HTSM ROADMAP AUTOMOTIVE 2016 - 2020

1. SOCIETAL CHALLENGES AND ECONOMIC RELEVANCE

Societal challenges addressed in this roadmap [1]

The European Road Transport Research Advisory Council (ERTRAC) is the European technology platform which brings together road transport stakeholders to develop a common vision for road transport research in Europe. ERTRAC has set out several key ambitions in its Strategic Research Agenda 2010 (SRA 2010), namely; the European road transport sector should be 50% more efficient by 2030, CO_2 emissions will reduce significantly (80% cars, 40% trucks) and new fuels will enter the market, and transport schedules (mobility) will be 50% more reliable and traffic safety will improve significantly. This roadmap is prominent for European policy deployment and automotive research in the coming decade.

The European automotive manufacturers cooperate under the umbrella of EUCAR to fulfill its mission to "Strengthen the Competitiveness of the Automotive Manufacturers through Strategic Collaborative Research & Innovation". EUCAR has identified the main priorities for collaborative research and innovation (R&I) in the automotive sector with the main objectives to be targeted for collaborative automotive R&I in the domain.

The current adapted Dutch automotive roadmap is partially based on the ERTRAC Strategic Research Agenda and the EUCAR Roadmap. This is a slight difference to the approach of the last HTSM Automotive Roadmap for 2014. The 2014 roadmap contains two subjects: *Green & Smart Mobility*. The development of *Manufacturing & Materials, Efficient, sustainable and flexible factories* is added. These three subjects form the pillars of the Automotive Innovation Programme together with the forth pillar, the so-called *engineer of the future*, which is a relevant enabler of the future innovations in terms of the availability of the right skills and competences (human capital) in the future. Together with the vision of major stakeholders in the road transport sector, this has evolved into the modified strategy for the period 2016-2020. This strategy will allow Dutch companies and knowledge institutes to excel in specific innovation areas. The strategy leverages the strength of the Dutch industry and potential synergy effects of the automotive ecosystem.

[1] From the perspective of the (7) European Societal Challenges in the Horizon 2020 Program

2. RELEVANT TRENDS AND CHALLENGES

The Dutch automotive sector consists of about 300 companies, research institutes and educational institutes. In the Netherlands almost 45,000 people are employed in the automotive sector, roughly 10,000 of them are working for OEM's (DAF, VDL, NedCar), 4,000 are manufacturing special vehicles and trailers, 29,000 are employed at suppliers and about 2,000 are working in research and knowledge institutes, well embedded in the 'system thinking' high tech Dutch industry. The Dutch automotive sector is functioning as a coherently triple helix ecosystem, where universities, TNO, government and industry are cooperating with a common focus: strengthening the Dutch automotive sector. The Dutch automotive sector can be described as an 'innovation team' collaborating along all phases of innovation. Next to this it's clear that the automotive industry is a global industry and it's key is that the team is closely connected to the international automotive communication community. For Europe the automotive industry is major important because 5.3% of the EU employed population - work in the automotive sector. Furthermore 10% of EU's manufacturing employment is automotive. The sector is a key driver of knowledge and innovation, representing Europe's largest private contributor to R&D, with over €32 billion invested annually. The automotive sector contributes positively to the EU trade balance with a €92 billion surplus.

<u>Technological Trends (system integration, electrification and automation)</u>
In the past few decades, a massive shift towards electronics and controls has entered the vehicle domain. ICT and software are one of the key technologies in the vehicle of the future and integration into more complex systems is evolving. The car is becoming more and more a part of a complex environment (the car functional partly as a sensor end is a part of traffic Management). This technology offers not only new solutions and applications for in car control systems, but also for car to car (V2V) and car to infrastructure (I2V) communication. Therefore, more and more development in the automotive industry depend of cooperation/ input of governments (traffic management), industry (providers) and ICT-industry for developing cars. Furthermore there is a clear trend towards vehicle electrification, in particular electric vehicle propulsion (incl. Hybrids) and electrification of vehicle functions.
The Dutch industry is well positioned for the challenges in the field of (on board) electronic networks, electric vehicle charging and vehicle navigation and communication.

