Business Model Design: Lessons Learned from Tesla Motors

Yurong Chen and Yannick Perez

Abstract Electric vehicle (EV) industry is still in the introduction stage in product life cycle, and dominant design remains unclear. EV companies, both incumbent from the car industry and new comers, have long taken numerous endeavors to promote EV in the niche market by providing innovative products and business models. While most carmakers still take 'business as usual' approach for developing their EV production and offers, Tesla Motors, an EV entrepreneurial firm, stands out by providing disruptive innovation solutions. We review the business model approach in the literature, then classify the innovation dimensions in the EV ecosystem. We study Tesla Motors in terms of: (1) innovation related to the vehicle, (2) innovation related to the battery (3) innovation concerning the recharging system, and (4) innovation toward the EV ecosystem.

Lessons for incumbent carmakers for their EV business model design: Tesla Motors (1) holds a product strategy entering from high-end market and moving to mass market, with a high level of innovation adaptation and learning by doing; (2) pays considerable attention to reduce range anxiety by high performance supercharger station network and high capacity battery; (3) shows a very high level of integration of information technology into many aspects of the EV business model, such as advanced in-car services and digital distribute channel; (4) shows a new value configuration which involving in high level of vertical integration towards battery and recharging network.

Keywords Business model · Electric vehicle · Tesla motors · Innovation management

Parts of the chapter was made available at: https://www.researchgate.net/publication/277675857_Business_Model_Design_Lessons_Learned_from_Tesla_Motors (Yurong, C., Perez, Y. (2015). Business Model Design: Lessons Learned from Tesla Motors).

Y. Chen · Y. Perez (✉)
Laboratoire Genie Industriel, CentraleSupélec, Université Paris-Saclay, Gif-sur-Yvette, France
e-mail: yurong.chen@centralesupelec.fr; yannick.perez@u-psud.fr

P. da Costa, D. Attias (eds.), *Towards a Sustainable Economy*,
Sustainability and Innovation, https://doi.org/10.1007/978-3-319-79060-2_4

1 Introduction

In the current disruptive period, established business models are under attack from new and incumbent firms with innovative business models. The supply side driven logic of the industrial era that only focus on technology innovation is no longer viable, rather, a successful business model becomes indispensable to convert technology innovation to high firm performance (Baden-Fuller and Haefliger 2013; Chesbrough 2007). Business model innovation does not discover new products or services, instead, it redefines the existing product/service and the way it is provided to the customer. Successful business model innovation can enlarge the existing economic pie, either by attracting new customers or by encouraging existing customers to consume more (Markides 2006). Therefore, business model innovation could set challenges to incumbent firms in matured industries, and also, plays a critical part in the process of commercializing emerging technologies to a new dominant design (Hung and Chu 2006). Business models have the potential to enable the technology advantages which can then be translated into a valuable market offering despite the technology still being immature, and, if proven successful, help gaining a competitive advantage (defensive position) for the firm in the long run (Chesbrough and Rosenbloom 2002). Therefore, business model innovation is congruous with a firm's survival and success for emerging technology as well as industry.

The electric vehicles (EVs, hereafter) industry, or electromobility, has been emerging for near a century, with a series of stops and starts in its development (Donada and Lepoutre 2016; Donada and Perez 2015). The current reintroduction of EV was triggered by high oil prices, climate protection concerns, battery technology and recharging infrastructure development, and the rise of organized car sharing and inter-modality (Dijk et al. 2013). EVs are believed to play an important part in the near future according to policy makers, carmakers and stakeholders (International Energy Agency 2016; MacDougall 2013). Ambitious regional and national goals have stimulated the progress of EV penetration by subsidies for the vehicle and corresponding infrastructure deployment (Dijk et al. 2013). In the year 2016 along, 28 different models of electric vehicle were available in the U.S. market and, among those, 13 are pure battery electric vehicle (BEV, hereafter) models (PluginCars.com 2016). However, the commercialization of EVs has been ineffective thus far, sales of EV are far from satisfactory and lag behind national goals. In 2015, 548,210 EV units (of which BEVs were 60%) were sold globally, which is near double than the sales of 2014, i.e. 317.895 units (EV Sales 2016). While worldwide car sales are expected to reach 742.4 million units in 2015 EV, represented less than 0.07% of the global vehicle market (Statista 2016). Furthermore, the dominant design is still unclear in the EV industry. EV firms are introducing diverse products with diverse business model competing to establish a 'dominant design' (Chen et al. 2016). Accordingly, the EV industry is still in the introductory stage of product life cycle, and struggling to take advantage of economies of scale in small niche markets. EV enterprises, including incumbent and entrepreneurial carmakers, have long undertaken promoting EV in the niche markets by providing innovative business models

and overcoming technological shortcomings such as range anxiety. Bohnsack et al. (2014) studied how the path dependencies of incumbent and new entrance firms affected the business models for EVs. And Wang and Kimble (2013) studied the business models of Chinese EVs. Research on how EV companies empirically innovate on business model help us understand how firm solving the complex and radical changing system (Von Pechmann et al. 2015), and bring insights to the industry.

