User Experience

The key to successfully combining electric mobility and connectivity

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Abstract

In the past decade, technology and especially vehicle technology has been developing dramatically. From configuration possibilities, over available digital functions, to interaction possibilities with the vehicle: the complexity of technology has been rising relentlessly – and more often than not, users are overwhelmed.

At the same time, the importance of electric mobility is increasing. More and more people are driving electric vehicles or planning to do so. These drivers have specific needs (e.g. “I need to charge my vehicle at home”), fears (e.g. “Will I be able to reach my destination with my current SoC?”) and desires (e.g “I want to get into a cool car, even in summer”).

On top of that other consumer goods and services such as phones, banking/payment processes or online shopping have fundamentally changed and shaped customer expectations: everything is connected, and so should vehicles be. The importance of technology has thus been increasing. However, betting on technology alone is not enough anymore. Indeed, the overall experience with a product or a service has become a significant feature for differentiation, for tech companies and automotive OEMs alike.

We want to argue, that, for too long now, connected mobility and electric mobility have been considered in a too dissociated manner. The “CASE” acronym is the perfect example for this. Often used as key word to describe the new mobility transition, each letter, or aspect, is mostly presented on its own. This is also something one can witness in automotive companies, where there is an “autonomous hub”, and “electric mobility department” and a “shared services branch”. However, both topics, electric mobility and connectivity, could hugely benefit from each other, by being considered together. And the link to successfully combine these two, the key for improving products and services for the end users, is user experience.
In this paper, we will firstly discuss what user experience really means and why it is so important. Following, we will take a look at the current market and examine the needs of users when it comes to electric and connected mobility. Afterwards, we will dive into the current automotive market, presenting trends in e-mobility products, connected services and HMI-concepts and then we will show electric mobility and connectivity in vehicles share common challenges. Finally, and most importantly, we will show how these different aspects can be successfully combined, to create great products and services, using user experience methods and tools. We will particularly focus on one of our developed solutions, the “eExperience Drive” and show how this method can increase awareness and understanding of the customers’ needs and how it can be integrated into the development process for electric and connected vehicles, to create a great and exciting user experience.

1. What is user experience and why is it so important?

The international standard on ergonomics of human-system interaction (ISO 9241-210) defines user experience as “a person’s perceptions and responses that result from the use or anticipated use of a product, system or service” [1]. This means that user experience encompasses all aspects of the end user’s interaction with a service or a product, from the purchase or use intention, over the use itself, right up to the end of use of said product or service. Basically, we can thus split user experience into three parts: before – during – after the use of a product or service.

If we abstract this, we can see that user experience is important as soon as you design, develop, or sell products or services. In the end, they will be purchased, used, and hopefully recommended by customers, so user experience is a fundamental component of that process.

Considering user experience with regards to vehicles and the automotive sector is particularly interesting right now because we have reached a turning point.

Indeed, several things are happening at once:

The complexity of technology, functions and interaction possibilities with the vehicle is growing. Our vehicles can become connected with a myriad of things: our phones, other vehicles, our smart homes… and that results in seemingly endless interaction possibilities with the vehicle. For instance, we can check the vehicle status from our living room via Alexa, use our smartphone to remotely check the charging status of the car, use it as a digital key to open the...
car and control various vehicle functions; there are in-car apps which allow us to connect our favorite entertainment accounts such as Spotify or Audible; assistance systems help us navigate in difficult situations or just to relieve us; we can communicate with the vehicle per touch, gesture control or voice; and all this information can be communicated back to the user over several and increasingly big displays, head-up displays, lights, sound or vibration… As a result, users are increasingly overwhelmed.

At the same time, other consumer goods and services such as phones, banking/payment processes or online shopping are fundamentally changing and shaping customer expectations. They have taught us one essential thing: Betting on technology alone is not enough anymore; it does not provide a long-lasting advantage any longer. The experience with a product or a service has become a significant feature for differentiation.

Last but not least, the forms of use for vehicles are getting more and more diverse. In the past, one would buy a car, own it for several years, sell it and buy the next one. Now you can buy a car, lease a car, rent a car, have a vehicle subscription or use car sharing. The users of these different cases also have different needs. Car-sharing users that only drive the vehicle for a couple of hours for instance don’t have time to properly get to know the vehicle and all its functionalities.

