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The Implications of E-Mobility for the Automotive Value Chain and Business Models

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Abstract: E-mobility will have broad implications on the value chain in the automotive industry. First, e-mobility combines three types of value chains: electricity production, charging infrastructure, and automotive, which were not necessarily coupled in the past. In addition, e-mobility will redistribute the activities within the value chain, leading to some actors taking over new activities, others losing activities, and even leaving the value chain. Third, three main scenarios with large implications for business models are possible in the future. In the first scenario, the automotive manufacturers will continue leading the whole value chain, but this is not guaranteed, as the Original Equipment Manufacturers (OEMs) in the car industry may have to give up their leading position, by losing control in favor to other actors. In the second scenario, the energy producers take a lead position, whereas in the third scenario the service providers are those who have a dominant role in the value chain. Whether scenario one, two, or three, will really emerge depends on market conditions (acceptance of e-cars by customers and hence the volume of e-cars sold), and the level of support that the government will allocate to e-mobility. For instance, good market conditions will be favorable for the first scenario, in which the OEMs are in the lead positions.

1. Introduction

Over the last years, electric mobility has become a ubiquitous buzzword, not only in individual transportation, but also in public transportation as well as in logistics. E-mobility is a (relatively) new technology that relies on electric engines and electricity as a source of power, instead of conventional vehicles driven by combustion engines and fossil fuels. Whereas most of the electricity produced worldwide uses fossil fuels as a primary source of energy, electricity can be also produced by leveraging renewable energies such as wind andsolar energy.

Currently, the automotive ecosystem is stable and composed of well-established actors such as OEMs and suppliers. E-mobility can lead the ecosystem to undergo many changes, making it hard to predict which actors will survive or lose and quit the automotive industry. As such, many scenarios are thinkable for the future. E-mobility, although not largely diffused in the individual mobility sector, has the potential to change completely the automotive ecosystem. In Germany, for instance, the electric vehicle market diffusion continues to lag behind the objectives set by the government: In 2009, the German government proclaimed the plan of having one million electric vehicles on Germany's roads by 2020 (Federal Republic of Germany 2009). Nine years after this announcement, the number of battery electric vehicles (BEVs) reached about 53.861 (Statista 2018). Thus, although e-mobility is expected to change the automotive ecosystem, recent figures do not confirm, at least, the short-term impact of the technology.

This research aims to analyse the changes in the automotive value chain due to e-mobility in the context of the German car industry. In addition, it deals with the main implications of e-mobility on business models in the automotive industry.

This paper is structured as follows. In the following section, we review relevant background literature on e-mobility, business models and value chains. The subsequent section outlines the methodology we used in this research. The fourth section presents our findings generated by means of a Delphi study that combines expert interviews and a structured survey analysis. The results section is followed by the managerial implications. The final section concludes and presents directions for future research.

2. Background

2.1 E-Mobility

The electric vehicle looks backs on a long history. At the beginning of the automobile era, the first engines were powered by electricity stored in lead-acid batteries. More than 100 years ago, the performance of electric vehicles was below the performance of the internal combustion engine (ICE). This marginalized the value of electric vehicles for the automotive industry. Over the last 15 years, the electric vehicle has become more and more important for mobility, due to its fast technological development that has triggered an improved competitiveness and its ability to use renewable energies, thus contributing to a clean and sustainable future.

E-mobility not only refers to electric vehicles, which can be classified into battery-powered electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), fuel cell electric vehicles (FCEVs) and other electric vehicles such as e-bikes and e-busses, but also to a completely new mobility system that affects many different actors and stakeholders. In the scientific literature, e-mobility is often not explicitly defined. For instance, Madina et al. (2016) define e-mobility as "the use of electricity for powering the drive trains of road vehicles" and emphasize the relevance of information and communication technology (ICT) for a functioning infrastructure. A more systemic point of view defines e-mobility "as a new traffic system, with new infrastructure, so called 'smart' electric grids, as well as new business models" (Delft 2013). Abdelkafi et al. (2013) characterize e-mobility as "a system of interacting actors, technologies, and infrastructures that aims to achieve sustainable transportation by means of electricity."

