Managing arising barriers through the involvement of stakeholders in the first stage of the product-life cycle of electric vehicles

Author: Tabea Sippel
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

ABSTRACT, This paper deals with the different key stakeholders of electric vehicle manufacturers and the potential barriers that arise through their involvement during the introduction and market launch of an innovative product. Electric mobility is a promising environmental friendly alternative for combustion engines and fulfills the customers demand for 'greener' products. At the moment, Tesla Motors is one of the market leaders, but also companies like Apple Inc. and Google Inc. want to enter the market to challenge Tesla Motors. The different manufacturers of electric vehicles are currently located within the Introduction stage of the product-life cycle and try to commercialize their product. The commercialization and diffusion process of electric mobility is limited through different barriers. On the one hand, key stakeholders like governments, battery producers, electricity providers and customers create barriers and on the other hand they are also able to support manufacturers, to successfully overcome them. For example, lower prices for lithium ion batteries would reduce the total costs for an electric vehicle and could reduce the customer resistance. Another weak point is the poor charging infrastructure. The skepticism and customer resistance towards the new electric mobility is a key barrier, which could be overcome through a complex relationship with all stakeholders or by innovation networks, for example.

1st Supervisor: Dr. ir. Sandor Löwik
2nd Supervisor: Dr. Matthias de Visser

Keywords
Electric vehicles, electric mobility, key stakeholders, product-life cycle, innovation adoption, customer resistance

5th IBA Bachelor Thesis Conference, July 2nd, 2015, Enschede, The Netherlands.

1. INTRODUCTION

1.1. Relevance of topic

As a consequence of increasing global resource shortage and the noticeable and visible consequences of the worldwide climate change, the pressure to operate 'greener' steadily grows on every organization and industry. Due to the fact that globally more than 90% of the organizations operating in the transportation sector use combustion engines (Van Vliet, Brouwer, Kuramochi, van Den Broek & Faaij, 2011), the industrial pollution is very extensive, especially the air pollution at the local, regional and global level (Gan, 2003). The pressure increased on the automotive industry to develop more eco-friendly, known as 'green' vehicles and engines. Another reason why the consumers demand on electric vehicles (EV) increased, are the rising oil and gas prices and furthermore, the great progress made in battery technologies (Kley, Lerch, & Dallinger, 2011). In general, an electric vehicle is a car with road-legal, which drives with an electric propulsion and without the conventional combustion engine (Qian, Zhou & Yuan, 2010). The general term electric vehicle is a very broad one, but can be divided into subgroups. Fully electric vehicles (FEVs) and fuel cell electric vehicles (FCEVs) are solely battery electric driven cars, but also hybrid electric vehicles are defined as electric vehicles, (Qian et al., 2010) although they have an internal combustion engine.

In 2000, the first Toyota Prius was ready for the American market, but the customer resistance towards electric vehicles was high (Høyer, 2008). Because of the novelty of electric mobility, customer resistance represents a key external barrier (Story, Daniels, Zolkiewski & Dainty, 2014), which needs to be overcome by the different car manufacturers through supportive activities from governments or financial service providers, for example. The different manufacturers rely on supportive initiatives from different institutions to make their innovations more attractive for consumers. Nowadays, electric mobility is seen as a promising eco-friendly alternative for internal combustion engines and in many countries, various external stakeholders, e.g. governments, support the emergence of the market (Van Vliet et al., 2011). The market for electric vehicles is still a new market where relatively new players, like the power supply industry and battery manufacturers are included (Kley et al., 2011). In general, the automotive industry is a $17 trillion industry that produces around 56 million new cars on an annual basis (Howard, Vidgen & Powell, 2003).

Because of more efforts made in R&D within the field of electric mobility, electric vehicles are now more popular and interesting for society and manufacturers of traditional cars with combustion engines. Especially Tesla Motors, Inc.[1], but also the BMW Group[2] or the Toyota Motor Corporation[3] recognized the demand and launched the first electric vehicles or hybrid cars into the market. Nevertheless, a very interesting fact is that Apple Inc.[4] tries to step out of its lucrative focus on mobile devices and hired different employees from the automotive industry, e.g. from General Motors Co. (Apple Said to Be Working on Electric Car to Challenge Tesla, 2015). Till now it is only a rumor that Apple Inc. is developing an electric vehicle, but in 2012 an Apple Board member said that co-founder Steve Jobs had wanted to build a car. However, it is already known that Google Inc.[5] is working on a self-driving electric vehicle (Apple Said to Be Working on Electric Car to Challenge Tesla, 2015). These are two big companies who want to enter the car market and also want to challenge Tesla as the only manufacturer of solely full battery electric vehicles. Even established car manufacturers like Porsche[6] plans to expand their product range with a new electric car to challenge Tesla. Both companies are operating in the luxury segment and by 2020 Porsche wants to launch their first electric vehicles, which could be another Panamera. In an interview Porsche CEO Matthias Müller said about Tesla Motors: "They have a pragmatic approach and set the standard, where we have to follow up now" (Porsche May Expand With New Electric Car to Challenge Tesla, 2015).

Furthermore, many electricity utilities and governments around the globe support the expansion of the market (Van Vliet et al., 2011), which alternatively means that completely new stakeholders for the automotive industry, for example battery manufacturers and governments, are now involved as relevant external factors (Kley et al., 2011). According to the involvement of new stakeholders, it is likely that those stakeholders can yield new barriers, which can influence the diffusion of electric vehicles, the value creation process and the achievement of the next stage within the product-life cycle (PLC). Barriers always evolve through the contribution of the different stakeholders in an industry, through strategic choices and of course differ these barriers within each stage of the PLC. In the near future the evolving barriers can differ between industrialized and developing countries. For example, China with its growing industries and broader transportation options face more difficulties to establish electric mobility faster. To sustain its growing demands, China is increasingly dependent on imported oil, which the country needs for its manufactories and not for private vehicles (Gan, 2003).

Based on the previous introduction and its argumentation, the following research question and sub-question evolved:

How can manufacturers of electric vehicles effectively overcome the main barriers that arise through the involvement of different stakeholders during the Introduction stage of the product-life cycle?

Sub- Research Questions:

- *What is the product-life cycle and what are characteristics of the Introduction stage?*
- *Which stakeholders are mainly involved in the market of electric vehicles?*
- *What are the most important barriers that can arise through involvement of key stakeholders?*
- *How can stakeholders influence the Introduction stage of an electric vehicle?*
- *What key resources are needed from the stakeholders to be successful during the first stage of the product-life cycle?*

During the Theoretical Framework part, the different models and theories will be explained more in-depth. Furthermore, the different potential stakeholders in the automotive industry will be mentioned and connected to the barriers they can evolve. Within the Results and Case Analysis part, each sub- research question will be answered and illustrated through the electric vehicle manufacturer Tesla Motors.

[1] http://www.teslamotors.com

[2] http://www.bmwgroup.com/d/0_0_www_bmwgroup_com/home/home.html

[3] http://www.toyota-global.com

[4] http://www.apple.com

[5] http://www.google.com/about/

[6] http://www.porsche.com

1.2. Background of the development of electric vehicles

In general we can say that the development of electric vehicles is highly dependent on the history and development of batteries, and already begun in the mid- 1830s when the first electric vehicles appeared in the US, the UK and the Netherlands. But fast charging batteries were a bigger challenge these days and since 1909 the Ford T-model with an internal combustion engine achieved high market dominance. However, also the Ford Motor Company[7] starts with the development process of a small urban electric vehicle in 1966 and the prototype was presented in 1976 (Westbrook, 2001). In the 1970s, governments and other parties recognized that energy supply would become a worldwide environmental problem in the near future (Høyer, 2008). Furthermore, the book 'The Limits of Growth' published in 1972 explicitly mentioned that globally an absolute limit of future growth for non-renewable resources exist.

