LES AMIS DE l'École de Paris du management

From the electric car to electromobility

by

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Overview

The success of electric mobility is generally associated with the technical performance of vehicles. However, an equally important factor is the presence of a favourable environment in which the electric car is more competitive compared to the 'dominant design' of the internal combustion engine car. The organisation of an electromobility system requires not only contact with new partners such as local authorities and electricity distribution companies, but also customers who must get used to this new form of mobility. The management of the deployment of electric vehicles is a significant change compared to the engineering, marketing and sales activities which used to exist in the automobile industry. A research study carried out at the École Polytechnique's Management Research Centre on Renault's electric vehicle programme reveals the multiple challenges which such an approach poses for a well-established company.

Report by Élisabeth Bourguinat • Translation by Rachel Marlin

Seminar organised with help from from the Directorate General for Enterprise (Ministry of the Economy, Industry and Digital Data) and thanks to the sponsors of the École de Paris:

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1. for the Technological Resources and Innovation seminar
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Christophe Midler: Renault launched an electric car project in 2007. The first cars rolled off the production line in 2011, but the project really materialised when the Zoe model, the first Renault car entirely designed as an electric car, was launched in March 2013. We were part of the project because we carried out a research study at the École Polytechnique's Management Research Centre. Consequently we were able to participate in several new groups which were original, such as the Business Development department and the Sustainable Mobility Institute which is a platform providing contacts between the industrial world and the academic world. These new tools and forms of organisation were intended to address problems created by the development of a product which was very different from the 'dominant' design of internal combustion engine cars.

Changing from a niche market to a mass market

The first electric cars date back to the 19th century, and the market was very small until 2008. Over the past few years it has started to expand rapidly, and in 2013, 8,800 new private electric cars were registered. However, compared to the total car market in France, which is close to two million new cars per year, this number is very small.

Car manufacturers have produced electrified cars for a long time (for example the Peugeot 106, Citroën Saxo and Renault Clio) rather than design them from the outset as strictly electric cars. These electrified cars had the obvious advantage of reducing noise and local pollution. However, they were not very attractive to the customer because they were twice as expensive as internal combustion engine cars, and the quality of their type of mobility was not really appreciated.

In order for the electric car market to grow from a niche market to a mass market, it must raise the public's perceived appreciation of electric cars at least to the level of their perceived appreciation of internal combustion engine cars.

This requires three stages. Firstly one must increase the value of the product by progressing from electrified cars to electric cars, and reducing the total cost of ownership (TCO) of the vehicle. Many manufacturers have already realised this. Secondly, one must increase the value of electric mobility by improving the car's environment, in other words its electromobility system. Thirdly, the public's perception of the value and advantages of electromobility needs to be improved and strengthened. Even if the value level is high, if the customer does not realise this, sales will not increase.

A disruptive platform

The innovation of the electric car presents two major changes regarding the manufacturer and the customer.

Under normal circumstances, the buyer of an internal combustion engine car can use it immediately and without any problems. By contrast, the buyer of an electric car must ensure beforehand that he has an electrical socket available in order to recharge the car regularly before using it. Therefore, the electric car sales staff must know about the electromobility system in which the car will exist. Car manufacturers should also make sure that electric car buyers can benefit individually from the benefit to the public of a vehicle which reduces noise and pollution.

As far as the customer is concerned, the purchase of an electric car cannot take place without the customer understanding the advantages of electric mobility. This is not necessary when one buys a traditional car such as a Clio or a Peugeot 508.

This last point explains Felix von Pechmann's wish to consider the electric car as less of a product and more as a 'disruptive platform'[1] combining two forms of instability related to the offer and the demand. To further this idea, he combined two concepts; that of 'industry platforms' (developed by Annabelle Gawer[2]) and that of 'disruptive innovation' (devised by Joseph L. Bower and Clayton M. Christensen[3]).

As a disruptive platform, the transition from a niche market to a mass market is similar to the paradox of the chicken and the egg. Putting an electromobility system into practice requires investment, and is only possible if there are enough customers to make the investment profitable. However, the expansion of the customer base is possible as a result of learning about the value of electric mobility, and this can only take place once the system is deployed in the field. Where should one start?

