

MOBILITY, SMART MOBILITY AND THE SOCIAL SCIENCES A VIEW FROM THE NETHERLANDS

FOR A SEMINAR IN SJANGHAI, AUGUST 2016

Introduction

In this contribution I would like to present a spectrum of insights and perspectives that the social sciences could offer in studying physical mobility. I will introduce four perspectives, each stemming from a discipline in the social sciences. The four perspectives are;

- The study of socio-cultural motives and positions related to mobility (relation with sociology)
- The identification of accessibility problems and social exclusion related to lack of mobility options (relation to human geography)
- The major societal challenges related to physical mobility, in the next two decades (relation to political science)
- The implementation perspective with a focus on implementation processes of mobility solutions in the real world (relation with policy science)

This contribution will have small bias towards the specific part of mobility that is now called "smart mobility". A short introduction of this smart mobility is appropriate.

Smart Mobility

What is smart mobility? Smart Mobility is one of the three Strategic Research Areas of our university. 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. The figure presented is 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 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 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.

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

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

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

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).

Perspective 1 ; Socio –cultural motives for car mobility

In my book *The Car Dependent Society* I introduced a number of motives for car use. In the literature many motives can be found and each author on motives for car use needs to decide some form of classification. With as a basis many articles (of which the most relevant are ; Maxwell (2001), Steg (2001), Hagman (2004), Steg and Gifford (2005) and Gatersleben (2007)), and recently Schwanen and Lucas (2011) I have chosen five composed motives ;

- convenience
- flexibility
- protection
- freedom
- habit

In measuring car use mostly standard statistical categories are followed ; age, income, gender, education. Most social scientists identify the population by these categories. However, Ulrich Beck (1992) call these categorisations of data “zombie categories”, and considers them old fashioned, and not able to clarify our complex risk societies. In his eyes the world as it develops can no longer be understood by these categories. Our societies are so complex that people with the same statistical profile (on income, gender, age, education) can define their chances, possibilities and problems completely different, and hence can lead different lives. Beck gets support from marketing experts, clarifying that the population can now better be distinguished by attitudes and lifestyles than by the normal statistical categories.

Trying to influence car use it seems necessary to use attitudes and lifestyles as agents of changes, and to move behind the motives. What is really at stake; why is convenience so important, and what does the motive protection mean in relation to car use.

