The Future of the Automotive Value Chain

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Abstract

Digitalization, climate change and alternative drive systems are generating disruptive changes and technological innovations but also in the value chains of the automotive industry. This requires restructuring and further development to significantly reduce costs on the one hand, but also to be able to commercialize new products. Value chains are no longer focused on the product itself and the related services such as insurance and aftersales, but additional features are offered like mobility solutions, environmentally friendly generated electricity or the sale and installation of wall boxes. These changes are leading to existing, predominantly linear value chains having to be extended to include additional elements, or parallel and interconnected value chains are being created through cooperation with other companies. This transformation requires the development of eco-systems in which automakers collaborate with other companies and industries providing an overall product that can only be successful if the value chains of the participating industries are effectively combined. The need for transformation and the prominent level of investment mean that it is essential for the automotive industry to modify and further develop its value chains.

Index Terms

Automotive, mobility, value chains, innovations, transformation

I. Introduction

The automotive, transport and mobility market is facing a social, technological and economic transformation that is fundamentally changing the way people and products are moved [1]. In addition to technological innovations, digitalization, climate change and alternative forms of propulsion are generating disruptive changes in business models and value chains of automotive manufacturers, suppliers and mobility companies [2]. Individually, each would significantly disrupt the ecosystem, but combined, they will create unprecedented change. While enthusiasts praise the excellent opportunities for customers, the environment and the economy, companies are forced to make important decisions that will be binding in the med to long term and will secure or endanger the company's continued existence [1]. In addition, they are confronted with new competition and the pressure to displace them increases significantly. This includes not only new companies and start-ups but especially technology companies that have significant financial resources and excellent knowledge in software, customer acquisition and data management [3]. As a result, the current vehicle-centric system can be replaced with a radically more

efficient, data-driven, and driverless ecosystem with the customer at its center. Users would be able to seamlessly switch between public, private, on-demand, and scheduled modes of transportation, supported by dynamic travel information [4].

The impact of these changes will result in a restructuring of the value chains in the automotive industry and the mobility sector to significantly reduce costs on the one hand, but also to be able to commercialize new products to satisfy customers value proposition. This change will result in existing, predominantly linear value chains having to be extended to include additional elements. Als new structure like parallel or interconnected value chains will be created through cooperation with other companies.

II. Future Automotive Technologies

The future of the automotive and mobility industry is based on information-centric technologies, which will be a key factor for the future of the industry. Future trends such as urbanization, digitalization, pollution prevention and the desire for individual mobility have a significant impact on developments in the automotive and mobility industry and will influence it over the next decades. The influence of the state is also significant in this context, for example, it plays a considerable role in the electrification of the powertrain through legislation and subsidies. The dwindling supplies of fossil fuels and the environmental damage caused by their use make it necessary to rethink drive technology. For acceptance, however, other environmental factors in addition to the technology must be built up and resolved. In addition to the charging infrastructure, these include the generation of environmentally friendly energy, longer ranges and a price that is acceptable to customers. The electric vehicle also plays a key role in the next trend, the shared mobility. The ability to choose easily and affordably between different modes of transportation is intended to support the desire for individual mobility but without the need to own a dedicated vehicle. These are mainly parked in garages and parking lots, and a lot of space and material can be saved and the environment helped by reduced production. From a purely technological point of view, self-driving or autonomous vehicles should provide a comfortable and safe way of getting around. Fleet operators or shared mobility companies would benefit from this, as they could overcome the last mile in deliveries or return vehicles cost-effectively with few personnel. The high investment costs and crippling expansion of the digital infrastructure, however, are hindering factors. This drawback also affects vehicle connectivity. Information obtained by the vehicle can be processed and implemented directly. This means faster detection of traffic jams, predictive maintenance, and more efficient traffic management. For the driver, connected vehicles bring more comfort and shorter journeys. AI can bring more safety, more comfortable driving, and more independence. Self-driving cars, managed fleets and assist drivers for more safety are just a few examples of the use of artificial intelligence [5]-[7].