All that is something one must keep in mind when designing a vehicle or a particular feature.

2. Current market and the needs of users of electric and connected vehicles

In 2020, the market for electric vehicles has exploded, reaching an all-time high of over 10 million vehicles worldwide. In comparison, the number of worldwide electric vehicles in 2014 was just under 850,000 [2].

We can see the same kind of trend for connected vehicles. In 2011, the global sales of cars with embedded telematics was of 1.3 million units. In 2019, it reached 28.5 million units [3]. And with customers getting more interested in these kinds of technologies and regulations pushing for these types of vehicles, we will be seeing more electric and connected vehicles in the future.

As these trends have been and are catching on, I want to focus on one particular aspect, that, as I think, will be a decisive factor for the success of OEMs in the field. In the past years, fears have been voiced over the viability of electric vehicles, complaining about too small electrical ranges, an immature charging network or even an unappealing design of products. However, as time passes and technological, political, and infrastructural progress is being made, more and more people will want (or will have to) use electric and/or connected vehicles. And this
means that, following the law of diffusion of innovation [4], not only “innovators” and “early adopters” but increasingly also the “early majority” will be buying and using electric and/or connected vehicles.

![Diagram of the law of diffusion](https://doi.org/10.51202/9783181023846-355)

**Fig. 1: Schematic of the law of diffusion, as defined by E. Rogers**

The dispersion of these innovations varies greatly on a worldwide scale, but several countries are already at a stage where significant diffusion will occur or is occurring [5]. We are thus witnessing the adoption of these technologies by the “early majority” group. And contrary to the two early groups, the “innovators” and the “early adopters”, the “early majority” has specific needs that must be addressed.

Indeed, for this group, the sole prospect of trying out technology does not suffice. And they are much easily dissuaded or discouraged by hurdles and challenges. Things must be simple and clear. Technical difficulties and operational problems cannot be compensated by the thrill of trying out new technologies. Where “innovators” and “early adopters” are much more forgiving, the “early majority” will be much more skeptical. If we apply this reasoning to electric and connected vehicles, we can deduce that it will get even more important to address fears such as sufficient electrical range and designing products and services that require little to no preliminary technological knowledge, that integrate themselves seamlessly in the customers’ daily life. For electric vehicles this means for example, that planning a trip, even a long one, should be as easy and hassle free as with an internal combustion engine vehicle. For connected vehicle this could for instance mean, that the vehicle is compatible with smartphones and smarthome systems.
And as electric and connected vehicles become more and more a mass product, more use cases and customer needs will have to be taken into account. For instance, charging an electric vehicle for people with reduced mobility can be difficult as a lot of charging spots have a standard parking size which is not adapted for disabled parking. Similarly, charging spots are often not designed for vehicles carrying a trailer. However, this can also be an opportunity as vehicle systems can assist drivers and passengers, maybe enabling in the future people who could not drive due to disabilities, to take the wheel again.

3. Trends of e-mobility products, connected services and HMI-concepts

Now that we have established, that electric and connected mobility is rising, let us dive into some of the current trends of e-mobility products, connected services and HMI-concepts.

First of all, users expect products to share some similarities with other products they regularly use. The example is often cited, but it is still relevant: the smartphone. If vehicles have displays that look like tablets and functions which have been inspired by smartphones, then customers will expect the experience to be as good, if not even better than on their personal devices – a tricky task if you consider the time difference of development cycles for phones and vehicles. We can see an equal trend for electric vehicles with fueling or more precisely charging. A lot of elements of the charging process already resemble the fueling process: for instance having the charging sockets where the opening of the fuel tank would be or having charging stations that roughly look like fueling stations. However, the expectation is not limited to the hardware component but also extends to the whole process of charging itself. Ideally, it should be as fast, as easy and as convenient as the fueling process today.

A second trend is the integration of more and more communication systems and touchpoints in and around the vehicle. I have mentioned before that the interaction possibilities with the vehicle keep growing. From the smartphone to smart home appliances, more and more touchpoints are being integrated, increasing the range of functions of the vehicle and making it possible to control the vehicle from afar.

