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INNOVATIVE PROJECT MANAGEMENT in the Automotive Industry: The Armand Peugeot Chair PROJECTS ON ELECTROMOBILITY

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ABSTRACT

In this paper we show how a prospective innovative project requires specific knowledge management, allowing people with different learning schemes, methodologies, and perspectives to work on a common research topic. The empirical framework is a set of projects carried out within a prospective research chair on hybrid vehicles and the economics of electromobility (Armand Peugeot Chair). In each innovative project, we favor a pluridisciplinary approach. The originality of this approach lies in the fact that we consider not only technico-economic scenarios with strategic and financial dimensions,but also socio-organizational issues, such as whether clients will accept new business models, the issue of technological disruptions, and the redefinition of the value chain of a future electromobility paradigm. In this regard, we have developed exploratory or lean methods. The tools we have chosen are both quantitative (cost analysis, feasibility studies) and qualitative (field research, market studies). These complementarities make proposals of electromobility innovative projects more inclusive.

INTRODUCTION

The industrial paradigm of the automotive industry is at a mature stage, but the development of electromobility is still emerging. To tackle the paradox of this situation and the extraordinary complexity of electromobility, we need to consider a large number of technological, economical, and business parameters, all of which are in line with the transformation of society's expectations for advancements in the the automotive sector.

There is no consensus on the exact meaning of *electromobility* and how to tackle its issues. However, the subject is of major concern to decision makers and scientists from different fields, including environment, energy, economics, and the social sciences, and all those involved acknowledge that electromobility is undergoing radical changes in many industries. Its development calls for public debates, practitioners' exchanges, and academic conferences.

Automakers are particularly concerned about the impacts of electromobility and the future of their industry. In January 2012, the automaker Peugeot Citroën Automobiles *(PSA)* initiated a prospective research chair on hybrid vehicles and the economics of electromobility *(Armand Peugeot Chair)*. The Chair consists of four partners with additional and complementary competencies: the automaker PSA and three international leading schools based in France *(the generalist engineering school Ecole Centrale Paris –ECP-, the business school ESSEC, and the reference in the fields of electric energy and information sciences, Supélec)*.

The objective of the Chair is to support research prospective projects on the new forms of mobility, on economic models related to electric or hybrid rechargeable vehicles, and on industrial and social challenges in the context of electromobility. Each project requires consideration of a complex mix of different technical, economical, and sociological fields. It also requires knowledge of the automotive industry and a global picture of its future.

Yet, the main challenge of the Chair is to produce coherence among the numerous projects. The general concept of electromobility is still emerging, and the methodology for prospective studies is still undefined. For each project, the researchers of the Chair have to define the most appropriate theoretical framework, identify the best methodology and tools to develop a prospective approach, determine how to coordinate different learning schemes for a common, multifaceted, research objective.

In this paper we explore the innovative project management process of the Chair Armand Peugeot. We present our activities on electromobility during the first 6 months of the Chair and give an overview of the projects already launched. The first part of this paper presents our two primary issues: the technological disruption and the socioeconomic transformation linked to the development of electromobility. In the second part of this paper we describe how the Chair is structuring its prospective approach with a set of tools and complementary methodologies. We conclude, in part, that the management of complex innovative projects, such as the ones carried out by the Chair Armand Peugeot on hybrid vehicles and electromobility, needs to deal with partnerships and a close link to the reality of the markets and incumbent business models.

1. From technological disruption to socioeconomic transformation:

What should be integrated in innovative project management of electromobility

Hypotheses about how mobility will evolve in the next 20 years or about the importance of personal vehicles are often contradictory. Although technological and economic incertitude is high, there appears to be agreement that electromobility will completely disrupt demand and supply. The electric mobility system is not about replacing a product with another product, i.e., a combustion vehicle with an electric or hybrid vehicle. The main change is rather a disruption to the traditional mobility system in response to new technological, environmental, financial, and socioeconomic conditions.

The first and probably one of the most fundamental problems in managing such an innovative project is to characterize the change that is happening. Therefore, we started with a broad analysis of the context in which the electromobility concept has emerged and with the different induced challenges. We raised a multitude of questions about energy choices and energy distribution, localization issues, value creation, and mode of appropriation in the automotive industry value chain. Are we witnessing a radical evolution in the mobility system? Do we see the premises of a disruptive technological business model change? Is a new industrial paradigm emerging?