2.1 E-mobility and Value Chain

Compared to the traditional automotive value chain, within e-mobility, electricity is used instead of diesel or gasoline, charging stations replace petrol stations, and gearboxes are not required at all but electronic control units. These changes will lead to a change in the value chain and to a transformation that may result in new players coming into or leaving the system, whereas others changing the scope of their activities.

E-mobility is a multi-dimensional issue. It is referred to as systemic innovation (Abdelkafi und Hansen 2018) that involves the interaction of many stakeholders. In spite of a simplified technical construction of electric vehicles, energy supply needs an extensive coverage through a broad network of charging stations. This leads to serious challenges in fulfilling the customer requirements and will affect the automotive industry significantly.

The idea of the value chain was introduced by Porter in 1985, in which he describes the firm's primary activities such as inbound and outbound logistics, operations, marketing and sales as well as services, and supporting activities such as human resources and financial services (Porter 1998). A value chain "describes the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final customer, and final disposal after use" (Kaplinsky und Morris 2002). In this context, margin is defined as the resulting difference between total value of the final product and total costs, caused by all activities of the value chain. As defined by Porter, the concept of the value chain is very focused on the single firm, in contrast to the supply chain (SC), which includes upstream suppliers (suppliers of the suppliers) and downstream customers.

In this paper, an e-mobility value chain is understood as the system of all activities required to ensure a functioning e-mobility, independently of the actors that carry out the activities. It not only covers the production process of electric vehicles, but also other processes such as the supply of energy and the installation and operation of charging infrastructure. To describe the value chain, there should be a good balance between the level of detail and clarity, as too much details can come at the cost of clarity. Most of the literature focuses only on a part of the e-mobility value chain such as charging infrastructure (Golembiewski et al. 2015; Vom Stein et al. 2015), or e-vehicle production. Only a few publications such

as Ernst & (Young 2011) deal with the whole system. A holistic analysis of the e-mobility value chain is required to enable a profound understanding of the impact of the transition process from the well-established mobility system based on fossil fuels as a source of energy to an electricity-based mobility system.

An interesting model that is used to represent the value chain is the ARA-Model. ARA stands for Activity, Resource, and Actor (Håkansson et al. 2009, p. 33). The activity structure denotes what companies do and what they perform in terms of developing technologies, manufacturing products, or exchanging information. The actors are individuals and companies that perform activities. Resources are what actors require in order to do their activities. Since actors have limited resources, they have to engage in interactions with other actors, in other words in business relationships (Håkansson und Johanson 1992). The ARA model explains to a certain extent why value chains have to adapt in the presence of new technologies. In effect, a new technology such as e-mobility can lead to activities eliminated from the system (e.g. producing the combustion engine) or new ones added to the system (e.g. installation of charging infrastructure). This change in the pool of activities will lead to actors going out or new actors coming into the system, or established authors reconfiguring their own system of activities and establishing links to other actors, while possibly relying on other types on resources than they used to rely on in the past.

2.2 E-mobility and Business Models

Simply speaking, a business model refers to how companies make money. In the 20th century, the automotive industry could develop highly profitable business models around the internal combustion engine (ICE). For instance, German car manufacturers could develop sophisticated cars and evolve to successful and profitable companies worldwide. Since the beginning of the 21th century, and the re-emergence of e-vehicles as possible substitutes for ICE vehicles, the competitive environment in the automotive industry started to change, making it possible for new players such as Tesla and some Chinese manufacturers to enter the market, while causing a serious threat for the established manufacturers.