Another trend, finally, is 3rd-party integration, respectively using the existing (digital) ecosystem of the customer. Several vehicle brands, for instance, offer the possibility to listen to music, podcasts and audiobooks via 3rd-party provider, such as Spotify, Deezer or Audible. The user can thus connect to his/her own account or use an account provided by the OEM and listen to his/her music. With some OEMs using operating systems such as Android Automotive OS,
users can even link their Google account, making it easier to set up the system and using it in an even more personalized fashion.

4. The common challenges for connected and electric mobility

Now that we have seen what some of the general trends are, let us make a user-centered reality-check and dive into some of the challenges customers are facing when using connected and/or electric vehicles.

Similarly as before, I will go through the challenges while showing that connected and electric mobility share the same type of difficulties.

First off, connected and electric products and services are still too complex for users. As mentioned before, the number of functions in a vehicle has been growing dramatically in the past years, leaving customers overwhelmed. Especially connected vehicles often have (too) many (new) functions that are too hidden inside the systems. Contrary to a lot of smartphone apps or even smartphones themselves, there is little to no onboarding for functions happening in vehicles or vehicle-related products such as OEM-apps. So, if users are completely unaware of particular functions, they will mostly just stumble upon these features by chance. This problem of complexity is also true for electric vehicles. As described previously, users will compare the process of charging with the process of fuelling. Users might be forgiving when it comes to longer charging times, as this is a fact they are aware of before using an electric vehicle, but they will be less so when the payment process is riddled with hurdles, such as not being able to pay directly at the charging station using regular credit card. Same goes for finding a charging station. Gas stations are scatter all across cities, highways or off the main streets. There are not yet as many charging stations but even so, when existing, they might be in hard-to-find places or at unattractive locations. For instance, a lot of highway gas stations have charging stations that are located at the end of the parking spot, in a secluded area, further away from the café, shops or restrooms that their diesel or gasoline counterparts. This is problematic for people with reduced mobility or women driving at night, as this makes them feel unsafe.

But not only are electric and connected products and services still too complex for users, even before being able to use them, users have to ensure several things. One thing which holds true for electric and connected vehicles is that, to this date, users have to educate themselves and spend time understanding the technology before using it. When taking your electric vehicle
for a longer holiday trip for instance, you cannot just go ahead and drive without at least preparing a route with sufficient charging stops. Another aspect is the preparation of technology itself. Future owners of electric vehicles will for example have to think about their need to take on a charge card or install a wallbox at home. For connected vehicles to be fully functional, users often must go through a lengthy enrollment process. This can include the set up of an account, pairing the vehicle with a smartphone, setting up and configuring the account inside the vehicle and on the smartphone app, going through a (video-) identification process or even buying data volume via a third-party provider. Lots to do! And obviously, each step represents additional effort and a potential challenge for the end-user.

A third and last challenge I want to stress, is the dependence on 3rd-party providers. Having interfaces between vehicles and 3rd party products or services can result in a great experience for customers when the integration is seamless and the connection results in an added benefit. However, if customers are dependent on these connections for their bought services to work, this becomes problematic. In the paragraph above, I gave the example for connected services. To be able to use those, several OEMs require their customers to use and buy data volume from selected network providers. The customer has no say in this matter and more often than not, the setup process is difficult and faulty, resulting in a really bad experience. This is also a problem for electric vehicles. Indeed, depending on the vehicle model, the plug type or the charging card(s) they have, electric vehicle drivers can only charge at given 3rd-party provider stations.

5. The eExperience Drive, a methodology to increase awareness and understanding of customer needs

All previous things considered, we can see, that at the heart of it all is the experience users have with given products or services. So how can one make sure that this experience is not only good, but great? By putting customers/users at the heart of the development process and including their needs. This should be done during the whole process, from cradle to grave (or cradle to cradle if the product or service is designed sustainably): so, from the early development stage, during the subsequent design phases and even after the product has been sold/the service has been performed, as user feedback is valuable at every stage. One model which can be used as a basis for this is the user-centered design process:
As the picture shows, this process encompasses 5 steps:

- **Plan**: General planning of the user-centered design process
- **Research**: Understand and specify the context of use
- **Define**: Specify the user requirements
- **Design** (sometimes also called “Prototype”): Produce design solutions to meet user requirements
- **Test**: Evaluate the designs against the requirements

The most important aspect of this process is that it is an iterative process. This means that each phase can be run several times, one can “jump back” to previous steps and go several times through the whole process.