We focus our study on exploring a single case (Yin 2013): Tesla Motors (Tesla, hereafter). Tesla is viewed as a black horse in the auto-industry. Compared with the incumbent auto companies who have decades-experience in making and selling cars, Tesla was a new entrant founded in 2003 by Silicon Valley engineers. Therefore, Tesla has less inert as other incumbent automakers for business model innovation. Tesla is dedicated to the EV-sustainability scenario with innovative products and business models. The product of Tesla, sportive EV Roadster and Model S changed people's idea of the EV and re-initiated the enthusiasm for pure EVs (Urban 2015). Compared to incumbent firms, entrepreneurial firms are generally less constrained and more flexible in pursuing radical technology and business models (Bohnsack et al. 2014; Hill and Rothaermel 2003). While most carmakers still take a 'business as usual' approach towards developing their EV production and offers, Tesla Motors stands out by providing radical innovation solutions (Markides 2006). As a result, we are concerned about the business model design of Tesla and draws several lessons for more incumbent carmakers in their business model design of EV.

This paper starts with presenting the emerging EV industry and business models in the literature, then classifies these innovative dimensions in the EV industry. By combining these two points, a business model innovation framework for EV is developed in Sect. 2. Section 3 is dedicated to reviewing and analyzing the business model innovations of Tesla. Section 4 follows up with the conclusion and recommendations for more classical carmakers.

2 Background and Literature

2.1 Context of Emerging EV Industry

We are currently witnessing the re-introduction of electrical vehicles (EVs) into automobile markets. Unlike the last enthusiasm for EV in 1990s, when the carmakers mainly focused on technological innovations and aimed at providing EV products. In the current EV enthusiasm, the carmakers focuses on many different dimensions, including technology innovations, user relations as a community (e.g. vehicle-to-grid services and car-sharing) and business models innovations (Donada and Lepoutre 2016). This new scenario of EV development is also referred to as electromobility or electromobility 2.0 (Donada and Attias 2015; Donada and Lepoutre 2016). Electromobility remains a nascent industry, where players are currently searching and competing for business models, dominant design, and defining the EV market

(Theyel 2013). Additionally, the network of suppliers, and its players, is in no way stable (Donada and Lepoutre 2016; Fournier et al. 2012).

The scope of the EV industry is much larger than it was in the 1990s: with the connection of the recharging system, EVs are at the intersection between the traditional car making sector and the electricity sector (Chen et al. 2016). The transition into an electric mobility trajectory will lead to fundamental changes in the value chain/ecosystem of the automobile which basically involves components from suppliers, core components and assembly from carmakers, and energy utilities.

First of all, some modules such as the internal combustion engine (ICE) will become less important in the long-term (Huth et al. 2013). While modules such as batteries, charging infrastructure will enter the value chain and play critical roles as a result of high cost and changing peoples' driving behavior (Kley et al. 2011; Weiller and Neely 2014). Secondly, new services enabled by EVs such as energy services or those enlarged by EVs such as car-sharing services and connective services will have numerous influences in the auto value chain (Fournier et al. 2012). At the moment, customers facing services such as energy services and mobility services still await for EV penetration and changes in electricity grid regulation and consumer behavior (Codani et al. 2014a; Weiller and Neely 2014). As a result, the current EV value chain emphasizes on batteries (battery cell manufacturing and battery packing), vehicle (EV design, assembling and sales), and infrastructure enabling grid connection (infrastructure manufacturing and infrastructure network deployment) as is showed in Fig. 1.

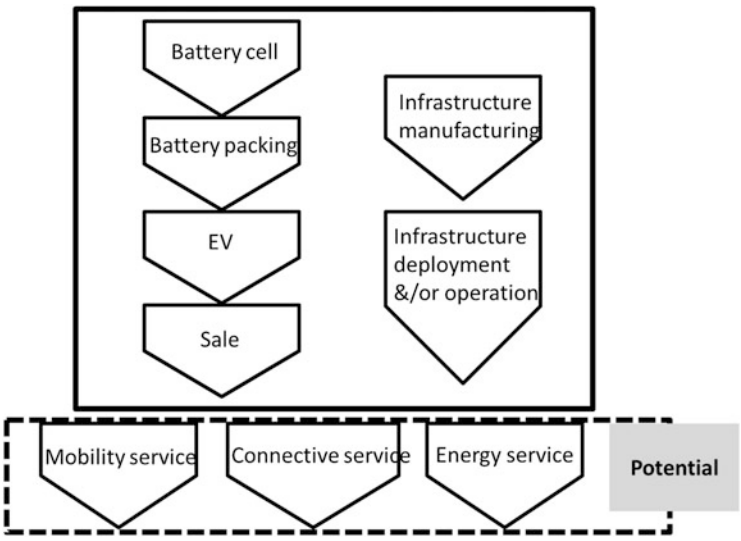

Fig. 1 EV ecosystem, adapted from (Fournier et al. 2012; Weiller and Neely 2014)

2.2 Business Model Innovation in Emerging Industry

The term 'business model' came along with the new challenges and opportunities in the business environment due to new communication technology and computer technology such as the social networks (Osterwalder 2004; Zott et al. 2011). The main goal of a business model is to understand how firm create value and capture value (Chesbrough 2007; Günzel and Holm 2013; Teece 2010; Zott et al. 2011) and they convert payments received on profits (Günzel and Holm 2013; Osterwalder 2004). With business model, we can understand the company's strategy and economic point of view, the statement of market reality, customer expectations, and technological prospects (Baden-Fuller and Haefliger 2013).

