Impact of Blockchain Technologies on Future Mobility

Masterarbeit

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1 Introduction

1.1 Relevance and Motivation

Each year more than 1,3 million people die as a result of traffic accidents (WHO, 2018). Additionally, between 20 and 50 million people suffer serious injuries, mostly due to human error. The World Health Organization estimates that these accidents cost most countries about 3% of their GDP (Gross Domestic Product). The trend of autonomous driving is promising to decrease these numbers drastically, but what does it take? The answer is simple: Data, a massive amount of data.

Google researchers published a paper in 2009 called "The Unreasonable Effectiveness of Data" (Halevy et al., 2009). They noticed that it is not about the algorithms to achieve excellent results with a minimum error – the algorithms are just a commodity – but it is rather purely about the amount of data. The data is the key to minimize errors from one in a hundred to one in a billion or even less. Likewise, the objective in the development of autonomous driving is the minimization of potentially occurring errors. Autonomous vehicles (AV) have to be safer than human driven vehicles by a multiple factor. Therefore, it will take an enormous amount of data to develop safe AVs. Vehicles are just starting to be equipped with sensors. Even if this sounds revolutionary, most of the generated data simply provides time and location every 10-30 seconds, is directly processed in the moment or not stored on an accessible database. Consequently, the data is lost or useless. This is nothing more than dropping bread crumps in the forest.

It probably takes more than a trillion kilometers of recorded, high resolution data to establish a manifold dataset – and the big players in the industry just have started to gather this data. Vehicles must not only be able to collect driving data of highways and well known streets of cities with a modern infrastructure (Heineke et al., 2017a). Particularly the data collection of extreme driving conditions is important. Driving data of any terrain, at any weather condition and of all kinds of traffic situations – including car accidents – is needed for the development of autonomous vehicles. How are OEMs (Original Equipment Manufacturers), mobility providers and tech-players planning to gather this amount of data in a short period of time? That is precisely where the real problem arises: it will take each of those companies a long time to collect the needed amount of data on their own.

The optimal solution – of sharing the data – is fairly easy to see. Yet, today the incentives are set to do something else: markets are driven by data advantages and the intent of it is therefore to silo the data. Probably none of the big players in the market – like Tesla, Google, Toyota, Daimler or VW – is willing to share their gathered data, it is their secret key to get there first, their competitive advantage. However, a marketplace might allow companies to source data from non-competitors – individual people, fleet owners or companies that have driving data, but are not developing autonomous vehicles themselves. Yet, even those are

probably unwilling to share, unless they are able to control their data rights. It illustrates the tragedy of the digital commons. Once data is sent to a platform, the property rights are basically lost. Consequently, no incentives for the sharing of data is given. What is therefore needed is the following: a technology that can register, control and protect generated data. In addition, it must be possible to utilize parts of such data under preset conditions and share only the data, which each individual wants to share. Fundamentally, the owners must be granted data-sovereignty.

Why is that important? The majority of the companies that have become one of the world's most successful companies in recent years are essentially platform companies. Those are companies like Google, Amazon, Uber, AirBnB or Facebook. These platform companies have software enabled applications that are built on (quasi) data monopolies. A closer view on the automotive industry shows that there is a strong movement towards "Mobility as a Service" (Goodall et al., 2017). These service-based mobility concepts also generate enormous amounts of data. The success of these concepts therefore depends likewise strongly on building (quasi) data monopolies. However, all the data – and the corresponding digital identities – would then be owned by only a few players in the market. By digital identities both patterns of movement and preferences are meant, like “where did you go at what point in time”. Therefore, it is important that individuals will keep the control over their own data. In addition, at the point in time when single mobility services become successful, more barriers to the introduction of new services automatically emerge. It consequently requires an independent infrastructure on which data-sovereignty can be preserved and individual players still are able to compete with each other. In other words: a market place with digital rights.

Up to today, it was technically not possible to establish independent infrastructure and enable applications like this. However, there might be a technology that can help to set the right incentives and potentially accelerate the future development of mobility. It is still not proven, since working applications do not exist yet. Nevertheless, there is a light at the end of the tunnel that is worth exploring. Considering the high number of traffic fatalities that could be prevented each year, a joint collaboration seems indispensable.

