DOCUMENT SMART MOBILITY

In dit document drie artikelen.

De eerste (2-21) betreft mijn inaugurale rede. Die ging vanzelfsprekend over de kern van mijn leerstoel, de maatschappelijke aspecten van smart mobility. Ik heb getracht een kader voor de bestudering van smart mobilty te presenteren, en vooral ook smart mobility te koppelen aan samenlevingsdoelen.

Het tweede artikel (22-35) verscheen twee jaar voor mijn inaugurale rede in het tijdschrift *Journal of Traffic and Transportation Engineering.* In dit artikel schetst ik twee sterk verschillende toekomsten voor het autogebruik, beiden wel gebaseerd op de mogelijkheden van smart mobility

Het derde artikel (36-43) , verschenen in het tijdschrift *Verkeerskunde,* geeft de stand van zaken inzake smart mobility in Nederland weer anno 2019. Veel verwachtingen, maar weinig wat steviger resultaten. Ik zoek naar een verklaring voor die stand van zaken.

Artikel 1

SMART MOBILITY AND SOCIETAL CHALLENGES : AN IMPLEMENTATION PERSPECTIVE, INAUGURAL LECTURE, 2016

Introduction

In our modern world physical mobility is a contested domain. On the one hand physical mobility is related to freedom, the freedom to move everywhere, and at all times. We all cherish this freedom, symbolized by the car. On the other hand, physical mobility faces boundaries, boundaries related to the carrying capacities of societies - ecological, but also social. Environmental norms, congestion but also border patrols, are elements to be mentioned here. We love being mobile ourselves, but at the same time we sometimes feel discomforted by the mobility of others (1).

1. Refugees and cars in Budapest (source; AFP Getty Images, 4-9-2015)

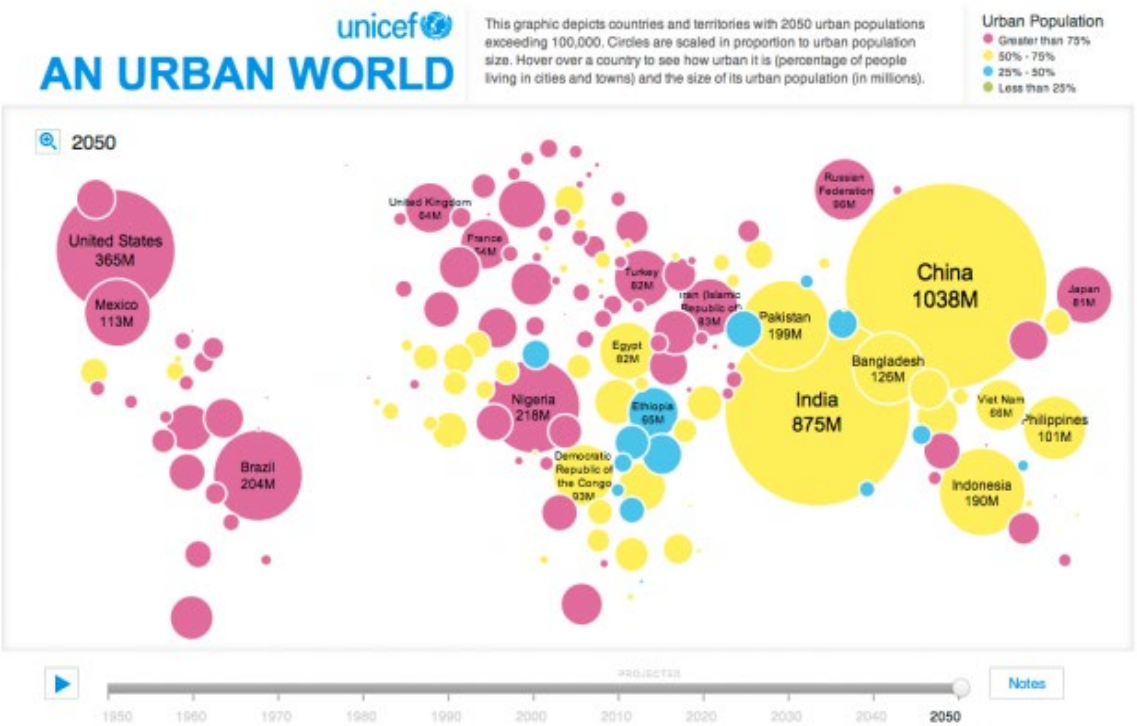
This lecture is built around three elements. First, I will focus on the great **societal challenges** related to mobility. Then I will ask the question what the potential contribution of **smart mobility** can be in coping with these challenges. Finally, I will concentrate on the **implementation challenges** to identify how these potential contributions of smart mobility can lead to real achievements.

Societal Challenges

I will present five societal challenges on mobility, as I see these challenges arising from literature.

The first challenge is the challenge of **urban mobility**

The future will be urban: according to the United Nations of the world's total population of 6.8 billion people in 2010, 51 % was living in urban areas and this urban share will rise to 61 % of 8.2 billion people in 2030, and to 70 % of 9.2 billion people in 2050 (2). We will be faced with more megacities. Arthur D. Little expects in 2040 almost a tripling of kilometres made in urban areas. (3).



2. An Urban World (source: Unicef, The State of Worlds Children, 2012)

The ***challenge*** therefore is to combine mobility with liveability. Cities and city regions are densely populated, they need mobility, but mobility in majority offered by private cars will lead to vast areas of car related infrastructures of roads and parking, extensive use of scarce space, and will create health problems.

3. Traffic jam in Dhaka, Bangla Desh, 2013

We do not know yet how urban mobility systems that are sustainable and efficient can look like, but the end result should not be like this…..

4. Sjang Hai on a normal day…(source: China Press Photo, via Getty Images)

Interesting developments on urban mobility can be found in the Global South, with Chinese cities investing in public transport, in new types of bicycles and bicycle infrastructures, while South American cities are now the most innovative in creating Bus Rapid Transit systems (Bogota, Medellin). There is a vast amount of literature on the development and implementation of Bus Rapid Transit systems (4), an innovation from the Global South, for the Global South.

5. BRT in Bogota (source: Inbus transport Onmibus)

Looking to our part of the world, the sharing economy provides us with a perspective of change with the introduction of urban mobility service providers owning a fleet of different transport modes, that could be used and left behind with their clients. Apps and other ICT tools can result in offering just in time - and "just in location" - solutions (5).

This brings me to the second challenge, the challenge of **IT in mobility**
ICT has moved to the world of mobility. In this university we consider cars to be "computers on wheels".

6.Ipad on wheels (source; Steinbuch World Press)

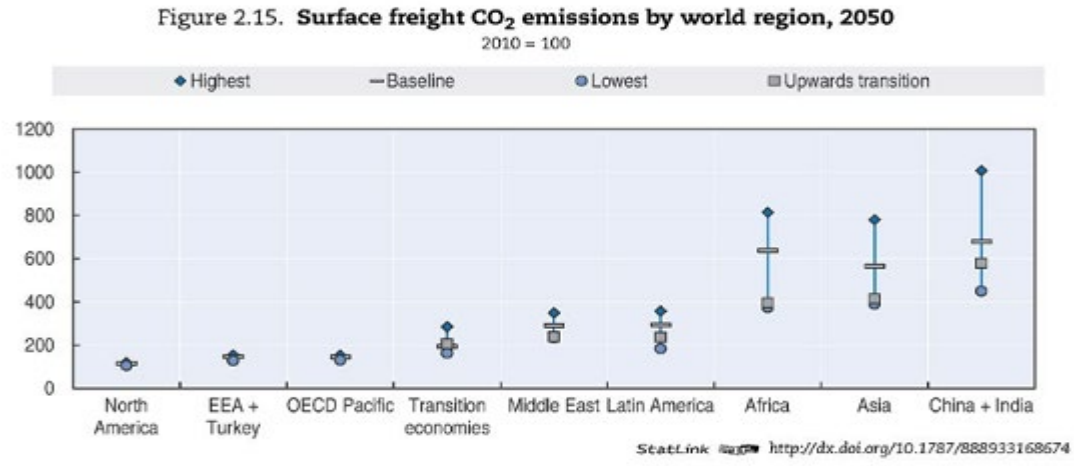
ICT is rapidly changing mobility. Many new technical possibilities are arising on sensors, controlling, driving support and automation, in the area of combining and integrating data, trip organisation and trip planning.

To give an example. We now witness a hype on automated driving. Expectations are rather high, some media claim that in a few years from now we will have automated driving available at a large scale. But before we can move in automated cars at least three social problems need to be addressed. The first is the unsafe situation of drivers as back-ups in case of failure of systems in automated cars, and the liability and reliability aspects involved (6). Second, the deployment of a system of connected cars asks for stable cooperation and joint investments of many stakeholders. This creates, looking at the current situation, a great organisational challenge (7)

And third, the reluctance of the majority of customers to accept automated driving needs to be overcome, as most marketing studies show only a 30-40 % of car drivers considering purchasing an automated car (8). These challenges need to be met to create implementation successes in automated driving.

The challenge of **globalisation and freight**
Globalisation is a major trend in our world. As a consequence, we will see a continued growth in the volume and the kilometres made for freight traffic. Globalisation and removing barriers in international trade, combined with low transport prices and a great differentiation in labour costs over the world can lead to very long and very differentiated supply chains.

The International Transport Forum presented in its Transport Outlook 2015 scenarios indicating a growth in surface freight kilometres between 232 and 423 % in 2050 (compared to 2010), while related CO2 emissions will increase between 136 to 347 %. (9).



7.Surface freight CO2 emissions , world region 2050 (source: ITF, International Transport Outlook 2015,56)

Can we work on paradigmatic changes in international trade patterns, in logistics, in IT based supply- demand modelling and related programming, where “just in time”- transports could create fewer empty trucks ? This seems possible only with huge changes in the institutional and organisational set-up of the private transport sector. Can two rather different developments; 3 D-printing, and platooning act as possible “ agents of change”?

This brings me to the fourth challenge, the challenge of **energy and climate**

The match on energy and mobility in creating cleaner cars is still being played. Each few years there seems, at least in the media, to be a new winner. A couple of years ago electric vehicles looked booming. The number of EV ‘s , however, remains below the targets, with a market share on new

cars below 1 % (10). We also note the initiative of FIA, IEA, ITF and UNEP suggesting that the average fuel economy of the global vehicle fleet can be improved by at least 50 percent by 2050 (11). And we still have the perspective of the hydrogen car.
The ***challenge*** here is to direct investments in energy infrastructure in such a way that the results lead towards reaching goals set to limit global warming.

Three elements need to be taken into account here.

First: there is no clear winner yet, and with all hypes, it remains difficult for public and private stakeholders to invest in alternatives for fossil fuels, as Farla, Alkemade and Suurs (12) have shown. Low oil prices are not helping either (13). As a result, fossil fuel infrastructures will likely remain dominant.

Secondly, the time needed for a change of the whole car fleet is often forgotten. In most developed countries, and certainly in the developing world, most households buy second- hand cars and not new cars. Even when all new cars have new energy technologies, which will not be the case – it will take quite a long time, more than 15 years, before new energy technologies and other power trains will be introduced in the complete car fleet. (14)

The third element is the most important. All the efforts to increase energy efficiency in cars will probably not be sufficient to reach the necessary CO2 goals in 2050, that is a reduction of CO2 – emissions of 60-80 % (compared to the 1995- level). We already presented some figures on freight. Transport is now the only societal sector still growing in CO2 -emissions. Other societal sectors now still accept this, but their solidarity will not last for decades. I looked at scenarios on mobility and CO2 levels, which take the best new technologies into account. I did not find any single scenario that reaches higher CO2- emission reduction levels than 50 % (15). It is even worse, as in most scenarios a huge mobility growth in the developing world is not even taken into account.