<u>Scientific Excellence and Trends</u>
The Dutch universities have a strong track record in the research fields relevant for the automotive sector. On a global scale our research is well-known in the fields of combustion processes, materials, electro-mechanics and power electronics, hybrid powertrains, new battery systems, testing, mechatronics and control, vehicle dynamics, systems research, car2car communications, model driven software engineering, verification of software, traffic modelling and flow control. Moreover, the involved scientific research teams are well embedded within the high tech systems research areas and benefit from the mutual questions at system level (i.e. mechatronics, systems and control, ICT and embedded systems). This makes the Dutch universities well-positioned for the challenges in the focus areas of automotive as mentioned above.

<u>Societal Trends (Environment, Mobility and Safety)</u>
The societal impact of traffic receives more attention. Moreover, the importance of the energy efficiency, air cleanliness and noise reduction, is increasing against a background of growing populations, urbanization and climate change. Intelligent traffic systems will offer integral system solutions towards road use efficiency, energy efficiency and road safety.
The Dutch industry will play a leading role in the transition towards smart mobility systems. The Netherlands will be the world's testing and launching ground for the development and deployment of these systems. The quality of life for the Dutch population will directly benefit from these new innovations.

Trends related to Human Capital

The changes enforced by the societal, market, as well as technological trends requires a response of the education institutions. The speed with which the companies innovate is different than how necessary changes within the educational system can be implemented. The engineer of the future will need to posses skills and capabilities that need to be addressed. The Netherlands has a sound educational system, recognized also internationally, and will continuously need to invest in 'innovating' itself as well. New technologies require new teaching skills, and new educational concepts (i.e. online) that will allow for a flexible adoption of new technologies within the scope of the curriculum. System thinking, new mobility solutions, manufacturing challenges of automotive OEMS and suppliers are some of the major trends as well as drivers of changes related to the Engineer of the Future. Parts of this has been implemented already within the new Automotive bachelor, master and PDeng at the TU/e, partly using HTAS support, as well as within the CoE ACE. The Automotive sector is often used as an example where the relation between trends in the sector and the changes within the educational system are well interlinked, and also the relation between all levels of education is often referred to as an example. Within the Topsector programme the focus on a further coherent cooperation between educational institutes and industry is one of the leading enablers for these drivers of changes.

Conclusion

The trends in the worldwide automotive sector are very favourable for the Netherlands.
The Dutch automotive sector has an excellent reputation as high tech, innovative automotive supplier. The technology demand is increasingly matching with 'Dutch' technological strengths, i.e. system thinking, electronics, mechatronics, navigation, sensor and actuator technology, control, ICT and material applications, etc. Finally, Dutch traffic conditions are an excellent driver for the development of the new mobility solutions the future urbanized world needs.

2.1 Major challenges to be addressed by this roadmap until 2025 [2]

The major focus areas in the roadmap can be summarized as 'Green Mobility, Smart Mobility and Efficient, Sustainable & Flexible Manufacturing.

Green Mobility

In Horizon 2020, the programmes on "Smart, Green and Integrated Transport" and "Leadership in Enabling and Industrial Technologies" are of direct relevance to R&I in Green Mobility (in the EUCAR Roadmap called Sustainable Propulsion). The roadmaps for Green Mobility present recommendations for collaborative R&I in two areas:

- **ICE-based Powertrains** (powertrains based on an internal combustion engine) and "xEV-based Powertrains" (powertrains which have a partially or fully electric drive function). These incorporate the cross-cutting technology domains "Fuels and energy carriers" as well as "Thermal and energy management".
  For ICE-based powertrains, collaborative research should concentrate on affordable design changes which increase efficiency and reduce emissions in engines for light and heavy-duty vehicles, including downsizing, advanced flexible combustion processes and alternative fuels supported by advanced after-treatment and efficient thermal management. Demonstration activities for holistic concepts for heavy-duty vehicles are an additional priority.
- For **(x)EV-based powertrains**, priorities include lithium-ion and post-lithium-ion batteries, fuel-cell systems, hydrogen storage, improved electric drives, charging systems and concept demonstration, as well as electrification for heavy-duty vehicles. The final target is

[2] Including Science for Competitiveness, Science for Society, Science for Science

to meet customer and regulatory demands for lower fuel consumption and emissions whilst maintaining utility, performance and affordability of passenger and commercial vehicles.