The business model is also linked to the company's performance as a result. However, it does not guarantee long-term competitive advantage as other competitors may imitate these practices (Teece 2010). Thus, the creation of a differentiation business models is considered a long term competitive advantage and can set a defensive position for a firm for imitating (Baden-Fuller and Haefliger 2013; Teece 2010). This is also the case since competitors are likely to find it harder to imitate or replicate an entirely new business model than an innovative product or service. With the emergence of a new industry, business model innovation can trigger the commercializing process to find an industrial dominant design and shape the patterns of industrial evolution (Hung and Chu 2006). Therefore, innovation literature treats business model innovation as a cornerstone of transforming technology innovation into a business offering of value (Chesbrough and Rosenbloom 2002; Christensen 1997).

2.3 An Operational Business Model Approach

We applied the business model approach developed by Osterwalder (2004) (known as the business model Canvas (Osterwalder and Pigneur 2010)) and research (e.g. Chesbrough 2010; Günzel and Holm 2013). Osterwalder's mapping of business models, based on extensive literature research, and real-world experience, utilizes nine elements to clarify the processes underlying business models. It contains:

1. Value propositions: defines the promised value of the firm's bundled products or services as well as complementary value-added services. These are packaged and offered by the manufacturer to fulfill customer needs beforehand;
2. Consumer segment: defines the type of customers a company wants to address;
3. Channel: defines how a company delivers the product and services to target customers. It includes direct channels such as through a sales force or over a website, and indirect channels such as reseller and dealer network;
4. Customer relationship: the relationships established with clients;
5. Revenue model: defines what type of payment the customer makes to the supplying shareholder in order to get the product or services.

6. Key partnerships: describes the network of suppliers and partners that make the business model work
7. Capability: are based on a set of resources from the company or its partners to implement the business model
8. Value configuration: defines the potential possibilities to design the product offered with regard to the different shareholders involved in a business model, it has three kinds of configurations which are value chain, value shop and value network. According to the main actors of the car industry, the value configuration is achieved by value chain.
9. Cost structure: describes all costs incurred in operating a business model

This business model mapping illustrates a value creating, delivering and capturing process in a company. While customer segments, channels and customer relationship are obviously value delivering processes (Günzel and Holm 2013), channels can also contribute to value creation—online shopping could bring convenience as a value for example to customers by shipping-to-destination services. Value proposition is critical for value creation, and partnerships, capability and value configuration are indispensable tools to make value creation happen (Osterwalder and Pigneur 2010). Value configuration is also related to value capturing, since it determines what value added activities a firm will perform and is highly linked to the cost structure of firm. Revenue model and cost structure are of great interest in such a business model, especially for executers and investors, as it is connected to profits profile and has a central place in the value capturing process (Günzel and Holm 2013).

3 Methodology

3.1 Case of Choice and Data Collection

We chose the case of Tesla for two reasons. The first is that in the field of electric vehicles, Tesla has already been recognized as a strong agent of change. Its flagship vehicle, Tesla Model S, was the world's best-selling plug-in car in 2015 (EV Sales 2016), and its share price has surged since 2013 (NASDAQ.com, 2016), indicating high customer satisfaction and investor expectations. Second, Tesla is a entrepreneurial company and established at the Silicon Valley, a cluster for innovations. Therefore, Tesla has less inert than incumbent automakers for business model innovation and could take more radical trajectory for innovation (Hill and Rothaermel 2003). Its business model stands out and attracts attention from business researchers (e.g. Bohnsack et al. 2014; Weiller et al. 2013). Third, Tesla is very open and transparent of their activities and strategies by posting on the official website and

blogs, while the incumbent carmaker are very strict to keep the information in secret. As a most popular EV makers, Tesla is very well-documented by the media, which facilitates the collection of rich and often real-time data.

Our a single case (Yin 2013) is based primarily on secondary qualitative data. We used secondary sources, which are abundantly available for the chosen cases as previously explained. We collected and analyzed data from the official website and annual reports of Tesla (e.g. Tesla Motors 2013, 2016); books such as *Owning Model S: The Definitive Guide to Buying and Owning the Tesla Model S* (detailed information on the products of Tesla); and *Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future* (information on the vision of Elon Musk, the CEO of Tesla); blogs for Tesla (where Elon Musk posts regularly); and reports of industry associations and magazines such as *Automotive News*, *Ward's AutoWorld*, *Autoweek*, and *Electric Cars Report*. The data was collected for the period from June 2011 (when Tesla went public) to June 2016. In addition to these sources, we also analyzed academic case studies on Tesla (e.g. Donada and Lepoutre 2016).