Reaching CO2 - objectives will be a great political challenge, and a conclusion could be that without reducing the number of kilometres travelled substantially, we will not be able to reach global warming - targets as defined in the recent Paris Summit. In this respect the Mobility Report of the Long- Term Scenarios of the Dutch Government (16) is interesting. After mentioning that reaching the minus 2 degree- target on climate change had not been taken as a starting point for the scenarios – which seems rather strange in itself - the planning agencies CPB and PBL conclude that reaching this goal:

- is technically possible, but asks for far more investments in biofuels, and in a fast electrification of the car fleet
- can create far higher costs for car use
- and will lead to blockades in trends towards globalisation.

I arrive at my last, fifth challenge: the challenge of the **next generations**
Looking at the future of mobility, the attitude of the new customers is crucial. What will new households, in the developed and in the developing world, see as appropriate mobility, and what are they able and willing to pay for mobility? Looking at the developing world, will growing economic prosperity there lead to the same developments in car purchases as we have noted in the developed world in the period 1960-1980? Will cars also be their symbol of individuality and status?

And what about the households in the developed world, where saturation in private car use can be noted (17). Will they move somewhat away from car ownership ? Can a paradigm shift really be observed ?

The ***challenge*** here is to understand the patterns behind the mobility behaviour of the younger generations, and to use the opportunities that this behaviour and their basic positions could create.

8. Mobility for younger people (source; Unknown)

Is the sharing economy a hype as well, or is it the start of a real paradigm shift ? On the choices of the younger generations a fierce debate is taking place in academia (19). Two opposing positions dominate: yes, we see a paradigm shift, and no, the younger generations are just postponing their car purchase until they start building their families, which happens somewhat later than in older generations.

This situation raises rather difficult questions, especially for investors. Where to invest with this rather unclear future? And with which allies? Will new players enter the market? It seems necessary to develop and design new business models bringing together car technology, cycling technologies, ICT in cars and public transport, infrastructure, mobility services, more or less at the same time, and from a common paradigm, combining investments in both private and public worlds. This will ask for far more cooperation between all stakeholders. (20)

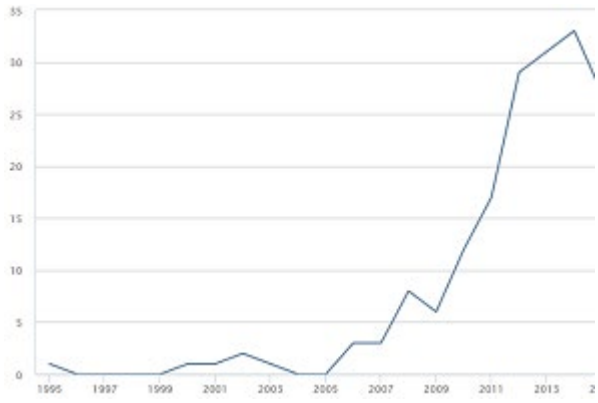
Many problems, and many uncertainties dominate the future of mobility. What has smart mobility to offer in creating perspectives and solutions for the challenges mentioned?

Smart Mobility

Smart Mobility is one of the Strategic Research Areas of our university. But what is smart mobility? And what can smart mobility potentially offer in coping with the five societal challenges on mobility? Smart is “in”, everybody loves smart. We now speak of smart grids, smart cities, smart mobility, and even about smart societies. It is interesting to note that this word received its take-off somewhat around 2009. I will show you some figures from Scopus, the search engine for academic literature, that I prepared. On the Y- axis you see the number of academic publications, on the X- axis the years.

Smart grids

Smart cities



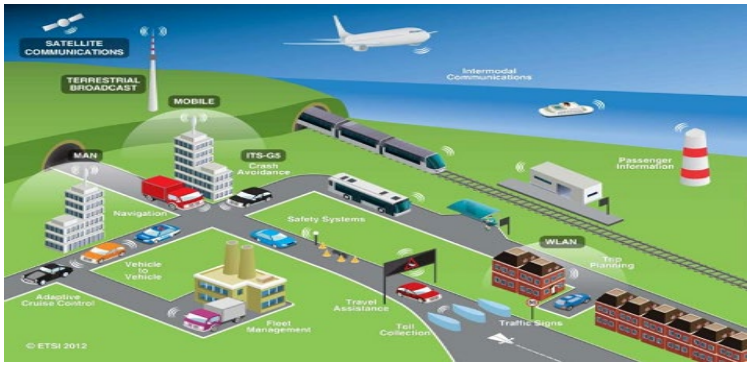
Smart car mobility

Smart relates to clever, to fast, and more recently also to dynamic. We seem to be waiting in cities, mobility, grids for clever, fast and new solutions.

a concise and generally accepted definition on smart mobility been developed in the last 6 years? This seems not to be the case. Smart mobility is a concept still lacking consensus about content and scope. Every organisation uses another definition. A web search visiting 12 sites of important stakeholders in the mobility domain (21) did give a basic orientation on the current scope of this concept. The common denominator will be presented here. Following the results of this web search, smart mobility can be seen as a combination of four domains.


9. Source: American Power Companies

Secondly, smart mobility is about **Intelligent Transport Systems**: cooperative adaptive cruise control, traffic management, connected automated driving, platooning of trucks

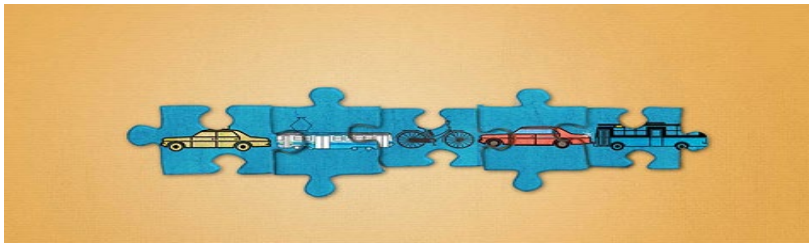


10. Source: ETSI,2012

Thirdly, smart mobility is about **data**: travel information, logistics planning, advanced IT- systems for matching supply and demand, big data solutions


11. Source: unknown

And finally, smart mobility is about **new mobility services**: seat management, car sharing, ridesharing, connecting transport modes, new cycling systems



These four domains – vehicle technology, ITS, data, new mobility services –broadly define the current scope of smart mobility. Smart mobility finds its origins in a combination of technical sciences (vehicle technology and ITS), data science, and social sciences (introducing new services).

However, we should not forget that with this actual framing some historic context is lost. In aviation and rail transport smart solutions did already found their way.

Most current smart mobility research is technical and practice oriented. Visiting the Smart Mobility -research meets at this university I observe that the technical issues related to the solar car, the solar motorbike, truck platooning, advanced cruise control, mapping for automated driving, electric mobility, and designing user friendly cars are prominent in the smart mobility portfolio. But what is the relation between those solutions and the five societal challenges ?

I present a first overview of this relation.

Domains of smart mobility/ Societal Challenges on mobility	**Urban mobility**	**Globalisation and freight**	**IT in mobility**	**Energy and climate**	**Next generations**
Vehicle Technology	**Smart biking**	**Powertrains** **Last mile systems**	**Automated driving** **Electric Vehicles** **Solar Cars**	**Fuel technology**	
Intelligent Transport Systems		**Truck Platooning**	**Connected and cooperative driving**		
Data	**Relation with smart cities**	**IT Matching supply-demand**	**Big data possibilities**		**Real time travel information**
New Mobility Services	**Integrated mobility services**	**Urban logistics** **Logistic services**	**Intelligent apps matching supply-demand**		**Sharing economy concepts (car sharing, ridesharing)**

This looks impressive however I do not want to present easy answers on the relation between the dominant portfolio of smart mobility research and the societal challenges on mobility. I even note that this relation is rather difficult. What is , for example, the relation between technical work on truck platooning and the societal challenges on freight mobility and logistics? We had six student groups on platooning, and they concluded that platooning can create more energy efficiency, and more quiet and safer traffic circumstances. All very useful, but this contribution is rather marginal *vis a vis* the societal challenge on freight transport. There seems to be a gap between the promise of smart mobility and the real- life contribution of smart mobility solutions to the great societal challenges on mobility. To mitigate this gap researchers mostly concentrate on intermediate targets

such as: to create safer mobility, to use existing infrastructures better, to realize mobility that fits into older environmental norms and standards, and to create less burden on scarce space, especially in cities.

However, from these targets to coping with the societal challenges is still a long way. In my opinion the connection between the researchers in the engineering departments and the researchers working on socio- technical transitions can benefit substantially when technical researchers try to develop stories, also for their students, on the relation of their current research with the great societal challenges on mobility and the transitions that should occur.

Implementation Challenge

In mobility at this moment developments go slow and fast at the same time. The development of new concepts goes fast. Electric driving, truck platooning, mobility as a service are cases in point. But at the same time developments are slow. To present some examples: electric cars can - considering that from 2018 10 % of car purchases will be electric, with electric car purchases growing to 60 % in 2025, and taking into account the start of a second- hand electric car market around 2019- be some 15 % of the car fleet in 2025, meaning that the real paradigm shift from fossil to electric will take place between 2030 to 2040. On truck platooning harmonisation between exemption strategies will take time, and as yet it is unclear who will drive the realisation of truck platooning in society. And on Mobility as a Service (MaaS) we see many new concepts, and the introduction of many smaller niche companies, but no great market shares arising.
In my opinion a clarification for this state of art can be found in the difference between possibilities and magnitude. Possibilities are there, but creating magnitude is another story. Media tend to forget this and publish articles as if new developments are already with us in important numbers, which is not the case.

This brings me to the third central word in the lecture, **implementation.** Smart solutions can meet societal challenges only when these solutions are implemented in society. Smart mobility is a concept, not only for the academic world, but also for practice.

Implementation of technical solutions and products varies greatly. There are examples of relatively fast implementations like mobile phones, and - for the older generations - color television but sometimes it can take a very long time (if ever successful) like the introduction of electric mobility or automated driving, where, as we now know, thanks to the work of our colleague Gijs Mom (22) and the work of Steve Beiker (23), director of the Stanford University Car Research Institute, the first narratives originated already a century ago.

New technical smart mobility solutions can be implemented relatively easy when these solutions are closely connected to technologies central to the regime. For example: a next step in creating greater fossil fuel efficiency fits nicely within the fossil fuel- based regime.

But, as we have seen, dealing with the societal challenges requires often a paradigm shift or transition. (24). New technical smart mobility solutions can face greater implementation issues when these technologies do not fit well within the normal regime routines. For example, the large-scale introduction of electric mobility will require major changes in the current regime. From transition studies we know how difficult it is to change the dominant system with its sets of rules, agreements, arrangements and institutions, the incumbent *regime*. On the other hand, we know that regimes are not static or stable, but can change. Change can come from within or originate from the *landscape,* the wider area of developments and trends like globalisation and the Paris agreements on the fight against global warming. Change can also originate from *niches,* new technological or social innovations like EVs or car sharing.

Studying implementation asks for a description of the state of the art of the regime. What is the dominant set of rules, arrangements, agreements and institutions ? Here I would like to follow Frank Geels, who published in 2012 an article in which he described the regime in mobility. This regime is in essence built around individually used and privately owned cars, driving on fossil fuels, with in cities a role for mass transit. He concludes that the automobility regime is still dominant and stable, although less so than fifteen years ago, that there are some cracks in the regime, and that most of the promising niches have limited internal momentum. This momentum is larger, however, for the technical niches of green propulsion technology and for ICT/ITS, which are therefore better placed to take advantage of the emerging windows of opportunity (25).

Smart mobility solutions can be brought into this regime by three routes. First, by normal purchasing. New technical solutions could be purchased by households, or by fleet owners. The acceptance and the willingness to pay for new technical solutions by potential customers is crucial here.
Second, via regulations, subsidies and norms Governments can support the implementation of new technical solutions by creating better starting positions for these solutions, in relation to normal solutions. And can create pro- active investments.
Third, by creating pilots and experiments, seen as showcases. In this route and in the second route, up-scaling is crucial. In the mobility domain there are many rather isolated pilots. Many pilots can create the impression that there is great energy on a new development, but as these pilots are often not connected there is no focused energy created, as Newman shows (26) for electric mobility.

