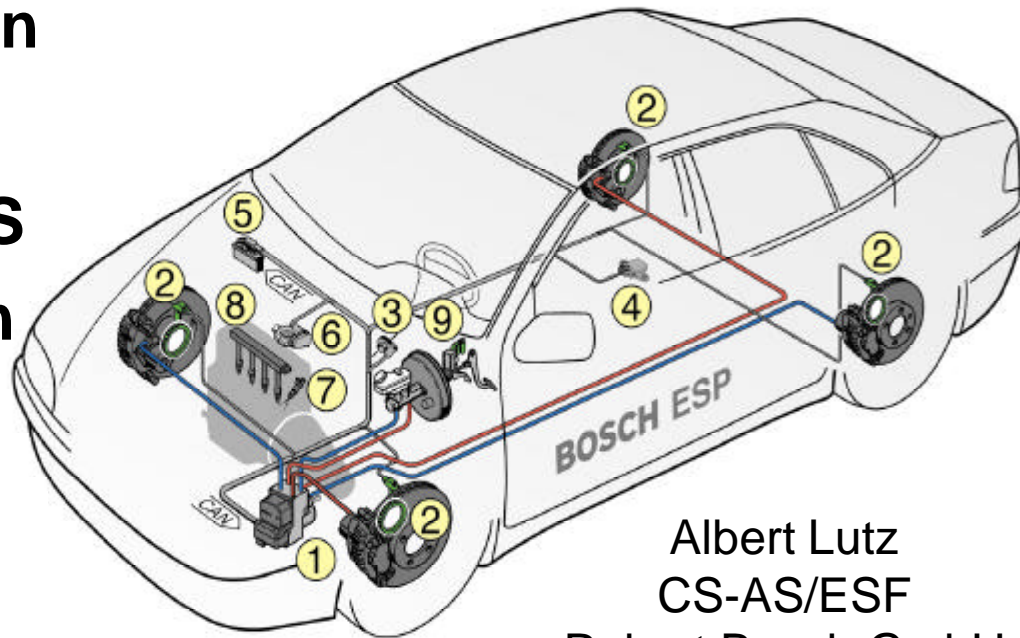




**SIMPACT as a
MBS-Tool in
the
BOSCH-CS
Simulation
Concept**



Albert Lutz
CS-AS/ESF
Robert Bosch GmbH



- **Simulation in the development process of Vehicle Stabilising Systems:
The BOSCH-CS Simulation Concept**
- **MBS-vehicle model**
- **Realisation and process**
- **Next steps**



The BOSCH-CS Simulation Concept

A Mechatronic System requires various Tools

BOSCH

Sensors: Yawrate, AY
Wheel speed, Steering
angle, Precharge pressure
Tools:
EDYSON, ...

ECUs:
ESP, ABSR, DME
Tools:
SABER, ...

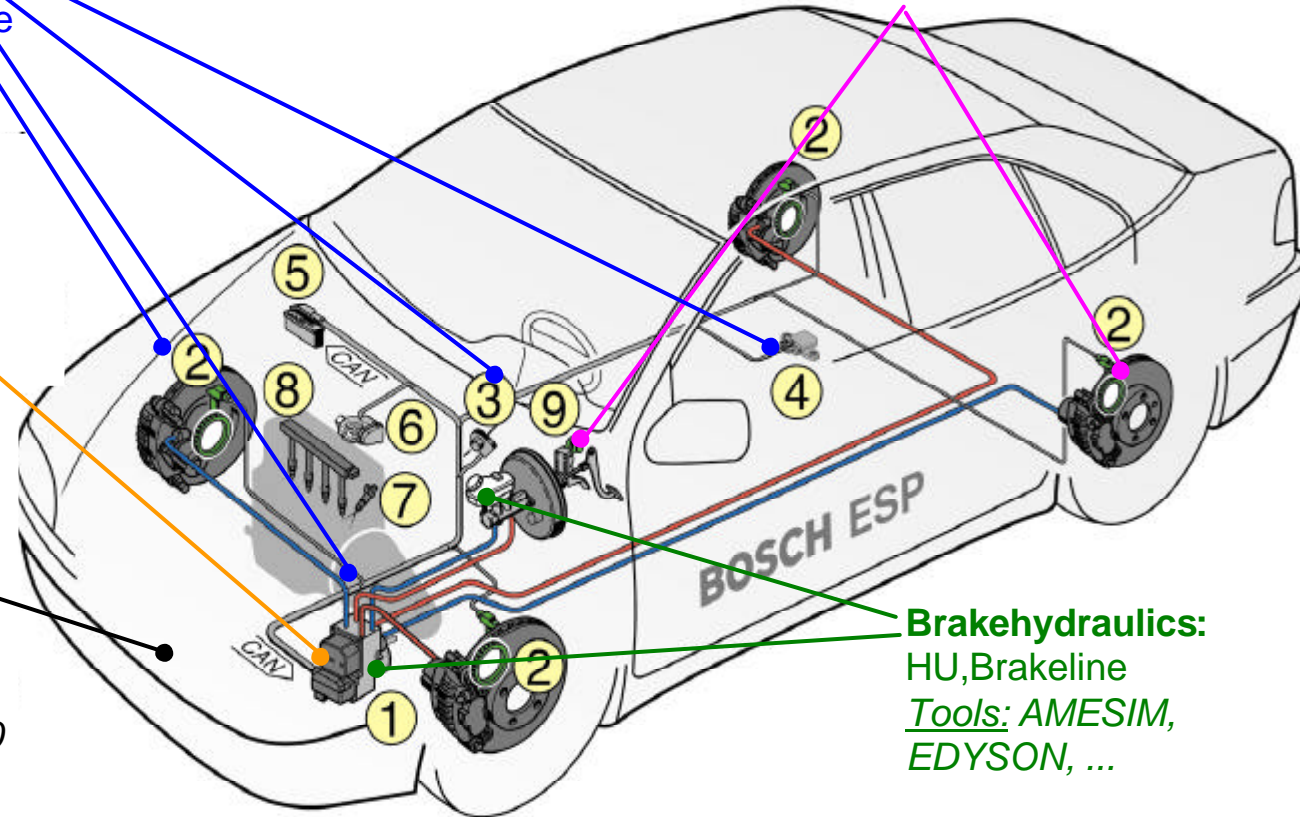
Mechanics:
Chassis with
suspension, steering
system, drivetrain, tyres
Tools:
FASIM, SIMPACK, PKW0

