Chapter 2
The Automobile World in a State of Change

From the Automobile to the Concept of Auto-Mobility

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Abstract The automotive industry is undergoing a profound transformation with the arrival of new types of vehicles, services, requirements and uses that break away from the traditional model of cars. The very nature of mobility is changing. User behavior is shifting; social symbols connected to vehicle prestige and journey priorities are not the same. The aspiration attached to private cars is also in the process of changing. A look back at the history of the automobile reveals how our relationship to the car object is altering. It also reveals the need for a different approach to the current concept of mobility. New services (car-sharing, carpooling, self-service cars) are making a significant contribution to the emergence of a new ecosystem. The resulting industrial, economic and ecological situation involves all of the traditional stakeholders in the sector, i.e. car manufacturers, parts manufacturers, recyclers, energy and fuel suppliers, as well as market newcomers like engineering, computing and communications companies. In this new mobility ecosystem, manufacturers are changing their strategies. They find themselves obliged to reinvent an entire industrial model and work with companies far removed from their core business. Are these strategies sufficient to respond to the economic transformations affecting the automotive industry? Is this mobility transformation the basis of a paradigm shift? And lastly, how can public authorities accompany this technological and societal rupture and establish mobility that is ecological, responsible and more shared?

Keywords New needs · Uses and services of mobility · New mobility ecosystem and societal rupture · Paradigm shift for the automotive industry

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D. Attias (ed.), *The Automobile Revolution*, DOI 10.1007/978-3-319-45838-0_2

2.1 Introduction

To better understand the current change in mobility, we need to take a close look at the major historical periods of the automotive industry—from Fordism to the manufacture of driverless cars—and at how vehicles were devised at these different stages. Mobility is linked to social organization and can profoundly modify the attitudes of modern society to time, space and inter-personal relationships. Thus, by taking a historical perspective, we show that the very *nature* of mobility is in the process of changing.

The socio-economic realities of the last decade has accelerated a change in the car's image—with a focus on downsides like noise, pollution, excessive purchase and usage costs, time wasted on journeys, etc. A car becomes an *auto-immobile* when subject to urban congestion.

New behavior patterns, uses and mobility requirements are emerging that no longer view vehicles as an object of pleasure, freedom and social mobility, and in which usage can substitute ownership. Users today are not only seeking more rational management of journey times and mobility costs, but ultimately, they want to choose mobility rather than be subjected to it.

The first issue concerns the characterization of this change. Does it involve an evolution in the mobility system, a change to the technological business model, or the emergence of a new paradigm? These questions are decisive because they determine the directions of the different scenarios of technico-economic or societal change.

The first part will outline the development stages of the automobile which, according to (Oliver Wyman 2015), prefigure "*manufacturers' inevitable preparation for radical change*" (Sect. 2.2). The second part shows that technological rupture is accompanied by a change in usage and behavior involving new positioning for all mobility stakeholders (Sect. 2.3).

2.2 Emergence of a New Mobility Paradigm?

2.2.1 A Context of Rupture

In a world inhabited by close to 7 billion people, 800 million vehicles exist. "*Global production has returned to pre-crisis levels, reaching 90.6 million vehicles in 2015*" (Freyssenet 2015), with a steadily rising global trend of around 3 % per year (Observatoire Cetelem 2015). However, we only spend about 15 days in our cars each year, and a whole year of our lives looking for a parking place (Klappenecker et al. 2014). Car pollution has reached record levels in major urban areas and, if the European Commission applies a tax of €90 per gram of CO_2 in 2020, it will be twice as expensive as a gram of gold at current bullion prices. Although governments and policies generally strongly support the automotive industry, profitability is only about 3–4 % compared to double-digits in many other sectors.