Smart Mobility

The ERTRAC roadmap is based on available documents for automated driving. The overall objective is to identify challenges for implementation of higher levels of automated driving functions. A lot of work has been done on this topic by various stakeholders and multi-stakeholder platforms (e.g. iMobility Forum, EUCAR, CLEPA, ERTICO, EPoSS) and in European Research Projects. Therefore, it is essential to avoid any duplication of activities and concentrate on the missing items, concerns and topics for future implementation.
Automated Driving is seen as one of the key technologies and major technological advancements influencing and shaping our future mobility and quality of life. The main drivers for higher levels of Automated Driving are:

- **Active Safety**: Reduce accidents caused by human errors.
- **Efficiency**: Increase transport system efficiency and reduce time in congested traffic.
- **Comfort**: Enable user's freedom for other activities when automated systems are active.
- **Accessibility**: facilitate access to city centres.

Efficient, Sustainable & Flexible Factories

In Horizon 2020, the programmes on "Leadership in Enabling and Industrial Technologies" and "Smart, Green and Integrated Transport" are of direct relevance to R&I in Efficient, Sustainable & Flexible Factories (in the EUCAR roadmap called: Affordability & Competitiveness). The roadmap present recommendations for collaborative R&I in three areas: "Application of Suitable Materials for Future Vehicles", "Virtual Engineering Product Process" and "Sustainable & Efficient Manufacturing".
For interior materials, collaborative research should concentrate on improvements in functionality, appearance, stability and acoustics as well as integration into the production process. For lightweight vehicles, priorities include new materials, shapeability, joining, sheet forming and again integration into the production process. In manufacturing, R&I priorities enhance productivity through collaboration and automation including safety, surveillance, tracking, reflexes and algorithms. Advances in different levels of robotics assistance are important, covering co-manipulation, assistant tools and full automation of heavy processes. Also in the factory, energy and resources efficiency of plants, including planning, renewables use and recovery are key areas of R&I focus. These activities can be supported by the deployment of advanced virtual engineering, including simulation, modeling and assessment.
The expected outcome from these activities is a technology readiness for automotive materials and for manufacturing technologies that provides a platform for further development and eventual industrialization. The final target is to support the fulfillment of customer demands for automotive vehicles which are affordable and continue to meet their needs and expectations on functionality, quality and safety. This is integrated with the fulfillment of societal and regulatory demands on vehicles, and supports a competitive European industry which, as well as providing valuable products, is a key part of the industrial landscape providing jobs and wealth to the continent and its regions.

Engineer of the future

The s*ystem* engineer of the future: the field of an Automotive engineer has always been evolving quickly into a multidisciplinary field, while shifting the focus from three separate disciplines (mechanical, electrical engineering and information technology) into a broad understanding and knowledge of these technical disciplines and it's connection within the entire 'system'. The complex technological and market trends put an enormous pressure on the educational organizations, which are responsible for preparing the students for their futures jobs in the quickly evolving automotive industry. The traditional focus has been predominantly on vehicle design and production, but will also need to change in other to prepare the engineers of the future that will be capable of tackling the relevant technological challenges and realizing the innovations that have been set out in this roadmap by the Dutch automotive sector.

Other relevant trends are the current *societal changes (and challenges) and mobility issues* that lead into a shift towards other cross-disciplinary fields such as traffic management and disciplines like psychology and user centered design for the design and engineering of in-car systems. Especially with the Smart Mobility area there will be an increase in focus on monitoring and aiding the driver in driver tasks in order to develop an adoption of the fully automated vehicle later on.

Last but not the least, the engineer of the future will need to be capable of contributing to the necessary *manufacturing processes*. As mentioned in the beginning of this roadmap, the Dutch automotive industry has tremendous potential especially as an innovative (Tier 1 and 2) supplier industry. For many of the automotive supplier companies the automotive engineers will need to have understanding of innovative manufacturing processes. Therefore it is necessary that new concepts such as Virtual engineering etc. already get introduced early, during the studies, and not only after the student graduate by their new employers.