3.2 Business Model Innovation Frame in EV Ecosystem

We apply the business model frame adapted from Osterwalder (2004) to analyze business model innovation in EV. The EV industry involves new modules and components as a result of battery-based electric mobility concepts, such as recharging infrastructure and related services. In the EV ecosystem, early studies have identified three dimensions for business models: vehicle together with battery; the infrastructure system; the system services which integrated electric vehicles into the energy system (Kley et al. 2011). However, regarding the current business and research of EV, electricity system services (e.g. Vehicle to Grid, Vehicle to Home) is in the very early stage of the life-cycle (Theyel 2013), where only researches and prototypes take place (Codani et al. 2014b; Weiller and Neely 2014). In this vein, we adapted the key dimensions of EV business model innovation into the following:

1. Innovation towards the vehicle;
2. Innovation towards the battery;
3. Innovation towards the infrastructure system;

We add another dimension which is the EV ecosystem in our analysis, more precisely, value configuration in the ecosystem.

4. Innovation towards the ecosystem.

We apply the business model mapping of Osterwalder (2004) to analyze the innovations in Tesla. Among the nine elements in the mapping, we select five (value proposition, value configuration, channel, consumer segment and revenue model).

4 Findings

4.1 Innovation Towards Vehicles:

Tesla motor has thus far released four vehicle models into market: a two doors sport car Tesla Roadster (2008–2012), a sedan Tesla Model S (2012-), a crossover Tesla Model X (2015-) and a family car Tesla Model 3 (2016-). The vehicles received high attention from the public and the media, because they address the high end customer segment, which are new for EVs, and its innovative multi-channel for distribution.

4.1.1 Value Proposition

Musk (2006) declaimed that "Critical to making that [EV becoming mainstream] happen is an electric car without compromises, which is why the Tesla Roadster is designed to beat a gasoline sports car like a Porsche or Ferrari in a head to head showdown". Tesla's first car, the Roadster, released in 2008, changed people's imagination of EV, which was small-size and low-speed. Roadster looks like a fancy sport car, using the body of Lotus Elites. At the same time, it also offers fast-speed and powerful acceleration as well as high performance in the range for one charge, which is an important parameter for EV. Range anxiety is one of the serious problems facing EV makers and EV users- EV users are afraid they cannot reach their destination and run out of battery. It can reach 100 km/h within 3.7 s acceleration and a standard range of 393 km with a one-time charge. An EV usually has an autonomy of less than 100 km, and has an image of small-size low-speed vehicle.

Following the success of the Roadster, Tesla released Model S in 2012, with purposed vehicle design for a premium family car. The intersection between aesthetics and performance attracted popularity from both customers and investors. The Model S range has a range from 335 km to 426 km, depending on the version, and with an acceleration speed as fast as 2.8 s (duel motor version), which is much faster than most luxury sport cars. Model S won many awards and honours such as "most stylish car in Switzerland", "best inventions of the year", and "Automobile of the Year" (DeMorro 2015).

Model X was released on the market on September 2015. It uses falcon wing doors for access to the second and third row seats, which gives a stylish appearance. The range and acceleration speed is similar to Model S.

Half a year later, Tesla unveiled its 4th Model 3, which is a compact sedan targeting lower segments compared to Model S and X. Yet, it choose a stylish design and "aesthetics will not be sacrificed" (Hull 2016). It offers range of 346 km and 0–100 km/h acceleration less than 6 s. As of 7 April 2016, 1 week after the unveiling, company officials said they had taken 325,000 Model 3 reservations, more than triple the number of Model S cars Tesla had sold by the end of 2015.

Tesla emphasises connective technology and self-driving technology. Tesla innovatively increased the connectivity between users and the environment (e.g. recharging navigation stations, charging control and autopilot) enabled by IT based hardware and software applications. It innovatively offers data network in the car with telecommunication partners, and connects the car with the maintenance centre, infotainment centre and so on.

4.1.2 Customer Segment

Tesla entered the market of EV by targeting the high-end niche market, by offering a luxury specific-purpose vehicle such as Roadster. Model S targets luxury the multi-purpose car market as a result sales are considerably larger than the Roadster. Furthermore, it continues to offer an SUV version luxury multi-purpose car, followed by a more economical multi-purpose car. It corresponds to the strategic goal of creating an affordable mass market EV. The customer segments of battery and recharging systems need to match the customer segment of vehicle.

The customer segment is vastly different to other carmakers which usually enters from a multi-purpose economy or specific-purpose market as the ownership cost for EV is high (Bohnsack et al. 2014).

4.1.3 Distribution Channel

As a newcomer to the car industry, Tesla Motors changed the conventional dealership network for vehicle distribution. It created a new multi-channel model for purchasing vehicles, which involved online stores and apple-like retail outlets. The online stores offer potential customers the chance to purchase the car directly online. The retail outlets are usually located in dense traffic, enhanced with technology which has high integration of IT in order to better present Tesla vehicle and its company culture. Tesla applies vertical integration on sales, which means the price of vehicles is unnegotiable.