Strengthening the electromobility system

Felix von Pechmann: Car manufacturers are in the process of realising that if they want to deploy the electric car, they can no longer simply work on the product, but must consider the broader electromobility system. At the heart of this system the authorities will play a major role. They only intervene marginally in the deployment of internal combustion engine cars, but as far as the electric car is concerned, they will have to play a crucial role in its growth.

A few years ago, the European Union imposed norms on the average levels of emissions for each manufacturer's fleets of vehicles. The graph showing the change in CO_2 emissions of new vehicles shows that manufacturers began to intensify their efforts from 2009 onwards when it was thought that the implementation of regulations was imminent. The vast majority of manufacturers already comply with the emission threshold defined by the European Union for 2015. The threshold fixed for 2020 will undoubtedly be more difficult to conform to because the decisions taken to lower pollution levels have already been implemented. The decision of the European Union is likely to have an impact on the emergence of a new offer of electric cars. The average level of emissions will be easier to comply with if there are more electric vehicles.

In France, car manufacturers are now waiting for public measures to make the deployment of electric cars easier. Norway's example proves that these kinds of measures can have a real impact. Of course, income levels are not the same in the two countries: Norwegians spend 1,400 Euros per year and per person on the purchase of a car compared to 600 Euros for the French population. However, there is nothing to stop bringing the measures adopted in Norway to France in order to encourage the use of the electric car, which include VAT exemption for electric cars or very high registration taxes for normal vehicles. France could also take the lead by adopting measures to develop an electric mobility infrastructures as well as advantages related to electric car use, such as the possibility of using bus lanes, a scheme which is not costly and is very motivational; or not having to pay motorway tolls, equally not very costly because the aim of electric vehicles is not generally to drive long distances.

The simulation model which I devised shows that if France had applied measures taken by Norway to encourage electric mobility since 2008, the French electric car market would currently have nearly 200,000 vehicles instead of 10,000.

1. von Pechmann, Felix, 2014. The Deployment Engineering of a Disruptive Platform – Thes case of the Electric Vehicule, Pd.D. Thesis, Palaiseau, France: École Polytechnique.

2. Gawer, Annabelle, 2009. Platforms, Markets, and Innovation, Cheltenham, United Kingdom: Edward Elgar Publishing.

3. Bower, Joseph L. & Christensen, Clayton M., 1995. Disruptive Technologies: Catching the Wave. Harvard Business Review, 73(1), p.43–53.

Increasing the number of customers

As mentioned earlier, it is not enough to create an environment which is favourable to the electric car: one must also help customers to understand the value of electromobility. By contrast to people who bought the Renault Clio 4 and realise that they have a better version of the Clio 3, potential customers of an electric car find it hard to appreciate the advantages it will bring them. Therefore, it is crucial to identify and encourage potential buyers.

Geoffrey Moore's 'diffusion of innovations' curve identifies five types of consumers[4]. They include those who are ready to buy an innovative product regardless of cost, and a much larger group who will buy a tried an tested product, already bought by their neighbours. Since there are too many so-called 'followers', Geoffrey Moore recommends identifying niches from which 'neighbours' will slowly create chains of adoptions.

As far as the electric car is concerned, the problem is that the niches are narrow and the possible progress limited. Two of these niches, however, appear more promising than others, namely the taxi market and car-sharing schemes. In both cases, the vehicles cover large distances and are used by many people.

I tried to estimate the value of these two markets in terms of customers learning about electromobility. I based my predictions on the amount of money which a car manufacturer had to spend in order to arrive at the same level of learning, for example by offering free trials at car dealerships or investing large amounts in advertising. For the taxi market, I reached a figure of 1,900 Euros per month, and for the car-sharing market, 1,200 Euros per month. These two values enable us to estimate the amounts which the manufacturers could spend on these two markets, for example by giving taxis additional discounts on the purchase price of electric cars, or by creating services intended for car-sharing customers in order to give them very high-quality assistance should they have any problems.

'Compatible' territories

Another part of our study consisted of simulating geographically the compatibility of the French *départements* with regard to electric mobility. This approach has surprising results.

The electric car is essentially an urban phenomenon. However, Paris is not a very favourable environment because not many Parisians own garages, or have a designated parking space where they can easily install an electrical terminal to recharge a car battery. If they live in a collective ownership property, they could seek authorisation from other co-owners to carry out the necessary building work, but this can take a long time. In the meantime, they can recharge their batteries in the Autolib' stations (the Parisian car-sharing scheme), but this solution is not always satisfactory.

