Key publications on automated driving

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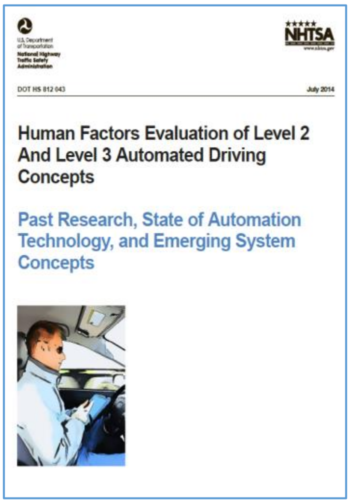
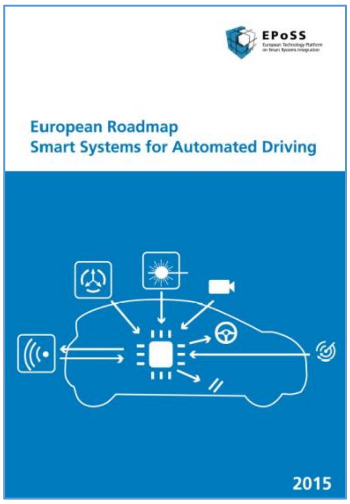
Automated Driving Roadmap (ERTRAC): This document provides an overview on the current status for Automated Driving technologies with regard to implementation in Europe. The ERTRAC roadmap is based on available documents for automated driving. The overall objective is to identify challenges for implementation of higher levels of automated driving functions. A lot of work has been done on this topic by various stakeholders and multi-stakeholders 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.

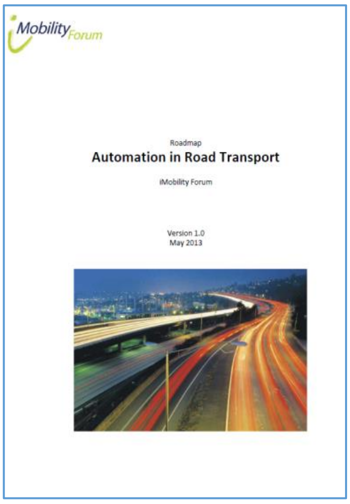
Verslag Kennisagenda Automatisch Rijden (RWS): Rijkswaterstaat organised a seminar to discuss the knowledge gaps that need to be closed to allow for automatic driving on public roads and what is needed in the short-term during the testing period. April 14th, 2015, 125 participants from governments, businesses and knowledge institutions gathered together in a seminar at Connekt in Delft. The outcomes of this meeting are summarised in this document that contains the basis for a research agenda on automatic driving in the Netherlands.



Human Factors Evaluation of level 2 and level 3 automated driving concepts (NTSHA): This report documents key human factors studies that were performed related to automated vehicle operations. This document expands results from a prior literature review that was performed for the US DOT. Studies directly addressing automated driving and those relevant to automated driving concepts have been included. Additionally, documents beyond the academic literature, such as articles, summaries, and presentations from original equipment manufacturers and suppliers, have been investigated. This document also identifies automated-driving relevant databases supporting future research.

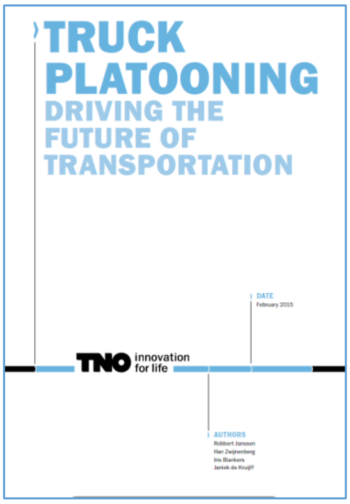


European Roadmap Smart Systems for Automated Driving (EPoSS): This roadmap is based on surveys and consultations among major European automotive manufacturers and suppliers. Starting from an analysis of goals and challenges towards the introduction of automated driving and a description of the state-of-the-art technologies, technology roadmaps about content and timescales of actions in Research and Innovation on technology and framework conditions, are presented. These roadmaps are organized along milestones for implementation of highly automated driving. This document allows private and public stakeholders, particularly the European Commission and Member States authorities to determine what actions have to be taken when and for what reason.

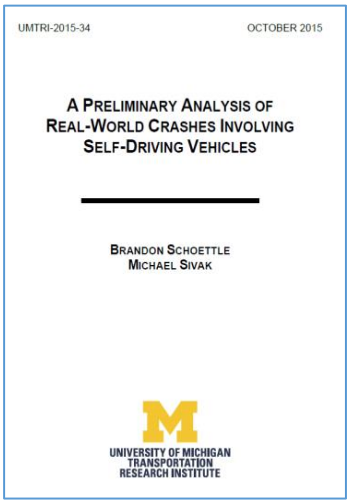


Automation in Road Transport (iMobility): The Working Group was created under the iMobility Forum after the successful workshop organized by the European Commission, DG INFSO in October 2011. This workshop commenced the three SMART studies, executed in 2011 for the European Commission, DG INFSO specifically focusing on automation, the future of internet and the connected car and during the workshop a clear need was identified to further discuss and guide the research, development and deployment of automation for road traffic and road transport systems.