4.1.4 Revenue Model

Tesla applied an ownership-as-usual model for the revenue. They the sell the car to individuals, and as a result, the customers possess the ownership of the car (other than a mobility service without car ownership). Tesla also sells powertrains and battery packs to other carmakers as a supplier to their EVs. For example, Tesla and Daimler have an agreement over battery packs and chargers for Smart Fortwo from

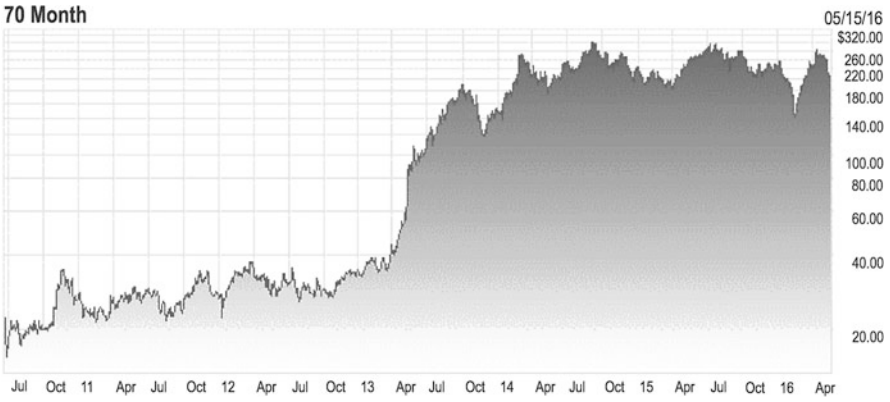

Fig. 2 Stock market of Tesla. Source: http://www.nasdaq.com/symbol/tsla, accessed May 15th 2016

2008 to 2013, and develops powertrain systems for Toyota RAV4 from 2010 to 2014.

Other types of revenue include government loans and investment such as in stock markets. In 2010, Tesla received US government loan for development and production of Model S (which has been paid back at 2013). Besides government loan, Daimler spent $50 million in 2009 for a 10% stake of Tesla, and Toyota bought $50 million worth of stock when Tesla went public in July 2010. The outstanding performance on stock markets brings further capital (Fig. 2).

4.2 Innovation Towards the Battery

In 2013, an electrical powertrain with a 10 kWh battery pack takes around 57% of the value-add in all components in an EV. And the average rate of added value for conventional powertrain is 26% (Huth et al. 2013). The choice of battery will largely decide the range anxiety and the cost that customers will have. Tesla applied an ambitious plan on battery strategy, with expecting movements on battery factory and enter the stationary battery market. It is attractive for its high range, and innovative battery pack technology.

4.2.1 Value Proposition

Starting with Roadster, Tesla innovatively chose battery packs with large capacities as a solution to range anxiety issues. The Roadster was equipped with a 53 kWh

battery and has autonomy of 393 km. Such capacities significantly exceed those of any other commercially available electric vehicle at the same time, for example, in 2009, the BMW MINI E chose a battery pack of 35 kWh with a range of 160 km, and iMiEV in 2010 offered a battery pack of 16 kWh and a range of 100 km. This outstanding feature continues in Model S and Model X. In 2016, the new versions of Model S has a battery pack options of 70 kWh and 90 kWh that provide a range of 335 or 426 km, respectively.

Tesla motor has a good knowledge of battery packs and management system. It has innovatively equipped Roaster with thousands of laptop Lithium-ion cells and assembles them into a performance and cost optimized battery pack. During the delivery of Tesla Model S, it developed a closer relationship with its battery cell supplier Panasonic, on both battery technology and the scale of production.

The connectivity service can link users to battery packs to some extent. Tesla users can have some control on the battery system. For example, users can control the temperature of the battery system before entering the car when the environmental temperature is too low.

4.2.2 Distribution Channel and Revenue Model

The battery is generally sold to customers along with the vehicle, with possibility for extra purchase when the old one is at the end of life and need to be replaced. As previously mentioned, Tesla also sells its innovative battery pack to other companies.

4.3 Innovation Towards Infrastructure System

Another ambitious plan of Tesla Motors is the expansion of the supercharger network. It is famous for its high performance in charging ability, well-established networks and free to Tesla user strategy.

4.3.1 Value Proposition

In alignment with the large battery capacity adapted by Tesla, the supercharger station offers fast charging in order to satisfy the charging needs of customers. It can deliver direct current up to 120 kW and capable of charging to 80% of an 85 kWh Tesla Model S within 40 min. Besides the premium function of the supercharger station, Tesla is undertaking an ambitious expansion plan to establish a network of superchargers along well-traveled highways and in congested city centers. Until May 2015, there were 2400 superchargers in 400 stations worldwide. One year later, there are 3708 superchargers in 624 stations in May 2016.

Tesla also has a pilot project for a battery swap program, it was launched in several regions to meet the charging needs of customers and reduce range anxiety. All of the superchargers are connected to Tesla, and users can access it via the screen in the car. Tesla users can find the nearest supercharging station and control the charging when connected.

4.3.2 Distribution Channel

The public network is solely deployed by Tesla Motors. This is mainly due to the different charging technology and standard adapted by the companies, and the different cables that are designed and adapted.

4.3.3 Revenue Model

Tesla users benefit from free entrance to the supercharger stations network. However, Tesla needs to bear all the cost including installment, maintenance and network reinforcement if needed. The rent for the place is shared by a supercharger partner program with local partners.

4.4 Innovation Towards Ecosystem

In the conventional car industry, the value chain consists in the pyramid relationship between the carmaker and suppliers, in which suppliers provide the different parts or modules such as the gearbox and auxiliary battery to carmakers, while the main role of carmakers is assembling the parts and designing core competents such as motor design as well as the vehicle body; on the other hand, energy utility will fill the car with fuel during the car's lifetime as showed in Fig. 3a. A classic carmaker in-house production share is around 25% for the total vehicle (Huth et al. 2013).