As it is usually the case when new technologies appear, companies need to adapt their business models in order to accommodate the new technology. The business models that functioned well with the old technology are rarely those that will ensure a successful commercialization of the new technology. In addition, business models are so important that an acceptable technology combined with an excellent business model is much better than a sophisticated technology commercialized by a mediocre business model (Chesbrough 2006).

For the term business model, there is no generally accepted definition. For example, Osterwalder et al. (2005) understand a business model as "a conceptual tool that contains a set of elements and their relationships and allows expressing the business model logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams". Abdelkafi et al. (2013) define business models as the description of "how the company communicates, creates, delivers and captures value out of a value proposition." In contrast to this value-based view on business models, the activity-based approach describes business models by considering them as a bundle of interconnected activities (Zott and Amit, 2010).

The value creation process, as part of a business model, depends not only on the company's internal resources and processes, but also on partnerships with other companies. A business model has to be economically viable. Hence, the value chain, in which a company interacts, has essential impact on a company's business model. The position within a value chain and the company's negotiation power with upstream and downstream companies influence significantly the company's margin, which again has an impact on the design of the business model. Furthermore, the scope of value chain activities a company takes over limit the design possibilities of business model. For instance, a company that only produces electric vehicles has fewer options in designing business models than a company that not only produces and sells electric vehicles, but also operates charging infrastructures.

3. Research Design

The research aims to investigate how the value chain of e-mobility will look like in the future. In particular, the following questions are in the scope of the present study: (1) How is the value chain for e-mobility looking in the future? (2) How will be activities to be performed re-allocated over the value chain, if any?, and (3) Who will be the dominant actor in the value chain and under which conditions?

The research methodology relies on the Delphi method in two phases: an exploration phase and an evaluation phase that combine qualitative research by conducting expert interviews and quantitative research by conducting a structured survey

analysis to identify the activities required in the e-mobility value chain and the actors that may execute these activities. Data collection took place between 04/2013 and 01/2014.

As a first step, we conducted a literature analysis in preparation for the Delphi study. We identified value chain activities in the automotive industry for a closer consideration in the following steps. Subsequently, we identified the sectors, in which we looked for key informants in the area of e-mobility. The key informants come from OEMs, automotive supply, charging infrastructure construction and operation, energy generation and supply, or from companies that can constitute large customers of e-vehicles such as logistics.

For the selection and segmentation of contacts, we used several sources. A big share of the contacts stemmed from Automotive Cluster Ostdeutschland (ACOD), a networking platform of OEMs, suppliers, service providers, research institutes and other institutes belonging to the automotive industry in eastern Germany. We assumed that actors of the automotive industry in general were well-informed about e-mobility due to the high economic, technical and political relevance, thus representing viable contacts for our research objectives. Other contacts derived from the research project, within which this study was conducted, from competence atlases of different model regions as well as from fairies and conferences on e-mobility. Furthermore, we identified contacts by a web search including speakers and member lists of congresses and associations such as Forum Elektromobilität.

The interview guideline included following thematic parts: current situation, impact of e-mobility on collaborations, impact of e-mobility on the position in the value chain, trends, and transitions within the value chain and business models. The basic guideline version was also adapted for actors from the energy industry and logistics providers.

As second step, the first round of the Delphi study was conducted by using guideline-based expert interviews. The guideline was used as a framework, but the interviews were conducted openly, so that the collection of individual information from the heterogeneous interviewees has been ensured. 83 phone interviews were carried out with actors along the automotive value chain.

For the second phase, an online survey was used to validate and enhance the elaborated e-mobility value chain derived on the basis of the expert interviews. Additionally, this phase provided the opportunity to go into more detail in some questions that were not treated in depth during the interview study. The closed questions guarantee that the data can be analysed quantitatively. In addition, the online survey selected certain questions depending on the answers of the respondents. Some sets of questions were shown randomly to ensure the coverage of all open questions. The questionnaire was sent partly to the interview partners of the first round, and partly to other potential respondents. In this way, 449 experts were invited in total, from which 80 has been interviewees from the first round. From this total population, 153 (34%) answered to the questionnaire, whereas only 96 (22%) finished it by responding to all questions.

