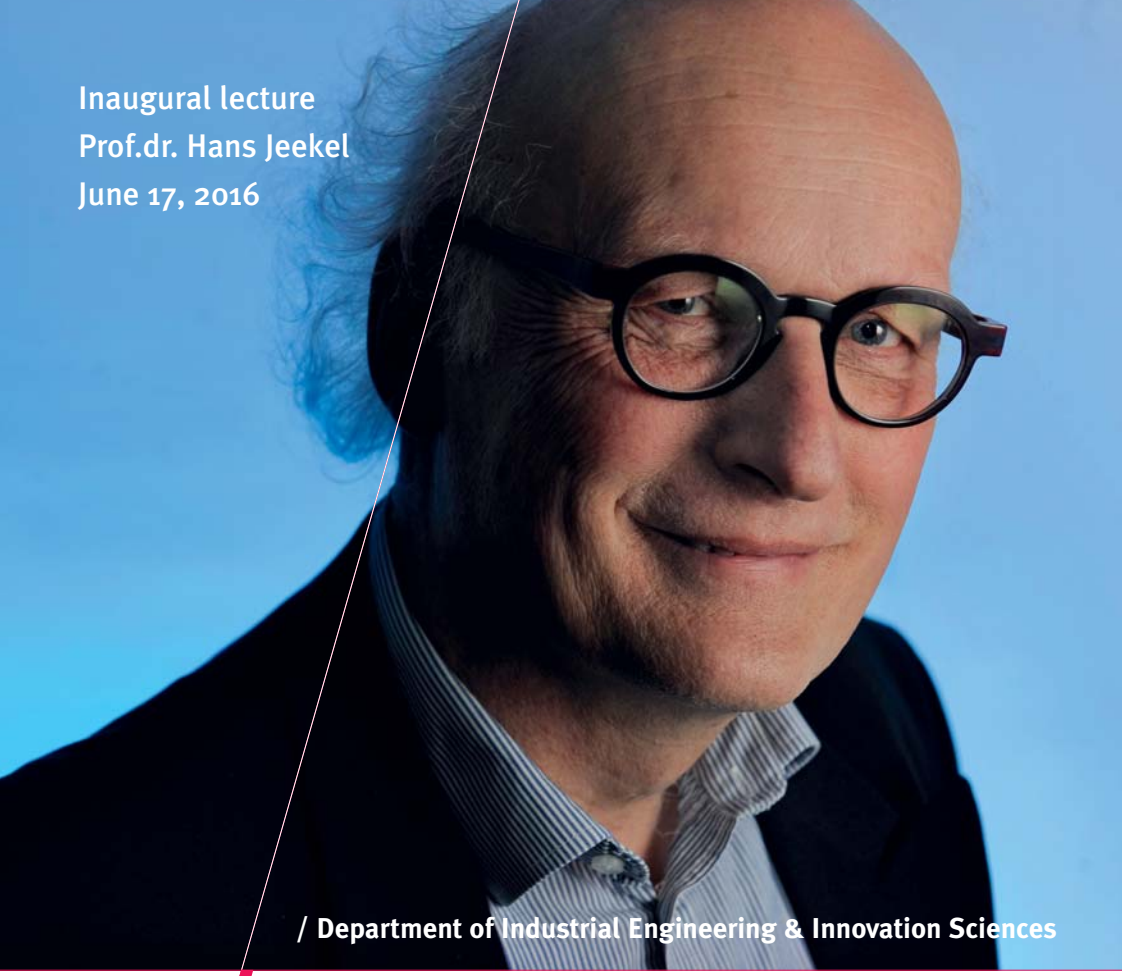
# Smart mobility and societal challenges : an implementation perspective



Inaugural lecture
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June 17, 2016

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TU/e Technische Universiteit **Eindhoven** University of Technology

# Smart mobility and societal challenges

## An implementation perspective

**Where innovation starts**

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Presented on June 17, 2016
at Eindhoven University of Technology

# 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 comes up against boundaries, boundaries related to the carrying capacities of societies – ecological as well as 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).

Figure 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.

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 and with more mobility in these megacities. Arthur D. Little expects almost a tripling of kilometers made in urban areas in 2040. (3).