The user-centered design process is a general framework which works as a guideline. For each step, different elements and actions can be done and different methods can be used. For instance, in the “Research” phase, different methods such as online surveys, in-depth interviews or focus group discussions can be used to identify typical user behaviours or understand a particular context of use.

In the rest of this article, I want to focus on one particular method, that we have been developing at P3: the eExperience Drive.
A little bit of history
For over seven years now, we have been conducting user experience benchmarks and tests. From connected vehicles, over charging stations to even micromobility solutions such as scooter-sharing services, we have been testing and analysing a lot of mobility products and services from a customer’s perspective. Some of our findings have been published in the “connect” magazine, the “Auto Bild” magazine, the “electrive” website and the “intellicar” website.
Over time, we have been able to witness the change of OEM strategies when it came to connected and/or electric products and services.
As mentioned before, these products and services share a lot of challenges. That is why, when it comes to electric and connected vehicles, it is of primal importance to consider the different functions together, as a whole.

One format, several possibilities.
One of the tools that we use to do just that is the eExperience Drive.
The eExperience drive is a framework we have developed and refined in the past years that allows a live experience around electric and connected vehicles from a customer’s point of view. It is very versatile and can be used with prototype vehicles, to test and validate functions that are being developed, it can be used to assess and analyze competitor vehicles or it can simply be used to experience the joys and struggles of electric vehicle drivers.
In a first step, we need to understand the needs of the target customers. Through user research we derive the most important and relevant needs, use cases and contexts of use. We then use this to formulate further use cases and whole user journeys, not distinguishing between classical “electric vehicle functions” and “connectivity features”. Depending on the functions to be tested or assessed, a particular focus can be set.
Additionally to this, an expert evaluation can take place, where we, P3 experts, evaluate the overall user experience of vehicles and their strengths and weaknesses, using different testing methods.
The next part is the preparation phase for the testing event itself. Prototype vehicles and/or competitor vehicles will be set up, registering accounts and connecting them with different devices.
Finally comes the “driving” part. This part can be adapted, depending on whether the goal is to validate functions and features from a customer’s point of view, or to increase awareness for the customers’ needs. If features must be validated, we will use the format to conduct user testing, inviting target customers to test out different functions, based on the afore mentioned
use cases. If the goal is to increase awareness for the customers’ needs, it will be product or service developers, designers and/or function owners that will test out the vehicles and their functions, following the developed use cases/user journeys.

All in all, this very versatile concept makes it possible to: experience connected e-services from a customer’s perspective and learn how to improve the UX of given services; discover current and common challenges and opportunities for EV drivers; experience vehicles in a holistic way, including external touchpoints such as charging stations, remote apps or other smart appliances; compare different vehicles and find out about their highlights and low lights and last but not least, make strategical decisions regarding the development of functions and service portfolios.

Finally, this concept can not only be used for “electric vehicle functions” and “connectivity features”, but also advanced driver-assistance systems or autonomous driving features.

**Conclusion**

To conclude, we can say that electric mobility and connectivity are on the rise. However, both fields have been considered in a too dissociated manner and a lot of the challenges these fields have, they share in common. And the core problem is not technology itself, but rather how it is implemented and used. Indeed, betting on technology alone and boasting with a large number of functions is not enough anymore, the overall experience with a product or service is the most important aspect for differentiation. And for OEMs to be able to succeed in the field of electric and connected mobility, they will have to address the needs of customers and users, especially those of the “early majority”. The key to all this is thus user experience. And it is with methods and frameworks, such as the eExperience Drive, that we can raise the awareness for users and their needs and make sure that they are integrated early in the development cycle of a vehicle or vehicle-related service. That way, not only will the developed products and service be great from a technological point of view, but they will ensure an exciting customer experience.
References:


[3]: Global sales of cars with embedded telematics from 2011 through 2019, statistics, BloombergNEF, April 2021