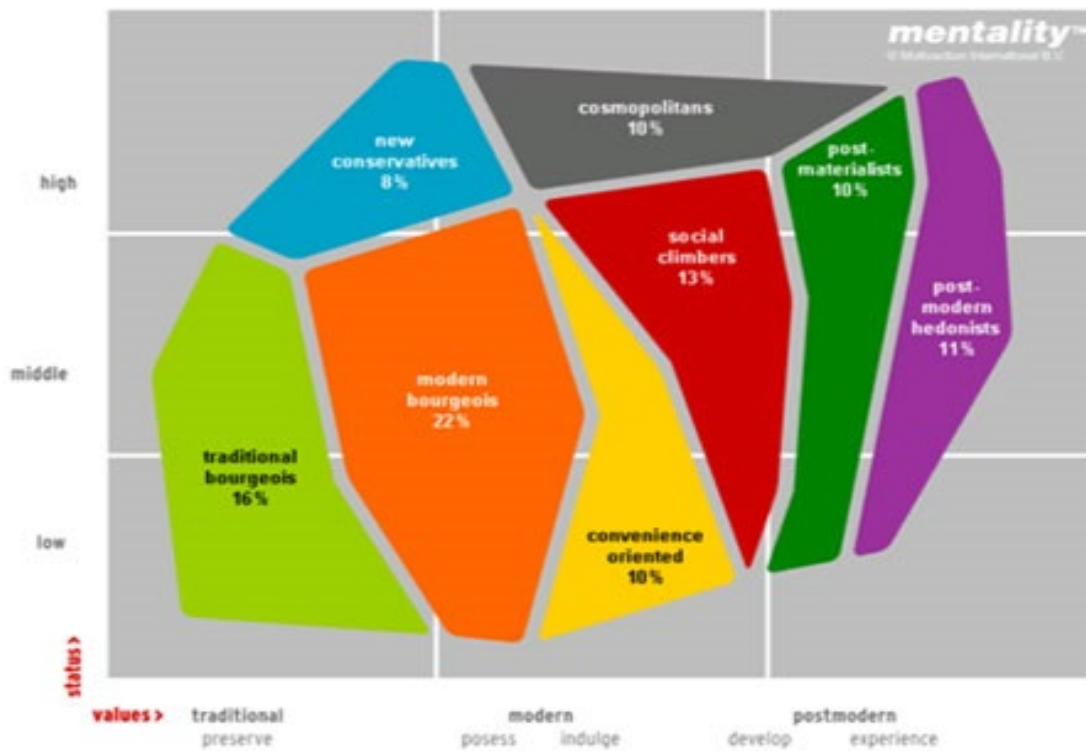
Attitudes and lifestyles

The Dutch marketing advisor Motivaction classifies the Dutch population in 8 mentality groups (Motivaction, 2002). This classification is based on the assumption that people with the same socio-economic-demographic profile can have completely different lifestyles and consumption patterns. Motivaction argues that who you are, what you think, what you appreciate and what you do is more dependent on personal preferences , norms and values than on statistical characteristics.

On the Y- axis the socio- economic status is presented; low, middle, high. The X- axis has a new variable ; a value orientation. Three value orientations are identified, from left to right: traditional value orientation (preserve, conserve and maintain), modern value orientation (possess material things and indulge yourself) and the post- modern value orientation (develop, learn and experience). Motivaction has a huge database and works with 8 mentality groups. These groups are defined for the Netherlands as follows;

The modern bourgeois. Social class ; middle, modern orientation with a focus on possession. Can be seen as ; conformist, status oriented citizens who search for an equilibrium between traditions and modern values such as consuming and enjoying. Are not very mobile. Their car is a symbol of their prosperity. The action space is relatively small, but greater than the traditional bourgeois and the convenience oriented.

The convenience oriented. Social class low, modern orientation with a focus on indulging yourself. Can be seen as ; the impulsive an passive consumer, who strives for a careless, comfortable life. They would like to have friends and family in the neighbourhood, but this is not always the case. Small action space. They like cars, but can not always afford a car, and are hence as a group not very car mobile. Are not oriented to sustainability.



The new conservatives. Social class high, traditional value orientation. Can be seen as ; the liberal – conservative societal upper layer, which likes technological advancements, but is reluctant to adopt social and cultural modernization. A very mobile mentality group, with the highest car use of all groups. Often buy a new car. Like to live in greener environments, but relatively near to highways. Friends and family are dispersed, great action space.

The cosmopolitans. Social status high, modern value orientation with a focus on indulging yourself. Can be seen as ; the open and critical modern citizens who live in and with the world. They combine modern and post- modern values ; they like to learn, to develop themselves, and love societal success. Are rather materialistic. Live more often in cities, are very mobile, but not very car oriented. Make the most air miles. Friends and family everywhere.

The social climbers. Social class middle, modern value orientation on indulging yourself. Can be seen as ; career oriented individualists with a fascination for social status, new technologies, adventures and risks. Rather mobile, family and friends live at a distance. Love to live near highways. Car is a status symbol. Little use of public transport, very little walking and cycling.

The post materialists. Social class high, post modern value orientation. Can be seen as ; societal focussed idealists who want to develop themselves, and who will aim at sustainability and social equity and welfare. Family and friend live at a distance. A highly mobile group, the most mobile of all groups, and second in car use!. Very busy with combining tasks. Tries to use public transport, but often fails.

The postmodern hedonists. Social class middle, post modern value orientation, with a focus on experiencing. Can be seen as ; the pioneers of the spectacle culture, with experiment, and breaking with moral and social conventions. Live mostly in cities, like to spend their evenings outside home with friends. Are mobile, car not very important, highest use of public transport of all groups.

