Disruption Technology in Mobility - Customer Acceptance and Examples

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Abstract

Important things become part of our language. "Do not reinvent the wheel" is an old German proverb, which refers to one of the most important "breakthrough" inventions (the wheel) in the area of mobility – a need of still increasing importance in today's societies. The history of mobility knows many more examples of disruptive technologies - all of them changed and shaped our world as we know it today.

Recent disruptive innovations within the mobility refer to

- Simple and cost-effective access to mobility: The example of Uber shows how motorized private means of transport can become part of public transport.
- Technological development: Tesla demonstrates impressively that eco-friendly electric cars with sporty design can beat traditional car technology. Self-driving cars are on their way and even telekinesis (steering by thinking) seems possible.
- New Mobility Dimensions: Companies like Space X work on commercialising space travels for private consumers, thus opening the door to interplanetary tourism and super-high-speed-travelling.

For every innovation there are two challenges: The first challenge is to invent it, i.e. all about engineering and technology, the second one is to market it, i.e. all about mind and design that shape the customer perspective. And both of them do not just consist of make-or-break leaps, but are continuous processes – on the way to the breakthrough, and beyond. The "Map of Disruption" combines these two perspectives and provides a useful visualization on what is technically feasible and what is profitably marketable.

We start off by illustrating major trends in mobility and the challenges emerging from them. Section two provides the theoretical basis for the market acceptance of disruptive innovations: value theory as a general framework for consumer decision-making and the Technology Acceptance Model (TAM) as a particular framework for technological innovations. In the third step we introduce the Map of Disruptions. Finally, we integrate examples of disruptive technologies in the mobility business in the Map of Disruptions. We conclude by providing explanations why some technological innovations in the area mobility are accepted by the market and become potentially disruptive technologies whereas others don't succeed.

Keywords: Mobility, Technology Acceptance Model (TAM), Sharing Economy, Self-driving Car, Map of Disruption, Disruptive Technology and Consumer Acceptance, Simplexity.

1.0 Challenges for Mobility

More than 2,000 years ago Heraclitus (540-480 BC) mentioned: All life is motion. At least in the western world mobility has become a more or less basic need. Mobility is part of most people's lives. Mobility is a real success story, but unsolved problems still exist and new challenges arise. We want to discuss these problems and challenges by integrating different perspectives: the user or consumer perspective, the supplier perspective, and the governmental / societal perspective.

Key challenges for the mobility of the future arise from the megatrends of our time: demographic change, urbanization, increasing environmental awareness and shifting mobility behavior:

- Looking at the demographic trends, the mobility industry has to face two mayor issues: Firstly, according to the U.N., in the next 30 years the total population of the earth will grow to 10 billion people. In consequence an overall increase both of passenger transport (individual or public) and - even more - of freight traffic will challenge existing mobility capacities. Secondly, especially in the industrialized countries, the ageing of societies is likely to be a key issue. In Germany, for example, the share of people at the age of 65 years and older will have doubled by 2060 and will amount to one third of the population (StBA, 2015). Rising age might sooner or later limit physical mobility of the human body, and therefore raise the requirements and challenges for most suppliers in the mobility sector. On a worldwide basis, some 50 % of the population live already in cities. This portion is expected to rise to more than 65% by 2050 (UN, 2014). In Europe, this ratio has already been reached and it is expected to further rise to amount to some 85% in the long run. Urbanization will have a strong impact on infrastructure. To prevent traffic collapse of cities and a further rise in cost of infrastructure, mobility solutions are needed that optimize the utilization of existing infrastructure and achieve a higher efficiency. Public passenger transport is already testing alternatives in rural areas: e.g. Swiss-based PostAuto is testing self-driving busses (PostAuto, 2015).
- Rethinking ownership: At least in the triad markets, car loses its significance as a status symbol or a statement of personal expression (Rossbach et al., 2013). This is especially true for the young, educated consumer in metropolitan areas. Even though car numbers are still growing on a worldwide basis, we see declining numbers in some countries and especially in some bigger cities indicating that the "peak car" has been exceeded (Newman & Kenworthy, 2015). In big cities in Germany the percentage of households without a car increased from 22% in 2003 up to 30% in 2013 (StBA, 2014). Alternative mobility concepts such as car sharing experienced unprecedented customer acceptance.
- Connected mobility: In addition, a new trend called intermodality, i.e. the flexible and individual combination of different modes of transport, is increasingly gaining relevance. What is important to the customer is the most efficient way to get from A to B, not the means of transport used or who owns them. Connected mobility aims at integrating various means of transport into one comprehensive transport system instead of competing against each other. A key element is the flexible choice of the most appropriate combination of transport means for a transport purpose. Separate information, booking and ticketing systems for the various competing modes of transport belong to the past. A mobility integrator assumes the role of a comprehensive mobility service (Fraunhofer, 2016). Mobility consumers are increasingly expecting one-fits-all-solutions and connected mobility (Henkel, Tomczak, Henkel & Hauner, 2015). However, in this area integrated solutions from the supplier side seem to lag behind.
- Living in a digital world: Thanks to smartphone and wearable permanent access to the Internet has become standard. The triumph of smartphones changes how and when we access

information, buy, sell, use, and communicate about products or services. As a side effect, customer needs are growing in the dimensions simplicity / convenience, real-time solutions, and ubiquity. Messenger Apps are the most growing social platforms, becoming soon the way to communicate with friends and family but also with business (Wolf, 2015).

