MERCEDES BENZ

Car leasing – Smart contracts

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1.0 Executive summary/abstract

The project examines the car leasing services offered by Mercedes Benz (**MB**) and how these processes can be improved by implementing smart contracts (**SC**) and add value for both MB and the end customer. The car leasing industry is worth 62 billion dollars and expecting high growth in the future, which presents some challenges that needs to be addressed. They are rooted in a lack of autonomy for the customer, which stems from a lack of transparency and trust in the interaction with the company.

The authors present SCs as a viable solution in the digital economy. SCs will add value in terms of transparency and trust to the leasing process, where all relevant information regarding the car is available to the customer and other stakeholders, and ensuring information cannot be tampered with. To illustrate the case of SCs and their added value, a prototype has been created and presented along with a website. This if further backed up with a description of the technology (**TEC**), platform and functionality etc. behind.

This is connected to MB' current business model regarding the current setup and how the implementation will impact that. Especially MB' innovative mindset in their R&D department coupled with their strong brand is found to be a good linkage with their customers. This is assessed to lead to a long-term relationship between MB and the customers, which is preferable in terms of profit and a sustainable for MB.

To ensure consensus of processes between stakeholders CATWOE, PQR and a root definition, the creates of a rich picture of the process. The entire case is evaluated and assessed critically in order to identify prevailing challenges and how to deal with them in an orderly and satisfying matter. Especially the issue of choosing a public/private ledger (**LD**) is discussed thoroughly regarding the trade-off between speed and security along with the fear of losing control in the connection with decentralization (**DC**). This all leads to the conclusion of SCs being a value-adding initiative but with several challenges associated.

2.0 Introduction

The automobile is one of the most influential and important inventions and contributes to 3,65% of global GDP. (Saberi, 2018). The demand for cars has historically been for private owned cars, but this structure of demand has been changing in recent years in order to focus on the more need-based consumption trend of leasing. This diminishes the importance of ownership in favor of leasing contracts normally lasting between 6-60 months. (Markets and Markets, 2019). In 2017 the car leasing industry was worth over 62 billion dollars on a global level and is expected to grow to over 86 billion dollars in 2023 thus providing a lucrative business opportunity to meet demand. (Market Watch, 2019). Although the market for leasing is sizeable and continuously growing, it is still facing many challenges that needs to be addressed. This can possibly be solved by implementing blockchain (**BC**) and, more specifically, SCs.

The major problem with the current setup of leasing can be described as a lack of autonomy for consumers and can be split into three parts. The industry faces high transaction costs. This is due to the amount of information that is needed in car leasing regarding actors, price, state of the car, terms of the contract, time of leasing, private information etc. along with the number of actors such as the consumer, the dealership, intermediaries, regulators and so on. With all the information needed to be processed between different actors, who often operate in different system, it adds a lot of complexity to the transaction.

The industry is facing concerns regarding trust and security (PWC, 2017). A common issue is encountered, when a leased car needs to be returned to the dealership after an ended contract. Here there are often differing views on the current condition of the car compared to the condition at the beginning of the contract and which potential damages where pre-existing. Consumers often have to trust the car leasing industry and that they have not tampered with the data. There is the constant threat of data breaches to compromise personal information or even delete data, which in 2018 alone happened to several big corporations such as Google, British Airways and T-Mobile (Business Insider, 2018).

There is a lack of transparency and efficiency in the industry (Triple Pundit, 2018). There are currently a lot of information that needs to be shared between different stakeholders, which is often done in a manually. This information is not always accessible making it difficult for customers in assessing the state and history of the car along with insurance companies for instance to assess the necessary premium for customers thus leading to added cost for the average car leaser.

On the basis of the current market and the challenges faced, our proposed innovation (**INN**) is for MB to implement BC TEC in the form of SCs. These SCs will use information based on a LD with all relevant information about a given car such as how many years it has been driving, mileage, where it has been, state and possible damages to the car, any modifications or repairs made etc. This will create a platform with very high transparency and trust, since all information is available and it is known that it cannot be tampered with. This in turn leads to higher efficiency, speed, accuracy and security when leasing cars with lower transaction costs associated. The INN of SCs itself can be described as a self-executing contract facilitator, where all information, rules and penalties are stated. When leasing a car, the customer will then choose a car to lease for a certain amount of time for a given amount of money. If all terms and conditions are met, the contract will execute itself automatically and the consumer will gain access to the leased car for an agreed amount of time while the currency, in this case Ethereum (**ETH**), is withdrawn from their account. Before assessing SCs and BC in the leasing industry for MB further, it is also necessary to discuss whether BC is the solution or another system is better suited. This can suitably be done by using the model of Henglein (2018), which evaluates whether you need DC, tamper-proof logging and store and transfer resources. If all criteria are answered with a yes, then BC is a viable option.

Decentralization: First of all, it is important to determine whether there is a need for decentralized system or if a centralized one is sufficient. With a centralized system, all the data is hosted by a privileged system provider, which provides several issues, namely whether the system provider can be trusted, single point failures and extra fees paid to the authority maintaining the system. With DC of a system, there is no single authority as a single point of control. This means that there is no single authority, such as for example MB, that needs to be trusted. This makes the system more trustworthy for consumers while also assuring a more cost-efficient system with low risk of failure or hacking. A decentralized system is highly favorable in this scenario of SCs for car leasing.

Tamper-proof logging: It is essential in the car sharing industry that historic data cannot be tampered with. This is for example the case when renting a car, where it is important to know the exact state of the car and possible damages at the point of renting together mileage and old customer history. MB or other car companies can have an interest in making a car's history appear better than it is by changing the log, which will be impossible with BC TEC making this a highly attractive solution in ensuring trust and transparency.

Store and transfer resources: Storing and transferring resources is essential to the business model of SCs and leasing cars. It is the basis for how SCs will execute themselves and exchange currency such as ETH for access to an asset, in this case being access to the leased car. With the need for BC established, we can start to introduce the INN of SCs and how it can add value and help solve the challenges faced by the industry.

Problem formulation

Based on the aforementioned outlook and challenges of the current car leasing industry we found our problem prioritization to be within BC based solutions and more specifically SCs. We will research how MB can implement SCs and what effects that will have. This has led us to the following problem formulation:

How can MB implement and use SCs through BC TEC in order to improve processes and create value for customers and themselves.

Since the chosen problem formulation is a complicated problem, which can be hard to research on its own, we find it relevant to break it down into smaller problems by a set of research questions as follows:

1. *Why should smart contracts be implemented and how specifically can it be done?*
2. *What is current Mercedes business model, and how could it change by using smart contracts when interaction with customers?*
3. *Which implications would the implementation of smart contracts have for Mercedes' car leasing services in the development process, and how will it create value for relevant stakeholders?*
4. *How should Mercedes overcome any possible challenges arising from the development process of smart contracts?*

Before answering these problems, we would like to delimit the project in order to be specific, focus on the essential and comply with both the space and time limitations of this assignment. We also limit our scope to deal with LDs only containing information on cars. It would also be possible to focus on information on drivers, but the authors assess this to be more relevant for the case of MB with fewer implications such as personal information and GDPR issues associated. In the creation of our prototype it is not done to be highly functional and the code are just the high-level description of the future SC and the website is also a low fidelity prototype which give the basic picture of the DApp.