4. Findings

4. 1 The E-Mobility Value Chain – Conceptual Thoughts

The E-Mobility value chain (**Fehler! Verweisquelle konnte nicht gefunden werden.**) is composed of three separate value chains, which are combined together: (1) the electricity value chain, (2) the charging value chain, and (3) the automotive value chain. The electricity value chain consists of four types of activities: electricity generation, trade, transport, and sales. The charging infrastructure value chain starts with the manufacturing of components and modules for the charging stations. In a second step, these components are assembled into charging stations, which can be commercialized and sold to private persons and individuals. A fourth activity in the charging station value chain is related to the planning and construction of the charging stations along the highways or in parking areas. The fifth activity is about operating the charging infrastructure. The automotive value is represented by four activities: component manufacturing, module assembly, car manufacturing and sales/distribution. All value chains provide a bundle of services that are combined in order to satisfy the mobility needs of customers.

It is noteworthy that the value chain contains the types of activities that can be conducted by actors along the chain. This does not mean that there is a one-to-one assignment of an activity to an actor. In other words, one actor in the value chain can take over many activities, or one activity can be shared by different actors. According to the activity-based view of business models, the business model of the actor depends on the activities that he carries out within the value chain.

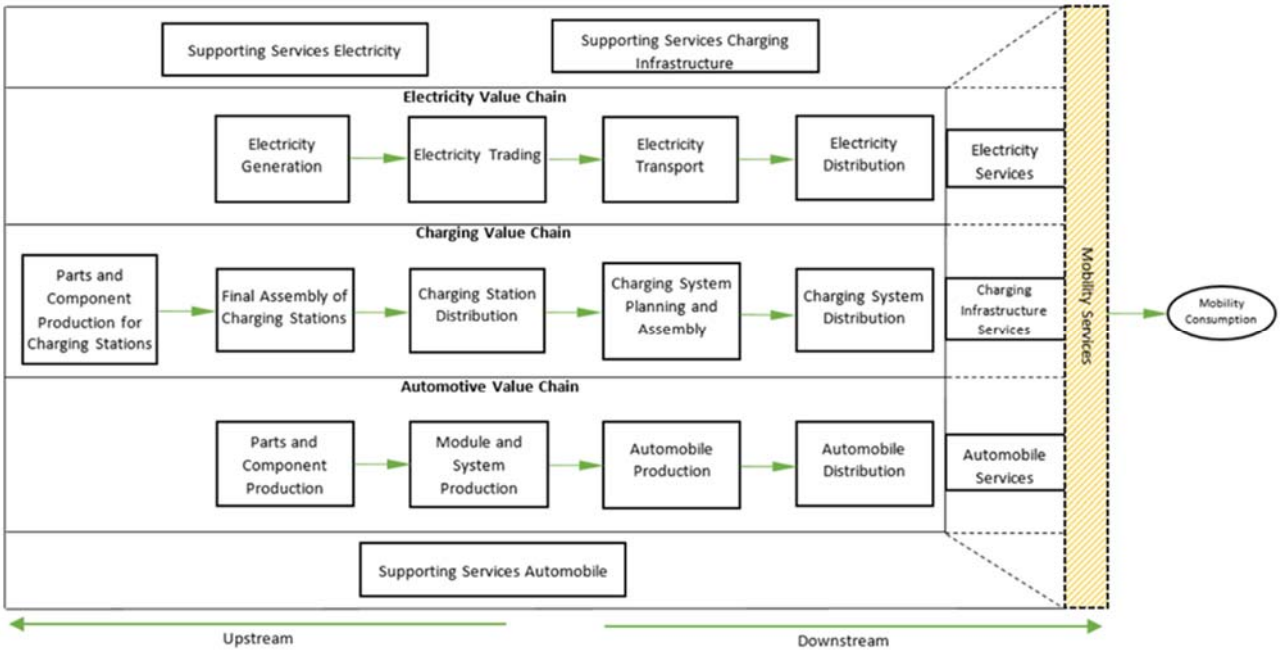

Figure 1: E-mobility value chain

Table 1: Overview of sub-scenarios from the online survey

Activities	Electricity services	X		X													X
	Charging infrastructure services	X	X	X			X	X							X	X	X
	Automobile services													X			X
	Supporting services electricity	X															
	Supporting services charging infrastructure								X								
	Supporting services automobile										X						
	Mobility services														X	X	
	Parts and component production automobile									X	X	X					
	Module and system production automobile									X	X	X	X				
	Automobile production									X							
	Automobile distribution													X			
	Parts and component production for charging stations					X	X					X					
	Final assembly of charging stations					X	X					X					
	Charging station distribution		X			X			X			X		X			
	Charging system planning and assembly			X	X			X	X						X	X	
	Charging system distribution			X	X			X							X	X	
	Electricity generation				X												
	Electricity distribution	X	X	X										X			