From a governmental / societal perspective the challenges concerning mobility are:

- Rural Depopulation: Urbanization leads to higher costs of infrastructure not only in the fast growing megacities of the world. Road congestion incur economic losses in the US, Great Britain, France, and Germany that amount to more than USD 200 bn per year (CEBR, 2014). Another analysis estimates economic costs up to USD 266 bn per annum due to paralyzed traffic flows in the world's 30 biggest megacities (Rossbach, Winterhoff, Reinhold, Boekeis & Remane, 2013).
- Global Pollution: Reducing global warming and pollution are major challenges for politicians on a world-wide basis. Private and public transport induce about 20% of all greenhouse gases in the European Union. The aim to decrease these emissions is particularly difficult in an age of increasing mobility. People in many cities already suffer from particulate pollution (European Commission, 2011).
- Security Issues: In the age of terror, attacks often target transportation systems at peak times such as subways, trains, airports. Needless to say that the need for secure mobility increases.

States and municipalities have already started to regulate mobility. Bonus as well as tax penalty systems have been developed to limit access to urban areas, especially for cars with high emission. In Paris, Beijing and Sao Paulo only cars with even or odd endings of the license plate are alternately allowed to drive when particulate loads are high. In Shanghai a license plate cost almost as much as a compact car.

However, public transport is revitalized in many urban or metropolitan areas. In Shanghai the largest metrosystem worldwide (500 km of metro) has been built within the last ten years. Even in the U.S. 40 larger projects contribute to the renaissance of the light rail system (The Transport Politic, 2016).

Suppliers of mobility solutions must address both the changing customer requirements and the governmental / societal issues. But there are some more challenges:

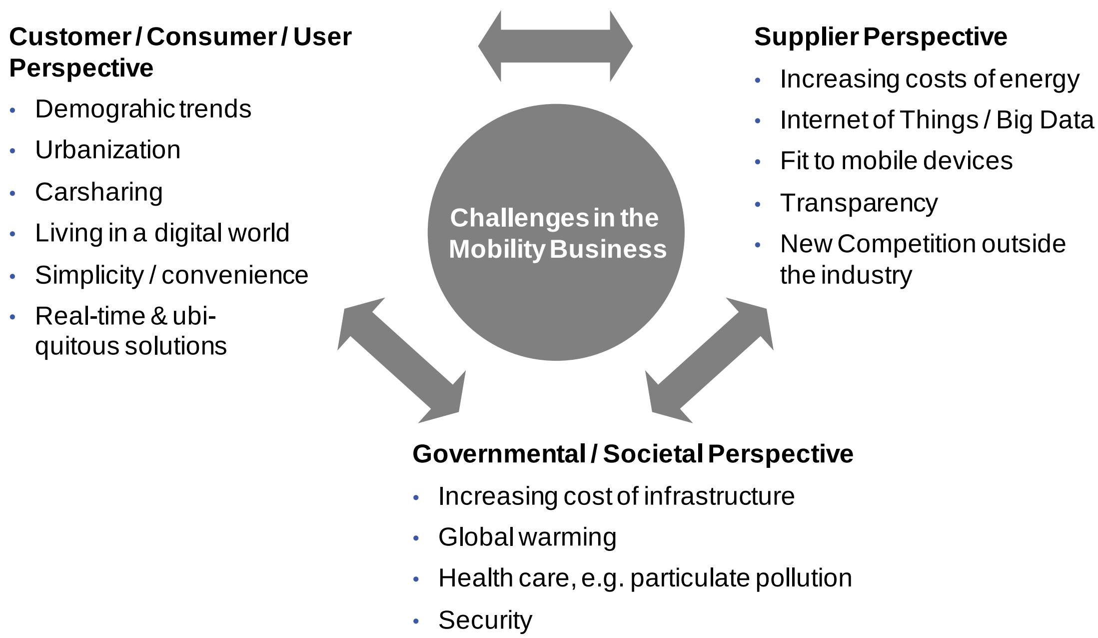
- Growing energy costs: They are among the most vital challenges in the mobility industry, especially when looking at the individual car transport. A lot of work is already done to reduce the consumption of fossil fuels. As an alternative form of propulsion electric cars still cannot compete against conventional drives as they are still more expensive. But the announcement of the new Tesla model “Tesla 3” priced at 35,000 USD shows that the price competition has just started, potentially enabling Tesla to make electric cars a success story of disruptive technologies in mobility.
- Internet of Things (IoT): IoT is another technical challenge. It will provide more and more data about products and services, even for companies with traditionally little end customer interaction. However, generating Big Data is one issue, transferring it into smart data the other: the challenge is to get the right results out of the data. Companies solving this analytical challenge will achieve a clear competitive advantage.
- Blockchain technology: Another technological development with huge potential for future disruptions is the blockchain technology. The main idea of blockchain is to exchange values without further instances like banks. Thus, it is a sort of distributed consensus system, in which none of the individual persons involved controls all the data (Webb, 2015). A maximum of

transparency can be achieved with simultaneously low susceptibility to manipulation (Kuhn, 2015). Blockchain technology can be used for anything requiring signatures or authentification and thus it potentially eliminates the need of all intermediaries in most transactions (Webb, 2015). In the mobility business, the use of intermediaries is very common - even disruptive business models like Uber are intermediaries as they basically provide a connecting platform for supply and demand. Thus, further developments of blockchain technology might render these intermediaries business models in the mobility sector obsolete.

- Changing communication channels: Any mobility solutions must fit to mobile devices as customers require using smartphones for the entire process chain of search, booking, ticketing, and billing of mobility services. New communication channels will change the way of interaction with end customers: As few apps are regularly used by consumers, Messenger Apps like WhatsApp, Facebook Messenger or WeChat will become the appropriate communication channel (Wolf 2015).
- Competition: Sudden appearance of new competitors from outside the mobility industry. Unexpected by incumbents, new competitors from outside the industry enter the market. Google Car (self driving) or Tesla (electric mobility) are typical examples from the automotive industry.

Figure 1 shows all challenges at a glance. Disruptive technologies can play a big role to get sustainable answers to solve these challenges - solutions are needed anyhow.

