Forum TERATEC
28 & 29 juin 2011

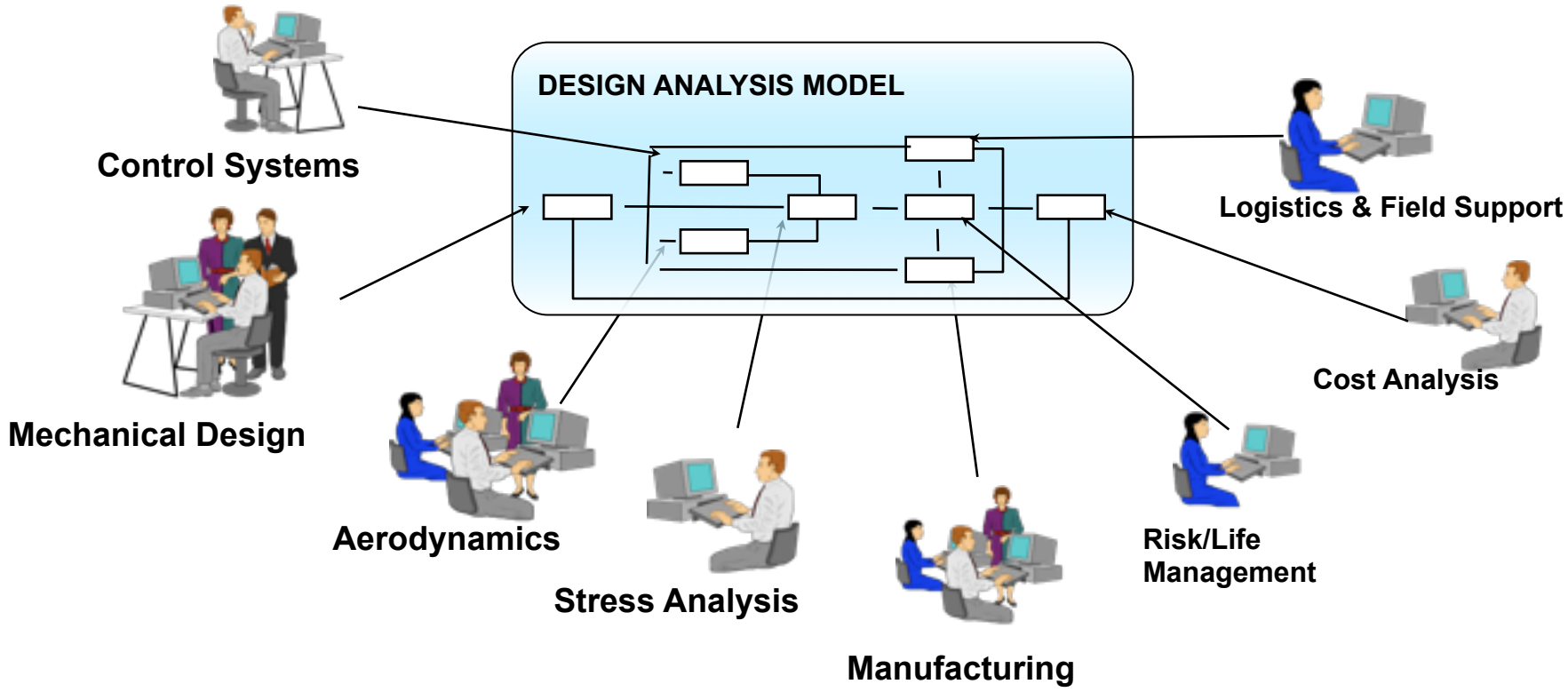
Complex system optimisation with modeFRONTIER

Carlo Poloni
University of Trieste
&
President - ESTECO srl

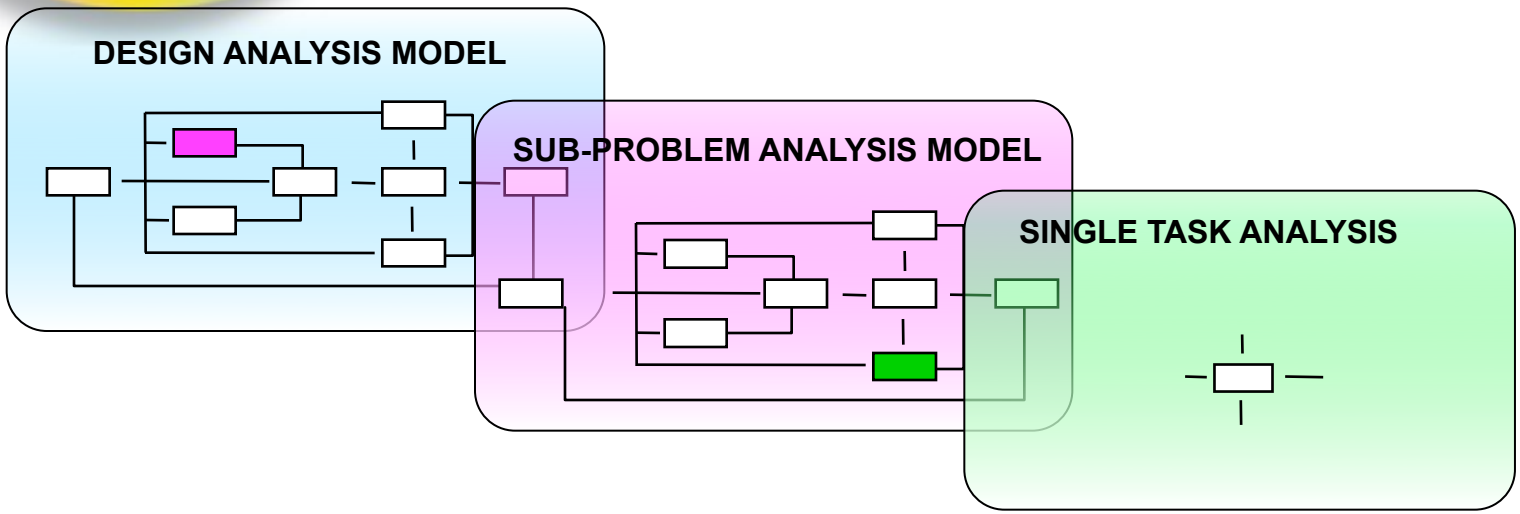
modeFRONTIER
the multi-objective optimization and design environment

