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AUTOMOTIVE TECHNOLOGY CENTRE

Automotive trends in cooperative mobility

Integrated, intelligent and connected systems, the highway forward

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Ministry of Economic Affairs

provincie limburg

Provincie Noord-Brabant

OP-Zuid

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Sustainable mobility

We are mobile. We are traveling more and more. We have more and more cars. We are transporting more and more goods. Even by expanding infrastructures, we cannot keep up with the increasing demand. Besides that we have set challenging targets with respect to safety and environmental protection. The increasing traffic growth and challenging targets require an innovative and broad approach in order to keep all of us mobile.

Zero-X

The growth of mobility itself is already challenging, additional long term targets make it even more challenging. As an ultimate goal, we want to reach Zero-x, which refers to no accidents (no fatalities around 2050), no congestion and no emission.

Next generation solutions

Over the last decades, Traffic management and Automotive have developed solutions from different perspective for these challenges. The two worlds, Traffic and Automotive, will become more and more connected in the near future in order to make significant steps towards the Zero-X targets.

Current situation

Main drivers

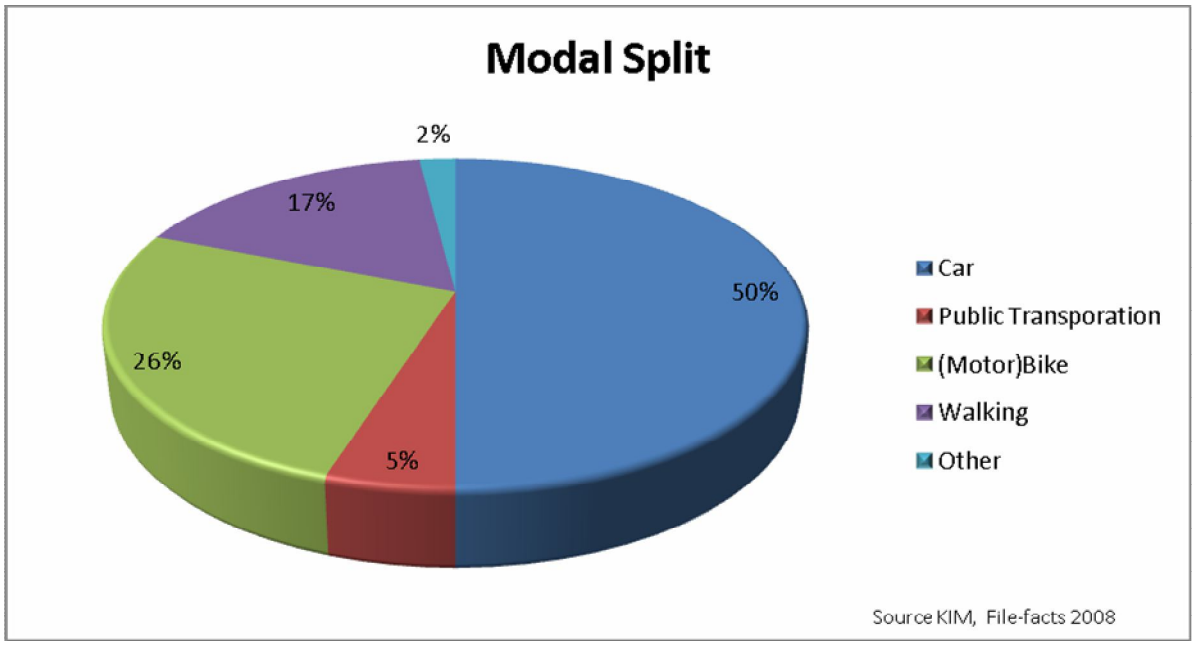
Why should we improve our vehicles and infrastructures?

- Fatalities: 39,000 per year fatalities in Europe; Total number of injuries is 1.2 million per year in Europe.
- Congestion cost: tens of billions Euros losses per year (The Dutch losses only are already estimated 3.5 billion Euros per year).
- Emission: In the Netherlands, traffic is responsible for 21% of the total CO_2 emissions and 62% of the NO_x emissions.

