# User Experience of On-demand Autonomous Vehicles

*- Part 1: Background and User Experience framework*

Pontus Larsson, Ph. D.
Human Factors Specialist, Ictech, Göteborg.

The way we travel may be very different in only a couple of years from now. New mobility services and vehicle automation rapidly change the landscape of the automotive industry and a new form of mobility business, as well as a "passenger economy", is on the rise. Going from today's situation where we both own and drive cars to a future where we trip-by-trip order autonomous vehicles to transport us from A to B, may seem far-fetched but is by many analysts considered to be an inevitable, not-so-distant future. However, for the change to actually take place, it is essential that users will consider these new mobility services as being a better option than the individually-owned car. Moreover, peoples' adoption of the mobility services is likely contingent on the services being able to offer a great user experience.

This article is the first in a series of articles in which we analyse the currently ongoing trends within the automotive- and mobility business and the consequences they might have on the user experience of everyday travelling. The current article focuses on the changing industry, the different actors, and how the relationship between user and the vehicle might change as a result of the emerging mobility business. In upcoming articles we will go into detail of the user experience-related aspects of future vehicle design and from the user perspective review some of the concepts and pilot vehicles that are currently being proposed by different companies.

## From individually owned cars to on-demand autonomous transport services?

The passenger car industry is currently undergoing a rapid change. Many analysts foresee that the established business model, where people both own and drive the cars themselves, may not be the dominant one in the future [1-3]. The concept of automated cars that can operate completely by themselves without any human driver support or supervision has definitely sparked the imagination of industries, authorities, researchers and individuals, who are all trying to find out how this new technology may be utilized in the future. One such idea is that, if cars no longer need to be driven by humans, new possibilities in terms of sharing them are enabled. Shared autonomous vehicles could have the potential of being both more convenient and less expensive per kilometer than the traditional car [1] and could therefore become the dominating person transport modality.

Actors from the IT sector take advantage of, and even drive, this technology- and business development. Companies such as Waymo and Uber seem to firmly believe that new automated and shared modes of transportation could radically transform the way people transport themselves. Some consider that the transformation of the transportation industry from today's

individually-owned, manually driven Internal Combustion Engine (ICE) cars to shared, pay-per-ride, electric drive autonomous vehicles is no longer a question of "if" - in fact, some of this transformation is indeed already ongoing [1,4].

In the report "Rethinking Transportation", American think tank ReThinkX [1] provides a thorough analysis of the currently ongoing trends in the car industry and elsewhere and poses a bold claim in their headlines:

*"We are on the cusp of the fastest, deepest, most consequential disruption of transportation in history. By 2030, within 10 years of regulatory approval of Autonomous Vehicles (AVs), 95 percent of U.S. passenger miles traveled will be served by on-demand autonomous electric vehicles owned by fleets, not individuals, ..."* [5]

The future envisioned by ReThinX seems to be less about the legacy vehicle manufacturers' current business models for cars and more about those involved in providing services related to transporting goods and people [1]. Or rather; legacy car OEMs who still think that the main part of their business will involve selling traditionally looking and functioning cars to individuals in the traditional sense, probably do not have a bright future. Although the type of vehicle automation optimism presented by [1] is being questioned more and more (see the section "What about public transport?" below for examples) several analysts share ReThinkX's view of the future and e.g. Deloitte even claims that "*Automakers might be overestimating how much power they have to manage the course of future events.*" [2].

Ride-hailing/ride sharing transport services such as Uber [6], Lyft [7], Grab [8] and Didi Chuxing [9], are gaining popularity and business all over the world. The prediction is that services like these will merge with autonomous driving technology at major scale and that governments and policy makers embrace this development since automation and car sharing potentially could mean less congestion and less impact on the environment [1, 4, 10]. According to ReThinkX, the average citizen will be more and more likely to favor the ride services over car owning and economics is what is ultimately going to drive this change [1]. Although many actually prefer owning cars and get a lot of joy out of driving, ReThinkX predicts that the travels offered by On-demand Autonomous Vehicle Services (OAVS[1]) are going to be so much cheaper that it will make individual car ownership appear irrational; perhaps a thing for only the true enthusiasts [1].