3.0 Innovation

3.1 Business case

The digital economy creates greater business opportunities for companies, while it also increases the involvement of the customer in terms of sharing data. Customers are willing to share data, when getting a return and additional value out of it (Ernst and Young, 2019). It is essential that companies work together with customers in order to visualize this additional value to the customer. A significant element to create trust as an attribute to the service is by providing radical transparency to the customer, by showing the intended benefit to the customer and advise them on risk (Ernst and Young, 2019). The use of new TEC from the digitalization can often trick biases from customers, which makes the TEC and the company less trustworthy. Creating trust with the customer is also set by unwavering integrity of the company to show that they work towards the customer's demands and on their behalf (Ernst and Young, 2019). Traceability through a distributed LD will provide customers with greater insight into the lifecycle of the products/services, and create a greater level of trust, with e.g. BC TEC. There are several improvements that can be achieved through the use of BC TEC. SCs are digital protocols that are set to verify or falsify the execution or performance of a given contract between two parties.

In terms of the purchasing of high-end services one of the decision criteria could be based on emotions and the degree of loyalty from high level of services from previous experience with the brand. From the customer relationship, the implementation of SCs could create benefits such as; accuracy of the leasing agreement and conditions of that between the costumer and manufacture, transparency of data and clear communication, speed due to the contracts running on software code and operating live online and high level of security of the contract between the two parties. From the manufacturer's perspective it could also lead to improvements such as; efficiency, since the transactions will be more transparent, storage and backup, since the data will be stored multiple places.

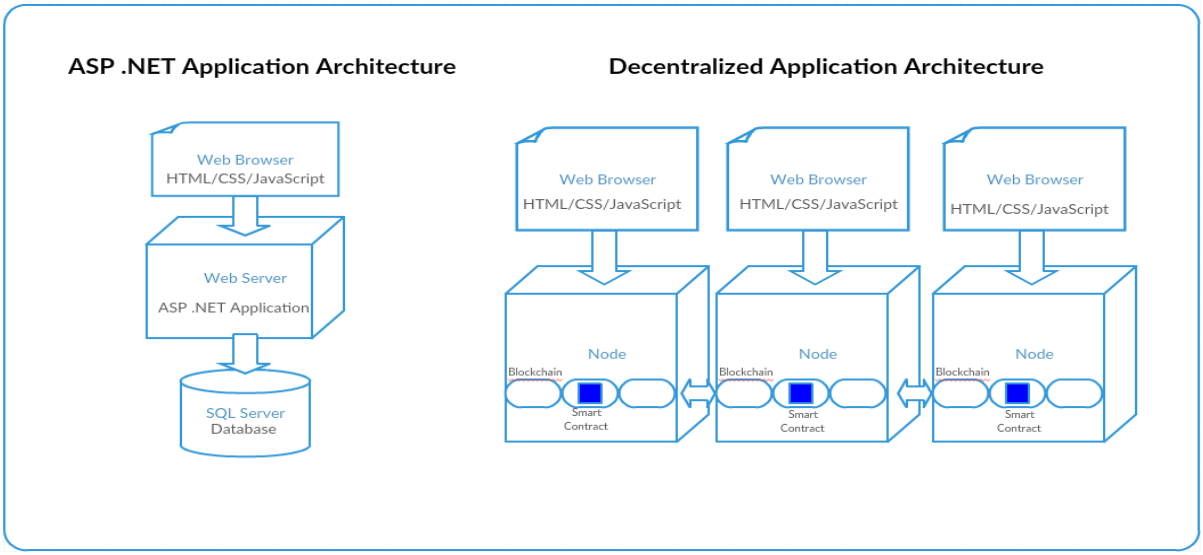
In overall terms, the implementation of SCs in the transaction process will reduce the cost of transactions between the two parties resulting in freeing up resources to use elsewhere (Eisenhardt, 1989). MB is chosen as the business case for the transformation shift from legal documentation for leasing agreement to a SC instead. MB is owned by the Daimler group, which were fined 870 million Euros for negligent violation of supervisory duties for their rigged Diesel cars (Bloomberg, 2019). This is in the aftermath of the diesel cheating scandal from the German manufacturer, Volkswagen AG.

This scandal is an inhibitor the brand value for the customers, and create less favorable brand association due to lack of integrity. Surveys show that are less trustworthy than other industries such as retail, airline and hotels, while also emphasizing the importance of car brands being genuine and not lying. (The DMA UK, 2017).

All of this supports the importance of transparency from the manufacturer to the consumer in order to create a long-term trust-based relationship with the key consumer. MB can use the BC TEC to embrace transparency for the consumer. The scope of the INN and project, is narrowed down to the business area of leasing, since it is the business area that is predicted with the greatest potential and growth for the future. The process of leasing a MB car is done by creating a legal bond, through a physical agreement. This method does not provide or allows the consumer with the possibility of information on the products through. The customer only has to possibility of verifying the product and brand through the description of the product's characteristics. The customer has no opportunity to verify whether the car is offered to the appropriate value or not. This information of the products life cycle is provided for the company, since it is used for inventory management. Allowing this information to the consumer would be a beneficial action for MB since it will create the transparency which is demanded from the consumer. It will create the possibility of verifying the condition and information specified in the leasing contract against the accurate information of the products. By doing this, it will create an image of the company as cooperating with the consumer and have an integrated business and brand.

Creating a distributed LD on a SC for a MB car, makes it possible for both MB and the consumer always to verify and evaluated on the accurate data. This secures the transparency and do not create distrust in the leasing process or between the brand and consumer. The use of SCs will also provide greater business/service experience for the customer in terms of clear communication, instant accessible, high level of security, and overall reduce the transaction costs between the parties, since there is no indication of, the other party interaction with another agenda or common goal because the transparency.

3.2 Traditional Database vs Blockchain Technology



MB cars are using traditional database to store all the information of their clients and vehicles. Our project demonstrates the shift in BC to store every bit of information during a transaction and make transactions more efficient. While all records secured on a database are centralized, each participant on a BC has a secured copy of all records and all changes so each user can view the provenance of the data. The real value-adding activity happens when there's an inconsistency. Since each participant maintains a copy of the records, BC TEC will immediately identify and correct any unreliable information. When data can automatically identify and correct itself based on coded business logic (SCs) and consensus, participants are intrinsically able to trust it. Currently when two businesses work together, they almost never share a single database with a single set of records, because the database is being maintained and updated by a database administrator (Pluralsight, 2019) (DBA). That DBA is being paid by one of the companies and thus has a stake in the success of one company but not necessarily the other. If they want to make a change that benefits their company, the other company would never know. Alternatively, on a more nefarious note, if a competitor decides to pay off the DBA, they can make any changes they want to the database without either participant ever knowing.

When BC TEC is incorporated into the data processing, which remove the single point of failure, in this case the DBA, and ensure that if one of the participants makes a change it is immediately corrected by the other participants. After the data corrects itself, the unalterable record of changes will also indicate which participant tried to make the change. With the data process secured, a business can not only trust the data shared between the companies they are working with but can even trust the data shared by competitors.

Internet users do not have sole control over the data they share on today's websites. Decentralized application, also referred to as the DApp, is based on the BC TEC where data don't require a middleman to function or to manage a user's information (Coindesk, 2019). DApps connect users and providers directly, and secures the transparency of data between the two parties. In terms of MB prospective their advantages of deploying the whole system on DApp could be using the SC instead of the traditional LD there would be a high level of transparency between customer and MB car leasing. It is so secure that it is almost impossible to hack or to put the server down as in order to do so high computation power is required which is impossible to achieve by any single party. This can further be enhanced by also by including several other features on it like use of cryptocurrency to pay the rental amount where all the monetary transaction can be done in cryptocurrency instead of cash, paypal or credit card. As the research in the field of BC further grows, DApp can further add features which are hypothetical right now since BC is still a new tech development.