	Bundles	Energy distribution and services	Energy generation and public charging infrastructure Distribution of energy and charging infrastructure	Provision of public charging infrastructure and electricity distribution	Energy distribution and public charging infrastructure	Production and distribution of charging infrastructure	Customized charging infrastructure	Operation of public charging infrastructure	Provider and installer of charging infrastructure	Supply production and manufacturing of electric vehicles	Production of supply products and consulting	Manufacturing of supply products for vehicles and production of charging infrastructure	Supply production including customer-oriented services	Joint distribution of energy, charging infrastructure and electric vehicle Energy generation and public charging infrastructure	Mobility services and operation of charging infrastructure	Own mobility and charging infrastructure offer	Full-service offer
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

4.2 The E-Mobility Value Chain and Business Models – Results from the Interview Study

The expectations of the experts regarding the future development of e-mobility are related, in particular, to the value chain and business models. Whereas at least in theory, new technologies can lead to a reconfiguration of the value chain, giving rise to new activities and to a redistribution of activities among actors, this does not mean that this will actually happen. Therefore, it was important in the interview study to get the estimations of the interviewees, whether they also expect a change in the value change due to e-mobility. The interview partners confirm the important impact of e-mobility on the value chain. In general, a change in the value chain because of e-mobility is expected, as illustrated by an Original Equipment Manufacturer:

> *"With electric mobility, the value chain is changing."*

With respect to business models, e-mobility seems to give rise to new opportunities for business. More importantly, mobility will have serious implications on the way of doing business. But these business model changes seem to not only take place in the main value chains that produce and sell electricity, charging stations, and e-cars, but also in the service areas that act as enabling for e-mobility such as logistics providers. A logistics company describes this change as follows.

> *"When end users embark more and more on e-mobility, new business model opportunities will arise for us."*

Nevertheless, not all companies will have to change their business models necessarily, as explained by one regional supplier of electricity:

> *"I say: Cobbler, stick to your last! So we want to be a credible, good energy provider."*

For the future, companies may embark on different value chain strategies. For instance, they may expand their activities along the value chain. For instance, an automotive supplier mentions that his company may envisage selling e-cars in the future:

> *"I could also well imagine that we would sell vehicles. [...] We install a cross-brand e-mobility center."*

In addition, companies may enter into a new value chain. For instance, an automotive supplier can take over the manufacturing and assembly of charging stations. One supplier arguments this by stating that if there are no major growth rates in one field, it is important to look for other areas in order to make money. Furthermore, e-mobility can lead to the creation of new product service systems by identifying new combinations of products and services such as the manufacturers that sell energy contracts.