Car manufacturers now have the choice of becoming high-volume, low-margin manufacturers of autonomous electric shuttles or stepping into the game of (also) actually delivering the service itself [1]. The analysis by [2] furthermore suggests that the legacy car OEMs, the "Insiders", have a fundamentally different view on how to progress towards the future of mobility compared to the newcomers in transportation, the "Disrupters" - see Figure 1. Basically, the Insiders are focused on incrementally introducing new mobility solutions alongside the current offerings and within the current, established ecosystem while the Disrupters try to jump directly to the future of on-demand, automated mobility. These

[1] ReThinkX refers to autonomous vehicle services as TaaS - Transport as a Service. In this article we chose to use the term On-Demand Autonomous Vehicle Services instead, as we find it more explicit.

non-traditional actors in the automotive scene have the advantage of not seeing the development as a series of incremental improvements to cars as we already know them [3] and unlike the Insiders they do not have any "*vested stakes to protect*", and can thus fully focus on developing and delivering the OAVS solution [2].

There are nonetheless several signs of the legacy car OEMs embracing the change towards OAVS, or at least are preparing for a possible future scenario where OAVS dominate. Several of them have realized the importance of setting up "smart mobility" divisions to manage the transition to an OAVS-based operation. Volkswagen recently presented a concept vehicle clearly designed for on-demand autonomous ride sharing (Sedric [11]) and aims with their own, newly formed ride hailing business MOIA to have a functioning (although manually driven) fleet of specially-designed vehicles already in 2018 [12]. Ford acquired the on-demand shuttle service Chariot in 2016 [13] and in January 2018 announced that they aim to to become the "*the self-driving OS for the future of transportation*" [14]. GM has teamed up with autonomous car tech company Cruise and has announced that they will produce a version of the Chevrolet Bolt electric car without manual controls that will go on road as soon as 2019 [15]. GM/Cruise is currently piloting its autonomous driving technology and mobility service at several locations in the US. In January 2018, Toyota - who earlier has been a strong advocator of keeping human drivers in their vehicles - presented a radically new, completely driverless concept vehicle without any manual controls that they will begin testing in various regions starting early 2020 [16]. Recently, Volvo Car Group revealed a partnership with Chinese internet giant Baidu, with whom they will develop the "safest automated car on the planet" intended for robotaxi (OAVS) operations [17].

The network of actors currently involved in the future mobility business is however highly intricate and it is far from clear who - if any - will come out as a winner. Navigant Research's report from January 2018, suggests that GM and Waymo (the car division of Alphabet/Google) are currently leading the development towards commercially available automated driving vehicles [18]. On the other hand, the ride hailing/sharing companies such as Lyft and Grab have the advantage of already having access to (potential) customers of the future mobility solutions through their platforms. These companies are (also) testing autonomous driving solutions with customers in real life pilots already today [19,20]. Autonomous vehicles will not happen without major technology advancements however, and autonomous driving tech companies such as Aurora, Comma.ai, Drive.ai, Cruise and Aptiv are actively part of current pilot tests and will likely play a big role also in the future. Newcomer manufacturers of purely autonomous vehicles such as Navya [21], EasyMile [22] and Local Motors [23] are also beginning to gain attention and may have both advantages and trouble in starting without any legacy when it comes to the design of the vehicle itself.

The complex and technical nature of delivering OAVS to the masses is reflected by the fact that several strategic alliances have been formed and acquisitions taken place between tech companies, the ridesharing/hailing companies and the legacy and newcomer vehicle OEMs. The problem is not only technical in nature however; there are numerous other issues that need to be solved including the establishment of new legislations and regulations, ensuring economic viability and how to ensure that society and users will trust and accept these new

types of mobility solutions. Given that not all issues of vehicle automation and ride sharing will be solved simultaneously, Deloitte [2] predicts that four different scenarios may play out depending on if and how quickly these obstacles can be overcome. A slightly modified version of the scenario description presented in [2] is shown in Figure 1.

In scenario 1 of Figure 1, the traditional car ownership model prevails and the legacy car OEMs try to perfect the assisting driver support systems up to automation Level 3 (where the driver still needs to take over driving in certain cases). In scenario 2, people will still own their cars, but they will have functions which allow fully autonomous driving in selected areas (and lower levels of automation in other areas). In scenario 3, services for shared mobility solutions are dominating in terms of total travelled kilometers, but the vehicles that are used for these services are piloted by human drivers. Finally scenario 4 represents the future that is the main topic of the current paper, where autonomous, shared transportation services are fully developed and accepted/adopted by society.

