

Research on the Application of Block Chain in automobile industry

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Abstract. The future automotive market will be different from today's, with more market integration and the ability to provide personalized services based on customer needs, including automatic pilot, car-sharing and intelligent network vehicles. Meanwhile, block chain, as one kind of distributed accounting technology through digitization and decentralization, could realize the collective recording, sharing and maintenance of data to face the upcoming industry transformation. This paper systematically teased out the technical characteristics of block chain itself, recent scientific research progress and its application in the automotive industry, and it studied the development trend of block chain technology to provide the reference for the development of automotive related industries in the future.

1. Introduction

Block chains are the underlying technology for encrypting money and can be widely used throughout the automotive industry to facilitate the transformation of services, products and processes. The accuracy and reliability of block chains provide a new solution for transaction execution and data management, whereas the auto insurance in auto finance is one good example [1].

The characteristics of block chains are analyzed and summarized by researchers and investment companies to solve the business problems in the automotive industry. According to assessing the technology in the industry value chain, the potential application can be broadly divided into the four categories as following [2~4]: (1) Pilot applications. The application of block chains is limited and the direct value is low. While these opportunities are less difficult than others and are more popular. Related block chain opportunities include: odometer fraud, electric vehicle payment and the incentives of dealer and customer. (2) Investigate applications. These opportunities are similar to pilot projects in complexity and cost, however, which are more attractive in value and higher in short-term return on investment. (3) Observation application. Compared with other opportunities, the value of this application is lower, meanwhile, it has more difficulty implementation and higher cost. Relevant opportunities include: insurance contracts, parts origin tracing and certification. (4) Transformation. This is one of the most valuable opportunities. The related block chain opportunities include interconnection services, interconnected supply chains, carpool and on-demand travel services. With the changing of car ownership and sales model, block chain will outbreak in a turning point in the next five years.



2. Blockchain operating principle and features

Figures 1 and 2 show the evolution of computation paradigm and the operation of block chains in recent years. Through the digitized and decentralized Distributed Accounting technology, the collective recording, sharing and maintenance of information can be realized.



Fig. 1 The evolution of computational paradigm

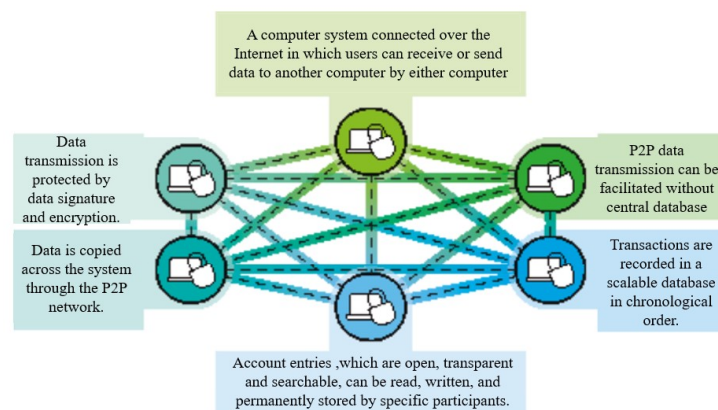


Fig. 2 The working principle of block chain [5]

The characteristics of block chain technology include the aspects as followed[6~7]: (1) Digitalization: almost all documents or assets can be coded and referenced in an account entry, which means that the application of block chaining technology is wide. (2) Unnameability: changes to block chains are bound to be found globally, which improves the reliability of information and reduces the risk of fraud. (3) Irreversibility: transactions are conducted irrevocably, which improves the accuracy of records and simplifies background processes. (4) Information disclosure: transactions are visible to all participants, and multiple computer systems maintain exactly the same copy, which are more convenient for information audit, and enhance the credibility of information. (5) High robustness: A block chain is shared by multiple participants, therefore there is no single point of failure, and it can withstand power outages or network attacks. (6) high real-time: the transactions recorded can almost instantly settle, eliminate friction and reduce risks.

3. The application foundation of block chain in automotive industry

3.1. Changes in automobile consumption behavior

Consumer behavior is changing in the automotive sector, and electric transport and on-demand services are growing. Meanwhile, people are more willing to share data and use technology compared to the past, which accelerate the transform. Car sharing/carpools is becoming increasingly popular

among urban young consumers. The demand for electric vehicles is also increasing as consumers pursue more affordable and environmentally friendly alternative means of transportation.

