

# Intelligent Energy Management Contributes again to the Le Mans Success

22 percent less fuel was realized within a very short amount of time in the Audi R18 e-tron quattro racing car



## Support from ITK with:

- conception
- function and software development
- virtual validation
- functional integration

## ► The Challenge for Audi Sport

**New energy management system, short development time**

The winner of long-distance races is traditionally decided, for the most part, by engine performance, aerodynamics, and reliability. For the first time at the 24 hours of Le Mans race in 2014, not only the performance of the racing car was regulated, but also its energy consumption. In accordance with the latest stricter regulations, the new generation of the Audi R18 e-tron quattro uses significantly less fuel than its predecessor. For Audi Sport this meant, among other challenges, developing an intelligent energy-management strategy within a very short amount of time in order to cross the line even more efficiently in first place.

## ► The Audi Sport Solution

**The Audi R18 e-tron quattro's energy recovery system**

Audi Sport is using an intelligent combination of a conventionally powered back axle and an electrified front axle with the energy-recovery system for the new Audi R18 e-tron quattro. The controlling software which coordinates the energy exchange between the motor generator unit (MGU) and energy storage (a flywheel) is completely integrated into the engine electronics. Two drive shafts connect the MGU with the front wheels. When braking, the kinetic energy of the wheels is converted into electrical energy that flows into a new optimized flywheel accumulator. The recovered energy is then converted back by the MGU when the car accelerates and this then powers the front wheels. Audi Sport was supported during development by ITK Engineering AG as technical partner. ITK contributed its expertise during conception, function and software development, virtual validation and functional integration.

**Further****ITK services:**

- software developments
  - > drive chain
  - > hybrid system
  - > driving dynamics
  - > driver assistance systems
- verification and validation of controlling devices
- race track simulations

**The Implementation****Model-based development and virtual verification and validation make it possible**

The development of the energy management system was characterized by an extremely tight timetable. In order to be independent from the availability of the individual hybrid components (control unit, MGU, and flywheel), the Audi Sport engineers employed, in cooperation with ITK engineers, model-based methods. For the purpose of accelerating the processes they developed flexibly-modifiable virtual surroundings that can then be used on various development- or test platforms such as PCs, HiL and Rapid Control Prototyping Systems. The real system components were simulated using physical and behavioral models. This entailed the exact replication of the interfaces, electrical signals, the bus communication and the physical reciprocal effects. These could all be accessed via a virtual I/O interface.

**The Result****Audi Sport wins again at the 24 hours of Le Mans race 2014**

Due to model-based development methods and providing a virtual environment, ITK Engineering ensured that modifications to the functions could be made available and validated within a short period of time for all test platforms (MiL, HiL and component test bench) without needing time-consuming adaptations. The results of the virtual validation could be directly transferred to the real vehicle. Thereby reducing the development time of the new energy management system, according to the LMP1-regulation, as well as reducing the fuel consumption by up to 22 percent. Audi Sport, with a hybrid vehicle, demonstrated for the third consecutive time at the 24 hours of Le Mans race 2014 that it is the number 1 in motor sport.

**The Challenge:**

- development of a new energy management system in accordance with LMP1-regulations
- short period of time required for development

**The Solution:**

- model-based development
- virtual validation

**Advantages:**

- independent from the availability of components
- flexibility when replacing real parts

**Results:**

- development of the energy management system within a very short period of time
- 22 percent reduction in fuel consumption compared to predecessor model
- victory at 24 hours of Le Mans race in 2014



” *To win again in Le Mans in 2014 was the absolute greatest achievement for us. We also have to say a big thank you to ITK Engineering for its competent support. The ITK team excellently supported us at all times during the development of the new generation of the Audi R18 e-tron quattro with its expertise and commitment to the project.* “

**Chris Reinke, Head of LMP Audi Sport**