1.2 Approach

This thesis is divided into seven chapters. Due to its topicality it is necessary to begin by providing a detailed background about blockchain technologies. It will give an introduction to the technologies on the basis of an illustration of the bitcoin blockchain. Following this, the emerging trends in mobility will be examined and correspondingly five blockchain use cases for mobility are presented and analyzed in depth. For this purpose, an evaluation model is designed to guarantee a standardized assessment throughout the different use cases. The model consists of a two-step process with a total of 13 individual criteria, in order to find meaningful patterns and challenges. Both the current situation and future development are

analyzed. For that the technology itself as well as external conditions are taken into account. For the second part of this thesis, expert interviews were conducted and evaluated to estimate how blockchain technologies will impact the future of mobility. In order to guarantee a high level of quality, only experts with expertise of both blockchain technologies and the mobility sector have been selected. To enable a direct comparison between the results of the interviews, the evaluation is divided into 7 main parts. In chapter 6, the limitations of this thesis are discussed. Finally, it is strived to demonstrate the challenges that the technologies are facing. It focuses on the arising technological, economic, regulatory and societal challenges. An overview of the structured approach is attached below in *table 1*.

Chapter	Content / Objective
1 Introduction	Explanation of the relevance and motivation of this thesis and an overview of the approach.
2 Blockchain Technologies	The technologies are described in detail to lay a knowledge foundation for the following chapters.
3 Blockchain Technologies in Future Mobility	An evaluation model for the analysis of blockchain use cases is developed. 5 mobility use cases are presented and analyzed based on the designed evaluation model to give an outlook of the future potential of the applications.
4 Expert Interviews	Interviews are conducted with experts in the field of blockchain and mobility under the topic of "*The Impact of Blockchain Technologies on Future Mobility*". The outcome is presented in depth to give a comprehensive estimation of the future development.
5 Challenges	Technological, economic, regulatory and societal challenges for the future role of blockchain in mobility are discussed in detail.
6 Limitations	Limitations are discussed.
7 Conclusion	The results of this thesis are concluded and a future outlook is given.

Table 1 Approach of this Thesis (own representation).

7 Conclusion

What impact will blockchain technologies finally have on the future of mobility? A multi-layered examination is necessary in order to give a specific answer to this question. Surely other technological trends – such as the four CASE trends, image recognition or AI – will have a much greater influence. When it comes to the consideration of the use of blockchain, companies are faced with one fundamental question: "do we need a blockchain at all?" In comparison, traditional centralized systems have historically brought with them decades of research, development and experience. The systems are reliable and easily accessible for the user. They are currently far ahead in terms of performance, usability and reliability. Consequently, in most cases a traditional system is clearly preferable. Replacing traditional systems for technologies such as blockchain therefore makes no sense at first glance. So why should companies invest in a new technology that requires a lot of research and still harbors a lot of uncertainty?

Applications must be found that do not yet exist, applications that make it possible to start anew on a greenfield. Blockchain has the potential to become part of the big mobility puzzle and will may function as a technical enabler to complete the holistic picture of a seamless mobility. The expert interviews have shown great potential for essentially three areas. First, blockchain technologies offer a great opportunity to establish an independent infrastructure for a shared mobility platform. Second, in the area of connectivity they may enable a "trusted handshake" with their environment to offer a secure exchange of data and additionally grant data-sovereignty. And finally they provide the possibility to set up a digital identity for both human beings and machines.

Five different use cases seem of particularly interest for the future use of the technology. First, the establishment of an ID-System that aims at the creation of a digital identity. Second and third, the handling of insurance contracts as well as leasing transactions on a blockchain. Processes could thus be automated extensively. Fourth, the integration of wallets into vehicles. In a scenario in which the vehicle functions as an autonomous entity, transactions could be automated and processed directly over the vehicle. And finally, the provision of an independent platform for shared mobility, on which several mobility providers can offer their services. This universal platform has a significant advantage especially for the end user. Various mobility services could be aggregated and potentially enable a seamless mobility.

However, without a doubt there are many challenges ahead, since the technology is still in its infancy. Starting with the fundamental technical obstacles described earlier, the technology still has a long way to go. It lacks in performance, scalability, stability and not least the usability of current applications. The understanding of the technology is not yet present in the entire industry and thus it lacks as well at the willingness to invest into its further development and research. Another important factor and equally a great challenge is the involvement of the government. The development depends to a large extent on future regulations. Many applications can thus only be facilitated with the legal introduction of a digital identity.

Whether the described possibilities are realized with the help of a blockchain or another – perhaps similar – technology seems irrelevant, since it is ultimately a matter of the greater objective behind the applications. In some cases, the objective even goes beyond pure mobility issues. We are moving towards a data driven economy, thus it is important to establish a secure digital identity and create data-sovereignty for the individual – in all industries. Do we want to live in a future in which only a handful of companies build (quasi) data monopolies and control our data?