3.3 Prototype of Car Leasing using Decentralized Application

3.3.1 Technology

To implement a car DApp we have to implement various functions in solidity programming language in order to make sure that the basic fundamentality of car leasing is satisfied. The TEC that can be used in the development process of the car leasing application can be based on BC where all the data is stored not on a single database server but distributed across the blocks of nodes. The advantages of using BCs here includes: Tamper-proof, Secure, Fast, Reliable, Efficient and Decentralized data. MB car leasing wants to implement their application decentralized by giving hold to data to the customers and other automobile companies. To deploy the SC on DApp there is a consumption of gas/ETH which is sent by the party who wants the SC to deploy and the gas/ETH is credited to the user/customer. The more complex and tedious the computation, the more gas is needed in order to execute the SC (Free Code Camp, 2018).

3.3.2 Designing application

The user interface for our DApp will reflect the transparency and all the important information required by the customer who is leasing the car. For instance, UI/UX of our DApp - date of availability, type of cars, car condition and available leasing option, car history to make things transparent for the customer. This is demonstrated in our website, which shows some interaction from the customers perspective, which can be seen appendix 1.

The code in the appendix demonstrates some of the important functions that can be implemented in a high-fidelity prototype during the initiation of the SC. Our website is just a low fidelity prototype of the final DApp that MB will develop and due to lack of resource and time our prototype is just a high-level idea of the actual website.

3.3.3 Platform

MB is currently using a centralized database system which can be hard to maintain. Basing the database on a BC platform could reduce this possible risk and dependency for the single centralized database. There are three types of platform of BCs (Ernst and Young, 2017), which MB have to evaluate:

1. Public Blockchain
2. Private Blockchain
3. Consortium or Federated Blockchain (Hybrid)

For MB rental services Consortium (Hybrid) BC is the suitable option. In Consortium BC, some nodes control the consensus process, and some other nodes may be allowed to participate in the transactions. Consortium BC is like a hybrid of Public and Private BC. It is public because the BC is being shared by different nodes, and it is private because the nodes that can access the BC is restricted. Hence, the hybrid is partly public and private (Ernst and Young, 2017) as the information about the car is between the automobile companies and the customers who are using the services.

3.3.4 Functionality of the application

The functionality is based on the case of leasing a MB car through BC. The information is based on the car, and the function has to be designed upon that. It can be information on the condition of the car in relation to the transparency and user interface with the consumer, and making sure that the data is synchronized with the parties in the DApp. The function encapsulates both the condition of the contract, and which party has to execute which actions at a given point. One of the main benefits of this functions through SC, is the possible of execution instantly both for MB and the customer, which makes the customer relationship more transparent and agile than previously. This is further elaborated in appendix 2.

3.3.5 Smart Contract

Another functionality of the application is SC between MB and customer, which have all the advantages of BC TEC and make user experience for MB and customers better and more instant. When the SC is deployed on the DApp, it goes through a series of tests written in Solidity.

Once those tests are verified the contract is deployed, which can be confirmed on the customer side by just plugging in the key (Hexadecimal Value) (Favi, 2019). In SC we can add functions like verify which will verify the parameters with the actual value and return true or false.

3.3.6 Exchange

DApp for MB car rental will have the payment options and which can be done either with the cryptocurrency or tokens can be exchanged between the two parties for leasing (UX Collective, 2018). Exchange in terms of SC is the value that is changed when a contract is signed between a customer and MB leasing and it can be in the form of tokens or ETH, where either the token or ETH will represent the value of digital assets in terms of the car.

4.0 Business model - Canvas business model

The business canvas model is used in order to explain how MB' current business model is structured in the perspective of financial, internal and external partners and key activities that creates value for customer relationship (Osterwalder, 2015). The revenue stream is not included in the business model, since it is seen as relevant for the implementation of SCs.

4.1 Key partners

The core business of MB is depending on external partners such as their key suppliers and manufacturers of subcomponents to their car. MB are only performing the assembling of the car, which makes them depending on the quality of output from the suppliers and manufacturers in supplying their consumers with a high-quality product (Investopedia, 2015). Currently, MB do not operate in a with a BC LD with any activity in their value chain. Some of the obstacles of implementing BC and SCs between the consumer and MB is the complexity, change of processes and other radical changes in that perspective. Based on the above, it can be a challenge for MB to implement, since it could require them to restructure both the front - and backup system. So, to summarize, MB do not currently possess any know-how in this area, making it critical in the future to gain key partners that can help solve these issues.

4.2 Key activity

It can be argued that the most value adding activities for the consumer is the level of service MB provides. The high level of service includes being proactive regarding customers' needs, being available with help and providing expert knowledge on said car.

It is also important that MB focus on the R&D both in terms of products, so it will meet the future demands from the consumer and expectation from the political and legal aspects e.g. Co2 restrictions (Daimler AG, 2018) etc. In terms of implementing BC, the essential activity for MB is the constant focus of optimizing the process for themselves and simplifying it for the consumer. Making it a consumer driven development will make sure that MB creates value for the customer experience, and do not make the development a market driven decision that removes the focus on simplifying the customer experience.

4.3 Key resources

MB have a great focus on TEC and development in order to stay competitive against other high-end car manufacturers. The focus on TEC is on improving the performance of the given MB product which translates to a very good R&D department as part of their key resources (Mercedes Benz, 2019). The improvement on MB cars is a part of the core business and primary activities, where the development of BC is set to be a part of the support activities. It shows that MB in general has an innovative mindset, which makes them more tractable towards changing the process, in terms of implementation SC . MB is a global brand, which is associated it with high quality (Mercedes Benz, 2019). This can be seen as a resource in terms of attracting the right competences.

4.4 Value proposition

The performance and durability of the car is one of the key value propositions for consumers. This also comes with the brand association of MB, which is based on a storytelling about high quality, design and performance. The value proposition for MB, is that they assemble and supply a world class luxury vehicle experience expressing high status. The experience is an interconnection between the product and service. This means that the level of service has to be equal or higher to the performance and quality of the car, since the level of service is an essential parameter in the post purchase phase. The implementation of SCs can be seen as a supplement to the overall service experience for a MB consumer. It will make the flow of data between the two parties more transparent and efficient. This can be seen as an extra dimensional of the service experience for the customer make sure MB are able to accommodate the demand and provide expected service level.

4.5 Customer relationship

The customer is served through physical and online platform depending on the inquiry and need from the customer. Since high starting cost for the leasing process on MB behalf along with high associated service costs, they want the relationship to be long term, being between 6-60 months at a time while also keeping the customer after ended period. The implementation of SC is also going to support the long-term relationship with the customer. The integration of SC is going to create a more agile and close relationship with the customer. Making the conditions and information of the leasing agreement more transparent between the two parties is set to increase the level of trust from the consumer and the loyalty of the brand.

4.6 Channels

The leasing customers are served through different channels today depending on their inquiry and demand. The information seeking in the purchasing process most often happens in a physical store, where the customer will experience the car and have different options to evaluate. The execution of the leasing agreement can happen either in the physical store or online through a self-service platform. The forwarded SC and verification process of this will happen through an online platform. The SC is built on an ETH LD, where the verification and agreement of the SC will be stored. This is also shown in the rich picture, which will be evaluated upon in point 5.0.

4.7 Customer segments

MB caters to a segment defined by a high purchasing power and with high expectations regarding quality and service. This segment often chooses car based on brand recognition or because they have earlier had good experience with MB. A part of the good experience for this segment is the ease of use of leasing contracts. Especially the apparent look of high complexity of SCs in the beginning of the implementation can be an element that might divest some consumers due to their expectations of low complexity of a leasing agreement. The implementation of SC could possibly be relative complex in the introduction phase. MB might complete their setup, it also requires the consumer to accept it and use it. In case the customer finds it to complex or too intricately it will not create the expected customer value throughout the supply chain.

