



The Automotive Industry R&D Challenges of the Future

Collaborative automotive R&D for safe,
energy-efficient and affordable mobility
of people and goods on European roads

Foreword

The European automotive industry employs more than 12 million people directly or indirectly, and is a major contributor to the economic wellbeing of our modern society. By providing efficient and affordable means for the transport of people and goods, the industry works to satisfy society's growing need for mobility and access to workplaces, shops, family and friends, leisure destinations, transport hubs and business sites.

This document presents the European automotive industry perspectives on the need for research in light of future challenges based on a vision of products and services for the transport of people and goods on the road network which provide improved safety, energy-efficiency, environmental compatibility and affordability. This is reflected in the fact that the industry will continue to respect its societal responsibilities for sustainable development while emphasising the need for pragmatic, cost-effective approaches, which ensure true sustainability and preserve economic well-being.

The recommendations for research and development described, concentrate on those areas, which the European automotive industry considers to be of highest priority and relate to delivering products and services for market launch in 2020 and market penetration in 2030. This document provides a framework for further elaboration and specification of the prospective automotive R&D programme, which will be initiated in the near future. The aim is to stimulate discussion with a view to defining key initiatives for future European research programmes, in which the European automotive industry will continue to contribute and participate fully.

The industry acknowledges the importance of the research work partly funded through national institutions within the EU and through the Framework Programmes of the European Commission in which the automotive manufacturers have played a key role from the outset. Over the coming years the industry foresees the need for an even greater level of collaboration and commitment of key players in order to meet the ever-increasing challenges of providing efficient, safe, environmentally friendly, diverse and affordable mobility and transport in a world faced with economic slowdown and scarcity of resources such as fossil fuels and raw materials.



A blue ink signature of Christoph Huss, written in a cursive style.

Christoph Huss
EUCAR Chairman
Vice President BMW Group
International R&D



A blue ink signature of Ivan Hodac, written in a cursive style.

Ivan Hodac
Secretary General
of the European Automobile
Manufacturers Association (ACEA)

Collaborative automotive R&D aims to contribute to a society that encompasses clean, secure and sustainable energy supply, safe and secure mobility and transport systems, sustainable mobility and transport at affordable costs, together with research, development and production in Europe.

To bring this vision to life the industry is highly active, participating in a wide range of collaborative European research and development projects.

The European Council for Automotive R&D (EUCAR) plays an important role in this context and provides the automotive manufacturers with a platform for identifying common pre-competitive European R&D. Using this platform, the industry has defined areas of research and development it considers to be of priority in order to deliver competitive products and services for potential market launch in 2020 and beyond.

The automotive industry envisions an accessible, diversified and affordable transport system for people and goods that works in an efficient way and is able to satisfy current and future mobility demands. The R&D topics in the area of Transport and Mobility include:

- Efficient traffic management and reliable real-time traffic information,
- Efficient use of all modes of transport through improved interfacing of transport hubs,
- Energy efficient transport of goods and improved logistics,
- Next generation driver assistance systems and assessment of their impacts.

The use of energy and other limited resources, and the protection of the environment, will form the cornerstones of tomorrow's Mobility and Transport systems. According to UN forecasts, 70 % of the world's population will live in urban areas in the future; as a result the focus of vehicle development, which for the last decades has concentrated on regulated exhaust emissions and its impact on air quality, is now shifting towards the combined targets of further reduced CO₂ emissions, higher energy efficiency and noise reduction. Moreover, the supply of energy carriers in sufficient quantity that meet the requirements of future powertrains and contributes to reduce CO₂ is of great importance to the automotive industry and society in general. Europe needs a clean, safe and sustainable transport system that combines efficient vehicles, secure and continuous energy supply and a clean environment in an optimal way by following a holistic approach. Such an approach requires the active involvement of all relevant actors, including the fuel sector, policy makers and vehicle users. For the automotive industry, the main R&D topics related to Energy and Environment have been identified as follows:

- Further improvement of combustion engines for greater efficiency,
- Diversification of energy sources,
- Diversified infrastructure for fuels and energy supply with limited energy carriers,
- Electrification of the drive train,
- Optimisation of vehicles,
- Co-operative systems and improved infrastructure (e.g. traffic control systems).

In the vigorous pursuit of a safer and more secure mobility and transport system, accidents and fatalities on European roads must be reduced further despite an increasing amount of kilometres driven. The safety and security of drivers, vehicles and goods can be improved significantly through integrated security products, services and policies that involve enhancement of infrastructure and road traffic regulation enforcement as much as by the introduction of new technologies. For the automotive industry, priority R&D activities in the area of Safety and Security include:

- Further development and integration of active on-board systems to support the driver and avoid or mitigate collisions,
- Co-operative systems for interaction and exchange of safety relevant information between vehicles and the infrastructure,
- Virtual systems for more efficient development of safety features, and ICT based security products and services.