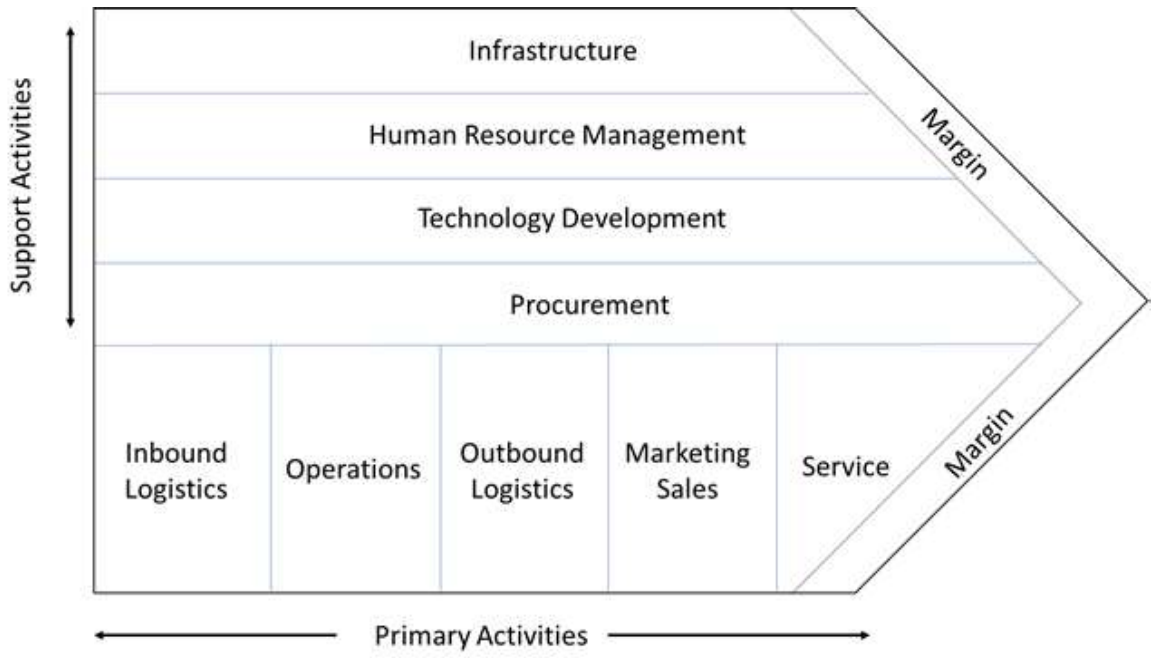

Fig. 1. Value chain by Michael Porter [8]

III. Value Chain

The value chain is a management concept that represents the goods production process and the company activities in a production company. It was developed by the US economist Michael Porter [8]. For him, the value chain is a collection of activities which a product is designed, manufactured, distributed, delivered, and supported. It represents the successive stages of a production together with the associated activities. It is used in strategic planning as a controlling management tool and aims to maximize value creation while minimizing costs. Porter [9] shows that competitive advantages can be achieved with new technologies and their associated strategies. Value chains divide the activities into distinct categories. Primary activities include inbound logistics, production, distribution, marketing and sales, and are required to create main products and services. The support activities assist primary processes. These include administrative infrastructure management, human resource management and procurement, see Figure 1) [8].

However, this classification only applies to the basic model. How exactly the individual processes are categorized into core and secondary activities depends largely on the characteristics of a company. Quite often, processes in companies are more complex and Porter's nine activities are supplemented and expanded by additional, industry-specific ones. The profit margin on the right-hand side of the basic model symbolizes the difference between the revenue and the resources used during the production of the product or service. It compares the costs incurred with

the revenue generated by the products created. The objective of a company is to maximize value creation throughout the entire value chain by reducing costs and increasing revenues. Within an industry, the value chains of suppliers and customers are interlinked and form a joint value chain system.

IV. Value Chain along the transformation of mobility

The automotive industry is often recognized as one of the most global industries. Its products have spread all over the world, and it is dominated by a small number of companies with worldwide recognition [10, p. 2]. A high degree of work sharing is required to create the products (a conventional internal combustion vehicle consists of an average of about 30,000 parts from suppliers all over the world [11]) with each participant taking an assigned role. Thus, the value chain is divided into a value-added oriented chain of suppliers. Here, the ranking of suppliers is differentiated based on the complexity of the goods produced. Tier-1 suppliers have a high level of integration competence while suppliers at the Tier-2 level are often technology leaders in their specialty. Tier-3 suppliers are process or cost leaders. The other tier-x suppliers produce individual parts in decreasing complexity [12].