In general, implementation of potential disruptive solutions in the mobility domain has not been easy. Geels concluded in 2012 that drivers for change like public concerns over climate change, government policies, or even car industry innovation strategies were not very strong. (27).

I will present and discuss three important implementation problems on mobility.

- reluctance of the potential users
- problems with up-scaling ideas and pilots
- lack of governance capacity

At first: reluctance of the **users**. An example: *Advanced Driving Assistance Systems (ADAS)* are helping drivers in traffic safety and comfort, are IT driven, and form the basis for further steps on the route to automated driving. ADAS contains elements such as:

- Blind spot monitoring systems
- Adaptive headlight systems
- Obstacle and collision warning, with as a core element ACC (Advanced Cruise Control)
- Lane keeping support systems
- Emergency braking systems

The implementation of ADAS differs in the western world, and mostly stops somewhere in the middle segments of the car fleet (28). The implementation of these newer ADAS systems seems rather slow, on two levels ; car manufacturers are not immediately introducing these systems in all their cars, and most customers do not seem very willing to purchase these systems yet (29).

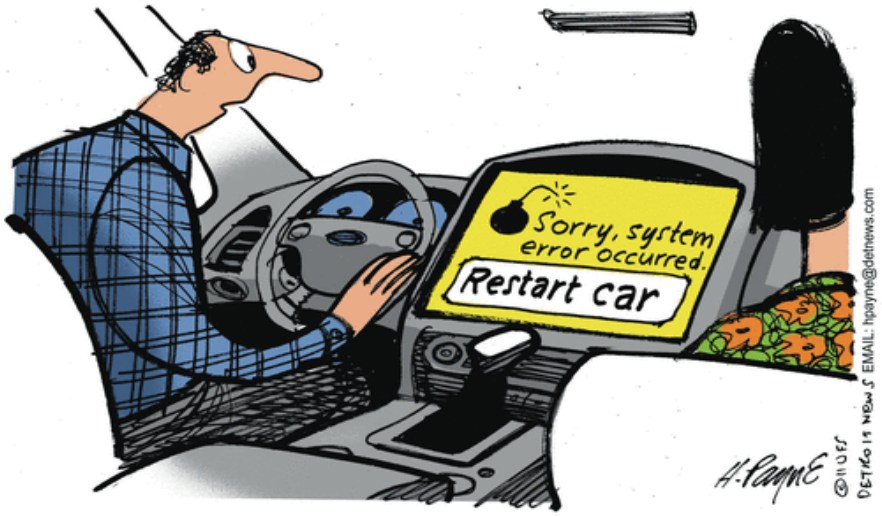
Why are these interesting ICT possibilities advancing so slowly ? On this issue the thesis of Peter Planing: *Innovation Acceptance. The case of Advanced Driving Assistance Systems* (2014*)* presents an analysis. Planing looked at the German situation, and notes, that “despite their potential, most intelligent driver- assistance systems have not yet reached the market “ (30). Based on a German Road Safety Council, between 12 and 35 % of car drivers in Germany are aware of certain ADAS

elements. Important reasons for the state of art among potential customers that are familiar with these systems is that “consumers generally appreciate the comfort or safety benefits that these systems offer, while on the other hand consumers have serious concerns about the reliability of these systems” (31). In Planing’s words, they form positive and negative evaluations at the same time (30). Behind this is also some fear of “losing control over their vehicle” (32).

The ambivalence of potential customers of ADAS needs to be overcome, before the visions on automated driving, as set by the media could become reality. Ambivalence and even reluctance among potential users is a larger phenomenon in new mobility options. The “range anxiety” related to electric mobility can also be seen as a case in point. An interesting question will be what sort of mobility options the first generations that have grown up with ICT, born from 1993 onwards, will prefer.

Next, the issue of **up-scaling.** From ideas and pilot towards introduction at a larger scale. Looking from a longer time perspective, the development of *automated driving* has not been an easy one. Successive smaller and bigger hypes have been created, starting with the World Fair General Motors’ “Futurama’s” at New York, 1939/40, continuing with the General Motors/RCA technology development and testing in 1950s-1960s, followed by the introduction of the PATH Program R&D from 1986, and leading to the National Automation Highways Systems Consortium 1994-98, with the San Diego pilot on automated driving in 1997. At all these moments the expectations for implementation were set on two decades later. Many pilots were made, but upscaling failed.

The history of automated driving has been well documented (33) Important reasons for slower developments than expected were difficulties , after many pilots, in reaching appropriate business cases, reluctance and doubts of car drivers, liability issues and pricing and equity issues. As you can note: all social issues.



13. Automated driving cartoon. Souce: A.Payne, 2014

And on *electric mobility* the development also has not been easy. Only looking at the last decade, we notice a real hype around 2010-2011, heavily subsidized. However, in a Dutch car fleet of nearly 8 million, we now have 10.000 full electric vehicle, and 80.000 hybrids, mostly used not as electric vehicles. With these figures we are in the top in Europe, in second place behind Norway. Electric driving still faces reluctance, from fleet owners, from households, related to “range anxiety” and related to lacking charging infrastructures.

Last example. Since the seventies we have *car sharing schemes* and *bicycle sharing schemes*. More cities have created pilots and have implemented smaller schemes (34). However, upscaling remains difficult.

The situation on implementation in mobility seems to be, at least in the western world: a strong regime, many ideas for change, many technical and smart solutions, and a rather difficult implementation of many of these solutions, at least beyond the spheres of pilots and experiments. And this within a landscape of great societal challenges on mobility.

The theory on **governance capacity** can create some insights. Governance capacity is a term coined by Innes and Boher (2003,2010), and by Healey (2007) (35); it defines the capacity of the stakeholders in a societal sector to create joint solutions for the societal challenge in that sector. This means that conflicting ambitions and interests have to be reconciled. To mobilise organisations to work towards common defined goals and targets, and to get decisions out of the debating rooms. In other words: this is about the creation of capacity to act jointly!

Governance capacity is high in some societal sectors and low in others. For example, the Dutch governance capacity in the water sector is high. In domains with a low governance capacity lots of reports are written, lots of research programs are created, many debates are held, but the end result is just a stand - still, with the same discussions coming over and over again. In my opinion, the governance capacity on mobility is rather low. I will concentrate on car mobility, being the core element of the mobility regime. A group of young mobility researchers presented an analysis on this issue and concluded that " the car system has nowadays a too small self - generating capacity for solving actual and future dilemmas and problems "(36)

In my book The Car Dependent Society I defined 22 relevant stakeholders related to car mobility (37). These stakeholders can be divided in three groups:

- the commercial stakeholders: the car dealers, the garage owners, the car industry, the car insurance companies, the oil companies, the petrol station managers, the driving schools, the lease companies, the service providers and the providers of travel information
- the government parties: the highway or road agencies, the juridical services, the enforcing institutions, the policy makers and the politicians, the financial institutions, the tax organisations, the incident and emergency institutions, the municipalities and the regional governments
- the societal stakeholders: the employers, the organisations of road users, the environmental organisations, the academic world.

There are only few systematic links between these stakeholders. These stakeholders have never been pressed to design together a robust, resilient and future oriented system of car mobility, reaching sustainability criteria and answering societal challenges. Each stakeholder follows his own policy.

But the situation is not completely hopeless. A few "nuclei of joint activity" can be found.

- There is a nucleus around traffic safety, with the enforcers, the incident and emergency institutions, the car insurance companies, the road agencies and the driving schools involved.
- There is a, somewhat weaker, nucleus around congestion management, with the employers, the car users organisations, the service providers, the suppliers of travel information, the road agencies and the policy makers involved
- And there are some initiatives on sustainability, with the car industry, the car dealers, the lease companies, academia and the environmental organisations involved.

For the future a central question is whether we can we work on a smart mobility programme to face the societal challenges. When we do not want to rely on rather slow purchase of new technical and social solutions, or on complete disruption, it will be clear that implementing smart mobility solutions asks for clever implementation networks.

Three steps can be identified in this respect.
Creating a joint implementation program, as for example has been done with the *Routekaart Beter Geinformeerd op Weg 2013-2023*, is a first step.
As each stakeholder needs its own positive business- case, the next step is in elaborating shared interests. This is often more difficult to reach.
And for the continuity of the implementation a last step, creating a value community working within a framework of shared values, seems essential.

We start to understand that for implementing smart solutions for societal challenges, cooperation is needed. Organizations need to cross their boundaries and make connections with outside worlds. For the connection between stakeholders and the smart mobility communities at our university I see three essential step:

- clarifying ideas and insights about smart mobility to stakeholders,
- getting into dialogue about what smart mobility solutions could mean for the strategy and the operations of the stakeholders and
- realizing a joint research program.

This is what the university did in cooperation with Rijkswaterstaat and broader, with the Ministry of Infrastructure & Environment.

A part time professor is a rather strange animal, with two different legs. I stand on one leg, the smaller one, in the academic community, and will follow rules and codes in academia. With the other leg, the bigger one, I stand in Rijkswaterstaat and the Ministry, and will follow their rules and codes.

My personal challenge is in working on questions relevant for both organizations. These questions focus on the implementation of smart technical and social solutions in the portfolio of Rijkswaterstaat, being the highway manager on the national level, and now moving towards a broader role as a national mobility manager.

Smart mobility, with its four domains, will certainly lead to changes in the work of Rijkswaterstaat, at a conceptual level, but also at an operational level. From the other side: the networks of Rijkswaterstaat can be seen as testing areas for technical new ideas and perspectives.

Rijkswaterstaat has questions about their users, about the speed with which users will pick-up smart mobility solutions, has questions about the future of traffic management, and would like to understand the dynamics on travel information and data. And Rijkswaterstaat and the Ministry would like to know whether the technical research at this university can change their future frames. Note that these questions are not about whether or not there will be a technical innovation, but about the impacts of such solutions in societies.

Towards a research program on the Societal Aspects of Smart Mobility

I identified five great societal challenges on mobility. I tried to describe the current scope of smart mobility. And I explained that many solutions from smart mobility research, potentially offering contributions to the societal challenges, will face difficulties on the road to implementation, due to

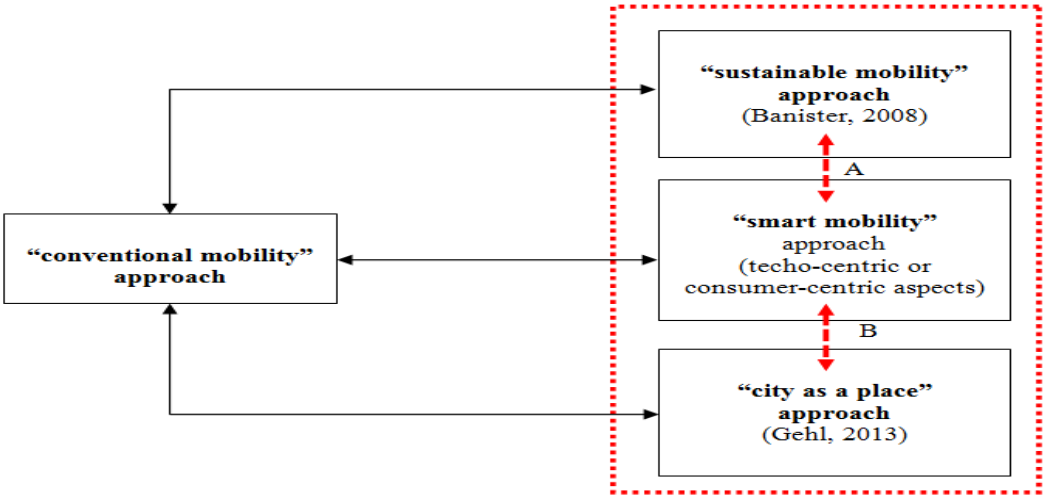
behavior of users, due to problems of scale and due to lack of governance capacity. My chair is called “societal aspect of smart mobility” and is centered around these related problems.