Affordability, including the costs of operation and maintenance, is essential for sustainability. At the same time, in a world of ever-increasing globalisation and international competition, the automotive industry intends to maintain R&D facilities and production units in Europe in order to preserve European employment and to safeguard the quality of its products. In the area of Affordability and Competitiveness the R&D focus should be on:

- Virtual tools for improved product and manufacturing engineering,
- Optimal utilisation of materials and development of advanced high performance materials to improve the characteristics of components and systems,
- Resource-efficient, flexible manufacturing and optimisation of production processes for mass production of affordable products,
- Virtual tools for optimisation of energy use.

In general, the impact of low-cost solutions that are implemented rapidly will be higher than the impact of high-end solutions for which market penetration will take more time.

To address these current and future needs, EUCAR is ideally placed to provide European automotive manufacturers the platform to identify challenges and R&D needs, communicate and interact with European key stakeholders and initiate, monitor and support R&D projects.

The implementation of the recommended R&D activities in conjunction with sustained efforts to apply the output of R&D work in a timely manner is intended to satisfy society's demand for mobility and transport of tomorrow and to enhance the competitiveness of the European automotive industry.

With a population of more than 700 million and the potential for consistent economic growth, particularly in Central and Eastern Europe, mobility and transport in greater Europe over the coming years is set to rise.

As a result, the demand for passenger vehicles, delivery vans, trucks, and buses will continue to increase. Unless drastic, innovative and, above all, intelligent action is taken urgently, traffic congestion will reach excessive levels, especially around the economic centres of Europe, exactly where high quality transport and mobility are required for the economy.

In addition, road traffic safety, the availability of fossil fuels and the impact of the increase in transport and mobility on the environment will continue to cause severe concern in the coming decades.

The entire automotive industry fully realises the need for a comprehensive strategy to address future needs and challenges.

The automotive industry has a sound track record of innovative and affordable solutions and will maintain its efforts to make vehicles cleaner, quieter, more efficient, economical and safer.

The European vehicle manufacturers are the largest private investors in R&D in Europe, with an annual spending of 20 billion € in R&D, or 4 % of their turnover.

Highlights of the success of research and development activities include the unprecedented progress made in recent years in the area of active as well as passive vehicle safety.

Furthermore, the drastically reduced impact on the environment can be appreciated by considering, for example, that twelve modern trucks together make the same amount of noise as a single truck produced 35 years ago.

Another very important result of these achievements is that commercial vehicles as well as passenger cars are approaching the zero level as regards pollutant exhaust emissions.

Significantly, the fuel consumption and CO₂ emissions of cars have decreased on average by 14 % since 1995, despite the fact that the weight of cars has increased 16 % on average over the past ten to fifteen years through increasing complexity for improved comfort and safety and EU regulation.

A further important reduction in fuel consumption has been achieved in commercial vehicles and buses, through further optimisation of combustion processes and the application of electronic motor and transmission management. Compared with 30 years ago, a modern truck uses up to 30 % less fuel - for roughly the same performance.

Additionally alternative fuels offer high potential. However, to achieve a sustainable and secure energy supply the well-to-wheel analysis has to be considered. Fuel Cell Vehicles fuelled with hydrogen have a very high potential to contribute to future sustainable mobility with significantly reduced energy consumption and emissions.

Without exception, time is a key element in developing successful products and services. Technological developments are not accelerated simply due to the perception of urgency or new legislation. Groundbreaking technologies require significant time for development and testing in addition to considerable research efforts and enormous budgets.

The European automotive industry strives to be the most innovative in the world and sets global standards in production and vehicle technology. New technological possibilities will continue to play an important role in addressing the enormous challenges arising from the expected future demand for transport for people and goods in Europe. Identifying solutions which are truly effective and sustainable will require more, however, than just the development of cleaner engines, alternative drive concepts, better vehicle aerodynamics, lower rolling resistance, telematics solutions and advanced electronic vehicle systems. The effective, efficient and above all lasting mobility policy for the future requires the full involvement of all relevant factors and stakeholders. A structural solution can only

be found when all concerned parties and stakeholders join forces and take a new common path together.

Key stakeholders include:

European Commission for determining priorities and for selecting the R&D activities to support for the benefit of the European Union;

National and regional governments, which are responsible for national transport policies and strategic funding for R&D and major road infrastructure projects as well as the programmes for general and scientific education;

Road authorities, which manage traffic on the urban and interurban road network;

The energy supply industry and infrastructure owners, which need to ensure there is an adequate supply and infrastructure of fuels and other energy carriers for the future that is sustainable ecologically and acceptable politically;

The automotive industry, responsible for the development and manufacture of vehicles that are efficient, safe, environmentally friendly and affordable;

The suppliers of the automotive industry, which are co-responsible for developing and manufacturing vehicles;

Vehicle users, bearing in mind in particular that the choice and use of vehicles and driving styles have an extremely important impact on safety, traffic, fuel usage and consumption, noise and the environment in general;

Telecom and ICT industries contributing to seamless communication using different technologies and the development of open platforms for unimpeded information exchange between systems;

Road infrastructure research institutions that can contribute towards improved road design and road surface materials; and

Public transport operators responsible for optimising the public transport systems and making the most appropriate choices also in terms of vehicle procurement.

