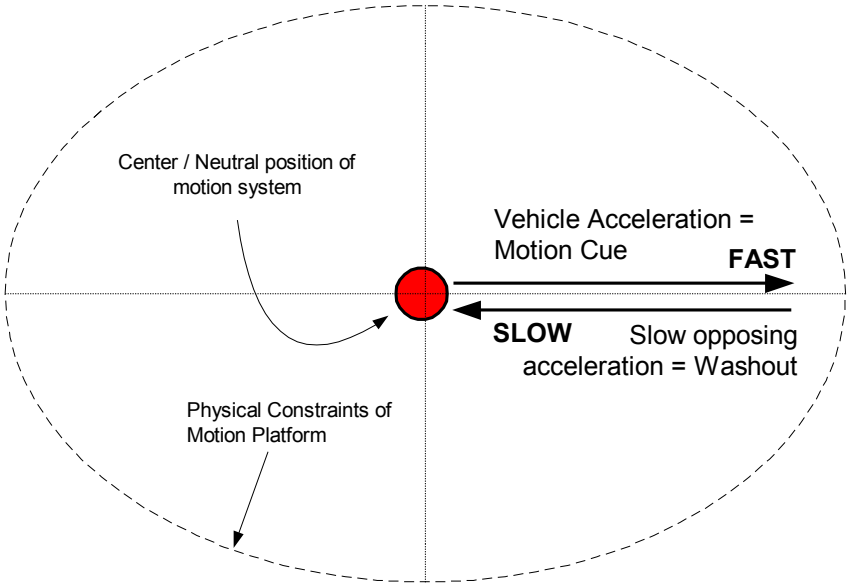


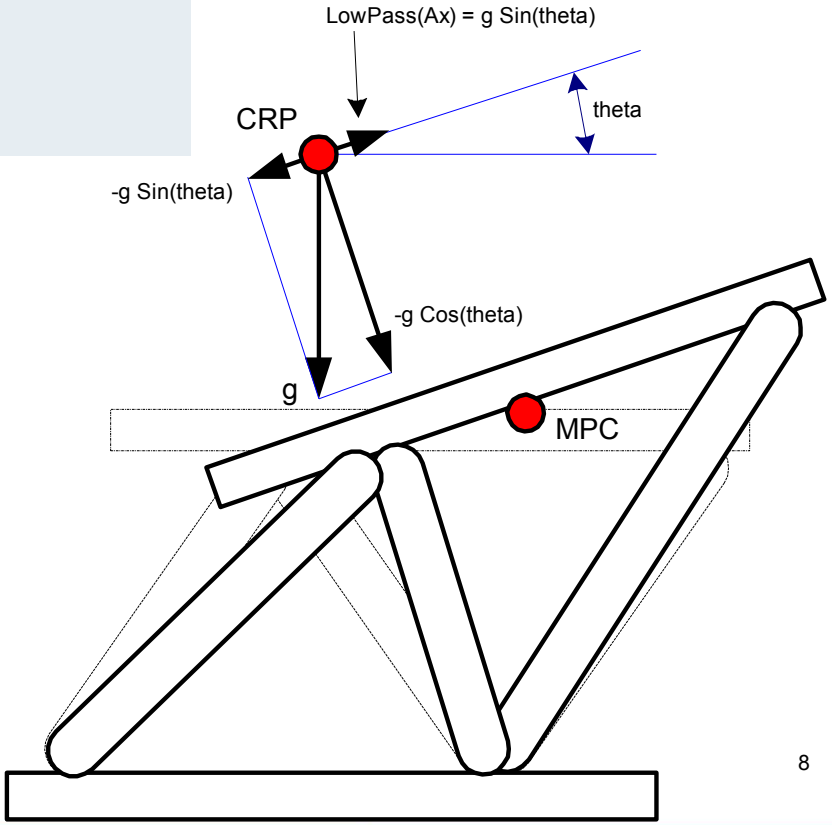
ALL contributing to the elusive “FIDELITY” (or lack of it)