The great differences in these lifestyles, related to car mobility seem to focus on ;

- action space
- the importance of the car as a status symbol
- the importance of living near highways

We can identify;

- the wish to live near the highway,
- the car as status symbol, and
- great action space,

as indicators for a strong reliance on the car. The new conservatives and the social climbers are very car reliant, and the traditional bourgeois, the post hedonists and part of the modern bourgeois are not car reliant. The other three mentality groups are in between, with a special position for the post materialists. They are ambivalent in their orientation, as they see all the disadvantages of car use in relation to sustainability, but need car mobility in their busy lives. The convenience oriented also show some ambivalence; they like driving, but can often not afford the purchase.

We could also use the differentiation of user groups to study the acceptance of smart mobility solutions in society. In my *Car Mobility 2014-2030; Material for a debate on Framing Smart Mobility* I introduced a typology by Arthur D. Little. They presented a division of new mobility types, which is useful in understanding new 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 for reception of technical oriented smart mobility" could be identified:

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(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 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 centres on the silver drivers, and contains some 30% 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 centres 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 centres on the greenovators, and contains some 30% 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.

I am sure that from a Chinese context you will arrive at other differentiations. But what remains is the potential usefulness of introducing a lifestyle- approach in defining and designing mobility policies. What do different households consider useful, acceptable or appropriate, and how to use this knowledge in policy making. Which lifestyles will grow, which will diminish?

Behind the motives

Rather often motives for car use are taken for granted. It is questionable whether this is a useful approach. Motives are always multi- layered and often real societal questions are hidden behind motives. I consider the search for motives behind the use of mobility modes as a contribution social sciences could offer to mobility studies.

To present three examples.

Convenience is seen in the Netherlands as the most important motive for car use. But what is behind this convenience ? Why has convenience become so important ? Partly because households love convenience, as an intrinsic value. But convenience also relates to helping to overcome stress and stress situations. Convenience is a big helper in stressful societies, where time pressure and multi -tasking at a high level is at stake. The car, with its flexibility, is a great helper here. But cycling can also be very flexible. Here another element of convenience comes in; comfort. Many households consider cars to be comfortable. When we would like to diminish car use, we could aim at making car use less comfortable (Just creating basic mobility), but also at making life for households less stressful and less time- scheduled.

Protection is an interesting motive. Cars can protect drivers and passengers to the anxieties of modern life. You do not have to confront yourself with the anxieties that are generated in the public sphere (contact with other people, criminality), you just can close yourself in the car, and drive in a protected sphere through the public sphere. Car use diminishes the need for contact with other people in the public sphere. Better stated, basically the car plays a paradoxical role ; the car creates the build -up and maintenance of contact networks over greater distances, and at greater geographical scales, while at the same time killing the necessity to invest and to keep investing in permanent contacts on the small action radius of the own neighbourhood, own village or city. When you consider these last elements essential, you need to define specific policies towards car use.

A last motive is health. Health is becoming an important motive related to mobility, and especially in helping to promote active modes. However , with great environmental problems in cities it could from an individual perspective be healthier to use the car than to go by active mode!

What I would like to stress here is the usefulness of discussing motives for mobility, just to define routes for mobility policy to take. In developing mobility policies it seems necessary to take positions in what sort of society you wish to see developing.

Perspective 2 : Accessibility and social exclusion

In OECD countries there is an underestimated problem, related to transport. It has to do with too little mobility options for a part of the population. They face difficulties in reaching key services. This problem has tended to be forgotten by transport researchers and economists, and has been put on the agenda by social scientists.

In France, Australia and the UK especially over the last decade attention has been given to the relationship between social exclusion and transport. What is the relationship between social exclusion and transport about? In *Transport and Social Exclusion ; A G-7 comparison* (2003) Lucas distinguished certain trends ;

- services and facilities move to locations that are difficult to reach without a car
- services and shops disappear from deprived areas
- personal restrictions and handicaps
- diminishing quality of public transport
- exposure to noise and air pollution from nearby transport

It mostly deals with complex interactions between ;

- the locations of activities
- the personal situation of households
- the disposal of transport possibilities

Litman (2002) designed a circle of car dependence. In his vision car dependence leads to an increase in social exclusion because possibilities for travelling without a car are being diminished, resulting in higher travel costs. To cope with this, people buy a car and their car dependence grows. For Litman social exclusion is not only related to the carless households (22 % in the Netherlands) , but also to the somewhat poorer and the poor households which have cars but have to pay a lot for transport, in relation to their incomes..