The purpose of this document is to:

- Highlight common R&D directions and priorities of the industry to meet the mobility and transport challenges of society and businesses in the future, and
- Initiate and engage in open dialogue with other key stakeholders associated with the road transport sector in order to launch the integrated approach for addressing the multi-faceted aspects of transport services and identify solutions that will enable totally sustainable mobility and transport of people and goods.

R&D investments and commitment of the European automotive industry is focused on topics related to the automotive key challenge areas that have been identified to be:

- Mobility and Transport,
- Energy and Environment,
- Safety and Security,
- Affordability and Competitiveness.

Mobility is the lifeblood of a modern economy. Road transport and mobility are indispensable to societal development, cultural activities and economic growth. However mobility also carries some risks: the possibility of damage to the environment, accident casualties, and delays and congestion. A key task of our time is to find sustainable solutions to meet future needs and concerns, and the industry will continue to respect its societal and environmental responsibilities in this context.

The importance of road transport to EU27 cannot be overstated. In 2006 approximately 83 % of passenger-kilometres were performed on the road (with a share of 75 % for passenger cars). Also in 2006, 73 % of tonne-kilometres freight was transported on the road (Source: European Commission, DG for Energy and Transport, Statistical Pocketbook 2008).

The need to transport people and goods in a manner that secures the safety of all road users, the sustainability of society with respect to resources and environment and the efficiency of traffic and transport operations is of paramount concern and importance to the European automotive industry.

Vision

Collaborative automotive R&D aims to contribute to an accessible, safe, diverse and affordable transport system for people and goods that works in an efficient way and is able to cope with today's and tomorrow's mobility demands.

Challenges

The challenges ahead are significant and complex. The trends in transport growth are in conflict with aspirations to limit global warming and climate change. Globally, it is anticipated that car ownership is set to more than double in 20 years or less, and truck transport and aviation will increase significantly.

The growing demand for mobility and transport on a road infrastructure, which is reaching its maximum capacity in many European towns and cities, is clear to see in terms of recurrent congestion and unpredictability of journey times. The susceptibility to network breakdown in the event of serious incidents is too common, particularly on urban and interurban roads. These manifestations have serious economic and social impacts on businesses and individuals.

Mobility, therefore, needs to be managed therefore in order to ensure accessibility in a cost efficient way, so that the huge benefits that road transport brings to society are not significantly compromised by the impacts on the environment, on people's health and safety, on the quality of life and on the efficient conduct of day-to-day business.

The current economic downturn, the rising cost of energy and raw materials, the need to meet societal needs for an efficient multi-modal transport system, and the policy to make full use of existing infrastructures before new roads can be justified, present formidable challenges to the automotive industry, which operates in a very competitive global market.

In conclusion, the European automotive industry needs to address these complex, and at times conflicting, challenges head on, in order to provide viable solutions and safeguard its role as a major player in global automotive market thereby maintaining its position as employer of many people in Europe.

Approach

Vehicle-to-vehicle and vehicle-to-infrastructure communication is expected to become a powerful means to improve road safety and to reduce congestion. Further research on co-operative systems is needed in order to enable evolution from basic conceptual models and prototypal components to integrated systems that enable functional testing and validation, followed by the development and deployment of a common European architecture for co-operative systems.

Extensive testing of this common European architecture for co-operative systems through Field Operational Trials (FOT) will ensure inter-operability of all different applications of vehicle-to-vehicle and vehicle-to-infrastructure communication for a safe and efficient mobility of the future.

To address these goals, a concerted action of the relevant stakeholders is needed at the European level, involving OEMs, automotive and technology suppliers, road and traffic operators, service providers and public authorities. An approach is required that allows the timely dissemination of safety messages to specific vehicles and guarantees European inter-operability thus avoiding the creation of multiple solutions for specific applications.

OEM R&D Topics

The industry sees the need for greater co-operation and integration in other related mobility and transport areas. The following R&D topics reflect the industry's priorities:

Efficient traffic management and reliable real-time traffic information

- Reliable, real-time multi-modal travel and traffic information that can be accessed anytime and anywhere, and
- Development of open ITS frameworks that allow for

system compatibility and inter-operability that lead to efficient area-wide traffic management within urban areas and across jurisdictional boundaries to interurban roads and adjacent urban areas.

Next generation driver assistance systems and impact assessment

- Development of ITS-technology platforms that facilitate in-vehicle systems integration, e.g. vehicle-to-vehicle communication, vehicle-to-infrastructure communication,
- Impact assessments of advanced driver assistance systems, and
- Impact assessment of advanced active on-board driver support on traffic efficiency and traffic flow.