www.esteco.com

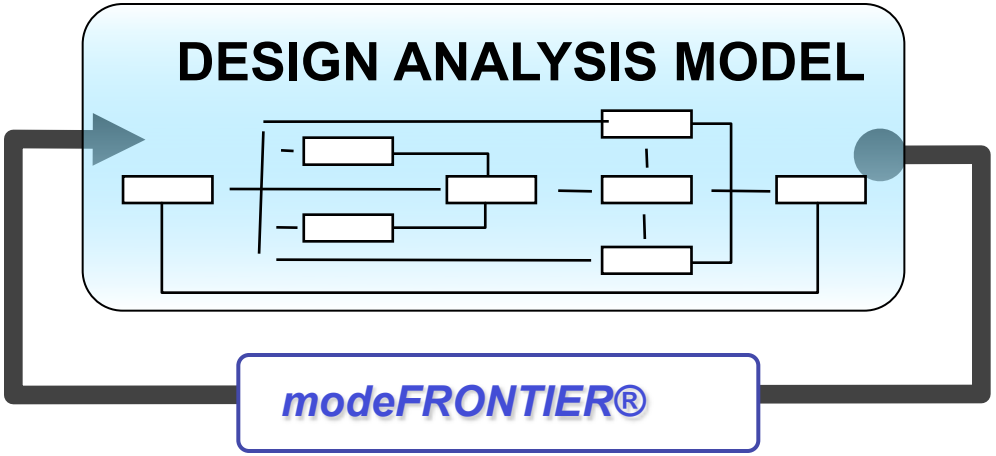
Design Process



Decomposed design process



- Design Of Experiment
- Optimisation algorithms
- Decision Making Procedures



JSME International Journal Series B
Vol. 48 (2005) , No. 2 Special Issue on Advanced Fluid Information pp.224-228
[PDF (378K)] [References]

Integrating Multibody Simulation and CFD: toward Complex Multidisciplinary Design Optimization

Stefano PIERI[1)], Carlo POLONI[2)] and Martin MÜHLMEIER[3)]
1) ES.TEC.O. srl
2) Dipartimento di Energetica, University of Trieste
3) AUDI Motor Sport AG

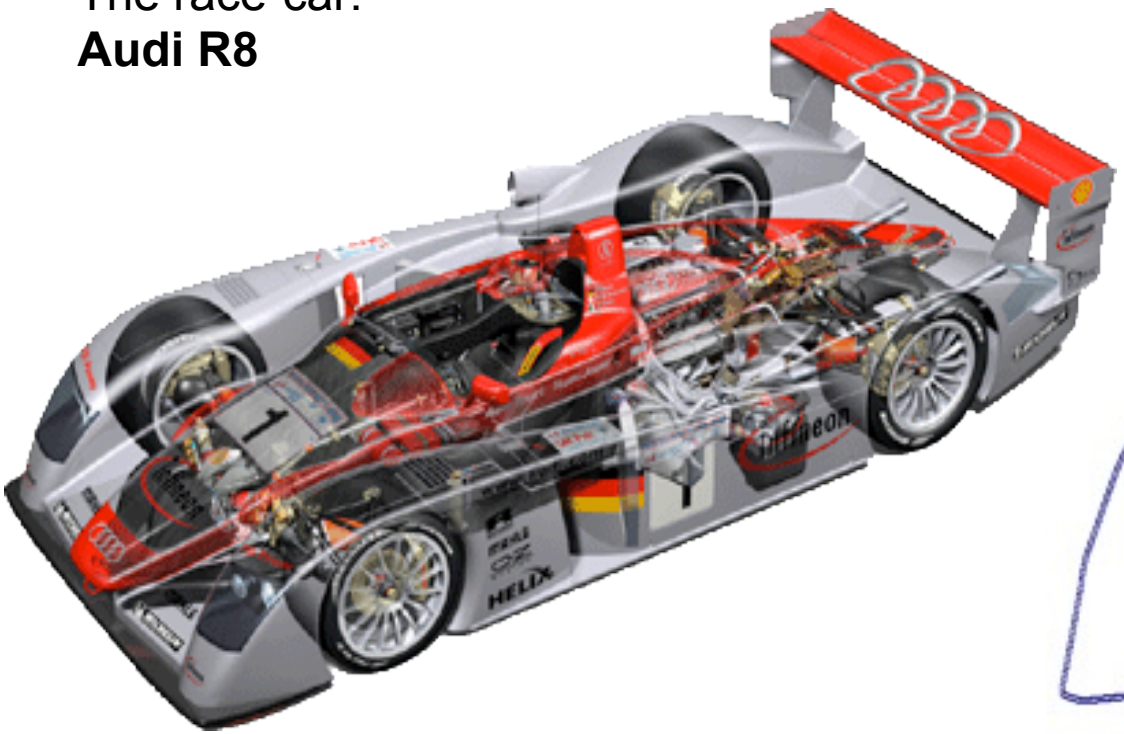
(Received November 22, 2004)