By contrast, the outer suburbs of Paris offer good conditions. Many inhabitants in these areas are sufficiently well-off and already have several vehicles and their own garage, all of which are very favourable conditions for the purchase of an electric car.

Ideally, the manufacturers should deploy electric cars according to geographical locations, and prioritise areas which have the most favourable conditions. However, for both practical and legal reasons, this option is difficult to envisage.

From 'product engineering' to the deployment of an electromobility system

As mentioned, manufacturers have to adapt their approach both to the offer and to the demand. Naturally this extends the scale of the project: they have to add the 'system' perimeter to the 'project' perimeter.

4. Moore, Geoffrey A., 1991. Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers, New York, NY: Harper Business.

A traditional car project is made up of three stages. The development of technologies (ABS systems, airbags, etc.); then, with a brief phase of overlap, the development of the product; and finally, once again with a slight overlap, the diffusion of the product and services. Once the sales and marketing services have taken over, the engineering ressources affected to the project diminish considerably.

An electric vehicle project is characterised by a much longer overlap phase between the development of technologies and the development of the product, because it is by developing a project that one perfects technologies. It is also characterised by a second type of activity in the technical development: disruptive platform leadership. The manufacturer must call on external participants and co-ordinate their intervention. The deployment of the electromobility system and the action taken to encourage customers to learn more about electromobility should occur simultaneously, with information being fed back in order to improve technologies, the product and the offer.

Between traditional projects and electric car projects, one moves from a sequential pattern to a pattern where the processes are both simultaneous and interwined. This may be called a 'concurrency' of upstream and downstream activities[5].

Finally, the extension of the project perimeter translates into a range of activities which are much greater than in the traditional development of a product. The car manufacturer needs to go beyond product engineering, towards the deployment engineering of a disruptive platform.

New forms of organisation at Renault

Christophe Midler: This idea of deployment engineering is a radically new concept and has led to remarkable changes in the ways in which Renault has organised its company.

In the past, electric car programmes were organised according to specific customer populations and platforms for 'small cars', 'medium-sized cars', and so on. Now, the programme is devised around a concept, electric mobility, with cars as different in terms of customer population and platforms as the Kangoo, Twizy, Zoe and Fluence. The role of the electric car project is to co-ordinate the different services and the people who are involved in implementing electric mobility.

Very soon after it was launched by Renault in 2007, the programme included meetings with the local authorities (for the reasons which Felix mentioned) and also with private individuals and companies such as Better Place, an Israeli service operator, and battery suppliers. This led to the emergence of new departments inside Renault in order to take on the disruptive platform leadership tasks mentioned earlier.

The role of the electric vehicle's Business Development department, for example, was to manage the interactions between Renault and the local authorities in order to set up pilot projects and create electromobility systems. The 'New Mobilities' programme was intended to develop services linked to the electric car which would be likely to bring value to the project. The Sustainable Mobility Institute played an important role in stimulating the scientific world, in the areas of management, sociology or simply technology. For example, it managed to convince the École Polytechnique to launch a research programme on car batteries, a subject which normally would not have been of interest to this establishment.

As a whole, the scope of the electric vehicle programme was widened to include collaborations with many more individuals and organisations compared to a traditional vehicle programme: public research centres, governments, regions and *départements*, towns, start-ups, electricity suppliers, electric goods suppliers, battery suppliers, and so on.

5. von Pechmann, Felix; Midler, Christophe; Maniak, Rémi & Charue-Duboc, Florence, 2015. Managing systemic and disruptive innovation: lessons from the Renault Zero Emission Initiative. Industrial and Corporate Change, 24(3), p.677–695.

Lineage management

Break-through innovations which have marked the history of the car have rarely benefitted, at least initially, the manufacturers which started them.

A most emblematic case study is that of the Prius hybrid car. The first generation of these vehicles did not sell well at all, the second had a little more success, and it was only with the third generation that sales took off, generating a considerable benefit in terms of both image and market. If the brand had not managed to stay on course for about ten years in spite of rather poor financial returns, it would have lost all these benefits.