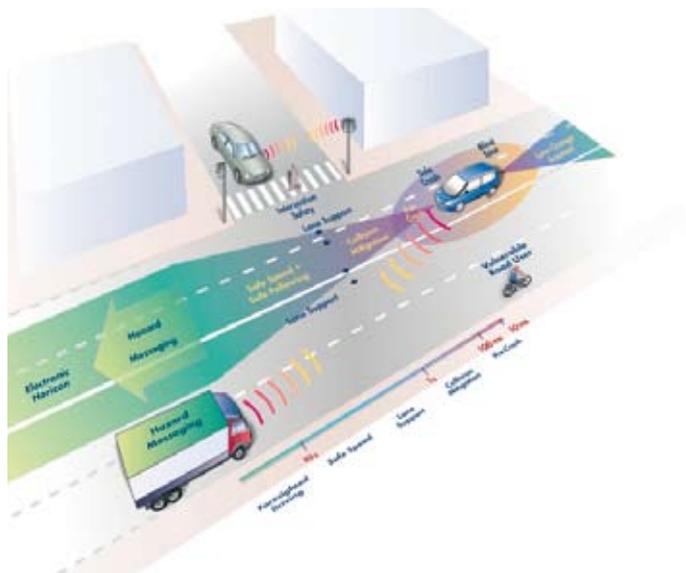


Figure 1:
Co-operative systems –
Vehicle-to-vehicle and vehicle-to-infrastructure communication



Figure 2: Efficient and flexible use of vehicles – Car rental concept for urban areas.

Efficient use of all modes of transport through improved interfacing of transport hubs

- Improved interfacing of transport infrastructures and services for different transport modes (road, rail, water-borne, and air) and increased accessibility to improve co-modality, and
- Efficient car-use, advanced forms of car sharing in urban areas through new ICT-approaches.

Energy efficient transport of goods and improved logistics

- Development of complementary modularisation principles and architectures for goods carriers and vehicles in order to facilitate an improved transport and energy efficiency, and
- Development of open ITS frameworks for goods logistic systems and cost and time data bases for different modes.

The use of energy and other limited resources and the protection of the environment play an important role in Mobility and Transport. Whilst in the last decades the focus has been on reducing exhaust emissions and their impact on air quality (Figure 3), it is expected that in future, when 70 % of the world's population will live in urban areas (Source: UN 2008, World Urbanisation Prospects – The 2007 Revision), R&D efforts will shift towards further reduction of CO₂ emissions, higher energy efficiency and lower noise pollution. Moreover, the secure supply of sufficient quantity and quality of fuels and other energy carriers to meet the requirements of future powertrains in order to contribute to reduced CO₂ emission is of great importance and interest to society and the automotive industry as a whole.

Vision

Collaborative automotive R&D aims to contribute to a clean, energy-efficient, safe and sustainable transport system complemented by energy-efficient vehicles, adaptive and responsive traffic control and management systems and infrastructure, as well as an effective energy supply infrastructure.

Challenges

Society and the economy in general, and the industry in particular, have to deal with increasing demand for fossil fuels, from Europe, the U.S.A. and from key emerging countries such as China and India. On the other hand the availability of petroleum crude oil is limited. For the automotive industry, that means to be prepared for a future of multiple energy carriers and the end of dependence on crude oil as the single most important source of energy for the industry.

Another challenge is the need for further reductions of CO₂ emissions, just as numerous technological innovations in the internal combustion engine and exhaust systems (filter and converter technologies, optimisation of combustion processes, etc.) have already yielded significant benefits.

Finally, the industry needs to ensure that new propulsion technology will be cost efficient.

Approach

The issues of energy supply and protection of the environment can be addressed by a multi-level approach that includes:

- Further improvement of combustion engines for efficiency,
- Diversification of energy sources (conventional fuels, biogas, hydro treated vegetable oil, biomass to liquid, biodiesel, hydrogen, electricity, etc.),
- Diversified infrastructure for fuels and energy supply with limited energy carriers,