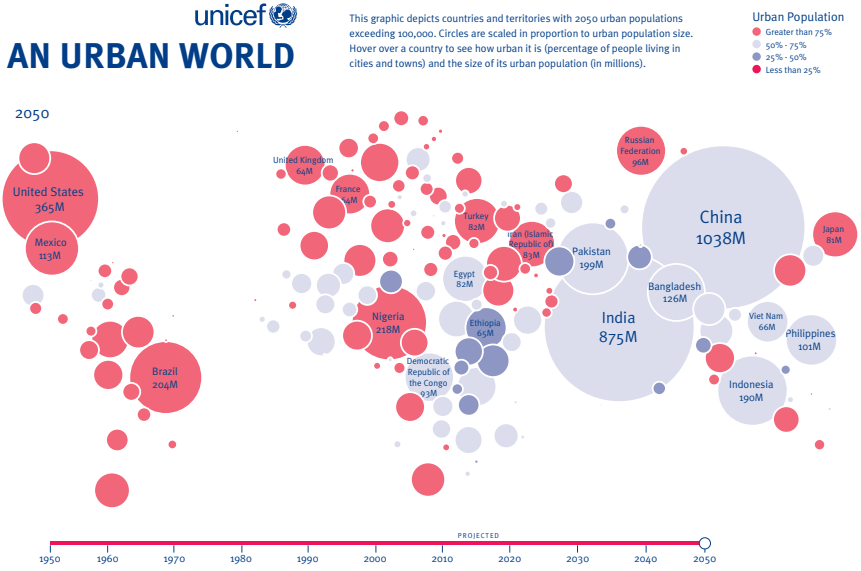



Figure 2

An Urban World (source: Unicef, The State of World's Children, 2012).

The **challenge** therefore is to combine mobility with livability. Cities and city regions are densely populated. They need mobility, but mobility offered in the

majority by private cars will lead to vast areas of car related infrastructures of roads and parking, to extensive use of scarce space, and will create health problems.

Figure 3

Traffic jam in Dhaka, Bangladesh, 2013 (source: unknown).

While we do not yet know how urban mobility systems that are sustainable and efficient may look, the end result should not be like this...

Figure 4

Shanghai 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, while South American cities are now active in cycling projects and are 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.

Figure 5

BRT in Bogota (source: Inbus transport Onmibus).

Analyzing the success of BRT, a key role in achieving results seems to be in combining two discourses: the discourse on necessary capacities for transport in densely populated cities with the political discourse about offering modern transport to the majority of poorer voters.

Looking to our part of the world, the Global North, 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. While the sharing economy in urban mobility is not completely new, apps and user-oriented ICT tools do have the potential of 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 or iPads on wheels".

Figure 6

iPad on wheels (source: Steinbuch World Press).

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

The **challenge** here seems to be to get a better idea of what will be possible and when this will be available. Getting better insights into the impacts and magnitudes of change and getting better insight into time schedules for introduction can bring more focus to stakeholder investments. We need to move away from the idea that ICT in mobility will be the solution for everything, or will just lead to disruption, and move towards defining and designing clever transition paths to be followed.

To give an example. We are now witnessing a hype on automated driving. Expectations are rather high and some media claim that in a few years from now we will have automated driving on a large scale. But before we can move around 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 system failure in automated cars, and the liability and reliability aspects involved (6). Second, the deployment of a system of connected cars requires stable cooperation between and joint investments from many stakeholders. Looking at the current situation, this creates a great organizational challenge (7). And third, the reluctance of the majority of customers to accept automated driving needs to be overcome, as most marketing studies show that only 30-40% of car drivers would consider purchasing an automated car (8). These challenges need to be addressed before automated driving can be successfully implemented.

The challenge of **globalization and freight**.

Globalization is entering a new phase of more connectivity and upscaling in our world. As a consequence, we will see continued growth in the volume and the kilometers made for freight traffic. Globalization and removing barriers in international trade, combined with low transport prices and the considerable disparity in labor costs around the world may lead to very long and very differentiated supply chains.