The concept of lineage management was developed by Hatchuel and his colleagues to characterise such a serial innovation track associated with permanent learning on technology and markets[6]. Renault also succeeded in implementing lineage management for its entry-level range of vehicles based around the Logan model[7]. Renault wanted to capitalise in the long-term on the advantages of the initial innovation while at the same time being aware of market signals in order to make this innovation grow.

In terms of electric vehicles, the intangible assets include different elements such as brand image or even the fact that there are electric charging stations in the streets of some towns[8]. Experience shows that only manufacturers sufficiently established and capable of asserting their strategy on a long-term basis can convince the rest of the industry to join with them in a systemic break-through change like the advent of the electric car. Without this determination and sustainability, innovators are at risk of seeing new entrants taking all the key assets away from them.

The Logan and the electric vehicle: two different contexts

The case of the electric vehicle is not similar to that of the Logan.

The Logan project benefitted from a degree of marginality, with relatively low, initial expectations and results which have always surpassed the objectives. This created good conditions, at a comfortable distance from the influence of the traditional dominant design which always puts innovations under pressure.

On the other hand, the electric vehicle project stemmed from a very strong strategic ambition on the part of Renault's general management. Initial expectations were very optimistic but initial sales fell short of them. In this context, it is much more difficult to maintain a strategy of lineage management. Added to this is a purely temporary element, the fact that conventional Renault cars are selling well at the moment. Why make things more difficult when the 'business as usual' approach produces satisfactory results?

Conclusion

The research work carried out by Felix von Pechmann highlights the transformation of the car manufacturing industry. 'Product engineering' is being replaced by 'deployment engineering of a disruptive platform'. This is a kind of oxymoron because in principle engineering stops when deployment begins. The two very different activities of engineering and marketing now become one, and the process to make this happen poses considerable challenges to companies the size of car manufacturers.

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6. Le Masson, Pascal; Weil, Benoît & Hatchuel, Armand, 2010. Strategic management of innovation and design, Cambridge, United Kingdom: Cambridge University Press

7. Midler, Christophe, 2013. Implementing a Low-End Disruption Strategy Through Multiproject Lineage Management: The Logan Case. Project Management Journal, 44(5), p.24–35.

8. Maniak, Rémi; Midler, Christophe; Lenfle, Sylvain & Le Pellec-Dairon, Marie, 2014. Value Management for Exploration Projects. Project Management Journal, 45(4), p.55–66.

This study also reveals another transformation of the car manufacturing industry. It is changing from its role as an integrator of a value chain to the role of leader of a disruptive platform which then puts it in contact with new players such as elected representatives and electricity distribution companies. When one reads about break-through innovation in management literature, one often thinks about upstream phases of creativity. In this case, one of the key phases of innovation is taking place downstream, when scaling up and deploying. The innovation, designed upstream, is not necessarily programmed either to succeed or to fail downstream, once it is put on the market. Deployment engineering transforms conditions for the user in order to make the context compatible with the disruptive platform.

Finally, this work reveals the importance of 'the step ahead'. It is essential for a manufacturer to keep producing several disruptive generations of vehicles, and implementing changes continually as Toyota did for the Prius, and Renault for its entry-level models.

Discussion

Financing the infrastructure

Question: *What was the cost of Renault's electric vehicle project?*

Felix von Pechmann: The figure was not made public, but it is a strategic project which has always been supported by general management and has never had its budget cut, even during the 2008-2009 crisis.

As far as the revenues are concerned, I am not giving any secrets away if I say that for a car company which makes profits by selling large numbers of cars, a production of some thousands of cars per year is not desirable. But this was also the case of the Prius project for ten years.

Q.: *Have the local authorities helped to finance some infrastructure, for example the charging stations*?

F. v. P.: They said that they would finance the charging stations, but only 50% was financed by the State. The rest had to be financed by the towns and this clearly limited the extent of the charging stations' network.

Private companies are not very interested in this project, not just because of the great uncertainty around the development of the electric car, but also because of a problem of profitability. We know that people do not buy electric cars unless they see that the necessary infrastructure has been installed, but almost all our experience shows that once these infrastructures are in place, drivers do not use them a great deal and prefer recharging their batteries in their homes. Stations placed in the street are therefore simply to reassure people, and this poses a problem regarding their profitability.