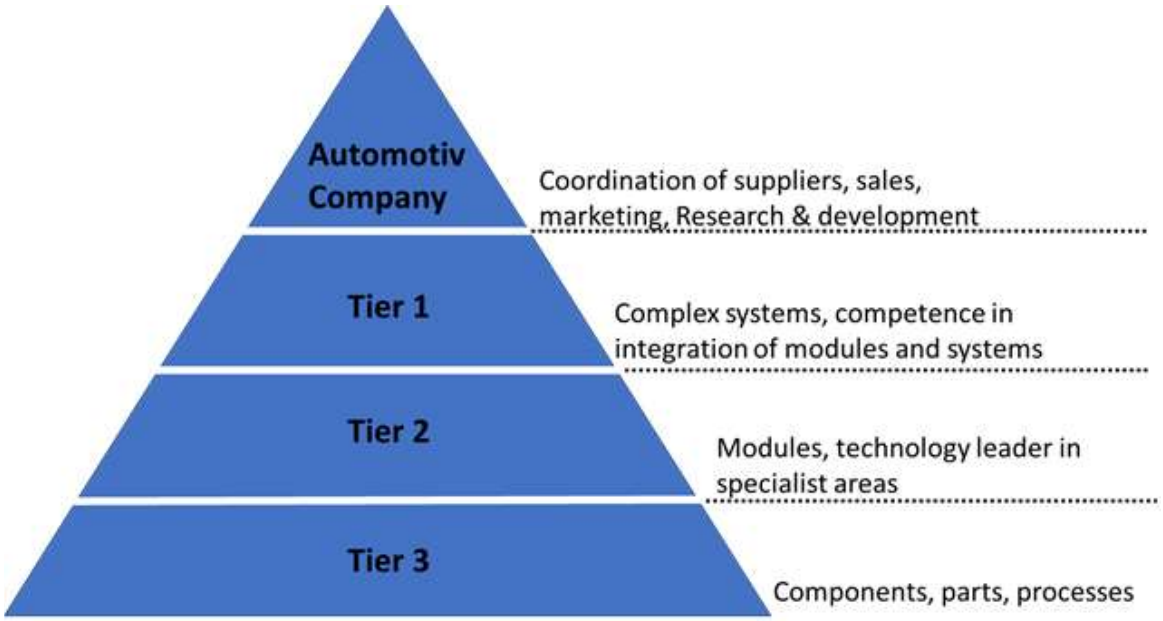

Fig. 2. Automotive industry supplier pyramid [13, p. 8]

Original Equipment Manufacturer (OEMs) re responsible for coordinating the suppliers and for a large part of the research and development activities. In recent years, the automotive manufacturers' own output has declined continuously at the individual levels of the value chain. The reasons for this are the high level of product proliferation with new additional model series (product diversification) and the fanning out of existing model series into different types (product differentiation).

[14]. A fixed assignment to the supplier levels is not always possible, so there are suppliers who deliver already assembled modules as well as parts for a downstream value creation level, see Figure 3.

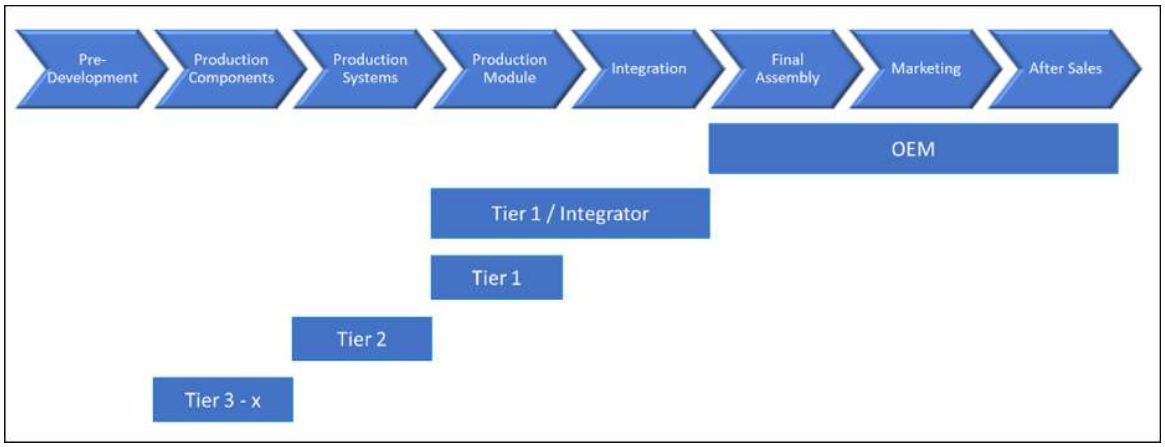

Fig. 3. Value chain and level of value added [15]