4.8 Cost structure

There is some implementation cost due to the development and integration of SCs in the process. This holds both advantages and disadvantages in terms of the integration the SC. The developing cost will be high in the introduction phase due to MB lack of knowledge and competence for the TEC. In the long term the TEC will become more mature and integrated into the system, which eventually will make the maintaining- and developing cost of the system to decrease. Mckinsey (2019) estimates that 70% of the increases value by BC is generated by the impact of reduced transactions costs. The cost benefits of BC will not be realized until MB has decommissioned their old system (McKinsey Digital, 2019).

4.9 Sub conclusion

To summarize, MB are highly dependent on their external manufacturers and suppliers in order to live up to their reputation of high quality. This high quality is linked to their key activities which includes high service level and a strong R&D process based on consumer driven development. The R&D are also a key resource in fulfilling the consumers' demands and living up to their other key resource - their highly valued brand. All of these resources and activities caters to a segment with a high purchasing power going for quality cars high, service without any complications. With the cost structure consisting of high start-up cost for BC along with the high value of the car, the relationship is preferred to be a long term.

5.0 The development process

The customers of the system are defined as those who will receive the output of the system for the transformation process. As shown in the above section in the project, the customers of the transformation process will be the end-user, who will gain the benefit of system (Checkland, 2000). The customer was defined in the business canvas model under customer segment, to determine who is the primary segment for the leasing through SC for a MB customer. The actors are defined as the ones who are going to perform activities in the transformation, defined by T. In relation to the soft system methodology for a company, it is essential to analyze at which hierarchical level the different stakeholders are performing and what activity they are performing. The actors are placed at the sub-system level, which is where individual activities meet the requirements of the root definition (Checkland, 2000). Taking this case of integrating SC in the leasing engagement between MB and their end-user, the input will be a system to share data. The output and transformation are highly dependent on good input since this will shape the entire process.

The increase of capabilities in terms of better data stored process and systems for SCs will transform the process of data sharing between parties to become more transparent and efficient. The change through the transformation will create an output of data sharing that is safer and more instant than previous processes and will create greater service opportunities for the customer.

One of the driving forces in the transformation process are the actors who are the ones that will execute the transformation. Looking at the traditional process of leasing, the first point of contact for a customer will be a service employee placed in the physical store, who will advise and guide the customer and propose several options for them. It can be assessed that, in order to gain some efficiency of the SC, MB will need to automate the process. Müller et. al. (2017) elaborate on how to automate the execution and engaging of a financial SC, which is seen as equal to a SC. In order to achieve automatization and efficiency, that has to be certain repeating patterns of the structure and execution of the contract. A contract evaluator is a systematic machine that encapsulates the basics of the contract, based on the content language. The language is built on constructions, where simple contracts are joined together by these. The constructions define the executions if the conditions are fulfilled, and makes sure that the conditions of the execution of the contract are not to be changed. This is making sure that uncertainty and lack of information will not have an influence on the assessment of the contract. In inspiration of this, the prototype based on this project had to be structured with similar constructions in order to be consistent with the criteria of; security, service and quality for MB. This is described in section 3.3.

There has to be a systematic approach in the fulfillment of the conditions of the contract. This is done by a contract manager that executes the contract based on an input driving contract strategy, which is shown in the rich picture. It is a systematic execution, where its behavior is based on patterns from the conditions of the contract e.g. in case of a counterpart do not cater it is requirement. Then the contract manager will have a backlash execution, to cancel the deal between them. Further development of the prototype will include a contract manager, for automation of the SC execution as an actor. The contract manager is partly driven by rational input from a manager in a corporation, then the performance and behavior of the contract manager is transparent and visible for the counterpart, which is the costumer as also shown in the rich picture.

After defining the transformation process, it has to be assessed in a broader regarding positive and negative impacts. Assessing the transformation through the world wide perspective different stakeholders have to include to determine both the positive and negative impact (Checkland, 2000).

Some of the negative impacts are associated with the uncertainty of the BC TEC, and the underlying use of SCs in the process. Shareholders of the company are the ones with the decision power to implement the TEC, however there are several practical challenges which prevents the implementation of BC to its full potential (Lacity & Khan, Exploring Preliminary Challenges and Emerging Best Practices in the Use of Enterprise Blockchains Applications, 2019). One of the challenges for implementing BC is the lack of blueprint for how to handle the implementation and how it will create additional value to a company. Without these blueprints and lack of evidence from a business case, it can hinder the shareholders to evaluate the business opportunity. From their point of view there can be some skepticism, since there is a high level of uncertainty and no guarantee for a potential return in the long run based on the lack of blueprint. Having a DC shared LD of data will raise some questions for owners such as shareholders. There are elements of intellectual property, which is not yet defined for the development of BC (Lacity & Khan, Exploring Preliminary Challenges and Emerging Best Practices in the Use of Enterprise Blockchains Applications, 2019).

Sharing data on a public distributed LD puts a new aspect to sharing data, which due to the lack of maturity of the TEC, and can have a negative impact. The EU have adopted regulations to strengthen the data privacy rights in terms of GDPR (BBC News, 2018). Additionally, due to the fact the BC is a radical INN in terms of sharing data, there are not any regulation, which determines the regulation, which company can act within. Despite possible violations of data privacy through a public LD, companies, are skeptic on sharing the data with other companies and customers (Lacity & Khan, Exploring Preliminary Challenges and Emerging Best Practices in the Use of Enterprise Blockchains Applications, 2019). There is a fear of this information will be used against them in order to gain a better pay off from the exploration of information. There are examples of multiple enterprises whom have developed and integrated BC in the supply chain (Forbes, 2017). This supports the argument of BC creating more economic value to the company in terms of increased revenue and reduced transaction cost. It could be argued that MB will have the same capabilities and resources to explore the BC TEC such as companies like EY, Alibaba, IBM etc. It also implies the implementation of BC is within reach for a company like MB.

The owner are the ones that possess the power to shut down the transformation process due to the ownership of the process. MB is a part of the Daimler Group, who owns companies such as Maybach, Chrysler etc. (Daimler AG, 2019). It can be evaluated to what degree the owner from Daimler will have an influence at the operational level for MB in terms of developing BC TEC.

A subsidiary like MB will have its own independence in terms of execution, as long as they are in accordance with the overall strategy and vision for the Daimler Group. The business area of exploring new technologies can be placed at R&D. Within R&D the person with the highest authority is the R&D directors, who is responsible for justifying the decisions based on key figures to the board. In case of a development project not being profitable or deviates too much from the plan, then he/she can cease the project.

Another very important aspect in terms of transformation with the BC TEC is culture (Deloitte, 2017). The transformation process is conducted by 20% of TEC implementation, while 80% is change of business process (Deloitte, 2017). Referring back to the example of EY, Alibaba and IBM implementing BC throughout the value chain, states that the TEC is accessible for MB. The change of business process is difficult, because it forces the actors to change their approach of working. The rules and standards of optimization and efficiency is grounded in the current business process for the actors meaning they will have to see the process from a new paradigm, in order to understand the potential and argument for using BC.

TEC creates most value when it is used together with multiple users or industries who shares the same opportunities or challenges (Deloitte, 2017). Companies are building their own BC applications, which could be the same case for MB, because of the uncertainty of sharing information through a distributed LD such as ETH. The possible lack of control for its own distribution of information makes it difficult for companies to achieve the full potential of BC. This is also related to the overall lack of understanding of how the system works, which is seen as an environmental constraint to the transformation towards BC (Deloitte, 2017).

(P) answers about what to do in terms of the transformation process. The overall shift in the business process is the change of using legal documentation to using SC through an ETH LD. The (Q) is a question of how to do/execute the transformation process. There are some challenges and constraints, both technological and organizational, that hinders the transformation towards BC in happening. By answering how to do, it will be shown how to overcome these challenges and highlight the greater potential of the actions. Most of these constraints or challenges are related to the uncertainty of BC, due to the missing blueprint. A solution could be to do a pilot test on some loyalty-based customers in order to get their feedback and show how it will work in their processes. Then it would be possible to demonstrate the value and benefit of implementing SCs.