Miscellaneous:
Driver, Environment

Application Software:
Control and Safety Algorithm
Tools: MS-Developer Studio, C-
Compiler, Simulink, ASCET-SD

Foundation and Actuation:
MC, Booster, Wheel Brake
Cylinder
Tools: CoBrake

Brakehydraulics:
HU, Brakeline
Tools: AMESIM,
EDYSON, ...

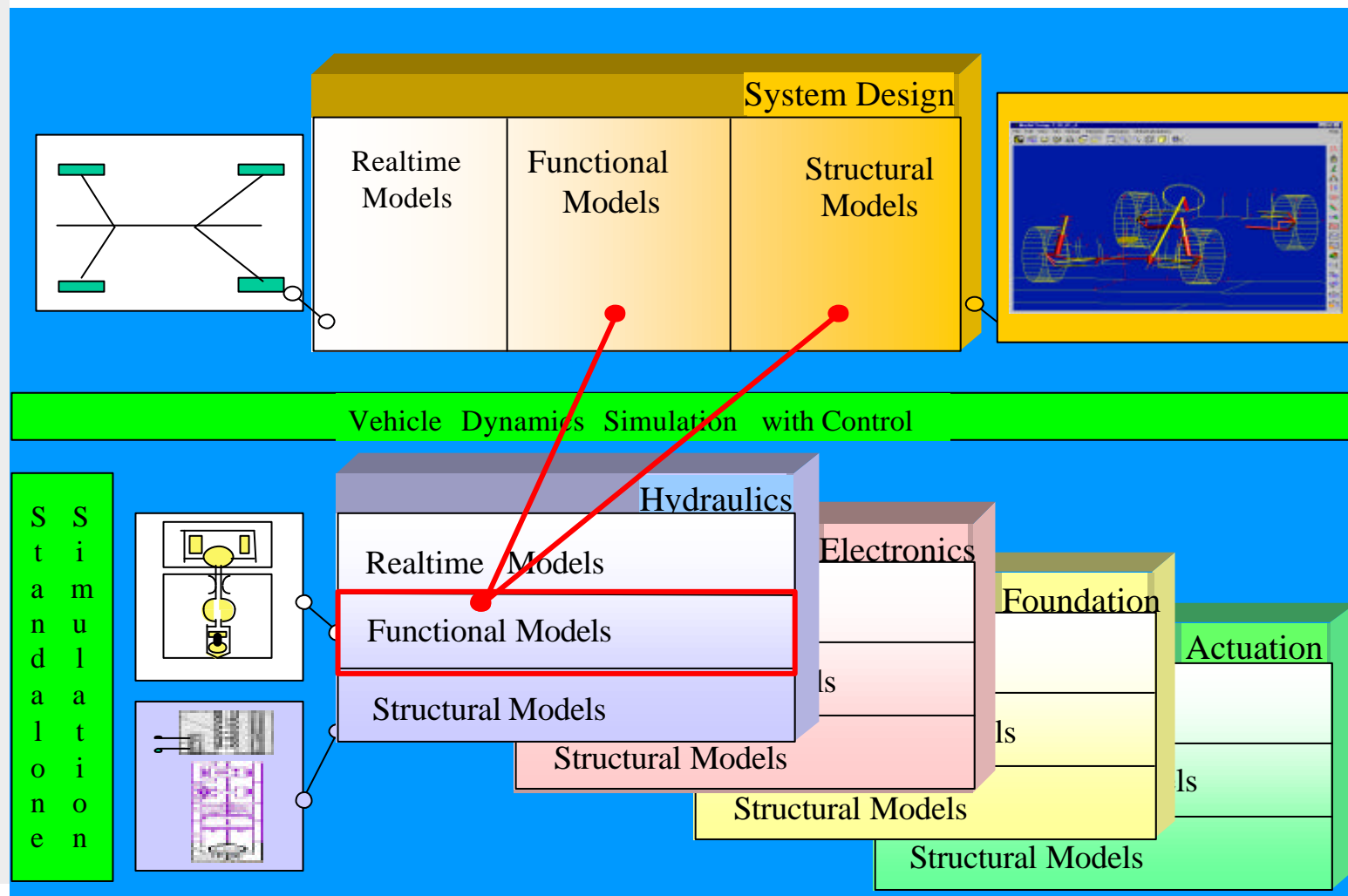




The BOSCH-CS Simulation Concept

Local Simulation Activities imbedded into the Concept

BOSCH

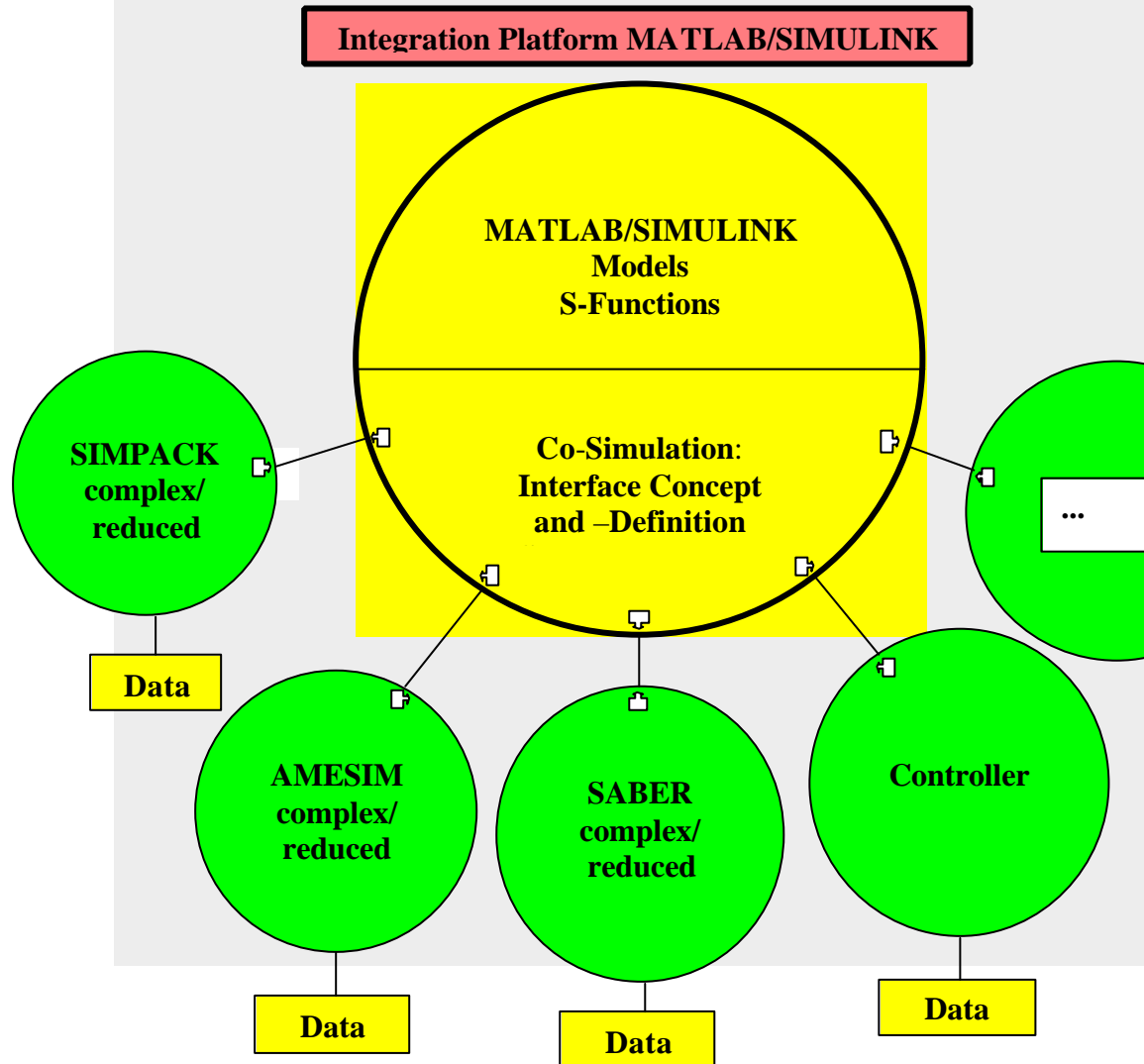




The BOSCH-CS Simulation Concept

Agreed Simulations Concept at BOSCH-CS

BOSCH



Aspects:

- **One integration platform** to set-up the complete system by agreed interfaces
- **Agreed interfaces** enable direct implementation of the models or coupling by communication modules (CoSimulation)
- **Tool decision** platform is MATLAB/SIMULink