In its Transport Outlook 2015, the International Transport Forum presented scenarios indicating a growth in surface freight kilometers by between 232 and 423% in 2050 (compared to 2010), while related $CO_2$ emissions will increase by between 136 to 347%. (9).

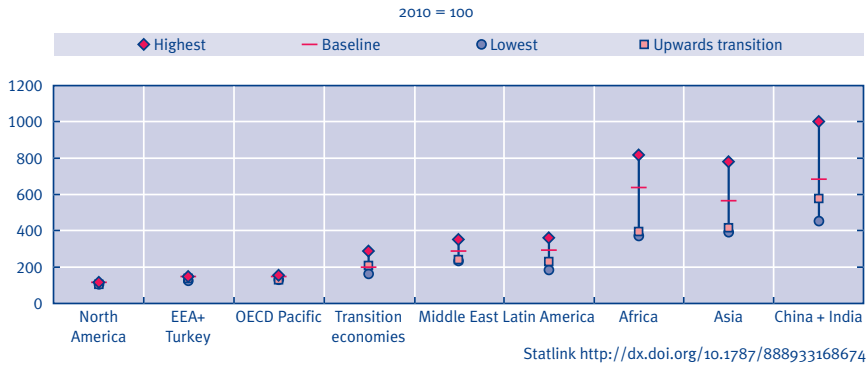



Figure 7

Statlink http://dx.doi.org/10.1787/888933168674

Surface freight $CO_2$ emissions, world region 2050 (source: ITF, International Transport Outlook 2015,56).

The **challenge** here is to realize forms of freight transport and logistics that will avoid increases in $CO_2$ emissions. This challenge requires paradigmatic changes in the organization of supply chains. As yet there is no vision on how to create sustainable freight transport, meaning an organization of international trade, supply chains and transport chains that creates possibilities to remain within the boundaries set by the goals of limiting global warming to only plus 1.5 degrees Celsius by 2050.

Can we work on paradigmatic changes in international trade patterns, in logistics, in IT based supply-demand modeling and related programming, where “just in time” transports could create far fewer empty trucks ? This seems possible only with huge changes in the institutional and organizational set-up of the private transport sector. Or do we have to rely on 3D printing, and platooning as “agents of change”?

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

The match between 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 to be booming. The number of EVs, however, remains still low, with only 1% of the total car fleet (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% by 2050 (11). And we still have the prospect of the hydrogen car. The **challenge** here is to direct investments

in energy infrastructure in such a way that the results lead to reaching the goals set to limit global warming.

Three elements need to be taken into account here.

First, there is no clear winning formula yet, and with all hypes it remains difficult for public and private stakeholders to invest in alternatives to fossil fuels, as Farla, Alkemade and Suurs (12) have shown. Low oil prices are not helping either (13). As a result, fossil fuel infrastructures are likely to 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 $CO_2$ goals in 2050, that is a reduction of $CO_2$ emissions by 60-80% (compared to the 1995 level). I have already presented some figures on freight. Transport is now the only societal sector where $CO_2$ emissions are still growing. While other societal sectors currently accept this, such solidarity will not last for decades. I looked at scenarios on mobility and $CO_2$ levels, which take the best new technologies into account. I did not find any single scenario that reaches higher $CO_2$ emission reduction levels than 50% (15). It is even worse since scenarios do not even take into account the huge growth in mobility in the developing world.

Reaching $CO_2$ targets will be a great political challenge, and a conclusion could be that without substantially reducing the number of kilometers travelled, 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. While the plus 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 requires far more investments in biofuels, and in a fast electrification of the car fleet
- can create far higher costs for car use
- and will hinder trends towards globalization.

I arrive at my final, 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 how much 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 behavior of the younger generations, and to use the opportunities that this behavior and their basic positions can create.

Figure 8

Mobility for younger people (source: Unknown).