Motion cueing

Motion cueing software uses several techniques to improve the performance for low frequent inputs:

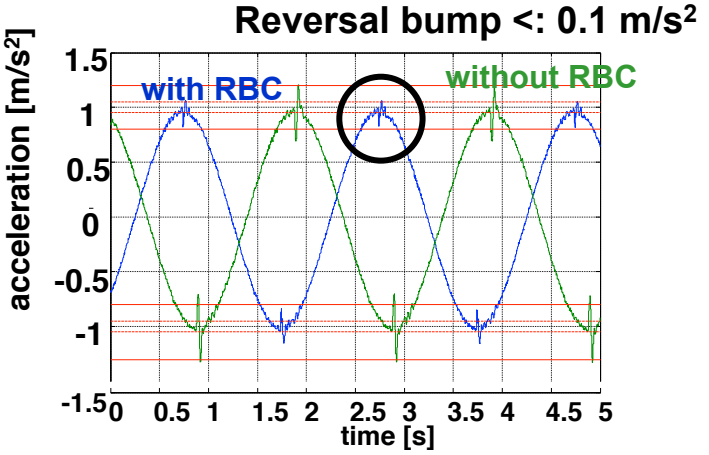
- Filtering
- G-tilting
- Wash-outs
- Pre-positioning
- Scaling

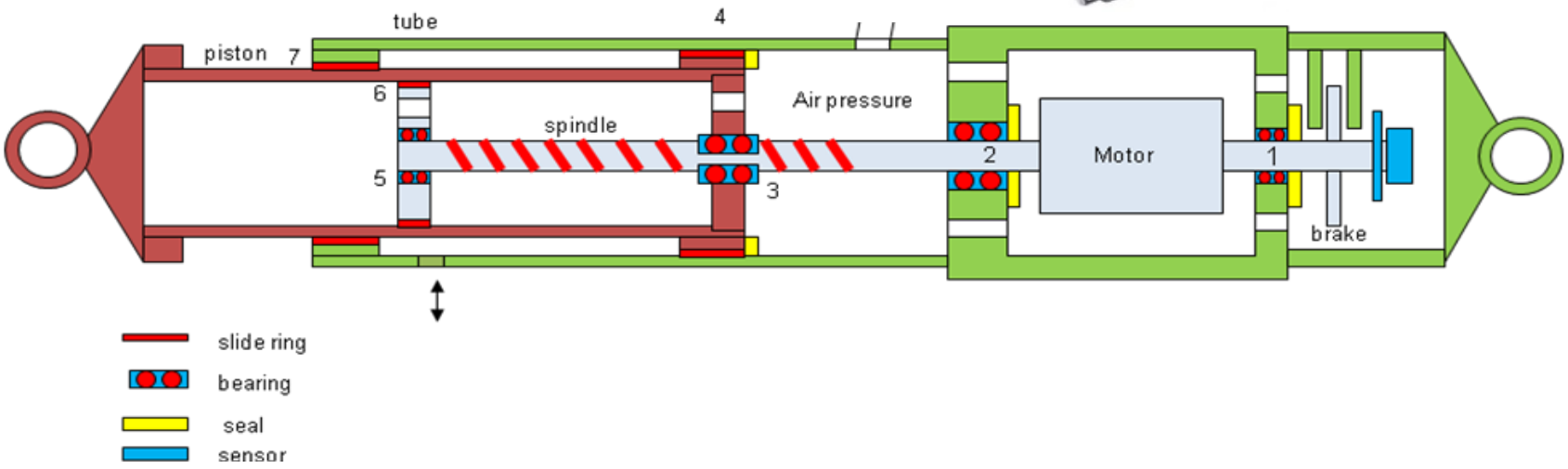




Electro Mechanical Motion Systems

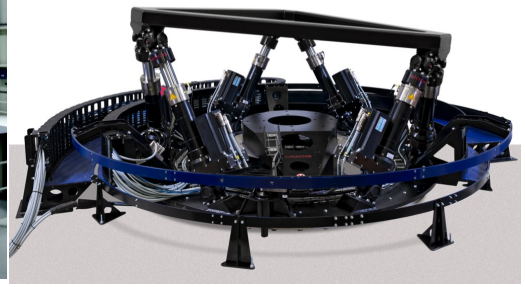
- Clean
- Low energy consumption
- Low noise
- Human rated
- Very small reversal bump!
- Low maintenance