Another very important milestone that supports the further development of electric vehicles and alternative fuels was the Kyoto Protocol (Høyer, 2008). This famous and revolutionary protocol is an international treaty, which was signed in 1997 by the member states of the United Nations and engaged these states to reduce their general gas emissions and the CO_2 emission in particular (Høyer, 2008).

At the end of the 20th century the Toyota Motors Corporation, the Audi AG[8] and Honda[9] launched their first hybrid models in different markets, focused more on the development of efficient batteries for solely electric vehicles and more R&D conferences for this topic took place (Høyer, 2008). Nevertheless, (potential) customers are still skeptical towards electric vehicles, due to their limited driving range and the long charging period (Sierzchula et al., 2014), which suggest that more R&D within this topic is necessary to fulfill the customers demand. Currently, firms like Tesla Motors or the BMW Group try to commercialize their electric models, to overcome the resistance and doubts of (potential) customers. But till the beginning of the 21st century, the development of electric vehicles was a history of many ups and downs.

1.3. Goal of study

The primary goal of the present study is to evaluate the main barriers that can arise through different stakeholders and how manufacturers of electric vehicles can reduce these barriers and their influence. Here, one highly important stakeholder are the customers with their doubts and resistance against the new technology. The focus on customers is important because they determine success or failure of a product, which means that they exert influence on the Introduction stage of the PLC. Other important stakeholders will be local and national governments and electricity providers, for example. Barriers could be missing financial incentives from the government, lacking in-depth knowledge or missing R&D opportunities.

Within this analysis the focus lies on the influence of the different stakeholder on the first stage of the PLC, namely the Introduction stage. Since there is a great costumer resistance (Story et al., 2014) and in most countries low support from the government to establish electric vehicles (Sierzchula et al., 2014), it is necessary to reveal different ways how these kinds of barriers can be overcome by car manufacturers.

[7] http://corporate.ford.com/homepage.html
[8] http://www.audi.com/corporate/en.html
[9] http://www.internationalhonda.com

According to a definition of Chiesa and Frattini (2011, p. 452) commercialization means "marketing an innovation with the aim of converting it into a profit-making position in the marketplace". In general, by the further commercialization of electric vehicles, it is obvious that also external stakeholders have to play a crucial role to guarantee long-term success and a profit-making position for all parties. In this literature review with a short case study, the main focus is on gathering and evaluating all relevant barriers within the electric mobility market, through the involvement of different key stakeholders.

1.3.1. Academic Relevance

In the present paper, the key focus lies on the different stakeholder types within the automotive industry and the arising barriers for electric car manufacturers through their involvement, and how those manufacturers can overcome different barriers on their own and/or with supportive initiatives from their key stakeholders. At the moment there only exist some studies, e.g. from Griffin et al., 2014, which highlight barriers of radical innovations in general or papers that focus on the traditional stakeholders within the traditional automotive industry, e.g. from Howard et al., 2003. This paper will analyze the different key stakeholders for manufacturers of electric vehicles and illustrate their influence on the basis of a case analysis.

1.3.2. Practical Relevance

With regard to the practice-oriented impacts, it is expected that the paper can support electric car manufacturers while planning the market launch of an (new) electric vehicle. On the one hand it will determine the influence of different stakeholder on the long-term success and the acceptance of electric mobility in society. On the other hand, it will highlight the main barriers at the first stage of the product-life cycle and demonstrate different methods, how the automotive industry can try to overcome these barriers.

This paper is structured as follows. In the Theoretical Framework part, all concerns of the electric mobility industry and its stakeholders will be explained in depth. Afterwards, the methodology is covered, which is used for the analysis part. Therefore, a detailed description of the product-life cycle and especially of the Introduction stage is necessary. Furthermore, different potential types of stakeholders will be evaluated and in the end a short case analysis of Tesla Motors will illustrate the different findings. Lastly, a discussion and conclusion of the result and analysis part will be provided, as well as limitations and future predictions.

2. THEORETICAL FRAMEWORK

The following section will elaborate a literature review on the development of electric vehicles and all relevant components.

2.1. Product-Life Cycle and Valley of Death

The term product-life cycle was first named in the 1960s and 1970s and should provide a management practice for successful planning of product strategies (Ryan & Riggs, 1997). But the product-life cycle itself was already introduced during the 1940s and the concept evolved from the diffusion theory and adoption of innovation. Since that time many researchers wrote management-oriented books and scientific articles in which they discuss the PLC (Rink & Swan, 1979). One of the most influential articles that build on the work of Mueller and Tilton (1969), was written by Abernathy and Utterback (1978). For their analysis they also used the automotive industry as a case

(Klepper, 1996). Traditionally, the product-life cycle is a bell-shaped curve, as shown in Figure 1, and is divided into four different stages: (1) Introduction, (2) Growth, (3) Maturity, and (4) Decline stage. Within this present study, the focus lies on the first stage of the product-life cycle where the diffusion process is at its very beginning and Innovators represents the relatively small customer group (Onkvisit & Shaw, 1986).

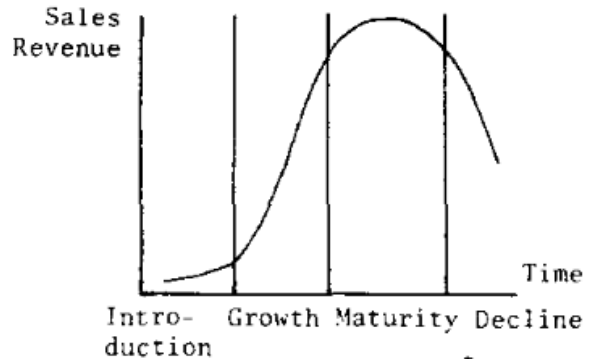

Figure 1. Classic bell-shaped PLC (adapted from Rink & Swan, 1979).

Within the Introduction stage of the PLC, typical characteristics are the minimal amount of competitors, but also high total costs and high risks for the innovative company (Onkvisit & Shaw, 1986). During the first stage of the PLC a lot of firms enter the industry and everyone offers a variation of the product (Klepper, 1996), due to low entry barriers. Typical characteristics of the Growth stage are the growing amount of operating firms and the condition that companies generate profit.

The fact that Tesla Motors do not make profit, probably till 2020, indicates that the company is still located within the Introduction stage (Tesla bleibt noch bis 2020 ohne Gewinn, 2015).

During the Maturity stage, the entry barriers are very high and the most firms are still established in the market. Therefore, the number of competitors also stays stable and now all these companies form kind of a market structure (Onkvisit & Shaw, 1986). In the last stage of the PLC, the last individuals, so-called Laggards, adopt an innovation as latest (see also Figure 4). This implies that the diffusion process of an innovation is completed. But the overall market is declining and financially unattractive for bigger companies, wherefore they leave the market and often only very specialized companies try to remain in the market (Onkvisit & Shaw, 1986).

Diffusion Process (Unstable Demand: Consumer Behavior)	*PLC Stage (Unstable Sales)*	*Monopolistic Competition (Unstable Competition: Corporate Behavior)*
Innovators	→ Introduction	← Monopoly
Early adopters	→ Growth	← Monopolistic competition
Early majority/ late majority	→ Maturity	← Monopolistic competition/ oligopoly
Laggards	→ Decline	← Not applicable

Figure 2. Theoretical Foundation of PLC (adapted from Onkvisit & Shaw, 1986).