Seen from a welfare state perspective this theme is about the well known problems of those at the bottom of modern western risk societies, worsened by the fact that in location decisions about work, health care and shopping good accessibility for other modes than the car is usually a non- issue. Households more at the bottom of society (in income terms) have to spend huge sums on transport and these households often live nearer to urban roads, creating noise and air pollution problems.

On the basis of the existing and still growing literature four interrelated problems can be identified. The first is the relative high transport costs with which lower income groups and the carless households are faced. All the FIA studies showed that poorer households spend a substantially higher share of their incomes on transport. When they are also faced with high rents or mortgages this can create stress. In Australia there is literature on so called "forced car ownership" where the poorest households live in locations where they can not reach many activities without a car, public transport is either non- existent or going in the direction of the city centres. These groups feel compelled to buy a cheap car from their limited incomes, and are faced with transport costs exceeding 40 per cent of that income. But at least activities are accessible! (Currie et. al, 2009, Johnson, 2007).

The second problem consists of the choices for the locations of the for lower income groups and car less households essential services and facilities of work, shopping and health care. These services tend to move outwards, out of the vicinity of the poorer residential areas, and more important, they often move to locations that are difficult to reach without cars. On this theme the French researcher Orfeuil (2004, b, 12) has said; "Basically the location of residences and amenities is more and more directed by the upper and middle class behaviour, for whom car use is not a problem." In Ile de France, the region around Paris, 50 % of the commercial centres (with big supermarkets and entertainment facilities) do not have public transport services.

Work locations can also be problematic. In the United States the Spatial Mismatch Hypothesis has been developed which states that the poorer populations remain in the city, while employment moves with the middle classes to the suburbs, to edge cities and to edgeless cities. The urban poor have to travel to find decent jobs, have to pay rather huge transport costs (remember ; there is only little public transport in the suburbs!) and are , when there is no car in the household, unable to reach

the work offered, and thus remain trapped in a circle of poverty. (Sanchez, Stolz and Ma, 2003, Stoll, 2005).

The third problem is the weak supply of other transport modes. Not, or only a great costs, being able to reach all sorts of destinations is no great problem, when other transport modes are available. However ; the growth in the efficiency of service providing in public transport seems to have led in a number of countries (Great Britain, France, New Zealand, to name a few) to a decline in the supply of public transport, sometimes in frequency, but more often in a smaller range of hours on which services are to be delivered (see Social Exclusion Unit,2003). Most countries do not have countrywide coverage by the so called "travel on demand "services whereby people needing transport can for example phone an a taxi which then comes to pick them up. This "travel on demand"- systems tend to be expensive and are thus mostly for designated target groups like the elderly, or the disabled.

Stokes (2002) and Bowden and Moseley (2006) studied car dependence in rural England. Thirteen per cent of rural households had no car, and these households had especially in areas where public transport was poor , great difficulties reaching medical services. Also shopping had become difficult with the closure of many smaller rural shops..

The last great problem is essentially the households, and their members, themselves. They miss opportunities because their perception of the transport and mobility reality, their "mental map", or better stated ; their "travel horizon" is inaccurate or even simply wrong! They perceive fewer possibilities than there are in reality. Low skilled workers have a specific search and travel behaviour towards work (Cremers, Backera, Faun,2007) and in general the space in which daily life takes place increases with higher education levels. To present some figures from the Netherlands ; people with the lowest education (only VMBO) travel daily 26,2 kilometres in 55 minutes, where people with the highest education (HBO/WO) travel daily double that distance (50,6 kilometres) in 84 minutes (MON,2007). Note that travel does not increase twice, these figures indicate the use of faster transport modes and greater travel on highways, by the best educated people. Lower educated people have less cars than better educated people, and as we already saw, this holds even stronger for members of the minority groups.

In general lower - educated people do not want to travel very far for their employment. This is even more so for people combining work with other tasks. Barriers and difficulties dominate their approaches (Morris,2006). As the chances are great that lower skilled workers do not live in the modern middle class oriented neighbourhoods nearer to the highways, they will have trouble reaching highway locations physically, but also mentally! Attitude, mentality, motivation, but also no access to the only transport mode that can bring them easily to these locations make work locations near highways to closed domains for at least a part of the lower educated groups.