A viable connection between stakeholders asks for an understanding at universities of the implementation challenges stakeholders are facing. On this implementation we can identify a long track. Products from academic research are mostly not directly implemented in societies, at least not at a greater scale. There is a complete *“implementation chain”* consisting of prototyping, small pilots, larger pilots, experiments in real life, product development, marketing, first purchases, developing niches market, sometimes ending in regime changes. And a greater part of this chain is outside the university. As we have seen many problems are related to the implementation phases. But technical researchers often frame these problems as “far away from their business”.
When this remains the case technical students will understandably ask questions about the usefulness of knowledge about implementation and societal aspects. And with this attitude the connection with stakeholders breaks.

These aspects of implementation, aspects like user perspectives - issues related to up-scaling pilots, ethics and societal changes, or issues related to decision making in stakeholder organizations - need to be built in the start of designing and defining scopes for technical solutions and discussed also between university professors and their students. But I must admit: looking at my experiences there seems still a world to win here.

I will finally introduce a research program related to the societal challenges and to the implementation challenges. And the core of this program is on smart mobility, its deployment and user perspectives.

Mobility can be studied from different perspectives. Papa and Lauwers (2015) (38) presented four perspectives for analysing mobility. Although these perspectives are not on the same level of analysis, they create some insights.



14. Four perspectives for analysing mobility. Source; Papa and Lauwers, 2015

First the dominant approach until 15 years ago, called conventional mobility- approach. In essence, this approach is about “predict and provide”. The growth in mobility, for different modes, for freight and passenger transport was predicted and infrastructure was provided to accommodate this growth.

Since the Brundtland Report (1987) a new perspective emerged: the sustainable mobility approach. This approach is dominated by analysing mobility from three starting points: ecological, economical

and social. Sustainable solutions can be found by taking all three starting points into account. Many researchers also include the global equity aspect, found in the original Brundtland report. One could state that the sustainable mobility- approach is now the leading approach to study mobility in the academic world. However, many researchers, especially in the engineering studies, use a definition of sustainability that is not in full accordance with the Brundtland terminology. Sustainability is than constructed as a form of "ecological, or environmental - plus". Mostly the social dimensions and the global equity aspects are left out.

A third perspective on analysing mobility starts with the challenge of urban mobility. Since the seventies there is a debate on the relationships between mobility and the liveability of cities. Radical solutions as traffic calming, pedestrianization, strict parking policies, and low emissions zones fit in this debate. This approach can be called the city as a place- approach. This approach is less analytical and more design- oriented: equilibrium between mobility and liveability can be created with clever spatial planning and urban design.

And now there is our approach, smart mobility. Papa and Lauwers (2015) locate smart mobility between the sustainable approach and the city as a place approach. And yes, smart mobility is a related to this last approach, as it is also more about designing, but now with technologies.

The relationship between sustainable mobility and smart mobility can be situated in a broader discourse, as introduced by Baker in *Sustainable development as symbolic commitment* (2007) (39). The theme of this study is the connection between ecological modernisation and sustainable development. Ecological modernisation is a theory of social change, exploring to respond to negative environmental consequences of modernity. In ecological modernisation the North- South dimension of the sustainable development agenda is side- stepped. And the notion that further economic growth in the North can be combined with far better environmental results is introduced, hoping for a "neatly ordered conversion to environmentalism (Newton and Harte, 1997) (40). In this respect, with its pragmatism and its developed world - orientation, in its current state *smart mobility can be seen as the "ecological modernisation in mobility".*

Our **program** will focus on what can be *seen as complementary elements on this current state of smart mobility.*

First: the start from societal challenges.

Second: the relation with the other research perspectives on mobility.

And third: the focus on implementation challenges.

The program will have three **core themes:**

- visions and perspectives on mobility of younger generations,
- the domain of the new mobility concepts, and
- implementation of smart mobility solutions at the national level and in urban regions, with a focus on users, up-scaling pilots and governance capacity.

And we will create our research programs in collaboration with stakeholder organizations, and in cooperation with the colleagues in the Smart Mobility research area.

One research program on smart mobility has started last autumn. This program *From Automobility to Smart Mobility*, with 5 Ph. D's. is an interactive research program, jointly funded by the university and the Ministry of Infrastructure and Environment and Rijkswaterstaat, the change from

automobility to smart mobility is framed as a transition process. Five perspectives are chosen, with one PH.D. per perspective. The first perspective is on users – who will be the users of smart mobility solutions? The second perspective is on governance- what will be the role of public and private partners in implementing smart mobility solutions. The third perspective is on the implementation process, and the role of experiments. The fourth perspective is on is on data, developing inter-operational data environments. And the last Ph.D. will work on security. The last two Ph.D. 's are in collaboration with the faculty of Mathematics and Computer Science. The core of this program is on car mobility, and on the national level.

This autumn a second program will start. This program will be on *Sustainable Urban Mobility*, under the leadership of prof. Ruth Oldenziel. In this program, funded by PON Holding, Rijkswaterstaat, and the university, two to three Ph.D's will work on *cycling perspectives*. As a contribution to implementation a societal cost- benefit analysis of cycling option – e bike, train- bike and pedelec- will be developed. And the role and function of new cycling systems in the urban mobility systems will be elaborated. A third Ph.D. – process, focusing on cycling in rural areas is in discussion. The focus of this work , in cooperation with the faculty of Building & Architecture , is on cycling and on the regional and urban level.

So: we made a good start. But at least two wishes remain.

The first is more attention in smart mobility to mobility outside the OECD world. Smart mobility solutions will be essential for the enormous societal challenges on mobility in the developing world. But smart mobility tends to be framed by technical solutions for the richest countries. Why not also smart mobility solutions for these transport vehicles?

15. taxi rickshaw in Delhi, India, source: Finding Sahs, 2013 (left) and bus transport, Nairobi, source: unkknown (right)

And the second is on freight transport. Here we just started an interesting cooperation at our university. With four groups from our faculty Industrial Engineering and Innovation Sciences we would like to create a flagship program on Sustainability Firms and Supply Chains, thus trying to contribute to shifting the growth of freight transport and related CO2 emissions in accordance with the plus 1,5 degree- global warming consensus policy from Paris' Global Warming Summit.

I end with my central message: to optimize the contribution of smart mobility to societal challenges on mobility, we need to connect researchers from the engineering departments with our social scientists to create potential solutions, and we need to connect to stakeholder organizations to get these solutions implemented in a smart way!

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take a long time to 'trickle down' to the mass market. Currently most of these innovative systems are only available in the top end luxury automobiles, which is a major barrier to further market penetration (European Commission for Information Society and Media, 2007, p.6). This development is comparable to the introduction of ABS and ESP technology, which were initially also restricted to luxury class vehicles. In terms of increasing acceptance rates, however, the comparison to the early assistance systems, ABS and ESP, shows a significant difference. While ABS and ESP have achieved s-shaped acceptance rates towards full acceptance ,ADAS still lacks the initial breakthrough that marks the start point of the increasing adoption curve. "

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Artikel 2

The Future of Car Mobility 2014-2030: Material for a Debate on Framing Smart Mobility, 2014

1. State of the Art on Car Mobility

What is the situation on car mobility in the economically most developed part of the world? Where does car mobility stand in 2014? Is car mobility still growing, do we reach saturation, or are we already in a situation of "peak car"? And could trends and developments be related to the different age groups?

1.1 Growth in Car Mobility Is Slowing Down

In Europe, there are great differences in the number of cars per capita [1]. The spectrum runs from Denmark with 380 cars per 1,000 inhabitants to Italy with 580 cars per 1,000 inhabitants. Most richer EU countries have car ownership rates around 480 cars.

Most countries still have some growth in car ownership, with Finland still having rather steep growth. In three bigger countries, the United Kingdom, Germany and France, since 2005, no growth can be seen anymore, with a very interesting situation in Germany: Car ownership per capita fell between 2000 and 2005 and is now consequently lower than in 2000 (510 versus 490). In the US, we can see a stagnation in car ownership from 2000 onwards at the level of 810 cars per capita. Looking at the vehicle kilometers travelled, we see all richer EU countries with very slow to zero growth since 2000, with now vehicle kilometers travelled in a range of 8,500-11,500 km per capita [3].

1.2 Difference in Age Groups Related to Car Mobility Is Growing

Looking at the results on car mobility in the different age groups, interesting developments can be noticed. In the US, from age 40, people still drive the same number of miles as they did before 2000. But the younger generation drives far less (Table 1) [4].
Similar trends are occurring in other developed countries [5].

Car ownership and car travel declined, and use of other modes increased, among German and British 20-29 year olds [6]. To present a quote of the study of Kuhnimhof et.al [6] presented at TRB (Transportation Research Board), "*The overall trend is composed of the following developments: Private car availability is decreasing among young travelers. There is a significant reduction of automobile mileage in dai1y travel with increases in other modes, predominantly public transport. This is not only caused by the decline in car availability but also by the increasing multimodal behavior of car owners. Moreover, as long -distance travel journeys get longer, there is also a shift from the automobile to air travel in long distance travel. Finally, men have reduced their automobile travel more significantly than women".*

In the US, the younger generation appears to place less value on vehicle ownership and suburban living due a combination of high costs, improved travel options and changing preferences [7]. And Sivak and Schoettle [8] found that, controlling for other factors, increased Internet use is associated with reduced young drivers' (16~30) license rates, suggesting that telecommunications substitute for physical travel.

Table 1 Miles travelled per age category, 2001 and 2008 in the US.

Age	Average miles in 2001	Average miles in 2008
15-19	4,200	3,800
20-24	10,300	8,200
25-29	11,800	9,500
30-34	12,000	10,000
35-39	13,300	10,800

Source: Ref. [4].

1.3 A Situation of "Peak Car" Could Be Reached in the Developed World

Peak car is the situation where car mobility will not grow any further and has reached its highest point. It looks like Germany has now reached a peak car-situation already.

Levine and Jones [5] state in their report for the RAC (Royal Automobile Club) Foundation: "*The aggregated traffic trends for Britain seem to show a 'peak car' phenomenon (the situation in which there is no increase over a sustained period of time (in some cases an actual decline) in average car mileage per person, even during periods of economic growth), with car use leveling off per person since the 1990s. But a closer look finds that this is limited to specific groups and areas. It does not apply to women's car travel outside London, which has shown a steady increase between July, 1995 and July, 2005. Indeed, if we just look at private car use (excluding driving in company cars), then overall car travel per person outside London continued to grow up to the start of recession, and for those residents aged over 30 was flat in London rather than showing a steady decline".*

Goodwin [3] wrote an overview article on peak car. He concludes, looking at many facts and figures: “It seems to me that evidence for the full version of the peak car hypothesis—we have now passed peak car use and are on a new, firmly established, downward trend—is not yet definite. But the evidence for its full rebuttal—we are still on a long-term trend of increase with only temporary interruptions due to recession—is even less persuasive. The key element of the discussion in the last year has been that there are changing features of car use, which clearly precede the recession and simply do not fit the traditional forecasts” [3].

1.4 A Paradigm Shift in the Car Attitude of the Younger Generation Can Be Noticed

People born before 1980 grew up during the period of automobile ascendency, when vehicle design and roadway improvements provided direct user benefits, and many of the indirect costs of automobile dependency were less visible. Driving was considered exciting and fun. Most members of that generation aspired to live in automobile-oriented suburbs.

People born after 1980 tend to drive significantly less, rely more on alternative modes, and many prefer to live in more compact, multi-modal urban environments [9]. Much of the money, time and excitement that previous generations directed at their cars is directed at electronic devices for young people, including mobile telephones, computers and sound systems [8].

Consumer preferences can be difficult to measure, and these trends are not universal. Certainly, many young people love their cars and are reluctant to use alternative modes, and some young people who currently drive little will probably drive more as they become economically successful.