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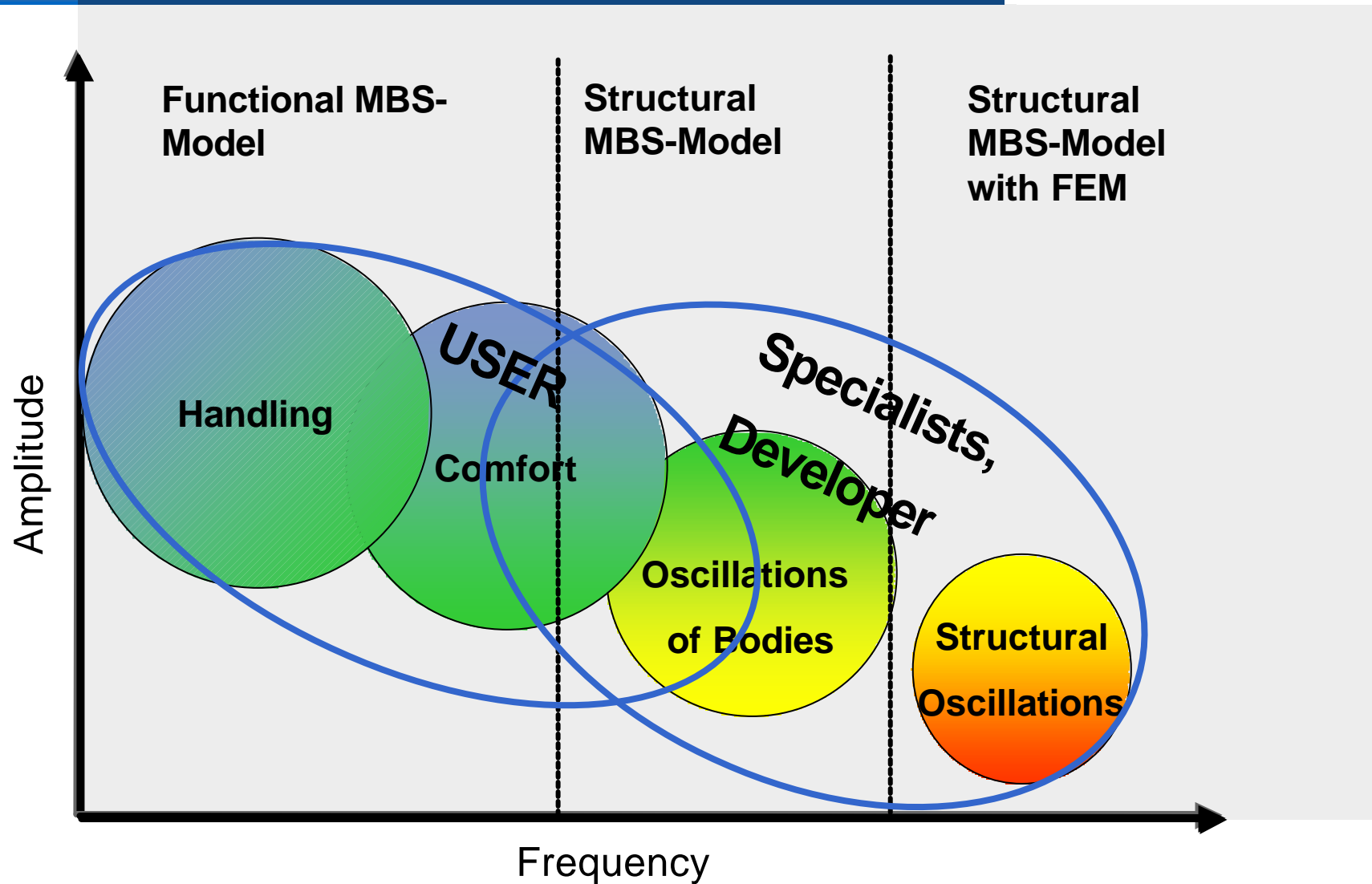
Simulation in the Development Process of Vehicle Stabilising Systems

- Systems Development
- Design of Control Algorithm
- Systems Application
- Component Development
- Fundamental Research
- Knowledge Management
- Co-operation with Customers



MBS-Vehicle Model Application Area of Vehicle Models

BOSCH



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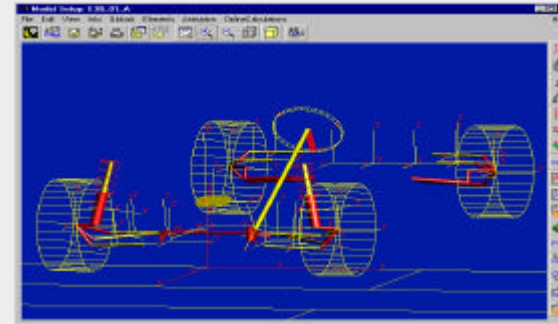


SIMPACK:

One Tool

One Basic Dataset

One Modeltyp



Model Development

Model Application

SIMPACK

SIMPACK

Code Export - CS CAR

Stand alone

in CoSimulation (SIMAT)