Will generations that grew up with IT see less need to be physically mobile and will they become clients of mobility service providers that can accommodate transport modes for them when needed? Will the car purchase market ultimately become a market for these providers and for older persons that will keep driving their own cars with advanced driving assistance systems? (18)

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,

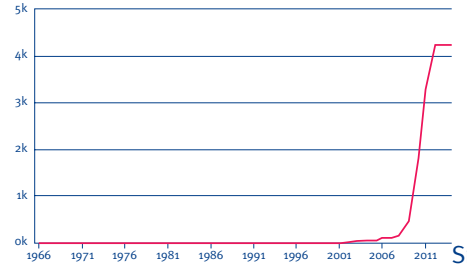
and no, the younger generations are just postponing their car purchase until they start building their families, which is happening somewhat later in their lives than among previous generations.

This situation raises rather difficult questions, especially for investors, for example for infrastructure related organizations. 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 demand far more cooperation between all stakeholders. (20)

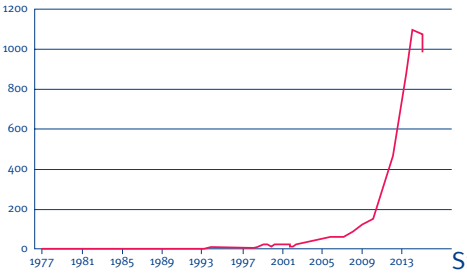
Hence, the future of mobility is highly uncertain. What has smart mobility to offer in creating prospects and solutions for the challenges mentioned?

# Smart Mobility

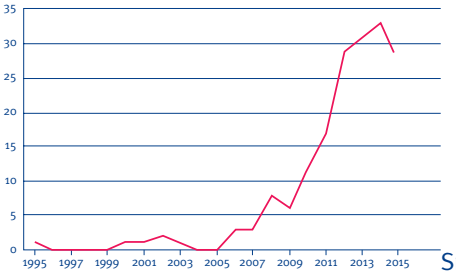
Smart Mobility is one of the Strategic Research Areas of our university. But what is smart mobility? And what can smart mobility potentially offer in coping with the five societal challenges on mobility? Smart is “in”, everybody loves smart. We now speak of smart grids, smart cities, smart mobility,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

Has a concise and generally accepted definition of smart mobility been developed in the last six years? This seems not to be the case. Smart mobility is a concept still lacking consensus about content and scope. Every organization uses another definition. A web search visiting 12 sites of important stakeholders in the mobility domain (21) did give a basic orientation regarding 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.

Firstly, smart mobility is about **vehicle technology**: power trains, electric car technology, fuel technology, autonomous automation, driver assistance systems, but also new types of bicycles.

Figure 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.

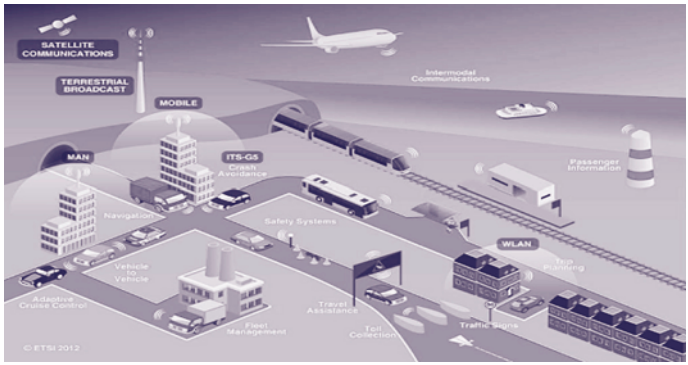



Figure 10

Source: ETSI, 2012.

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

Figure 11

Source: unknown.

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

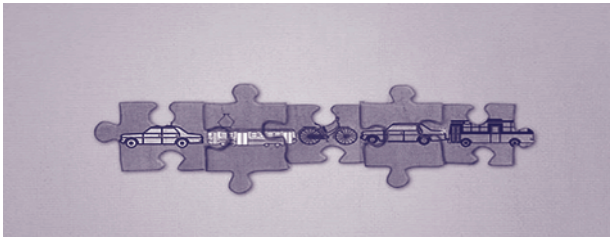


Figure 12

Source: unknown.

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

Most current smart mobility research is technical and practice oriented. Looking at the Smart Mobility research 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 relationship between those solutions and the five societal challenges?

