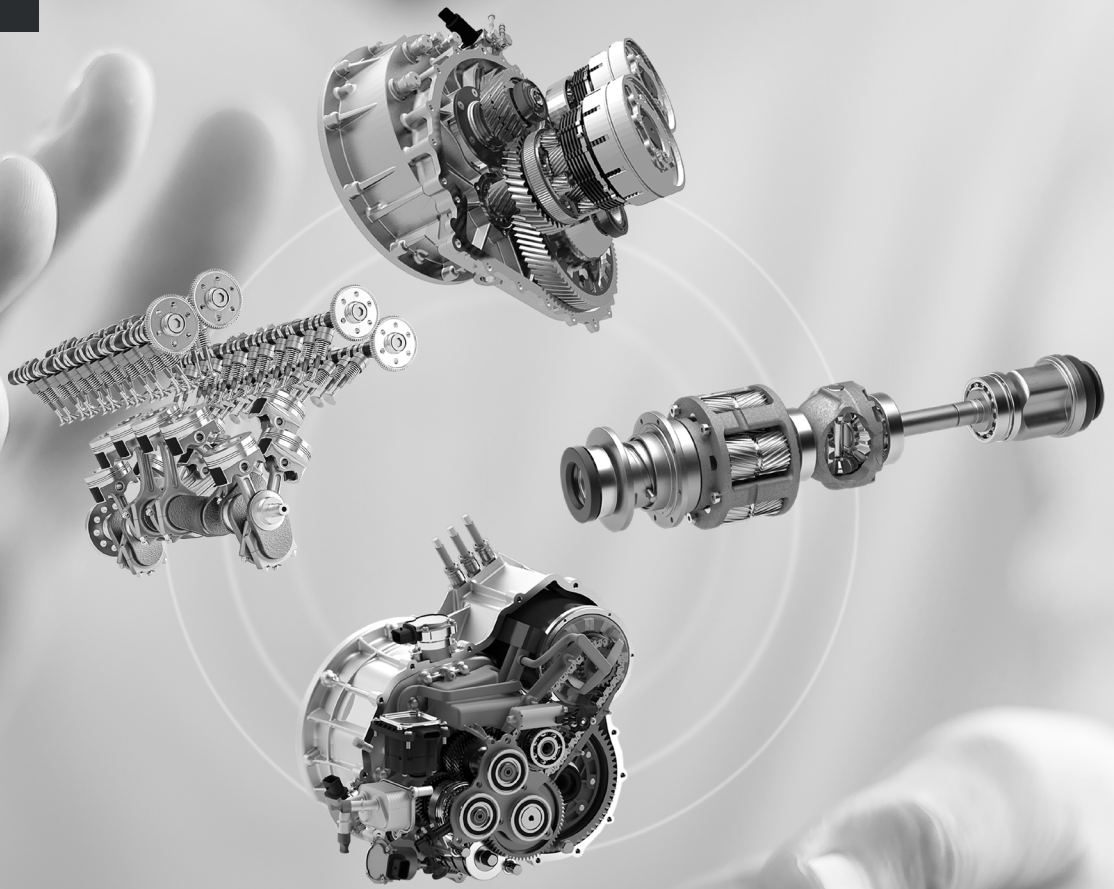


Software &  
Testing  
Solutions



**VIRTUALDYNAMICS™**

**Powertrain and electric drive dynamics  
in your hands**



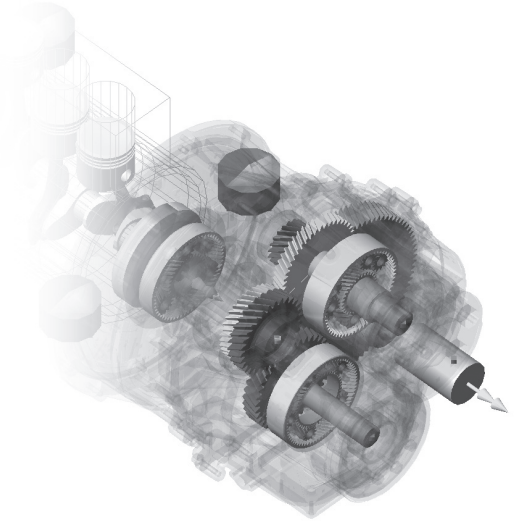
# VIRTUALDYNAMICS™

## Benefits at a glance

From project kick off to start of production

Virtual Dynamics™ helps to develop Powertrain and electric drive units.