Plugin to SIMULink

Vehicle Modelling

- ABS-Development

- SW-Development and
Quality Assurance

Fundamental Investi-
gations w.r.t. MBS

- MBS-Investigations

- System Development

- New Actuator Concepts

- System-Application

- Wirkketten-Engineering

- Small number of projects,
- SIMPACK know how

- Big number of projects,
- no SIMPACK know how



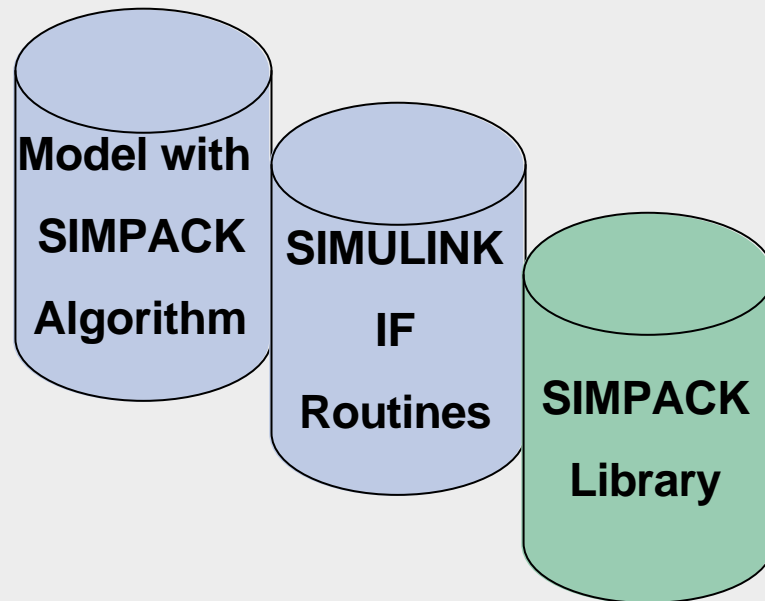
Specification of CS-CAR

- Vehicle with rigid bodies and 15 DOFs
- Suspension kinematics described by kinematics maps
- Interfaces for tyre models of different complexity
- Environment described by files and evaluated by SIMPACK-function
- Interfaces for other vehicle components
- Interfaces to BOSCH components (sensors, actuators, controller, brake, ...)
- Implemented in SIMULink as a plug in using the SIMULink solver
- Modelling based on SIMPACK with Code Export
- Parameterisation capability
- Vehicle data base according to BOSCH-CS requests