Let me present an initial overview of this relationship.

| Domains of smart mobility/ Societal Challenges on mobility | Urban mobility | IT in mobility | Globalization and freight | Energy and climate | Next generations |
|---|---|---|---|---|---|
| Vehicle Technology | Smart cycling | Automated driving<br><br>Electric vehicles<br><br>Solar cars | Power trains<br><br>Last-mile systems | Fuel technology | |
| Intelligent Transport Systems | | Connected and cooperative driving | Truck Platooning | | |
| Data | Relationship with smart cities | Big data possibilities | IT matching supply-demand | | Real-time travel information |
| New Mobility Services | Integrated mobility services | Intelligent apps matching supply-demand | Urban logistics<br><br>Logistic services | | Sharing economy concepts (car sharing, ride sharing) |

This may look impressive but there are no easy connections between the dominant portfolio of smart mobility research and the societal challenges on mobility. I even note that this relationship is rather difficult to pin down. For example, what is the relationship 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 as well as quieter 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 technical researchers mostly concentrate on intermediate targets such as creating safer mobility, better use of existing infrastructures, realizing mobility that is aligned with older environmental norms and standards (air and noise), and reducing the burden on scarce space, especially in cities.

However, there is still a long way to go from these targets to really contributing to the societal challenges. Once researchers in the engineering departments focus their research on these societal challenges instead of on the intermediate targets, cooperation with the researchers working in social science traditions will become far easier.

# Implementation Challenge

In mobility at this moment developments are alternating between go slow and fast at one and the same time. Whereas electric driving, truck platooning, mobility as a service are all cases of new concepts that are coming quick and fast, at the same time the development of real applications has been slow, for example in the case of electric cars. Assuming that from 2018 10% of the new car purchases will be electric and that electric car purchases will grow to a 60% market share of new cars in 2025, and taking into account the start of a second-hand electric car market around 2019, electric cars could be some 15% of the car fleet in 2025, the real paradigm shift from fossil to electric will take place between 2030 to 2040. On the truck platooning front, harmonization between exemption strategies will take time, and as yet it is unclear who will push the realization of truck platooning in society. And on mobility as a service 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 the art can be found in the difference between prototype and upscaling. Media tend to forget this, and publish articles as if new developments are already with us in significant numbers, which is not the case.

This brings me to the third central element in this 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 in practice.

The implementation of technical solutions and products varies greatly. There are examples of relatively fast implementations such as 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. To broaden this point: as we now teach our Bachelor students in the USE base course that we need to understand how the past shaped our present in order to design for the future.

We cannot implement any innovation without understanding stakeholders and their vested interests. Social scientists and historians have shown that new technical smart mobility solutions can be implemented relatively easily 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 often requires a paradigm shift or transition (24). From transition studies we know how difficult it is to change the incumbent *regime*. By regime is meant the dominant system with its sets of rules, agreements, arrangements and institutions. New technical smart mobility solutions can face major 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. 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 globalization 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 requires a description of the state of the art of the regime. What is the dominant set of rules, arrangements, agreements and institutions in mobility? In essence, this regime is built around individually used and privately owned cars, driving on fossil fuels, with a role for mass transit in cities. Here I would like to cite Frank Geels, who published in 2012 an article in which he described the regime in mobility. 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 can 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, upscaling is crucial. In the mobility domain there are many rather isolated pilots. This may create the impression that there is great energy on a new development but, as these pilots are often not connected, no focused energy is actually 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 by potential users
- problems with scaling up ideas and pilots
- lack of governance capacity.

First, reluctance by **users**. An example: *Advanced Driving Assistance Systems (ADAS)* help driver safety and comfort in traffic, 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, noting 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. 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 vision of automated driving as imagined by the media can 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 after 1993, will prefer.

Next, the **scaling up** issue, from ideas and pilot to larger scale introduction. Looking from a longer term 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” in New York, 1939/40, continuing with the General Motors/RCA technology development and testing in 1950s-1960s, followed by the introduction of the PATH R&D Program 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 expected implementation was supposed to happen two decades later. Many pilots were made, but scaling up failed.