Lastly, purchasers of cars in richer countries no longer view them as objects of social standing to own and display, but as a mobility item to be shared (Schaefers 2013). Thus, the authors of the final report on innovative car uses and new mobility (CGDD et al. 2016) point out that, "*Car demand is primarily a demand for mobility: if it can be satisfied without a car or with fewer kilometers, households do not hesitate to use other services that bring down their costs.*"

This context, which involves paradoxes and hesitations at every decision-making level (macro-meso-micro), results in a questioning of the automotive product, a review of mobility paradigms, and a reflection on the future of auto-mobility. The golden age of car manufacturing in the Triad countries is over. The new mass markets are in Asia and emerging countries, and forecasts for 2020 confirm this trend in several studies (OECD 2013; KPMG 2015), backed up by a PWC Autofacts report (PWC 2014): "*Car sale forecasts show that most growth will take place in emerging markets. The growth rate forecast up to 2020 is on average 3 % per year for OECD countries and 9 % for emerging countries… of which China and India are likely to represent 40 % of vehicle demand*.".

Nevertheless, buyers in emerging countries hesitate between owning "the same cars as rich people" or obtaining a means of transport that perfectly corresponds to their local realities (Qian and Soopramanien 2015).

The car is a century-old, mainstream product with significant industrial and technological content, but whose development can only be comprehended from a historical, geopolitical and social perspective. To determine the vehicle of the future and which industry will produce it, the question is whether it will involve continued incremental innovation or a conceptual shift (Boyer and Freyssenet 2006). For this reason, we have chosen to set out the development stages of the automobile to identify the levels of innovation relating to the car's different functions.

2.2.2 The Car, a Means of Transport to Be Seen

In its first stage, the motor car was a European-American concept defined as a personal or family tool used for traveling from one point to another, as best as possible, as fast as possible, and with optimum safety, comfort, ergonomics, etc. The first level of innovation therefore involves optimizing the car as an object of personal or family transportation. For a century, the car's technical fundamentals (i.e. 4 wheels, a motor and a body) changed little. Cars were massively produced in the Triad countries, and constituted a basic component of social achievement through personal mobility. The automobile was an object of social recognition and value to be owned. This positive image was accompanied by an idea of pleasure and personal freedom. The automobile was an object "to be seen" (cf. the Concours d'Elégance) with incremental innovations mostly centered on design and comfort.

This first stage has been taking place since the 1990s in emerging countries in Asia, with a range of innovations aimed at making the car a symbol of social achievement as well as an efficient means of travel (Artus et al. 2011).

However, denser urbanization and the development of megacities are increasing the vehicle stock and creating serious ecological and economic issues (urban pollution, dangerous driving, traffic jams, etc.). These dysfunctions have for a long time been the subject of studies by public institutions (in France mainly by ADEME—French Environment and Energy Management Agency (ADEME 2012); in the USA by the EPA), with analysis from a forecasting angle. Current R&D also takes these dysfunctions into account, perceiving tomorrow's vehicle in terms of energy savings and greenhouse gas emissions reduction (Plassat 2012).

Whether internal combustion, electric or hybrid, cars as a means of transport are still conceived with the same idea of mobility. The modes of innovation are incremental; they center on ergonomics to suit lifestyles and on reducing general energy costs, CO_2 emissions and total cost of ownership. Car manufacturers are the only ones to decide on these modes.

2.2.3 The Car, a Component of Mobility 2.0

The second stage considers the automobile as an element of mobility with which users "do more than move"[1] No longer simply an object of transport, the car takes on a concept of interactive mobility that creates a specific relationship between the driver and space and an information and communication network. Over and above transportation, the priority for drivers is no longer to be seen in their car, but to remain constantly connected to their information networks (GPS, WiFi, 3G etc.).

In this situation, product innovation is no longer simply incremental. It includes services that close the gap between individual transportation and collective transportation and encourage shared usage like rental, car sharing and carpooling. As a reminder, car sharing increases the productivity of a vehicle by maximizing its usage time, whereas carpooling maximizes its occupancy.

The immediate consequence is that the mobility range is reconfigured and diversified to become multimodal (people move from car to train, from train to bicycle or another (hire) car, while their own car might be used for a journey by another user who might also share it with others, etc.). We are gradually moving towards personal public transport (PPT). We are moving away from a set-up in which accessing mobility, i.e. freedom, involves owning a vehicle, and towards transportation in which journey satisfaction is determined by diverse means, easy access and low cost. And also obviously moving from a business model based on selling a product, towards a model based on selling a set of services whose value depends on the usage time of a vehicle, the volume used in a vehicle, or the distance travelled.