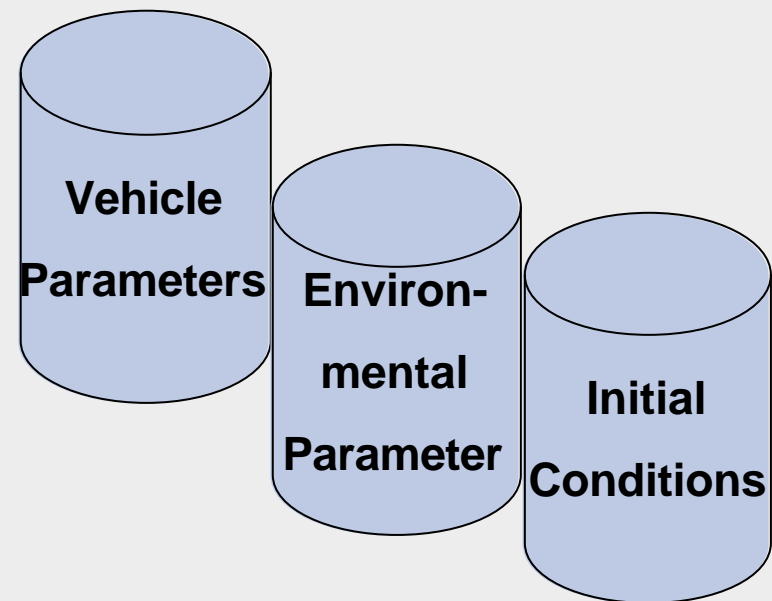
Model Library

owned by BOSCH by INTEC



Data Library

owned by BOSCH

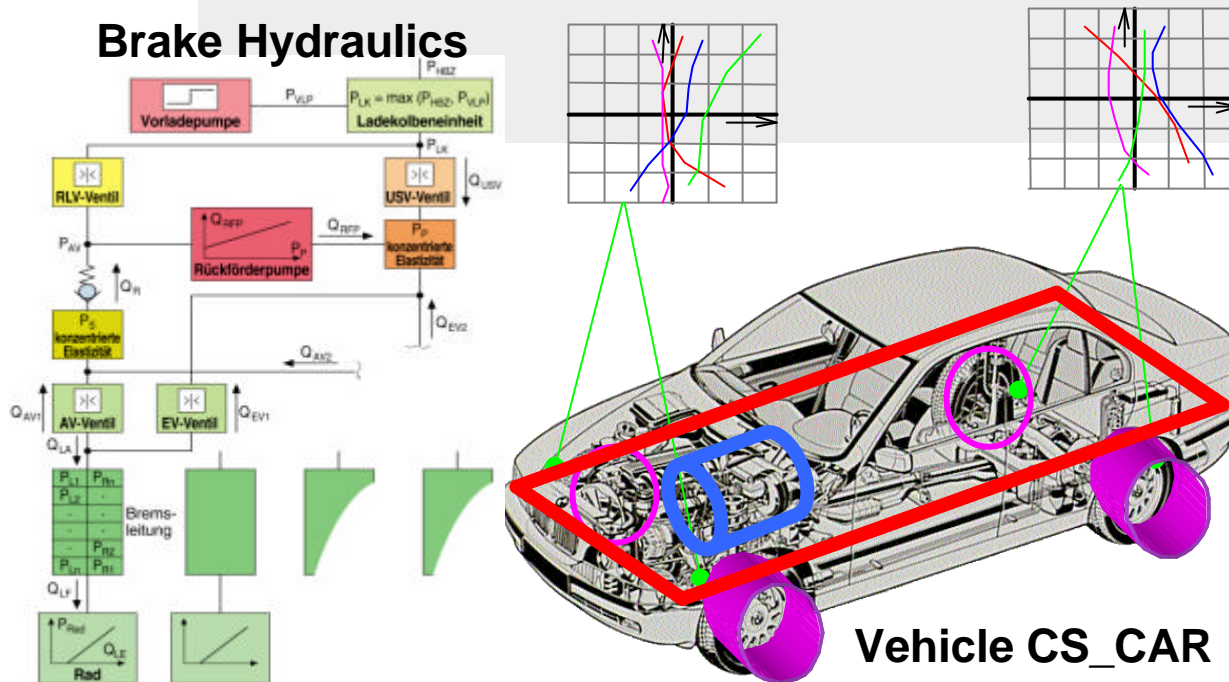




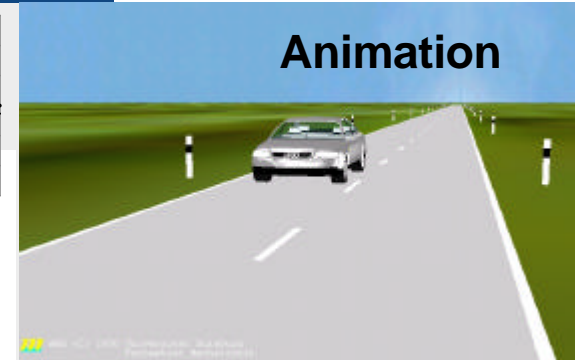
Realisation and Process CS_CAR with Components modelled by BOSCH-CS