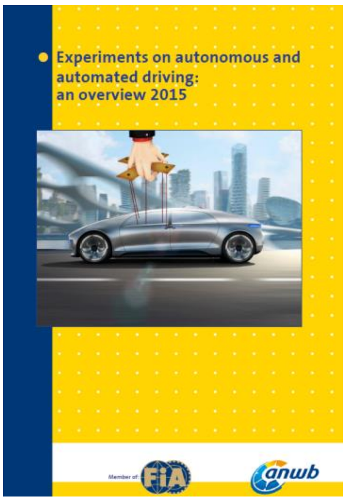
Driver at the wheel? (KiM): Self-driving cars may change our society radically. This depends on how much the car can actually do itself, but also on what the consumer wants. Will cars become a luxury second home or does a car driver remain a necessity? Also the sharing-economy has an impact. If many people will share self-driving vehicles and rides, this may change the traffic and transport system fundamentally. This report presents four scenarios for a future traffic and transport system with self-driving vehicles. These images differ from each other in terms of technology and acceptance (or, how 'automatic' will the self-driving car become?) and in terms of the extent to which consumers intend to share car ownership and rides.



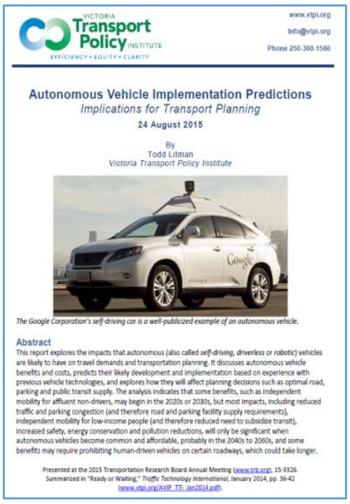
Truck platooning (TNO): Developments in the underlying Cooperative Adaptive Cruise Control (CACC) technology have been ongoing for years, yet widescale deployment of truck platooning is a system-wide challenge that requires concerted actions of all stakeholders in society. The political and economic climate is positive for broad deployment of platooning as initial legislation amendments are proposed to allow experimentation on Dutch roads. For this system-wide innovation, TNO suggests to establish a Shared Innovation Programme - based on open innovation principles - to jointly work towards commercial deployment of platooning to implement a safe, reliable and efficient two-truck platooning concept by 2020.



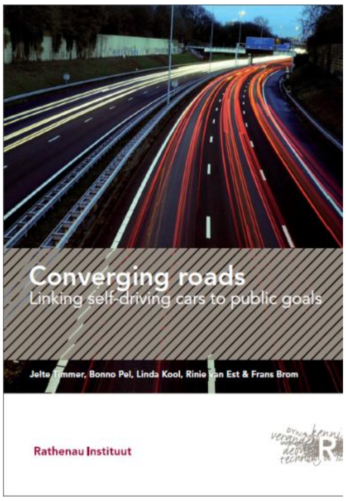
A Preliminary Analysis of Real-World Crashes Involving Self-Driving Vehicles (UMTRI): This study performed a preliminary analysis of the cumulative on-road safety record of self-driving vehicles for three of the ten companies that are currently approved for such vehicle testing in California (Google, Delphi, and Audi). The analysis compared the safety record of these vehicles with the safety record of all conventional vehicles in the U.S. for 2013 (adjusted for underreporting of crashes that do not involve a fatality).



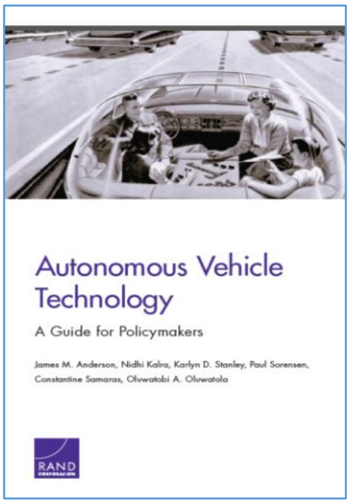
Experiments on autonomous and automated driving (ANWB): Autonomous and automated driving will be happening in the near future. Manufacturers like Audi, Mercedes and Volvo are developing and testing new vehicles. New players like Google and Apple have also arrived at the scene. Governments need to be involved in these developments because testing on the road means changing existing legislation. Therefore, ANWB created an overview of what activities are happening all around the world. The collected information has been combined with information provided by the clubs and from websites and reports like 'The pathway to driverless cars' (UK DfT) and 'Regulatory needs and solutions for deployment of vehicle and road automation' (VRA).