[1]The expression "mobility 2.0" is a reference to Web 2.0, which "allows users to do more than retrieve information". The expression was coined by Dale Dougherty in 2004 when he suggested that the Web was in a phase of renaissance or mutation, with a paradigm shift and evolving models.

Mobility 2.0 raises new strategic questions for today's car manufacturers. Firstly, it has an impact on their production volumes, because a shared car replaces 4–8 cars (IEA 2012). Next, the resources and skills indispensable for developing this mobility are not at all restricted to the traditional automotive industry. They depend on complementary operators (e.g. providers of complementary transport services, urban planners and infrastructure designers) and especially on the development of ICTs, which are essential for interconnections between transport means and users. More than ever before, manufacturers' innovation efforts are therefore linked to those of these operators and to changes in mobility patterns.

The traditional motorist no longer exists. Today's drivers are users who are part of a community; they are service users. They do not choose their vehicle based on material features or immaterial characteristics (status, size, brand, price, etc.); they are looking for a means of mobility within a community of practice. This is illustrated by the success of specialist carpooling companies like Blablacar in France and Lift and Uber in the USA. In less than 10 years, the number of Blablacar users has gone from a few thousand to 3 million people. The company employs around thirty staff and has subsidiaries in Europe (Spain, Portugal, Germany, Italy, etc.). The same trend can be seen in the USA, where the number of users tripled (450,000–1,400,000) from 2010 to 2014. The value proposition of these carpooling companies' centers on lower costs, reduced CO_2 emissions ["*10 million journeys and 700 thousand tons of CO_2 saved*" (BlaBlaCar 2016)], in addition to a more sociable trip.

Overall, mobility 2.0 means radical upcoming changes in the way that means of transport are used. This usage is connected to new social practices involving communities and social networks (Facebook, LinkedIn), the need for information and freedom (unrestricted internet), and indisputably free, shared, immediate facilities (open source and zapping). In this situation, manufacturers of "personal cars" produce goods that are no longer a priority for mobility 2.0 users. What is more, innovations to this product now depend on other contributors to mobility 2.0 goods and services.

2.2.4 *The Vehicle of the Future: Intelligent Transportation in a "de-Mobility" Context*

The third stage of the evolution of automobile innovation has yet to take place. It envisions mobility in general and the car as an intelligent component of our mobile and social lives (Nazem et al. 2011). The idea is that the mobility-car tandem is outdated in as much as we already live in a society in which life is so mobile that it compels *de-mobility* (i.e. not making journeys): work becomes tele-work; teaching takes the form of distance learning; meetings and discussions take place on social networks; culture and leisure are transformed or reinterpreted by mobility. Individual relationships with space and territory are changing the specific

relationship between motorists and space and communication (as in mobility 2.0) are added their relationships with time and quality of life. This involves conceiving a particular way of life in which journeys are free from constraints and transport time creates value. How will today's automobile manufacturers fit into these new innovation modes?

2.3 From Automobile to Auto-Mobility

2.3.1 The Automotive Industry Is Reinventing Itself

According to Freyssenet (2009), the automotive industry needs to reflect deeply on how it can convert to meet technological and energy challenges and deal with the major changes in usage and types of mobility. Several questions arise regarding manufacturers' capacity to first tackle these new environmental challenges. According to a study produced by KPMG on the automotive industry in 2015 (KPMG 2015), the automotive value chain is undergoing considerable change and the battle to control it is only just beginning. The automotive industry is organized around a structured, homogenous supply chain that evolves in line with manufacturers' externalizing policies. Its sequence organization is firmly anchored in the hierarchies between suppliers, manufacturers and distributors (Frigant and Jullien 2014). Until now, the efficiency of this supply chain has resulted from its simplicity and stability.

Each stakeholder's role is the direct outcome of strategic decisions made by the manufacturers who control the main resources. Power games are therefore likely and, even though the most dependent stakeholders are critical of the value-sharing rules, they change only very little on the margins. However, as part of our investigation into how the automotive industry's technico-economic paradigm is changing, like Jullien and Pardi (2013) we wonder, "*Who will control the value of the future automobile products*?".