This paper describes the use of integrated multidisciplinary analysis and optimization of a race car model on a predefined circuit. The objective is the definition of the most efficient geometric configuration that can guarantee the lowest lap time. In order to carry out this study it has been necessary to interface the design optimization software *modeFRONTIER* with the following softwares: *CATIA v5*, a three dimensional CAD software, used for the definition of the parametric geometry; *A.D.A.M.S./Motorsport*, a multi-body dynamic simulation software; *IcemCFD*, a mesh generator, for the automatic generation of the CFD grid; *CFX*, a Navier-Stokes code, for the fluid-dynamic forces prediction. The process integration gives the possibility to compute, for each geometrical configuration, a set of aerodynamic coefficients that are then used in the multiboby simulation for the computation of the lap time. Finally an automatic optimization procedure is started and the lap-time minimized. The whole process is executed on a Linux cluster running CFD simulations in parallel.

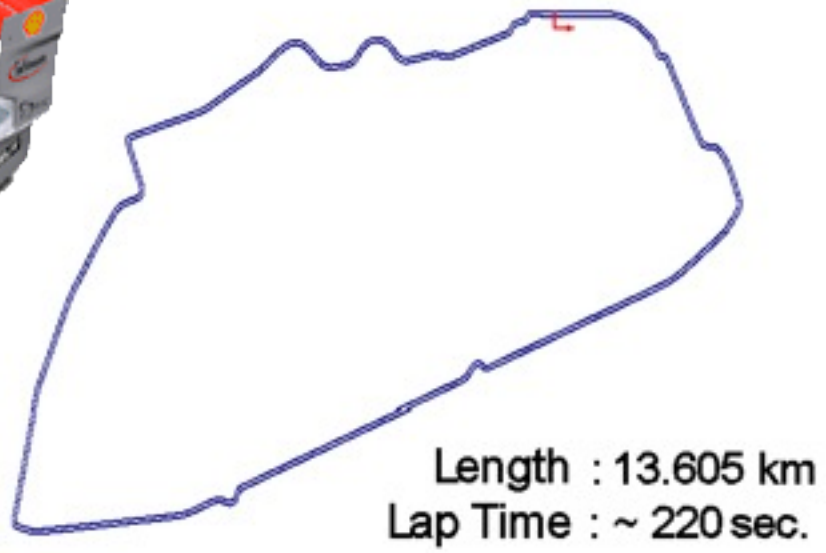
Key Words:
Automobile, Computer Aided Design (CAD), Optimum Design, Computational Fluid Dynamics, Dynamic Programming