In general, it can be said that the interview partners have different views with respect to the impact of e-mobility on the value chain. In other words, having different expectations regarding the future are rather the rule than the exception. These different opinions can be illustrated by the following statements made by two vehicle manufacturers:

> *"Today we agree that you can really differentiate yourself from the competition through the engine and the battery system."*
> *"I believe that the components for the electric vehicle will be commodities in the future."*

4.3 The E-Mobility Value Chain and Business Models – Results from the Online Survey

An actor can cover several activities of the e-mobility value chain. We combine these activities into so-called bundles. Based on the results from the interview study and an extensive literature analysis, we identify 16 relevant bundles such as "Distribution of energy and charging infrastructure" or "Supplier production of components for vehicles and charging infrastructure". An overview of these bundles is provided in Table 1. In the online survey, we ask questions regarding the actors that are more likely to offer these bundles in the future. Furthermore, we ask about the general conditions that are conducive for each of these bundles. Since we have 16 bundles of activities, each respondent cannot evaluate all bundles, but only a subset of them, as answering all of them would need a lot of time. Because the respondents come from different areas in the value chain, each one estimates the future activities of the value chain of his or her company and two randomly selected bundles of activities out of the remaining ones. These cross-questions (i.e. an actor evaluating a bundle that is not related to the own company) can capture the views of respondents on areas of the value chain, in which they are not operating. A major result is that the expectations of actors regarding their respective fields are different from what other

actors think of that particular field. For instance, we found that electricity producers were optimistic with regard to the number of e-cars in 2025, as the majority expect that Germany will be able to reach one million BEVs by 2025. However, they are pessimistic regarding the number of charging stations across Germany, since most of electricity producers believe that a good coverage of charging stations is not achievable by 2025. The automotive manufacturers, on their side, believe that the charging infrastructure will achieve by 2025 a good coverage, while the number of e-cars will stay below the target. This means that each of both actors is optimistic with respect to the activity of the other actor. It is a typical chicken-egg problem.

Regarding the general conditions, we identify two different types. The first type refers to market development and the second to political conditions, in particular the level of governmental support. Data suggest that, under certain conditions, an actor can occupy a dominant position in the e-mobility value chain and can carry out several bundles of activities. Overall, we identify three main scenarios that actually reflect the dominance of large OEMs, utilities, and service providers (Figure 1).

The **first scenario** is referred to as "Large companies". A relatively good development of the market for electricity storage (battery) and plug-in hybrid vehicles characterizes this scenario. Due to good technological development (e.g. driving range, battery cost), there is only a small need for political and regulatory support of e-mobility. In this scenario, a few large companies take on high levels of value creation in e-mobility by carrying out activities from all three value chains such as the manufacturing and sale of electric vehicles, the provision of a (private) charging infrastructure and, in part, the sale of electricity. In this scenario, energy producing companies take over, in addition to power generation and supply, the task of planning, construction and operation of public charging infrastructure.

The **second scenario** is called "Energy producing companies". This scenario is characterized by a moderate market development and moderate political intervention. The incumbents retain their position within each of the three value chains, and there are only slight shifts in the entire value chain, leading some actors to take over small shares of activities outside their own value chains. In this scenario, energy producing companies have the largest potential to develop to a dominant player in the e-mobility value chain. The established energy companies maintain their strong position in power generation, and serve a large part of the market for public and private charging infrastructure. The increased diffusion of smart grids will be also favorable for energy producing companies to expand the public charging network, as compared with companies from other industries.

The **third scenario** is referred to as "Service providers" and characterized by a slow market development. The stock of battery-electric vehicles with and without range extender as well as plug-in hybrid vehicles is comparatively low and remains below expectations, which is also due to the slow technological development, especially in the area of electricity storage technology. Due to the weak market development, the government initiates many funding opportunities. These include monetary and non-monetary incentives, such as restricting the use of internal combustion vehicles or creating privileged parking facilities for electric vehicles. This leads to the emergence of a rather heterogeneous market for e-mobility. In addition to the established players, new companies, in particular service providers, enter the value chains as niche suppliers and take over on significant market shares.

