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Digital Transformation of The Automobile Industry

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Abstract

Nowadays, the sustainable development of an industry relies on the new services it creates by applying networks and data. Therefore, the collection and analysis of data has received strong attention from manufacturers and service providers. Through the analysis of the paper, the automobile industry, as one of the traditional industries, has matured in various aspects and the competition within the industry is fierce, but it still has to follow the general trend of digitization. The interaction between in-vehicle AI and driver being applied nowadays is not enough. More connections need to be created to form a large real-time information platform-the Internet of Vehicles. The paper conceived and proposed new directions and connections generated by this IoV. As a result, the production and consumption ecosystem within the industry will become more dynamic. The usage information will be fed back to sellers and manufacturers, and it will also be passed on to other platforms through APIs so that driving information can be used for more services. Digitization in automobile industry will greatly improve the efficiency of service provision and driving experience. It will also create new value for human life, which is the meaning of the sustainable development for an industry.

Keywords

Digitization; Automobile industry; Internet of Vehicle.

1. Introduction

Automobiles have played a significant role in people's lives for many decades. Ever since they replaced old forms of transportation such as with horse carriages, the combustion engine-based technology behind modern automobiles has advanced greatly. The automobiles were considered a technological marvel when they were introduced. With several advancements in their features over decades, the industry has become mature, and automobiles have brought great convenience to people's lives. Cars today have more engine power, and they are far more reliable than what they were decades back.

However, nowadays, the automobile business is at cross-roads. The advancements that people expect is not about the strengthening of the car's own attributes but in the new services they can generate. These new services are driven by modern digital technologies and are developed in the worldwide background of digitization. Nowadays, The overall trend in urban planning is to create a "smart city" that uses Open Data Science to acquire data from various sensors and cameras to build up models of behavior, figure out trends, reduce accidents and allocate the resources[1]. For instance, Tesla has developed a customer-centric strategy to embrace digitality. In order to enhance the driving experience, Tesla condensed the car's navigation system into a 17-inch touch screen, which is also connected to the user's mobile phone. The

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user can simply click the screen to let artificial intelligence meet the driving needs. This new rapid data processing platform can also help to unlock and upgrade more services and functions of the vehicle for the customer. Very likely, customers would be able to receive notification on their phone if new autonomous functions have been developed, which enables them to unlock those new features and enjoy better services conveniently[2].

Digitization uses information and data not only to establish a new connection between users and service providers, it also creates an organic connection between users. The automotive industry will evolve from Sensor Web in which users are directly connected with sellers to Internet of Things where terminals with sensors are networked with each other. Therefore, in the field of autonomous driving people tend to rely on the combination of two information interacting modes: v2v and v2i to create new products. Some information is processed by uploading to the vehicular cloud, and some data is received from another vehicle through the vehicle itself and then immediately analyzed in real time, and the vehicle-mounted artificial intelligence makes decisions. Such information applications are needed in platoon coordination, road alarms and intersection announcement, etc.[1].

These new expectations from automobiles with regard to data-driven services has a profound impact on how cars are produced, sold and how they compete for market share. Traditionally, automobile companies competed within established industry boundaries when they primarily focused on the vehicle product itself. Today, they also have to compete with data-driven services. This requires them to consider digital ecosystems – rather than industries – as their primary competitive environment[3].

This paper provides an overview of what that shift entails for traditional automobile firms. It lays out how automobile companies traditionally compete within its industry. It describes what its new digital ecosystems are and how they help generate data-driven services. Finally, it provides some options for traditional automobile companies to change their mindsets from competing within industries to competing within digital ecosystems.

2. Background: The Traditional Industry Structure of Automobiles

Industry structure is a well-established concept that helps firms adopt a competitive strategy. A popular framework is the five-force framework introduced by Michael Porter[4].

This framework presents five forces that influence the attractiveness of any industry, These five forces are: buyer power, supplier power, threat of new entrants, substitute, and rivalry. The work will apply this framework in order to analyze the traditional automotive industry.