3A. PRIORITIES AND IMPLEMENTATION: GREEN MOBILITY

For both “ICE-based Powertrain” and “xEV-based Powertrain” a EUCAR R&I roadmap has been compiled.
The themes “Fuels & Infrastructure” (Advanced fuels, including electricity, produced sustainably and under efficient processes including required infrastructure) and “Vehicle Thermal and Electric Energy Management” (Efficient management of thermal and electric energy flows in the vehicle) are key elements of the powertrain domain.
The development of powertrains can be enumerated up into the following components

ICE-Based Powertrain – Light Duty
1. Spark-ignition engine technology (Flexible injection and valvetrain,downsizing, Aftertreatment & emissions control Combustion process
2. Alternative fuels (Gassystems)
3. Alternative propulsions and transmissions (Hybridisation, Advanced transmissions)
4. Electrified Powertrains (electric components, electrified transmissions)

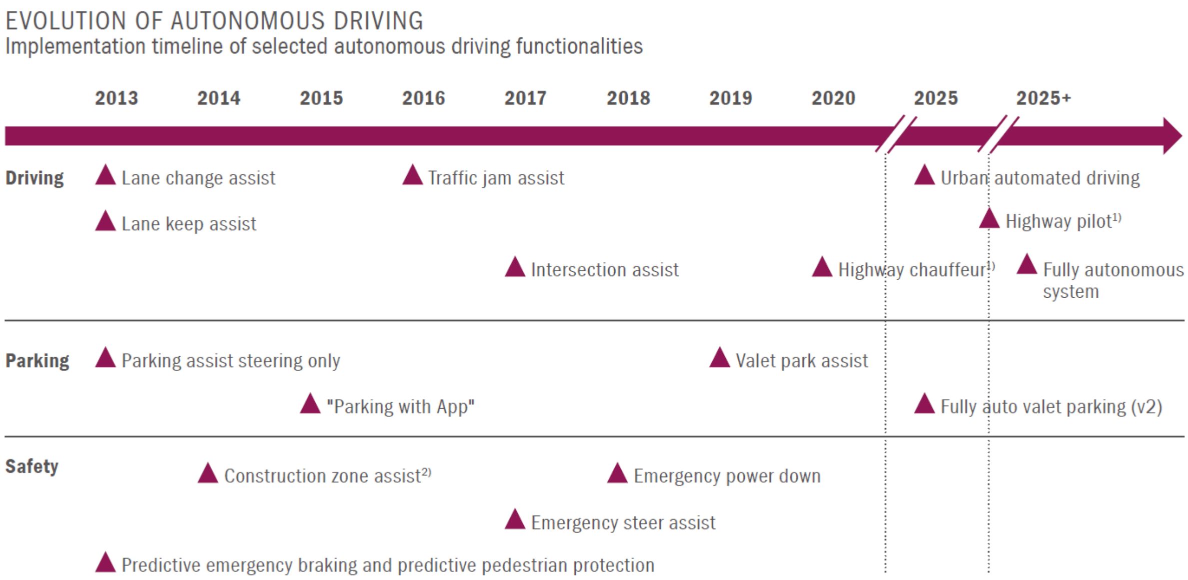
ICE-Based Powertrain – Heavy Duty
5. Efficient heavy-duty vehicles
- Hybridisation (incl. impact of electrification on engine) and energy management
- Real-world performance
- Driveline control systems
- Interaction / integration with fleet- and traffic management
6. Efficient HD-engines
- Combustion improvements (high pressure loop; including aftertreatment, also including low heat rejection and fuel flexibility)
- Scavenging loop improvements
- Friction reduction (incl. auxiliaries)
- Waste heat recovery (Rankine cycle; turbocompound; TEG)
7. Future HD-Diesel engine technology (Concepts for HD low temperature combustion (high efficiency; low emissions) with dual fuels or alternative fuels (but good well-to-tank efficiency needed)
8. Alternative and/Sustainable fuels

(x)EV-based powertrain
1. Electrochemical storage systems (Lithium batteries ageing Second Use and Recycling Post Li-ion batteries)
2. Electric drives (Electric motors, Power electronics, Traction powertrains)
3. Electric vehicles (New vehicle architectures for electric powertrain systems)
4. Heavy-duty electrification (fully electric and fuel-cell bus, fully electric truck), auxiliary management