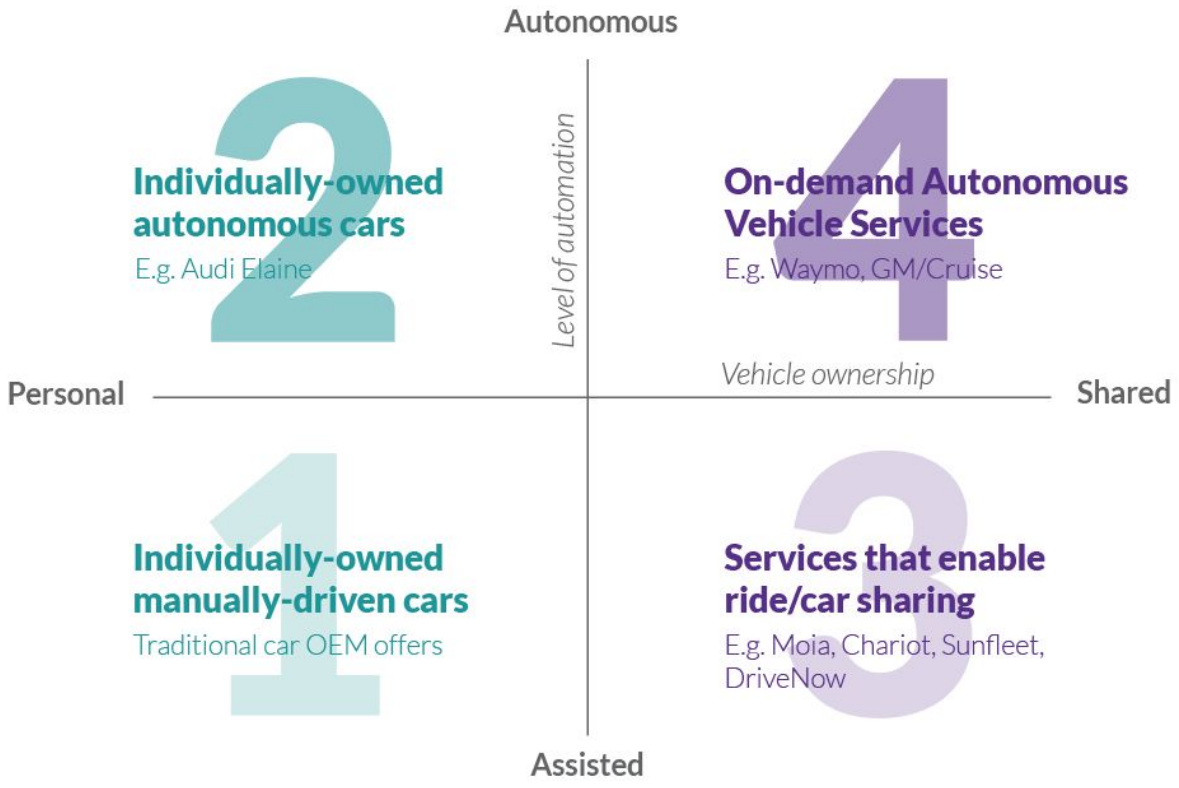


***Figure 1: Possible scenarios for person transport (adapted from [2])***

It is important to stress that these four future scenarios may well exist simultaneously, that the situation will look different depending on geographic or demographic context, and that the evolution will take place in different phases within these contexts [2]. Worth to note again is also that it is not only the technology and legal frameworks that may hinder the most futuristic scenario 4 above - users must accept and adopt the new way of travelling and this may go at quicker or slower pace. ReThinkX [1] suggest the change will inevitably come quickly and will be mainly driven by economy since an OAVS will be so much cheaper for the customer than owning a car ("*we may love our cars, but we love money more*" [1]). Other analyses also have come

to similar conclusions regarding the price [24], although some do not foresee a price as low as the one predicted by [1].