For buyers, nowadays, the demand for private cars is very large while the entry of new car brands and new products are relatively difficult. Moreover, buyers are price sensitive and are easy to switch to other brands with lower price. Nowadays, as more and more new and high-tech products appear in the market and the customers' needs are continually changing this year, competition in the automobile industry is more intense. However, as car manufacturing is a complex process, possibility of buyer's backward integration is low. Overall, buyers' bargaining power is moderately strong.

As for suppliers, the bargaining power is weak because most of them are small players while most manufacturers supplied by them are subordinate to big brands. Suppliers have to play according to the rules set by car brands. Therefore, it is very hard for suppliers to forward integrate. For manufacturers, raw materials are always available and abundant in the market so switching from one supplier to another is not difficult for them. In this way, the bargaining power for suppliers is considerably low.

As for the threat of new entrants, the cost of producing vehicles is high and it requires a strong advantage to win in the fierce competition, so there is a high production-profitability threshold requirement for the company to gain a firm foothold in the market. Although the traditional

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automotive industry has not yet formed effective network effects and the concentration of the automotive industry varies from country to country, the initial capital investment is very high and the requirement of proprietary technology and material is also very high, therefore overall, the barrier of entry is high and the threat of new entrants is low.

With regards to substitutes, there are a lot of choices for potential customers. For example, shared bicycles, trains, buses and other public transport provide alternate options for travel. However, although there are many substitutes to private cars, they have little impact and little threat on the huge automobile industry with a solid foundation. There are many reasons. It is more convenient for users to use their own cars. Public transportation has to meet the needs of the public, such as time, space, comfort, while private cars can be a more personalized choice. Sometimes the schedule of public transportations isn't perfectly matched to people's work time. Private cars allow people to choose whenever they want to use the car and where they want to go. The choice is up to the car owners. Also, some people want to buy a car in order to meet their pride. Having a car can make people more confident among their friends, just like most students take and use cell phones on school day. Moreover, for businessmen who have their own companies, having their private cars can make customers feel that their companies have a good economic power. Overall, the threat of substitutes is low.

Generally speaking, the rivalry in the automotive industry is fierce. The industry is in a stage of monopolistic competition. There are many giants and large companies occupy a large market share. The product is updated very quickly, which means there is strong rivalry in innovation. Also, the degree of differentiation is very high, because of intense rivalry in advertising. Rivalry also spills into pricing as firms try to achieve scale and cover their fixed costs.

In sum, according to the 5 forces analysis, the bargaining power for suppliers is low, the bargaining power for buyers is moderately high, the threat of new entrants is low, the threat of substitute products is low and the competitive rivalry among existing player is very high[5]. Weak forces are more than strong forces, so the automotive industry appears attractive. In order to make the industry more profitable, digitalization is an inevitable trend. With the current digital age, firms compete not just with products but with the data their products can generate[6].

In the digital age, due to the importance of data in various fields, the traditional auto industry is facing new challenges. People begin to rely more on data services provided by various platforms. For example, people are more willing to share economy drivers instead of using cars. Uber, taxi, subway are more popular choices to make among people. With the development of technology, people are living in a digital environment, and their demands are getting higher. Under this new environment, as consumers become more aware of personal information protection, it becomes more difficult to collect customer information online. At the same time, consumers are also reluctant to waste time on a broad advertisement. In the future, building a customer-centric automotive ecosystem will enable the industry to have new market opportunities. Only the users have a better experience, the ecological competition will be stronger. Therefore, it is time for cars to have a revolution by transforming the autos into digital ones. When establishing a connection with customers, car companies can conform to the habits and cognition of consumers, and provide accurate information to the customers or potential customers that they need. To understand this new trend however, one has to understand what digital ecosystems are.