In general, the concept of the PLC is based on absolute sales levels over time and the resulting changes over time. This means that *instability of demand* and *instability of supply* are major causes for a product behavior during the PLC (Onkvisit & Shaw, 1986). Furthermore, there are also critics of the PLC like Porter (1983) who argues that the PLC is "an imprecise concept that does not appear to apply to all new products, especially ones for which buyer tastes are diverse" (Klepper, 1996, p. 563). Another critical view, substituted by some researchers, predicts that the concept of the PLC "ignores the competitive setting of the product and the relevant profit considerations" (Onkvisit & Shaw, 1986, p. 51).

The Valley of Death theory also explains the difficulties of technologies to become a product concept or product development (Griffin, Price, Voyak & Hoffman, 2014). As shown in Figure 3, the Valley of Death represents the space between opportunity discovery and product development (Markham et al., 2010). The problem of the Valley of Death is always present during the Introduction stage of the PLC. Within this stage, companies try to cross the Valley of Death to develop and commercialize their product or service. The term Valley of Death is not as old as the term product-life cycle and was employed by Bruce Merrifield (1995). From its original meaning the term is nowadays further extended to characterize the funding handoff from governmental to private sources of renewable energy technologies, which in this case also implies electric vehicles (Markham, Ward, Aiman-Smith & Kingon, 2010).

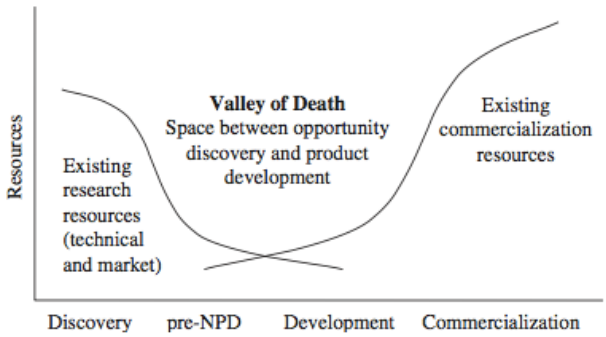

Figure 3. The Valley of Death (adapted from Markham et al., 2010).

The commercialization of a product or service as one aim after 'crossing the valley of death' is always a critical area of the innovation process (Chiesa & Frattini, 2011) as already mentioned in the Introduction part. The process of commercialization also includes the launch and market introduction of a product or service, which indicates for the case of electric vehicles, that those manufacturers still operates in the Introduction stage of the PLC.

It is obvious that the first three stages of the Valley of Death are finalized before a company enters a market and consequently are positioned in the Introduction stage with its product. Because within the Introduction stage, companies of an industry offer already developed products and try to commercialize their variation of the product or service. Furthermore, Crawford and Di Benedetto (2008) define commercialization as "the moment of facing markets and disseminating the innovation". This means that the commercialization part of the Valley of Death can be implemented within the Introduction stage of the PLC.

2.2. Diffusion curve of Rogers

Rogers (2002) model of innovation adoption represents the trajectory of the diffusion of an innovation over time (Figure 4). The original curve was developed by Rogers (2002) but the used model within the present study was adapted from the book "Managing and shaping innovation" by Conway and Steward (2009). The bell-shaped curve is categorized in five 'ideal-types' of individuals in a social systems, according to their degree of innovation adoption. 'Adoption' and 'diffusion' go

hand in hand because diffusion of an innovation only occurs through its adoption by consumers (Conway & Steward, 2009).

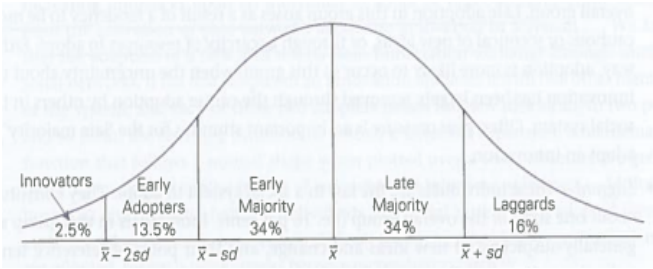

Figure 4. Adopter categorization on the basis of time of adoption (adapted from Conway & Steward, 2009).

In the following each of the five-adopter categories will be explained separately:

1. Innovators: Sometimes 'innovators' can act proactively in importing an innovation into a specific society. In such cases they represent the 'connector' between social systems that may be geographically or socially distant (Conway & Steward, 2009). However, 'innovators' represent only the first 2.5% of the individuals that adopt an innovation. These individuals are very interested in new ideas and they are the first who adopt an innovation (Rogers, 2002).

2. Early Adopters: The 'early adopters' represent the next 13,5% of individuals in a society who adopt new product or service ideas (Rogers, 2002). Their position is more centralized within a communication network, wherefore they can have a major impact on the adoption of an innovation (Conway & Steward, 2009).

3. Early Majority: The next 34% of the individuals in a society adopts an innovation just before the average person. Those individuals' play an important role in the diffusion process through building a critical mass of adopters, for example (Conway & Steward, 2009).

4. Late Majority: This group of individuals is the next 34%, which adopts innovations after the average person in a society (Conway & Steward, 2009). The late adoption of innovation may be a result of skepticism towards the innovation.

5. Laggards: Laggards are the last 16% of individuals that adopt an innovation. These late-adopters are skeptical of new ideas and only accept innovations if other people around them are satisfied with it (Rogers, 2002).

The connection between Rogers (2002) model and the traditional four-stage PLC is illustrated in Figure 2. Onkvisit and Shawn (1986) already assigned the different categories from the diffusion model to the four stages of the PLC.

2.3. (Green) Stakeholders

A meaningful quotation from Fineman (1997, p. 36) says that: "Thinking and feeling green is a fickle process in the automotive industry". Still in the 1990s the automotive industry was seen as environmentally disastrous through the great use of different materials, e.g. plastics, chemicals and steel (Fineman, 1997), and in general it was recognized that the overall pollution from industrial organizations continuously increases (Schot & Fischer, 1993). The rise of industrial pollution also increases the depletion of stratospheric ozone and the greenhouse effect, for example. These developments lead to more green education, green consumerism (Fineman, 1997) and a growing demand for green products and services. The electric vehicles are often seen as green innovation products and particularly eco-friendly. But what do researchers mean if they use such terms in actual research papers. According to Driessen and Hillebrand (2002, p. 3344) green innovation does "not have to be developed with the goal of reducing the environmental burden". In contrast, Oltra and Saint Jean (2009, p. 657) define such innovations as "innovations that consists of new or modified processes, practices, systems and products which benefit the environment and so contribute to environmental sustainability". Due to the eco-friendly aspects, the European INNOVA panel concludes "eco-friendly innovation means the creation of novel and competitively priced goods, […] that can satisfy human needs and bring quality of life to all people with a life-cycle-wide minimal use of natural resources (cited from Reid & Miedzisnki, 2008, p. 7).

According to Fineman and Clarke (1996), the most influential stakeholders are customers, creditors, and employees who are able to influence the success and failure of a whole company. Additionally, governments, competitors, NGOs and supplier are generally thought to qualify as potential or actual stakeholders (Mitchel et al., 1997). Another definition from Freeman (1984, p. 46) states: "a stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization's objectives". A more modern definition from Donaldson and Preston (1995, p. 85) define stakeholders as "persons or groups with legitimate in procedural and/or substantive aspects of corporate activity".