In the EV industry, most carmakers who are engaging in the EV market choose to follow their old routine of value configuration: they tend to use their existing production infrastructure, capabilities, as well as supplier network (Chen et al. 2016). In this type of value chain, carmakers treat battery as a module for outsourcing, it could be because of the limitation on technological knowledge or transaction cost concern. BMW i3 and Renault Zoe are examples as showed in Fig. 3e,f respectively. A better choice could be the carmaker and battery supplier form an joint venture company, as it is the case for Nissan leaf (Fig. 3d). On the other hand, as for the recharging network deployment, most carmakers wait for the action from the recharging operation company or other stakeholders such as national or local governments. Renault and BMW followed this strategy, and their EVs are able to access to the recharging network deployment by chargepoint and chargemaster in USA and UK. Furthermore, BMW has started to invest in the fast recharging infrastructure

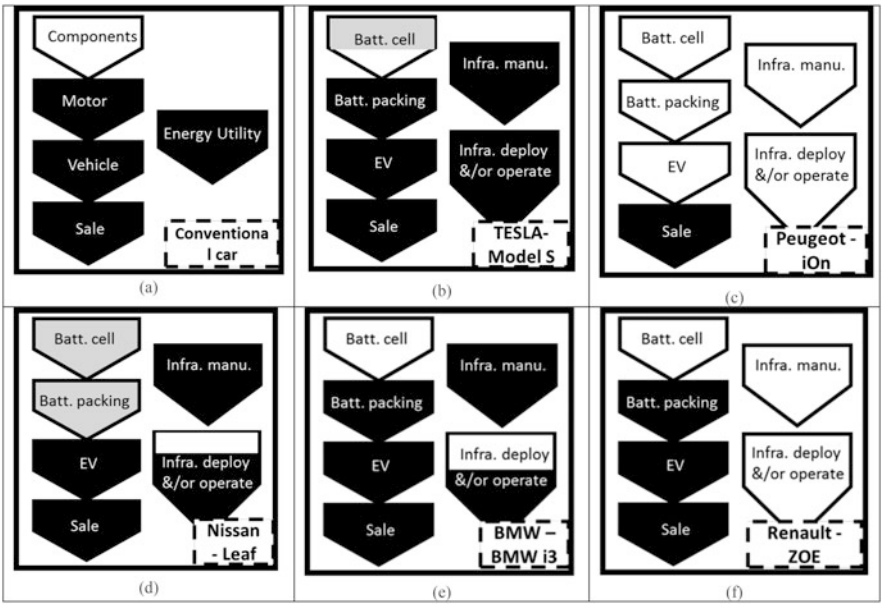

Fig. 3 Value configurations of Tesla Motors and other carmakers (black- outsource from supplier/ other utility; grey- joint venture; white- Vertical integration by carmaker)

network with partners as of end of 2014 (Fig. 3e,f). Nissan started developing quick charging networks in 2012, earlier and more aggressively than BMW, but still by partnership with utility providers (Fig. 3d). At the same time, companies which are less engaged in the EV market thus far, who wish to keep EV in their product portfolio could choose to be less integrated in their value chain, and purchase the EV from another carmaker. As Citroën C-Zero and Peugeot iOn from PSA are examples for this type of value configuration, it purchases the i-MiEVs from Mitsubishi, and resale it in europe under the brand Citroën and Peugeot. As a result, PSA only occupies the sale position in the value chain of EV (Fig. 3c).

In contrast, Tesla shows a very high different value configuration compare to other carmakers, from high level of out-sourcing to high level of in-house making. During the delivery time of the Tesla Roadster, most components are outsourcing to the suppliers, including battery cell, vehicle design and manufacturing. It is mainly due to that the company is in the initial stage, and in lack of knowledge and capacities for vehicle production and fast repond to the market. However, the packing and assembling of the battery cells and the energy management are conducted by Tesla. When the commercial delivery of Tesla Model S began, Tesla motors began to show a high level of vertical integration along its value chain: body design, battery packing, recharging system as well as recent move towards batter cell manufacture as the Gigafactory with Panasonic (Fig. 3b).

Therefore, a map for the business model innovation of Tesla Motors is summarized in (Table 1).

Table 1 Business model of Tesla Motors from value-related perspective

	Innovation towards vehicle	Innovation towards battery	Innovation towards infrastructure system
Value proposition	High performance regarding to range and vehicle performance; innovative connective services and intelligent services	Innovative management of battery packs enables high capacity and low cost; connective service enables interaction with users; new products towards stationary battery market	High performance recharging station with highly developed recharging station network; connective service enable interact with user;
Customer segments	Innovatively starting with high-end market; and moving to mass market		
Distribution channel	Innovative multi-channel model, involving high integration of IT; vertical integration on selling	Together with vehicle, replace possible	Public network deployed by tesla motors only
Value configuration	Innovatively possess high level of vertical integration		
Revenue model	Ownership; government loan	Purchase with vehicle or separate purchase when update	Free to tesla users
	Selling powertrain and battery pack to other EV maker		
	Market share		

5 Conclusion

This paper discusses the business model innovation of Tesla Motors regarding vehicle, battery, infrastructure systems and their corresponding value configurations. Following the analysis, we arrived on a systematic view of how Tesla innovates in the business model.