The three stages of the automobile's development that we have described involve several levels of innovation. Some are incremental, others are radical. Although there is some overlapping between levels, does the thesis hold of a technico-economic paradigm shift in a context of rupture in the automotive industry (Freyssenet 2011)? For Womack et al. (1991), who are researchers at MIT and authors of a seminal work, *The Machine that Changed the World*, the automotive industry will be saved by *technology*. Yet, the economic and global space is undergoing a fundamental reorganization and, as pointed out by Boyer and Freyssenet (2006), "*Countries are emerging. The relevant profit strategies for this new situation are not yet clearly defined, nor are the productive organizations.*" They go further by stating that, "*A century of automotive techniques suggests that no manufacturer has succeeded in totally revolutionizing the product through technology alone, apart from the ground-breaking Ford T episode…*".

The significance of this rupture should not just be judged from a historical perspective, but everything indicates that mobility as a whole is likely to be reinvented (Attias 2013). We have invented "cars for living" (Renault's "voitures à vivre"), and we accept the idea that tomorrow's mobility will transform relationships with others, lifestyles and the sources of value creation.

2.3.2 What Production Model for Auto Mobility 2.0

Manufacturers are obliged to evaluate their own skills and build new cost-reduction and commercialization strategies adapted to customers' purchase decisions. Since technology is increasingly complex and has shorter life cycles, it seems unlikely that a car manufacturer could on its own have sufficient financial resources and expertise to take the lead. In fact, alliances and joint developments already exist with partners from other industries (e.g. suppliers of batteries and electrical parts, technological information services for connected vehicles). Examples of how the global automotive industry is being reorganized and the need to build alliances further afield include cooperation between the French car manufacturer PSA-Peugeot-Citroën and the American computer company IBM; the partnership between the Spanish manufacturer Seat and the Korean telecommunications company Samsung; the alliance between the suppliers TomTom and Bosch; and the Chinese car manufacturer SAIC and the e-commerce company Alibaba.

Thus, numerous stakeholders are emerging that can be mobilized to work on the same project, i.e. the electromobility economy. In addition to the usual, directly concerned stakeholders, newcomers include rental companies, public transport operators, and energy providers that, alongside IT companies, are the emerging players in the game. They participate in drawing up these new business models and in other forms of cooperation that have dominated up till now.

By studying different strategies, some authors (Arjaliès and Ponssard 2010) have shown that, in situations similar to that of the automotive industry, two approaches are implemented. The so-called "conformity" approach is different from the "opportunity" approach. In the opportunity approach, a company's proactive attitude can give it a competitive advantage.

This is the case for some manufacturers that radically change direction, technological program and, ultimately, their image. Carlos Tavares, CEO of PSA Peugeot-Citroën, made a speech in January 2016 that broke with the traditional image of a car manufacturer and announced a major strategic shift, with the launch of electric/autonomous cars when the company's core business is internal combustion/hybrid cars. In assuming this approach, a company that knows how to take into account structural factors inherent to its business sector, such supply network, connection with suppliers, and the necessary cooperations and alliances, can hope to obtain a leading position in its area of activity (Arjaliès et al. 2011). The Chap. 4, on car manufacturer strategies, analyzes this major change and the economic, financial and social implications for all stakeholders.

If the auto-mobility 2.0 industry is to survive, should it place innovation at the heart of its system? The analysis made by the Austrian economist Schumpeter in his writings on innovation sheds light on the relationship between systems and innovation (Deblock 2012). For the author, new structures or organizations need to be created to truly permit disruptive innovation. Schumpeter shows that when innovative companies become more technocratic, they are no longer capable of challenging existing paradigms, knowledge and production modes. They then lose their capacity to come up with innovative products. For Schumpeter, "*Innovation is multi-dimensional and also concerns changes in the company's in-house organization and its ecosystem*."