The process has to be a gradual development in order to gain a competitive advantage, when not taking competitors into consideration for MB.

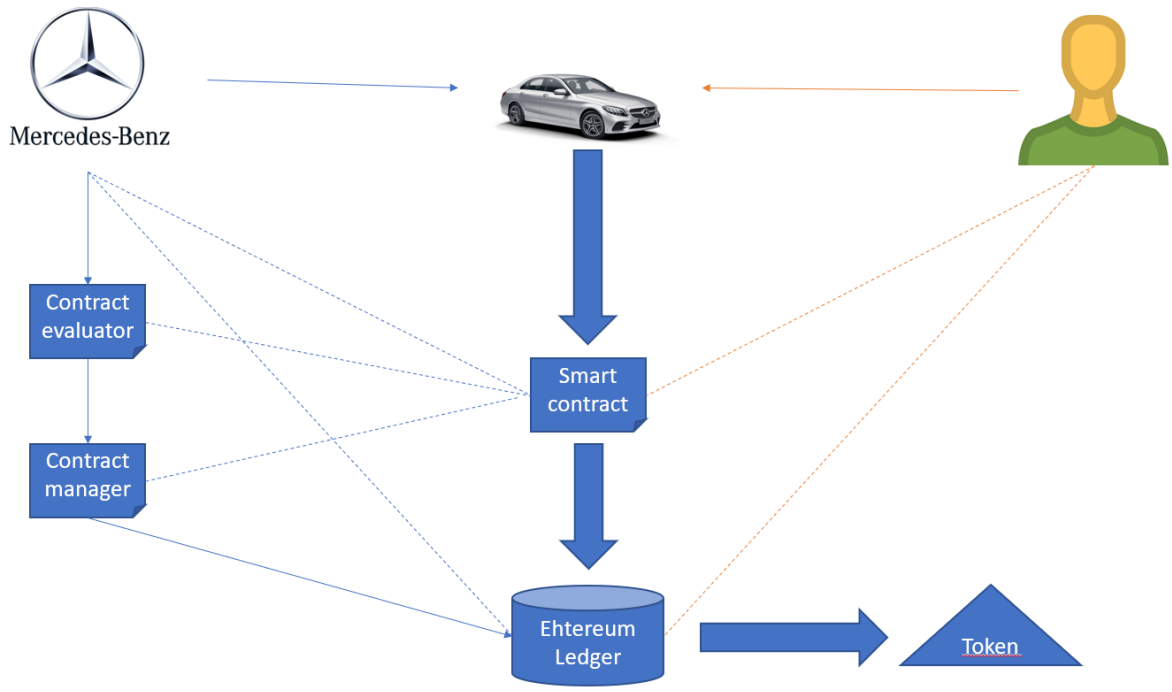
Since there is uncertainty, the process cannot be implemented instantly, because it would do it more difficult and cumbersome to overcome this uncertainty for the internal stakeholders. It can be argued that when taking the stage BC in Gartner's Hype Cycle (O'Leary, 2008), the only way to create the fundamental laws and regulations within BC is to explore the opportunity of it, which eventually will move further than “Peak of inflated Expectations” towards “Trough of disillusionment”.

The last question of why to do it (R) takes on the purpose of which value the process will generate. The argument mainly focuses on business optimization in terms of engagement with the end-user. It creates greater user and service opportunities for MB and the end-user, which have been addressed previously. The root definition, that is, the core description of the development process making crucial to take all of the thoughts and arguments into consideration when creating the root definition. We have done so as follows: “A contract manager owned system to automate the execution of leasing MB vehicles with a SC through an ETH LD, in order to create a more sustainable and transparent business process, and to provide a greater experience of the MB brand for the high end B2C segment”.

The rich picture identifies actors and how the data is structured in between the different stakeholders as identified in CATWOE. The elements of owner and previous activities in the supply chain is omitted in the picture and narrowed down to the dataflow and interaction between MB and the customer. The sharing of data through a SC is based on the transaction history and information on the car, since it is the element that initiates the buying process and connects MB with the consumer. Secondly, it can be assumed that it will not provide any additional value for the consumer to provide personal information for MB through a SC. That value will only visible for MB and not for the consumer. It will also entail some difficulties with complying with the GDPR regulation for an EU member country.

Aforementioned sections can all be summarized in the rich picture below. The data of the car will be stored on an ETH LD, which will be accessible for the parties that have been verified on the contract. From MB’ perspective, they will include actors such as contract evaluator (Müller, Henglein, Henglein, & Ross, 2017) in order to encapsulate the condition of the SC and agreement of the car. The contract manager will execute on conditions from MB to enforce the agreement.

Verifying the agreement between the parties and the car for the leasing agreement will eventually create the token which represents that value on the ETH LD (Müller, Henglein, Henglein, & Ross, 2017), also as the digital assets. In case of the car will be offered to a new consumer, the token will change ownership and all of the data will be accessible for the new consumer. Creating this transparency for all consumer and the LD will eventually reduce the overall transaction cost for MB, and create a long-term customer relationship.



6.0 Evaluation and assessment

Throughout the development process several challenges has been addressed related to the perspective of stakeholders in the CATWOE framework (Checkland, 2000). In addition to that, it is very important to evaluate how the use of ETH LD for the SC is set to meet the criteria for the outcome of BC for MB. The prototype is built on an ETH LD on DApp, which is primarily a public BC, but can also be created as a permission or private BC. One of the challenges for use of ETH the LD, is the lack of scalability. A key argument for switching towards BC is the simple and instant access execution on the network. The use of a public ETH LD can only process 15 - 20 transactions per second, compared to a Visa which can process around 45.000 transaction per second (Cointelegraph, 2019). Since the BC TEC, including ETH, is relatively new there is still some uncertainty, the system can be unstable, even though there is heavily development of the system E.g. The DOA attack gave a step back in development (Atzei, Bartoletti, & Cimoli, 2017), since it was a fork to the ETH's own testament on stability, safety and cost (Medium, 2019).

Despite the DOA attack, one of the unique selling points is their demonstrative security, which many new centralized networks continue to struggle with (Medium, 2019). ETH have also recorded 620,267 transactions on September 2, 2018, compared to Bitcoin transaction which was recorded to 187,101 on the same date (Medium, 2019).

For many enterprises such as MB, it is a challenge regarding potential loss of control and greater exposure to risk from competitors or other users on the network, who could exploit that data MB provides on the BC network. Despite the desire for DC, the BC can be built as a public or private/permission-based BC. The public BC is considered to be more secure and more accurate. The interaction between the users on a public BC is determined by consensus protocols across the network, which will determine the communication and transmission of data between the network, and can only become validated if enough users votes for the agreement (Lisk, 2019). By having consensus protocol the users will have an incentive to act within the limits and depending on each other to act within these limits and provide true information. Secondly, the information is stored on several points of storages, which reduces the risk even more (Lisk, 2019). One of the weaknesses of the ETH public LD is low speed of transactions per second. The challenges can be solved by creating a private LD. Having a private LD will only contain certain amount of participants, which will result in shorter time for authorizing and accruing on a network consensus (Hedgetrade, 2019). This also leads to private BC having a greater scalability since there are fewer users on the network. For MB, this is a trade-off between speed or security, in terms of building a private or participate in a public BC for the "Double down" - or "Hedging bets" strategy (Lacity, Steelman, & Cronan, 2019). The trade-off between security and speed has more criteria to be considered for MB in the long-term perspective.