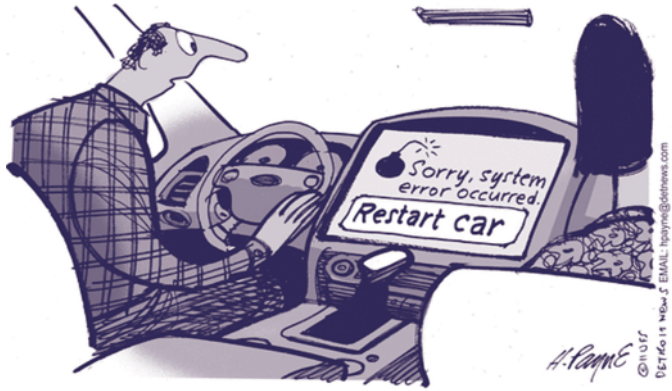



Figure 13

Automated driving cartoon. Source: A.Payne, 2014.

The history of automated driving has been well documented (33). Important reasons for slower developments than expected have been difficulties, after many pilots, in arriving at appropriate business cases, reluctance and doubts among car drivers, liability issues and pricing and equity issues. As you can observe, all these issues, often with a long history, are social and not technical.

In terms of *electric mobility*, the development has also not been easy. Just 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 fully electric vehicles and 80,000 hybrids (34), mostly used not as electric vehicles. These figures put us in the top in Europe, in second place behind Norway. Electric driving still faces reluctance from fleet owners and from households, related to "range anxiety" and a lack of charging infrastructures.

One final example. Since the seventies we have *car sharing schemes* and *bicycle sharing schemes*. Many cities have created pilots, and have implemented smaller schemes (35). However, scaling up remains difficult.

The situation regarding mobility implementation 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. Why is this so?

The theory on **governance capacity** can create some insight. Governance capacity is a term coined by Innes and Boher (2003, 2010), and by Healey (2007) (36); 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 mobilize organizations to work towards common defined goals and targets, and to get decisions out of the debating rooms. In other words, this is about creating capacity for joint action!

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 stagnation – still as the same discussions are constantly recirculated. In my opinion, the governance capacity related to mobility is rather low. I will concentrate on car mobility, being the core element of the mobility regime. A group of young mobility

researchers has presented an analysis on this issue and concluded that “the car system nowadays has an insufficient self-generating capacity for solving actual and future dilemmas and problems” (37).

In my book ‘The Car Dependent Society’ I defined 22 relevant stakeholders related to car mobility (38). These stakeholders can be divided in three groups:

1. 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.
2. The government parties: the highway agencies or road authorities, the legal services, the enforcing institutions, the policy makers and the politicians, the financial institutions, the tax organizations, the incident and emergency institutions, the municipalities and the regional governments
3. The societal stakeholders: the employers, the organizations of road users, the environmental organizations, the academic world.

There are only few systematic links between these stakeholders. These stakeholders have never been urged to design together a robust, resilient and future oriented system of car mobility, fulfilling sustainability criteria and answering societal challenges. Each stakeholder follows its 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 highways agencies and the driving schools involved.
- There is a somewhat weaker nucleus around congestion management, with the employers, the car users organizations, the service providers, the suppliers of travel information, the highways 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 organizations involved.

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

We start to understand the need for cooperation in implementing smart solutions to societal challenges. 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 steps:

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

This is what the university has done in cooperation with Rijkswaterstaat and more broadly 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 around 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 new technical ideas and perspectives.

Rijkswaterstaat has questions about its users, about the speed with which users will take 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 research at this university can change their future tasks and roles. Note that these questions are not about whether or not there will be a technical innovations, but about the impact of such innovations in society.

# Towards a research program on Smart Mobility

I have identified five great societal challenges on mobility and tried to describe the current scope of smart mobility. I have also 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, problems of scale and a 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 requires 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 on a larger scale. There is a complete *"implementation chain"*, which consists of prototyping, small pilots, larger pilots, experiments in real life, product development, marketing, first purchases, developing niche markets, 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.

Technical researchers often frame these problems as "far away from their business". If this remains the case, technical students will understandably ask questions about the usefulness of knowledge about implementation and societal aspects. It is an attitude that breaks the connection with stakeholders. 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 at the start of designing and defining scopes for technical solutions, and also need to be discussed between university professors and their students. Looking at my experiences, there seems still plenty of gains to be made here.