The problem

The race-car:
Audi R8

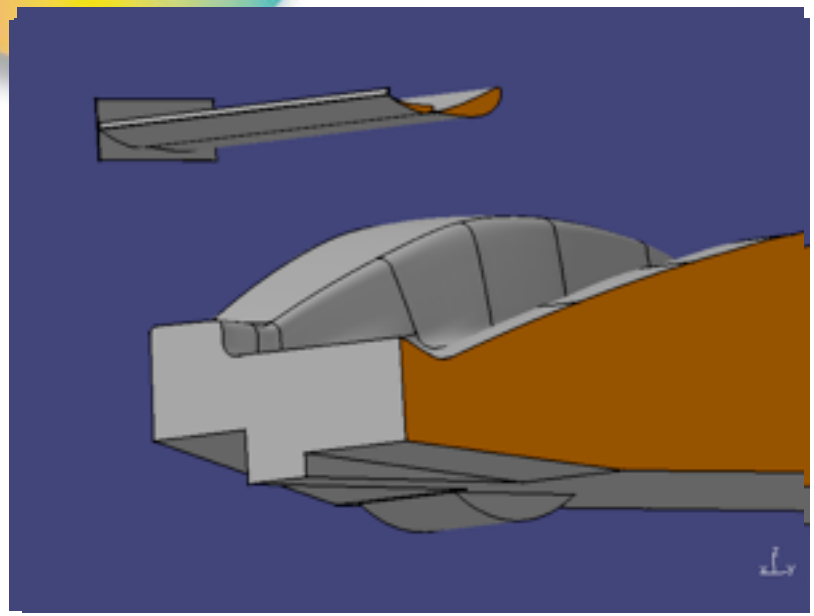


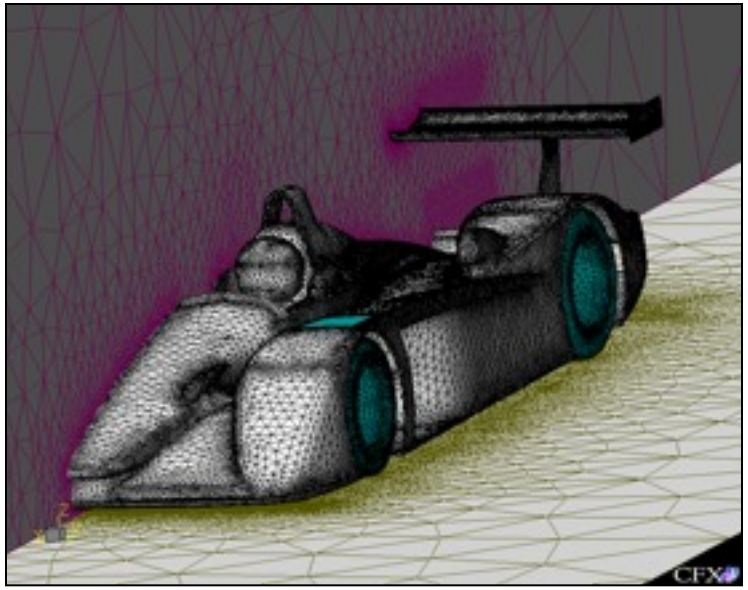
The track:
Le Mans

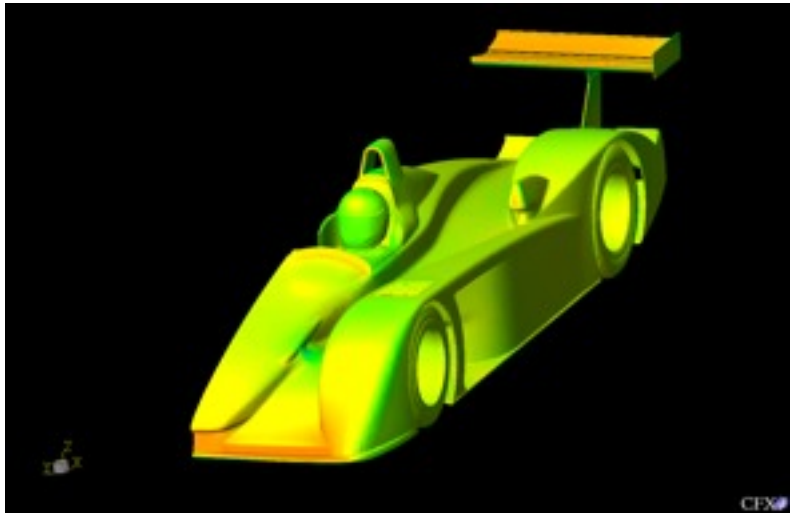


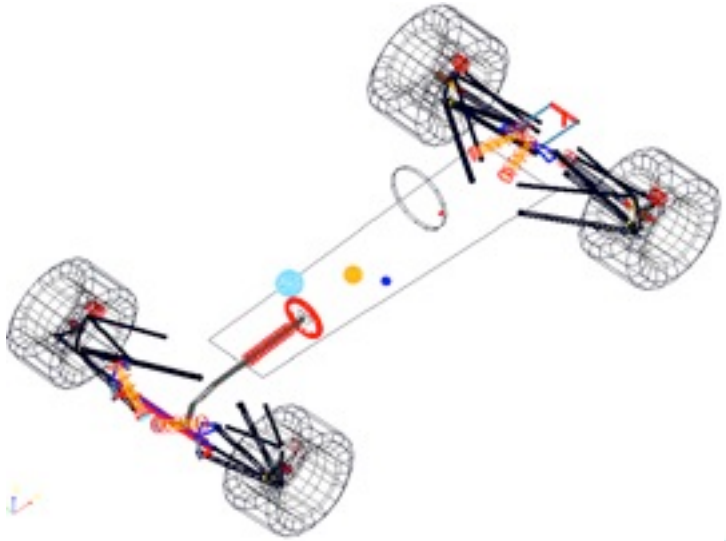
Racing from 2000 to 2006 - 1st at 24h Le Mans 5 times

The physics (numerics?!?)