One of the advantages of participating in a public BC is the removal of third parties and unnecessary duplication of data. Using a private BC will make sure that MB are centralizing the control. As mentioned before, there is an element of fear of losing control for companies related to the shift towards SC. Participating in a public BC creates uncertainty on the governance compliance level (Lacity, Steelman, & Cronan, 2019), and raises questions regarding who owns the data, who has access to it etc. Secondly, there is a lack of legal framework for interaction and sharing data within a BC. Having a private BC will help MB to act within the data protection laws, that is subdued the current approach for legal documentation. In the case of developing a private BC, there is permissioned access for the users, which will a lower number of participants to maintain the BC. This is both in terms of proof of work and proof of stake. It can be argued that users do not have an incentive to maintain and determine possible attacks on the LD by mining, since they will not be awarded for that.

The private BC will have a slower process on creating new blocks, and it might be unlikely for the private LD to be exposed to challenges from external input. The verification of new blocks by proof of stake, will not occur either since the creation and verification of new blocks is done by a centralized authority as MB. The private BC is faster in terms of transactions then a public BC, it can be assessed on to which extent the speed of a private BC will be a criterion for interaction with the consumer. Since the TEC of BC is still at an early stage in the development there are still some missing knowledge of it, meaning that the speed difference between a public and a private BC might be difficult for a consumer to notice. Secondly, is can be questioned whether the MB consumer will pay for high level of secure for the data or faster transactions.

Lacity and Khan (2019) also touch upon the lack of blueprint for companies to have a guideline for a successful implementation of BC. It forces companies to some degree standardize their data in order to be incompliance with the structure of BC. There are some BC standard initiatives that work towards creating a common foundation and enhancing standard, such as GS1. They are working together with IBM and Microsoft to enhance steps for business to simplifying the implementation (Lacity, Steelman, & Cronan, 2019). Use of public network will provide an enterprise like MB with blueprints of successful implementation. Based on the consensus and design of the LD of the public BC, then it is specified for MB on how to interact in this BC, and how to become a part of it.

It can be evaluated if participating in a public BC will show the guidelines for MB' implementation of SC as shown in the prototype. There are more aspects to take into consideration for enterprises and users, because they cannot be seen equally, since there are differences in terms of industry, product/service, segment, capabilities etc. The blueprint has to be based on a company or industry that has a link to MB, to make a business similar for their challenges. Emerging standards between different distributed LD can be difficult since there are difficult industrial and cognitive conditions and structures of industries, which creates a certain gap between enterprises and BC. It can be argued that due to the lack of maturity of the TEC, it can be difficult for developers and backers to discuss LD and consensus across BC for different industries (Lacity, Steelman, & Cronan, 2019). The gap between business and technologies is something that creates uncertainty and skepticism for owners towards BC. There are no external factors in the micro or macro environment that pushes MB or other companies towards this radical shift. In order to create a blueprint reference point for MB, they could collaborate on a private BC with competitors in order to exploit some of the potential of increased user capacity on the BC. Currently BMW, Honda and GM are on a trial basis for integrating BC for self-driving vehicles (Leder Insights, 2019).

To conclude, the collaboration between BMW, Honda and GM shows that companies within the automobile industry are creating private BCs with competitors in order to gain the potential of using BC across more users, which also will be the most likely for MB to happen for this case. Having a private BC will make the power centralized at MB, and eventually create more optimism for the owner to invest in the TEC. Due to the lack of maturity it won't be a good case for MB to engage in a public BC, and use a hedging bet strategy with more competitors within the industry. Both the public - and private BC has gains for MB seen from different perspective. There are three types of platform for BC, where the Hybrid model is a combination of both the private - and public platform (Ernst and Young, 2017). The Hybrid will still provide a limited access for users, since it will be the owner of the BC that determines the consensus and rules. Secondly the Hybrid makes it possible for MB to distinguish data for what should be kept in a private BC and what should be accessible in a public BC. It will accommodate the fear of losing control and get exposed to espionage, while also communicating with another public BC.

7.0 Conclusions

The car leasing industry is growing and constantly facing new challenges with customers having ever increasing demands. The customers are willing to share a greater amount of data and get more involved with the company in return for an increased benefit. Some of the demands are related to the transparency and openness towards the customer. In this project, BC and SCs have been identified to solve it

These challenges regard improved transparency, accuracy, speed, efficiency, trust and security, which will eventually add value for the customer and create a sustainable long-term loyalty-based relationship with the customer. The SC it is deployed on solidity programming language using remix IDE and every time a new SC is deployed there is a transaction fees in ether which is sent by the party. The code is high level glimpses of the function that will be deployed in the final version of the prototype.

MB’ business model has been identified to be very dependent on their brand and INN. The key activities within R&D identifies the innovative mindset of MB and their willingness to explore new TEC implying a suitable mindset for the implementation of SCs. The association of the MB brand is essential for the value proposition with customers and is key to strengthen the customer relationship with MB, which is preferably based on a long-term perspective.

The use of SCs in the customer relationship is to some degree a radical shift from the current process. There are some gaps and challenges for implementation for MB, since the TEC is still at its early stages of development.

The implementation of SCs for MB can lead to possible challenges that MB will have to handle or take into consideration. One of the challenges is the lack of blueprints for companies, since the development of BC is still at an early stage in the life cycle. The lack of common guidelines and framework for BC creates a certain skepticism for owners. It can result in the fear of losing control over the data for the DC of data. Companies are fearing that competitors or other users on the BC will expose their data and use it for their own purpose e.g. blackmailing MB. Secondly there is missing legal aspect for companies, which defines the law and regulation within shared data through a distributed LD.

There are three critical challenges, which is a result of the missing guidelines and blueprint for BC, due to its early stage of development. The challenges are associated with the distribution of data and how to handle that with external stakeholders such as customers, competitors and legal. The selection of platform is important in order to accommodate the uncertainty and create boundaries that MB can executed within. This is down to the assessing on creating a private BC, participating in a public or combining both in a hybrid BC. The benefit of a private BC is the speed of transactions, since there is reduced number of users on the network. There is lower level of security than at a public BC, and reduce incentives of proof of work for maintaining the BC and proof of stake for verifying the BC. Combining those in a hybrid BC will provide some of the benefits from both. Secondly, it will insure the possible fear of sharing data, since the companies can distinguish which data should be accessible for the public and private.

To conclude, the reason for implementing SCs along with the technical aspects of how to do it have been established. This has been followed with describing MB' current business model as well as how this will be impacted by the implementation of BC and how this process development will transpire. This is lastly followed by an overview of possible challenges and how to overcome them. This all leads to the conclusion that implementation of SCs in MB' car leasing business will encounter challenges but ultimately prove value adding.

8.0 References

Atzei, N., Bartoletti, M., & Cimoli, T. (2017). *A Survey of Attacks on Ethereum Smart Contracts (SoK).*

BBC News. (2018). *https://www.bbc.com/news/technology-43657546*. Tratto da https://www.bbc.com/news/technology-43657546.

Bitsch Olsen, P., & Pedersen, K. (1999). *Problemorienteret projektarbejde.* Frederiksberg.

Bloomberg. (2019). *https://www.bloomberg.com/news/articles/2019-09-24/daimler-fined-960-million-to-settle-rigged-diesel-car-probe*. Tratto da https://www.bloomberg.com/news/articles/2019-09-24/daimler-fined-960-million-to-settle-rigged-diesel-car-probe.

Business Insider. (2018). *https://www.businessinsider.com/data-hacks-breaches-biggest-of-2018-2018-12?r=US&IR=T*. Tratto da Businessinsider.com.

Checkland, P. (2000). Soft systems methodology: A thirty-year retroperspective. *System research and behaviroal science, 17(S1)*, 11-58.

Coindesk. (2019). *https://www.coindesk.com/information/what-is-a-decentralized-application-dapp*. Tratto da https://www.coindesk.com/information/what-is-a-decentralized-application-dapp.