New technologies such as durable electric drivetrains and the fact that autonomous vehicles do not need a human driver and thus can have much larger utilization rate than manually driven ones will certainly help keeping the operating cost of an OAVS down. Nonetheless, the end customer price is still very difficult to estimate since there are still a lot of unknowns in terms of running an OAVS business; one aspect being the pricing strategies that will be employed. Volkswagen's ridepooling branch Moia has for example claimed that they will not underprice the public transport system in order not to draw people that currently use public transit into their smaller vehicles [25], while others suggest that companies could even offer free rides [24].

Furthermore, it is likely that fast customer adoption is contingent on the OAVS being both cheaper AND at least as convenient as owning your car. It has been suggested that factors that may influence users' preference of an OAVS over a traditional car is whether it is reliable, safe, always available, able to go anywhere and everywhere, and capable of operating in all weather conditions [10]. After all, this would be a completely new mode of transportation and as with any new technology, the potential user have to consider and balance the (uncertain) costs of adopting it with its (uncertain) benefits and/or drawbacks before deciding whether or not to adopt it [26].

Adoption could likely be sped up if the mobility service offers its potential customers new types of tangible benefits [26]. A concrete example could be a shuttle service that allows making it easier to start your workday already in the shuttle and maybe end it there too - thus making the workday more efficient and freeing up time for the user. Relieving people from the everyday hassle of finding a parking spot could be another concrete example of where the OAVS would seem more attractive than a normal car [10]. In the worst case, companies will have to struggle hard to find that specific benefit or extraordinary experience that will attract customers and make them overcome fears of automation [10], and their love for the personal car.

In general however, achieving user acceptance and adoption is contingent on a solid foundation of understanding- and optimization of users' perceptions, emotions, behaviours and attitudes in relation to the OAVS; aspects which all belong to the research and development area of User Experience (UX). As been witnessed with many other technologies: If a great UX can be achieved, user acceptance and adoption will follow. The new form of mobility and the new types of applications and services that OAVS could enable are by Intel believed to generate a new market, The Passenger Economy; a market that is believed to hold massive economic potential [27].

## What about public transport?

Some of the critics of autonomous vehicles claim that few of the problems that automation promise to solve will not be delivered anytime in the near future, simply because full

automation technology is nowhere close of being ready for deployment [28]. Critics furthermore claim that the problems that automated vehicle services try to solve - less congestion, less pollution, higher traffic safety and so on - can already today be solved by improving public transport solutions so that people would use these more for they everyday trips [29]. In fact, congestion and pollution could actually can be worse if an on-demand automated transport service becomes so attractive that the usage of it will exceed that of individual car use today [30].

Utilization rate of public transport systems would need to increase quite drastically however, in order to fulfil transportation improvement goals, although the situation is different in different countries [31]. For example, in the US, only two percent of daily travels are currently made by public transport in comparison to Sweden where the corresponding number is 15%, or Switzerland where as much as 24% of all daily trips are made by public transport [31].

The current reasons for people choosing car over public transport may also be different in different parts of the world, but convenience and feeling of independence are likely two big reasons [31, 32]. In the US, the relatively low cost of owning and driving cars probably contributes a great deal to peoples' strong preference of individual car ownership over public transport, but the convenience factor certainly plays a role to, which is stimulated by high roadway capacity and good parking possibilities [31]. In a Dutch study [32] it was found that both frequent- and infrequent car users rated car as being more attractive than public transport when rated on number of different items such as Convenience, independence, Comfort and reliability. The only item for which public transport seemed to be consistently more attractive compared to the car was in terms of its safety [32].

Can public transport system be improved in such ways that it solves current and future mobility problems in a more efficient way than OAVS? A full discussion on this topic is out of the scope of the current paper. It is difficult however to see that improved public transport systems would be able to meet most people's everyday transportation needs in such a good a way that they would abandon their personal car.