Figure 1: Challenges concerning mobility



2.0 Using the Technology Acceptance Model to understand disruptive technology

While technology becomes more powerful, better, faster and cheaper, people change their behaviour and attitudes only slowly. The different rates of development of man and machine creates a "Reality

Gap" indicating that the technical possibilities might grow beyond average human capacity to imagine, accept, and to adapt to – they sometimes seem to become overwhelming (Rushkoff, 2013). If what is technically possible exceeds the adaptability of people the technological progress in societies increasingly becomes dependent on the acceptance of the population, i.e. whether people understand, demand, and use the new technology.

Before looking at disruptive technologies in the mobility industry we first turn to value theory and the Technology Acceptance Model (TAM) to provide a theoretical framework to explain the adoption of disruptive innovations. In order to do this the Technology Acceptance Model (TAM) will be adapted to provide determinants for ease of use in the mobility sector.

Value is one of the core concepts explaining why people buy or adopt a new product. The classical economic view took products or services as sources of value. Lancaster (1966) interpreted products as "bundles of characteristics" and thus shifted the focus of value creation to the individual characteristics of an offer that form the aggregated product or service value. Whereas many product or service characteristics are perceived as beneficial by the customer and therefore contribute to the aggregated value in a positive way, some characteristics like price may rather diminish the perceived overall value of a product or service. Price management therefore often illustrates the price as the "sacrifice" a customer has to make in order to enjoy the benefits of a product or service (Monroe, 2003).

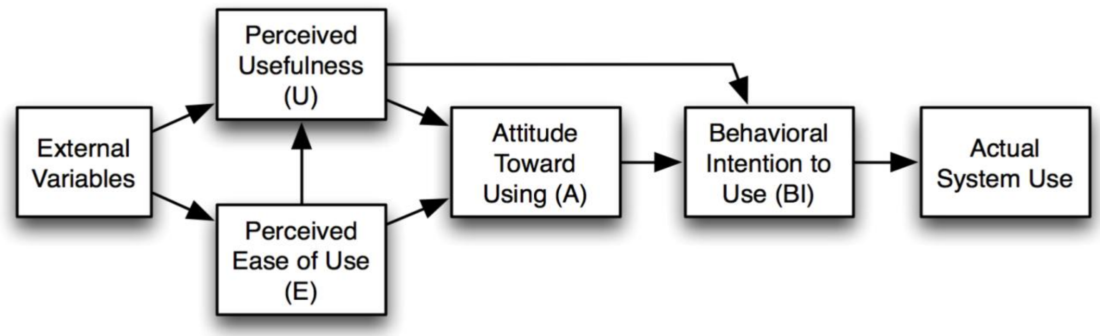
Transaction cost analysis (Williamson, 1979) suggests that there is not just price to be added to the sacrifice side, but all costs incurred during searching, negotiating, contracting, using and even disposing of a product. Moreover, risks associated with a product or service could diminish the overall value. The difference between the positive and the negative value attribute evaluations form the net-value. Customers form their choice typically on the basis of the highest net-value among the given alternatives. However, they might not necessarily be aware of it. Net-value as the key determinant for product- or service choice serve as a basis for understanding when and why new products are adopted by the customers at large. However, in a technology-driven market environment the Technology Acceptance Model provides some deeper insights for the adoption process of technological innovations (Davis, 1989). Therefore we adapt this model to the acceptance of new technologies in the mobility sector.

Originally, the technology acceptance model was conceptualized to explain the adoption of new IT systems by users in a work context (Figure 2). However, adaptions to explain the adoption of new technology in a variety of fields exist (Davis, 1989). Main drivers of technology acceptance are the Perceived Ease of Use (PEU) and the Perceived Usefulness (PU) of the new technology which affect the attitude towards usage and therewith the behavioural intention to use and eventually the actual use.

Perceived usefulness is influenced in this model by perceived ease of use, relevance, output quality, and social factors like status enhancement and social norms as well as demonstrability of results (Venkatesh & Bala, 2008). Perceived ease of use itself is triggered by the perception of self-efficiency enhancement, by the perception of external control, anxiety as well as playfulness and perceived enjoyment coupled with objective usability, i.e., the effort required to use a new system. To transfer these factors to a mobility context within a net-value framework we likewise distinguish between perceived ease of use and perceived usefulness for accepting new mobility technologies.

Perceived ease of use is defined as the degree to which an individual perceives the new technology to be usable with minor effort (Davis, Richard & Warshaw, 1989, Venkatesh & Bala, 2008). One influencing factor that determines ease of use is the degree of self-confidence a user has in being able to handle a new technology (technology self-efficacy). For a mobility context this might transfer into having the right technical equipment (Smartphone, App, …) to be able to use a mobility service like Uber.

Figure 2: Technology Acceptance Model



Perceived ease of use is further enhanced with the perception of external control (Venkatesh/Bala 2008), which is described as "degree to which an individual believes that organizational and technical resources exist to support the use of a system". In a mobility context we might rather refer to this factor as "external support" which could refer to government support of e.g. electro mobility. Conceivable examples are subsidies for buying e-cars or tax-reduction when driving e-cars as well as free-parking for e-cars in inner-city areas as in Norway or fast-lane access.

Computer anxiety (Davis, Richard & Warshaw, 1989) could transfer into perceived risk associated with using new mobility technologies. Among the perceived risks often named as reasons why consumers refrain from buying electric cars are: high price (economic risk), low ranges and missing availability of electric chargers (functional risk), catching fire that is nearly impossible to be ignored (safety risk), low speed of driving (time risk) or even doubt about data security and potential misuse (information risk). Furthermore, the potential loss of self-determination in self-driving /autonomously driving cars/devices could be considered an additional risk (risk of loss of control).