Hypotheses about this are decisive as they provide different directions for technicoeconomic or societal evolution scenarios. A reflection on the mobility of tomorrow clearly leads to a reflection on the city and the urban lifestyle of tomorrow. Electromobility is increasingly becoming a prevalent issue.

We do not pretend to be exhaustive with regard to all possible hypotheses in our issue tree. However, from the inception of the project we chose a pluridisciplinary approach, which allowed us to expand and coordinate the set of possible issues linked to the different disciplines *(engineering, economy, sociology, and so on)*. Using this logic, we can integrate knowledge on the technological disruptions as well as the practices, behavior, and relative positioning of the different actors in the development of electromobility.

The Chair assumes that to deal with the new concept of electromobility, it is necessary to draw simultaneously upon the sciences of economics, engineering, management, and social and to use systems analysis as an approach. Doing this helped us to question the development of electromobility as a new paradigm and a source of value creation.

1.1. Is a new mobility paradigm emerging?

Did environmental policies create major innovation opportunities, such as the development of electric or hybrid vehicles? Were the constraints imposed by public policies aimed at carbon emissions reduction seized by car manufacturers as a strategic opportunity? It could be that car manufacturers transformed an environmental constraint into a development opportunity, for instance by redefining their value chain or by designing radically new products and services.

What is clear is that these regulations represent strong constraints for car manufacturers that force them to rethink their value chain and their business models.

This is a controversial point in the management literature. Based on different strategic studies, Arjaliès and Ponssard *(2010)* showed that in situations similar to the automotive industry, two approaches, "conformity" and "opportunity," have been employed. In the latter approach, the only way a company can gain a competitive advantage is through a proactive attitude. In a subsequent paper, the same authors showed that these effects can be limited by sector factors, such as the structure of the supply network, the economic and technical ties with suppliers, or the cooperation and alliance networks *(Arjaliès et al., 2011)*.

Within the auto industry, the capacity of car manufacturers to face these new environmental challenges is questioned. KPMG in their Global Automotive Executive Survey *(2012)* noted that the automotive value chain is undergoing radical transformation and that the war for control is just beginning. The role of electrical component suppliers is becoming more important, constraining car manufacturers into taking difficult and complex decisions that could undermine their position as industrial leaders.

In this context, car manufacturers have to reevaluate their own competencies and build cost-cutting strategies as well as marketing strategies adapted to consumer behavior. With technology increasing in complexity and having shorter life cycles, it seems unlikely that any company could have enough financial resources and competences to take leadership alone. All studies converge to show that in the near future, cross-industry alliances and joint ventures will be required, for instance with suppliers of batteries, electrical components, or information technology services for connected vehicles.

More and more actors have a reason to be mobilized around the same project, the economics of electromobility. In addition to the traditional actors who are directly involved, emerging actors, such as rental companies, public transportation operators, or information technology industries, are becoming involved and taking an increasingly active part in the development of new business models and novel forms of cooperation.

Aggeri and Hatchuel *(1999)* showed that in situations where multiple actors have different objectives and operating methods, innovative experiences are important; when multiple stakeholders face uncertainty and realize that knowledge accumulation is key, they might base their decisions on more than a short-term cost-benefit analysis. If this change happens with electromobility, coordination between different actors could be beneficial to more actors of a larger value chain. In particular, attention to customers should be increased.

1.2. Are consumers at the heart of expected value creation?

Electromobility gives consumers new motorization choices. This new order should be put into perspective with the energy choices of car manufacturers, from oil to electricity. Energy efficiency of vehicles is inseparable from their price, which should be kept competitive. Economies are made on the long term, since kilometric consumption is cheaper with electricity than with fuel.

However, the question of cost brings a more complex issue for consumers: how to manage the energy source for the vehicle. Users have to adjust to new services related to charging an electric vehicle. The whole business model is completely new.