A radically new form of (public) transport offering convenient, comfortable and reliable door-door transportation may however have that ability - a solution where shared bikes and low speed driverless shuttles are integrated with longer range transportation modes such as buses, shared cars, trains and even flight [33, 34]. This is the vision of Mobility as a Service (MaaS) which is a concept emerging across the world with the aim of giving users the possibility to conveniently access and use a range of transportation modes through a single gateway. The whole idea of MaaS is to offer mobility services as packages based on consumers' needs instead of consumers buying the means of transport [34]. In a MaaS future, the distinction between public and private forms of transport will, to the user, be less distinct or even disappear [30]. OAVS will play an important role in such a mobility ecosystem, by e.g. allowing for convenient transportation between door and train station. Based on the discussion above, it is reasonable to assume that the future will not be ruled entirely by either automated or manual forms of transport, or by public or private forms of transport. Instead there will likely be a mix between different types of transport and the most successful overall

solution will be identified by its ability of adapting to the user's needs and giving the best travel experience.

## User Experience of On-demand Autonomous Vehicle Services

If we assume that individually-owned and manually driven cars are sooner or later a thing of the past, how will the users' perceptions, emotions, behaviour and attitudes in relation to the car/vehicle change and what consequences does this have for UX design?

First of all, the user-vehicle relationship is of course quite different when comparing a OAVS and a manually driven, individually-owned, car (IOC). We believe that the user-vehicle relationship shift when going from IOC to OAVS can be illustrated by the Figure 2 below. One big difference is the users' needs and desires related to the IOC vs the OAVS. With an IOC, the user can have different desires or needs regarding the car itself; he/she may want it to be reliable, cheap, or safe - or have enough seats and cargo space to accommodate all family members and their belongings. Maybe it should be able to tow a caravan, have enough range and other features to make it suitable for a holiday trip. Or maybe it should primarily be a commuter vehicle, only big enough to accommodate you and a passenger. Basically, there are a number of practical features that need to be prioritized when shopping for a car. The user's car choice is not seldom also driven by the desire of having something that symbolizes status or gives you a certain image. Owning a car is for many also a source of joy, connected to positive emotions such as the love of driving or the feeling of independence [35].

A user of an OAVS on the other hand does not need to find the best compromise once and for all but will likely simply select the service that best fulfills his/her needs for each trip. For some users and trips, fast and cheap might be prio 1 while for other, comfort and privacy might be prioritized - perhaps driven by the need to work efficiently or get some much needed sleep. The key point is that the service should be able to adapt to the user and his/her the *current* needs. Connected to this adaptability/personalizability could be services that allows you to do what you want in an efficient way (e.g. a secure network connection to your employer for those who want to work, a bed for those who want to sleep). New types services could also be invented that enable new types of in-vehicle experiences, e.g. mobile stargazing [36], or personalized sightseeing.

What this difference means to the vehicle manufacturer is that several UX aspects which are currently in focus in the IOC scenario - primarily those which are connected to the joy and personal status of car owning/driving and other hedonic values - will not be important in a OAVS scenario. The vehicle OEM can decide to either make one vehicle which is able to adapt to different user needs, perhaps in a modular fashion as conceptualized by Rinspeed in their "Snap" concept [37], or as modular as the Next interconnectable transport pods [38] or to make a range of different vehicles that each fulfils a specific purpose. These concepts are obviously quite far from the typical vehicle the legacy car OEMs have in their range today - the "*one- or two-ton metal box that spends more than 95 percent of its time sitting idle.*" [3] - and the challenge for vehicle OEMs in general is anticipating what that these new types of vehicles

should look like. But one idea suggested by [3] is that there will be different types of vehicles for different purposes such as premium high-end lounge vehicles and travel and experience vehicles, simpler vehicles and taxis for commuting and short family trips. It is likely also that users would want to do different things during a trip however, so it may be necessary to have a vehicle interior that is flexible and adaptable enough to accommodate all the desired tasks/needs (see e.g. the concept vehicle 360c by Volvo cars in which the interior can be changed to suit both working and sleeping [39]).

Secondly, in the IOC scenario, the user is interacting with several different agents besides the car manufacturer which all contribute to forming the user's total experience of the car, - the car dealer, the workshop, insurance companies and so on. The car OEM/brand may have as a strategy to include these agents under the brand umbrella - workshops, insurance companies and even gas stations - to be able to create a uniform user experience of the brand. In the OAVS scenario, users' primary interaction is with the provider of the OAVS, the Mobility Gateway [40], and the overall user experience can more-or-less be designed and controlled by this provider. The user might not care about or even be aware of which company manufactured the vehicle itself [4]. In-vehicle services from third parties can however be made available and contribute to the overall UX (cf. e.g. the Next transport [38], where a coffee company pod can hook up to your transport pod and sell coffee to the passengers) - but the OAVS provider may be selective in terms of which third-party suppliers to collaborate with in order to keep the UX consistent.