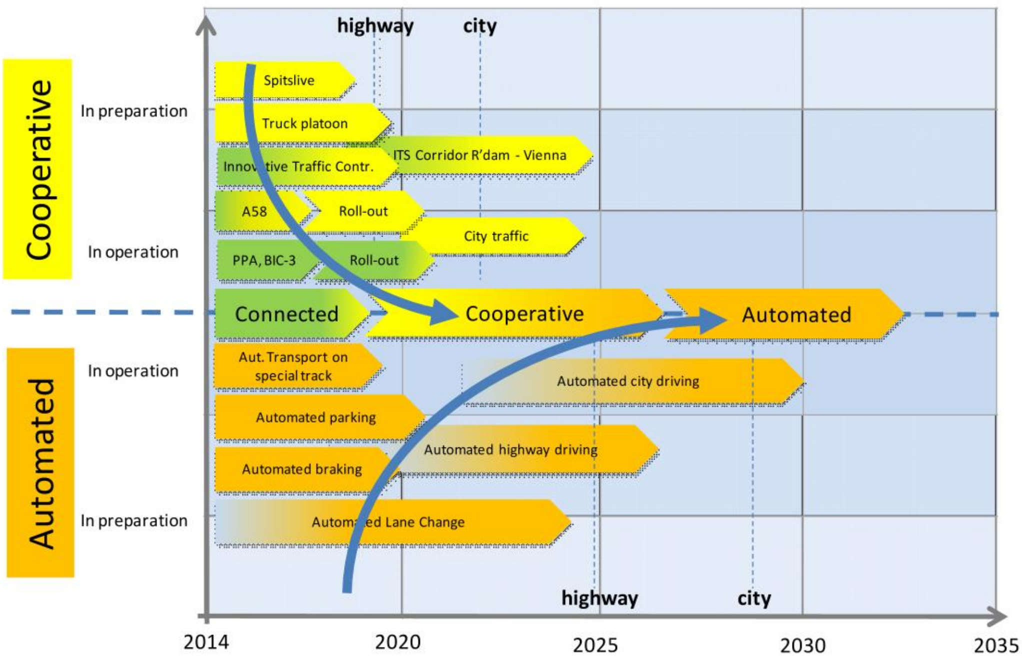
3B. PRIORITIES AND IMPLEMENTATION: SMART MOBILITY

In technological terms the advancement towards highly Automated Driving is seen as an evolutionary process to ensure that all involved stakeholders can develop and evolve with the adequate pace. This process already started with the development of ABS, ESP and Advanced Driver

Assistant Systems (ADAS) and will progressively apply to more functions and environments. In parallel, driverless automated systems can be deployed to provide transport solutions in restricted areas with dedicated infrastructure or at specific locations e.g. airports. Cars will work more and more cooperative and connected to the cloud, because of the development and the integration of ICT (more realtime, higher information density and custom fit)
The Automotive Industry is facing important challenges to enable or implement higher levels of Automated Driving in all environments. It is utmost important that these challenges and existing gaps (technology, legislation, regulatory, policy, etc.) are early recognized and appropriate measures are taken. The evolution of Autonomous Driving can be displayed in a timeline with different technologies set.



The theme Smart Mobility can be divided in three subthemes; Cooperative Driving, Automation and Connected to Cloud. In the near future these three themes come together and form Automated driving. Cooperated Driving means that cars are communicating with each other and/or with the roadside. Automated Driving means that cars are equipped with technologies that enable them to act automatically independent of other cars or traffic management. Connected means that cars exchange information with the cloud.



Some of the technologies fall under more than one theme, but for the sake of simplicity, these are placed under the theme which is the best fit. The following conditions can be addressed within the three subthemes

Automation (emphasis on developments in the car)

- Control Longitudinal and lateral algorithmic
- Functional safety (robust and reliable)
- User interface (lower driver workload, driver behaviour change)
- Security (in vehicle and interaction surroundings)
- Connectivity (related to automation)
- Digital infrastructure (accurate positioning, gps technology, reliable maps)
- Environmental Perception (sensors and sensor fusion, image processing)
- Controlled Actuation (Vehicle Dynamics)

Cooperative driving (emphasis on scaling up and therefore safety, security, interoperability)

- Functional safety
- User interface, HMI (driver behaviour)
- Security
- Platform Design
- Digital infrastructure, Communication and Sensing Network
- Traffic management
- Autonomous Emergency Braking
- Resilience
- Traffic Information

Connected to the cloud (emphasis on the increase of data and consequences):

- Data processing

- Privacy
- Value chains
- User interface (information load)
- Reslience
- Security (Authentication)
- Traffic Information

3C. PRIORITIES AND IMPLEMENTATION: EFFICIENT, SUSTAINABLE AND FLEXIBLE FACTORIES

The EUCAR statements include an overall vision statement for Efficient, sustainable and flexible Factories (in EUCAR called: Affordability & Competitiveness) and three statements, each representing the strategic vision for part of the domain from the automotive manufacturers' point of view. Application of materials is part of the Roadmap, design of materials not, because the latter is treated in the M2I (materials) Roadmap. For each of the themes a EUCAR R&I roadmap has been compiled.