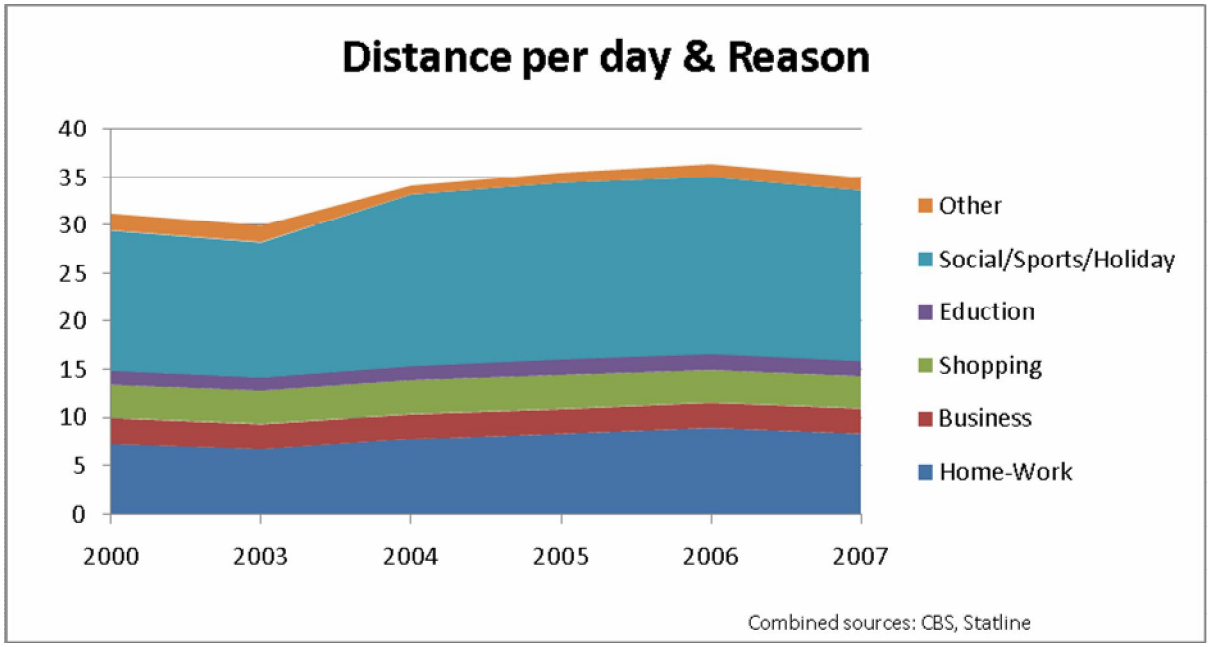
General facts

Let's try to understand mobility first. What is the size? What are the costs and how can we breakdown mobility? The figure below shows the general numbers.

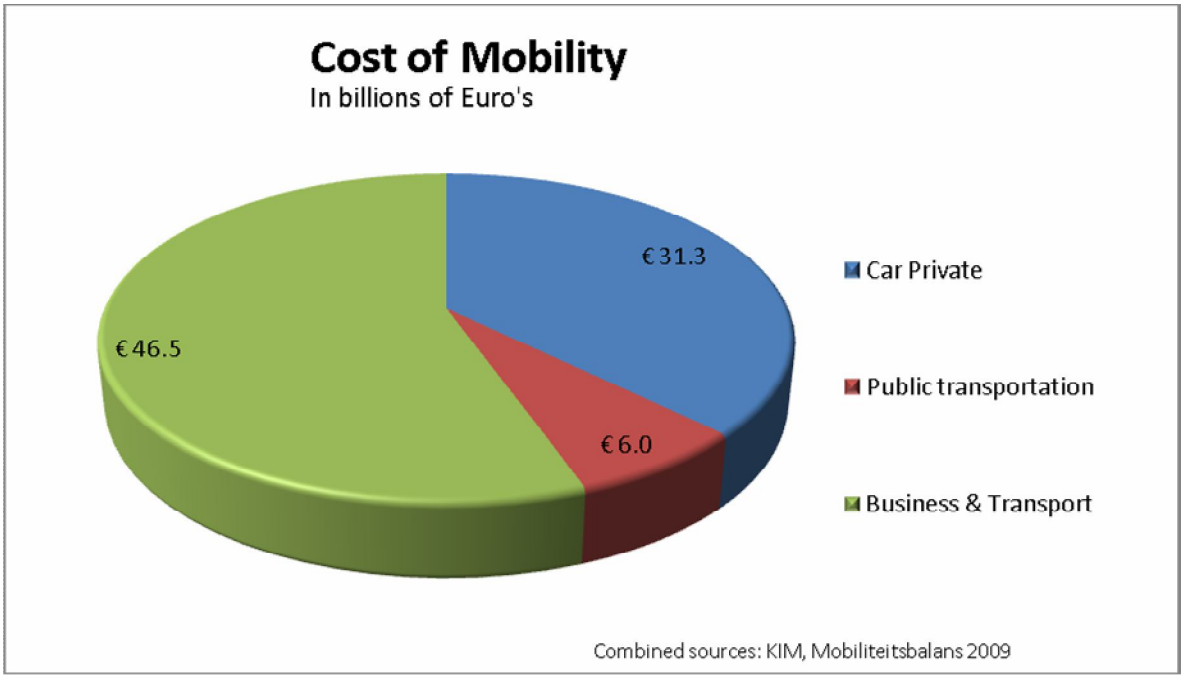
This chapter, analyzing the *current situation* is based on Dutch statistics.



In 2008 the Dutch citizens traveled almost 200 billion kilometers, compared to 1995 an increase of 13%. Most kilometers are traveled by car. Typically we travel 3 trips which are 35 km in total per day. This modal split has not changed significantly in the years up to 2010. The figure below indicates the reasons for traveling.