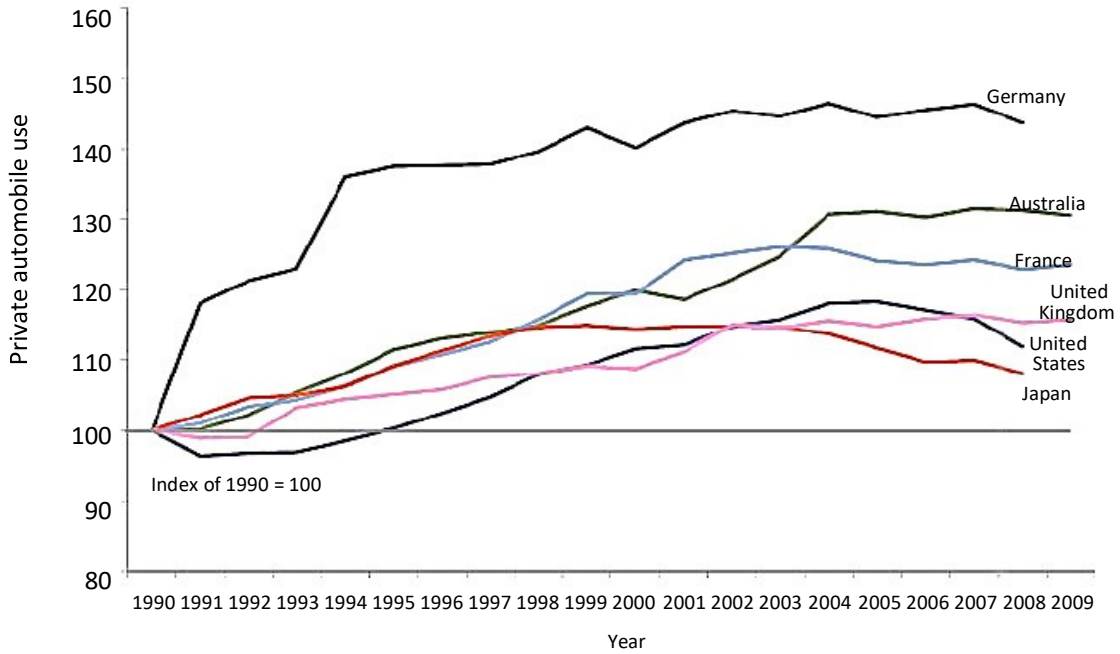

Fig. 1 Private automobile use, 1990-2009.

Source: International transport forum statistics, Goodwin [3].

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However, available evidence indicates that consumer preferences are changing in ways that support more urban, multi-modal lifestyles, particularly for younger people, which is likely to reduce automobile travel demand and increase demand for alternative modes.

However, as a contrast to all new trends over a longer period until now, a rather stable landscapeon car mobility can be noticed: The stabilizing and destabilizing trends for the car regime are known for years already.

We can see the following stabilizing trends, responsible for the huge share of car mobility in total mobility, and for the growth in this mode until recently:

- globalization;
- the creation of the network society
- the economic growth, resulting in prosperity.

And we can notice the following destabilizing trends, responsible for putting at least question marks at the sustainability of the domination of car mobility:

- climate change;
- the delivery situation and the related pricing situation on fossil fuels
- the impact of information technology on car mobility.

All in all, car mobility as a system (the regime of car mobility) still looks fairly stable, at least from the outside. There are however interesting new trends.

2. Wishes and Expectations of Car Customers

Consulting firms, active in the automotive world, produced yearly state of the art reports for the business world. From reports of companies like Arthur D. Little [10], Roland Berger [11] and KPMG [12, 13], a number of trends among car customers in most developed countries can be noticed. Seven trends can be noticed:

(1) Car driving finds its budgetary frontiers. Customers feel they need to drive cheaper, need to optimize their driving costs and urge for more efficiency

(2) Cars are more than ever seen as just commodities, not as important expressions of lifestyles;

(3) Sustainability becomes somewhat more important, especially in the younger generations. However, most households do not want to pay more

(4) Car driving time is more and more considered as “not connected”-time, rather useless time

(5) There is a trend towards ever greater safety in and of cars, especially with the older drivers

(6) Owning a car becomes, for many younger, urban and households less important than having access to a car, when needed

(7) The suburban middle classes and middle ages would like to have a broader range of IT (information technology)-services in cars.

Arthur D. Little [10] presents a division of new mobility types, which is useful in understanding these trends: greenovators (27% of car driving households), reflecting the socio-ecological consequences of mobility, with a demand for innovative and sustainable solutions; family cruisers (11%), with an increasing demand for mobility in an increasingly fragmented network of family and friends; silver drivers (24%), proactive in their third phase of life, experienced with products, high quality (and safety) awareness; high-frequency commuters (24%), with a daily life characterized by high frequency of mobility; global jet setters (2%), with global mobility requirements as a prerequisite for their jobs; sensation seekers (4%), seeing mobility as a symbol of leisure time, fun and lifestyle, status and prestige; and low-end mobility (8%), households with limited mobility budgets, a need for affordable solutions, and a willingness to downgrade mobility.

From the analysis and with the trends and this division in mind, three “poles in future car mobility” could be identified:

(1) A first pole would be around the older drivers. Older households will remain driving and they mostly have budgets available. We know from Motivaction [14] studies in the Netherlands that older drivers have an inclination towards buying new cars. They seem to be keener on safety than on information technology-services, as they drive more outside the congestion periods. This pole centers on the silver drivers, and contains some 25% of car driving households

(2) A second pole would be around the middle- aged drivers. Most middle -aged drivers have families and a need for mobility in increasingly fragmented networks. Many of them will be commuters. They have a wish for clever, flexible cars. And in most of these households, two cars will be the standard. They have to be careful for budgetary consequences.
Sustainability is not that important for them, but these households like to have services on board that make their frequent car travel easier and more reliable and predictable. This pole centers on high-frequency commuters and on the family cruisers, and contains of some 40% of car driving households

(3) And a third pole would be around younger drivers. These drivers have grown up in the Internet age. Driving time for them is often seen as “not-connected time”, and they support innovative and sustainable solutions for car driving. Cars are seen by many younger drivers as just commodities, and not any longer as special products. They need cars, but they do not need, and certainly not in all households, cars of their own. Cars should not cost that much, not all services possible are needed, cars just have to bring you somewhere when public transport, where you can be connected, which fails to deliver the service. This pole centers on the greenovators, and contains some 25% of car driving households.

There is a danger of over-systematization of the three poles. Note the situation that at least 10% of car driving households will not fit in these poles, and that, in most western European countries, some 20% of all households are car-less.

For producers of cars, a number of elements should be guiding on the western European car markets:

- There will be a stabilization in car purchases in the years to come;
- There is a more differentiated market for cars growing (the three poles);
- There is a need to produce cheaper, stripped, but more sustainable cars;
- Downsizing prices with higher performance on sustainability issues is asked.

Car producers have to rethink their strategy. Are they primarily:

- product focused manufacturers?
- service focused manufacturers?
- basic mobility providers?
- mobility services providers?

It seems necessary to adapt to new markets, to look at the chains in car mobility, and to organize partner networks with providers of information technology—industries and mobility services.

Especially, the new situation of three different futures on car mobility, related to the three poles, asks for rethinking the producers' positioning and market strategies. This rethinking is now taking place and forms a background for investments in smart mobility.

3. Sustainability and Oil: Framing the Future or Just One Aspect?

One of the great challenges in the future of car mobility is sustainability, meaning here the complex of climate change, reaching more sustainable cars, and using less fossils fuels. There seems to be no consensus on the role of sustainability and fossil fuel development in shaping and framing future car mobility.

To present a spectrum, Arthur D. Little sees the rising of the greenovator, willing to pay a little bit extra for sustainability, and asking for low weight and stripped cars. Arthur D. Little also notes a development towards a greener economy.

Shell Germany [15] presented two scenarios to reach CO_2-targets. The common denominator in these scenarios is that targets will not be reached completely and that it will take a long time, until after 2030, to come near to these targets. This is due to the situation in western Europe that the turnover rate of the car park is long, some 16~17 years.

Even in the US, the turnover rate is a critical factor: "*Over the last decades, one striking feature of the household vehicle fleet is the increase in the number of years an average vehicle is operated. In 1977, about one out of six vehicles were 10 years old or older and automobiles averaged 6.4 years of age. In 2009, vehicles averaged 9.6 years of age—a 50% increase of 3.2 years and nearly two out of five cars were in the old stage category" [7].*

In *Automobility in Transition* [16], the authors note that policy makers hope for technical solutions on fossil fuels and sustainability. These authors frame the ever- present enthusiasm for greener power trains (fuel cells, hybrids and electricity) as a successive hype pattern and state that the notion of sustainable mobility is much weaker than the notion of sustainable energy.

The consulting firm Roland Berger [11] sees a growth in environmental awareness, translated in a need to create higher efficiency levels in using fuels. And in the Global Automotive Executive

Search 2012 of KPMG [12], this fuel efficiency is, together with environmental issues, considered to be the top priority of car customers. KPMG notes a rather slow perspective for full electric cars, not reaching higher levels than 15% at 2025.

In the Europe wide EU Trans Visions study [17], targets are formulated that can be reached when policy makers take their full responsibility. A target of 58% CO_2 reduction from passenger cars in 2050 (compared to 1995) can be reached with a combination of fuel efficiency, speed reduction, introducing pricing policies and selective road investments. Trans Tools mention four possible scenarios on reaching sustainable mobility: a hypermobility scenario, a constraints scenario, a decoupled scenario (with decoupling of driving kilometers and environmental damage), and a scenario focused on reduced mobility.

More academic articles relate to this range in options and visions.

The objective of CO_2 reduction in a range from 60%~80% reduction (from the levels of 1995/2000) creates enthusiasm among transport researchers in different countries. Scenarios for reaching this challenging objective for transport are being designed. In this section, a short introduction to the spectrum of considerations and views will be given [1, 18].

Sperling [19] from the Institute of Transport Studies of the University of California presented in a keynote lecture in November 2010 his *Steps into Postfossil Mobility*. His comprehensive plan consists of measures in three so called arenas: Vehicles must become far more energy efficient; The carbon content of fuels must be greatly reduced; Consumers and travelers must behave in more eco-friendly manners. Sperling considers this last arena the most difficult one: “Cars are firmly entrenched in our culture and modern way of life. Reducing inefficient car dependent vehicle travel requires reforming monopolistic transit agencies, anachronistic land use controls, distorted taxing policies, and the mindset of millions of drivers who have been conditioned to reflexively in the car every morning” [19].

Sperling designs and defines a specific set of measures but warns for each arena: “Achieving a 50% to 80% net reduction in greenhouse gas emissions is not something that businesses, consumers and politicians can fully imagine. Life after cheap oil evokes images of crises to come. There is no escaping that there will be winners and losers, but strong leadership and good policy can ease the transition” [19].

In the United Kingdom, Buchan [20] prepared a report *A Low Carbon Policy for the UK*. His conclusion is: “Policies which produce more efficient patterns of travel will be needed alongside those for improving fuel consumption both in the medium and the long terms, and that they need to be implemented as a matter of urgency”. There is a need for land use regulation, for behavioral change, with specific initiatives on shopping, the school run, work and leisure, walking and cycling, speed limits in car traffic, and on taxes.

The same line of thinking could be noticed in Sweden. Akerman and Hojer [21] published in 2005 *How Much Transport Can the Climate Stand—Sweden on a Sustainable Path Towards 2050*. The conclusion of their study is: “*A development towards sustainable transport requires*

significant changes in the organization of daily activities and daily travel". To reach the objectives, total car travel volumes have to be cut strongly, more in urban areas and less in the rural areas.

For France, Lopez-Ruiz and Crozet [22] have prepared three quantitative scenarios in "*Sustainable Transport in France: Is a 75% Reduction in CO_2 Emissions Possible?*". In each of the three scenarios, a 50% reduction will be possible by 2050. However, it will be more difficult to achieve in Pegasus, a scenario promoting individual travel with strict technology standard. The other two scenarios create better results. In Chronos, constraints on speed are introduced, and green multi-modality is promoted. And in Hestia, the relationship between physical planning and transport is elaborated: Increase in densities is a key element, and the decoupling of transport activities and economic growth is promoted. Going further than the 50% would require very big advances in zero emission vehicles. To cite Crozet, "*Au total, les grandes tendences dans les prochaines annees se resument ainsi: moins vite (en ville et sur la route), plus cher et plus concurrentiel" [22] (In total, the big trends in the coming years are: less speed (in the city and on the highway), more expensive, and more in concurrence with other modes (translation by author*).