To conclude there seems to be a spectrum in countries expecting social exclusion from transport. On the one end of the spectrum we find not densely populated countries, with insignificant public transport, and without the full range of subsidies from the state. In these countries, for example the U.S., the United Kingdom or New Zealand and the peri- urban areas of France social exclusion by means of transport should be an important issue on the societal agenda. On the other end of the spectrum, in densely populated countries, with rather well developed public transport, and with a complete welfare state, like Germany, the Netherlands or Denmark it can be expected that problems are of smaller scale. In the Netherlands signs of social exclusion trough transport are seen in the more rural regions. Harms (2008,195) showed that rural households without cars can only get " travel by demand" at high individual costs.

For the future of Western Europe it will be important how the following factors will interrelate for the low income households and for the carless households ;

- greater travel distances to get to services and facilities
- greater commuting distances
- working locations are more difficult to be reached without a car
- employment possibilities are beyond the "travel horizons"

There is a chance that driving will become more expensive for poorer households. More research on social exclusion, household budgets and accessibility of reasonably - priced transport is a necessity

(Jeekel, 2014). I wonder what the Chinese situation is. Are you following this part of the academic studies on mobility?

Perspective 3 Societal challenges to mobility and the perspective of smart mobility

I will present five important 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 % in 2030, and to 70 % in 2050 . We will be faced with more megacities and with more mobility in these megacities.



The challenge 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.



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).



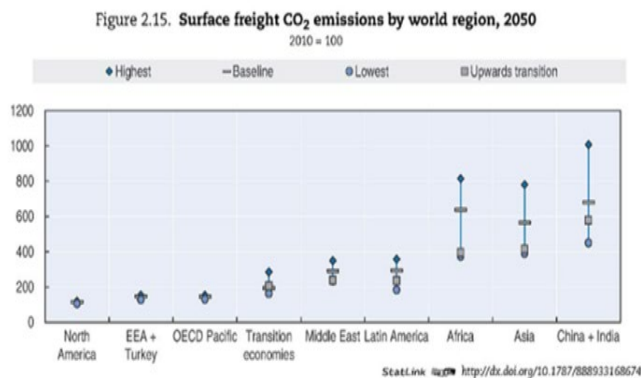
This brings me to the second challenge, the **challenge of IT in mobility**.



IT 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.

The challenge of **globalization and freight**.



In its Transport Outlook 2015, the International Transport Forum presented scenarios indicating a growth in surface freight kilometers by on average 320 % (compared to 2010), while related CO₂ emissions will increase on average by 240 %.

The challenge here is to *realize forms of freight transport and logistics that will avoid increases in CO₂ 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.

This leads 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. We also note initiatives suggesting that the average fuel economy of the global vehicle fleet can be improved by at least 50 % by 2050. And we still have the prospect of the hydrogen car.

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 stakeholders to invest in alternatives to fossil fuels, as Farla, Alkemade and Suurs have shown. Low oil prices are not helping either. 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 17 years, before new energy technologies and other power trains will be introduced in the complete car fleet.

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 by 60-80%* (compared to the 1995 level). I have already presented some figures on freight. Transport is now the only societal sector where CO2 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 CO2 levels, which take the best new technologies into account, and did not find any single scenario that reaches higher CO2 emission reduction - levels than 50%. It is even worse since scenarios do not take into account the huge growth in mobility in the developing world.

The last challenge is the challenge of the **next generations**.

Looking at the future of mobility, the attitude of the new customers is crucial. What will new households 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 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. 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? Is the sharing economy a hype as well, or is it the start of a real paradigm shift?

Interesting to see what smart mobility, or broader; more technical oriented solutions could offer to these challenges.

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	Automated driving	Fuel technology	

		Last mile systems	Electric Vehicles Solar Cars		
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 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 difficult way to go from these targets to really contributing to the societal challenges. Once researchers in the engineering departments start focussing their research on these societal challenges instead of on intermediate targets, cooperation with the researchers working in social science traditions will become far easier.

