

Dynamic business model for electric vehicles (EV) over the product life cycle

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Summary

Electric vehicles (EV) is getting attention and expanding its market thanks to policy and technology improvement. Since EV require new ecosystem, new business model is necessary for each stakeholder to keep up with the development EV technology. In this paper, dynamic business model for EV is proposed from each stakeholder's point of view according to product life cycle. The key players for each technology status are identified and nine blocks business model of Osterwalder is used to visualize the business model.

Keywords: BEV (battery electric vehicle), business model, policy

1 Introduction

Electric vehicles have radically revolutionized the trend of business models. First, the target market of EVs has different characteristics from that of conventional vehicles, since EVs' customer segments and stakeholders are entirely novel. In addition, the EV industry requires different technological improvement such as electricity and electrochemical technology, while the conventional vehicle only requires mechanical and chemical technology. Therefore there is more room for divergent novel entrepreneurs to enter the automotive area. Furthermore, high connectivity is necessary for EVs to overcome range anxiety and utilize electricity more efficiently by implementing vehicle-to-grid (V2G) or vehicle-to-home (V2H) technology. EVs can also play a significant role in regulating the renewable energy disturbance [1].

In this paper, we suggest dynamic business models for each stakeholder within the EV product life cycle (PLC). Like other products or services, EVs will have certain life cycles – from product development through to product introduction, growth, maturity and decline [2]. Currently, EVs are likely to exist between the product development and product introduction phases, depending on the location and stakeholders. In the near future, it is obvious that the EV life cycle will progress to the next phase with the introduction of new technology and/or regulatory adjustments. As the EV market matures, stakeholder's business models must also adjust.

Below are the lists of questions we intend to address in the research:

- What are the specific differences in EV business strategy across each phase of the EV product life cycle?
- What type of business model is necessary for each EV business stakeholder?

- What strategic variables are associated with high performance at each stage of the EV product life cycle?

In order to answer these questions, the authors suggest a dynamic business model for electric vehicles. The dynamic business models comprise three steps: First, significant aspects of the EV market and its key stakeholders are analysed for each phase of the PLC. Second, based on results from the first step, the framework of the dynamic business model and the relationships between stakeholders are introduced. Third, detailed business models for significant stakeholders in each phase of the PLC are established through a nine-block business model. The analysis in this study can provide not only the methods to analyse the PLC of the EV market, but also has implications for business entrepreneurs and policy makers seeking to establish an EV market.

2 Literature Review

EV business model research has grown in prevalence alongside EV technology research as EVs gain more attention. A holistic methodology of developing business models or a morphological box is suggested for EV stakeholders [3]. This research provides insight into electric vehicle business possibility to electric vehicle, battery, infrastructure and service perspective. In addition, the evolution of EV business models is critical in order to compensate for the higher initial investment than that required for conventional vehicles. Under these circumstances, Williander and Stålstad [4] suggested a new business model for plug-in cars, including EVs. They currently provide business models that are appropriate for particular geographical locations such as Sweden (i.e. EV leasing, EV subscription, floating EV sharing and EV company fleet vehicles). Another case study examines suggested EV business models such as fast-charging BYD vehicles, battery swapping by WanXiang, the EV manufacturer of Tesla Motors (Tesla), and EV sharing by Autolib [5]. Furthermore, Budde Christensen et al. [6] explore the business case of the Better Place in Denmark, arguing that its business model (leasing and monthly subscriptions) remained niche rather than mainstream. Therefore an innovative business model is still an insufficient means of creating substantial change.

Since the electric vehicle industry provides a new business opportunity and therefore requires new entrants, EV business researchers have suggested the introduction of a brand-new business model. With regard to the development of electric business ecosystems, infrastructure providers, as well as not only mobility providers, play a critical role then the integrated business model for them, which multiple partner would interact continuously and produce additional value [7]. In addition, as new entrants come into the EV business, incumbents and entrepreneurs are required to modify and develop their business model to coincide with the context of the market. In order to move toward more sustainable technology, the role of new entrants, as opposed to incumbents, is emphasized in the research.

While previous papers have suggested EV business models for particular situations and time periods, dynamic business models are vital, as EV business environments change at an unprecedented speed. Since the current EV business context is analogous to that of Internet communication technology (ICT) business in terms of high levels of adaptability to accommodate ongoing changes more efficiently, the EV BM should be favourable to dynamicity so as to cope successfully with these changes. Similar to previous telecommunication technology, EVs have undergone continuous revolutions driven by innovative technologies, market changes and new entrepreneurs, such as Tesla motors. Owing to these factors, the EVs business environment has greatly changed. Therefore in order to survive in the current business environment, EV business stakeholders are required to develop more explicit and flexible business models [8].