The innovation issue obviously depends on corporate strategy, but it highlights the difficult choices facing car manufacturers. Back in 2006, Boyer and Freyssenet questioned the "right" strategy for manufacturers to adopt. "*Should they anticipate some radical innovations in terms of technology (e.g. combining mechanics, electronics and new materials), or on the contrary, does the key to success for new profit strategies lie in the social uses of the automobile (urban vehicles with multiple ownership, widespread rental, etc.)*?" A decade on, the car industry is having to face all of these challenges and choose an "optimal" position. This involves at once seeking and achieving maximum volume, the required diversity, quality and innovation, and permanently reducing costs at constant volume.

For Womack et al. (1991), "*The future is already written. The only survivors will be those with the courage to adapt and apply the best solutions, resulting from* '*lean production*'". The debate remains open on the strategies to apply in different regions of the world, faced with the growing need for mobility and an obligation to respect the environment. The future also involves meeting a rising demand for communicating vehicles (Xerfi Study on the 2020 horizon, 8 % of future buyers). Using embedded systems and communication technologies, vehicles can communicate with each other and with the road infrastructure via the internet and local networks, bringing users access to new safety, intelligent navigation and personalization features.

Cars will need to complement other transport solutions in innovative production models that remain to be defined. Making these models a reality will mean rethinking the way that the innovation process is organized so that the chosen production model fits in with mobility requirements, i.e. it needs to be customer-focused (Gatignon and Xuereb 1997; Gotteland et al. 2007).

2.3.3 *Public-Private Partnerships for an Overall Approach to Mobility*

Yet, can state action create the conditions for new production models to emerge? Another issue raised by the current ecosystem is the connection between public policies and major innovation opportunities, such as electric or autonomous vehicles. Have the constraints of public policies aimed at reducing CO_2 emissions in

fact created a *strategic opportunity* for car manufacturers? In other words, have manufacturers transformed an environmental constraint into a development opportunity, for example by reconfiguring their value chain or designing new products and services? It is clear that these regulations have put significant constraints on manufacturers, forcing them to redefine their value chain, alliances and business models.

Several recent examples illustrate this trend, with new programs emerging between different stakeholders to produce cleaner, more energy-efficient and autonomous cars. Thus, the European Union project Elibama gathers car manufacturers, battery suppliers, recyclers and universities; another project led by PSA-Peugeot-Citroën, AbattReLife, is built on the same model; and private-public partnerships like the EGVI-EU project aim to accelerate R&D on clean technologies.

These projects show that various partners are keen either to maintain a place in this new ecosystem, which is the case for manufacturers, or to enter it and position themselves as "key players" in the new value chain, which is the case for battery suppliers, recyclers and high-tech companies. However, it is worth mentioning that these projects or research programs are actively supported by public authorities since they play a major role in developing the new mobility ecosystem. They organize mobility by setting up services (charging stations, self-service cars) and provide the necessary impetus for developing alternative technologies, creating de facto alliances between car manufacturers, car park operators, spare parts manufacturers, insurance companies and user representatives.

Although the targets are clear, one question remains, which is that of the overall governance required to coordinate all of these decision-making levels. Stakeholders are increasingly numerous and diverse, regulations are put into question, and local authorities are confronted with new modes of transport that oblige them to reorganize the way that their territory is managed. Urban policies are challenged and obliged to redefine their investment choices and set up incentive measures or usage restrictions in urban areas.

2.3.4 The Customer, the "Kingpin" of Expected Value Creation?

Another issue that should be considered by manufacturers and other stakeholders in the industry is the new requirements and usages of customers, who, from one generation to the next, confer cars with a different role and social status. Generation Y, which emerged over ten years ago, has introduced new societal values, including a very different relationship to mobility. This generation designates 25–35 year-olds, also known as "digital natives" and "Generation Why", who grew up within the internet ecosystem and have built a new generational identity through social networks. Numerous surveys have analyzed their behavior, preferences and lifestyle (Dagnaud 2013).

These young people, the successors of Generation X (Coupland 1991), live in a system of constant communication dominated by new usage types; they expect to use objects and products for free or almost nothing, enjoy open access to knowledge technologies and, in particular, consider that ownership can be shared or exchanged and is not a symbol of social success. This is particularly striking for example in their representation of the car (Parasuraman et al. 2013). Lastly, the idea of a "*reversibility between producers and consumers*" is interesting, and has been the subject of several original research papers. This situation occurs, for example, when the owner of an electric car produces her own electricity to drive and may even sell it to a third party to make a profit! (Kempton and Tomić 2005).