3.2. Automotive data requirements

Advances in technology and greater demand for data use will encourage businesses to provide more travel services, logistics services, innovative products and manufacturing technologies. While a large amount of data and consumer information have not yet been utilized. Insight can be gained by customers with analyzing these consumer data to achieve commercialization purpose. New commercial opportunities can be brought by the analysis of vehicle use and vehicle experience.

3.3. Vehicle utilization

There are other inefficient phenomena in the automobile industry, for example, the shortage usage of vehicles and the high cost of holdings. Vehicles are parked and unused at 95% of the time, and owners still have to pay fixed costs such as insurance, taxes, maintenance and parking fees. Therefore, the block chain opportunities exist among the whole industry, including vehicle manufacturers, suppliers, dealers, financial institutions and users.

3.4. Government regulation

Government regulation and new competitive situation have significant impact on the banking operation mode and IT system, which hamper the financial services institutions. Open banking and P2P lending have introduced non-traditional auto companies into competition.

4. Application of block chain in automobile industry

The existing literature and the reported block chain applications are statistically classified in this paper [7~11]. The case group of application block chain in the whole automobile market are obtained by statistically classification and preliminary analysis.

According to the classification, the application of block chain are mainly summarized as three aspects in the following: (1) finance, payment and insurance (2) vehicle management and incentive innovation (3) validation and process improvement.

4.1. auto finance, insurance and payment

There are many block chain applications in the whole value chain for financial, payment and insurance services. The case analysis of this application direction is as follows:

(1) Insurance Contract: Gem/Toyota Insurance Management Solution, which develops insurance services based on usage data. The service is one kind of solution based on block-chain to help insurers to develop customized automobile insurance contracts, which conform to owner's driving habits and automatically settle pay after initiating claiming.

(2) Electric Car Payment: RWE jointly launched Biocharge, which is a P2P charging and payment system for electric cars. The contracts, bills and payments are managed when the owner charges the electric vehicle at a third-party charging station or transfers the remaining electricity from the electric vehicle to the grid to help stabilize the power network.

(3) Internet Services: ZF / UBS CareWallet: the tolls, parking fees and car charges can be easily paid by users without needing cash. The technology is based on block chain solutions, where owners can seamlessly purchase "infotainment" services or other customer services according to contracts or agreements defined in advance and executed on the block chain.

(4) Car Rental and Finance: Executing Financial Transactions are launched by Daimler/Baden-Wuerttemberg State Bank. This technology connects all parties involved in car rental in a safe way. It includes the customer information surveys before taxis, storing lease agreements/contracts in block chains and automatic payment after the customer returns the vehicle.

4.2. *Validation and process improvement in vehicle supply chain*

Throughout the value chain, there are many chain application cases to achieve validation and process improvement. It is mainly applied in the following directions:

(1) Accurate recall: Deloitte Tracechain, based on a block-chain solution, allows automakers to identify vehicles with defective parts and issue accurate recalls or service announcements. The application can also track recall status, such as sending the distributor for maintenance, submission of regulatory reports to the government when reparations are completed.

(2) Origin traceability and validation: automotive parts information including spare parts can be acquired, stored and updated by ArtTrackti's solution based on block chain. It helps service centers, automakers and customers to track the origin and production dates of parts along the supply chain.

(3) Vendor Information Inquiry: SmartID's digital identity, managed by an individual or institution, is verified and recorded on a block chain and can be used for digital contracts, digital assets, and workflows. This technology is a solution based on block chain, which can obtain, store and validate the detailed information of suppliers before suppliers provide services to automotive enterprises.

(4) Interconnected Supply Chain: Tracechain establishes one digital identity for physical goods in the supply chain to track products and materials. This technology is an end-to-end supply chain solution based on block chain, which provides a seamless link between ordering, selling, goods tracking and payment for arrival.

4.3. *vehicle management*

Many existing reports on vehicle management and incentive applications deserve analysis. The cases supporting these mechanisms are as follows:

(1) On-demand and carpool travel services: Toyota Research Institute's application is a block-chain-based solution for P2P vehicle sharing, vehicle access and travel payments. It records the agreements and currency transactions to help owners commercialize their trips.

(2) Customer incentives: block chains and intelligent contract technology are used by Loyyal's Point Exchange Award Platform to achieve instant exchange points, eliminating delays, saving costs, and improving integration with other systems.

(3) Milestone Fraud: block chains are used to explore the Bosch Internet of Things Laboratory in applications to verify mileage data. Based on block chains, on-board connectors are used to send mileage data regularly to "digital logs".