Cointelegraph. (2019). *https://cointelegraph.com/news/ethereum-blockchain-solutions-for-enterprise-business-pros-and-cons*. Tratto da https://cointelegraph.com/news/ethereum-blockchain-solutions-for-enterprise-business-pros-and-cons.

Daimler AG. (2018). *https://www.daimler.com/sustainability/vehicles/climate-protection/wltp/wltp-part-5.html*. Tratto da https://www.daimler.com/sustainability/vehicles/climate-protection/wltp/wltp-part-5.html.

Daimler AG. (2019). *https://www.daimler.com/company/*. Tratto da https://www.daimler.com/company/.

Deloitte. (2017). *Key Challenges - UK Survey Blockchain.*

Eisenhardt, K. M. (1989). Agency Theory - An Assessment and Review. *Academy of management, review*, 57 - 74.

Ernst and Young. (2017). *Blockchain: How this technology could impact the CFO.* Ernst and Young.

Ernst and Young. (2019). *https://www.ey.com/en_gl/innovation-realized/five-ways-to-make-trust-your-competitive-advantage*. Tratto da https://www.ey.com/en_gl/innovation-realized/five-ways-to-make-trust-your-competitive-advantage.

Favi, D. (2019). *https://www.danielefavi.com/blog/testing-a-smart-contract/*. Tratto da https://www.danielefavi.com/blog/testing-a-smart-contract/.

Forbes. (2017). *https://www.forbes.com/sites/jwebb/2017/08/31/alibaba-ey-ibm-and-microsoft-use-the-blockchain-to-create-a-transparent-supply-chain/#5a2370254b37*. Tratto da https://www.forbes.com/sites/jwebb/2017/08/31/alibaba-ey-ibm-and-microsoft-use-the-blockchain-to-create-a-transparent-supply-chain/#5a2370254b37.

Free Code Camp. (2018). *https://www.freecodecamp.org/news/how-to-write-and-deploy-your-first-smart-contract-341d5e2ffb35/*. Tratto da

https://www.freecodecamp.org/news/how-to-write-and-deploy-your-first-smart-contract-341d5e2ffb35/.
Hedgetrade. (2019). *https://hedgetrade.com/what-is-a-private-blockchain/*. Tratto da https://hedgetrade.com/what-is-a-private-blockchain/.
Investopedia. (2015). *https://www.investopedia.com/ask/answers/060815/who-are-daimler-mercedes-dai-main-suppliers.asp*. Tratto da https://www.investopedia.com/ask/answers/060815/who-are-daimler-mercedes-dai-main-suppliers.asp.
Lacity, M., & Khan, S. (2019). *Exploring Preliminary Challenges and Emerging Best Practices in the Use of Enterprise Blockchains Applications.* HICSS.
Lacity, M., Steelman, Z., & Cronan, P. (2019). *Towards Blockchain 3.0 Interoperability:.*
Leder Insights. (2019). *https://www.ledgerinsights.com/bmw-ford-gm-honda-collaborate-on-blockchain-trial-for-vehicle-identity/*. Tratto da https://www.ledgerinsights.com/bmw-ford-gm-honda-collaborate-on-blockchain-trial-for-vehicle-identity/.
Lisk. (2019). *https://lisk.io/academy/blockchain-basics/benefits-of-blockchain/what-is-decentralization*. Tratto da https://lisk.io/academy/blockchain-basics/benefits-of-blockchain/what-is-decentralization.
Market Watch. (2019). *https://www.marketwatch.com/press-release/auto-leasing-market-2019-to-showing-impressive-growth-by-2024-industry-trends-share-size-top-key-players-analysis-and-forecast-research-2019-06-28*. Tratto da marketwatch.com.
Markets and Markets. (2019). *Car Leasing Market by Leasing Solution (Electric Car Leasing, Private Car Leasing), Leasing Model (Finance Leases, Operating Leases), End Users (Commercial, Non-Commercial), and Region - Global Forecast to 2027.*
McKinsey Digital. (2019). *https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/blockchain-beyond-the-hype-what-is-the-strategic-business-value?fbclid=IwAR3sCk6D_iRS9H_rJZnj5qB7yb2LGMuuw7dPTY-7VU4MEKSrMtBbBjaTWNM*. Tratto da https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/blockchain-beyond-the-hype-what-is-the-strategic-business-value?fbclid=IwAR3sCk6D_iRS9H_rJZnj5qB7yb2LGMuuw7dPTY-7VU4MEKSrMtBbBjaTWNM.
Medium. (2019). *https://medium.com/@georgealexpopescu/pros-and-cons-of-the-ethereum-network-68c5e5ec7bd*. Tratto da https://medium.com/@georgealexpopescu/pros-and-cons-of-the-ethereum-network-68c5e5ec7bd.
Mercedes Benz. (2019). *https://www.mercedes-benz.com/en/next/advanced-engineering/*. Tratto da https://www.mercedes-benz.com/en/next/advanced-engineering/.
Mercedes Benz. (2019). *https://www.mercedes-benz.com/en/vehicles/service-parts/the-best-or-nothing-when-it-comes-to-service-as-well/*. Tratto da https://www.mercedes-benz.com/en/vehicles/service-parts/the-best-or-nothing-when-it-comes-to-service-as-well/.
Müller, B. E., Henglein, O., Henglein, F., & Ross, O. (2017). Automated Execution of Financial Contracts on Blockchains. *Business & Information Systems Engineering, 59(6)*, 457-467.
O'Leary, D. E. (2008). Gartner's hype cycle and information system research issues. *International Journal of Accounting Information Systems*, 240 - 252.
Osterwalder, A. (2015). *Value Proposition Design: How to Create Products and Services Customers Want.*

Pluralsight. (2019). *https://www.pluralsight.com/resource-center/guides/guide-to-becoming-a-database-admin*. Tratto da https://www.pluralsight.com/resource-center/guides/guide-to-becoming-a-database-admin.

PWC. (2017). *Consumer Intelligence Series: Protect.me.* PWC.

Saberi, B. (2018). The role of the automobile industry in the economy of developed countries. *International Robortics and Automation Journal*, 179 - 180.

The DMA UK. (2017). *Focus on automative.* Foresigt Factory.

Triple Pundit. (2018). *https://www.triplepundit.com/story/2018/volkswagens-lack-corporate-transparency-still-problem-us-monitor/11006/*. Tratto da Triplepundit.com.

UX Collective. (2018). *https://uxdesign.cc/designing-a-decentralized-profile-dapp-ab12ead4ab56*. Tratto da https://uxdesign.cc/designing-a-decentralized-profile-dapp-ab12ead4ab56.

9.0 Appendix

Appendix 1 – Webpage

Low fidelity prototype of Mercedes-benz-Leasing. The website shows the basic of the functionality of the Dapp and give a good idea about how in future the Mercedes can implement it by using more sophisticated technology.

https://sharadkochhar18.wixsite.com/website-2

Appendix 2 - Prototype of the Car Smart contract

The address of the car which will sign transactions made by this contract.

address public carSigner; Value of the car, in wei

- uint public carValue;
- bytes32 public licensePlate;

Owners of the car, they will be the ones that receive payments from the car.

- We assume each owner owns the car equally.address[] public owners;
- uint constant MAX_OWNERS = 100;

Earning from driving will be distributed to each owner for them to withdraw:

- mapping (address => uint) public ownersBalance;
- uint public balanceToDistribute;
- uint constant INITIAL_CAR_SHARES = 100;
- mapping (address => uint) public carShares;
- DriverEntity currentDriverEntity; To keep track of who's currently using the car
- DriveStatus currentDriveStatus; -To keep track of who's currently using the car

If the owners are driving it, it will be their address.

If someone rented it, it will be the renter address, so he can be held accountable.