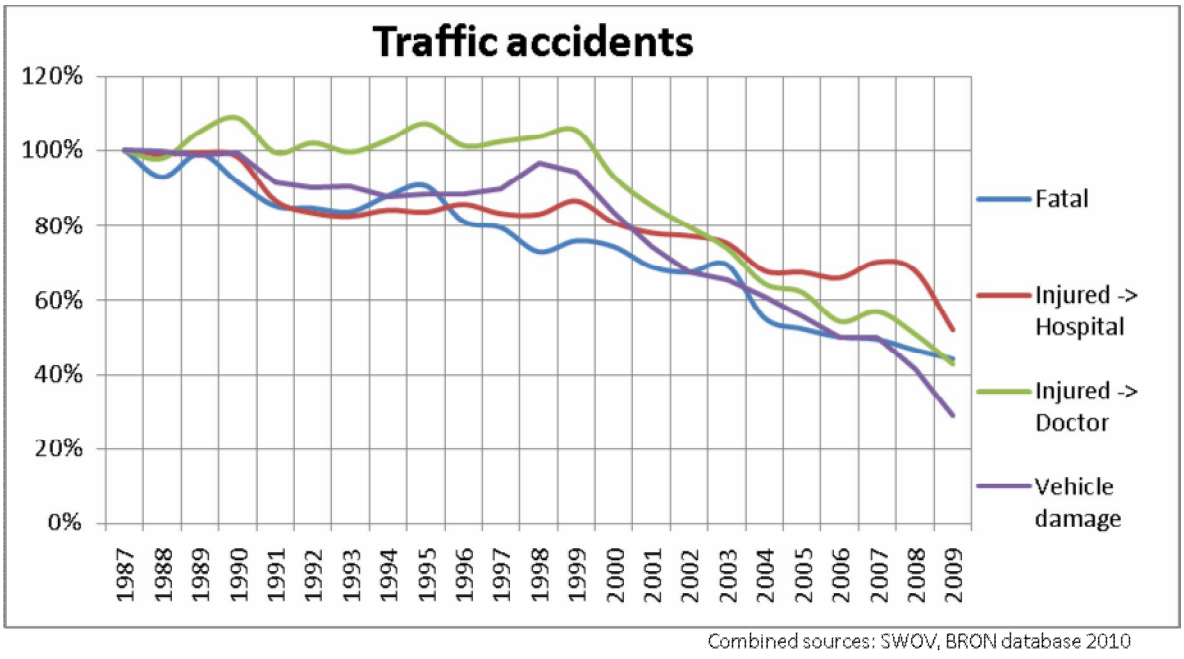


Mobility costs are equal to 11% of the GDP. Besides the cost shown by the figure above, there are the indirect costs like taxes and insurance (estimated around 6.5 billion Euros per year) as well.



Fatalities

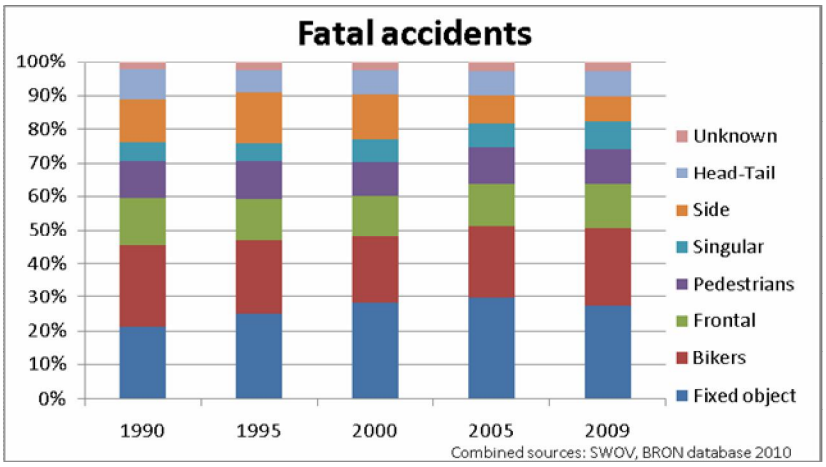
In the fatalities trends we see a clear positive trend, some figures are even ahead of the targets set by the Dutch government.