Moriarty and Honerty [23] clarify the challenges, climate change and oil depletion. Then, they analyze all the offered solutions—fuel efficiency, use of alternative fuels, and sustainable public transport. Confronting the challenges with the solutions, they find gaps. In their opinion, it will not be possible to find technical solutions for the two challenges. At best, a 2.5 times higher fuel efficiency can be reached, and this result could be offset with higher fuel costs and with lower car occupancy rates. And electricity in car mobility will find its boundaries in the non-availability of enough carbon neutral renewable energy to derive electricity from. From their analysis, they end with a far= reaching conclusion: "…vehicle travel levels will need to be reduced threefold or even more, depending on population growth..." [23].

From the spectrum of views and visions, a few generic conclusions can be drawn:

- Sustainability is considered a great issue for the future
- However, although there is a willingness towards taking sustainability into account, most car driving households do not want to pay much more for sustainability;
- Most authors expect rather long time periods (25 years plus) before car mobility will be sustainable
- The possible perspective on fossil fuels with problems of scarcity, delivery and very high prices plays only a minor role in the actual societal and professional debates on car mobility
- Much is expected from behavioral change of the younger generations
- Much is also put in the hands of the policy makers: Their leadership should in some way lead to speeding up in reaching sustainable mobility.

To finalize, it seems that, on sustainability in relation to car mobility, a non-stable situation has to be faced. Sustainability issues are noticed, but are not met with clear focus, clever objectives and strong policies.

4. A World of Scenarios

A rather great number of scenarios on car mobility can be found. Transition is a key element in most of these scenarios. Three elements are central in the vocabulary of transition management: the landscape (important developing trends), the regime and the niches. Landscape elements related to car mobility were already introduced in the end of Section 2. The regime on car mobility, which can be seen as the complete system of regulations, rules, laws, byelaws, institutions, which is now dominant, is still fairly stable.

Upcoming new areas that can be noticed are:

- cultural and socio-spatial changes, mostly related to urban mobility
- user innovations related to information technology in cars (near to the regime);
- demand management and mobility management
- intelligent transport systems and next generation traffic management (near to the regime);

 green power trains.

Also, a number of cracks are identified. Cracks in a system/regime are potential hick-ups, potential problem—creators for the stability of that system/regime.

Cracks on car mobility are:

- lack of physical capacity and congestion
- changing perception of cars, from lifestyles to just commodities
- diminishing growth on car ownership and car use;
- problems with the delivery of fossil fuels
- changing attitudes of major policy makers.

In *Automobility in Transition* [16], three possible scenarios are introduced:

(1) The first scenario contains greening car mobility, using smart grids and well-defined ITS (intelligent transportation systems) solutions. This is a rather technology- oriented scenario, near to smart mobility

(2) The second scenario is on creating multimodal transport services, redefining the car, from ownership to flexibility in use, and using the urban fabric in clever ways. This more urban mobility focused scenario is more societal based;

(3) The last scenario is continuing “business as usual”, resulting in a spectrum of IT ideas and solutions in cars, and at the same time rather difficult future fuel deliveries.

The scenarios of Terlouw [24] are in the same range. He identified: technology taken over, more or less comparable with the first scenario; conscious customer, more or less comparable with the second scenario; and exploiting conventional technologies, more or less comparable with the last scenario.

Roland Berger [11] also arrives at three scenarios: High tech is about clever cars with all IT-equipment; The budget scenario is about low- cost cars, stripped cars and car sharing; Sustainability scenario is about introducing the whole spectrum of green technology.

It can be noted that scenarios “high tech” and “sustainability” seem to fit into the technology-oriented scenario, while the “budget” scenario fits in the societal based scenario.

In general, three basic scenarios can be made from now on for the future of car mobility:

(1) A technology focused scenario: information technology, intelligent transport systems, smart grids and a full range of technical sustainability measures (focus on cars);

(2) A societal focused scenario: small cars, stripped cars, car sharing, relating to other modes, less focus on new information technologies (focus on multimodality);

(3) Business as usual: incremental changes, mostly related to sustainability and IT-services, no plan available.

In the United Kingdom, the Office of Science and Technology [25] commissioned, as part of its foresight program, a project on intelligent infrastructure systems.

In this project, four scenarios towards 2055 were developed [25]. Two axes of uncertainty were central in the design of the four scenarios: The first was whether we will develop transport systems with low environmental impact; the second was whether people will accept intelligent infrastructure (elements of driving being taken-over).

Basically, there are two success and two failing scenarios. The two failing scenarios are tribal trading (which describes a world that has gone through a sharp and savage energy shock with long distance travel being a luxury) and good intention (wherein the market failed completely, and government has taken over to reduce carbon emissions, with a “big brother is watching you” attitude).

The two success scenarios are more interesting. The first is perpetual motion, which looks comparable to the alternative Shell Germany scenario. It describes a society driven by constant information, consumption and competition. Demand for travel remains strong, new, and cleaner fuel technologies are increasingly popular. Road use is causing less damage. Urry calls this scenario: “…essentially a version of what has been termed ‘business as usual’ or ‘hypermobility’” [25]. It is however unclear how much CO_2 can be reduced in this scenario. There is also no attention for carless households or for fossil fuel delivery aspects.

The second scenario is urban colonies. In this scenario, investment in technology is primarily focused on minimizing environmental impact. Good environmental practice is in the heart of mobility policy: sustainable buildings, distributed power generation and new urban planning policies have created compact and dense cities. Transport is permitted only if green and clean: car use is still energy intensive and is restricted. Urry considers this scenario attractive, however, he makes a very interesting point: “How would this scenario come about? It is difficult to see its emergence as being a linear development from existing patterns or something that governments could simply introduce…There would be some kind of ‘shock’ to the system and this would almost certainly be a ‘global’ shock that provides a ‘tipping point’, a little akin to the global shock of 9-

11…a global shock that is understood worldwide as a threat to the pattern of 'business as usual'" [25].

5. Framing Smart Mobility

There is a market for smart mobility, framed as making cars smarter, cleaner and safer. The search is for the most intelligent cars, and for a productive and efficient traffic network, which will have these intelligent cars as a basis. Smart planning and communication for the use of this network are also essential. Especially in households with persons aged between 40 and 60, there seems to be enthusiasm for this development. Smart mobility is, as mostly defined, in the sphere of the technology scenarios. And it is not about mobility in the broad perspective, but about cars. As noticed in Section 2, probably some 40% to 45% of households with cars see this route to smart mobility as their favorite route towards the future of mobility.

Near to this middle- aged households is probably the position of most older car owning households. For them, not all IT services are necessary or useful (e.g., congestion information, as older households drive not much in rush hours). Safety and possibly
sustainability are seen as more important, but they can, certainly for a part, be persuaded to buy smart mobile cars. Some 25% of households with cars belong to this group.

The situation is different for two other groups:

(1) At first, for the carless households, some 20% of all households, for them, smart mobility as defined is a no-go area. Car solutions are not useful for them. They define sustainable mobility along other frames

(2) And secondly, for the mostly younger households with cars, in customers wishes and in the scenarios for these households, a route towards smaller cars, stripped cars and low-budget cars, delivering basic mobility, could be identified. Ownership is less important than use and there seems to be a real need for car sharing and multimodal mobility services. This group is about 30% to 35% of the households with cars.

Combining the elements, we see the following picture arising:

- 20% car less households;
- 25% households aiming at basic car mobility

(societal scenarios) (focus on younger people);

- 35% households in favor of technology solutions with a focus on smart mobility (focus on the middle aged);
- 20% households in favor of technology solutions with a focus on safety (focus on the elderly).

There is probably an interest of somewhat above 50% of all households for solutions in the area of technological defined smart mobility. The smaller half of all households seems to initially favor other solutions and is probably not yet willing to invest in smart solutions as defined**.**

To give this conclusion more background, it could be useful to identify why many IT based services are facing skepticism of a part of the car customers. In *Automobility in Transition* [16, 26], a number of reasons are given:

- too little involvement of the car users
- too much focus on technical learning
- too much already focused solutions
- too much technological push; □ experiments dominated by the status quo.

KPMG [13] notices in *Self Driving Cars* the need for discussing technical adoption strategies. To quote, “It is 2022, and autonomous vehicle technology is fully developed within reach of most vehicle owners. Interest is high: The technology appeals to the usual technophiles, but many people are still on the fence”.

Some 50% of all households and some 60% of driving households will pick up smart mobility, the other 40%~50% will probably be still on the fence, or even further away. KPMG introduces three adoption scenarios: aggressive, base case and conservative. In the conservative scenario, the adoption level never reaches the critical mass needed to make smart technology the driver for car mobility in the future. When too many car driving households are not planning to invest in smart IT cars, the paradigm shift on car driving and car mobility will fail, the self steering perspectives and automated driving will not be introduced completely, thus leaving smart mobility as a useful package for many car drivers, but not as the solution for safe, reliable, connected mobility.

Smart mobility as the solution on car mobility can thus face problems of acceptance. In this respect, two basic different strategic attitudes are possible:

(1) To remain defining smart mobility as technology and create smart mobility solutions. These solutions will show car driving households the great advantages. The last 20% of car driving households just have to buy and introduce the technology, or will be unable to drive any longer (compare with Internet banking versus paper banking work)

(2) To define smart mobility broader as a bundle of solutions for mobility (not only car mobility, but also the slow modes and public transport) and take into account the wishes of many car customers for only basic car mobility with simple cars, develop a strategy towards multimodality, arrange and frame smart mobility into the broader search for sustainable mobility.

From the evidence presented here, Option (2) could be taken more serious. And an extra element could be introduced. At the moment, the relationship between the world of smart mobility solutions and the world of sustainable mobility is still rather weak. What, for example, is the relationship between reaching CO_2 targets of minus 60%~80% (2050 compared to 1995) and the smart mobility technology work? What can smart mobility deliver here? And what is the storyline from the smart mobility perspective towards the trends identified in this paper under the heading: younger generations, only basic car mobility, cheap, cost-effective car mobility, and multimodality and car sharing solutions ?

6. Conclusions: The Situation of Car Mobility from 2014 Onwards

Some conclusions could be drawn from this study:

- The greater picture on car mobility still looks rather stable: The regime still stands and most landscape developments are already known for a longer time;
- There are a few already well-known cracks in the system like congestion, while a big possible crack such as the delivery perspectives of fossil fuels does not get much attention in societal debates on car mobility
- There seems to be a saturation in car mobility in the most developed countries on its way
- Underneath this stability, two paradigmatic, but paradigmatic different, routes for the future of car mobility can be noted: a technology -based route and a societal based route;
- Policy focus and investments are now concentrated on the technology -based route, while a rather huge minority of customers certainly see a need or have a wish for the other route and already act accordingly
- In a second analysis, the picture on car mobility looks less stable than on the first sight. No clear and broadly accepted strategies on car mobility for the future, relating to and using both routes, are being prepared.

