The amount of electronics in the vehicle has risen dramatically in recent years and is set to increase yet further in the future. Technical developments in semiconductor technology support ever more complex functions with the increasing integration density. The functionality of electronic systems in motor vehicles has now surpassed even the capabilities of the Apollo 11 space module that orbited the Moon in 1969.

Overview

Development of electronic systems
Not least in contributing to the success of the vehicle has been the continuous string of innovations which have found their way into vehicles. Even as far back as the 1970s, the aim was to make use of new technologies to help in the development of safe, clean and economical cars. The pursuit of economic efficiency and cleanliness was closely linked to other customer benefits such as driving pleasure. This was characterized by the European diesel boom, upon which Bosch had such a considerable influence. At the same time, the development of the gasoline engine with gasoline direct injection, which would reduce fuel consumption by comparison with intake-manifold injection, experienced further advancements.

An improvement in driving safety was achieved with electronic brake-control systems. In 1978, the antilock brake system (ABS) was introduced and underwent continual development to such an extent that it is now fitted as standard on every vehicle in Europe. It was along this same line of development that the electronic stability program (ESP), in which ABS is integrated, would debut in 1995.

The latest developments also take comfort into account. These include the hill hold control (HHC) function, for example, which makes it easier to pull away on uphill gradients. This function is integrated in ESP.
Many kinds of new functions appear in conjunction with driver-assistance systems. Their scope extends far beyond today’s standard features such as Parkpilot or electronic navigation systems. The aim is to produce the “sensitive vehicle” that uses sensors and electronics to detect and interpret its surroundings. Tapping into ultrasound, radar and video sensor technologies has led to solutions that play an important role in assisting the driver, e.g. through improved night vision or distance control.

**Value creation structure for the future**

The latest studies show that the production costs of an average car will increase only slightly by 2010 despite further innovations. No significant value growth for existing systems is expected in the mechanics/hydraulics domain despite the expected volume growth. One reason here being the electrification of functions that have conventionally been realized mechanically or hydraulically. Brake control systems are an impressive example of this change. While the conventional brake system was characterized more or less completely by mechanical components, the introduction of the ABS brake-control system was accompanied by a greater proportion of electronic components in the form of sensor technology and an electronic control unit. With the more recent developments of ESP, the additional functions, such as HHC, are almost exclusively realized by electronics.

Even though significant economies of scale are seen with the established solutions, the value of the electrics and electronics will increase overall (Fig. 1). By 2010, this will amount to a good third of the production costs of an average vehicle. This assumption is based not least on the fact that the majority of future functions will also be regulated by electrics and electronics.

The increase in electrics and electronics is associated with a growth in software. Even today, software development costs are no longer negligible by comparison with hardware costs. Software authoring is faced with two challenges arising from the resulting increase in complexity of a vehicle’s overall system: coping with the volume and a clearly structured architecture. The Autosar initiative (Automotive Open Systems Architecture), in which various motor vehicle manufacturers and suppliers participate, is working towards a standardization of electronics architecture with the aim of reducing complexity through increased reusability and interchangeability of software modules.