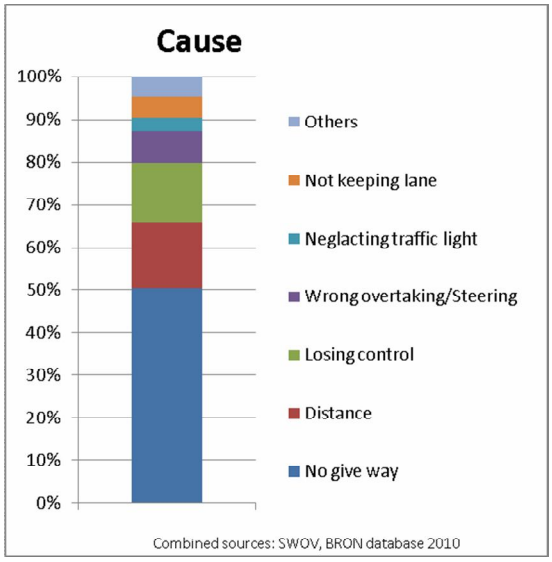


The reduction in accidents is a result of:

- Automotive safety improvements (safety-belts, ABS, ESP, Airbags, specific mirrors for trucks, etc.)
- Traffic improvements like 30 and 60km/h limitations, additional high- and motorways, roundabouts and cycle roads.
- Regulation and education

In order to reduce accidents and injuries, it is important to understand the traffic accidents in more detail. Refer to the picture below for the main reasons for fatal accidents. Note that the drivers and passengers in the cars are protected relatively well compared to bikers and pedestrians. In 55% of the cases a "vulnerable road user" is involved. Also visible is the reduction in side impact accidents as a result of the automotive safety solutions in combination with traffic solutions (roundabouts).