- > Shorter timeline
- > Lower cost
- > Higher quality



## Innovative Key Features

From powertrain engineers for powertrain engineers

With the state-of-the-art GUI, solver and post-processing technologies, Virtual Dynamics™ is:

- > Easy to use in:
  - > Model set up and simulation
  - > Post-processing and result reporting
- > Intuitive in workflows, fitting powertrain engineers' needs
- > Integrated easily into existing processes
- > One for all:
  - > One environment for all analysis
  - > One model for all phases of the development
- > Proven technology: fast, reliable, and validated

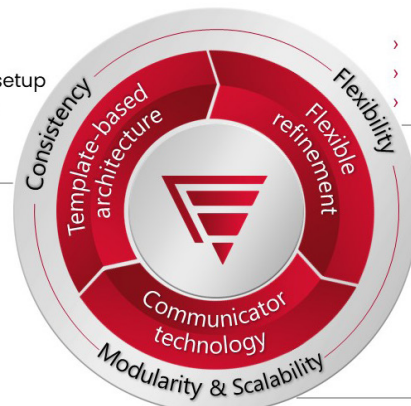


## Unique Technology

From component to system level

The unique communicator technology and the template-based architecture support modular modeling.

- > Easy model setup
- > Re-usability
- > Quality assurance



- > One environment
- > One base model
- > Diverse fidelities

- > Subsystems
- > Components
- > Assembly



# High quality simulation rapid low-cost powertrain and electric drive development

## Fields of Application

### E-mobility

Electric Motor



Hybrid



Range Extender



A48V HEV BSG



### IC Engine

Valvetrain



Timing Drive



Cranktrain



Piston Group



VCR

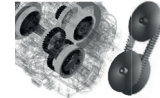


Turbocharger



### Driveline

Transmission



Testbench



Vehicle



A/C Compressor

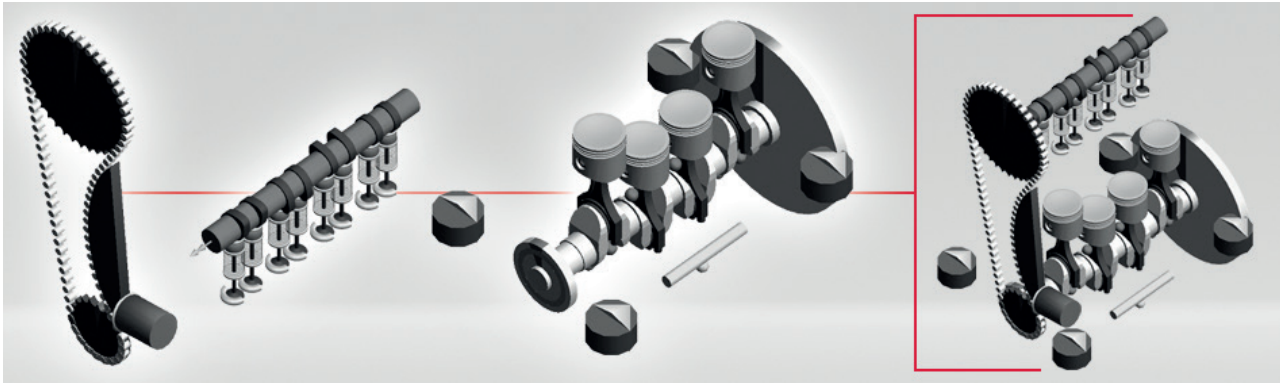


**VirtuAl Dynamics™** is an advanced simulation software for dynamic analysis of powertrain, driveline and their components. The software provides all building blocks needed to create dynamic models of engine, transmission, conventional, hybrid and electric drivelines.

**VirtuAl Dynamics™** uses the core technology of the world leading Multi-Body-Simulation Software Adams as numerical integrator, pre- and post-processing features. The template based architecture perfectly combines the advantages of single purpose software - ease of use and multi-purpose software - no limitations in extendibility.

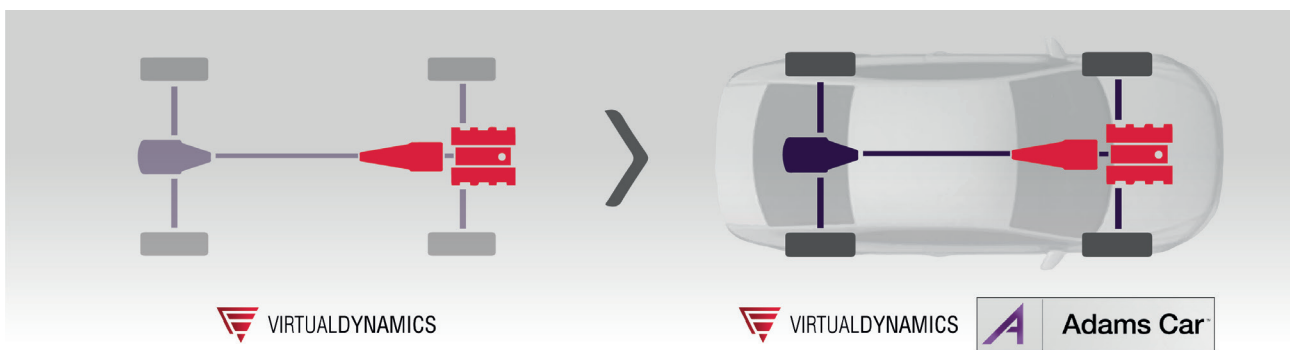
**VirtuAl Dynamics™** is a truly open system – featuring a powerful scripting language for task automation, the ability to customize the user interface, support for own solver routines and extending the modeling component library with own user-defined elements. Wizards automate and accelerate the creation of complex models like crank and drive trains. Models and corresponding data are organized in databases, strengthening data management even for global scale companies. Advanced generic 3D contacts plus fast analytical approaches for powertrain-specific contacts ensure a vast scope of application.