3. Digital Ecosystems

What are digital ecosystems? Ecosystems are about interdependencies between different activities in a firm and with external parties. Ecosystems become digital when these interdependencies are driven by digital connectivity[6]. Digital ecosystems have two

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components: production and consumption ecosystems. Production ecosystems are digitized value chains that consist of interdependence connections. It originates from the sensing unit that collects the activities of individuals and entities in the value chain. It helps to extend the features of the traditional product and allows companies to structure and see how digital technology can create new possibilities of the interdependencies in the traditional value chain. On the other hand, the formation of the consumption ecosystem is due to the new interdependencies that data generate by the use of products. Different from the production ecosystem that enriches the interdependencies in the traditional value chain, the consumer ecosystem is the result of large series of interdependencies between the company and third-party entities outside the value chain[3].

Because of data connectivity, digital ecosystems make it possible now to generate new data-driven services. The focus of competition shifts from the vehicle's basic driving function to the variety of new services and satisfying driving experience it can offer. Nevertheless, those services are created based on data that are collected from the sensors on the automobile and processed on the digital platform, meaning the competition has to raise the requirements for hardware technology while pursuing comprehensive services. In addition, as the world progresses, customers desire more convenient auto-operative products. Hence, customers would absolutely prefer autonomous vehicles if they provide convenience and safety simultaneously, which can also be features and advantages in the rivalry. Although people would suspect the emergency measures of such technology, the concern can be easily solved since the ecosystem includes a rapid data processing platform that can deal with any emergent situation and find out the optimum plan.

3.1. What services through production ecosystems?

At present, the traditional automobile industry has been digitized by introducing artificial intelligence, so the entire value chain is getting more digitized. For example, firms can now use robots to monitor inventory in real time to achieve closer ties and realize coordination with suppliers. In this way, the total amount and types of raw materials required will be quickly communicated to the supplier.

In the production process, several functional robotic arms, replacing traditional man-made or semi-artificial manufacture methods, will perform a much more effective manufacture[7]. Additionally, because manual manufacturing is risky to be injured due to operational error, robotic arm will not only prevent such injury and its following consequences but also increase the accuracy of producing components of vehicles. The manufacturer would have developed a digital model of each type of vehicle and break those into small components, which enables each robotic arm to understand details of the component and specific requirements. Furthermore, while ensuring efficiency, it is possible to enhance flexibility of production to adapt to real-time situations. Assignments of each arm can be altered, if, for instance, the demands of the new series suddenly increase, it can be easily solved by assigning more robotic arms to work on this. Each arm is created with an assignment list, and, for this case, the manufacturer would momentarily cancel the current production and assign another one as the prior task on the arm's list.

Artificial intelligence can also collect information on the using condition of the machine and product quality according to production standards. According to the data collected, artificial intelligence is then able to analyze the real-time information and make corresponding evaluations, such as adjust the production load of the machine, or raise warnings. This function effectively carries out the entire automobile production process.

At present, the link between suppliers and manufacturers and the link between manufacturers and sellers in the automotive industry have completed the basic structure of digitalization, in

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the future, the efficiency and accuracy of information transmission in these processes will be improved.

The car brand can also collect information on the car parts that need to be maintained. The service point will inform users to maintain their car on time and will purchase goods according to the users' needs. In this way, the after-sales service point can be responsive and save resources. In terms of product design and marketing, the car manufacturers will know users better by collecting more data. After selling a vehicle, a car brand will use on-board artificial intelligence to track the usage of each individual product customer to understand the customer's needs, such as a comfortable interior environment for a customer, including temperature information, humidity information, and cleanliness information; the music or programs that are played in car, the speed they drive, the destination they prefer, etc.. Based on the analysis of user portraits, car brands can target their new products and related products. For example, for a family, the car can push more ads for family cars to them, focusing on comfort, safety, and low cost. Some family car accessories can also be recommended, such as children's car TVs, child safety seats, etc. For business people, brands can recommend higher-end products to them, focusing on appearance and performance. Some higher-end auto parts proposed should also be designed more in line with business people's preference.