A. *Linear Value Chain*

Independent of the propulsion technology (ICE, BEV, HEV), the predominant form of the value chain in automotive and mobility is linear. However, new opportunities exist in the case of electromobility and innovative technologies. Kampker et al. [16, p. 42,53] analyze the change in the value chain for electric vehicles. Like the ICE, they divide the activities in the value chain into upstream (material, development, and production efforts) and downstream (marketing, sales, financing) (Figure 4). They show that new activities and business areas can change the scope of incumbents and new players can appear. Changing components (propulsion battery, elimination of combustion engine, exhaust system, and liquid tanks) will create new opportunities, especially upstream. In their analysis of the value chain in the automotive industry, Fournier et al. [4] point out that these can be expanded to include additional functions. These include new services for mobility, information, and communication applications. The extensions can represent market potential for OEMs. However, there is a risk that new competitors with innovative business models will replace OEMs. Rath and Bozem [17, pp. 103-114] address the close link between the value chain of car manufacturers and energy suppliers in electromobility. They note that various elements of the value chain can be bundled and taken over by one player. For example, in addition to developing, producing, and selling electric vehicles, OEMs can also offer their customers electricity supply services, such as generating and selling electricity or offering mobility services. However, these approaches do not sufficiently consider the potential that can arise from a cross-sector ecosystem: Customer benefits could be further enhanced than through cut-throat competition. In several studies of mobility in Japan, Beeton and

Meyer [18, pp. 208-213] show an extension of the value chain by linking electric vehicles with battery manufacturers and operators. Communication and cooperation between different actors in the value chain are prerequisites for successful implementation. In addition, further value creation modules can be developed, such as data and energy management.

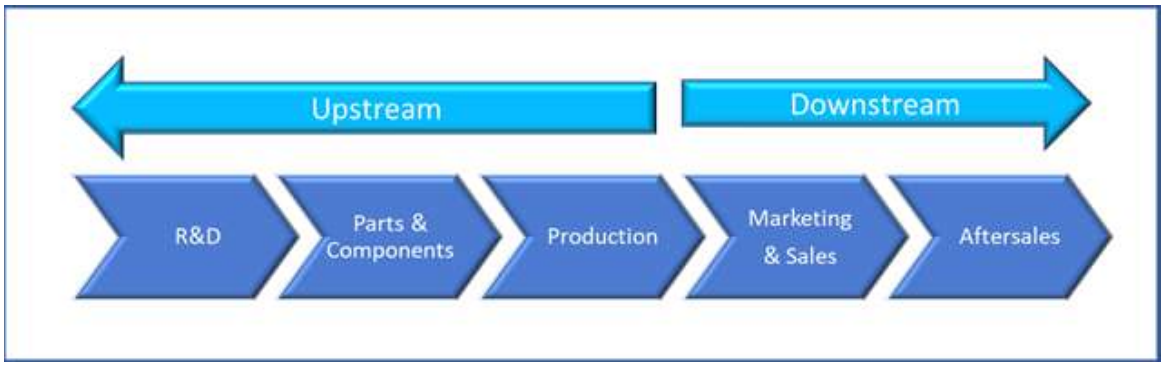

Fig. 4. Linear value chain of ICE vehicles.

Although there are significant changes in the product and suppliers (BEV, additional services, changed and reduced number of components), the value chain remains linear. As a result, automakers can benefit from their experience of production processes, but it significantly reduces the possibility of cost savings and flexibility. It is also necessary to build up additional expertise in subject areas that were not previously part of the core competence. Optimization of value creation can only be achieved if the value chains are also changed structurally.