- <u>Application of suitable materials for future vehicles</u>
  Vehicle production technologies to implement suitable materials (new materials, hybrids, joining technologies etc.) for enhanced affordable and competitive design.

- <u>Virtual engineering product process integrated approach</u>
  Innovative engineering solutions to guarantee and ensure the European automotive competitiveness for future vehicle generations

- <u>Sustainable and Flexible Manufacturing</u>
  Efficient and effective manufacturing systems capable of producing affordable and competitive vehicles in Europe

The following technologies and developments will be addressed.

Materials, technologies and process for interiors
• In technological research: Acoustics, Thermal stability, Shapeability, Process compatibility, New architecture
• Integration into the production process and large scale production in pilots and eventual industrialization

Materials, technologies, process and simulation tools for lightweight vehicle structure
• In technological research: Glass / composite reinforcement, Biobased materials, Shapeability, Joining technologies, Sheet forming, Process compatibility, reparability
• Integration into the production process and large scale production in pilots and eventual Industrialisation

Virtual engineering & simulation
• Basic research in virtual engineering
• Simulation for manufacturing and ergonomic assessment
• Lightweight vehicle creation
• Simulation and modeling for materials and flexible parts

Energy and resource-efficient plants
• Energy planning

• Renewables use
• Energy recovery

3D. PRIORITIES AND IMPLEMENTATION: ENGINEER OF THE FUTURE

The impact of the societal, market, as well as technological trends on the education institutions is tremendous. The engineer of the future will need to posses skills and capabilities that are perhaps not taught at schools today. System thinking, new mobility solutions, manufacturing challenges of automotive OEMS and suppliers are some of the major trends as challenges related to the Engineer of the Future.

The goals of the relevant human capital activities are related to three major goals:

- quantity – more students, more engineers of the future.
- quality – students are educated for the future needs of the industry – smaller gap between educational organizations and industry – inspiring teachers with up-to-date knowledge inspire and educate the Engineers of the Future!
- research – joint participation and involvement of students, teachers, researchers, and companies in projects is necessary in order to keep the knowledge level of all stakeholders up-to-date. Career talent development, employability to a future sustainable workforce.

Summary of major challenges in regards to human capital:

- Introducing and implementing the system engineering aspects within the bachelor study Automotive Engineering (hbo).
- Further improvement of the cooperation between the already existing 'systems thinking' BSc MSc and PDeng Automotive at TU/e and the HBO/ACE programs.
- Facilitate a growth of the number of the TU/e Automotive Systems Design PDeng students
- Enable student exchange with EU countries.
- Introducing and implementing various ‘flexibility’ solutions and new innovative concepts (on-line education for example) within the educational organizations so that students (and teachers) continuously get introduced to new research and technological trends related to Green and Smart mobility.
- Inspired teachers lead to inspired students!
- Introduce and implement ‘manufacturing’ as part of the study and research areas within the automotive engineering.
- Workforce gets a lifetime employment

4. RELEVANT HIGH TECH AND AUTOMOTIVE ECOSYSTEMS

The automotive sector consists of about 300 organizations in the Netherlands. About 150 of these organizations in the sector are member of AutomotiveNL
AutomotiveNL is the cluster organization for the Dutch automotive sector with services in the areas of Innovation, Networking (Ecosystem), Facilities (Campus) an International acquisition.

Important for the realization of the roadmap is the potentially more active role of the government: the involvement the Ministries of Economical Affairs and Finance, and the Ministry of Infrastructure and Environment. The latter intends to participate as a partner in the realization of the automotive roadmap. This cooperation on societal issues (mobility, environment and safety) can vary from interest to facilitator to partnership to even launching customer.