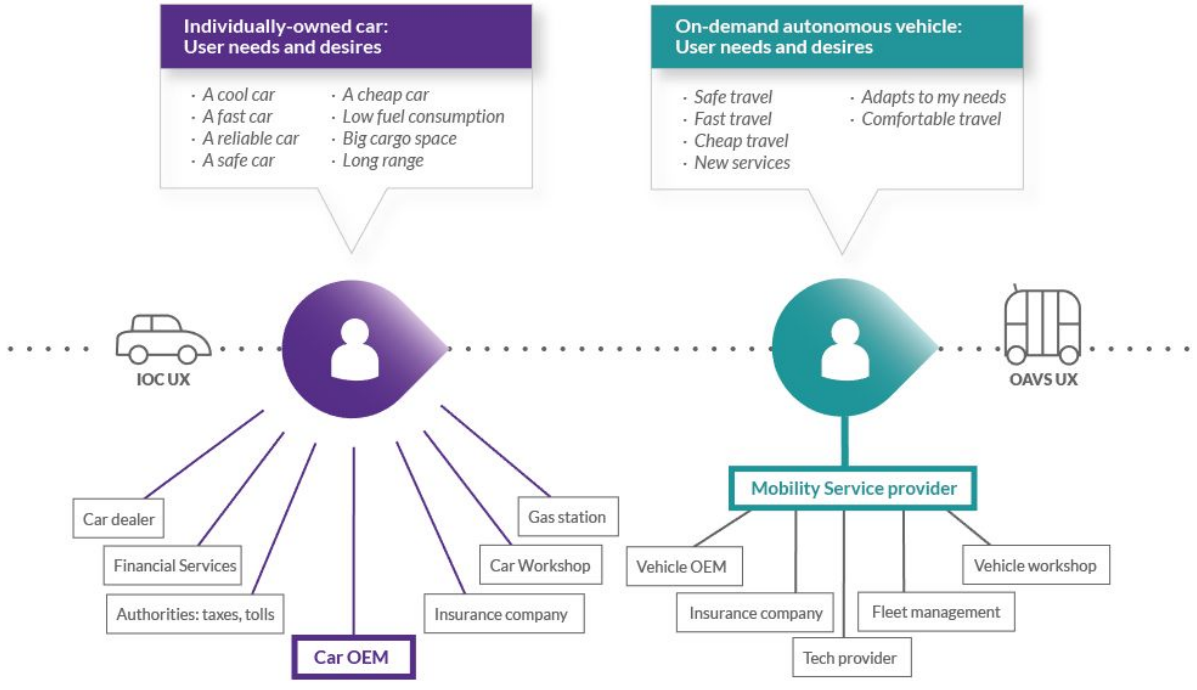


*Figure 2: Illustration of how the user-vehicle relationship may change when going from individually owned cars to on-demands autonomous vehicle services*

Following this reasoning, it is likely that these new types of services will have to employ new business models and lead to new types of partnerships compared to the reigning IOC

paradigm. The OAVS consortia that are underway involve, to greater or less extent, both vehicle manufacturers, service platform providers, and autonomous driving tech providers. One example of such a consortium is the Volkswagen (vehicle manufacturer) - MOIA (ridesharing) - Aurora (autonomous driving specialists) partnership [41]. Waymo (Google), has previously announced a partnership with ridehailing company Lyft [42], but currently seem to develop their own service. They are however partnering with both car OEMs FCA (Fiat Chrysler) and Jaguar Land Rover [43, 47] to be able to supply vehicles, and has taken a step further and also involved a partner to be responsible for service and repairs, AutoNation [44], as well as one for insurance of the passengers, Trov [45]. As these pilot operations progress towards commercial services, one could imagine additional partners hooking into the operation; a fleet management provider operating the back office solution that keeps track of all the vehicles and regularly cleans them, in-vehicle infotainment technology providers, in-vehicle infotainment content providers as well providers of services such as in-vehicle delivery of e.g. packages and groceries, etc. Some speculate that we will see new types of partnerships that would enable better user experiences by streamlining processes to a degree not possible before [40]. Consider e.g. a partnership between a OVAS provider and an airline - maybe you could perform security checks already when going to the airport and be transported directly to the gate [41]?