Perceived enjoyment (computer playfulness) as factor of influence on ease of use refers to the degree to which a system or technology seems enjoyable irrespective of any functional or efficiency enhancement through the technology. In a mobility context this might refer to the joy that is generated from the mode of transport itself. For example space travels, once they become accessible to a larger number of consumers, might provide a unique experience that cannot be compared to any other mode of transport.

Objective usability as driver of ease of use refers to the actual effort required to use a new system (not so much the perception) in comparison to the established system. In a mobility context this could refer to time efficiency for booking, waiting for and using a mode of transport as well as the steps required in the process to book and use a mode of transport. It could be encapsulated in the terms efficiency, performance or even convenience of the mode of transport.

The drivers of ease of use contribute as value-generating features to the overall evaluation of a new technology. They do so in a positive way, except for the perceived risks associated with the new technology. The diverse risks associated with a new technology typically diminish the net-value of the new technology and have to be taken into account as potential barriers to diffusion. However, disruptive technologies are often characterized by very low price positioning in comparison to established technologies. Typically, disruptive technologies benefit from comparatively low cost structures, for example, by accessing / using spare capacities (e.g. Airbnb). With price as the number one denominator of negative value contributions, disruptive technologies might have the most powerful leverage on net-value. Table 1 depicts the transfer of the technology acceptance model to a mobility context.

Table 1: Determinants of "Ease of use" transferred to new mobility technologies

Determinant acc. to Vankatesh/Bala 2008	Determinant mobility context	Example
Computer Self-Efficacy	Owning/able to use new technologies	Smartphone usage confidence, access / usage of apps required
Perception of External control	External support	Subsides, tax reductions for new technologies (like e-cars), free parking, fast lanes
Computer anxiety	Perceived risk of using the new technology	Functional risk of e-cars because of low range
Computer Playfulness	Perceived enjoyment	Enjoyment of space travel
Objective Usability	Efficiency, flexibility and convenience of usage	Smartphone payment of travel tickets
Cost	Low cost	Low budget overnight stay (Airbnb)

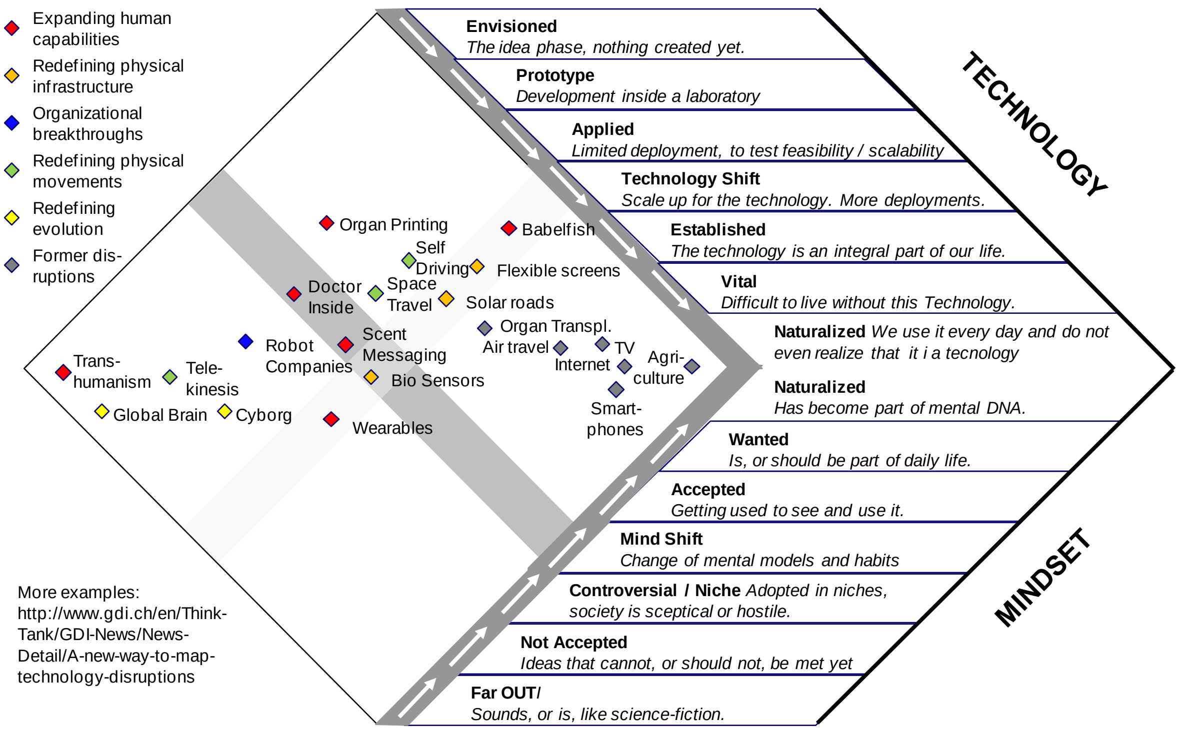
3.0 Map of Disruption

For every innovation there are two challenges: It must be made, and it must be accepted. The first challenge is all about engineering and technology, the second one is all about acceptance by the customer. And both of them do not just consist of make-or-break leaps, but are continuous processes – on the way to the breakthrough, and beyond. The GDI introduced 2014 the "Map of Disruption" (GDI 2014). IT combines these two dimensions and gives us a useful framework about what is technically feasible and what is acceptable by society (Figure 3).