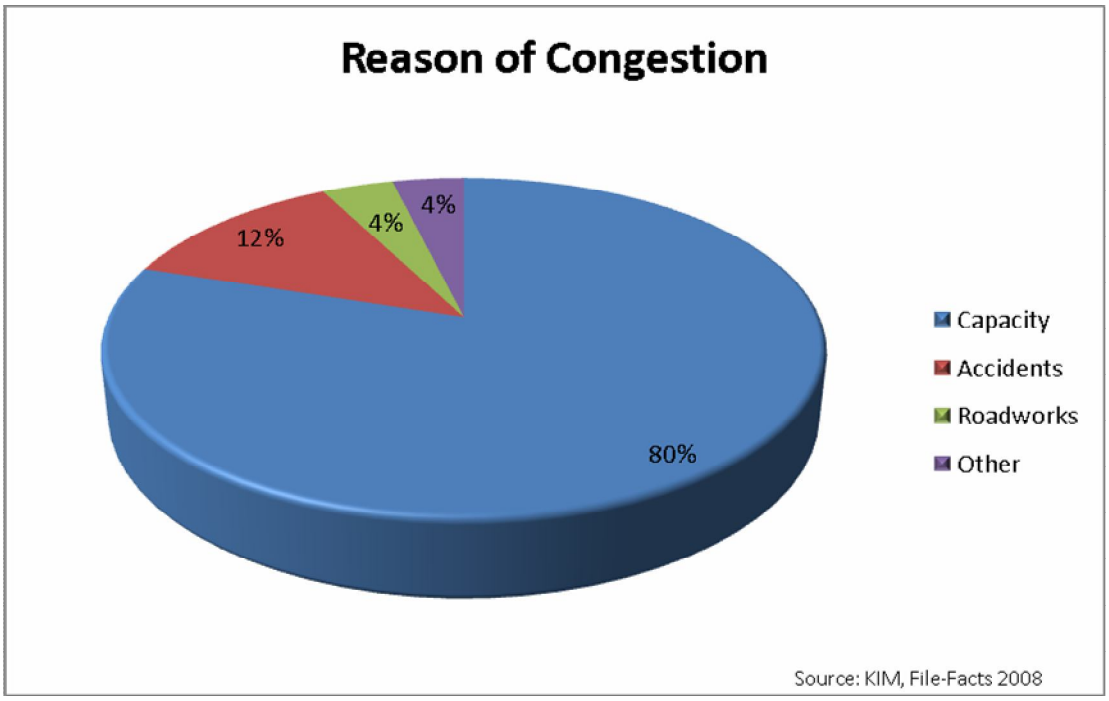




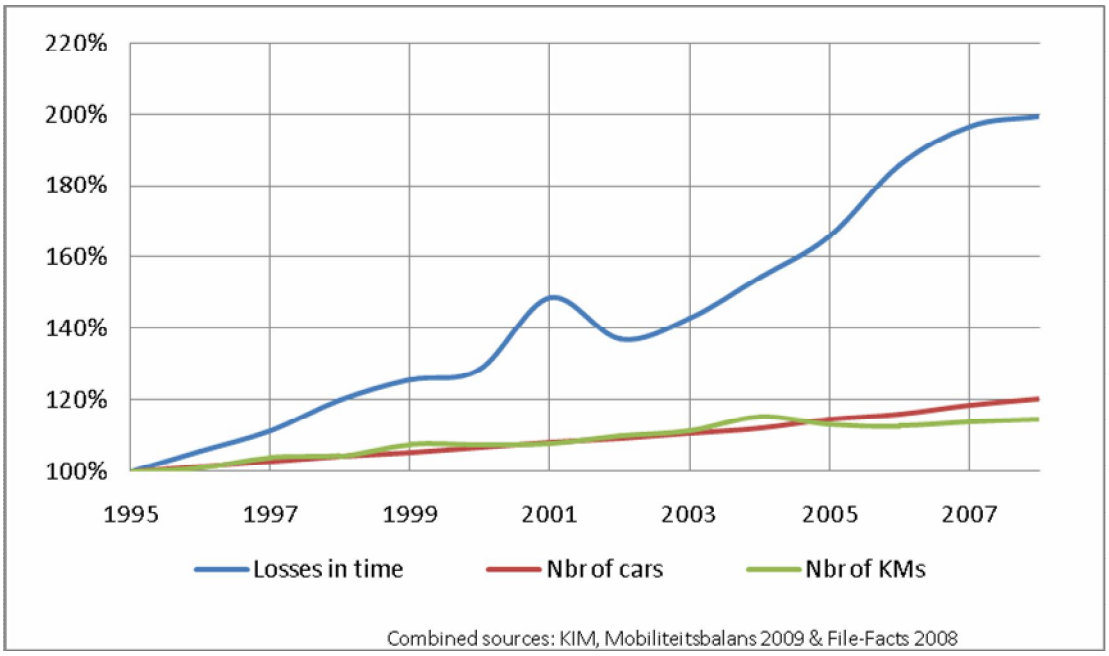
Where do we as road users make mistakes? In one out of two cases we do not give way or we do not see or realize we have to give priority. Additionally, the time of the day influences our capabilities. The numbers of accidents in the afternoon/evening are significantly higher than the numbers in the morning.

Congestion

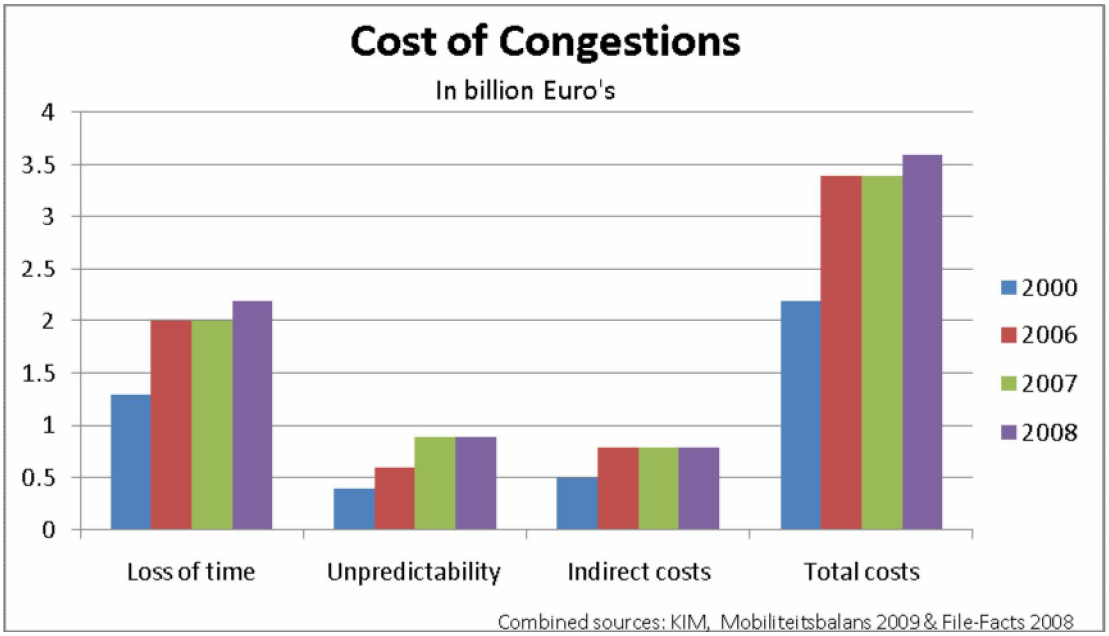
Main reasons for congestion are limited road network capacity.



In average the capacity of a highway is around 2000 vehicles per hour per lane. When reaching maximum capacity, human behavior might influence the capacity in a negative way.