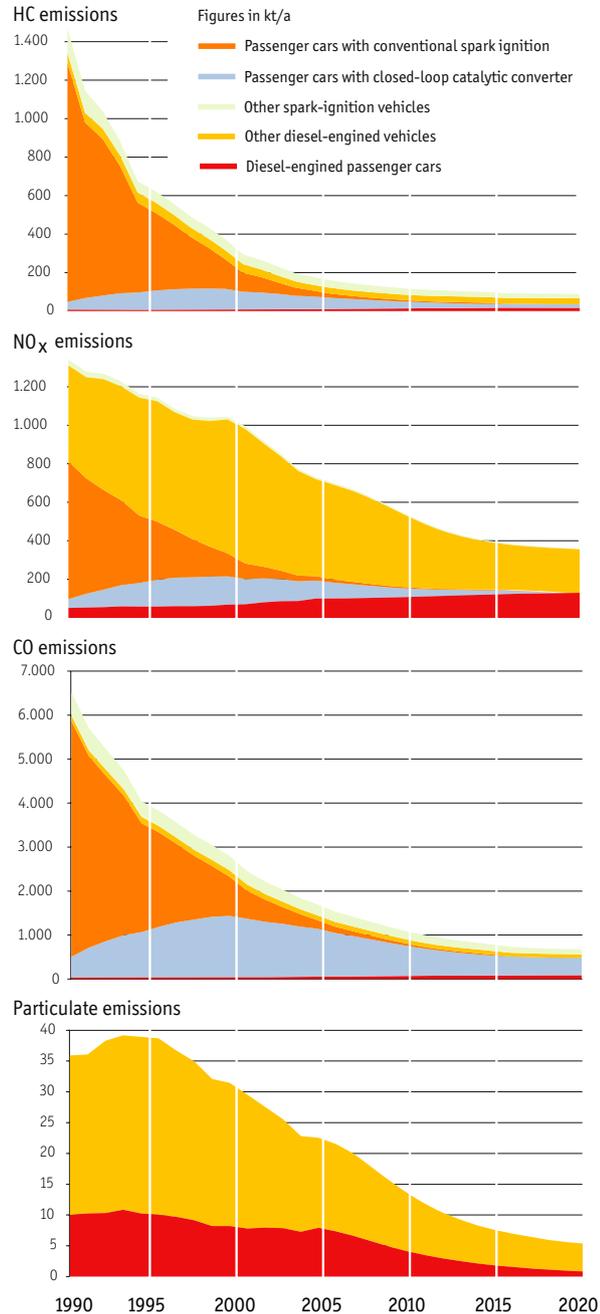


Figure 3: Reduction of emissions

- Electrification of the drivetrain (hybrid system, electric drive train, hydrogen and fuel cell propulsion, energy storage system),
- Optimisation of vehicles (improved energy management, energy recuperation, lightweight structures, new vehicle concepts), and
- Co-operative systems, improved infrastructure (e.g. traffic control systems) and eco-driving in an integrated approach with participation of all relevant stakeholders.

Powertrains for different energy sources, as well as storage and distribution systems, have to be developed and adapted further. Each of these steps (primary energy base, energy carriers, power trains, storage and distribution) has to be balanced against the environmental, social and ethical demands of society in order to avoid, for example, unfair competition between food and fuel for arable land.

To achieve success, effective actions need be taken urgently by adopting an integrated approach from the key stakeholders: energy industry, automotive industry, national governments and the European Commission. With respect to propulsion, an innovative powertrain scenario is needed

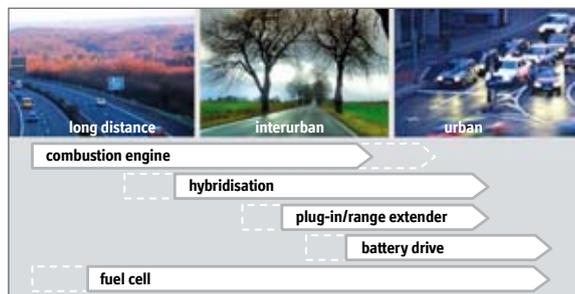


Figure 4: Application areas of conventional and future propulsion systems.

which is based on specific needs for mobility. Hence, different efficient and affordable propulsion technologies must be developed.

OEM R&D Topics

The European automotive industry is a leader in R&D and CO₂-cutting technologies. Corresponding innovations in direct diesel and gasoline injection, optimised transmission systems, stop-start systems with energy-recovering brakes and hybrid technology are some of the recent developments... As a result, 100 cars today produce roughly the same amount of pollutant emissions as 1 car in 1970 (Source: ACEA 2008, Cars, Trucks and the Environment).

Looking towards the 2030 horizon and in order to further reduce energy consumption and better protect the environment in Europe, the automotive industry sees a current need for research and development in:

Further improvement of conventional powertrains

- High efficient combustion engine technologies allowing significant reduction of CO₂,
- Improved exhaust after-treatment technologies, and
- Optimisation of the overall system: "efficient engines – efficient fuels".

Diversification of energy sources

- Development of CO₂-neutral fuels from renewable raw materials (conventional fuels, biogas, hydro treated vegetable oil, biomass to liquid, biodiesel, hydrogen, electricity, etc.) and strategies for their use (no adverse effects for food and feed production and markets).

Diversified infrastructure for fuels and energy supply with limited energy carriers

- Development of the energy supply network for fuel cell and electric vehicles including hydrogen, and
- Limitation of energy carriers in order to limit the complexity of filling stations.

Electrification of the drivetrain

Electrified drivetrains will play a key role combining new propulsion technologies (hybrid system, plug-in, electric drive, hydrogen and fuel cell). This leads to the need for research in the following fields:

Hybrid system

- New electric motors and recuperation technologies for hybrid systems, optimised for different application scenarios e.g. plug-in and range extenders for urban and mid-range traffic.