> *"The map … is inspired by a concept of the Dutch futurist Koert van Mensvoort (www.nextnature.net). His "Pyramid of Technology" is made of seven stages from vaguely envisioned up to completely naturalized. "Moving through the seven stages" Mensvoort says, "we will learn that new technology may seem artificial at first, but as it rises from the base of the pyramid towards the top, it can become so accepted that we experience it as a vital or even a natural part of our lives." (GDI, 2014)*

The Gottlieb-Duttweiler-Institut (GDI) added a second dimension to this concept to create the Map of Disruption. The seven stages of technology development are completed by seven mindsets representing different technology acceptance stages (GDI 2014). The developments in both dimensions are interrelated: The more sophisticated a technology is, the higher the chances that it will be broadly accepted. Yet, this is only true if perceived usefulness and perceived ease of use are high. In other words, for the consumer a technology needs to be convenient to accept it. This contrast of complexity on the technological side and the simplicity required by the customer to provide ease of use is encapsulated in the term “simplexity” (Wippermann, 2006). Some technological innovations would make our lives a lot easier (high perceived usefulness), however the technological feasibility seems to be lacking behind (self-parking cars in cities, automated translation à la Babelfish). Yet, other technologies are ready for use, but far away from being accepted e.g. In Vitro Meat.

Figure 3: Map of Disruption



The Map shows some 30 of (potential) ground-breaking disruptive innovations. As GDI (2014) pointed out, ”the map might equally be useful as a framework to better understand the innovation processes of the past and the future, or of specific industries, regions, epochs or companies”. We would like to pick up the map as a framework for the mobility industry. In Table 2 some mobility related technologies are categorized along the two dimensions of the map of disruption.

4.0 Examples for Disruptive Technologies in the Mobility Business

“Uber, the world’s largest taxi company, owns no vehicles. Facebook, the world’s most popular media owner, creates no content. Alibaba, the most valuable retailer, has no inventory. And Airbnb, the world’s largest accommodation provider, owns no real estate. Something interesting is happening“ (Goodwin, 2015).

In this section, we present company break through-examples that represent disruptive technologies in the mobility sector. These aim to provide solutions to needs specifically driven by the megatrends depicted in the introductory section. Furthermore, we integrate those examples into the Map of Disruption. The examples are taken to the Map of Disruption and shown simultaneously which address the aforementioned trends and challenges.

Table 2: Mobility technologies and their stages in the Map of Disruption (adopted from GDI, 2014)

Technology	Stage of technology	Stage of mind
Air Travel	*Vital*: Difficult to live without this technology	*Wanted*: is or should be part of daily lives
Self Driving Cars	*Applied*: Limited deployment, to test feasibility and scalability	*Accepted*: Getting used to see and use it
Commercial space travel (Planetary tourism and super-high-speed round the world travel)	*Applied*: Limited deployment, to test feasibility and scalability	*Mind Shift*: Change of mental models and habits
Telekinesis (Thought-control. Activate machines and move objects by thought alone)	*Prototype*: Deployment inside a laboratory	*Not Accepted*: Ideas that cannot, and should not be met yet.

New technologies are not necessarily disruptive technologies. This is only true for technologies that succeed in capturing the mass market and don't stay in a niche market. Looking at the mobility business: Carl Benz invented the car, but it took Henry Ford's mass production - decades later – before traditional transportation became disrupted (Uphill, 2016). The established technology, in contrast, is displaced in the mass-market and becomes niche market product. The common characteristics of disruptive technology are to be cheaper, simpler, smaller, and providing ease of use (Christensen, 1997). In this sense, some of the examples presented here actually are not disruptive technologies as will be shown for better understanding.

4.1 Uber

Uber has been one of the most popular disruptive technologies in the last years. The business model is being copied by a large number of other companies. The phenomenon has become so prevalent that it is commonly referred to as "Uberification" or “Uber-Principle”. The San Francisco based ride-hailing company Uber was founded in 2009. It operates in more than 58 countries and is valued approx. USD 61.5 bn (Newcomer, 2015). Reuter estimated Uber revenues 2015 to roughly reach USD 2 bn; a number that is assumed to more than double by 2016 (Zhang & Shih, 2015). In a number of countries, however, the legality of Uber has been questioned by governments and taxi companies, who allege that its use of drivers who are not licensed to drive taxicabs is unsafe and illegal. In Germany, for instance, Uber has reduced its operation to currently 2 cities only.

Business model: Uber uses the basic idea of the sharing economy to better utilize spare capacity. The idea of the sharing economy is to replace ownership by renting or sharing spare capacities for part-time usage or access (Frick, Hauser & Gürtler, 2013). Within the mobility sector this idea has led to a lot of new business models like car sharing, bike sharing and nowadays even plane and drone sharing. Without smartphone and internet, it was hardly possible in particular for individuals to market their spare capacities like private cars. The average spare capacity of cars is estimated to be more than 23 hours a day (Plouffe, 2015). Digital transformation brings together both excess supply and demand, simply (via smartphone) and at low cost. Uber acts as a provider and earns a commission fee. The business model might be questionable, since the supplying taxi driver is not participating from profits. However, the interesting part is the concept of platformization and other examples like Israel-based "La'Zooz", where the drivers make the profits using the blockchain technology show, how interesting this concept is for the future.

4.2 Lyft

Lyft, like Uber is a transportation network company based in San Francisco. It was launched in 2012, as part of Zimride, the biggest US-ridesharing company. Whereas Zimride focuses on city to city-rides, Lyft concentrates on inner city-rides. The company is valued approx. USD 2.5 bn. Like Uber it faces more or less the same regulatory and legal issues.

Both, Lyft and Uber attract not only private passengers but also business travelers (Peltier, 2015). Uber and Lyft meet the criteria for being characterized as disruptive: they are cheaper, simpler, smaller, and provide ease of use. In the technological dimension of map of disruption Uber and Lyft reach the stage "established". The customer dimension mindsets for these business models range between "accepted" and "wanted". With reference to the challenges discussed in the introductory section, these companies serve to both needs: the need for flexible mobility at low costs and disburdens the infrastructure.