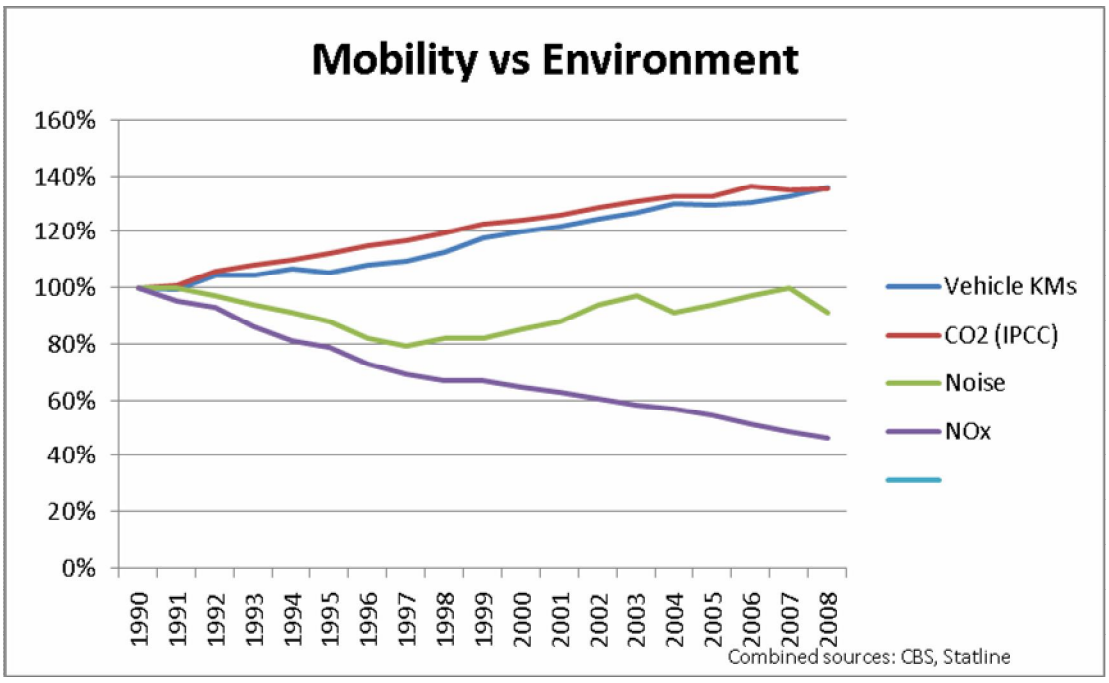
The capacity problems are becoming clear when we put the number of cars and the traveled distance in perspective of the losses in time, the losses in time grow exponential.



The total costs or congestions can be categorized as loss of time, loss of time which is due to unpredictable estimated traveling time (you have to leave earlier because you never know) and indirect costs.

Emissions

The total costs due to the negative effects of emissions are an estimated 8.5 billion Euros. CO_2 emissions keep on growing with vehicle mileage: the effect of more efficient powertrains is offset by larger/heavier vehicles and the wide spread use of airconditioning systems.



Government & Regulations

Government has a strong influence on mobility through policy and regulation. The most recent policy guidelines from the Dutch government are defined within the "Programma Beter Benutten" which focuses on optimum road usage, partly to be realized by implementing large scale ITS measures. In this national program public private partnerships will be created to solve mobility bottlenecks in effective and efficient ways, including the deployment of innovative cooperative technologies and methods. There is a large overlap in priority areas of this program and the priority areas as set forth in the European Directive 2010/40/EC on ITS:

I. Optimal use of road, traffic and travel data
II. Continuity of traffic and freight management ITS services
III. ITS road safety and security applications
IV. Linking the vehicle with the transport infrastructure

Especially the fourth priority area, the area of cooperative mobility services, is considered to represent the next major growth area for mobility, as well with respect to economic impact as to environmental and social impact.

Changing Industry, new products

The automotive industry is working on safe products for many decades. Recently the safety checks are extended with tests that measure the impact of a vehicle in a crash on the vulnerable traffic participants like pedestrians. Recently "green" is gaining a lot of attention (again), partly supported by government subsidy packages. New Intelligent Transport systems are the base of further efficiency improvements of mobility. These technologies are enabled by modern ICT and mobile communication solutions.

Recent achievements

In the years 2009-2011 significant progress has been made in (a.o.) the following projects and initiatives:

PROJECT	PARTNERS	RESULTS	REMARKS
MILLS	SKF, Sensata, NXP, TNO, PdiT(I), IKA(D), TUDelft, TU/e, HAN, Fontys	an improved Vehicle Stability System, based on Load Sensing input, Vehicle State Estimation and state-of-the art Tyre Technology.	
VERIFIED	TNO, NXP, ICT, Verum, TU/e	Demonstrated functionality, robustness and cost effectiveness of in vehicle x-by-wire network integration based on Flexray technology.	
CCC	TUDelft, TU/e, Universiteit Twente, Navteq, NXP, Technolution, Clifford, TNO	architecture and implementation of retrofittable Connected Cruise Control	Final showcase in 2012
C&D drive	SAM, TNO,TU/e, TUDelft, Universiteit Twente,Centric, WMC, Fourtress	Proven concept of a second generation Adaptive Cruise Control (ACC) sytem based on Ultra-Wide-Band communication	Including automatic merging
uCAN	Beijer, TASS, TU/e, NXP	Webbased Concept for on-line Automotive Services through 1st open aftermarket In-Car CAN-data OBU platform	
FREILOT (CIP program)	PEEK, Volvo, van den Broek Logistics, Gemeente Helmond, Brandweer, +14 european partners	Urban freight energy efficiency by adapting traffic light cycles and driver behaviour at intersections.	Coordinated effort in Helmond, Bilbao, Lyon, Krakow
EcoMove (EU FP7)	DAF, Continental, Navteq, TomTom, Peek, TNO, Technolution, Vialis, Logica +23 european partners	V2V & V2I communication applied to reduce fuel consumption and emissions; adapted driving patterns, logistics handling and traffic management	Tests in 5 European cities Integration & evaluation in 2012
SPITS	NXP, TomTom, Logica, TNO, TU/e, TUDelft, Universiteit Twente, Universiteit Leiden, Peek, Fourtress, NSpyre, Catena, GreenCat	Platform for ITS applications with on-board, roadside and backoffice components. Extendable architecture using a.o. USB, Android, DAB, Wifi-p and other European standards.	Showcase on IAC 2011
Sensor City	TNO, NXP, Peek, Goudappel Coffeng, MagicView, Mobuy, Dysi, Elevation Concepts, TomTom, OV9292, Unive	Large scale data fusion of fixed sensor grid data + floating car data enabling advanced traffic management, car pooling, multimodal routing.	User trails in 2012