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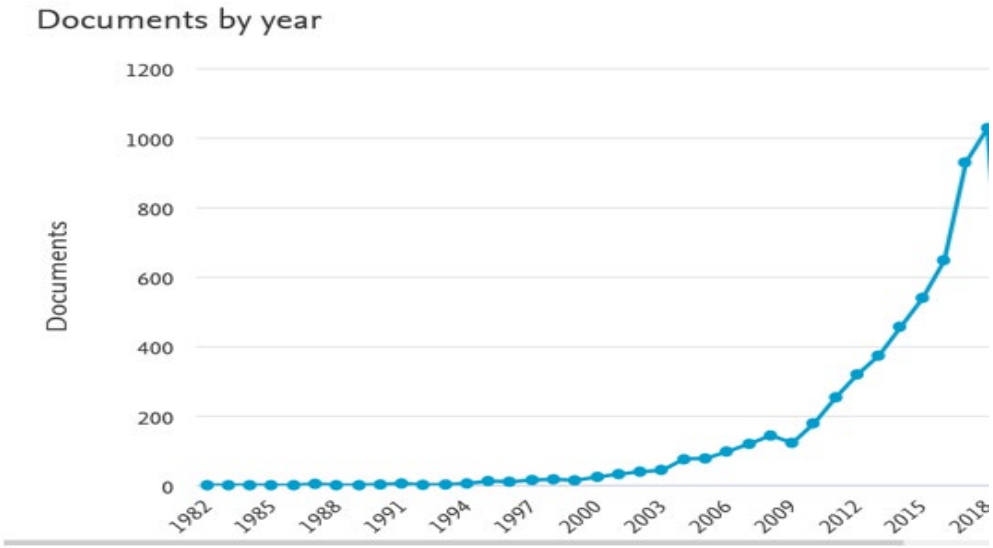
Artikel 3

SMART MOBILITY IN NEDERLAND: HOE STAAT HET ER MEE? , 2019

INTRODUCTIE

Smart mobility is een begrip dat nu iets minder dan 10 jaar aanwezig is in de wereld van verkeer en vervoer. Op de academische zoekmachine Scopus is de opkomst van dit begrip in de wetenschappelijke literatuur volgen (zie figuur 1).



We kunnen er van uitgaan dat het begrip net iets eerder opdook in de populaire pers en in de wereld van websites van consultants en studies.

Maar waar staat smart mobility eigenlijk voor? In 2015 hebben we op de TU Eindhoven geïnventariseerd wat stakeholders nu omschreven als smart mobility. We hebben de 14 meest uitgebreide beschrijvingen (van bijvoorbeeld Toyota, Ford, het Duitse Frauenhofer Instituut, maar ook van de gemeente Kopenhagen) daarbij als basis genomen. Dat resulteerde in de volgende vierdeling, die ik ook als uitgangspunt heb genomen voor mijn oratie medio 2016 (Jeekel, 2016). (zie figuur 2)

Smart mobility omvat in algemene zin vier thema's; voertuigtechnologie, ITS (intelligente Transport Systemen), omgang met data in relatie tot verkeer en vervoer en MaaS (Mobility as a Service, of in het Nederlands; Mobiliteit als dienst). De opkomst van smart mobility is vanaf het begin begeleid met verhalen over het ontstaan van een echt ander mobiliteitssysteem, IT- gedreven, veel meer gebruikersgericht, en technologie gericht, maar wel zo dat er zowel doelen van veiligheid, bereikbaarheid als duurzaamheid gehaald zouden worden. Zo na 8 a 10 jaar is het nuttig om eens te bezien waar smart mobility nu staat, en wat er van de verwachtingen uit is gekomen of uit begint te komen. Ik concentreer me daarbij op de situatie in ons land. En ik concentreer me op personenvervoer.

STAND VAN ZAKEN

Plannen in overvloed

Landsdeel	**Plan/programma**
Noord	Autonoom vervoer in Groningen, Fryslân, Drenthe
	Letter of Intent Autonomous Transportation Systems
Oost	GO Voort, Actieprogramma Slimme Mobiliteit Oost -Nederland
	Koersnotitie en Werkagenda Slimme Mobiliteit Gelderland
West	Mobiliteitsprogramma Utrecht en onderdeel Smart Mobility
	Actieplan Smart Mobility Flevoland
	Smart Mobility Plan MRA (Metropool Regio Amsterdam) en Uitvoeringsprogramma
	Koers Smart Mobility Noordholland en Uitvoeringsprogramma Smart Mobility
	Smart Mobility in de Verkeersonderneming Zuid Holland
Zuid	Smartwayz en Smartwayz projectenkaart smart mobility

TABEL 1 PLANNEN EN PROGRAMMA'S SMART MOBILITY

Wat in deze plannen opvalt, is dat smart mobility primair wordt benaderd als een aanpak voor het vergroten van de doorstroming, de bereikbaarheid en de veiligheid. Gebruikersgerichtheid wordt zeker genoemd, maar de relatie met duurzaamheid is meestal nogal zwak. En veel overheden schuwen de grote woorden niet. De plannen zijn meestal slecht tot matig voorzien van stevige budgetten.

Kleine pilots en projecten in overvloed.

In de plannen worden erg veel pilots geïntroduceerd. Zo kent Smartwayz (Brabant en Limburg) 31 smart mobility projecten en biedt GO Voort (Oost Nederland) maar liefst 46 projecten. De meeste

pilots en projecten zijn erg klein van omvang. Globaal is er een duidelijke tweedeling in geografisch gebonden pilots, en niet- geografisch gerichte pilots. Een overzicht van een aantal projecten is te vinden in de tabellen 2 en 3, en een meer volledige poging tot overzicht is te vinden in de bijlage bij dit artikel.

TABEL 2 GEOGRAFISCH GEBONDEN PROJECTEN EN PILOTS: EEN SELECTIE

Verkeersmanagement	Transport Radar, 076 Singel Mijden, slim handhaven parkeercapaciteit, Praktijkproef Amsterdam, Crowd-management monitoringssysteem, integratie verkeerscentrales en fleetmanagement centrales, proef C-ACC, Cargohitching
iVRI's/ stoplichtprioriteiten	Talking Traffic, Samen stad in, Stad uit, diverse prioriteit-instellingen, buienradar- verkeerslichten koppeling, sluisbediening op afstand
Shuttles en people movers	Scheemda, Flypod Lelystad, shuttles Noord Holland, Bravoflex, Wepod Ede-Wageningen (gestopt)
Geografisch begrensde apps	Fiets ID Amsterdam, app tourbussen Amsterdam, Tiel
Mobility as a Service voorlopers	7 Pilots van het rijk, Bravoflex, Slimme reis, Amber Mobility, elektrische deelauto- pilot, bereikbaarheidsplatform ZuidAs, MaaS in OV concessie Meerlanden, fietsdeelconcept, reisbureau doelgroepenvervoer
Relatie met infrastructuur	Schipholzone, Smart Logistics N 279 Veghel- Asten, ITS corridors, Intercor, Smart Last Mile Commerce (SAILOR), verwarmde fietspaden

Dominante onderwerpen voor de pilots en projecten zijn de introductie van iVRI's (intelligente verkeers- regelinstallaties, stoplichten) en Apps voor gebruikers. Ook zijn er een aantal shuttles en people movers in ontwikkeling, en worden wat eerste MaaS initiatieven geïntroduceerd. Tot slot zijn nogal wat pilots gericht op optimalisatie van verkeersmanagement, zoals bijvoorbeeld de grotere praktijkproef Amsterdam. Opvallend is dat veel projecten een korte looptijd hebben, en vaak worden geïntroduceerd als eerste stappen op weg naar iets groter, dat echter nog niet zichtbaar wordt in concrete zin.

TABEL 3 NIET- GEOGRAFISCHE GEBONDEN PILOTS EN PROJECTEN

Voertuigtechnologie	Start-ups, Co-exist, MAVEN, proef NH met Nissan, H2Share, Autopilot, FABULOS, LAB testcentrum Lelystad, zero emissie bussen
Apps	Parkeerapps
Kaarten	Talking maps
Data	Concorda, Prystine, meetfiets 2.0

De niet- geografische pilots zijn redelijk sterk geconcentreerd rond de Automotive Campus in Helmond. Dat is binnen Smart Mobility een aparte entiteit. In Helmond zijn nu zo'n 40 bedrijven bij elkaar bezig met de toekomst van verkeer en vervoer. Dit vanuit de gedachte dat nabijheid wel synergie en gezamenlijk leren zal opleveren. Uit de innovatieliteratuur weten we echter dat daarvoor echter meer nodig is. Het creëren van een echt incubatiemilieu vraagt grote investeringen in menskracht, enthousiasme en vooral openheid. In de nogal gesloten mobiliteitswereld, waar bedrijven vaak op hun eigen concepten en data zitten en maar weinig willen delen is dat laatste vaak een lastig punt.

Nauwelijks grotere regionale activiteiten

We zitten met mobiliteit kijkend naar de klimaatopgave in een hoek waar nog bijzonder veel moet gebeuren. In feite is het huidig mobiliteitssysteem zo niet houdbaar, zal het snel duurzaam moeten worden, en zullen we in de relatie tussen automobiliteit en steden een nieuw evenwicht moeten vinden. Tezelfdertijd zullen we een verkeersinfarct moeten vermijden. Wat is nu de bijdrage van smart mobility aan deze grote uitdagingen? Het antwoord kan eigenlijk niet anders luiden dan; nogal beperkt. Veel praktijkmensen die ik sprak in de voorbereiding van dit artikel zagen smart mobility als iets wat nog niet zo behulpzaam is. '*Het zal nog wel komen, vermoeden wij"* is een stellingname die ik vaak mocht vernemen. En inderdaad; echt grotere projecten ontbreken nog. Om een voorbeeld te geven; waarom is het nog niet mogelijk om als je een stad inrijdt direct te zien waar de vrije parkeerruimte is. Je hoeft dan niet te gaan zoeken, met alle uitstoot van dien. En waarom wordt niet vervolgens de hoeveelheid parkeerruimte systematisch gedurende een aantal jaren verlaagd, met gelijktijdige bouw van een uitgekiend systeem van people movers, die de stad als openbaar vervoer tot in de haarvaten, en aanvullend op het bus-systeem, ontsluiten. Dit type pilots wordt na 8-10 jaar smart mobility in ons land nog niet waargenomen. Tezelfdertijd leggen politieke bestuurders wel vaak dit soort t ambities neer in de grote serie meestal wat vrijblijvende bijeenkomsten over smart mobility.

Wel meer voortgang in voertuigtechnologie en start-ups

Er zijn in de wereld van de voertuigtechnologie zeker een aantal positieve signalen. Het is hier niet de plaats om uitgebreid stil te staan bij de ontwikkeling in het automatisch rijden, maar ons land wordt wel gezien als een heel goede testlocatie (KPMG, 2019). En we hebben recent de ontwikkeling van Light Year en Amber gezien. Daar waar bedrijven daadwerkelijk deelnemen of realiseren aan pilots voor smart mobility komt vaak wat meer van de grond Zie bijvoorbeeld de European Truck Platooning Challenge). Hier moet ook het plan van ASML voor de eigen werknemers genoemd worden (Unieke,2018). Wat echter ook opvalt, is dat het samenspel tussen bedrijven, kennisinstellingen en overheden, dat vaak geroemd wordt, wel veel publiciteit maar nog betrekkelijk weinig feitelijkheid heeft opgeleverd. Het kost tot nu toe blijkbaar grote moeite om levensvatbare businessmodellen te maken. Speciaal rond de uitwisseling van data ligt er een "grid" van disclaimers, eigenaarschap, privacy en security.

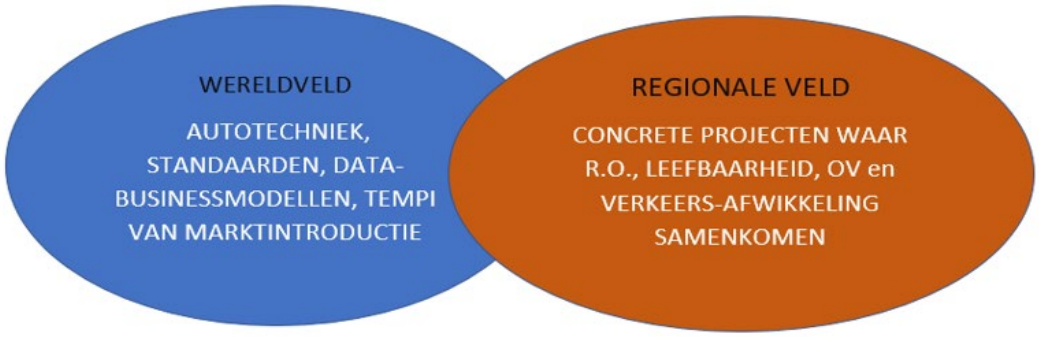
Veel positieve publiciteit, weinig schaal

De grote hoeveelheid kleinere projecten die starten in smart mobility creëren evenzovele publiciteitsmomenten voor regionale en lokale politieke bestuurders. Er is steeds wel een aardig verhaal te houden en te maken. Je ziet nu dat in het Zuiden, maar ook in de metropoolregio Amsterdam er wel mooie plannen liggen, maar slechts weinig resultaten in steden, voorsteden en dorpen te zien

zijn, terwijl bijvoorbeeld Noord Holland veel minder publiciteit genereert maar wel heel praktisch bezig is met optimalisatie van het verkeersmanagement en als enige een proef met een autofabrikant (Nissan) realiseert, en er in Scheemda in Groningen al een people mover functioneert. Voor mij is en blijft bij de voortgang van smart mobility de vraag; wat hebben onze gebruikers er in de feitelijkheid aan?