B. Combined Value Chain

Through new technologies and electromobility, the Amsterdam Roundtables Foundation, in collaboration with McKinsey [19], identify opportunities in the value chain for incumbents and new entrants. Government regulations in terms of laws and subsidies have an impact on the development of total costs and can accelerate adoption, which impacts OEMs and their suppliers as well as the charging infrastructure and the power grid. The Bremen Electric Mobility Potential Analysis Report [20] analyses that new technologies require additional components to be added to the automotive value chain. The vehicle-related value chain is extended by an energy-related value chain, such as electricity generation, infrastructure needed to charge the vehicles, and mobility services, see Figure 5. A link between the vehicle-related and energy-related value chains exists in the areas of infrastructure, vehicles, and mobility services. One possibility is the development of the vehicle battery components are coordinated with the infrastructure charging station. This creates considerable time and cost benefits. There is a common value chain in sales, maintenance, and recycling to provide the maximum benefit to customers and reduce costs. The players are companies that are specialist in the respective elements of the value chain.

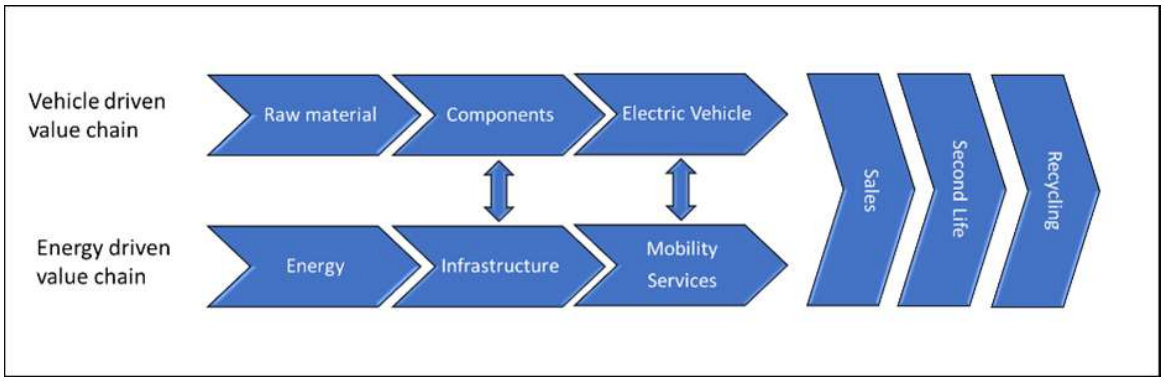

Fig. 5. Combined value chains of electric vehicle and energy [20], [21]

C. *Ecosystem*

Innovative technologies and forms of mobility require broader cooperation between the players involved to increase the benefits for customers and give companies the opportunity to make profit. Therefore, strong interaction between the players is required and can only be solved by a new electromobility ecosystem, see Figure 6. This network comprises companies from different industries that are focused on jointly creating added value for the customer. They are mutually dependent, so that market success cannot be guaranteed without this ecosystem. The individual company takes a back seat in favor of the companies working together within the entire value chain and increases its market share and profit through the value creation of all companies. Innovation performance can be significantly increased through common goals [22], [23].

V. Discussion

Although there are several approaches to the structure of value chains in the automotive industry and mobility market when transformed by modern technology, the ecosystem appears to be the most successful. It consists of institutional, cultural, social, or economic actors from the automotive industry, energy suppliers, Information Technology (IT) companies, charging infrastructure operators, local and national governments, end users and complementary services.

There are already many collaborations in individual areas and activities, such as the automotive industry and IT suppliers, but these are not sufficient to deliver the desired benefits to customers. For example, relationships like between automotive industry and energy producers are still new and require further clarification. As an example, there may be different structural models for charging infrastructure: The energy suppliers can conduct the necessary construction of the charging infrastructure themselves since they are producers and/or suppliers of electricity. However, the legislator can also conduct the development since there is a strong interest in the implementation of electromobility. Ultimately, car