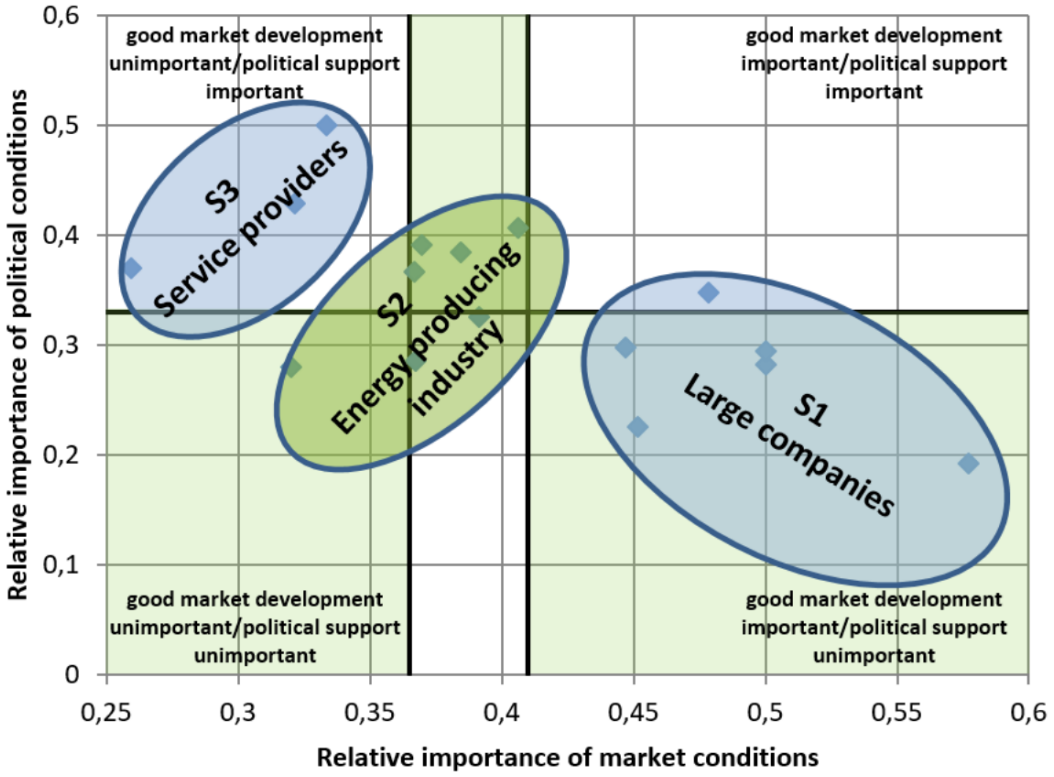

Figure 1: Future possible scenarios for e-mobility

5. Managerial and Research Implications

This research maps the e-mobility value chain and illustrates its complexity due to the presence of three interdependent, but somehow separate value chains. In these value chains, different actors play different roles and might take the lead of different activities following various configurations. The evolution of the e-mobility value chain is therefore difficult to be foreseen, thus the need to develop scenarios. In fact, developing scenarios can help one to understand how roles in the value chain and how activities may be redistributed among actors.

First, the interviews show that at the moment the e-mobility value chains is blocked by a chicken-egg problem. Moreover, political support and market conditions might vary, thus leading to three different scenarios. From a policy maker perspective, this paper provides support to the definitions of incentives to the sector. In particular, incentives are needed when technological development of electricity storage systems is slow.