In the electric vehicles market among others national and local governments, electricity providers, and producer of high-efficient batteries play a very important role as stakeholders (Van Vliet et al., 2011; Kley et al., 2011). Regulatory parties, like governments, try to apply environmental laws to protect the society from environmental harm (Fineman & Clark, 1996), to reduce the greenhouse effect or minimize global warming. Another influential stakeholder party in the electric vehicles industry are the consumers of electric mobility products. Nowadays, consumers have a deeper indirect interest in the environmental performance of a company if they prefer to buy green and eco-friendly products (Fineman & Clark, 1996). Through the European Union (EU) and national governments within Europe, environmental regulations are now more established in the automotive industry than at the end of the 20th century. For example, the EU has set targets for the use and development of renewable energy, and reducing carbon emissions in the next decades (European Commission, 2010). Furthermore, many national governments have set penetration targets for the introduction of electric vehicles till 2020. For example, Germany wants to achieve an amount of 1 million licensed electric vehicles by 2020 (Loisel, Pasaoglu & Thiel, 2014). And the Dutch national government wants 250,000 electric vehicles to drive on Dutch roads by 2025 and become an international test bed for electric vehicles in general and for smart charging infrastructures in particular (Bakker, Maat & Van Wee, 2014). To achieve such targets, the national governments as one of the key green stakeholders in the electric vehicle and automotive industry have to support the manufacturers and other stakeholders to successfully overcome the resistance to change of consumers, to succeed with the Introduction stage of the product-life cycle.

Cooperation between a set of key stakeholders is needed in the changing automotive industry to produce affordable vehicles (Bakker et al., 2014), which fulfill the demand of (potential) customers and promote innovation adoption. Within its 'Stakeholder salience theory' Mitchel et al. (1997, p. 854) identify one to three possible relationship attributes of stakeholders: (1) Power, (2) Legitimacy, and (3) Urgency. In this case power is the extent to which a group has "access to coercive, utilitarian or normative means for imposing its will in

the relationship". Legitimacy is defined as "a desirable social good". Urgency is "based on time sensitivity and critically". These attributes are no steady variables and are socially constructed (Mitchel, 1997).

2.3.1. *Barriers of Green Radical Performance and Innovation*

Generally speaking, all organizations are confronted with both internal and external barriers, which sometimes dramatically minimizes their radical innovation effort (Story et al., 2014). The innovation literature often makes a clear distinction between radical and incremental innovation. Radical innovations often replace existing innovation on the basis of prevailing technology, to deliver new and improved performance and functionality to the consumer (Conway & Steward, 2009) and maybe to fulfill new demands. In case of the electric vehicle, the conventional car represents the existing innovation and the further developed batteries represents the technology, which improves the performance of vehicles and is environmentally friendly. In contrast, an incremental innovation provides minor or major improvements in performance and functionality to an existing innovation. It can be described through the 'experience curve' or so called 'learning by doing' (Conway & Steward, 2009).

For the development process of a radical innovation, different skills and competences are required than for incremental innovation. This also means that innovative companies, like car manufacturers, have to involve internal and external stakeholders because ones interactions and business relation have a considerable influence on radical innovation (Story et al., 2014). Naturally, internal and external barriers exist, which may be related to specific stakeholders. During the Introduction stage of the PLC, typically organizational or internal barriers could be a general lack of know-how (González-Torre, 2010) or a restrictive mindset and insufficient resources (Story et al., 2014). Another internal barrier could be a lack of commitment on the part of management (Zhu et al., 2008a). According to Story et al. (2014), the main barriers relate to resistance or lack of support from external stakeholders.

In the electric vehicles industry, the customer resistance towards the new battery technology, the short driving range of electric vehicles and the recharging time is still high. Other external barriers could be reluctance on the part of national and local governments or a deficient industrial infrastructure (González-Torre, 2010).

2.3.2. *Overcoming Barriers*

The management of PLCs has gained attention in the last decades within the field of production and engineering management (Cao, Folan, Mascolo & Browne, 2009). Both fields are relevant for the long-term success and adoption process of green products and services. According to Gmelin and Seuring (2014, p. 1), a product-focused management approach is necessary for a "jointly sustainable new product development on grounds of cross-company processes, data and people". At the beginning of the 21st century the attention from governments and industries only increased recently but such concepts are becoming more and more important to be environmentally friendly (Kley et al., 2011). Therefore, different barriers within the electric vehicle industry have to be overcome, to successfully increase the acceptance of electric mobility as priority area.

Additionally, to the great customer resistance to change and the skepticism towards electric mobility, customers are also becoming more price conscious and the demand for quality of services and for individual specifications within cars grows (Howard et al., 2003). To overcome the resistance barrier of consumers as stakeholders, the purchasing cost of an electric vehicle needs to become lower. Currently, the running costs of an electric vehicle are relatively low, but these costs do not stand out sufficiently on a total costs basis (Kley et al., 2011). Batteries have a high impact on the total buying price within the cars. For example, the price for a battery of Tesla's Model S begins at $56,500 (McCall, n.d.). To effectively lower these essential costs, more R&D is necessary to develop the current battery technology. Therefore, Tesla Motors is now building its own Gigafactory in Nevada, USA to produce electric vehicles and cheaper batteries in a sufficient volume. Tesla Motors plans to open their Battery Gigafactory by 2016 (Porsche May Expand With New Electric Car to Challenge Tesla, 2015). The name Gigafactory comes from the planned battery production capacity of 35 gigawatt-hours. Furthermore, 'giga' is a measurement units that represent 'billions' (www.teslamotors.com, 2015).

Another field that urgently needs further developments is the charging infrastructure as main area within electric mobility (Kley et al., 2011). Therefore, charging places need to be available in public and maybe at work but further, places at home are needed that consumers can recharge their electric vehicles off-peak (night from 23:00 to 07:00) (Van Vliet et al., 2011).

Overall, it is necessary that governments as external stakeholders support the diffusion of electric vehicles more in-depth, through tax incentives for example. Nowadays, governmental restrictions towards products with sustainable characteristics continuously increase (Gmelin & Seuring, 2014) from national policy-makers but also from the EU. Furthermore, electric vehicle manufacturers want to overcome the different barriers that arise during the Introduction stage of their products, because they recognized that through the growing demand, products with sustainable characteristics can create a competitive advantage in the market (Maxwell & van der Vorst, 2003; Campbell, 2007).

3. METHODOLOGY

In order to identify the influence of key stakeholders on the market launch of electric vehicles, the present paper already analyzed numerous academic articles concerning the topic of electric mobility and its core components. For the literature review part, the raw data were mainly obtained by making use of electronic academic search engines like Google Scholar, Scopus, Web of Science and the online library of the University of Twente.

The key search terms used in order to get access to relevant academic article were primarily 'electric mobility', 'electric vehicles', 'green stakeholder', but also 'radical green innovation', 'product-life cycle' and 'electric vehicle barriers'. It is important to mention that when the term 'electric vehicle' was entered into Web of Science, it yielded 18,200 results, when the language filter was limited to English results. Through a further search within the results to minimize the relevant articles, in this case the search term 'green stakeholder' was used and only 3 results were yielded. The same was done with the term 'barriers' and in the end 204 results were yielded. Within this procedure, every article considered to be relevant was judged independently, which lead to numerous additional useful article.