Note: non-exhaustive list of representative projects

Based on the resulting project deliverables, assets and collaboration a large portion of these partners have committed to work together in the DITCM initiative as of 2012 (ref. page 14). This will enable The Netherlands to export its combined ITS knowledge internationally as European projects will be attracted to perform testing and piloting. An early example of this successful approach is the Drive2CX project that selected the Netherlands to complete the verification phase before the actual testing will take place in various countries. It is also expected that the SPITS platform will be re-used for other European Field Operational Tests in the context of FP7 and FP8 projects, opening up new export opportunities.

Future perspectives

Expected results

In order to predict the value of Intelligent Transport Systems (ITS) TNO has set up a simulation model. After advanced analysis TNO states that Intelligent Transport Systems (ITS) will bring:

- 50% less traffic jams
- 25% less fatalities
- 20% less emissions
- 10% less CO_2

TNO expects that in the long run even better figures may be realized.

Technologies

New ICT based technologies are fundamental for ITS. A combination of smarter vehicles, affordable mobile communication and smart traffic management enables these ITS solutions.

Automotive

Vehicles are becoming smarter and smarter. With Advanced Driver Assistance Systems (ADAS) the surrounding of the vehicle is scanned and the information is used by the vehicle in order to perform more safe and efficient. Some of the information available inside the vehicle is very interesting for overall traffic management. Within the future, it is expected that more and more information between vehicles, and between vehicles and infrastructure is exchanged. Establishing this kind of information exchange will bring automotive ADAS and ITS to the next level; the 'car-as–a-sensor' will become an integral part of the ITS system architecture.

Communication

Wireless communication between vehicle and infrastructure is of vital importance. It connects the two worlds of automotive and traffic.

Short range

For safety critical applications vehicle to vehicle and vehicle to infrastructure short range communication is required. New communication standards are in development, with the most promising standard being the "automotive wifi" standard (IEEE 802.11p). This standard is based on the consumer wifi standard and is made more robust, with faster setup times, and has an increased range.

Long range

Long range mobile (phone) communication is available almost anywhere. The bandwidth of the digital communication channels is becoming high and is still increasing. The costs of mobile communication are reducing and no longer a significant (blocking) issue in the business cases. Especially the introduction of 4G (LTE) technology in the period 2012-2014 will enable applications that were previously deemed only feasible with wifi p technology. New digital radio solutions offer broadcast channels with increased bandwidth especially setup for traffic management, enabling cost effective delivery of fresh dynamic traffic content.

Traffic management

Traffic management systems are becoming more intelligent. More and more sensors are installed on the road and the integration of traffic systems is ongoing. Huge databases (in Holland: NDW) are setup that are storing all kind of information with respect to traffic flow and traffic management. The new technologies will raise questions on whether to continue with measuring traffic through road sensors and cameras or to move towards new methods like connected vehicles that act as sensors or tracing mobile phones. Furthermore a major research field will be the most effective way how to provide advice to the driver: offering more advanced electronic information boards or transmitting this information directly into the vehicle systems/displays, integrated with navigation and ADAS systems. Actual driver behavior as a result of this extended information supply will become a very important success factor for all future mobility applications.

Challenges

Bridging the gap

Surprisingly the traffic and automotive domains are operating rather independent. In the organization like car2car.org, we see mainly automotive OEMs, and the traffic organizations seem to be rather passive. The big challenge is to bring these industries together. Note that these industries have completely different backgrounds. Automotive has a mechanical and production background, traffic management has mainly a government background.

Domain Integration

As already mentioned above we have to bring different industries together, traffic and automotive. An important step will be the close collaboration between AutomotiveNL (the leading Dutch automotive sector organization from 2012 onwards) and Connekt/ITS Netherlands (the leading Dutch cluster organization for traffic & logistics). Research programs and roadmaps will be aligned and a coordinated approach to public institutions will be pursued. Within this cooperation telecom service providers will play an important role as they provide long range communication services and access to the internet and related services.