BOSCH

Brake Hydraulics

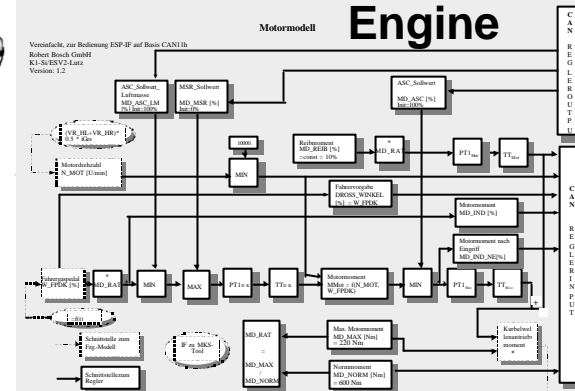


Vehicle CS_CAR

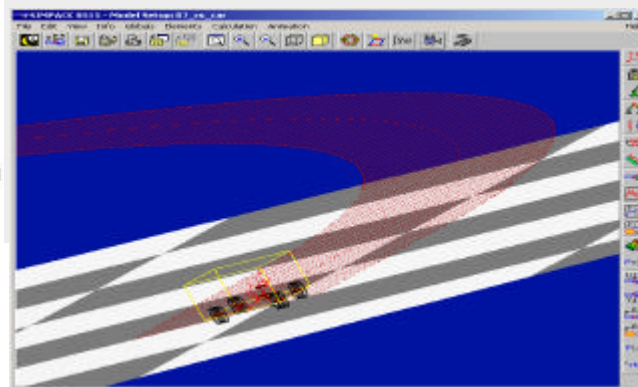


Animation

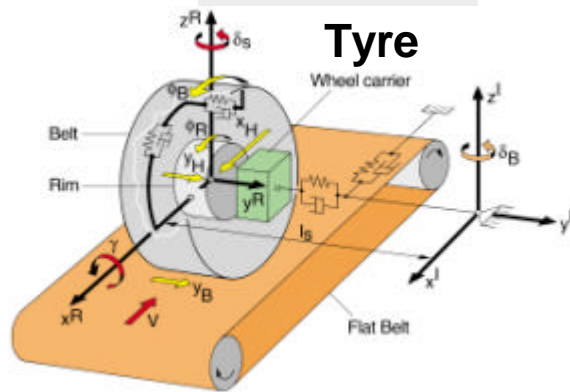
Engine



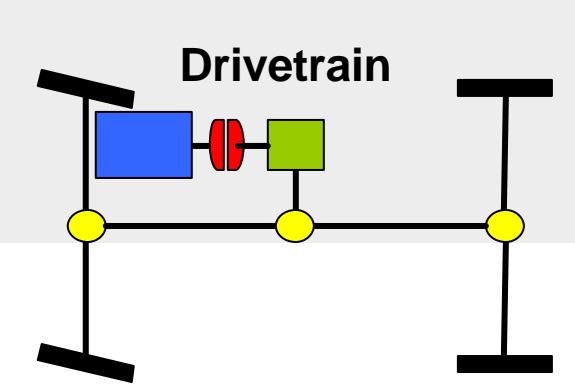
Environment

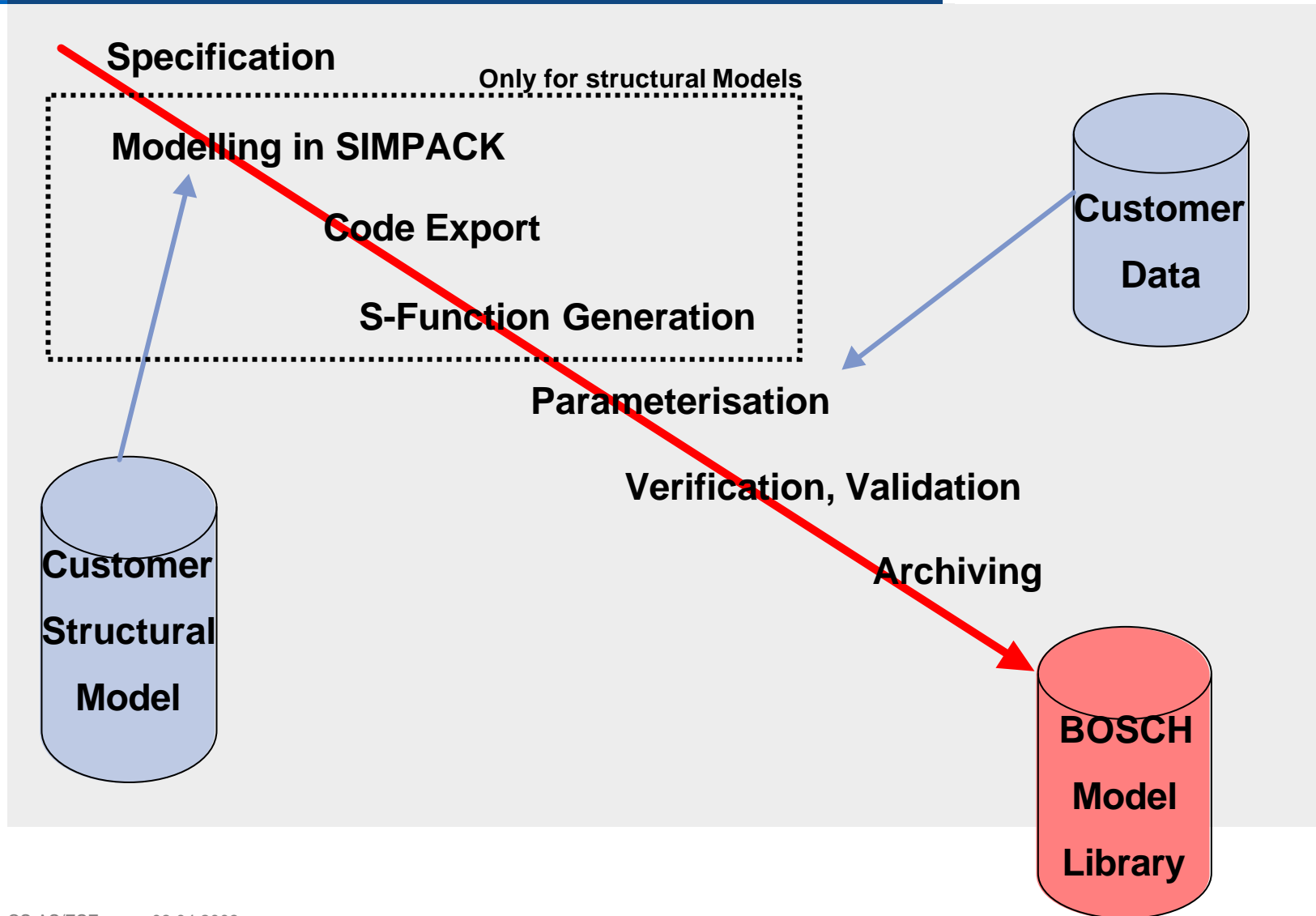


Tyre



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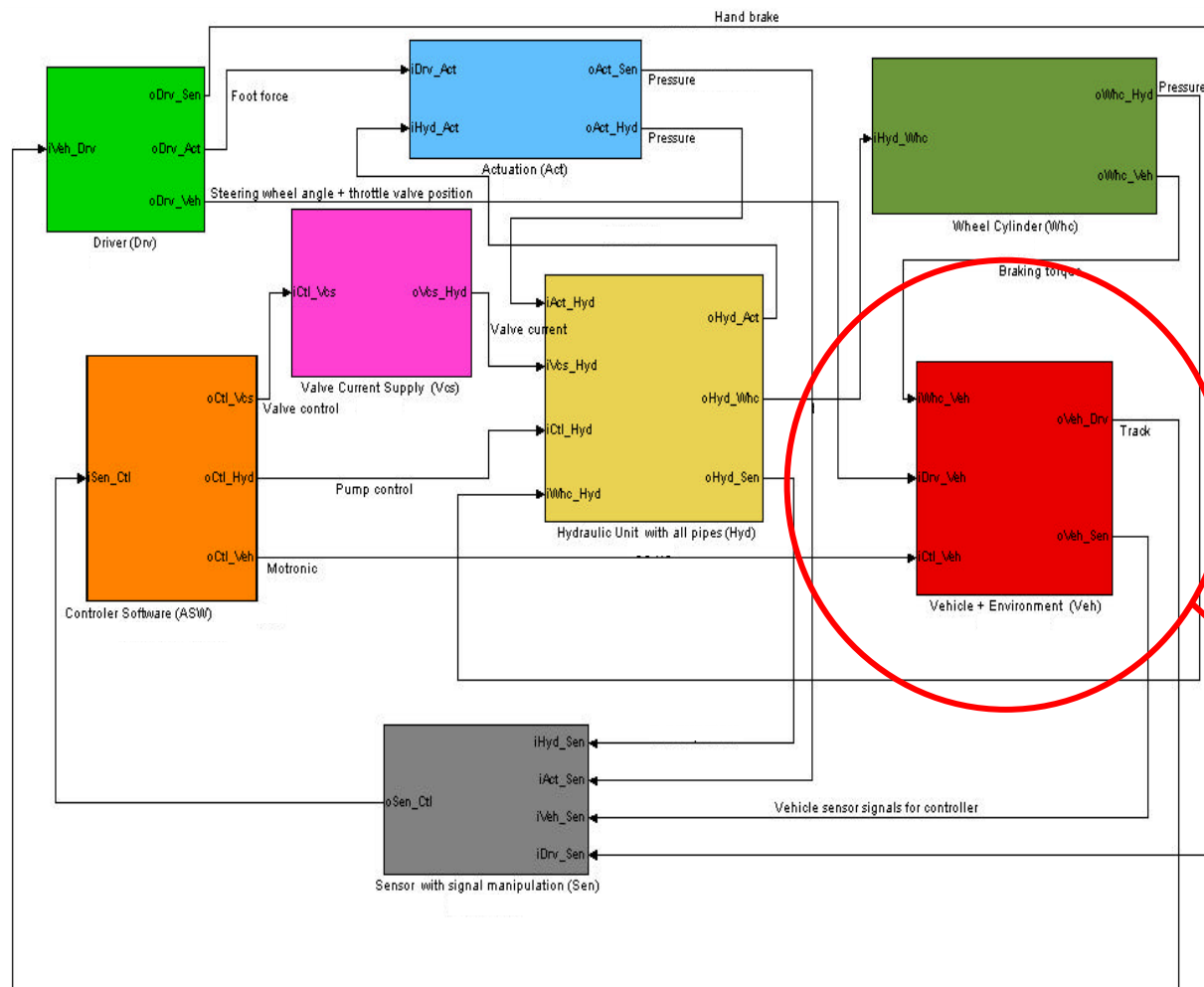
Using CS-CAR for several projects requires automised conversion of data sets to target tool

- **Development of tool specific converters**