International Cooperation
The main market for the Dutch automotive sector is dominated by Europe and the BRIC countries. Cooperation in innovation with partners from these areas is therefore a logical strategic choice for the Dutch automotive sector. AutomotiveNL made the choice to cooperate mainly with top technology partners in NW Europe varying from OEM, Tiers, and knowledge institutes. Successful collaboration is not only a matter of technology, but also of communication, culture, and distance. Furthermore, the automotive sector will participate in European Programmes as Horizon 2020, Eureka, Eurostars and Interreg.

Cross (Top) Sector Cooperation
The automotive sector can profit from generic research developments inside and also outside the HTSM top sector. Therefore, an intensive cooperation with several technology partners will be extended into this new road map well, i.e. M2I, Photonics.
In order to intensify the cooperation between educational institutes and the Automotive industry, increase the number of students and most importantly, increase the number of Automotive educated engineers, talented students are given the opportunity to participate in talent programmes. In these programmes, they will participate in innovative research projects with industry partners, being an ambassador for both the company as well as the Automotive sector towards other students and closing the gap between education and industry.

SME Activities
Due to limited financial means for SME's, an additional programme will be needed especially for this category of companies. AutomotiveNL is aiming to bundle the innovation forces of SME's around the topics of the programme lines into Theme- Clusters. Furthermore AutomotiveNL will offer individual management support for incubators with the aim to lower the extremely high entrance barriers in the automotive sector for new entrepreneurial initiatives. Finally, advice and support for SME's is required with respect to project finances ((inter)national funding and subordinated loans).
Financial support of SME's will focus on regional (Provinces), (TKI, Innovation Loan) and international (SME program Horizon 2020 and Eurostars)

4.1 Collaboration and leverage with European and multi-national policies and programs

Horizon 2020:
For the Horizon 2020 programme a number of institutions are working on road mapping and positioning subjects important for Dutch industry. Dutch partners are actively involved in the following European bodies: ERTRAC (DAF, TNO, TU's), EARTO (TNO), EUCAR (DAF), EGVIA (DAF), EARPA (TNO, TU/e), ERTICO (TNO, Technolution, TomTom, NXP, Imtech, Vialis).
The main topics for European research are:

- ‘Smart mobility’ and the increasing interest of ITS for traffic flow, GHG reduction and traffic safety
- Electrification of vehicle propulsion and future energy carriers for transportation combined with innovation in combustion engines
- Increasing interest of ICT for a networked transportation system and vehicle control
- New themes like urban mobility and mobility for an ageing community

Within the framework of Horizon 2020 a new instrument, especially for SME’s, is called SBIR, (Small Business Innovation Research). This instrument is aiming strengthening and participation of SME’ s in the innovation cycle. This instrument consists of three phases and a mentoring scheme. Details of SBIR will be published in 2014.