4.3 AirBnB

Another well-known example in the world of travel and leisure is AirBnB. It is an online marketplace for vacation rentals (instead of cars like Uber and Lyft) and connects users with property to rent with users looking to rent the space. The company was launched in San Francisco in 2008, valued in 2015 app. USD 20 Billion. The service is offered more or less worldwide. Recent data shows that AirBnB is the number one booking site in the US and UK (Clampet, 2016).

Thus AirBnB can be categorized within the map of disruption as naturalized in both dimensions (technological as well as consumer mindset).

The Uberification especially takes place in the mobility industry. Other examples are (GDI 2015): Flight-sharing by "JetSmarter", drone-sharing by "Sky-Cath", tow away-Serivce by "Tow-Choice". "Justpark" is another example: the UK-based company matches drivers with spare parking spaces through its website and mobile application.

4.4 Carsharing

Carsharing is not a really new or disruptive business model, but some interesting changes are to be seen. car2go (Founder: Daimler & Europcar, approx. 1 m customers), drivenow (Founder: BMW & Sixt, aprox. 300 k customers) or multicity (Founder: Peugeot & DB Rent) are car-sharing-providers in big European and North-American cities. Unlike traditional car-sharing companies, those companies do not required their customers to pick up and drop-off the cars at designated parking areas. Rather, the cars are parked everywhere and can be located via smartphone-App. Users are charged by the minute, with hourly and daily rates available.

Compared to traditional taxi business the common characteristics of disruptive technology are met: car2go, drivenow, and multicity are cheaper, simpler, smaller, and provide ease of use. Looking at the disruptive map, their classification is similar to Uber & Lyft. Both from a technological perspective and the customer mind-set perspective view the stage of Carsharing solutions can be described as "naturalized".

4.5 Self-Driving Cars

The next step in the technological development of individual transport is the deployment of self-driving cars, like the Google Driverless Car. More or less the whole automotive industry is working on automatic driving systems or driverless car technology. Driver assisting systems like parking assistance or pre-crash alarm can be categorized as established. Completely self-driving cars are presently in the test phase. Though Tesla founder Elon Musk already considers steering wheels as gadgets when buying a car, a lot of regulatory and legal issues have to be settled first. From a technological point of view self-driving cars seem feasible by now. From a customer perspective they seem to offer large benefits, however, perceived loss of control may pose a risk to the acceptance or use of autonomous driving.

On a macro-perspective self-driving cars are expected to reduce the number of accidents via vehicle-to-vehicle-communication. Subsequently, cost for vehicle liability insurance should drop significantly. Especially the aging societies of Western industrialized countries might be able to increase mobility for old people that are not able to walk, cycle, or drive themselves. MIT research shows that the combination of self-driving cars and car-sharing concepts could generate the existing traffic volume in cities like New York with 80% less cars (Claudel & Ratti, 2015). Correspondingly the cost for infrastructure will decrease.

As already shown in Figure 4 self-driving cars view the stages "applied" from a technical view and "accepted" from the customer perspective.

4.6 Tesla / electric cars

Despite the advantages of electric cars regarding pollution and at comparatively low energy costs the market acceptance is still poor. The above mentioned reasons why consumers refrain from buying electric cars, are high price, low range and low speed, and missing recharge possibilities. Up to now Tesla managed to build electric cars with a wide range at a high speed and furthermore established a grid of electric chargers. With the announcement of a price around USD 35,000 for its new model "Tesla 3" in March 2016, Tesla targets the mass market, especially when looking at total cost of driving due to hardly no energy cost, tax reduction or even public subsidies.

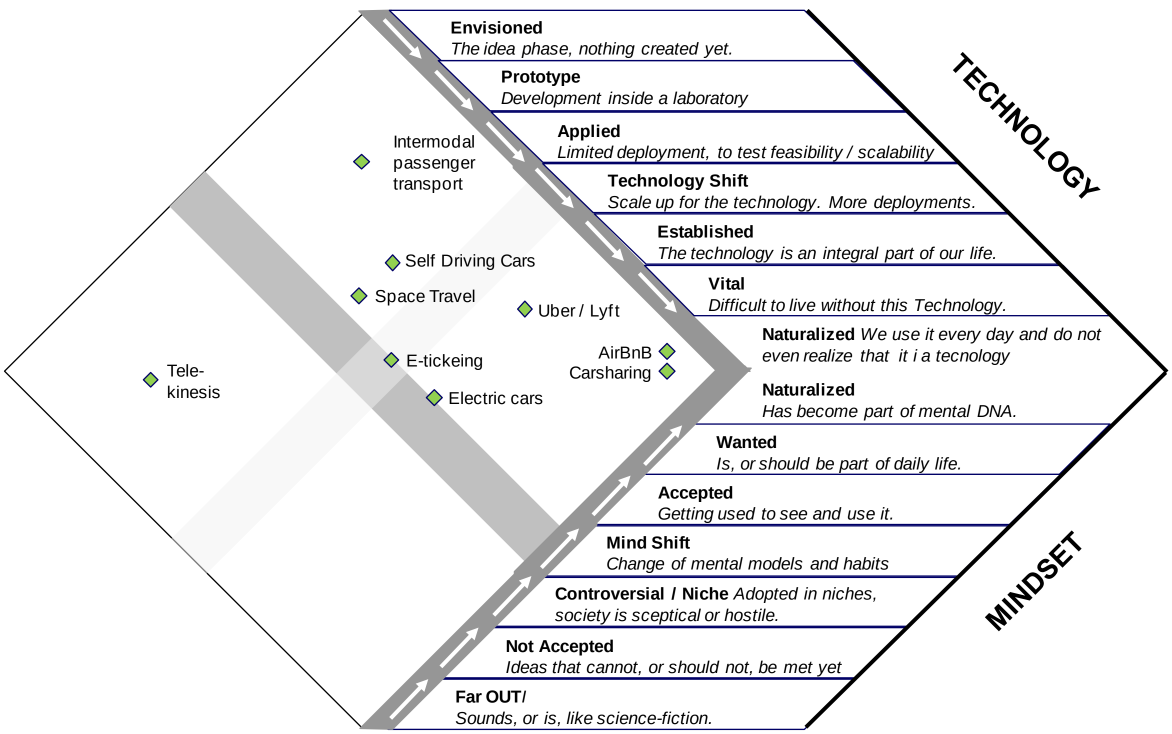
We expect that this announcement will lead to change in the stage of mindset in the map of disruption towards "accepted" or even "wanted". The market reaction after start of selling was tremendous: within 36 hours 253,000 vehicles were ordered valued more than USD 10 bn.