Full electric drivetrain

- Key technologies for all electrical drive and fuel cell systems,
- Advanced electric motors (efficiency, light weight materials, new motor types),
- Improved power electronics, and
- Electromagnetic compatibility.

Hydrogen and fuel cell propulsion

- Improved robustness and durability of the fuel cell system,
- Reduced cost of fuel cell components, including on-board hydrogen storage,
- Manufacturing technologies for all ground-new components like fuel cell stacks, and
- Material research for fuel cell stack components and hydrogen storage.



Figure 5: Electrification of the drivetrain
- The path to sustainable mobility

Energy storage systems

Two major roadmaps should be developed:

- Further improvement of Lithium Ion based battery cell systems,
- Basic research on new open cell systems technology for highest energy density with focus on electrochemistry of battery cells and storage capacitors (packaging, crashworthiness, durability, reliability, adoption to different vehicle concepts) with an appropriate level of safety.

Optimisation of the vehicle

- Energy management,
- Energy recuperation,
- Light weight structures (high-strength steel, aluminum, plastics, compound materials), and
- New vehicle concepts required for electric propulsion technologies.

Road safety is an essential element of sustainability in mobility and transport. The number of casualties on European roads has halved in the past three decades, while traffic has tripled (Source: European Commission, European Road Safety Action Programme, 2003). The European automotive industry has contributed significantly to the safer use of roads and safer vehicles through continuous improvements in active and passive safety measures.

Further improvements in road safety require an integrated approach involving all relevant actors: policy makers, infrastructure designers and engineers, road users and vehicle manufacturers.

Apart from the inherent safety risk of any road transport due to complex traffic situations, there is an increasing security threat on European roads. Drivers, vehicles and cargo run the risk of falling prey to criminal activities on the road. For commercial transport in the European Union, the total loss of value caused by theft of cargo and/or freight vehicle is estimated to be more than 8.2 billion € per year. If the loss value is related to the number of loaded trips, a value of some 6.7 € per trip results (Source: NEA, Organised Theft of Commercial Vehicles and Their Loads in the European Union, published by European Parliament, Brussels, 2007).

Vision

The automotive industry envisages an ongoing evolution towards a safe and secure mobility and transport system through an integrated approach. Accidents and fatalities on European roads shall be further reduced despite an increasing number of kilometres driven.

The security of drivers (in particular truck drivers), vehicles and goods shall be improved significantly through integrated and interoperable security products and services. ICT will continue to play an important role to fulfil this vision.

Challenges

Until now efforts of the industry have focused on passive and active safety systems on board the vehicle.

Passive occupant safety systems such as structural energy absorption, on-board protection and containment systems have reached a level of performance that cannot be significantly improved without additional cost and weight, thus decreasing affordability and reducing vehicle efficiency. Instead, the continuing development and introduction of active in-vehicle systems will enable further safety benefits, both for drivers and other road users.

The next breakthrough in traffic safety requires an integrated approach to create co-operative systems using Information and Communication Technologies (ICT). Enhanced communication, interaction and co-operation of driver, vehicle and infrastructure are prerequisites for further significant improvements.

In this framework, Intelligent Transport Systems (ITS) should support and interface with in-vehicle safety systems to exchange information and reinforce operational strategies in order to optimise safety goals.

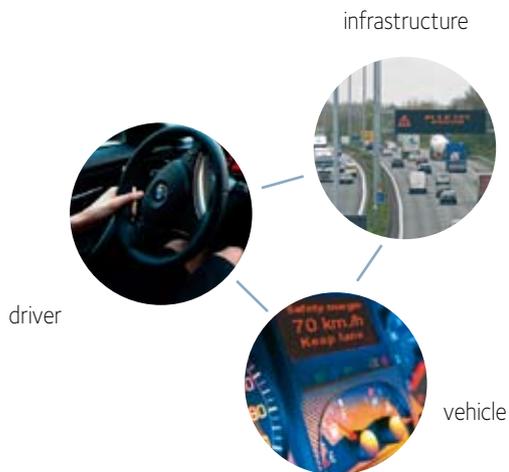


Figure 6 – An integrated approach to safety

On-board functions controlling vehicle dynamics, supplemented by monitoring of vehicle position in relation to other vehicles and information from infrastructure or broadcast systems on road and traffic conditions, have the potential to prevent critical situations by supporting the driver with information and even enable mitigation and correction for drivers' errors or inattention.

Real time driver information provided by on-board systems, interconnected vehicles and via roadside infrastructure may lead to more responsible and compliant driver behavior and reduce journey stress. Driver assistance functions designed to mitigate the impact of accidents will prove to be key to achieve improved safety within a new trade-off between passive and active safety.

Whilst the safety of vehicle occupants and vulnerable road users can be improved by introducing the new technologies which the automotive industry are currently developing, good design of the road infrastructure (openness and lighting of intersections and pedestrian crossings) and education, for example of vulnerable road users regarding traffic regulations and systems designed for their safety, are also vital.