Autonomous Vehicle Implementation Predictions (VTPI): This report explores the impacts that autonomous vehicles are likely to have on travel demands and transportation planning. It discusses autonomous vehicle benefits and costs, predicts their likely development and implementation based on experience with previous vehicle technologies, and explores how they will affect planning decisions such as optimal road, parking and public transit supply. Some benefits may begin in the 2020s or 2030s, but most impacts, including reduced traffic and parking congestion, independent mobility for low-income people, increased safety, energy conservation and pollution reductions, will only be significant when autonomous vehicles become common and affordable, probably in the 2040s to 2060s



Converging Roads (Rathenau Instituut): This study aims to clarify the different innovation approaches of the self-driving car. It shows that the two approaches – cooperative systems and autonomous robot cars - raise different governance issues and social questions. To benefit from previous investments and achieve Dutch policy goals, the Netherlands should aim for convergence, and integrate the robot car with the existing approach towards cooperative systems. On the one hand, that requires robot cars that fit in with the cooperative communication structure. On the other, it means that cooperative systems should be made more effective by using the smart technology of robot cars.



Autonomous Vehicle Technology (RAND): Autonomous vehicle technology offers the possibility of fundamentally changing transportation. Equipping cars and light vehicles with this technology will likely reduce crashes, energy consumption, and pollution—and reduce the costs of congestion. This technology is most easily conceptualized using a five-part continuum suggested by the National Highway Traffic Safety Administration (NHTSA), with different benefits of the technology realized at different levels of automation. Careful policymaking will be necessary to maximize the social benefits that this technology will enable, while minimizing the disadvantages. The goal of this report is to assist policymakers at the state and federal levels to make wise policy decisions in this rapidly evolving area.

Selected scientific articles

Banks, V. A., & Stanton, N. A. (2016). Keep the driver in control: Automating automobiles of the future. *Applied ergonomics*, 53, 389 - 395.
doi: 10.1016/j.apergo.2015.06.020

Beller, J., Heesen, M., & Vollrath, M. (2013). Improving the driver–automation interaction an approach using automation uncertainty. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 55, 6, 1130 - 1141.
doi: 10.1177/0018720813482327

Hancock, P. A. (2015). Automobility: The coming use of fully-automated on-road vehicles. In *IEEE International Multi-Disciplinary Conference on Cognitive Methods in Situation Awareness and Decision* (pp. 137 - 139). IEEE.
doi: 10.1109/COGSIMA.2015.7108188

Körber, M., Schneider, W., & Zimmermann, M. (2015). Vigilance, boredom proneness and detection time of a malfunction in partially automated driving. In *Collaboration Technologies and Systems (CTS), 2015 International Conference on* (pp. 70-76). IEEE.
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Kountouriotis, G. K., Wilkie, R. M., Gardner, P. H., & Merat, N. (2015). Looking and thinking when driving: The impact of gaze and cognitive load on steering. *Transportation research part F: traffic psychology and behaviour*, 34, 108 - 121.
doi: 10.1016/j.trf.2015.07.012

Merat, N., Jamson, A. H., Lai, F. C., Daly, M., & Carsten, O. M. (2014). Transition to manual: Driver behaviour when resuming control from a highly automated vehicle. *Transportation research part F: traffic psychology and behaviour*, 27, 274 - 282.
doi: 10.1016/j.trf.2014.09.005

Merat, N., & Lee, J. D. (2012). Preface to the Special Section on Human Factors and Automation in Vehicles: Designing highly automated vehicles with the driver in mind. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 54, 5, 681 – 686.
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Merat, N., & de Waard, D. (2014). Human factors implications of vehicle automation: Current understanding and future directions. *Transportation research part F: traffic psychology and behaviour*, 27, 193 - 195.
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study. *Accident Analysis & Prevention*, 40, 2, 818 - 828.
doi: 10.1016/j.aap.2007.09.029

de Waard, D., Dijksterhuis, C., & Brookhuis, K. A. (2009). Merging into heavy motorway traffic by young and elderly drivers. *Accident Analysis & Prevention*, 41, 3, 588-597.
doi: 10.1016/j.aap.2009.02.011

De Winter, J. C., Happee, R., Martens, M. H., & Stanton, N. A. (2014). Effects of adaptive cruise control and highly automated driving on workload and situation awareness: A review of the empirical evidence. *Transportation research part F: traffic psychology and behaviour*, 27, 196 - 217.
doi: 10.1016/j.trf.2014.06.016

Key EU projects on automated driving

An overview of the EC funded projects that support the development of automated driving. The analysis has been done for the period of the last ten years. The red arrows show completed projects, and green arrwos show the projects that are still active (from EPoSS European roadmap on automated driving). Additionally a Marie Curie project Human Factors in automated Driving started in 2014 (13PhDs and 1 Postdoc).