In the end Rogers (2003) 'Diffusion curve model' will be implemented and a case analysis of the Model S by Tesla Motors will illustrate the key stakeholders as external factors,

which highly influence the electric mobility industry and how these stakeholders could reduce barriers and promote the adoption process of electric vehicles. Tesla Motors was chosen for the case analysis because they solely produce full battery electric vehicles for a luxury segment. With their founding in 2003 they were the first car manufacturer who only develops electric vehicles for a niche market with a small amount of potential customers through the limited driving range and the high purchase cost. But nowadays Tesla Motors, Inc. represents a competitor for established car manufacturers of internal combustion engine cars like the BMW Group or the Volkswagen AG[10]. Now, the information about Tesla Motors and its Model S are collected from the official website, but it was also tried to get interviews with experts from the different manufacturers. Sadly, this was impossible due to the limited amount of time and the secrecy obligations of employees.

4. RESULTS

This section will analyze the above-mentioned literature review and answer the sub- research questions, named in the Introduction part. Therefore, the different stakeholders within the electric vehicles industry and the potential barriers will be elaborated more in-depth, and illustrated with a case analysis of Tesla's Model S and Rogers model of innovation adoption, also called 'Diffusion curve model' (Rogers, 2003). Tesla Motors was founded in 2003 by a group of engineers in Silicon Valley who wanted to prove that electric vehicles could be better than cars with an internal combustion engine. In 2012, Tesla Motors launched with their Model S, the world's first premium electric sedan. Nowadays, Tesla is also a technology and design company with a focus on energy innovation and Elon Musk as visionary ahead (www.teslamotors.com, 2015).

4.1. Identification of key stakeholders

Among others, the German national government represents an influential external stakeholder, which could also positively influence the market launch and the diffusion process of electric vehicles. First, Germany has the largest installed capacity of renewable power sources in the EU. Mostly the power sources are in form of wind and photovoltaic power systems (Loisel et al., 2014). Furthermore did the German government recognized, that major changes in the current power system will occur in the near future. Current strong social pressure and a growing demand for more environmental friendly behavior appeals on the different governments in Europe. The individual governments or also the European Commission as external key stakeholders have the ability to influence a radical innovation, like electric mobility, through supporting the development of innovation networks, for example (Story et al., 2014). National and regional governments often have the relevant power, influence and funding to support additional R&D within a field. For example, the Dutch government offers different incentives, like tax breaks, to early adopters of electric vehicles (Bakker et al., 2014). Through such incentives from the government side, the acceptance and diffusion of electric vehicles could increase in society.

Electricity providers represent the next key stakeholders, because they are jointly responsible for the recharging process of electric vehicles and can also benefit by offering special charging locations. Additionally, a growing use of electric vehicles provides a great opportunity for electricity providers to expand their market (Bakker et al., 2014). Nevertheless, it will be necessary to carefully balance the demand for and supply of electricity with a growing diffusion of electric vehicles. In 2000, the average electricity consumption of a Dutch household was 3350kWh. For 2015 an average consumption of 3900kWh is expected in the Netherlands (van Vliet, 2011). Maybe it will expect in the near future, that electricity providers cooperate with fuel station operators to guarantee a high amount of charging stations and that both parties can benefit from a large-scale adoption of electric vehicles.

Furthermore, battery suppliers have to be added as key stakeholders (Kley et al., 2011). Due to the relatively new battery technology, such batteries are still very expensive and highly influence the buying price of electric vehicles. If car manufacturers or governments further invest in R&D, the prices for batteries could decrease and the driving range could increase.

As already mentioned, a main barrier relates to the resistance or lack of support from customers due to electric mobility (Story et al., 2014), but on the other hand, customers demand more sustainable products (Bevilacqua, Ciarapica & Giacchetta, 2007). Therefore, customers represent the demanding stakeholder due to a definition of Mitchel et al. (1997). For car manufacturers it is essential nowadays to cooperate with their (potential) customers and to consolidate those relationships in the long-term, also to create competitive advantages. The manufacturers of electric vehicles need to convince their customers that an electric vehicle offers the same benefits like a car with a combustion engine, but additionally is environmental friendly, reduces air pollution and fulfill the demand of 'greener' and sustainable products.

Those key stakeholders are really important for manufacturers of electric vehicles because "green innovation could possess the first mover advantage that enables companies not only to enjoy higher benefits for their green products but also obtain competitive advantage" according to Porter and van der Linde (1995, p. 127).

4.2. Barriers that mainly influence the Introduction stage

In relation to the topic of electric vehicles, the customers show resistance to change a key external barrier (Story et al., 2014), which deeply influences the adoption process and simultaneously a successful market launch. Nevertheless, it is necessary to classify the electric vehicles within the Valley of Death. As shown in Figure 3, a product is located within the Valley of Death, during the pre- new product development and the regular development process. After these steps, when a technology crossed the Valley of Death, the commercialization begins. Actually, the electric vehicle is situated between the regular development step and the commercialization of the product because the batteries urgently need further development to increase the driving range, their lifetime and to decrease the charging time. This implies that the Valley of Death as concept is not fully crossed and theoretically embodies a barrier for the long-term success of electric mobility.

Furthermore, companies need to be overcome their internal management barrier. Due to the new customer demands and the changes within the products or services a company offers, it has to adapt their management towards an environmental management system to satisfy the 'green needs' of key stakeholders (Chen, 2008). Therefore, additional business ethics or sustainability managers need to be employed.

Another barrier that needs to overcome, to decrease the external barrier of customer resistance, is the relatively small availability

10 http://www.volkswagenag.com/content/vwcorp/content/de/homepage.html

of charging stations (Egbue & Long, 2012). A growing amount could help to increase the acceptance of electric vehicles and alternative fuels. This field will be further discussed within the next sub-section of the present study.

Governments in Europe, the US and Japan are already pushing the electric vehicle industry towards further commercialization of low- and zero-emission vehicles (Bakker et al., 2014). Besides, different governments set milestones for the market launch and diffusion of electric vehicles. To achieve those milestones, a government often provides different financial incentives. As shown in Figure 5, the market share of electric vehicles in all observed countries is very small and in 17 out of the 30 countries the financial incentives are obviously higher in relation to the market share.

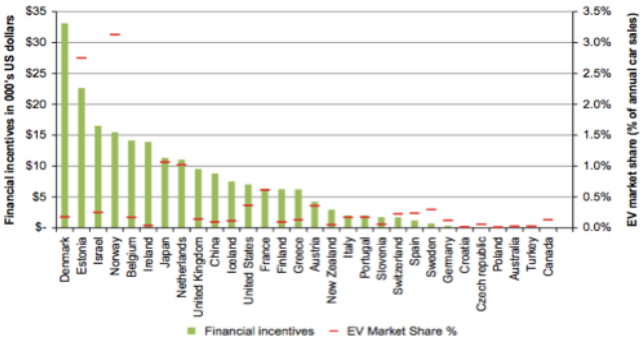

Figure 5. Financial incentives by country and corresponding EV market share for 2012 (adapted from Sierzchula et al., 2014).

In some countries such as Estonia and Norway high financial incentives led to an increased adoption of electric vehicles. But Denmark and Belgium also offer high financial incentives, which result in relatively low levels of adoption. Generally, in all observed countries the market share is under 1,0%. The results from Sierzchula et al. (2014) suggest that also other factors, like customer resistance, could influence the adoption of electric vehicles.