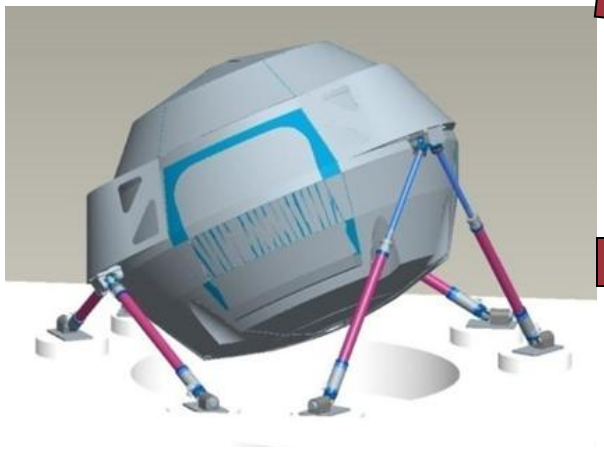


Different purposes with increasing fidelity & performance

Training



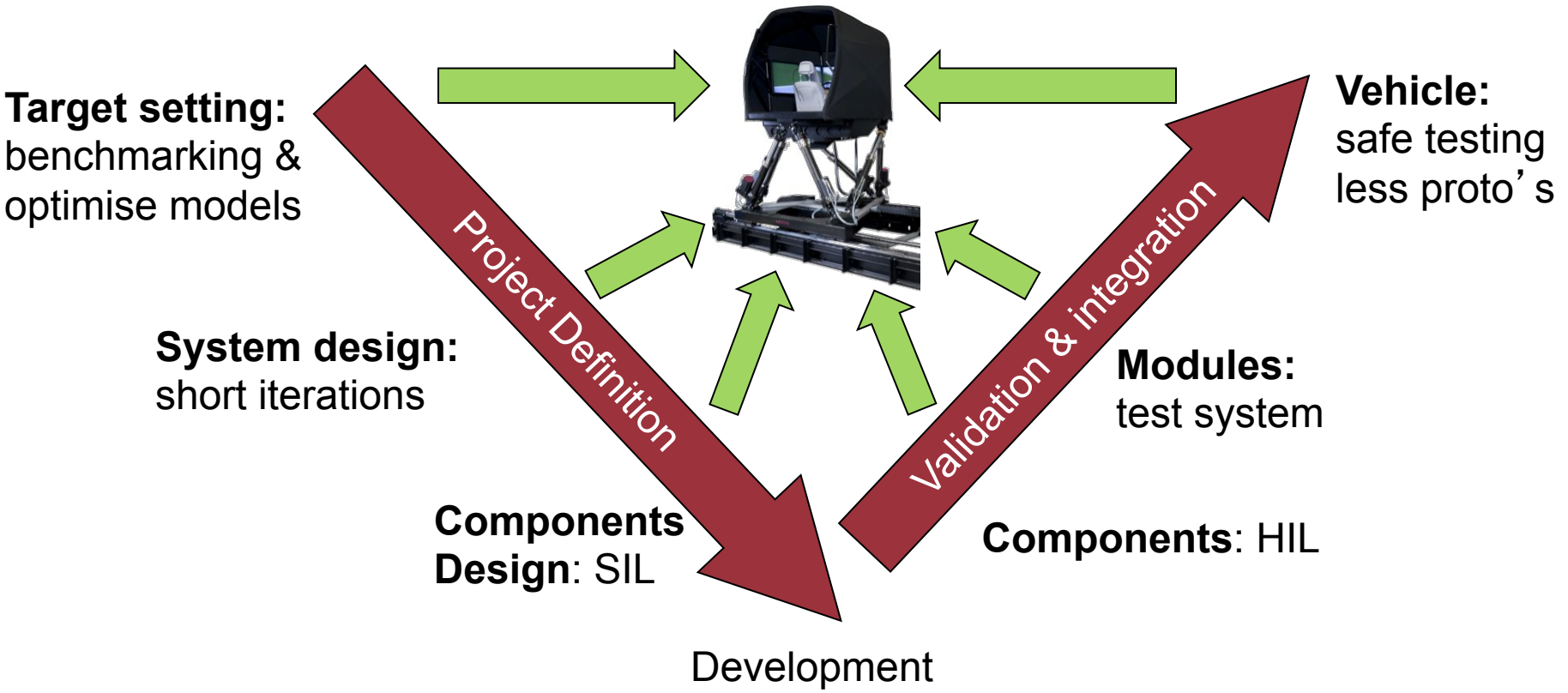
Human Machine Interface



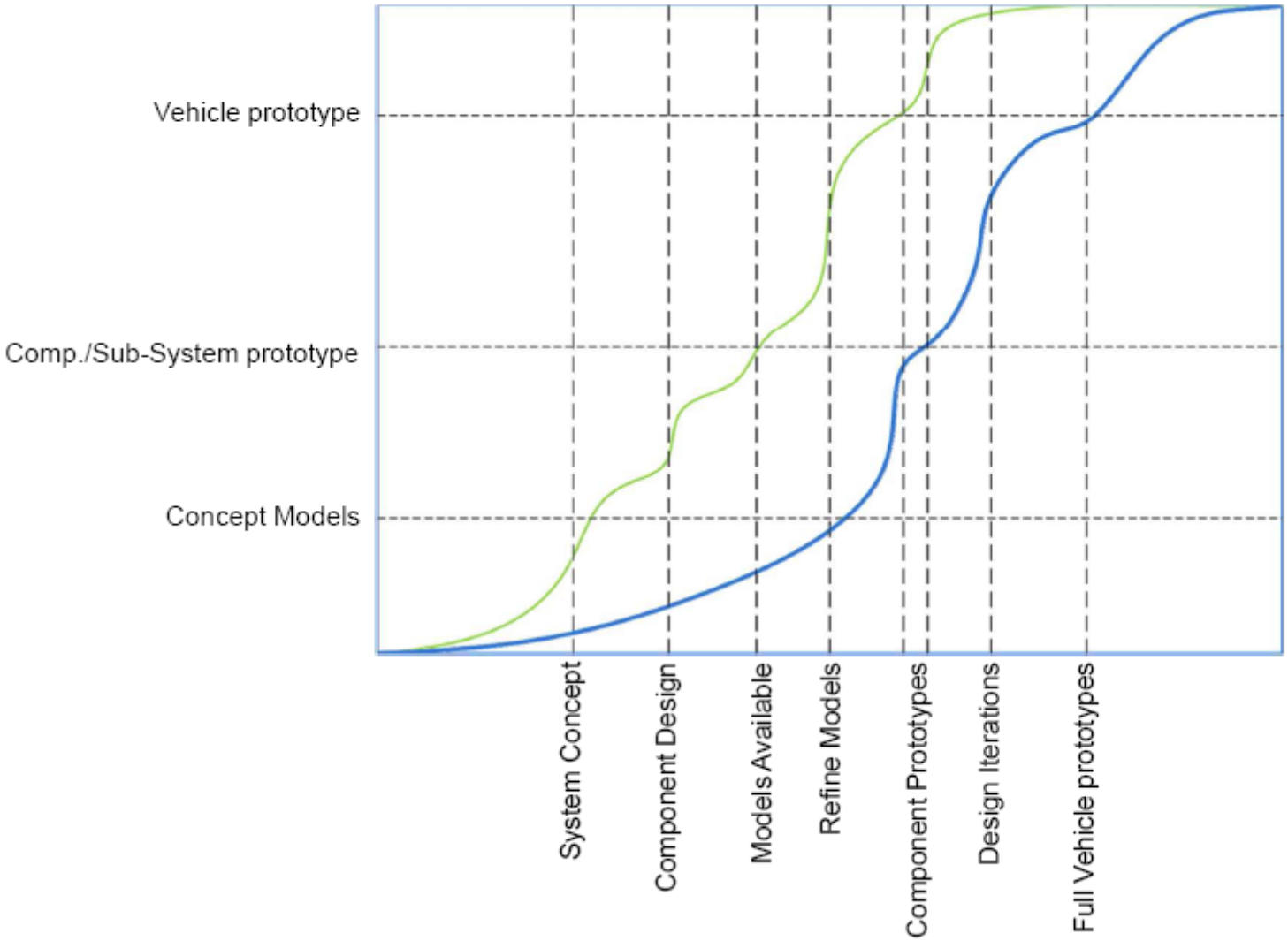
Advanced driver assistance

Vehicle dynamics

Use of Vehicle Dynamics Driving Simulator in the development process



Design confidence & development time



Hardware and Software in the loop

Road Model

Maneuver

Vehicle Model

Software Model

ECU1

ESP

ABS

ACC

…

Hardware Model

Motor

Chassis

Steering

Tire

…

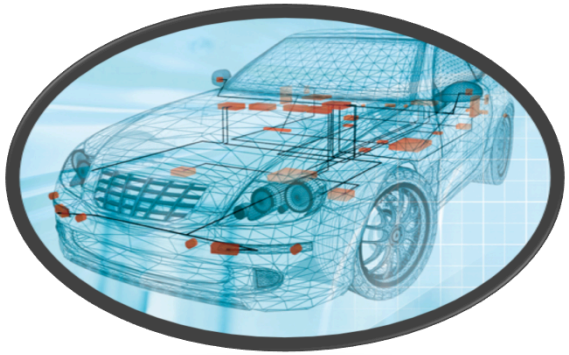
ECU1

Test Results