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

Mobility can be studied from different perspectives. Papa and Lauwers (2015) (39) presented four perspectives for analyzing mobility. Although these perspectives are not on the same level of analysis, they create some insights.

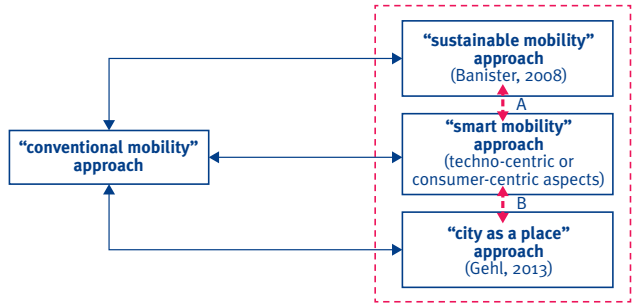



Figure 14

Four perspectives for analyzing mobility. Source: Papa and Lauwers, 2015.

First the dominant approach until 15 years ago called the 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 has emerged: the sustainable mobility approach. This approach is dominated by analyzing mobility from three starting points: ecological, economic and social. Sustainable solutions can be found by taking all three starting points into account. Many social 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 engineering studies, use a definition of sustainability that is not in full accordance with the Brundtland terminology. Sustainability is then constructed as a form of "ecological, or environmental plus". Mostly the social dimensions and the global equity aspects are omitted.

A third perspective on analyzing mobility starts with the challenge of urban mobility. Since the seventies there has been a debate on the relationships between mobility and the livability of cities. Solutions such as traffic calming, pedestrianization, strict parking policies and low-emission zones are applicable to this debate. This approach can be called the city as a place approach. It is less analytical and more design-oriented: equilibrium between mobility and livability can be created with clever spatial planning and urban design.

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) (40). The theme of this study is the connection between ecological modernization and sustainable development. Ecological modernization is a theory of social change, exploring the response to the negative environmental consequences of modernity. In ecological modernization 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) (41). In this respect, with its pragmatism and its developed world orientation, in its current state *smart mobility can be seen as the "ecological modernization in mobility"*.

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

First: starting from societal challenges.
Second: the relationship with the other research perspectives on mobility.
And third: the focus on implementation challenges.

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

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

And we will create 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 started last fall. This program *From Automobility to Smart Mobility*, with 5 PhDs, is an interactive research program, jointly funded by the university, the Ministry of Infrastructure and Environment and Rijkswaterstaat, whereby the change from automobility to smart mobility is framed as a transition process. Five perspectives have been selected, with one PhD 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 data, developing inter-operational data environments. And the last PhD will work on security. These last two Ph.D.'s have been put forward as candidates in collaboration with the department faculty of Mathematics and Computer Science. The core of this program is on car mobility, and at national level.

This fall a second program will start on *Sustainable Urban Mobility*, under the leadership of prof. Ruth Oldenziel. In this program, funded by PON Holding, Rijkswaterstaat and the university, as well as NWO-SURF, 6 PhDs will work on *cycling perspectives* from a long-term perspective. For example, as a contribution to implementing a societal cost-benefit analysis of cycling options – e bike, train-bike and pedelec – will be developed in the context of a modal split analysis. And the role and function of new cycling systems in the urban mobility systems and governance will be elaborated. A third PhD – process, focusing on cycling in rural areas – is in discussion. The focus of this work , in cooperation with the department of Building & Architecture, is on cycling and at regional and urban level.

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

The first is a greater smart mobility focus on 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?


Figure 15

Taxi rickshaw in Delhi, India, source: Finding Sahs, 2013 (left) and bus transport, Nairobi, source: unknown (right).

And the second is freight transport, an area in which we have just started an interesting cooperation at our university. With four groups from our Industrial Engineering and Innovation Sciences department 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 $CO_2$ emissions in accordance with the Paris Global Warming Summit consensus policy on a maximum 1.5 degree increase in global warming.

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 and humanities scholars to create potential solutions, and we need to connect to stakeholder organizations to get these solutions implemented in a smart way!

# Dankwoord

Mijn oratie op rijpere leeftijd is het resultaat van wilskracht bezitten en mogelijkheden krijgen. Die wilskracht heb ik denk ik zelf opgebracht. Voor de mogelijkheden die ik heb gekregen, wil ik graag een aantal mensen bedanken.