A top-down and flexible product strategy: Tesla Motors holds a product strategy entering from high-end market and moving to mass market customer segments. It started with offering performance sport EV which ignited the market enthusiasm, followed by providing the premium family EV and aiming to create affordable mass market for EV. At the same time, as an entrepreneurial firm, it has a high level of innovation adaptation and flexibility in learning by doing. More classical carmakers should also be more flexible in pursuing radical business models, especially when the dominant technology design in EV industry are unclear.

A huge endeavor on range anxiety reduction: Tesla Motor holds plan to solve the range anxiety problem along with EV. It pays a considerable attention to both large capacity battery packs and high performance supercharger stations. One of the most important long term strategies of Tesla Motors is the high performance supercharger station and its aggressive expansion around the main intercity highways in US and Europe. Furthermore, the strategy choice of battery range is much higher than the choice of other carmakers. All these aspects contribute to reducing the range anxiety

of Tesla users and enable high performance in the value proposition of business model. As range anxiety comes with the attributes of EV and become the most critical concern for the customer, carmakers should also take certain actions to reduce the range anxiety with certain cost.

An integration of information technology: Tesla shows a high level of integration of information technology into the EV business model. In the value proposition, Tesla innovatively increased the connectivity between users and the environment such as charging stations and infotainment services. Tesla benefits from the attackers' advantage in the connectivity of car (Christensen and Rosenbloom 1995). A high share of information technology is involved in both online and retail outlet distribution channels for Tesla. The connective service will increase the add-on-value of vehicle or after sell services, carmakers should take action on integrating information technology for both the vehicle value proposition and distribution channel.

A new value configuration with more integration: Tesla Motor holds a new value configuration which involves a high level of vertical integration towards battery and recharging network. The integration strategy will reduce coordinate costs between carmakers and their suppliers, and reduce risks caused by lack of supporting infrastructure. However, it also involves high investment and risk coming from the uncertainty of the EV industry.

Acknowledgements Yurong Chen benefits from the support of the Chair "PSA Peugeot Citroen Automobile: Hybrid technologies and Economy of Electromobility", so-called Armand Peugeot Chair led by CentraleSupélec, and ESSEC Business School and sponsored by PEUGEOT CITROEN Automobile. She would like to express her gratitude towards all partner institutions within the program as well as the Armand Peugeot Chair. An early version of this paper has been presented in Gerpisa annual conference 2015.

References

Baden-Fuller, C., & Haefliger, S. (2013). Business models and technological innovation. *Long Range Planning, 46*(6), 419–426. https://doi.org/10.1016/j.lrp.2013.08.023.

Bohnsack, R., Pinkse, J., & Kolk, A. (2014). Business models for sustainable technologies: Exploring business model evolution in the case of electric vehicles. *Research Policy, 43*(2), 284–300. https://doi.org/10.1016/j.respol.2013.10.014.

Chen, Y., Chowdhury, S., Donada, C., & Perez, Y. (2016). *Mirroring hypothesis and integrality in the electric vehicle industry: Evidence from Tesla Motors*. Administrative Sciences Association of Canada Conference, Montréal.

Chesbrough, H. (2007). Business model innovation: It's not just about technology anymore. *Strategy & Leadership, 35*(6), 12–17. https://doi.org/10.1108/10878570710833714.

Chesbrough, H. (2010). Business model innovation: Opportunities and barriers. *Long Range Planning, 43*(2–3), 354–363. https://doi.org/10.1016/j.lrp.2009.07.010.

Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spin-off companies. *Industrial and Corporate Change, 11*(3), 529–555. https://doi.org/10.1093/icc/11.3.529.

Christensen, C. M. (1997). The innovator's dilemma. *Harvard Business School Press*, 1–14. https://doi.org/10.1016/j.jbusres.2010.12.002.

Christensen, C. M., & Rosenbloom, R. S. (1995). Explaining the attacker's advantage: Technological paradigms, organizational dynamics, and the value network. *Research Policy, 24*(2), 233–257. https://doi.org/10.1016/0048-7333(93)00764-K.

Codani, P., Petit, M., & Perez, Y. (2014a). *Missing money for EVs: Economics impacts of TSO market designs*. Available at SSRN https://ssrn.com/abstract=2525290

Codani, P., Petit, M., & Perez, Y. (2014b). *Diversity of transmission system operators for Grid Integrated Vehicles*. In 11th International Conference on the European Energy Market (EEM14) (pp. 1–5). IEEE. https://doi.org/10.1109/EEM.2014.6861209.

DeMorro, C. (2015). *How many awards has Tesla won? This infographic tells us*. Accessed May 17, 2016, from http://cleantechnica.com/2015/02/18/many-awards-tesla-won-infographic-tells-us/

Dijk, M., Orsato, R. J., & Kemp, R. (2013). The emergence of an electric mobility trajectory. *Energy Policy, 52*, 135–145. https://doi.org/10.1016/j.enpol.2012.04.024.