3.2. What services through consumption ecosystems?

As for the consumption ecosystem, today, although the in-vehicle artificial intelligence is being promoted, its application is not mature enough to form a large vehicle network. Most of the collected real-time data is directly used before it has been analyzed and turned into archived data. Today's consumption ecosystem in the automotive industry can be divided into 2 parts: related services and complementary products. Necessary services related to vehicles such as gas stations, car maintenance, car decoration, parking, license service (learn to drive) and second-hand car trading. These services are being initially digitized through car GPS and electronic map apps. Drivers can find their location through the map, and then check customer reviews to evaluate its service quality. In addition, there are complementary products such as gas, decoration accessories (seat covers, cushions, stickers, etc..), car parts, car care products (engine oil), parking space, optional facilities (event data recorder, parking sensors, anti-theft alarm, etc..). These products can be purchased offline or online. At present, these products are only used by cars and car owners. Their data is generally not uploaded to the network for analysis. The in-car artificial intelligence is not yet fully aware of all aspects of the vehicle, and they cannot be connected into a network to provide services with other departments. Today's car services are separate and private for most users.

In the future, the in-car artificial intelligence and Internet systems will become more developed, the entire transportation system will become digitized and informatized, and the "Internet of Vehicles" will be formed. This is a large platform that contains information of road traffic and individual vehicles throughout the city, which realize the digitalization of all kinds of services mentioned above. This idea becomes extremely necessary when dealing with emergent or significant incidents.

In-vehicle artificial intelligence can respond to emergencies by integrating the driver's psychological state and surrounding traffic conditions. From a psychological perspective, the driver's brain usually is insensitive at the instant of a car accident, and such unconscious state of brain directly causes one's death. In fact, this situation can be effectively improved if artificial intelligence analyzes data detected simultaneously from external sensors to get the optimal solution due to its high-speed computing feature and avoid accidents to occur, as the computer would only address problems objectively and will not appear unconscious like humans. For example, in order to avoid a coming accident, artificial intelligence will warn the driver

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according to the situation or even seize the driver's driving rights and enter the automatic driving mode.

In addition to the original services that are digitized, the “Internet of Vehicles'' will trigger new services. It will firstly enhance the driving experience with the help of AI in cars. As all cars are connected to “Internet of Vehicle '', all real-time transport information is available on the platform, so AI in the car can provide better driving (or auto-driving) experience by analyzing the user’s data they collect. For example, it can provide the best route according to the user's personal preferences, avoid congestion, fewer traffic lights and turns, better scenery, automatically play music during traffic jams, share information with other contacts, etc. Secondly, the car will be able to share information with public agencies (police, hospital, bureau of public road…) through “Internet of Vehicles''. The authority has the right to obtain detailed information from the Internet of Vehicles to handle accidents more efficiently. For example, after the accident, the driver does not need to call the police, because the real-time status monitoring of each car directly transforms the accident information to the relevant departments, and they will react as soon as possible. In addition, if a driver violates the traffic rule, it can be immediately detected and noted, and a connection with his online paying application will automatically give him a punishment.

In the future, it is possible to connect people’s cell phones with In-vehicle artificial intelligence, which helps people reduce the time to use their cell phone. In other words, if it is possible, cars can provide the function that the cell phone does, like phone, message, WeChat and so on. Then, the car can generate new value to the driver based on their cell phone. Take a message as an example, cars can analyze which message you want to read most, which is advertisement or useless to read based on the history of your message. Furthermore, installing an acoustic control system (like Siri) in cars enables the driver not to type words while driving, which further enhances the safety of drivers.

3.3. Consumption ecosystems for cars in China: What the future looks like?

A collaboration of individual vehicles, “Internet of Vehicle'' and other applications will be possible in the future. Some of the transport data of the Internet of Vehicle platform can be accessible to applications, and the AI in cars can apply the API and connect with them by giving them data it collects. In this way, by analyzing detailed data of both sides, the application can provide the user with better services. At present, China's app market is relatively saturated, and the introduction of the Internet of Vehicles will create more links between automobiles and applications in other fields.