Open systems

In automotive as well as traffic the systems tend to be closed from an historic point of view. Interfaces to the available information in the in-car systems are scarcely available and differ from OEM to OEM. This makes connecting automotive and traffic solutions practically impossible. Hence a strong emphasis in European programs can be seen on establishing standards and protocols for open data exchange and/or system architecture. An important step towards an open platform for ITS applications has been set in the SPITS project from 2009-2011 and it is expected that this initiative will have a follow up in the various Field Operational Trials that will be performed in the coming years.

Business climate

Vehicle installation

Due to the fact that the systems are not open and each OEM uses its own propriety solution, integration of third party solutions makes sense from an overall perspective but is not yet feasible. The vehicles are currently not prepared for third party ITS solutions. There are limited standard interfaces and protocols and there is no standardized space for mounting an ITS device. Currently the vehicle OEM can set up an integrated and proprietary system quite efficient with sufficient comfort for the users, and automotive OEMs are generally quite reluctant to give up this 'vendor lock-in' position. Nevertheless recent developments in the internet domain and smartphone market indicate that open platforms are the future trend and that no single company can match the innovation rate of a wide community of application and service providers. Sooner or later this rationale will also be adopted in the in-car mobility platforms because customers are just used to seamless and instantly available services regardless of time and location.

Who makes money?

A huge part of the cost of congestion, environmental and safety costs are borne by society, with government as the representative party. It is the government which is investing heavily in traffic management solutions through infrastructure, traffic control centers and data management. Although it could be much more cost effective to make the shift to de-central traffic management using in-car devices the business case is rather problematic: for the vehicle manufacturer there is not sufficient incentive to add extra functionality and costs to the vehicle to help solving a 'public' problem. How will they make money when they improve congestion? Initially the proposed introduction of 'Anders Betalen voor Mobiliteit' promised to provide a obligatory localization and telematics platform that could serve as a basis for additional services, but this was halted due to political decisions. Currently the future obligatory deployment of e-call (automatic emergency call) seems to hold the same promise; however, because of its safety related nature it remains doubtful if third parties will be allowed to deploy services on such a platform. It might well be that mobility services as an add-on to user oriented, value added services such as usage based insurance or infotainment systems turn out to be the most successful carriers for new mobility services and de-central traffic management.

Safety & Reliability

Currently the driver is all the time in charge of the vehicle. With increasing supporting functionality in the vehicle - generally indicated with the term advanced driver assistance systems (ADAS)- this might not longer be the best option from a safety point of view. Recently the first cars with override emergency braking have been introduced in the market and this is only the beginning of a continuing trend. However, most insiders consider it still a long road towards fully autonomous driving, because next to technology there are also legal, liability and user acceptance hurdles to overcome. Nevertheless, the phrase 'do you want to drive yourself or do you want to drive safely' seems to gain more importance in this decade.

Human Vehicle Interaction

Human vehicle interaction is already a topic for several decades and is becoming even more and more important. More information has to be provided to the driver and the information is becoming more critical and safety related. In order to create more human like interfaces, new technologies are becoming available. An example of a new technology is the cameras that are able to read position and movement of arms and faces of the driver. Note that human vehicle interaction solutions cannot be developed in the technical domain only, cooperation with other domains is required.

From Research to Deployment

Recent years have shown a multitude of research projects in which the proof of concept has been shown of many technologies and applications. Mostly these tests have been restricted to single vehicle makes and -types resp. single communications technologies and/or driving patterns and environments. A real challenge is to proof the robustness , interoperability and effectiveness of these applications in (near-) real environments and on a larger scale.

Based on experiences and investments in previous projects an ambitious initiative is now being prepared to take on this challenge: The Dutch Integrated Test Site for Cooperative Mobility (DITCM) will be launched early 2012. Backed by a host of internationally leading private and public parties a unique combination of facilities, infrastructures, data and knowledge will become available to push new and promising mobility services towards large scale market introduction. This will be a decisive factor to position the Netherlands as the cooperative mobility solution provider in the international arena.

ATC Partners & Participants:

As of 2011 the following ATC Partners & Participants were active within cooperative mobility:

PARTNERS:
Eindhoven University of Technology
Fontys Hogescholen (Automotive Center)
Gemeente Helmond
HAN Automotive
N.V. Brabantse Ontwikkelings Maatschappij (N.V. BOM)
NXP Semiconductors B.V.
TNO Industrie en Techniek, BU Automotive
TomTom Eindhoven

PARTICIPANTS:
ACTIA Nederland BV
Baesis Automotive BV
Centric T-Solve/Automotive
Continental Automotive Trading Nederland BV
DTI – Drivetrain Innovations b.v.
Fourtress BV
High Tech Automotive Campus
LMS International BV
MECS mechanical & electronical control systems b.v.
NAVTEQ Europe B.V.
NHTV – Breda University of Applied Sciences
Sensata Technologies Holland B.V.
Sioux Embedded Systems B.V.
TASS B.V.
TE Connectivity
Technocon
TOPIC Automatisering B.V.
Verum Software Technologies

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Automotive Cluster
Euregio Meuse Rhine

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