In this case, we could even ask for a warranty which will be sent back if the car is ok.address currentDriverAddress;

- uint currentDriveStartTime = 0;
- uint currentDriveRequiredEndTime = 0;//Rates
- uint constant RATE_DAILYRENTAL = 1 ether; //1
- ETHenum DriverEntity {

  None,

  Owner,

  Autopilot,

  Cab,

  Uber,

  DailyRental,

  Other

```
        }
    - enum DriveStatus {
                Idle,
              Driving,
            TurnedOff,
        }
```
Somehow, the car should be able to communicate its "internals" to the contract.
These internals are the ones relevant to the functioning of the contract, such as it's fuel.
We don't care about oil or coolant for example, at this point at least.struct

```
    - CarInternals {
      uint fuel; //Measured in percentage
        }
    - CarInternals carInternals;
    - bool carIsReady = false;modifier onlyIfReady {
      require(carIsReady);
              _;
      }
    - function SmartCar(bytes32 _licensePlate, uint _carValue){
       require(_licensePlate.length >0 && _carValue > 0);
       carSigner = msg.sender;
       carValue = _carValue;
        licensePlate = _licensePlate;
       carShares[address(this)] = INITIAL_CAR_SHARES;    currentDriveStatus =
DriveStatus.Idle;
        currentDriverEntity = DriverEntity.None;
      carInternals.fuel = 100;
       }
```

Assigning the owners

We will assume, for the time being, that the owners are set by the carSigner automatically,and that they can't be changed.We are basically doing the purchase of the car, off-chain.We also assume that each person paid the same amount for the car, thus owning equal shares.

```
    - function setOwners(address[] _owners) public {require(msg.sender ==
      carSigner);require(_owners.length > 0 && _owners.length <= MAX_OWNERS);  Can only set
      owners once.
    - require(owners.length == 0);  owners = _owners;
```
We take the total carShares the "car" owns and we distribute them equally among new owners If the shares are not properly divisible (I.E: 100 shares / 3 owners) the remaining shares stay with the car

```
    - uint sharesToDistribute = carShares[address(this)]/owners.length;
       for (uint8 i; i<owners.length;i++){
      carShares[owners[i]] = sharesToDistribute;
```

```
carShares[address(this)] -= sharesToDistribute;
 } carIsReady = true;
}
```

The setOwners function receives an array of addresses making them the owners of the car. After this function is called, the car will have one or more owners which will share the carShares in equal parts.

Leasing the car for six months

Anyone can rent the car for the day, as long as it is idle.

In real life, the workflow could be as follows:

1. User calls this function from his mobile device or browser web3 dapp, sending the correct amount of eth
2. The system generates a PIN number (we are just using his address as PIN right now)
3. User gets on the car and unlocks it using the pin.As it stands, we assume that the car, somehow recognizes that the user

that paid is actually in the car.

We added a activateCar function that acts as if it was a PIN.

- ```
  function rentCarDaily() public onlyIfReady payable{
   require (currentDriveStatus == DriveStatus.Idle);
   require (msg.value == RATE_DAILYRENTAL);
    currentDriverAddress = msg.sender;
   currentDriveStatus = DriveStatus.Driving;
  currentDriverEntity = DriverEntity.DailyRental;
  currentDriveStartTime = now;
   currentDriveRequiredEndTime = now + 1 days;
   balanceToDistribute += msg.value; // ADD SafeMath Library
  E_RentCarDaily(currentDriverAddress,msg.value,
  currentDriveStartTime,currentDriveRequiredEndTime);
  }
  ```

CarSigner

carSigner will need eth to pay for gas stipends being used throughout the day.

It should be able to get it from the car contract balance.

This would be called by the car automatically each day, for example.

- ```
  function triggerTransferEthForStipends() public onlyIfReady{
   require(msg.sender == carSigner);
   transferEthForStipends();
   }
  ```
- ```
  function transferEthForStipends() internal onlyIfReady
  { uint amount = 1 * (10 ** 17);  // 0.1 eth per day should be enough
  require (carSigner.balance < amount);
  require(balanceToDistribute >= amount);  balanceToDistribute -= amount; // ADD SafeMath
  Library
  ```
  ```

carSigner.transfer(amount);
E_TransferEthForStipends(carSigner,amount, now);}

This function makes sure carSigner (the car) has enough eth for calling the car contract functions throughout the day.

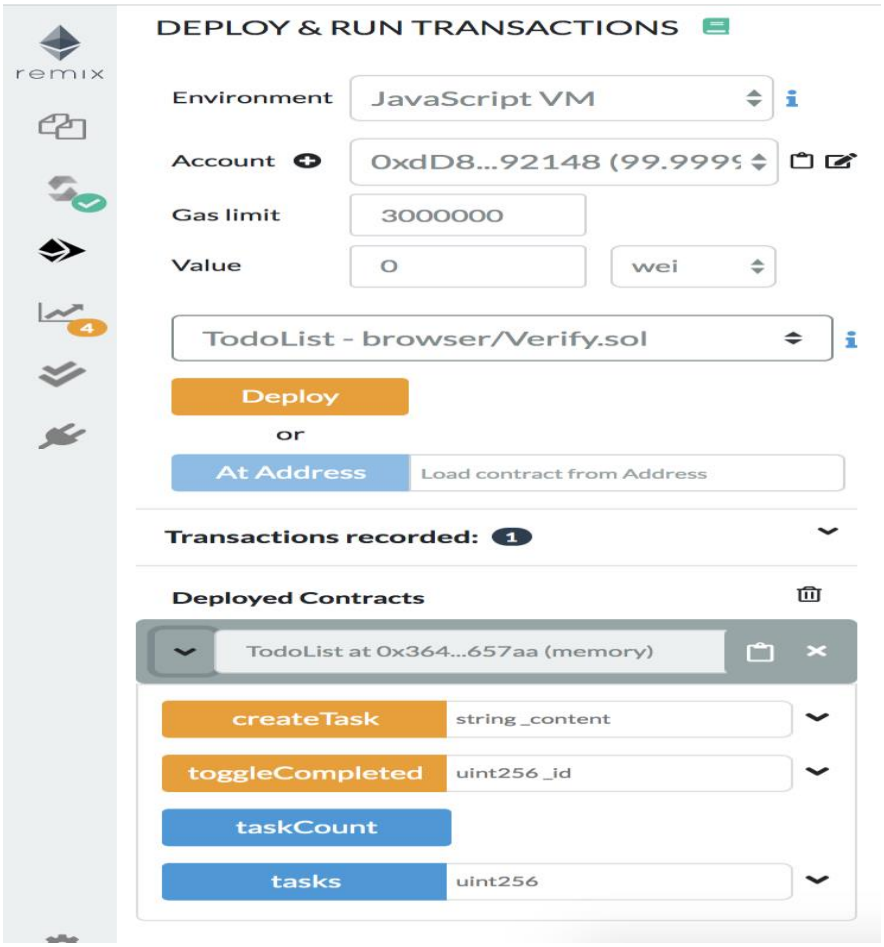
Withdrawal of funds

Each owner should call this function to withdraw the balance they have pending.

- function withdrawEarnings() public onlyIfReady{ //Make sure the one calling the function is actually an owner bool isOwner = false; for (uint8 i=0;i<owners.length;i++){ if (owners[i] == msg.sender){ isOwner = true;break; } } require (isOwner); uint balanceToWithdraw = ownersBalance[msg.sender];require (balanceToWithdraw > 0); ownersBalance[msg.sender] =0; msg.sender.transfer(balanceToWithdraw

Some additional features that can be added in the actual application:

- Verification can be further added to our smart contract that can verify the details of the customer and return true if that matches to a valid person.



- Function like location can also be developed that help the customer to navigate in the DApp.CryptoWallet can be created in the DApp where a customer can do all sort of transaction in the cryptocurrency.