A positive aspect about this change for the legacy Car OEM that decides to take the leap into becoming an OAVS provider is that it will likely be easier to provide a uniform User Experience of the brand than within the current IOC model - since there is only one main interface between the company/brand and the user: the Mobility Gateway. A difficulty is obviously to build vehicles that allow for creating the services and user experiences that attract the customers. Furthermore, completely new demands in terms of durability and reliability - and *cleanability* - will have to be put on these vehicles since they will operate significantly more than conventional cars. This might mean having to start from scratch and create entirely new vehicle platforms. There might however be ways to build partially on existing platforms and components (such as been done for the VW/MOIA vehicle which will be based on VWs new electric MEB chassi [45]). Car/vehicle OEMs having the in-house knowledge and resources related to the design and production of vehicles are in this sense obviously in an advantageous position compared to disrupter companies which most realistically have to source the vehicles from a vehicle OEM (cf. e.g. Uber's deal with Volvo Cars [46] or Waymo's partnerships with FCA [47] and Jaguar Land Rover [43]).

From a human-machine interface design point of view, the shift towards OAVS also means a shift from focusing on primarily safety-related to primarily non-safety-related use cases. Much effort has been spent on difficult driver-vehicle interface problems such as providing the right type information and of warnings to the driver, driver distraction, and keeping the driver in the loop for partly automated driving systems. But when the driver is no longer human, these problem areas become obsolete. With the advent of OAVS, the main role of HMI/UX research and development efforts is instead to optimize passengers' comfort and wellbeing and in general to ensure willingness to use.

In sum, the shift from IOC towards OAVS means a radical change for the car industry in many ways. From the UX perspective, we see three main differences between IOC and OAVS when it comes to how the user experiences cars/vehicles for person transport:

1. User needs and desires will change and companies can no longer rely on the positive experiences that are connected to owning and driving cars. Instead there will likely be many new types of user needs. These may include e.g. customization and personalization, the need for privacy, the possibility to comfortably perform different tasks as well as access to different services.
2. The user will interact with their travels mainly through a Mobility Service Provider (MSP) and not a car/car brand and that whole experience can be defined by the MSP. The user might not even be aware of the car/vehicle manufacturer, let alone all the other agents that are connected to traditional car usage (such as car maintenance, insurance, financing etc). This will enable greater possibilities in making the vehicle/trip UX seamless and consistent. It also means that the vehicle manufacturer that aspires to become also an MSP should put substantial effort into making the mobility gateway for interacting with the mobility services and the vehicle as good as possible.
3. Instead of having to live with a car that needs to serve many purposes but is optimal for very few of them, the user could be offered to, for each trip, be able to select the car/vehicle that best fits the trip's purpose. This should open up for optimization of the experience of the vehicle and the trip. The vehicle manufacturer could choose to utilize this fact by e.g. offering multiple vehicle types specialized for different purposes, or by allowing for exchangeable and/or flexible passenger compartments or interior features.

The transformation from the reigning manually-driven, individually-owned car paradigm to one where on-demand autonomous vehicle services are part of our everyday life has massive implications for the car industry, but holds also a lot of opportunities. In the next article we will dive into some of the UX-related topics we believe are the most important in the design of the OAVS in this sense: trust in automation, security, vehicle sharing experience, acceptance, ride comfort, motion sickness, and general usability.