4.7 e-ticketing system at public passenger transport

But what about disruptive technologies within the public passenger transport? A lot of projects show that traditional paper tickets are replaced by electronic ticketing. In closed systems like air travel or some long-distance passenger rail like French SNCF this is not a technical problem at all. But most public short-distance passenger transport system are open, which means you can get on or off the train wherever you want. This implies that advanced technical problems have to be solved. One solution is called CICO (check-in-check-out): Customers are provided with a chip-card or a mobile device with Near-Field-Control-Technology (NFC) enabling them to actively register electronically each time when stepping into or out of a bus or train (Check-in Check-out) – an example is the Dutch Smartcard introduced in 2004. Another possibility is called BiBo: Customers also are provided with a chip-card or a mobile device, but are registered automatically when entering or leaving the transport system. SBB, the Swiss Railway Company launched the SwissPass, a chipcard that is being used as a discount card at the moment, but with the purpose to develop it to become part of a Bibo-System. Part of e-ticketing is monthly payment and a best-price guarantee.

Customers rank lack of transparency of pricing schemes among the major problems and difficulties in public passenger transport (Krämer, 2016). When combining e-ticketing with best price-guarantees customers don't have to bother about the transparency of pricing scheme anymore, while the biggest advantage for mobility providers is to gather real time travel data to optimize the supply of transport capacity or the pricing schemes.

Figure 4: Discussed Case Studies in the Map of Disruption



Looking at the disruptive map, e-ticketing solutions can be described as "technology shift" and the customer mind-set perspective as "mind shift" or "accepted".

But still one problem is not addressed: the easy and convenient use of combinations of different transport means or systems as we know from intermodal freight transport still does not exist for passenger transport, especially when thinking about including a combination of private and public means of transport. One of the few examples where customer acceptance is supposed to be rather high ("wanted") but at least on a higher stage than the technological feasibility described as "Prototype".

In figure 4 the above mentioned examples are integrated in the Map of Disruption.

5.0 Conclusion

The mobility industry is facing a number of major challenges, e.g. urbanization, ageing societies, pollution, global warming, increasing cost for energy and infrastructure.

Drivers of technology acceptance in the case of mobility are discussed by using the Technology Acceptance Model (TAM). In combination with the technical perspective the Map of Disruptions (GDI, 2014) is a useful framework to better understand disruptive technologies. It helps anticipating both, new customer needs or wants and to create new or to review existing business models.

Mobility is more than ever influenced by digital innovations that change quickly and directly the behavior of the end-users. Examples of technically feasible and market-accepted disruptive technologies in the Mobility business are Uber, Lyft, AirBnB and Carsharing-Models. All of them try to better utilize existing spare capacities. The market acceptance of electric cars will be increased, if the main reason for not buying, i.e. the high price will be addressed. It is expected that autonomous car driving in combination with car-sharing will dramatically change the amount of cars in bigger cities, with positive effects on the climate, infrastructure, number of accidents, and cost of energy.

e-ticketing increases the convenience in public passenger transport, but intermodal solutions (combination of different mobility systems/provider) are still to mature, though they are widely accepted by customers. Established industries like the mobility business need to be more flexible in their organizations (holistic and not top-down) to let new ideas within the organization happen. The industry should work more experimental to fail faster and therefore learn in faster cycles. That’s the way how disruptive business models are establishing today.

The development of blockchain technology might result as a new impulse to further think in connected mobility. Traditional intermediaries might not needed anymore, as so called “smart contracts” between user and supplier carry out their actions themselves. However a platform is needed that searches for the best possibility to go from A to B. The platform itself includes all possible transport means (private and public) and suggests the best combination. Customers just use the offered transport means, everything else runs in the background.

As mobility in the 20th century was car mobility, in the 21st century it will be connected mobility. Users / consumers seem to be ready for radical changes. Thus the acceptance of new technologies regarding connected mobility is higher compared to other industries. The digitization can reduce complexity in the mobility business and maybe manage the connected mobility wanted by users and customers.

6.0 References

CEBR - Centre for Economics and Business Research. (2014). The future economic and environmental costs of gridlock in 2030. London 2014. Available http://ibtta.org/sites/default/files/documents/MAF/Costs-of-Congestion-INRIX-Cebr-Report%20(3).pdf (accessed April 6, 2016).

Christensen, C. (1997). The Innovator’s Dilemma. Harvard Business Review Press.

Clampet, J. (2015). The Top 10 Room Booking Sites in the U.S., UK and India for February 2016. Skift Report. Available http://skift.com/2016/03/09/the-top-10-room-booking-sites-in-the-u-s-uk-and-india-for-february-2016/? (accessed April 6, 2016).

Claudel, M., Ratti, C. (2015). Full speed ahead: How the driverless car could transform cities. McKinsey Quartely (August).

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS quarterly, 319-340.

Davis, F. D., Richard P. B., Warshaw P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. Management Science 35 (8): 982-1003.

European Commission (2011). WHITE PAPER - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. Brussels 2011. Available http://eur-lex.europa.eu/legal-content/en/TXT/PDF/?uri=CELEX:52011DC0144 (accessed April 6, 2016).