Donada, C., & Attias, D. (2015). Food for thought: Which organisation and ecosystem governance to boost radical innovation in the electromobility 2.0 industry? *International Journal of Automotive Technology and Management, 15*(2), 105–125. https://doi.org/10.1504/IJATM.2015.068545.

Donada, C., & Lepoutre, J. (2016). How can startups create the conditions for a dominant position in the nascent industry of electromobility 2.0? *International Journal of Automotive Technology and Management, 16*(1), 11–29.

Donada, C., & Perez, Y. (2015). Editorial – Electromobility at crossroads. *International Journal of Automotive Technology and Management, 15*(2), 97–104.

EV Sales. (2016). *World top 20 2015 special edition*. Accessed May 11, 2016, from http://evsales.blogspot.fr/2016/01/world-top-20-december-2015-special

Fournier, G., Hinderer, H., Schmid, D., Seign, R., & Baumann, M. (2012). The new mobility paradigm. Transformation of value chain and business models. *Enterprise and Work Innovation Studies, 8*(IET), 9–40.

Günzel, F., & Holm, A. B. (2013). One size does not fit all – Understanding the front-end and back-end of business model innovation. *International Journal of Innovation Management, 17*(1), 1340002–1340034. https://doi.org/10.1142/S1363919613400021.

Hill, C. W. L., & Rothaermel, F. T. (2003). The performance of incumbent firms in the face of radical technological innovation. *The Academy of Management Review, 28*(2), 257–274. https://doi.org/10.2307/30040712.

Hull, D. (2016). *Tesla says it received more than 325,000 model 3 reservations*. Accessed May 17, 2016, from http://www.bloomberg.com/news/articles/2016-04-07/tesla-says-model-3-preorders-surge-to-325-000-in-firstweek

Hung, S. C., & Chu, Y. Y. (2006). Stimulating new industries from emerging technologies: Challenges for the public sector. *Technovation, 26*, 104–110. https://doi.org/10.1016/j.technovation.2004.07.018.

Huth, C., Wittek, K., & Spengler, T. S. (2013). OEM strategies for vertical integration in the battery value chain. *International Journal of Automotive Technology and Management, 13*(1), 75. https://doi.org/10.1504/IJATM.2013.052780.

International Energy Agency. (2016). *Global EV outlook 2016: Beyond one million electric cars*. https://www.iea.org/publications/freepublications/.../Global_EV_Outlook_2016.pdf

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

MacDougall, W. (2013). *Electromobility in Germany: Vision 2020 and beyond*. Berlin: Germany Trade & Invest.

Markides, C. (2006). Disruptive innovation: In need of better theory. *Journal of Product Innovation Management, 23*, 19–25. https://doi.org/10.1111/j.1540-5885.2005.00177.x.

Musk, E. (2006). *The secret Tesla Motors master plan: Blog – Tesla Motors*. Accessed January 9, 2017, from https://www.teslamotors.com/blog/secret-tesla-motors-master-plan-just-between-you-and-me

Osterwalder, A. (2004). *The business model ontology: A proposition in a design science approach*. Lausanne: HEC Lausanne.

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers*. https://doi.org/10.1523/JNEUROSCI.0307-10.2010.

Statista. (2016). *Global car sales by manufacturer 2015*. Accessed May 11, 2016, from http://www.statista.com/statistics/271608/global-vehicle-sales-of-automobile-manufacturers

Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning, 43* (2–3), 172–194. https://doi.org/10.1016/j.lrp.2009.07.003.

Tesla Motors. (2013). *2012 annual report of Tesla Motors Inc*. California.

Tesla Motors. (2016). *2015 annual report of Tesla Motors Inc*. California.

Theyel, G. (2013). A framework for understanding emerging industries. In *EAEPE conference*. Paris.

Urban, T. (2015). *How Tesla will change the world*. Accessed May 12, 2016, from http://www.businessinsider.com.au/how-tesla-will-change-the-world-2015-6/

Von Pechmann, F., Midler, C., Maniak, R., & Charue-Duboc, F. (2015). Managing systemic and disruptive innovation: Lessons from the Renault zero emission initiative. *Industrial and Corporate Change, 24*(3), 677–695.

Wang, H., & Kimble, C. (2013). Business model innovation in the chinese electric vehicle industry. In G. Calabrese (Ed.), *The greening of the automotive industry* (pp. 240–253). London: Palgrave Macmillan.

Weiller, C., & Neely, A. (2014). Using electric vehicles for energy services: Industry perspectives. *Energy, 77*, 194–200. https://doi.org/10.1016/j.energy.2014.06.066.

Weiller, C., Shang, A., Neely, A., & Shi, Y. (2013). Competing and co-existing business models for EV: Lessons from international case studies. In *Electric vehicle symposium and exhibition* (pp. 1–12). https://doi.org/10.1109/EVS.2013.6914776.

Yin, R. (2013). *Case study research design and methods* (5th ed.). Thousand Oaks, CA: SAGE.

Zott, C., Amit, R., & Massa, L. (2011). The business model: Recent developments and future research. *Journal of Management, 37*(4), 1019–1042. https://doi.org/10.1177/0149206311406265.