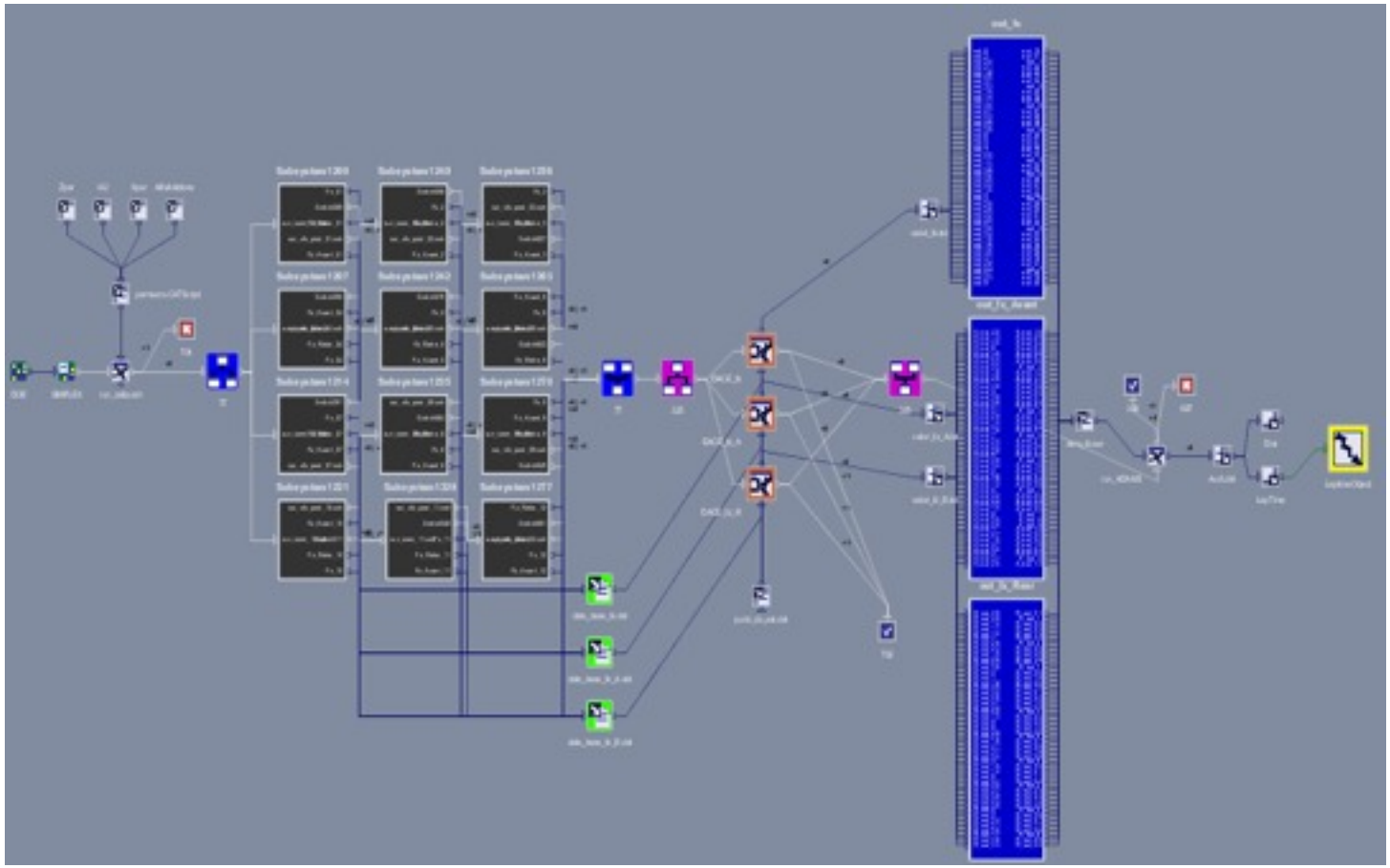








400+ “software activations” are needed



Handling of uncertainties...

When facing “creative design” uncertainties in the performance prediction must be taken into account:

- Noise due to unpredictable environment
- Noise due to geometrical tolerances
- Numerical inaccuracies

Different tools are available in modeFRONTIER to face these issues:

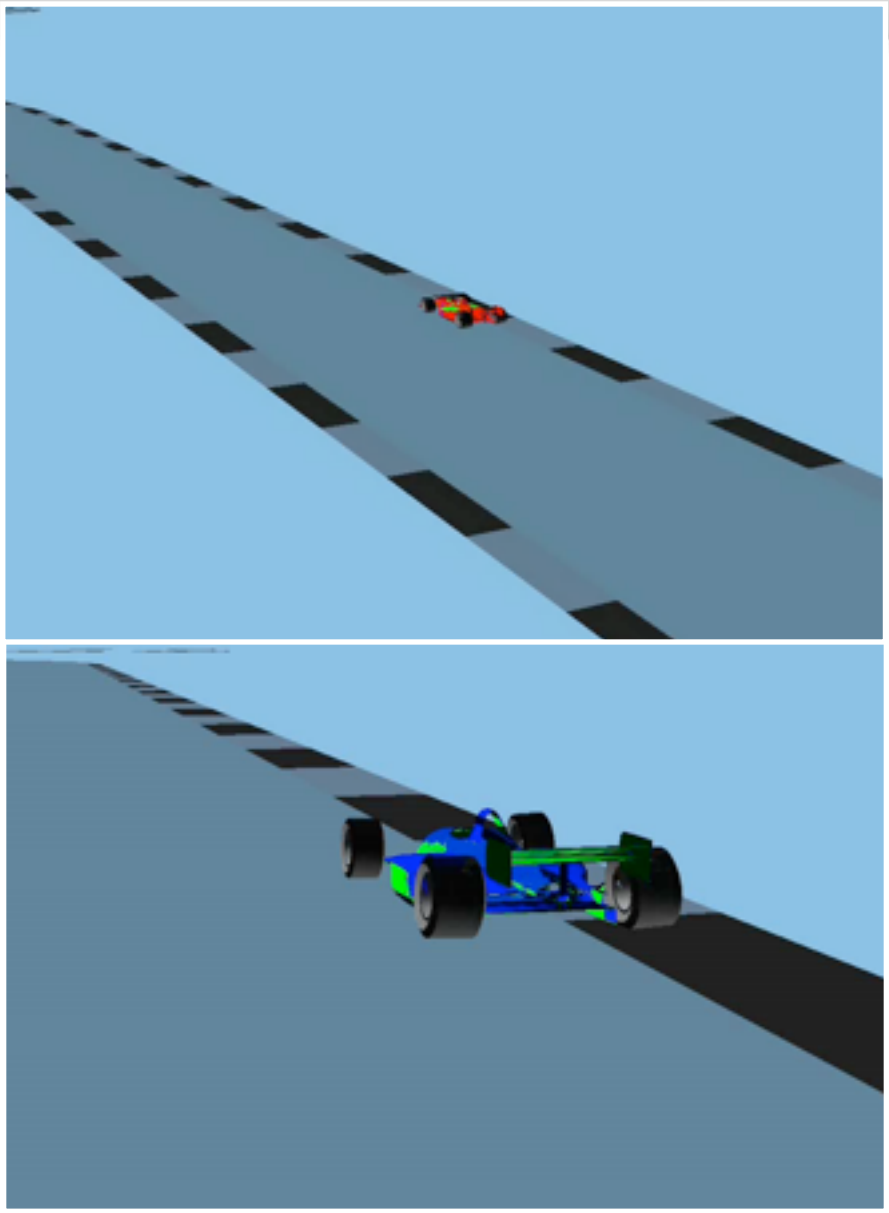
- statistical tools for DFSS
- RSM methodology
- MORDO techniques

Porsche911-GTO (McNish) **Le Mans '98**

http://www.dailymail.co.uk/news/article-2002561/Pictures-Allan-McNish-crash-Le-Mans-24-hour-race.html

handling of uncertainties...on the numerical model

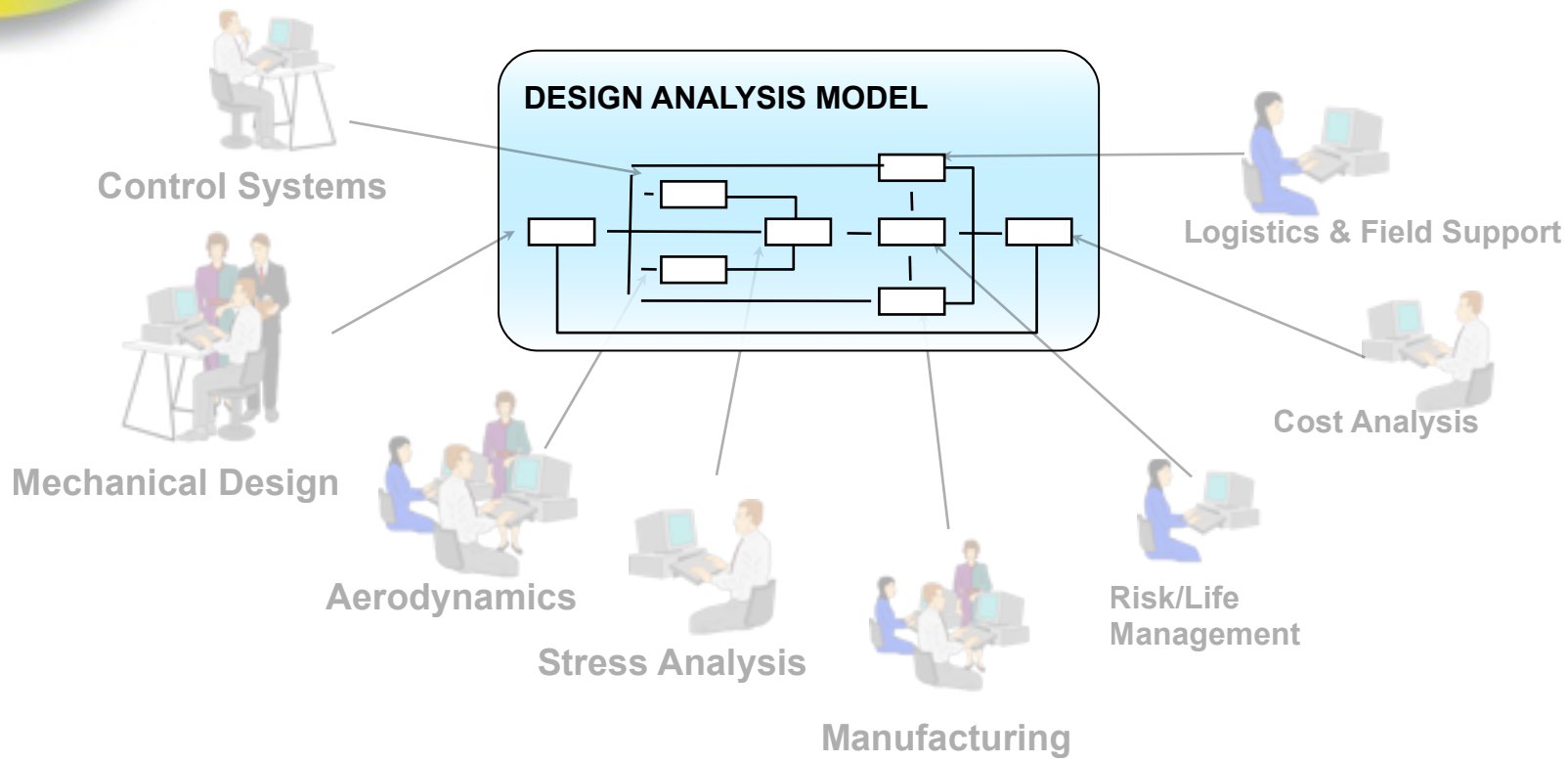
Model: open wheel car
Software: VI-Car_Real_Time
Targets:
Increase AVG speed
Minimize the Steer Oscillations
Standard Parameters (10):
Setup of the car:
front/rear ride_heights (2)
front/rear springs_stiffesses (2)
front/rear antirollbar_stiffnesses (2)
front/rear dampers scaling factors (2)
Limited Slip Differential setting:
C0 coefficient Preload (1)
C1 coefficient (1)
Stocastic Parameters (3):
Driver behaviour: preview_time (1)
Tires: front/rear lateral grip factor (2)