## References:


[1] https://www.rethinkx.com/transportation/
[2] https://dupress.deloitte.com/dup-us-en/focus/future-of-mobility/transportation-technology.html#endnote-sup-7
[3] https://www.atkearney.com/automotive/article?/a/how-automakers-can-survive-the-self-driving-era
[4]http://blogs.lse.ac.uk/businessreview/2018/02/02/is-car-ownership-going-to-die/
[5] https://www.rethinkx.com/headlines/
[6] http://www.uber.com
[7] http://www.lyft.com
[8] https://www.grab.com/sg/
[9] http://www.didichuxing.com/en/
[10] https://www.itf-oecd.org/sites/default/files/docs/human-factors-ride-sharing-automated-vehicles_0.pdf
[11] http://www.discover-sedric.com/en/
[12] https://www.volkswagenag.com/en/brands-and-models/moia.html
[13] https://en.wikipedia.org/wiki/Chariot_(company)
[14] https://www.theverge.com/2018/1/9/16868814/ford-self-driving-autonomous-vehicle-ces-2018
[15] http://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2018/jan/0112-cruise-av.html
[16] https://www.toyota.ca/toyota/en/connect/2000/toyota-e-palette-concept-vehicle-ces-2018
[17]https://www.reuters.com/article/us-volvo-autonomous-baidu/volvo-cars-taps-baidu-tech-to-develop-robotaxi-for-china-idUSKCN1N63R6?utm_medium=Social&utm_source=Twitter&utm_medium=Social&utm_source=Twitter
[18] https://www.navigantresearch.com/research/navigant-research-leaderboard-automated-driving-vehicles
[19]https://www.washingtonpost.com/news/innovations/wp/2017/12/07/using-the-lyft-app-in-boston-you-might-get-picked-up-by-a-self-driving-car/?utm_term=.c0c7fd7b48a5
[20]https://www.grab.com/sg/press/tech-product/nutonomy-grab-launch-partnership-expand-public-trial-demand-self-driving-car-service-singapore/
[21] https://navya.tech/en/
[22] http://www.easymile.com/
[23] https://localmotors.com/
[24] https://www.2025ad.com/latest/autonomous-vehicles-low-income/
[25] https://techcrunch.com/2017/12/04/volkswagens-moia-debuts-its-all-electric-rideshare-vehicle/
[26] https://eml.berkeley.edu//~bhhall/papers/HallKhan03%20diffusion.pdf
[27] https://newsroom.intel.com/newsroom/wp-content/uploads/sites/11/2017/05/passenger-economy.pdf
[28] https://medium.com/@parismarx/the-driverless-revolution-isnt-coming-anytime-soon-fdf569cd6c6f
[29]
https://medium.com/@parismarx/are-driverless-cars-the-future-of-transport-or-the-last-gasp-of-the-automobile-51acb706cccc
[30] https://blogs.crikey.com.au/theurbanist/2018/03/13/driverless-cars-public-transport-winner/
[31]http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=1736&context=jpt
[32] https://www.sciencedirect.com/science/article/pii/S0386111214601412#bbib15
[33]http://www.metro-magazine.com/technology/article/724770/driverless-vehicles-and-the-future-of-public-transit
[34] http://discovery.ucl.ac.uk/1502113/1/1-s2.0-S2352146516302836-main.pdf
[35] https://www.rug.nl/staff/e.m.steg/steglustandmust.pdf
[36] https://www.nio.io/visioncar-experience
[37] https://www.rinspeed.eu/en/Snap_48_concept-car.html
[38] http://www.next-future-mobility.com/
[39] https://www.volvocars.com/intl/cars/concepts/360c

[40] https://www.2025ad.com/updates/driverless-car-interior-business-models/
[41 ]https://www.bloomberg.com/news/articles/2018-01-04/ex-google-tesla-driverless-car-czars-partner-with-vw-hyundai
[42]https://www.reuters.com/article/us-lyft-waymo-collaboration/lyft-partners-with-waymo-to-launch-self-driving-car-pilots-idUSKCN18B02L
[43]
https://media.jaguar.com/news/2018/03/waymo-and-jaguar-land-rover-announce-long-term-partnership-beginning-self-driving

[44]https://www.reuters.com/article/us-autonation-results/autonation-announces-waymo-fleet-repair-deal-shares-jump-idUSKBN1D21FS
[45] https://www.trov.com/blog/trov-waymo-accelerating-trovs-bigger-picture
[46]https://www.reuters.com/article/us-volvocars-uber/volvo-cars-to-supply-uber-with-up-to-24000-self-driving-cars-idUSKBN1DK1NH
[47]https://www.reuters.com/article/us-fiat-chrysler-waymo/fiat-chrysler-waymo-expand-deal-for-self-driving-public-ride-hailing-service-idUSKBN1FJ0GN?il=0