A study commissioned by Deloitte consulting company in 2014 on Generation Y's relationship with mobility illustrates our point.[2] The survey questioned 23,000 young people from around twenty countries in North America, Europe and Asia. When asked to rank criteria for the future purchase of a car, the young people put cost and utility first, followed by ecology and pleasure, and lastly technology and safety. What is striking about these choices is the low-cost requirement for purchasing a vehicle, which is very different from past generations, who placed social image and status recognition above cost, even if it meant making financial sacrifices.

The second interesting point is the ecological requirement, which implies that this generation would happily accept a move from internal combustion cars to electric cars. In their replies to questions on vehicle ownership, these young people clearly positioned themselves as "*very favorable to alternative solutions: car sharing, carpooling and rental*". Their priority is optimal, "comfortable" journey solutions, the lowest cost for a means of travel that significantly saves time. This also involves benefiting from using mobility without the concern of managing it.

Lastly, young people replied favorably to a question on advanced automation and future driverless cars, in particular stating that it is, "*difficult to stop using technologies when I'm driving, I want to stay connected to my friends and family, I want to carry out tasks while I drive*". To sum up, in terms of the connection between this generation and mobility, Generation Y members have mobility requirements that are very close to their ideals, preferring a community of users to private, personal transport; they want freedom to travel at a low cost, want to live spontaneously, and especially stay permanently connected to social networks. Their lifestyle reflects their mobility choices: to connect with their "tribe", be informed of everything immediately, and be able to do several things at the same time. The connected/autonomous car is clearly the solution that responds to these new requirements.

However, the question of whether this new economic and ecological model would be acceptable to customers is not so simple (Bühne et al. 2015) for a number

[2]Study carried out in 2014 by students from ESSEC, ECP and Dauphine universities for Deloitte Conseil on Generation Y and Electromobility.

of reasons. Consumers will soon be able to choose between different means of travel: connected cars, autonomous cars, robot taxis, shared shuttles, etc. But will users be capable of defining their own strategy to match their needs?

In addition, a vehicle's energy efficiency cannot be dissociated from its price, which must remain attractive. The question of the cost of using a vehicle raises another, more complex issue, i.e. how the vehicle's *energy source* is managed. Users must, for example, adapt to the new services on offer for charging their vehicle with electricity. Creating efficient charging facilities in a town requires a densely meshed electric grid with significant power.

This type of innovation transforms the traditional interface between cars and users and, at the same time, creates a structural, systemic interaction between towns, energy and information. That means a radically new business model.

2.4 Conclusion

The solutions to this profound change in mobility come from both private initiatives (carpooling, car sharing) and public initiatives through tax incentives, regulations, and investment in infrastructures to encourage intermodality. The economic, social and technological consequences are considerable, since they modify the place of traditional stakeholders in the automotive industry (car manufacturers, spare parts manufacturers, suppliers, service operators, recyclers, etc.) and raise the issue of organizing, managing and sharing urban space. Cooperation, alliances and partnerships are taking shape around the world involving all car manufacturers, since the question of leadership will be crucial in determining who will stay in the race and who will drop out.

In this new mobility paradigm that we have called *auto-mobility*, car manufacturers are subject to greater complexity and uncertainty when making their strategic decisions. In this respect, technological questions are correlated to societal issues, including whether users accept a new mobility model that must first satisfy their needs.

The traditional concept of a powerful, personal car is being replaced by other types of mobility. The social symbols, priorities and preferences of young people are no longer the same. Real-time access to information has become essential. Mobility is more important than power. People want to remain constantly connected to their environment. Cars can no longer be considered as an end in themselves, but as tools for gaining mobility. These new services contribute to the arrival of new types of mobility that are more relaxed, rational and sustainable, and to the emergence of a new ecosystem.

Acknowledgment This research benefits from the support of the Chair "PSA Peugeot Citroen Automobile: Hybrid technologies and Economy of Electro mobility", The Armand Peugeot Chair led by CentraleSupélec, ESSEC and sponsored by PEUGEOT CITROEN Automobile.

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