- Adaptation to different data formats and number of input and output files
- Conversion of characteristic maps and curves for suspension kinematics
- Adaptation to transformation matrix parameters and direction of rotation
- Determination of conversion function concerning spring, damper and anti-roll bar
- Transformation of spring and damper data fields into global coord. system
- Conversion of tyre maps
- **Estimation formalisms for none available parameters**



Aspects:

- Feasibility Study
 - Fundamental questions
- MATLAB/SIMULink
 - used as platform
- Models of all components
 - all CS-Business Units engaged
- ESP Controller implemented to MATLAB/SIMULink
 - using ECU-Code
- **CS_CAR_1**
 - specified by BOSCH
 - developed by INTEC





Function and Projects

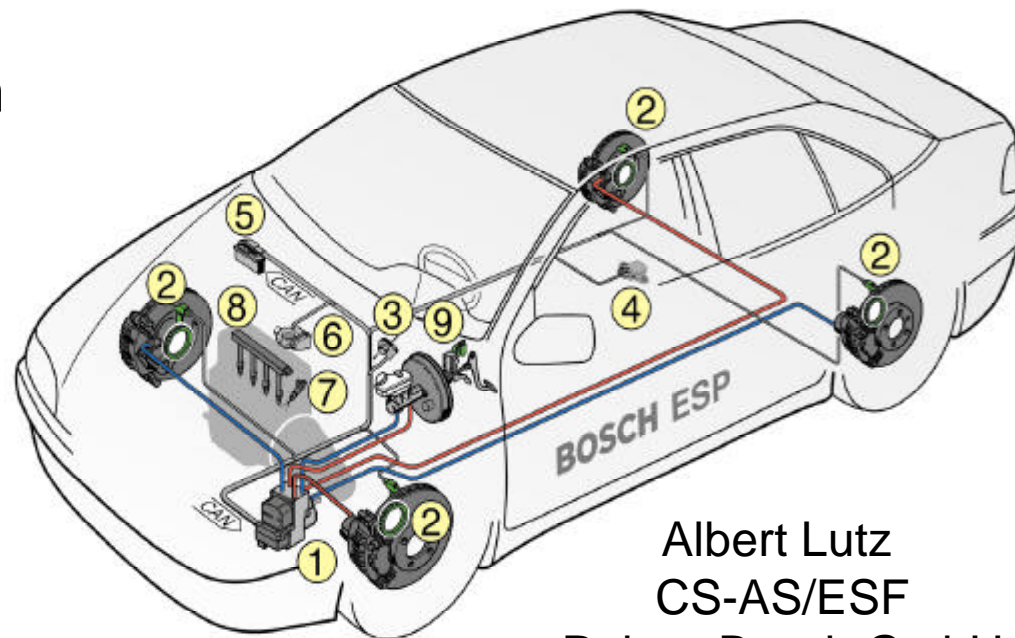
- Application in different pilot projects
- Build up of a model library for several projects
- Using elastokinematics
- Using structural axis

SW-Architecture, Environment

- Set up archiving and data base
- Documentation
- GUI



- Thank you for your Attention



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