Second, this research provides guidance to the actors in the e-mobility value chain to position themselves adequately and to integrate the activities that enable them to survive, after the automotive industry makes the transition toward the new technology. In fact, it suggests the direction that large companies can take in the future in order to leverage the market for e-mobility products. In particular, in order for the e-mobility system to start functioning effectively, results suggest that two main options are open to large companies: either (1) internalize some activities, especially with respect to the charging infrastructure, and sell bundles of e-vehicle and electricity, or (2) collaborate intensively and build trust relationships with energy suppliers. Moreover, the focus should be more on business customers that buy new cars, and less on private customers that might not be so interested in e-mobility. It becomes clear that due to e-mobility, companies may lose value-added activities to competitors as well as their ability to differentiate themselves. Thus, to prevent a migration of value-added activities to other actors that can lead to a loss of their current leading position in the automobile industry, OEMs need to anticipate such a future development. By taking over activities from the electricity and charging value chain as well as upstream (e.g. battery technology) and downstream processes (services), OEMs might defend their leading competitive advantages. This could be achieved through corporate acquisitions, or if OEMs embark on partnerships with actors from within as well as from outside their traditional automotive value chain. Nevertheless, a study by Späth et al. (2016) has shown that incumbent firms in the automotive industry try to slow down the transition process to electric mobility by fending off radical innovations, and this might increase the risk of giving up technology leadership.

Third, as far as research is concerned, results suggest that the focus of the research should be moved from technology to value chain management and business model. Put differently, the effort now should be placed in helping companies finding ways to build business models to sell e-cars profitably, and design and manage efficiently and effectively their value chains. Once the business model is in place, when production has ramp-up, then changes and improvement to the technologies can be implemented, in line with innovation diffusion literature (Rogers 2003).

6. Conclusions and Directions for Future Research

E-mobility will have broad implications on the value chain in the automotive industry. First, e-mobility combines three types of value chains: electricity production, charging infrastructure, and automotive, which were not necessarily coupled in the past. In addition, e-mobility will redistribute the activities within the value chain, leading to some actors taking over new activities, others losing activities, and even leaving the value chain. Third, three main scenarios with large implications for business models are possible in the future. In the first scenario, the automotive manufacturers will continue leading the whole value chain, but this is not guaranteed, as the Original Equipment Manufacturers (OEMs) in the car industry may have to give up their leading position, by losing control in favour to other actors. Thus, in the second scenario, energy providers take a lead position, whereas in the third scenario the service providers are those who have a dominant role in the value chain. Whether scenario one, two, or three, will really emerge depends on market conditions (acceptance of e-cars by customers and volume of e-cars sold) and the level of support that the government will allocate to e-mobility. For instance, good market conditions will be favourable for the first scenario, in which the OEMs are in the lead positions.

Future research can focus on the conditions that enable the e-mobility value chain to function. The chicken-egg problem of e-mobility can be effectively solved, if we identify the critical point that has to be reached, in order for the system to embark on self-reinforcing loop, leading to more e-cars and more charging stations. This critical point may be identified by using system dynamics modelling of e-mobility systems within a specific region.

From a microeconomic point of view, the future changes in the automotive value chain will probably have significant impact on value creation. However, research on entrepreneurial and incumbent firms revealed differences in their ability to innovate and, thus, to react to the impact of changes in the value chain on their business models (Bohnsack et al. 2014; Budde Christensen et al. 2012; Dijk et al. 2016; Wesseling et al. 2014; Sierzchula et al. 2012). Business model research might reveal important insights in this regard. So far, technology was usually the responsible element for the initiation of changes in business models in order for companies to be able to further take part in the value chain. Rarely, however, did companies anticipate changes, by starting to adapt their business models early enough to be prepared for the technological change when it becomes relevant. Hence, business model research that deals with different branches might help us to learn how to cope with change that is triggered by external forces. To adapt successfully to external changes by modifying the firms' business models, companies must realize that the necessity of change and associated processes can permeate all company levels and activities (Sosna et al. 2010). This can constitute a direction for future research, in which research can explore to which extent business model innovation can ease the accommodation of new technologies and the transformation of value chain networks.

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