	Office / Excel Version			
Month	2000	2002 (XP)	2003	2007
Jan	10%	9%	65%	17%
Feb	14%	13%	49%	25%
Mar	15%	12%	55%	19%
Apr	10%	4%	56%	31%
May	0%	18%	46%	36%
Jun	2%	13%	54%	30%
Jul	8%	13%	47%	32%
Aug	14%	7%	50%	29%
Sep	9%	7%	52%	32%
Oct	10%	9%	54%	28%
Nov	11%	9%	55%	26%
Dec	8%	8%	49%	35%
Avg	9%	10%	53%	28%
Std. Dev.	4%	4%	5%	6%
Min	0%	4%	46%	17%
Max	15%	18%	65%	36%
Range	15%	14%	19%	18%

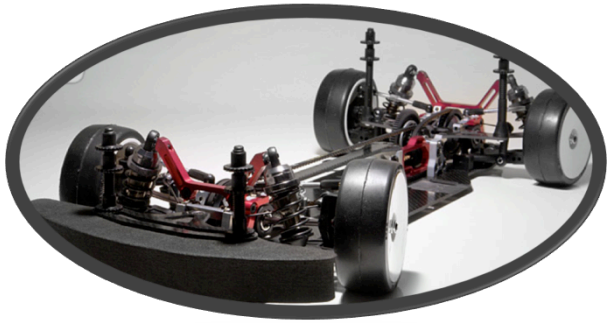
Decrease development time

Computer model ready & tested



Subjective driver In the loop testing

Prototype testing



Driving Simulators

Driving simulators are used for over 30 years in the automotive industry

Until recently mainly for training and Human factors investigation

Improvement in computer performance and simulation software have improved the simulation fidelity and accuracy

Driving simulators help to evaluate new designs early in the design phase and even Hardware in the loop tests

This leads to less prototype-vehicles and costly testing whilst offering quicker and better development programs

Recent driving simulators are a viable tool for designers to reduce development time and costs while improving the design

Thank you for your attention

For more information: Moog booth 1624