(4) Expanding Vehicle Accounts: Car Vertical collects and validates vehicle history information from different sources, and users pay for data. This technology is a block chain-based solution, which can safely store, update, trace and share vehicle data between the main engine factory and external parties in real time.

5. **Future value assessment of block chain**

In this section, Deloitte Enterprise Value Map is used to assess the value of block chains as one standard in all directions in the automotive industry. This tool is one value map for assessing factors that contribute to the growth of an enterprise. The criteria include the following factors: (1) increase in operating profit: factors including sales, administration and the cost of products sold; (2) strong revenue growth: including supporting sales and prices; (3) anticipation: including factors that affect the company's strengths and ideas; (4) asset efficiency improvement: asset efficiency factors such as real estate, plant, equipment and inventory.

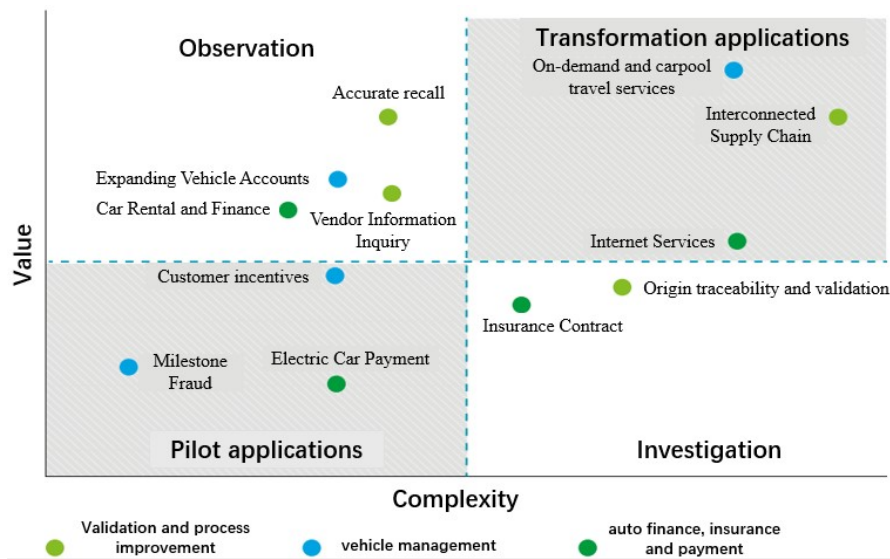


Fig. 3 Application value and implementation simplicity of block chain

Each strategic factor is scored according to the value of the application block chain. In addition, whether block chaining is the most appropriate solution is considered. Figure 3 shows the value range of the block chain application case. The higher the position is, the greater the value is.

Criteria for assessing the complexity of block chains include the changes one enterprise needs, the number of specific and active participants, the number of services, and whether application cases have been tested. The position is further to the right on figure 3, the more complex the process of implementation and adoption is.

According to the application direction, the influence of each application of block chain is analyzed by matrix and divided into four categories: (1) Pilot: The feasibility of application of this block chains is less difficult to implement, however, the scope of application of block chains is limited compared with other applications, therefore, the direct value is also lower. (2) Investigation: This kind of application opportunities are as complex as pilot projects, however, the short-term return is higher on investment and more attractive in value. (3) Observation: these application opportunities are currently less valuable and more complex to implement than other block chain opportunities. (4) Transformation applications: these application opportunities are the most attractive in terms of value generated, however, the external factors is most sensitive and the risk category is highest. (5) The application of block chain, which generate maximum value, is often the most complicated and the most expensive. Even for the same purpose, the value and complexity of the application of different block chains vary. It suggest that the opportunities for applying block chains to the value chains of the automotive industry are widespread.

6. Conclusion

The principle and characteristics of block chain are introduced in this paper. The application foundation of block chain is expounded in automobile consumption behavior, automobile data demand, vehicle utilization and government supervision. The application of block chain is compared and evaluated in automobile finance, supply chain and vehicle management. The conclusions are as follows:

(1) the block chain will flourish in the next five years. However, there are some uncertainties in the future value and initial application of the block chain, which means that many enterprises will choose the exploratory application projects rather than the application of the whole enterprise at the current stage.

(2) the most potential direction of development will come from multiple chains which are seamlessly integrated and operated together on the value chain.

(3) The development potential and impact of a single block chain are different, and the potential value and complexity of the block chain in all directions of the automotive industry are diversified.

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