Fraunhofer - Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (2016). Vernetzte Mobilität. Available http://www.verkehr.fraunhofer.de/de/mobility/vernetzte_mobilitaet.html (accessed April 11, 2016).

Frick, K., Hauser, M., Gürtler, D. (2013). Sharity - Die Zukunft des Teilens. Gottlieb-Duttweiler-Institut (GDI), Studie 39 /2013.

Goodwin, T. (2015). The Battle Is For The Customer Interface. Available http://techcrunch.com/2015/03/03/in-the-age-of-disintermediation-the-battle-is-all-for-the-customer-interface/ (accessed April 6, 2016).

GDI - Gottlieb-Duttweiler-Institut (2014). A new way to map technology disruptions. Available http://www.gdi.ch/en/Think-Tank/GDI-News/News-Detail/A-new-way-to-map-technology-disruptions (accessed April 6, 2016).

GDI - Gottlieb-Duttweiler-Institut (2015). Das Uber-Prinzip. Available http://www.gdi.ch/de/Think-Tank/Das-Uber-Prinzip (accessed April 6, 2016).

Henkel, S., Tomczak, T., Henkel, S., Hanauer, C. (2015). Mobilität aus Kundensicht. Wiesbaden: Springer Gabler.

Krämer, A. (2016). The future of passenger rail - how competitive is the German rail system in a changed competitive environment? In: ZEVrail, April 2016.

Kuhn J. (2015). Das Bitcoin-Prinzip. Available http://www.sueddeutsche.de/digital/blockchain-prinzip-erst-bitcoin-dann-die-welt-1.2272735 (accessed April 11, 2016).

Lancaster, K. (1966). A New Approach to Consumer Theory. Journal of Political Economy 2, p. 132-157.

Monroe, K. (2003). Pricing – Making Profitable Decisions. Boston: McGraw-Hill Companies.

Newcomer, Eric (2015). Uber Raises Funding at $62.5 Billion Valuation – The ride-hailing company is said to seek $2.1 billion in a new funding round. Bloomberg News. Available http://www.bloomberg.com/news/articles/2015-12-03/uber-raises-funding-at-62-5-valuation (accessed April 6, 2016).

Newman, P., Kenworthy, J. (2015). The End of Automobile Dependence: How Cities are Moving Beyond Car-Based Planning. Washington DC: Island Press.

Peltier, D. (2015). 6 Charts That Show Business Travelers Prefer Uber During Trips. Skift Reports. Available http://skift.com/2015/10/20/6-charts-that-show-business-travelers-prefer-uber-during-trips/ (accessed April 6, 2016).

Plouffe, D. (2015). What the rise of the sharing economy means for transport. Available http://2015.internationaltransportforum.org/shared-economy#sthash.9hVcyuCO.dpuf. (accessed April 6, 2016).

PostAuto (2015). Schweizer Premiere mit autonomen Shuttles. Press Release 04.11.2015. Available https://www.post.ch/de/ueber-uns/unternehmen/medien/medienmitteilungen/2015/autonome-shuttles-fahren-zum-ersten-mal (accessed April 6, 2016).

Rossbach, C., Winterhoff, M., Reinhold, T., Boekeis, P., and Remane, G. (2013). Connected Mobility 2025. Roland Berger Think:Act Study 01/2013. Munich 2013. Available https://www.rolandberger.com/media/pdf/Roland_Berger_TaS_Connected_Mobility_E_20130123.pdf (accessed April 6, 2016).

Rushkoff, D. (2013). Present Shock. Penguin Group, New York.

StBA - Statistisches Bundesamt (2014). 30% der Haushalte in großen Städten setzen allein aufs Rad. Press Release 191/14, 02.06.2014. Available https://www.destatis.de/DE/PresseService/Presse/Pressemitteilungen/2014/06/PD14_191_632pdf.pdf?__blob=publicationFile (accessed August 22, 2016).

StBA - Statistisches Bundesamt (2015). Neue Bevölkerungsvorausberechnung für Deutschland bis 2060. Press Release 153/15, 28.04.2015. Available https://www.destatis.de/DE/PresseService/Presse/Presse-mitteilungen/2015/04/PD15_153_12421.html (accessed April 6, 2016).

The Transport Politic (2016). Planned Light Rail Systems. Available http://www.thetransportpolitic.com/under-consideration/planned-light-rail-systems/ (accessed April 6, 2016).

Uphill, K. (2016). Creating Competitive Advantage. London: Kogan Page.

United Nations (2014). World Urbanization Prospects: The 2014 Revision. Available http://esa.un.org/unpd/wup/Publications/Files/WUP2014-Highlights.pdf (accessed April 11, 2016).

Venkatesh, V. Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. Decision Science 39(2), 273–315.

Webb, A. (2015). 8 Tech Trends to Watch in 2016. Available: https://hbr.org/2015/12/8-tech-trends-to-watch-in-2016 (accessed April 11, 2016).

Williamson, O. E. (1979). Transaction-cost economics: the governance of contractual relations. The journal of law & economics, 22(2), 233-261.

Wippermann, P. (2006). Simplexity. In: Research&Results 05/2016. Available http://www.research-results.de/fachartikel/2006/ausgabe5/simplexity.html (accessed April 6, 2016).

Wolf, M. (2015). Think Again: Tech and Media Outlook 2016. Wall Street Journal WSJD Live Conference 2015. Available http://www.wsj.com/articles/think-again-nine-top-insights-into-tech-and-media-for-2016-1445618763 (accessed April 6, 2016).

Zhang, S. and Shih, G. (2015). Uber seen reaching $10.8 billion in bookings in 2015: fundraising presentation. Reuters, 21. August. Available http://www.reuters.com/article/us-uber-tech-fundraising-idUSKCN0QQ0G320150821 (accessed April 6, 2016).