4.3. Main resources that car manufacturers need from their key stakeholders to create competitive advantage

According to a study of Adner (2002) it is widely known that new emerging technologies, like electric vehicles face further barriers than established technologies, because they often compare poorly to existing design in criteria such as price and performance. These criteria are also the most critical ones that car manufacturers face and have to overcome through the support of their different key stakeholders, to be successful during the Introduction stage and to create a competitive advantage. Manufacturers of electric vehicles are only able to create competitive advantage if they minimize the customer resistance against electric mobility, while reducing the purchase cost and improving both the driving range and the charging possibilities.

Geels (2002) mentioned in his paper, that radical innovations first have to attract a significant number of Innovators and Early Adopters to develop a capable market niche. A wider adoption of electric vehicles would also lead to a higher environmental impact (Sierzchula et al., 2014). To achieve a wider adoption of electric vehicles, the manufacturers and also governments have to invest more in R&D, so that especially the battery cost decreases and that the driving range increases. Today an increased battery size rises the driving range but also the purchase cost (Sierzchula et al., 2014).

To gain the acceptance of (potential) customers, to use further R&D results from battery producers or other entrepreneurs, and to benefit from governmental support and incentives, manufacturers have to create or join an innovation network of their industry. Furthermore, it is important to maintain complex relationships with customers, battery producers, and national governments. A combined exchange of demands and needs could help to develop electric vehicles, which are accepted by society and are useful for both households and company fleets. Within the existing literature it was already stated that survival and success of a company is a consequence of its capacity to establish and maintain a relationship with its network of key stakeholders (Clarkson, 1995; Sachs, Post & Preston, 2002).

5. CASE ANALYSIS OF TESLA MOTORS

The following case analysis of Tesla Motors will illustrate the way in which Tesla Motors, as leading manufacturer of electric vehicles tries to handle and overcome barriers that originated from the involvement of different stakeholders during the Introduction phase.

Table 1 represents the main facts about Tesla Motors new battery Gigafactory in Nevada, USA and their Superchargers for their Model S and Model X.

Table 1. Main facts about Tesla's Gigafactory and the Supercharger.

Gigafactory	Supercharger
Expected begin cell production in 2017	Free connector that charge Model S in minutes
Will reach full capacity by 2020 and produce more lithium ion batteries annually than were produced in 2013	Strategically placed stations along well-traveled highways to minimize stops during long distance travel (each station contains multiple Superchargers)
Will produce batteries for significantly less cost using economies of scale, innovative manufacturing etc.	Stations are shown in Google Maps on the 17" touchscreen
Expect to drive down the per kWh cost of their batteries back by more than 30%	Model S app to see when your car is charged
The factory will be powered by renewable energy sources (goal of achieving net zero energy)	Growing network of charging partners
Cooperation with Panasonic and other strategic partners	

Even Tesla Motors is a company, which has problems with the current charging situation of electric vehicles. Due to the limited possibilities of charging options Tesla Motors mentions on their website, this feature is not a big argument to buy an electric vehicle, so far. To expand the infrastructure of charging stations, car manufacturers have to cooperate with governments to gain different assistance. Furthermore, it is conceivable that either car manufacturers or governments, or both build up a relationship with oil companies to support the expansion of charging stations at their gas stations. When solely the different manufacturers of electric vehicles build up a complex

cooperation with the oil companies (e.g. Shell and BP), regulatory actions from governments or the European Union could be necessary. Another option, that manufacturers could not directly influence, would be cooperations between electricity providers, oil companies and gas stations. Therefore, it is essential for electric vehicle manufacturers to maintain a relationship with its own network of key stakeholders.

As presented in Table 2, Tesla Motors selected another way to overcome the arising barriers during the Introduction stage, through the involvement of different stakeholders. Tesla Motors is the first and only car manufacturer who builds his own factory to produce batteries, especially lithium ion batteries that can save the energy unlimited. With the Gigafactory Tesla Motors is able to avoid potential barriers, which can arise through external battery producers and minimize the skepticism of (potential) customers against the new technological development. Through their own R&D department for batteries and the huge manufacturing plant, the production costs and finally the purchase cost for electric vehicles from Tesla Motors will decrease till 2020. Furthermore, Tesla Motors plans to produce 500,000 cars per year by 2020 (www.teslamotors.com, 2015). Even this means that the prices for a Model S will decrease through the growing production rate in the next years. If these goals will be achieved by 2020, electric mobility might become suitable for the mass. To realize the Gigafactory, Tesla Motors cooperate with Panasonic[11] and other strategic partners. The Panasonic Corporation as a Japanese multinational electronics corporation is not a typical stakeholder for a car manufacturer but as producer of electronic devices also interested in high-tech batteries and new technologies. With those kinds of partnerships, Tesla Motors guarantees further external cash flows and the advancement of batteries for electric vehicles to optimize the driving range, for example. The Japanese corporation represents an important investor for Tesla Motors to materialize their visions. To ensure that solely professional workers, with up to date technological know-how works for Tesla Motors, among others they are hiring employees from Apple and simultaneously do they weaken the potential of Apple to enter the electric mobility market.

However, also shareholders are an important group of stakeholders to have a suitable amount of financial resources to implement strategic choices. To convince (potential) shareholders to invest their money in Tesla Motors, Elon Musk as CEO plays an important role. He is the visionary and the face of Tesla Motors in public.

The Supercharger system of Tesla Motors presents the other opportunity how the company wants to overcome arising barriers through the typical involvement of gas stations and electricity providers. They already started to establish their own worldwide charging infrastructure for electric vehicles only produced by Tesla Motors. Currently, they have 445 Supercharger stations with 2,473 Superchargers, which are strategically placed along well-traveled highways to guarantee long distance travels and to have a minimum amount of stops (www.teslamotors.com, 2015). Furthermore, all stations are shown in Google Maps on the 17" touchscreen and are often placed at gas stations where restaurants, cafes and toilettes are near by. For this purpose Tesla Motors cooperates with different charging partners to create a big network.

Overall, it can be mentioned that Tesla Motors as the leading producer of electric vehicles extensively tries to overcome the different barriers that arise through their different key stakeholders. Due to their different approaches they want to minimize the resistance of customers towards electric mobility, they want to decrease the purchase cost of a Tesla Model, and finally they want to achieve the Growth stage of the PLC and successfully finish the Introduction stage to become profitable.

[11] http://www.panasonic.com/nl/.

6. DISCUSSION

Possible key stakeholders of electric vehicle manufacturers have been identified and the arising barriers through their involvement were analyzed and explained. In previous parts all relevant models were explained in detail. In this part the results will be discussed.

Table 2. Overview of key findings.

Main stakeholders	Main barriers/ challenges	Barriers of e-car industry	Solution/ actions taken by Tesla
Customers	Skeptical about performance, missing demand	Limited driving range, long charging period	Gigafactory, Supercharger
Governments	Regulations, Treaties	Only few buying incentives	Service advantages, 7-years warranty
Supplier/ battery producers	Employee know-how, technological know-how	Batteries are still in the development process, high costs	Gigafactory
Electricity providers	Missing financial resources, employee know-how	Lacking infrastructure of charging stations	Supercharger
Creditors/ Investors	Missing financial resources	Not enough R&D	Cooperation with Panasonic
Competitors	Employee know-how, creativity or technological know-how	All manufacturers are located within the development process	Hiring employees from Apple
Shareholders	Missing financial resources (e.g. credits)	Strategic choices	Elon Musk as CEO and preliminary as visionary
Political parties	Missing financial resources, regulations	Hinder R&D	Cooperation with Panasonic to build Gigafactory
Employees	Lacking know-how and motivation	No progress	Hiring experts from Apple

At the present days Tesla Motors holds the monopoly of electric vehicles in the luxury segment. With their emerging Gigafactory for the production of lithium ion batteries and the growing network of Supercharger stations, they invest a lot of resources to stay as the leader. Furthermore, they actively minimize the influence of stakeholders on their success while establishing electric mobility worldwide. Other manufacturers of electric vehicles do not implement such regulatory actions to reduce the influence of their key stakeholders. They are still dependent on R&D results from battery producers or governmental actions to increase the infrastructure for electric vehicles, for example. Another advantage of Tesla Motors is, that they collaborate with more untypical stakeholders, like Panasonic as producer of electronic devices. As shown in Table 2, through the corporation with Panasonic, Tesla Motors tries to minimize the effect of investors or political parties for example. But companies like Panasonic are also interested in new technologies and innovative batteries; therefore they are more willing to spend financial resources in R&D.