Christophe Midler: Inasmuch as 90% of battery recharging takes place at home, it would have been undoubtedly preferable for the local authorities to encourage buildings which have multiple co-owners to install electric sockets in their garages and car parks. This would have been much less costly and more efficient, but it was more complicated from a legal point of view.

Misappropriation of use

Q.: *In the digital world, platforms may be used for totally different uses than those initially intended. Is it possible that the stations may be used to recharge drones, for example?*

C. M.: Absolutely. Currently design offices are working on a 'second life' for batteries. After seven years, batteries are not completely useless, but they do not guarantee sufficient driving ranges anymore. Renault and Bouygues had a joint venture, and experiments were carried out to find an opportunity in positive energy buildings. Second-hand batteries can be used to stock solar energy in the framework of a local, intelligent network.

There is also a possibility that EDF could use electric cars to stock electricity which it could use as a back-up whenever there are peaks in demand.

Work groups came forward with the idea of using the electric car not as a means to move people, but as a source of mobile energy. For example, a craftsman can use it to plug in his electric drill on a worksite which does not have any source of electricity. It might also be possible to install a coffee-making machine in an electric car.

The Norwegian model

Q.: *In spite of the difficulties which have been encountered, is it possible to say that France is following Norway's example?*

C. M.: The problem of real-time research is that one does not know the end of the story in advance. On the other hand being part of the fairly chaotic innovation process one can identify the real obstacles. Drawing up a geographical map of the *départements* which are more or less in favour of electric mobility seemed to help to contribute to a more efficient deployment, but the Renault sales managers explained to us that it was out of the question to favour one dealership over another.

Q.: *Norway has a number of islands. People move around in relatively small urban and semi-urban areas. No-one travels from Oslo to Bergen by car, for example. This fact greatly helps the diffusion of the electric vehicle.*

Additionally, Norwegians have got into the habit a long time ago of connecting their cars to the grid at night so that the oil remains hot and the engine starts well in the morning. This favours the availability of sufficiently powerful electric sockets for a large majority of potential users of electric vehicles.

Being different by designing differently

Q.: *From the outside, and with the exception of the hole which makes it possible to plug it in, the Zoe is extremely similar to an internal combustion engine car of the same size. Why not try to design it differently so that people recognise it as an electric car in the street?*

C. M.: This question has been at the centre of many discussions with two opposing choices; one in favour of differentiation, and the other with a desire to reassure the customer. The decision was finally taken to choose an average size car, like a Clio, have a design which was not too unusual, and to sell the electric car at the price of a slightly over-equipped Clio. The aim was not to add more risks to a risky project. Twizy's mixed success with its very specific design does not argue in favour of a strategy of differentiation.

The case of the Tesla is interesting because it combines the two approaches. From the outside, the Tesla is similar to any luxury car (the target market), but on the inside, this is not the case. One even feels that one is not in a car.

Those who designed the Zoe model believed that it is not because of its design that customers buy an electric car, but because of the 'driving experience' which is totally unique. The rate of satisfaction of Renault customers is ten points higher (out of one hundred) with electric cars than with internal combustion engine cars. The problem is that when one has not driven and been inside an electric car, one only sees it from the outside.

F. v. P.: A strategy of differentiation could have been interesting if it were a question of a niche market, but Renault has always targeted a mass market even if the deployment required exploiting niches in the beginning. It is this 'mass market' strategy which has justified the sales price of its electric cars. More generally speaking, adopting a strategy of differentiation could contradict the general motto of the brand 'Sustainable mobility for everyone'.

Renting batteries

Q.: *Renault is the only manufacturer which still sells electric cars without the batteries and rents the batteries separately. Why?*

C. M.: In the Better Place model, which was abandoned in the end, empty batteries could be exchanged for charged batteries in a few minutes. It is logical to design both a physical scenario and a business model which are coherent.

Furthermore, when renting batteries separately, the electric car was the same price as the internal combustion engine car. I remember that I was at the World Motor Show and the Peugeot iOn and Renault's Fluence were on either side of the same alley. The iOn, which is a very small car, was more expensive than the Fluence. Psychologically, the effect was devastating.

The third reason is that there is great uncertainty about the life expectancy of the batteries. No-one has sufficient experience to know whether they will last five, six or seven years. It depends on the way in which they are used, the temperature, and so on. It seems more appropriate that the manufacturer whould ensure the longevity of the battery rather than make this a concern for the customer.