Eurostars

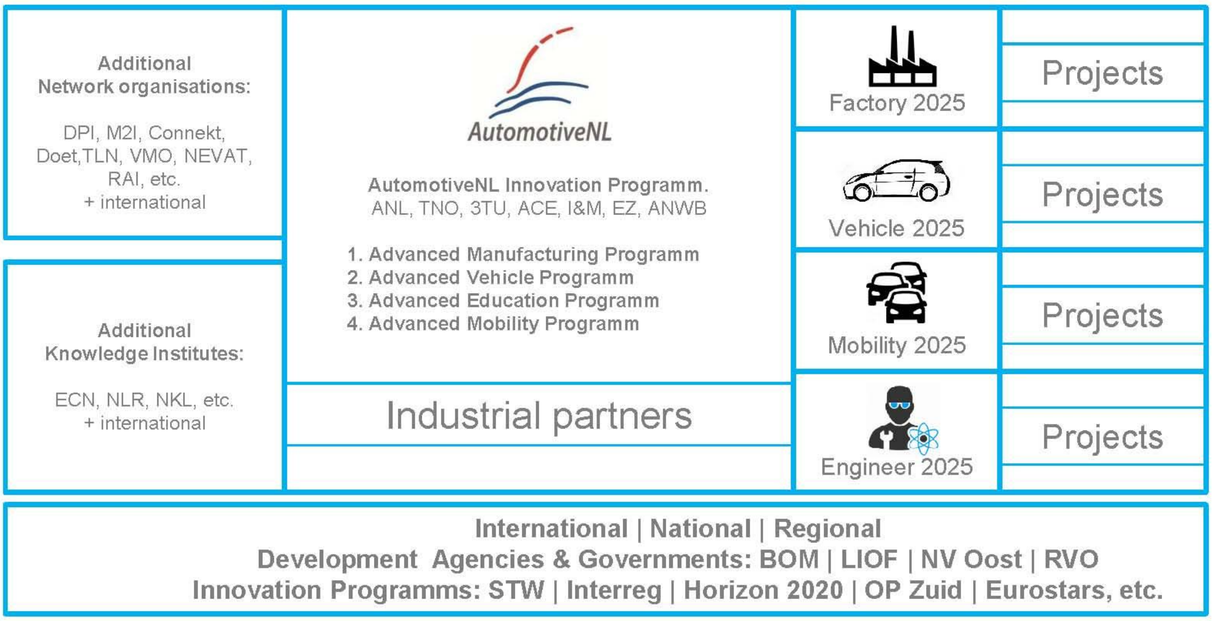
Eurostars aims to stimulate R&D performing SMEs to lead international collaborative research and innovation projects by easing access to support and funding. The arrangement Eurostars is open to any existing technology and market! The bottom-up approach allows the participants to freely decide on the topic of its project. An important additional condition of this arrangement is that the result of the project must be in the market within 2 years of its completion.
A typical Eurostars project has 3 to 4 partners from 2 to 3 countries. The average size of a project was about 1.5 M€ for a period of 30 months.

Interreg

INTERREG is a European Commission initiative financed by the ERDF (European Regional Development Fund). The aim of this programme is to strengthen economic and social cohesion in the European Union through cross-border, transnational and interregional cooperation. Especially for SME's the GCS Cross border cluster stimulation programme offers opportunities for financial support in collaborations across the borders of The Netherlands, Germany and Belgium.

AutomotiveNL Innovation Programme

To amplify the innovation strength of the Dutch Automotive Industry, AutomotiveNL starts an innovation Programme with visions of the future in four areas: Factory 2025, Vehicle 2025, Mobility 2025 and the Engineer of 2025. In the Automotive Innovation Programme, four themes are set with specialists of organizations within the quadruple helix. Contacts and knowledge transfer with additional organisations and knowledge institutes will be enhanced. In this way developed technology can be better used included knowledge valorisation and assurance.



5. INVESTMENTS

All data refer to contributions of the stated parties in public-private collaborations of any kind in relation to this roadmap, including but not limited to contract research, public funded national and international projects, and TKI-related activities. The figures requested are annual cash flow, including the value of in-kind contributions, not the multi-annual commitments stated in that year.

The contributions in the (lower) European agenda are considered to be included in the (upper) overall agenda of the roadmap.

Roadmap	**2016**	**2017**	**2018**	**2019**	**2020**
Industry	10	10	11	11	11
TNO	4.6	4.4	4.2	4	3.8
NLR	0	0	0	0	0
NWO	1	1	1	1.5	1.5
Universities (scientific and applied)	7	7	9	9	10
Departments[3] and regions[4]	0.5	0.5	1	1.5	1.5
Grand total	**23.1**	**22.9**	**26.2**	**27**	**27.8**

European agenda within roadmap	**2016**	**2017**	**2018**	**2019**	**2020**
Industry	5	5	5.5	6	6
TNO	1.2	1.2	1.2	1.2	1.2
NLR	0	0	0	0	0
NWO	0	0	0	0	0
Universities (scientific and applied)	5	5	6	6	7
Co-financing of European programs[5]	0.5	0.5	0.5	1	1
European Commission	4.8	4.8	5	5.3	5.3

Sources:

Eucar: Ready for Horizon 2020
http://www.eucar.be/wp-content/uploads/2015/01/Consolidated-Executive-Summaries.pdf

ERTRAC: Automated Driving Roadmap:
http://www.ertrac.org/uploads/documentsearch/id35/ERTRAC_Automated-Driving_draft3-web.pdf

[3] Ministries, excluding contributions to TKI HTSM
[4] Regional and Local Authorities
[5] Ministry of Economic Affairs contributions to JU ECSEL and EUREKA clusters