The increase in crimes against private and goods vehicles has led cargo fleet owners, transport industry, insurance companies and private motorists to seek new ways of protecting their assets, lowering the risk to crime as well as ensuring the tracking of the assets in case of a crime. Better theft protection has shifted the danger from breaking into vehicles to hijacking, thus putting the driver at additional risk.

OEM R&D Topics

The European automotive industry has contributed significantly to the safer use of roads and safer vehicles through continuous improvements of active and passive safety. Collision mitigation systems (e.g. airbags, pre-tension of safety belts and energy absorbing car bodies) have been developed and successfully introduced into the market. Active safety systems like electronic stability control, collision warning systems, adaptive cruise control and lane departure warning systems support the driver on European roads of today.

Further reduction in serious and fatal accidents on European roads cannot be achieved with improvements to vehicle design or the deployment of in-vehicle telematics alone. To successfully deliver safe and sustainable mobility, an integrated approach is needed that takes into account the driver, vehicle manufacturers, road infrastructure designers, owners and operators, ICT service providers and policy makers.



Figure 7: Effectiveness of active safety measures, e.g. ESP

With the high level of safety already built into the vehicles of today, the automotive industry will concentrate its research and development efforts on preventive safety systems of the future. In particular R&D is needed in the fields of:

Further development and integration of active on-board systems to support the driver and avoid or mitigate collisions

- Advanced collision avoidance and mitigation systems with co-operative lateral and longitudinal support systems,
- Semi-autonomous vehicle functions,
- Human Machine Interface (HMI) integration and flexibility, and
- Low cost pre-crash systems including impact assessment.

Co-operative systems for interaction and exchange of safety relevant information between vehicles and the infrastructure

- Driver safety information with vehicle-to-vehicle and vehicle-to-infrastructure communication systems,
- Intelligent vehicles and roads in a co-operative safety concept,
- Sensors and actuators (low cost, reliable, sensor-fusion etc.),
- Safety impact assessment methods,
- Improved facilities for the safe and secure transport of goods on the road network including vehicle tracking and monitoring, safe resting places and appropriate routing, and
- Post-crash communication.

Virtual systems for more efficient development of safety features

- Human body modeling for computer simulation of advanced protection systems,
- Virtual safety testing, and
- Driver behaviour modeling.

ICT based security products and services

- Further development of integrated and interoperable security products and services.



Figure 8: Visualisation of biofidelic human body modeling used for simulation of advanced protection systems

Fundamentally the automotive industry is oriented towards mass-market production. In this sense the affordability and diversity of vehicles and the competitiveness of the industry are closely linked.

Competitiveness in the industry's home market means offering European customers affordable products they want to own. Europe intends to stay a world-class high volume automotive design, engineering and production region and consequently safeguard existing jobs and create new employment opportunities.

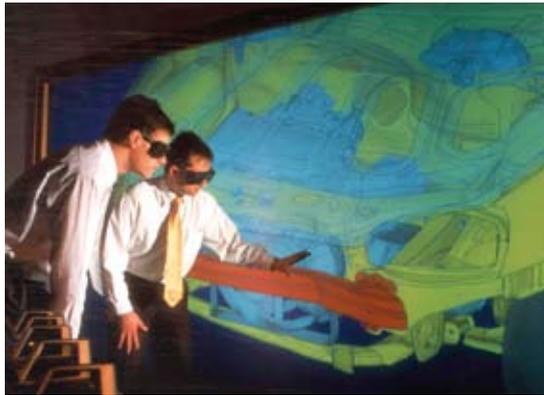


Figure 9: Highly educated and skilled employees are vital for the competitiveness of the European automotive industry

Vision

European mass produced road vehicles must continue to be affordable and of world class standard in an ever-increasing competitive global market. This will be achieved through innovative engineering and manufacturing/production processes, the efficient use of existing and new raw materials, as well as through the retention of R&D, design and production skills and facilities in Europe.

Challenges

The ever-increasing demand for raw materials is leading to frequent market price rises and fluctuations and uncertainty in the flow of supply. The need to develop and adopt energy and material efficient processes and production has never been greater.

The environment of the automotive industry has changed significantly over the past decades due to technological advances, automation of production, regulation and increasing competition from outside Europe. The optimisation of production efficiency and costs remains a challenge.

The availability of raw materials will remain a central challenge of the mid-term future. Besides forecast shortages in the oil and gas sectors, demand for materials like platinum, nickel, steel and copper will have significant upward impact on prices. From the aspect of competitiveness, the challenge for the industry will be how to use rare raw materials in the most efficient way so as to continue production and avoid supply crises due to continuing increasing demand.

The trends towards development of more efficient and cleaner vehicles should be sustained by a parallel effort to decrease energy consumption in production and recycling processes.

The high cost of employment and a significant ageing population in Europe pose further challenges to the automotive industry especially concerning ergonomic design and manufacturing.