The greatest cooperation could be found in the creation of new mobility services. Two examples here. The sharing economy related to the development of apps can provide 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 .

And in the Netherlands we now work with four scenarios on the societal impact of automation of the driving task (Kennisinstituut voor Mobiliteitsbeleid, 2015). Two axes are central; the first is on individual use, or on sharing use. And the second is on partial automation, or full automation. Individual and full automation leads to a world in which automation leads to an extension of the car fleet with a new option, available only to car drivers. Sharing and full automation will lead to new forms of public transport, and people movers. Sharing and partial automation could lead to more investments in ridesharing, drive sharing, and trains of cars on highway (where automation can be introduced earlier). And individual and partial could lead to just a new device for car use on highway; the automation button. From these scenarios it is clear that the position taken from now on is important; what do we want ; just an extra car device/option, or creating a new perspective on what could be called public transport ?

Perspective 4 ; Implementation challenges

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 , for the Netherlands, 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, it is as yet 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.

Smart solutions can meet societal challenges only when these solutions are implemented in society. 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 like the introduction of electric mobility or automated driving, where, as we now know, thanks to the work of Gijs Mom and the work of Steve Beiker director of the Stanford University Car Research Institute, the first narratives originated already a century ago and 77 years ago.

In general, implementation of potential disruptive solutions in the mobility domain has not been easy. 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*. Here I would like to present an example: Advanced Driving Assistance Systems(ADAS) which help driver safety and comfort in traffic, are IT driven and form the basis for further steps on the route to automated driving.

The implementation of ADAS differs in the western world, and mostly stops somewhere in the middle segments of the car fleet. This implementation 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.

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. They form positive and negative evaluations at the same time. Behind this is also some fear of “losing control over their vehicle”

This 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.

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 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 started, but scaling up failed. 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 8 million, we now have 10,000 fully electric vehicles and 80,000 hybrids, mostly used not as electric vehicles. These figures put us in the top in Europe, in second place behind Norway, but are still minor.

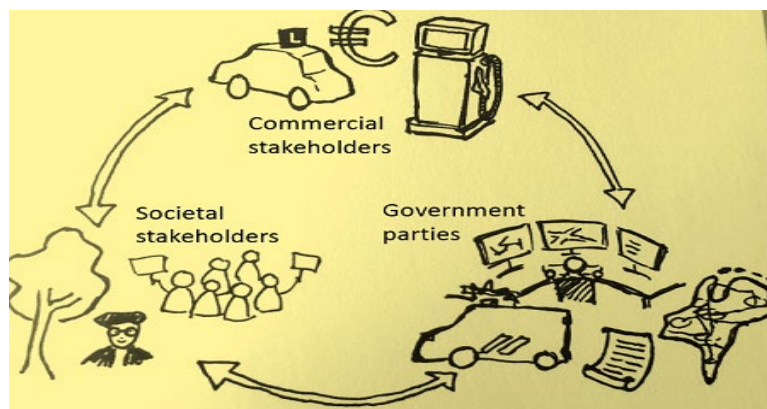
To conclude; In the mobility domain there are many rather isolated pilots. This may create the impression that there is great energy on a new development but, as these pilots are often not connected, no focused energy is actually created.

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, and by Healey. 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, and about coordination!

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.



In my book 'The Car Dependent Society' I defined 22 relevant stakeholders related to car mobility, divided in three groups ;

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

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, and is not keen on cooperating on a longer term..

For the future a central question is whether we can 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.

There is on implementation another element to be mentioned. 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 aspect.*

These aspects of implementation, aspects like user perspectives – issues related to upscaling 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.

Conclusion;

What I have tried to present in this contribution is some perspectives from social sciences towards mobility in the future. I hope I succeeded in showing that;

- a. Elaborating on the motives for mobility can create new insights for designing policies
- b. Differentiating between users groups can make policies more focussed
- c. Orientations on social impacts related to developments in mobility are necessary
- d. Technical research, with its mostly smaller societal focus, needs to be accompanied by studies presenting the broader picture on societal challenges to be met
- e. Implementation studies and research on implementation strategies for smart mobility solutions are essential to make things happen.

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