There are several different modes that consumers could choose from—using private recharging stations or buying a vehicle without a battery and the car manufacturer offers a battery rental package, which might also include electricity consumption. Another mode requires a recharging infrastructure in a city; this would need to include active involvement from public actors and a significantly dense and powerful electrical network. In this last case, users could define their strategy depending on their needs. Outlets for a quick recharge of several minutes could be provided throughout the city; individual outlets could be set up at home; or an exchange mechanism could be established, allowing rapid access to a new battery with full autonomy.

However, the acceptance by users of this new economic and environmental model is not a simple issue *(Olivier and Rosen, 2010)*. Electric vehicles have not taken off, which raises questions about conditions of consumer practices as well as about the newly offered technology. Travel autonomy *(from 100 to 250 kilometers)* is still an obstacle because users are not confident that they will find available recharging stations on their route. Another strong constraint on users is the recharge duration, which can be up to 8 hours for a full charging. This functionality should be tied to a sophisticated communication system to provide consumers with useful information: battery status, traffic, recharging station availability, charging duration, etc. It could change the traditional interface between cars and users, while creating a structural and systemic interaction between the city, energy, and information.

In view of this deep accelerated change in technologies and practices, how did we structure our prospective approach within the Armand Peugeot Chair? Which methodological tools did we use in order to successfully complete our research and build scenarios of technological, economic, or societal evolution?

2. Suggested methodology for prospective project management

The originality of our approach lies in the technicoeconomic scenarios we developed, integrating strategic, financial, and technological dimensions. Examples of ongoing theses are: deployment of the battery recycling industry by 2025; and development and optimization of scenarios; integrating rechargeable vehicles in the electric system: which business model for car manufacturers? All subjects integrate the analysis of technological disruption as well as disruption of the automotive industry value chain.

Our approach also includes socio-organizational issues, as shown by a student's group study titled "Identifying youth expectations regarding mobility." This study highlighted strong needs for alternative mobility forms *(car sharing, carpooling, public transportation)* and for specific communication policies.

To carry out the different projects of the Chair, we favored networking between groups of students who were inexperienced in the field, PhD students who were already working on the subject, and postdoctoral researchers as well as established researchers specialized in electromobility. Doing so, we benefited from the competencies of professors from different fields *(technology, economics, management)* as well as from practitioners and industry experts from PSA. In this context, the contribution of J.M. Mousset, Head of Partnerships Coordination and Projects within the PSA Corporate University has been a crucial key success factor.

Our methodological approach falls within a moderate constructivist epistemology *(Attias, 2000)* and an iterative approach between theory and practice. It is also the best approach to make the links between emerging and vague concepts, such as electromobility and real technological and managerial innovative experiments.

Taking our inspiration from the work of Midler *(2012)*, we set up a joint exploratory methodology enabling researchers to acquire new knowledge, to integrate it, and to reshape it in a nonlinear way. Faced with the complexity of our subject and its high uncertainty *(for instance regarding the energy issue, changing regulations, and consumers' mobility choices)*, we had little choice but to use exploratory methods. We chose quantitative *(cost analysis, feasibility studies)* as well as qualitative tools *(field research, market studies)* to collect the largest sets of data. In the next paragraphs, we present three examples of projects we have launched.

In our first example, a group of ESSEC students realized a field survey on the perception of young people *(20–30-years old)* about cars and electromobility. Results showed how the relation to cars is changing from object of pleasure and symbol for social accomplishment to utility and cost criteria. The analysis of sample responses showed that the relative costs of car ownership are increasing for young people: oil, maintenance, and insurance are increasingly costly. This is particularly true in our industrialized economies but should be put into perspective in emerging markets where the relation to cars is growing. Even though cars are evaluated on utility criteria, they should still reflect some social and economic success. For this reason Peugeot–Citroën in China had to adjust its offer to the Chinese market where a growing middle–high class is asking for top-end high technology-oriented vehicles. However, if we consider the emerging markets, the relative costs of car ownership for young people should still be in phase with the country's average life standards.

The survey also showed the negative image associated with cars in cities with respect to the environment: bulkiness, traffic jams, and pollution. In summary, our work identified strong research needs regarding alternative mobility forms, such as public transportation, car sharing or carpooling services, and electric or hybrid motorization services, that would be more adapted to future buyers of mobility services.