Nevertheless, all electric vehicle manufacturers are confronted with internal and external barriers. To overcome internal engineering and manufacturing barriers Tesla Motors, for example, employed 150 former Apple employees (Apple Said to Be Working on Electric Car to Challenge Tesla, 2015). Through the hiring process of employees with core competences in technological design like the one from Apple, Tesla Motors minimize the influence from its (potential) competitors and is able to increase its own firm performance. Other potentially arising internal barriers through their shareholders, Tesla Motors try to handle with its CEO Elon Musk. He is believed to be the visionary of Tesla Motors with great ideas and the knowledge about sustainable products.

An external problem actually is the small adoption rate of electric vehicles, which is well illustrated in Figure 5. In the most countries, the market share of electric vehicles is less than 1%. This indicates that at the moment, the small group of Innovators (2,5%) are the consumers of electric vehicles (see Figure 4) and that the resistance and skepticism toward electric vehicles is still high. To overcome these external barriers, each manufacturer has to find the best solution for the company, the employees and the key stakeholders. Different innovation networks, cooperations with stakeholders or governmental support can help to establish electric vehicles in society to achieve the Growth stage successfully.

7. CONCLUSION

As a conclusion, it is obvious that within the electric vehicle industry different key stakeholders are involved in comparison to the regular car industry that use internal combustion engines. First of all, national and local governments represent an important external stakeholder who is able to support the acceptance of electric mobility, for example through tax incentives, because environmental benefits are not seen as a strong buying argument for customers, although the demand for 'greener', sustainable and environmental products steadily increase. Furthermore, governmental initiatives could help to expand the infrastructure for electric driving or promote the R&D within this field. Secondly, electricity providers are necessary to expand the infrastructure. They can build up charging stations in cities through cooperation's with local governments or along highways if they cooperate with gas stations and oil companies. Through cooperation with oil companies and a growing infrastructure, electricity providers can expand their market share and gas stations would not be the obvious losers if the transition to electric mobility were successful. A third key stakeholder, the suppliers and developers of lithium ion batteries for cars represent an important stakeholder. Electric vehicle manufacturers need to establish a strong relationship with these manufacturers, because the current high prices for the batteries also affect the high total costs for an electric vehicle. In an ideal situation, manufacturers of electric vehicles work in an innovation network, together with battery producers to advance the technology and to share knowledge. Furthermore, employees with extensive know-how about battery technology or design are essential to produce a product that is accepted and useful in society. Therefore, a steady hiring process is necessary, which also might influence competitors negatively. Lastly, customers represent the most important group of stakeholders that influence the overcoming of different barriers during the Introduction stage of the product-life cycle. The skepticism and resistance against innovation and electric mobility is a key barrier for manufacturers, which need to overcome contemporary. Their resistance builds on the limited driving range of electric vehicles, the charging possibilities, and the long charge period. Furthermore, the buying price is currently very high, wherefore the amount of (potential) customers becomes smaller.

All these aspects mentioned above are barriers, created by different kind of stakeholders, which currently influence the diffusion of electric vehicles and hinder manufacturers to successfully launch their cars. Now, different scenarios can be developed how each manufacturer can overcome barriers. If a company found its own promising and effective way to handle and manage the influence of stakeholders on their performance, it could be easier to overcome the Valley of Death and to operate profitable. This could be done through the involvement and the creation of stable relations with all relevant stakeholders or companies can try to minimize their amount of stakeholders, like Tesla Motors, who exclude battery suppliers and gas stations with their own production plant for batteries and their own Supercharger stations for Tesla's.

8. LIMITATIONS

The present study is subject to several limitations. First of all, the study is based on scientific theoretical literature performed by other researchers, which indicates that only secondary data was reviewed. All evaluated articles were written in English, which may narrow the perspectives. In addition, the time aspect restricts the dimension of the study. The restricted time frame of maximum ten weeks in total also limited the chance to find suitable interview partners from the car manufacturing industry to gather more data. Finally, the case analysis is limited to one American manufacturer who operates in the luxury segment for electric vehicles.

9. FURTHER RESEARCH

For further research it is advisable to conduct interviews with car manufacturers and specific stakeholders and to perform different surveys with potential customers. Furthermore, it could be useful to enlarge the number of cases and to consider companies from different countries. Also the interviews or surveys could be done specifically for one country or region. Overall, the industry is at an early stage, doing a new and enlarged analysis at another time will result in new and may more concrete findings.

10. REFERENCES

Adner, R. (2002). When are technologies disruptive? A demand-based view of the emergence of competition. *Strategic Management Journal*, *23*(8), 667-688.

Apple Said to Be Working on Electric Car to Challenge Tesla - Bloomberg Business. (n.d.). Retrieved from http://www.bloomberg.com/news/articles/2015-02-14/apple-said-to-be-working-on-electric-car-to-challenge-tesla.

Bakker, S., Maat, K., & Van Wee, B. (2014). Stakeholders interests, expectations, and strategies regarding the development and implementation of electric vehicles: The case of the Netherlands. *Transportation Research Part A: Policy and Practice*, *66*, 52-64.

Bevilacqua, M., Ciarapica, F. E., & Giacchetta, G. (2007). Development of a sustainable product lifecycle in manufacturing firms: a case study. *International Journal of Production Research*, *45*(18-19), 4073-4098.

Cao, H., Folan, P., Mascolo, J., & Browne, J. (2009). RFID in product lifecycle management: a case in the automotive industry. *International Journal of Computer Integrated Manufacturing*, *22*(7), 616-637.

Campbell, J. L. (2007). Why would corporations behave in socially responsible ways? An institutional theory of corporate social responsibility. *Academy of management Review*, *32*(3), 946-967.

Chen, Y. S. (2008). The positive effect of green intellectual capital on competitive advantages of firms. *Journal of business ethics*, *77*(3), 271-286.

Chen, Y. S., Chang, C. H., & Lin, Y. H. (2014). The Determinants of Green Radical and Incremental Innovation Performance: Green Shared Vision, Green Absorptive Capacity, and Green Organizational Ambidexterity. *Sustainability*, *6*(11), 7787-7806.

Chiesa, V., & Frattini, F. (2011). Commercializing Technological Innovation: Learning from Failures in High-Tech Markets*. *Journal of Product Innovation Management*, *28*(4), 437-454.

Clarkson, M. E. (1995). A stakeholder framework for analyzing and evaluating corporate social performance. *Academy of management review*, *20*(1), 92-117.

Conway, S. & Steward, F. (2009). Managing and Shaping Innovation. Oxford University Press.