Het rijk op enige afstand

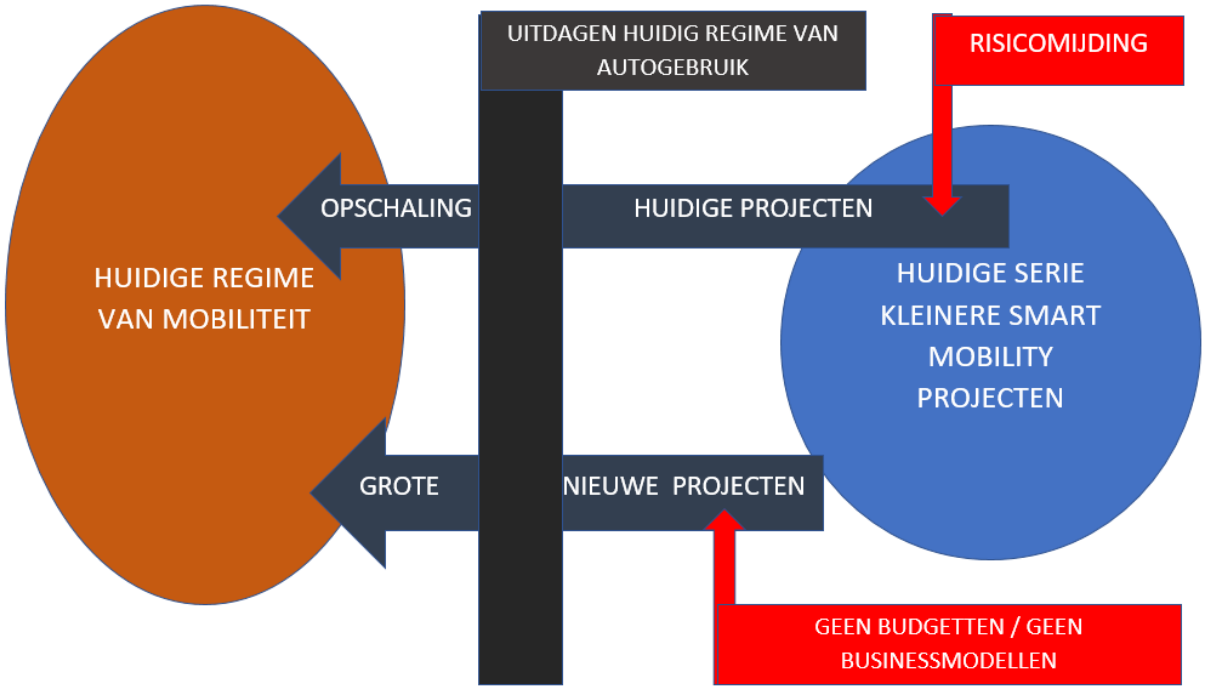
Smart Mobility kent in feite twee speelvelden. Er is een veld waarop het primair gaat over de condities voor nieuwe voertuigtechnologie, waar in de kern ook marktcondities voor de introductie van nieuwe voertuigen, en nieuwe data- arrangementen op de agenda staan. En er is het regionale veld van pilots en projecten dat in dit artikel centraal staat (zie figuur 3). Kortgeleden heeft



de rijksoverheid de eigen positie in smart mobility verduidelijkt, in de brief *Smart Mobility, Dutch Reality* (I&W, 4-4-2018). In deze brief zijn vier actielijnen opgenomen. De eerste twee actielijnen gaan vooral over het wereldveld en betreffen het stimuleren van het gebruik van bestaande producten en diensten (waarbij het meestal gaat over rijtaak- ondersteunende functionaliteiten), en de verantwoorde introductie van de nieuwe generatie voertuigen. De laatste twee actielijnen raken meer aan het regionale veld en gaan over verkeersmanagement en data. Op twee velden, de introductie van iVRI's (Talking Traffic) en MaaS (zeven pilots) neemt het rijk zelf de leiding, maar voor het overige wordt het initiatief gelegd bij de andere overheden. Wel is er een actie gericht op krachtenbundeling van de gezamenlijke overheden, maar deze is primair procesgericht.

EEN KORTE ANALYSE VAN DE HUIDIGE SITUATIE

Waar leidt dit alles nu toe? Waardoor wordt deze situatie van veel plannen, veel kleinere projecten en pilots, en als geheel nog in beperkte mate zichtbaarheid in de feitelijke openbare ruimte nu veroorzaakt? In figuur 4 probeer ik hiervoor een verklaring te geven.



Links staat het huidige regime in het mobiliteitssysteem, gedomineerd door de automobiliteit. Rechts staan de huidige projecten smart mobility. Die zijn beperkt van omvang en groot in aantal. Wat nodig is om echt in het regime van mobiliteit te raken en een integraal groter onderdeel te worden in een veranderend mobiliteitssysteem is a. het opschalen van de aanwezige kleinere projecten, en b. de introductie van grotere projecten. Voor a. geldt dat de meeste bestuurders een goede kijk hebben op risico's en proberen risico's en daarbij behorende negatieve publiciteit te vermijden. Ze voelen en weten dat voorbij een bepaalde grens projecten gevaarlijk worden. Daarbij beschikken regionale en lokale overheden niet over voldoend grote budgetten om opschaling te realiseren. Over het verschijnsel "opschalen" zo meteen nog wat meer. En voor b. geldt dat er dan gerekend moet worden op forse weerstanden bij de bestaande stakeholders, die het huidig systeem van mobiliteit realiseren en daarvan profiteren. Je komt dan snel aan hun businessmodellen en verdiencapaciteiten. In het schema is ook een "*fire wall*" (in zwart) te zien. Smart mobility benaderingen die in de kern raken aan het in beperkter mate faciliteren van de mobiliteit per individuele eigen auto worden door politieke bestuurders grotendeels gemeden. Kijkend naar de samenstelling (maart 2019) van het gezelschap regionale politieke bestuurders bezig met smart mobility, met een meerderheid aan gedeputeerden van de VVD – de zelfbenoemde "vroempartij" ! - (7 van de 12), en slechts 2 gedeputeerden van meer linkse komaf is dat zeker begrijpelijk, maar het beperkt natuurlijk wel de breedte en reikwijdte van inzet van smart mobility- aanpakken.

Opschaling

Een hele serie kleine projecten is een aardige start, maar het wordt tijd voor opschaling. Dat wordt nogal eens voorgesteld als gewoon een volgende stap, maar is in feite een enorme sprong. Opschaling brengt je in de kern van het huidige regime van mobiliteit. Uit de redelijk omvangrijke literatuur over dit thema – meestal gekoppeld aan smart energy en smart city projecten- komt naar voren dat om op te schalen er vele barrières zullen moeten worden overwonnen. In een artikel in Energy Policy (Mosannenzadeh et. al, 2017) worden dergelijke barrières erg aardig geschetst. De meest omvangrijke

en frequent voorkomende zijn steeds weer; het gebrek aan langjarig echt politiek commitment en steun, het ontbreken van goede samenwerking tussen stakeholders en partners, een ingewikkelde relatie tot aanbestedingsprocessen van overheden, gefragmenteerd eigenaarschap, een tekort aan bewustzijn bij overheden van wat echt nodig is voor het grootscheeps welslagen, en een gebrek aan testfaciliteiten en bewezen aanpakken. Het niet bezig gaan met deze barrières leidt er vaak toe dat projecten stoppen bijna onmiddellijk nadat de subsidies eindigen (van Winden, 2016). Sterker; er is vaak een "paradox van de proef"; pilots lijken moeizaam verbonden te raken aan reguliere in- en uitvoering, en dat komt door de kenmerken van de meeste proeven (Groenendijk, 2017). Succesfactoren voor pilots, zoals meer vrije speelruimte, aanvullende subsidies, enthousiaste betrokkenen, en eigen werkwijzen zijn nogal eens evenzovele faalfactoren voor reguliere introductie in bestaande regimes. Alle initiatiefnemers zouden zich langzaamaan toch van dit soort waarheden bewust moeten zijn.

HOE VERDER?

Eerst maar het positieve nieuws. Er komt langzaam maar zeker meer realisme in de verwachtingen rond smart mobility. De inzet van voertuigtechnologie, het meer zelf rijden van auto's, het gebruik van data en data arrangementen, en de introductie van Mobiliteitsdiensten staan nog redelijk in de kinderschoenen, en leiden niet in 5 jaar tot grote wijzigingen in het huidig mobiliteitssysteem. Die noodzakelijke wijzigingen zullen toch van politieke uitspraken over de toegang tot wegcapaciteit, parkeerruimte en breder tot de stedelijke ruimte en over het op verstandiger wijze van beprijzen van automobiliteit moeten komen.

De afgelopen 8 jaar moet voor smart mobility worden gekarakteriseerd als een incubatietijd. Er is nog niet veel te zien in onze openbare ruimte, maar er is wel het nodige in ontwikkeling. Dat blijft nogal klein, en is meer gericht op optimalisatie dan op disruptie. Met de politieke kleur van de regionale politieke bestuurders viel dit ook niet anders te verwachten. Wat ook wordt waargenomen is dat de techniek vaak nog niet zo ver gevorderd is als werd aangenomen. Het stoppen van de pilot met de automatische people mover tussen Ede en Wageningen is hier een mooi voorbeeld.

Voor de komende 8 jaar zie ik vier richtingen. Allereerst natuurlijk opschaling. We zagen al dat dit niet een lineair proces is, maar echt een schaalsprong behelst. Vervolgens zou het behulpzaam zijn als er een nationaal testprogramma ontwikkeld zou worden. Dat zou energie kunnen genereren voor de niet-geografisch gebonden elementen van smart mobility. Voor alle regionale pilots is een inhoudelijke krachtenbundeling essentieel. Nu lijkt elke regio een eigen serie pilots op te zetten. Samenhang kan ontstaan door op nationaal niveau een leeromgeving in te richten. En tot slot wordt het essentieel Mobility as a Service en datamanagement voor mobiliteit goed te problematiseren en te politiseren. Onder welke voorwaarden kunnen nieuwe datagedreven mobiliteitsdiensten echt een vervanging van het verkeer van auto's met slechts de bestuurder als inzittende worden? Want dat ons land zonder een verhogen van de bezettingsgraad per auto (en per vrachtauto) nooit uit de ruimtelijke problemen van wegcapaciteit, parkeerdruk en stedelijke leefbaarheid zal kunnen komen staat nu langzaamaan wel vast.

Alles bijeen is de oogst van 8 -10 jaar smart mobility nogal ambivalent. De rol van IT in de mobiliteit is zichtbaarder geworden, er zijn veel plannen, veel kleine pilots, een paar interessante start ups. Er zijn geen grote zichtbare projecten, er is wel een hoop bestuurlijke drukte, een blijkbaar noodzakelijke incubatietijd, en een bestuurlijke oriëntatie die meer gericht lijkt op het nog wat langer in de lucht

houden van het bestaande, op termijn onhoudbare mobiliteitssysteem dan op echte verandering van dat systeem.

Met dank aan Serge van Dam, Tanja Manders, Frans Tillema, Geert Verbong en Erik Verroen voor het meedenken en meelezen.

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