Allereerst bedank ik het College van Bestuur voor mijn aanstelling hier in Eindhoven. En direct daarna wil ik de drie hoogleraren bedanken die de *founding fathers* voor mijn late loopbaan in de academische wereld zijn. Allereerst Geert Teisman, mijn promotor die het toch maar op zich nam een enthousiaste buitenpromovendus met een erg drukke baan naar een proefschrift te leiden. Vervolgens Johan Schot, die de architect van de samenwerking tussen de TU en RWS genoemd moet worden, en tot slot Geert Verbong, mijn directe collega, maar bovenal een fantastische wegwijspiet in academia.

Een samenwerking moet van twee kanten komen. Vanuit I&M hebben Jeroen Haver en Hans Leeflang de basis gelegd voor de samenwerking tussen I&M en onze universiteit. En een kwartet, Jan Hendrik Jan Dronkers, Peter Struik, Jowi Bijsterbosch en Gerri Blekkink, heeft het binnen Rijkswaterstaat praktisch mogelijk gemaakt dat ik boegbeeld van deze samenwerking kon worden.

Binnen de Technische Universiteit Eindhoven heb ik de afgelopen jaren heel veel inspirerende collega's leren kennen. Ik ga die niet allemaal met naam en toenaam noemen, dan blijf ik bezig, maar graag benoem ik een kwartet dat voor mij belangrijk is geweest. Allereerst Frank Schipper, mijn grote bondgenoot in het maatschappelijk doordenken van mobiliteit, vervolgens Mieke Rompen, mijn praktische steun en toeverlaat. En dan Ruth Oldenziel en Carlo van de Weijer. Ik noem jullie bewust bij elkaar, omdat jullie samen zo prachtig het scala van perspectieven rond toekomstige mobiliteit omsluiten.

Vervolgens is er een kwartet waar ik grote verwachtingen van heb. Darja, Edgar, Tanja en Jeroen, jullie kunnen echt smart mobility gaan verdiepen en verhelderen.

En dan tot slot het laatste kwartet: mijn thuisbasis en met maar liefst drie studenten. Jeroen en bovenal mijn drie vrouwen. Jeroen: het is mooi om te zien hoe jouw bewerken van je eigen ruwe steen straks kan leiden tot mooie bouwwerken. Coosje: jij zat nog op de basisschool toen ik begon met mijn academische tocht, en zie: nu zit er een rechtenstudente. Ons studeren liep min of meer parallel. Dat was nog meer het geval bij jou, Puck, omdat we ook zo veel inhoudelijke en maatschappelijke belangstellingen delen. Iets wat telkens weer een feest is.

En tot slot: ik begon met mogelijkheden en daar wil ik ook mee eindigen. Marjo, jij hebt dit alles hier mogelijk gemaakt, door mij te laten doen wat ik écht nog wilde doen in mijn werkleven. Jij stimuleerde me én liet me begaan en mijn dank daarvoor is heel groot.

Ik heb gezegd.

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# Curriculum Vitae

**Prof.dr. Hans Jeekel was appointed part-time professor of Societal Aspects of Smart Mobility at the Department of Industrial Engineering & Innovation Sciences at Eindhoven University of Technology (TU/e) on January 1, 2015.**

Hans Jeekel gained his MSc in Human Geography from the University of Utrecht, cum laude, in 1979 and his MSc in Urban and Regional Planning from the University of Amsterdam in 1980. He was awarded a PhD degree from Erasmus University Rotterdam in 2011. From 1980 to 1995 he worked on environmental issues for the government after which he became a member of the Dutch Parliament until 1998. In 1999 he joined Rijkswaterstaat, first as a Director at the Dutch Transport Research Centre AVV, and since 2007 as the Corporate Strategist on Knowledge and Innovation. He has been a member of the Steering Committee of the Joint Transport Research Centre of OECD and ITF, Member of the Executive Board of CEDR, the European Conference of Directors of Roads, and he is now Chairman of the Association of European Transport (AET), which focuses on the implementation of mobility research in society.

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