For example, travel applications such as Ma Feng Wo, TripAdvisor and Lonely Planet can use the data from local transport platforms and travelers to plan a detailed and personalized driving route. The in-vehicle artificial intelligence knows the user's driving preferences. The Internet of Vehicles platform has comprehensive real-time data of local traffic. The travel application has tourist attractions information, shopping information and hotel and restaurant information. These three kinds of data are collected and analyzed, which will provide customers with the perfect self-driving tour experience.

In addition, apps for diet can also be connected to cars. The application such as Dianping.com and Meituan can combine and analyze the transport platform data, the car’s location and user’s driving habits to calculate when the user gets to the restaurant, so that it can automatically make an appointment for him. Takeaway service apps such as eleme.com can also serve office workers, calculate the driver’s home time through real-time traffic data, and then find the right time to place an order based on the restaurant’s food preparation and delivery time, so that the driver can enjoy hot and fresh takeaway dishes immediately once he returns home.

The shopping app can also be connected to the car. For example, Taobao and JD.com can obtain relevant information from the artificial intelligence of the car to better understand the user and

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recommend him suitable products for him. If the driver is a business person, he would like to see products with high-quality in his application's home page. If the driver is a newly graduated student, he may pay more attention to fashionable and cost-effective products. Car accessories, insurance services and other related services can also be recommended according to customer needs. The stronger the analysis ability of artificial intelligence, the more data it acquires, the more detailed the user portrait it draws, and the more accurate the online targeted marketing will be.

The payment app connecting to the car is also the thing that people are trying to achieve in the future. Alipay and WeChat payment are the most popular choices that people prefer to use for defraying. If cars can integrate these two apps, it will bring users a lot of convenience. Thus, every license plate number will correspond to a Alipay/WeChat pay. For instance, if your car violates the traffic regulations and needs to be fined, a surveillance camera can record your license plate number and track your Alipay or WeChat pay to pay the fine automatically. What's more, when you park your car in the parking area, you have to pay the fee by your cell phone based on the hours you parked. As long as these payment apps connect to cars, it can do the payment through the apps internally instead of turning on your cell phone and open your Alipay/WeChat to scan the QR code to pay the fee.

4. Conclusions

Digitization is an inevitable development trend in every industry. The ultimate goal of automotive digitization is to achieve complete autonomous driving and establish a car network, so that people can be liberated from driving behaviors. This will be a long process. The work envisages a stage in the gradual evolution of the automotive industry, that is, the formation of the Internet of Vehicles platform and its combination with in-vehicle artificial intelligence. It also analyzes the current situation of the modern automobile industry and find that only data can bring broader development prospects to the already fiercely competitive industry.

In fact, the automobile industry has been advancing on the road of digitization, but the collection of the data is relatively separated, and the analysis and application of the data are superficial. If people want to maximize the use of these data, they need a large platform, the Internet of Vehicles, to organize all data organically to acquire more accurate and representative information from individuals. The formation of the Internet of Vehicles and the development of artificial intelligence and sensors will make data the dominant factor in competition and allow data to circulate in the digital ecosystem and create value.

In the production ecosystem, data can reduce costs in the R&D process and coordination in manufacture, and can make efficient use of resources in marketing and after-sales services. In the consumption ecosystem, data is continuously circulated and analyzed on the user side, the Internet of Vehicles platform, and the seller side. Data also flows to more platforms through APIs, making it possible to provide more precise and personalized services in other fields. The real-time and fast-disseminate nature of the data will closely connect the producer, supplier, seller, buyer and extended service provider. These applications of data will continue to reduce human efforts. Information is transformed into data, data forms a model, and the model improves services and creates new value. In the future, the entire transportation system will be fully automated by data, and users only need to make choices based on their preferences. The maximum use of data enables us to experience a fast and comfortable lifestyle just by driving. This is precisely the purpose of an industry to continue to develop, and the value of data will eventually be reflected in our future daily life.

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