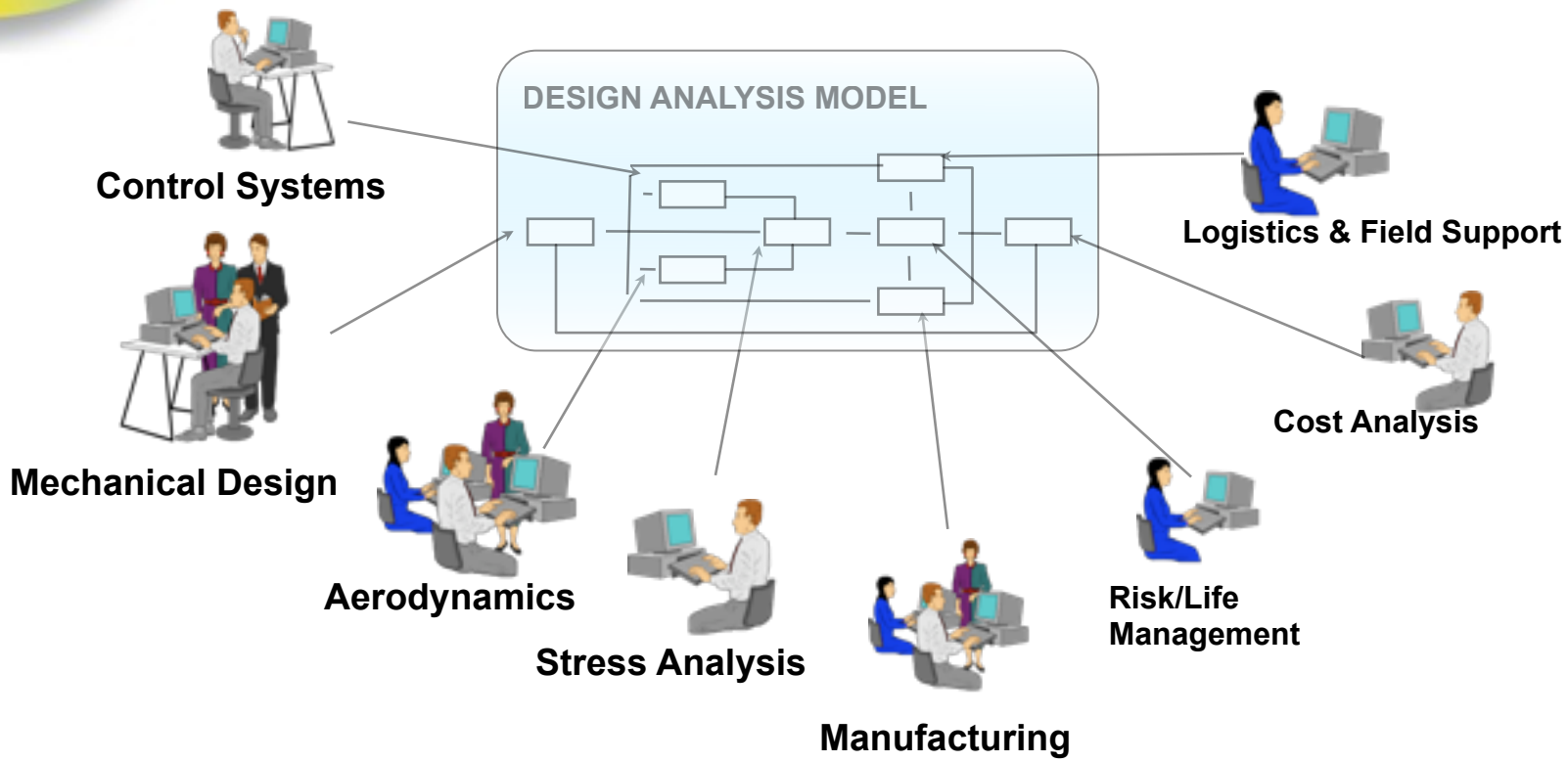
Intensive computation for:

- For more accurate prediction
- For multiple simulation

Design Process

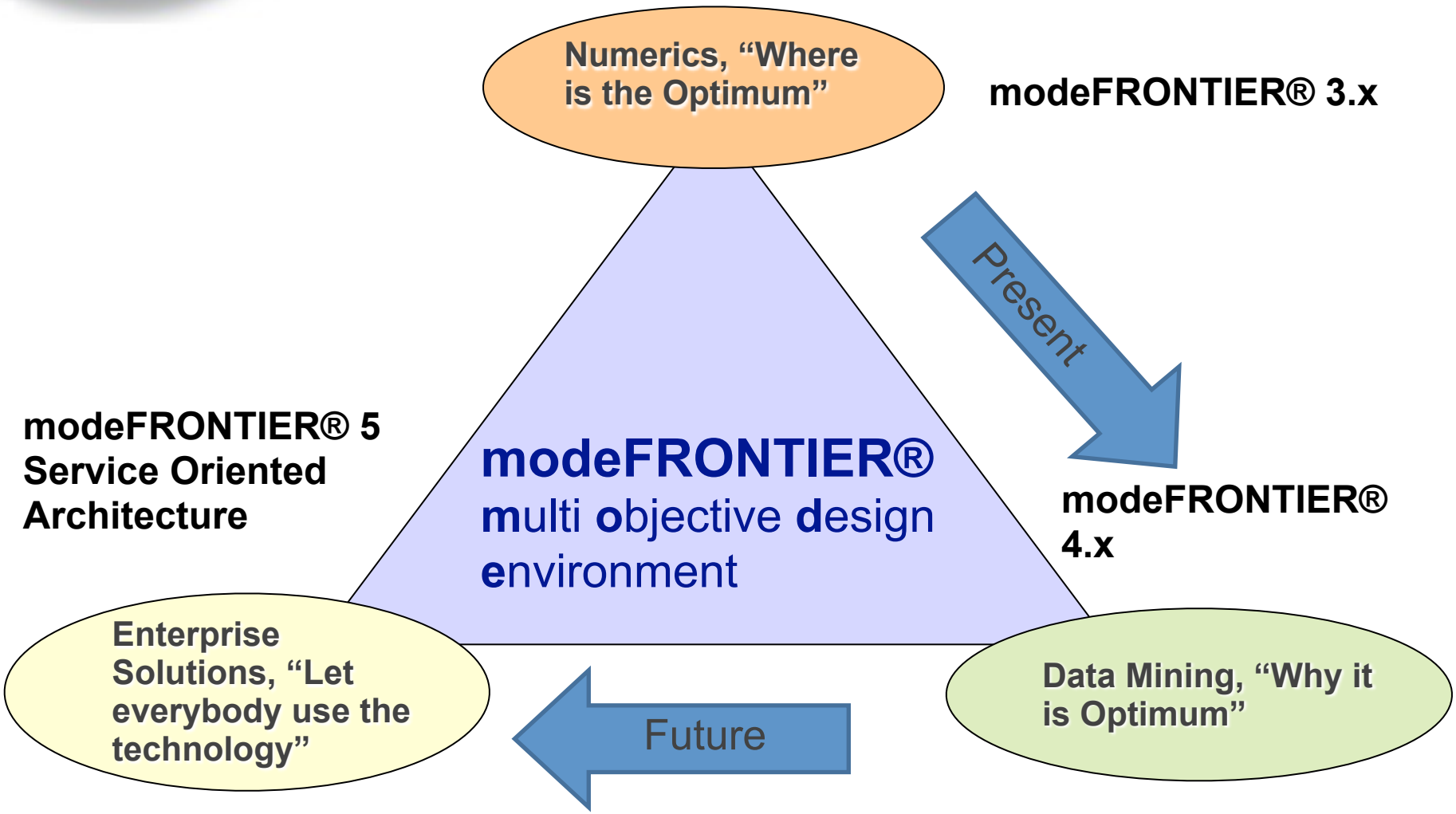


Design Process



Cooperation through IT communication standards

Our Strengths



Thank you!

modeFRONTIER distribution & support:

ENGINSOFT France
88,Avenue du Général Leclerc
Bâtiment A
92514 BOULOGNE-BILLANCOURT Cedex
Tél Std: +33 (0)1 41 22 99 30
Fax: +33 (0)1 46 03 65 12
Site Web Français: www.enginsoft-fr.com