Bohnsack et al. [9] studied the EV business model for two stakeholders (incumbent and entrepreneurial) over the course of five years (2006-2010). Rieg et al. [10] emphasized the dynamicity of e-mobility changing over business model; however they developed a dynamic model for one stakeholder under certain conditions, rather than considering a variety of stakeholders, over a significant time period. Lu et al. [11] suggested a dynamic business model for electric vehicles, or the 'Triple oscillation model', that is relevant with regard to lifecycle and stakeholders; they also emphasized the transformation of the role of EV stakeholders as the life cycle progresses. This research, however, primarily focused only on one particular market (e.g. the Chinese market) or on limited stakeholders. On the other hand, this research has progressed

not only by suggesting a general electric mobility business model, but also by putting more weight on relationships between stakeholders.

3 Research methodology

Although the electric mobility business, as opposed to the conventional automotive business, depends upon a variety of stakeholders, previous EV business research has not been widely considered as a business model for multiple parties. Therefore, the relationship between EV business stakeholders is necessary in the establishment of a value creation structure [12]. Furthermore, as seen in the previous chapter, it is also essential for EV business stakeholders to develop a time-variant or dynamic business model due to the variable environment (e.g. technology and policy). Therefore this study emphasizes the network of electric vehicle business stakeholders, alongside the business cycle.

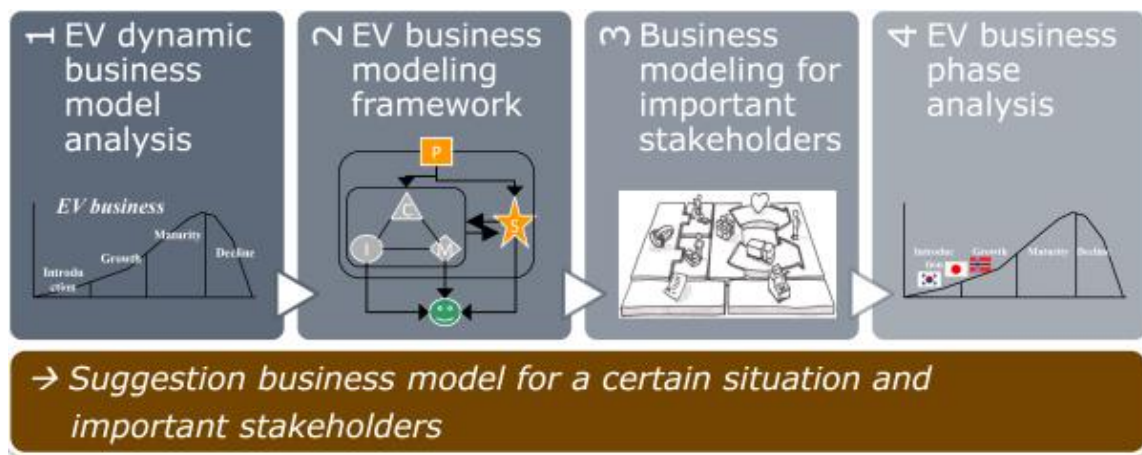


Figure 1: Research methodology

Previous product life cycle analysis [2], [13] determined important factors alongside the product life cycle. It is plausible that electric mobility would have similar characteristics to other products with regard to its product life cycle. Therefore, generic property, along with its product life cycle, can also be applicable in the analysis of the EV product life cycle. This life cycle is subsequently predicted on the basis of previous studies, and the EV business model framework is drawn for each phase of product life cycle. Instead of focusing on business models for individual entities, this study emphasizes the relationship of whole stakeholders and suggests a framework for the EV business. Although each stakeholder is essential to building a business ecosystem, certain business circumstances would require a significant player. In this context, the analysis determines the key players in each particular phase, and business models for significant stakeholders are suggested through Osterwalder and Pigneur’s nine-block business model [14]. Overall research approaches are shown in Figure 1.

In this paper, significant electric vehicle business players are categorized as five entities: policymaker, infrastructure provider, mobility provider, components provider and service provider.