In a second example, two groups of students and a PhD student worked on battery businesses and recycling issues for hybrid and electric cars. Each year in France, 1.8 million vehicles reach the end of their life cycle. In light of this

figure, we can easily imagine the harmful consequences that this waste can have on the environment. These vehicles mostly come from independent garages *(15%)*, individuals *(25%)*, insurance companies *(30%)*, car dealers *(15%)*, and car impounds *(10%) (ADEME, 2008)*. Some estimates indicate the scale of the recycling challenge: by 2022 the market for lithium-ion batteries should reach more than $2 billion, and over 500,000 battery packs should be recyclable in the waste channel.

In this regard, the thesis on the battery recycling industry examines the issues of processing, recycling, and elimination of contaminating waste related to batteries at the end of their life cycle. The subject is original in that it considers the "global" value chain by 2025 as a complex multi-stakeholder system; the managerial responsibility of PSA should be defined in that framework, along with their strategic partnerships and the governance type that should be set up. The current research work consists in elaborating a methodology for designing the battery recycling sector. Each link of the value chain should indeed create value but also keep the environmental impact under control.

The research approach is systemic because it enables the researcher to take into account the complexity of the problem and to consider its entirety. It also allows developing scenarios based on a modeling prototype of nine levels to structure complex models, going from the identification and the control of a phenomenon to levels where the system is finalized and new decisions are made possible *(Le Moigne, 1999)*. We followed a two-step approach *(Bocquet et al., 2007)*. The first step identified the expectations, constraints, and utility criteria of the different actors in the industry and highlighted the variables of the models. The second step corresponded to an optimization phase, including infrastructure dimensioning and logistic flow optimization with respect to performance criteria, costs, and benefits. This requires identifying each material from the most expensive ones, such as cobalt and nickel, to the least valued ones; this is followed by defining their exact value based on extraction and recycling but also on the material market value *(for instance, the demand for lithium recently peaked)*.

Finally, we launched several projects to understand some benefits and opportunities of electromobility for the incumbents. For example, we were interested in the growing importance of Asian competitors and the risk that new entrants might overcome the traditional entry barriers. We analyzed the structure of the distribution channel, its fit with the emergence of electromobility, and the limits of the conventional marketing strategies for the auto industry. These ongoing projects could benefit from other projects being undertaken by master students or postdoctoral researchers. They also help us to understand the actual paradigm of the auto industry and to question its conventional drivers. The findings call for a reorganization of the industry, from supply to distribution.

Another issue is the urgent development of new business models that no longer impose a clear distinction between generic strategies. In addition, profitability on low volumes, environmental constraints, and affordable resource limitations have to be more seriously taken into account in the prospective business models. The more we advance, the more questions emerge: Will users of tomorrow still own their vehicle or will they rent or share? Will car manufacturers keep their production role or will they become mobility services providers? What type of vehicle or combination of mode of transport will really start the electromobility era?

3. Conclusion

The projects carried out within the Armand Peugeot Research Chair are in line with our main aim, which is to guide the emergence of electromobility. The management of all the projects is innovative because we have to deal with multiple interests, theories, methodologies, and tools in order to design the future of a concept that is presently not defined. However, after 6 months of studies, we can defend two convictions.

The first one is that the automotive industry is undergoing a complete recreation, that innovations happen in networks and partnerships, and that the youth of today will behave with cars in a completely different way compared to the actual customer base.

The second one relates to strong needs in research for innovation in technological, industrial, economic, and marketing models that should be in line with new markets. This should help decision making in a context of technological, economic, and socio-organizational disruption. The automotive world has entered the age of uncertainty. This is in line with the KPMG's prospective study *(2012)* confirming "the high uncertainty faced by car manufacturers and suppliers regarding which technologies will be used for vehicles by 2025 and at what pace they will be adopted." A critical subject for the sector is overcapacity management, which was estimated to be 30 million vehicles in 2011. Uncertainty about how fast the market will adapt electric technologies makes industrial rationalization significantly harder.

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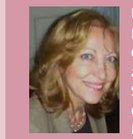

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