Q.: *The manufacturer could take on the risk by guaranteeing the batteries as is the case for other parts of the car. The great inconvenience of renting batteries is that their price does not decrease over time, and in these circumstances it is very difficult to re-sell an electric second-hand car.*

Q.: *Re-selling a car when the batteries are as expensive to buy as the price of a new car and where one does not know whether they will last one, two or three years is also quite tricky…*

F. v. P.: From this point of view, selling a car without the battery may guarantee a better resale value.

The Israeli experience

Q.: *What lessons has Renault learned from its experience in Israel with Better Place (a battery-charging and –switching service which was liquidated in 2013)?*

C. M.: In the beginning, Better Place played a very useful 'guinea pig' role and helped Renault to get started. The experience in Israel was a commercial opportunity because of the anticipated tax exemptions. However, Renault quickly saw the risk that it would become the manufacturer of products for a mobility system which was going to be operated by a third party. This was one of the main lessons learned from this experience. Many other manufacturers also copied it and are in the process of looking into economic models related to the service industry.

F. v. P.: Better Place decided to conduct experiments in several countries at the same time (such as Denmark, Israel and Japan), and this required huge investments. The lesson learned is that one should perhaps begin by establishing the scheme in a defined area before replicating it elsewhere.

A paradigm shift?

Q.: *Booking.com was not created by hotel keepers, Uber was not invented by taxi drivers, and Blablacar (a French car-sharing scheme) was not thought up by car manufacturers. Have Renault and manufacturers in general really taken into account the paradigm shift which is taking place right now, and the fact that their electric car business will undergo an in-depth transformation?*

C. M.: Renault created the Sustainable Mobility Institute and PSA launched the City On The Move Institute ('*L'Institut pour la ville en movement*'). All the car manufacturers are fully aware of the coming changes. But making the change is not that easy. When the chemical company Monsanto saw that its patents for the Roundup

weedkiller were coming to an end, it stopped this activity and developed seeds which are resistant to Roundup! Very few large companies are able to make such a strategic change.

The shock of changing to electric cars

Q.: *For a manufacturer of internal combustion engine cars, changing and manufacturing electric cars must be a major shock. What was the reaction at Renault?*

C. M.: The shock was not just about the engine. One of my students worked on the energy performance of heating the vehicles. In an internal combustion engine vehicle this is not important at all: on the contrary, one tries to cool the engine. In an electric vehicle, every hour used to heat up the car means fewer kilometres driven. All the auxiliaries of the car (such as heating, air-conditioning, radio) have to be energy efficient because any performance gain leads to a greater driving range. Energy therefore has value, and drawing conclusions from this requires a radical change in the way in which technicians do their job.

Synergy with Nissan

Q.: *Why do Renault and Nissan not combine their electrical activities, or even create a specific brand for electric cars?*

C. M.: Renault benefitted considerably from Nissan's earlier work on batteries. Afterwards, each went its separate way. They have come together recently, but I do not think that it will culminate in the creation of a specific brand. In terms of image, Renault would lose all the benefit of the investment it has made since 2008.

Presentation of the speakers

Christophe Midler: CNRS research director at the École Polytechnique's Management Research Centre (*Centre de recherche en gestion*) and professor in charge of the Chair of Innovation Management. His work focuses on change in large industrial companies with respect to innovation strategy, project organisation and the design of new products. He has published numerous articles and several works on the subject including *L'auto qui n'existait pas: management des projets et transformation de l'entreprise* (ed. Dunod); *Management de l'innovation de rupture* (co-edited with Sihem Ben Mahmoud-Jouini and Rémi Maniak, ed. Dunod, 2012); *Réenchanter l'industrie par l'innovation, l'expérience des constructeurs automobiles* with Rémi Maniak and Romain Beaume (ed. Dunod, 2012); and *L'épopée Logan, nouvelles trajectoires pour l'innovation* with Bernard Jullien and Yannick Lung (ed. Dunod, 2012).

Felix von Pechmann: member of the French Corps des Mines; Ph.D. from the École Polytechnique. His Ph.D. thesis is entitled The Deployment Engineering of a Disruptive Platform – The case of the Electric Vehicle.

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