The automotive industry requires highly educated and skilled employees for the design and development of appealing, competitive and affordable quality products, which comply with emissions and safety legislation. In this context an R&D environment that supports the world leading technical edge of the automotive industry in Europe is a necessity.

OEM R&D Topics

Future material developments and manufacturing processes are essential key factors of vehicle technology innovation.

New materials and new processing technologies serve as basis of increased competitiveness by increasing the perceived value of the vehicle while maintaining or reducing cost and investment.

Adequate manufacturing systems including new forming, joining, assembly, surface protecting and painting processes are necessary. Progressive R&D allows to profitably use new materials coming from basic and industrial research and to overcome technical constraints and economic boundaries.

The automotive industry will focus its R&D activities not only on technical solutions to specific challenges of vehicle development but also address production processes to achieve improvements and efficiency from the extraction of fuel and raw materials to production of vehicles in an efficient and environmentally friendly way at affordable prices.

The automotive industry intends to meet these challenges by research and development in the fields of:

Virtual tools for improved product and manufacturing engineering

- Virtual tools and methods as well as application of virtual manufacturing engineering to improve time to market, supplier integration and distributed engineering footprint.



Figure 10: Planning for the future in 3D with virtual manufacturing

Suitable materials

- Optimal utilisation of raw materials and their re-use at the end of life,
- Exploration and use of sustainable alternative materials to replace depleted and costly existing ones (e.g. biomass as a raw material for the production of natural polymer systems),
- Development and integration of adaptive material systems into vehicle structures for intelligent optimisation of vehicle comfort and performance,
- Development of advanced high performance, multi-functional materials and surfaces and improvement of enabling technologies to innovate the design of all main vehicle modules and key parameters (e.g. next generation of low density steel alloys and light metal alloys with improved properties and large scale application characteristics), and
- Performance improvements of components and systems (reduced weight and power consumption, higher efficiency), enabled by intelligent materials with emphasis on the integration of nanostructures and nanotechnologies into macro-systems.

Ecological, resource-efficient, flexible manufacturing and optimisation of production processes for mass production of affordable products,

- Next generation manufacturing processes and architecture concepts, including ICT manufacturing,
- Extended manufacturing enterprise concept including demand monitoring and connected logistics systems (Innovative organisation of manufacturing including the supply chain.),
- Flexible manufacturing processes for combined low and high volume production,
- Possible change of vehicle platform within the same production line,
- Improved design and production principles and processes through an integrated design approach (intelligent combination of existing and new functions) to fulfil the needs related to new vehicle systems,
- Advanced and adaptive manufacturing processes and strategies covering all aspects of product and process lifecycle, integrated with flexible and complex production systems for multifunctional and high performance materials at competitive costs and high quality level, and
- Improved implementation of research results in cost-efficient large-scale production processes to achieve a favourable time-to-market.

Virtual tools for the optimisation of energy expenditure

- Energy optimisation tools for the overall vehicle life cycle, from raw material extraction to the final product recycling. The automobile manufacturers intend to improve the energy-efficiency of all phases of vehicle production.

The European automotive industry is a global technology leader, largely thanks to its innovative research and development. In fields where there are common interests and non-competitive advantages, the manufacturers work collaboratively so as to:

- Combine forces in a targeted way to devise strategies and solutions for future challenges,
- Develop and agree common frameworks that can serve as a basis for future standards (e.g. standards for new fuels),
- Gather the critical mass and necessary momentum for faster implementation of R&D results, and
- Share R&D costs.

European trans-national collaborative R&D efforts are amongst others carried out under the auspices of the European Council for Automotive Research and Development (EUCAR), focusing on pre-competitive issues of mutual interest. The automotive manufacturers founded EUCAR in 1994 as a platform and body to enable and support collaborative R&D in Europe.

EUCAR identifies future challenges and automotive R&D needs, communicates and interacts with European key stakeholders and initiates, monitors and supports R&D projects. The outcome affects innovations that are introduced to markets in the next 10 to 20 years.

EUCAR involves other stakeholders, vehicle users and customers, where necessary, in order to define a common vision, goals and road maps for innovative technologies.

The collaborative R&D through EUCAR provides automotive manufacturers with a means to demonstrate their commitment to pragmatic, cost-effective approaches, ensuring sustainability while preserving the economic well-being of Europe.

The direction of the collaborative R&D projects underlines the paramount importance EUCAR attaches to ensuring that solutions developed today prove to be sustainable in the long term, especially for the generations that will become the vehicle users of tomorrow. Correspondingly education and training, regarding vehicle use and driving styles, for example, which influence traffic safety, fuel usage, and the environment, will form an increasingly important aspect of automotive manufacturers' efforts. The industry will help to promote the culture of safe and efficient driving while enhancing awareness of society regarding the new technologies available and under development through the collaborative R&D activities supported by EUCAR.

These R&D activities in conjunction with stimulating the implementation of R&D results provide for society's demand for mobility and transport of tomorrow and enhance the competitiveness of the European automotive industry.

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