Crawford, C. M., & Di Benedetto, C. A. (2008). *New products management*. Tata McGraw-Hill Education.

Dewar, R. D., & Dutton, J. E. (1986). The adoption of radical and incremental innovations: an empirical analysis. *Management science*, *32*(11), 1422-1433.

Donaldson, T., & Preston, L. E. (1995). The stakeholder theory of the corporation: Concepts, evidence, and implications. *Academy of management Review*, *20*(1), 65-91.

Driessen, P. H., & Hillebrand, B. (2002). Adoption and diffusion of green innovations. *Marketing for sustainability: towards transactional policy-making*, 343-355.

Egbue, O., & Long, S. (2012). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. *Energy Policy*, *48*, 717-729.

European Commission. (2010) Energy Infrastructure Priorities for 2020 and Beyond –A Blueprint for an Integrated European Energy Network, *COM*, 677 final.

Fineman, S., & Clarke, K. (1996). Green Stakeholders: Industry Interpretations and Response*. *Journal of Management Studies*, *33*(6), 715-730.

Fineman, S. (1997). Constructing the green manager. *British Journal of Management*, *8*(1), 31-38.

Freeman, R. E., Wicks, A. C., & Parmar, B. (2004). Stakeholder theory and "the corporate objective revisited". *Organization science*, *15*(3), 364-369.

Gan, L. (2003). Globalization of the automobile industry in China: dynamics and barriers in greening of the road transportation. *Energy policy*, *31*(6), 537-551.

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research policy*, *31*(8), 1257-1274.

Gmelin, H., & Seuring, S. (2014). Determinants of a sustainable new product development. *Journal of Cleaner Production*, *69*, 1-9.

González-Torre, P., Alvarez, M., Sarkis, J., & Adenso-Díaz, B. (2010). Barriers to the implementation of environmentally oriented reverse logistics: Evidence from the automotive industry sector. *British Journal of Management*, *21*(4), 889-904.

Griffin, A., Price, R. L., Vojak, B. A., & Hoffman, N. (2014). Serial Innovators' processes: How they overcome barriers to creating radical innovations. *Industrial Marketing Management*, *43*(8), 1362-1371.

Howard, M., Vidgen, R., & Powell, P. (2003). Overcoming stakeholder barriers in the automotive industry: building to order with extra-organizational systems. *Journal of Information Technology*, *18*(1), 27-43.

Høyer, K. G. (2008). The history of alternative fuels in transportation: The case of electric and hybrid cars. *Utilities Policy*, *16*(2), 63-71.

Johnson, G., Whittington, R., Scholes, K., & Pyle, S. (2011). *Exploring strategy: text & cases*. Harlow: Financial Times Prentice Hall.

Klepper, S. (1996). Entry, exit, growth, and innovation over the product life cycle. *The American economic review*, 562-583.

Kley, F., Lerch, C., & Dallinger, D. (2011). New business models for electric cars—A holistic approach. *Energy Policy*, *39*(6), 3392-3403.

Loisel, R., Pasaoglu, G., & Thiel, C. (2014). Large-scale deployment of electric vehicles in Germany by 2030: An analysis of grid-to-vehicle and vehicle-to-grid concepts. *Energy Policy*, *65*, 432-443.

Maxwell, D., & Van der Vorst, R. (2003). Developing sustainable products and services. *Journal of Cleaner Production*, *11*(8), 883-895.

Markham, S. K., Ward, S. J., Aiman-Smith, L., & Kingon, A. I. (2010). The valley of death as context for role theory in product innovation. *Journal of Product Innovation Management*, *27*(3), 402-417.

McCall, T. (n.d.). The Price of Batteries. Technology Review. Retrieved from http://www.technologyreview.com/sites/default/files/legacy/jan11_feature_electric_cars_p61.pdf.

Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W. W. (1972). The limits to growth. *New York*, *102*.

Merrifield, B.D. (1995). Obsolescence of Core Competencies versus Corporate Renewal. *Technology Management* 2(2), 73-83.

Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *Academy of management review*, *22*(4), 853-886.

Oltra, V., & Saint Jean, M. (2009) Sectoral systems of environmental innovation: an application to the French automotive industry. *Technological Forecasting and Social Change, 79*, 567-583.

Onkvisit, S., & Shaw, J. J. (1986). Competition and product management: Can the product life cycle help?. *Business Horizons*, *29*(4), 51-62.

Porsche May Expand With New Electric Car to Challenge Tesla - Bloomberg Business. (n.d.). Retrieved from http://www.bloomberg.com/news/articles/2015-03-13/porsche-nears-decision-on-expanding-lineup-to-seven-models.

Porter, M.E., & van der Linde, C. (1995) Green and Competitive. *Harvard Business Review, 73*, 120-134.

Qian, K., Zhou, C., & Yuan, Y. (2010). A Review of Research on the Interaction between Fully Electric Vehicles and Power Syste,s. *Power System and Clean Energy*, *26*(11), 1-7.

Reid, A., & Miedzinski, M. (2008) Eco-innovation – final report for Sectoral Innovation Watch. *Final report to Europe INNOVA initiative*. Technopolis Group.

Rink, D. R., & Swan, J. E. (1979). Product life cycle research: A literature review. *Journal of business Research*, *7*(3), 219-242.

Rogers, E. (2002) *Diffusion of Innovations*, 5th edn, New York: Simon and Schuster International.

Romm, J. (2006). The car and fuel of the future. *Energy Policy*, *34*(17), 2609-2614.

Ryan, C., Riggs, W.E. (1997). Redefining the product life cycle: the five-element product wave. *Journal of Product Innovation Management*, *14*(3), 227-228.

Sachs, S., Post, J. E., & Preston, L. E. (2002). Managing the extended enterprise: The new stakeholder view. *California management review*, *45*(1), 6-28.

Schot, J., & Fischer, K. (1993). Introduction: the greening of the industrial firm. *Environmental strategies for industry*, 3-36.

Sierzchula, W., Bakker, S., Maat, K., & van Wee, B. (2014). The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy*, *68*, 183-194.

Story, V. M., Daniels, K., Zolkiewski, J., & Dainty, A. R. (2014). The barriers and consequences of radical innovations: introduction to the issue. *Industrial Marketing Management*, *43*(8), 1271-1277.

Tesla bleibt noch bis 2020 ohne Gewinn - manager magazin. (n.d.). Retrieved from http://www.manager-magazin.de/unternehmen/autoindustrie/tesla-bleibt-noch-bis-2020-ohne-gewinn-a-1012851.html.

Tesla Gigafactory | Tesla Motors. (n.d.). Retrieved from http://www.teslamotors.com/gigafactory.

Tesla Motors | Premium Electric Vehicles. (n.d.). Retrieved from http://www.teslamotors.com.

van den Hoed, R. (2007). Sources of radical technological innovation: the emergence of fuel cell technology in the automotive industry. *Journal of Cleaner Production*, *15*(11), 1014-1021.

Van Vliet, O., Brouwer, A. S., Kuramochi, T., van Den Broek, M., & Faaij, A. (2011). Energy use, cost and CO 2 emissions of electric cars. *Journal of Power Sources*, *196*(4), 2298-2310.

Westbrook, M. H. (2001). *The Electric Car: Development and future of battery, hybrid and fuel-cell cars* (No. 38). Iet.

Zhu, Q., Sarkis, J., Cordeiro, J. J., & Lai, K. H. (2008a). Firm-level correlates of emergent green supply chain management practices in the Chinese context. *Omega*, *36*(4), 577-591.