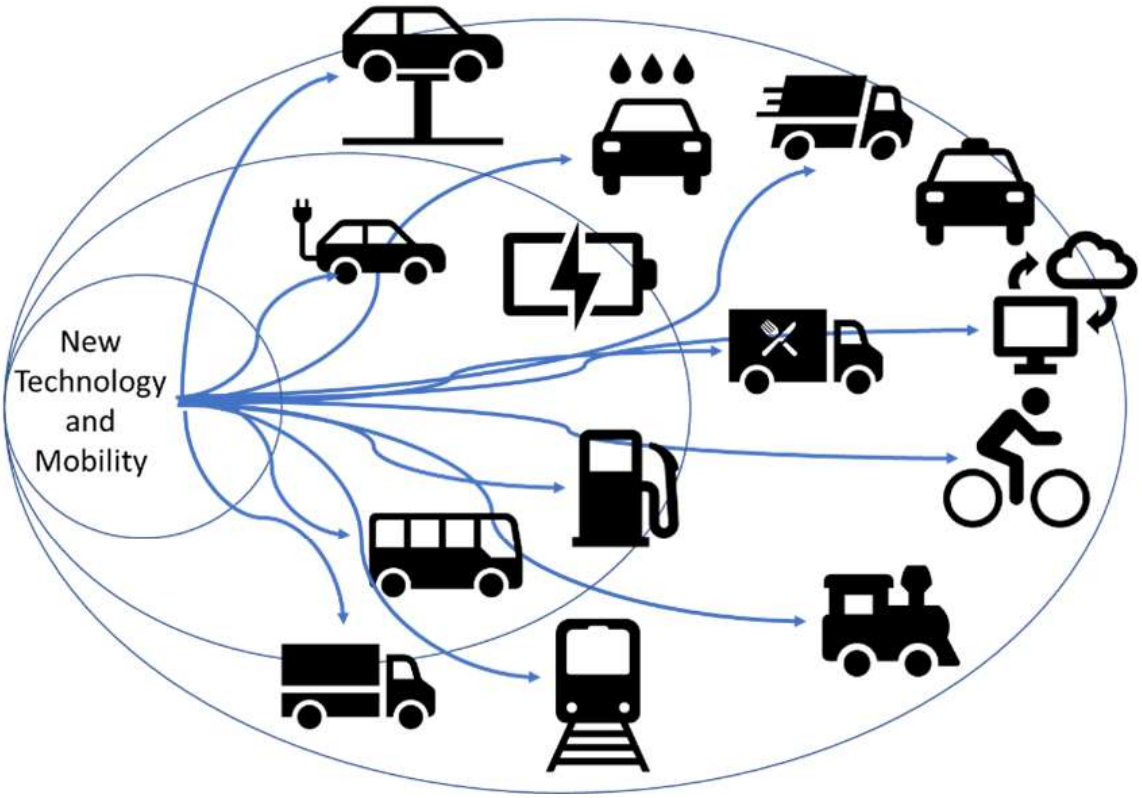

Fig. 6. New ecosystem of electromobility includes stakeholders from different industries [24]

manufacturers are also forced to provide charging infrastructures, otherwise sales of electric vehicles will fall short of the necessary figures and the CO2 emission levels decided by governments will not be achieved. In the mobility approach of Mobility-as-a-service (MaaS)[1], the ecosystem in the value chain is particularly evident. Seamless interoperability requires close collaboration in the ecosystem, otherwise a smooth and user-friendly transition of the different transportation systems cannot be guaranteed due to different applications and systems. This goes far beyond the supplier relationship and cooperation model of today's mobility companies. Value creation becomes a collaborative effort, ideally benefiting the focused company and all its stakeholders, in line with the multi-directional value flow approach. However, for the car manufacturers, there are other options in addition to the ecosystem. For example, they could primarily supply the hardware (chassis, engine, propulsion battery) and the software comes from tech companies like Apple, Google, or Microsoft. This would go far beyond entertainment and imply complete coordination of the hardware components. This would result in significant shares of value creation being shared between the parties involved. Another opportunity is to remain as the coordinator for the vehicle and the

[1]Mobility-as-a-service (Maas) is a single interface where users can plan, book, and pay for a wide range of mobility services to meet any travel need

services. Technological innovations such as autonomous driving, electromobility, interconnectivity and mobility services are controlled by the OEM through the value chain. This would also make it possible to exploit the resulting data and use it for further development, customer requirements and additional services. A certain monopoly position would be possible here due to the technology sovereignty of the OEMs. However, there are also considerable risks for companies that hinder the further development of value chains. This could lead to a reduction as an elementary vehicle supplier for transport companies such as Ubber or Sixt, or even to the disappearance of their own company.

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