## From components to system level simulation



Virtual Dynamics™ is a template-based product which provides a modular modelling approach. A library of pre-made templates is provided with the installation and can be extended by user-created templates consisting of one or more interacting components. The templates provide the topology blue print to generate individual

systems, such as Cranktrain, Geartrain, Valvetrain, Timing drives etc., whose fidelity can be refined as necessary throughout the development process. A fully coupled and scalable model of the complete powertrain or any part of it can be easily created by assembling the systems using the communicator technology.



## From components to system level simulation

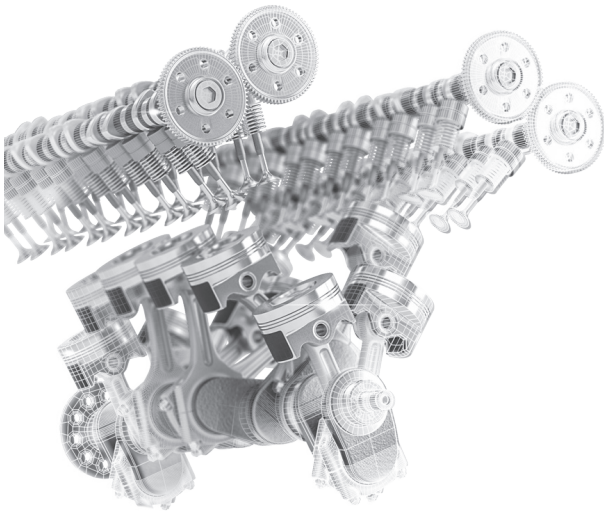
Virtual Dynamics™ and Adams Car share the template based architecture that perfectly combines the advantages of single purpose software - ease of use and multi-purpose software - no limitations in extensibility. Given the same template based

architecture and communicator technology Virtual Dynamics™ powertrain model can be directly coupled to Adams Car's vehicle model and this complete powertrain and vehicle system level model can be simulated dynamically.

# VIRTUAL DYNAMICS™

## provides specialized products following your tasks

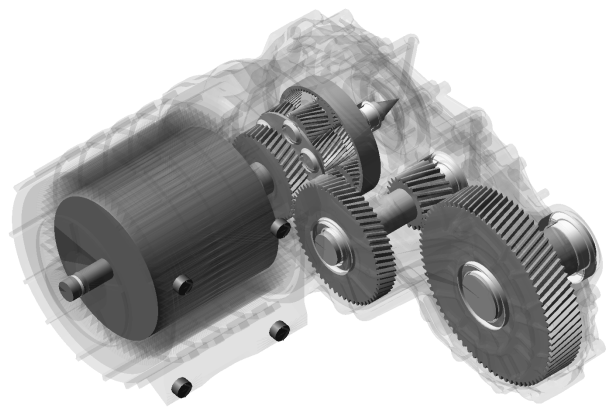
### Modelling and simulation of all parts of the engine



**Virtual Dynamics™** provides all building blocks needed to create dynamic models of engine including cranktrain, valvetrain, piston and rings, bearings, timing and accessory drive, and geartrain. It supports modelling of all conventional and novel engine designs including inline, V-type, VR-type, W-type or Boxer-type engines. The simulation can be run in a single or series of steady-state operations as well as in speed sweeps and ramp-ups. A built-in virtual testing feature allows estimating design parameters under critical operations. Diverse fidelity levels support development from concept to SOP with parametric (rigid, torsional, beam) or fully flexible modeling elements (FEA).

- > Cranktrain
- > Valvetrain
- > Piston and Ringpack
- > Timing and Accessory Drive
- > Geartrain
- > TEHD Bearing analysis
- > Load prediction
- > Firing order optimization
- > Friction and wear prediction
- > NVH analysis
- > Gas Force Wizard

### Complete tool set to build any type of gearbox and electric powertrain



**Virtual Dynamics™** is a complete tool set to build any type of gearboxes and transmissions to analyze them using either 2D or 3D advanced gear contacts and assemble them with other subsystems. Complete electric drive units (EDU) and electric powertrains can be modeled and analyzed dynamically with the dedicated e-Motor module in Virtual Dynamics™. Gears can be used to build gearboxes or transmissions but can also be part of multi-staged timing or accessory drives. External or internal, spur, helical, scissors, bevel, hypoid and planetary gear sets can be modeled along with transmission shafts, roller bearings and transmission casing using diverse fidelity levels including parametric rigid or fully flexible modeling elements.

- > Load prediction
- > Backlash studies
- > Tooth flank modifications
- > Fully flexible gears
- > Roller bearings
- > Transmission error and resulting speed irregularities
- > Gear whine & rattle
- > NVH analysis
- > Time domain solution



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