First, the role of policymaker consists of the implementation of policy and regulation that can stimulate the EV business in its initial stage. Policymakers can include governments and local governments, and areas in which they can provide support include subsidies for electric vehicles and charging facilities, tax benefits, and credits related to carbon tax and fuel economy for car manufacturers. Second, infrastructure providers in the EV business are equivalent to companies related to charging EVs, such as charger providers, grid operators and utility operators. Third, mobility providers provide electric mobility, which operates primarily through electricity from a charger. In this case, electric mobility can encompass electric bikes to electric scooters to electric vehicles. Fourth, components providers manufacture the components of electric mobility (e.g. electric motors and high-voltage batteries). Examples of components providers include Samsung SDI, LG Chemistry, and Panasonic, among others. Finally, service providers are equivalent to EV-based service providers. There may be a plethora of service providers based on electric mobility – from charging service providers to charger or EV certification providers, to EV sharing service providers. In this study, we place greater emphasis on the service provider perspective due to its critical role in the

introduction phase and its ability to present new business opportunities in the later phase. Current examples of sharing or similar services are EV sharing services (Autolib, France), E-bike sharing (Denmark) and E-mobility usership (Mu by Peugeot, Peugeot). There may be other stakeholders such as solar generating facility providers, electric mobility providers or non-government organizations (NGOs); however they are merely treated as customers or partners.

4 EV dynamic business model

In the Figure 2. EV business model framework is suggested. The relationship and influence between each stakeholder in EV business can be drawn along with the product life cycle from the research study. At each phase the influence is shown with rectangle and the possible partnership and competition / value proving relationship is shown with line and arrow respectively. The critical players at the each phase are emphasized.

At the introduction policymaker would have connection with every stakeholders to establish business ecosystem. Especially its can be able to tie up with service provider for increase the number of charging station and promote electric mobility to the public by EV sharing service. Product and components manufacturer and infrastructure provider cooperate closely to expand EV market. Their relationship would be like that of the mobile phone and telecommunication service providers, in that they are inseparable particularly at first and one's improvement can lead to increase the total value provider to customers. Customers might purchase or use electric mobility from manufacturer or sharing service provider. And also they would regularly visit the infrastructure facility to fill up the EV.

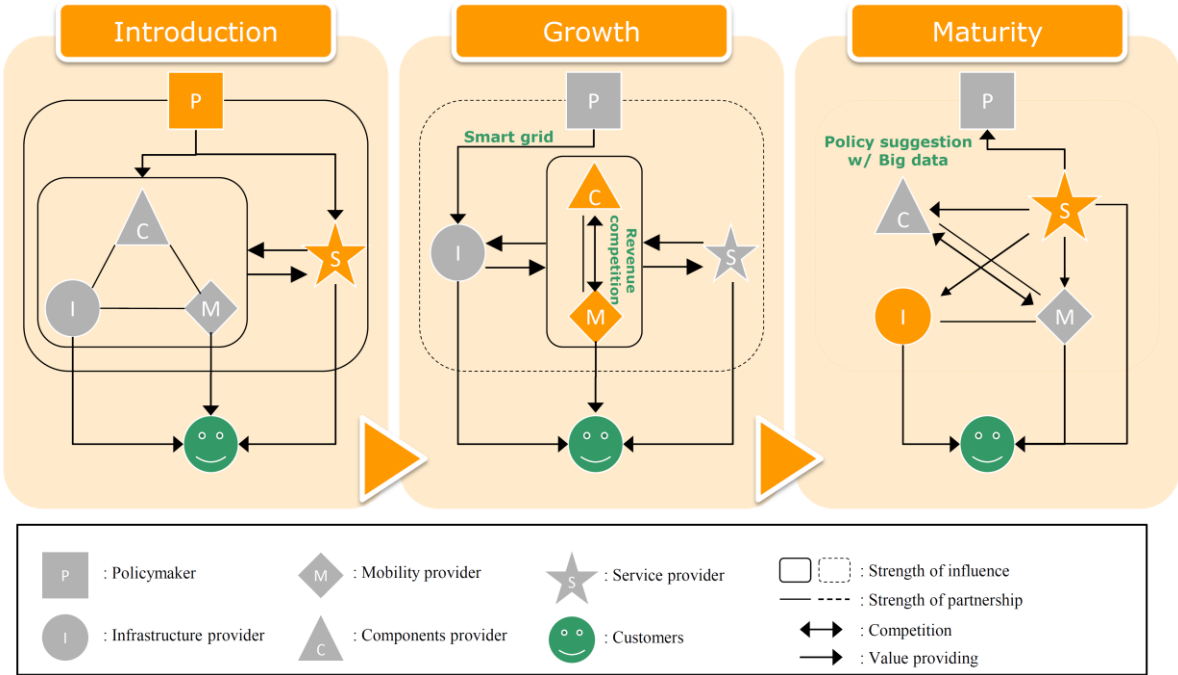


Figure2: EV business model framework

At the next phase, growth, the role of policy is getting weaker since the EV market would be healthy enough to sustain by itself. Nevertheless government has an effect on the EV market because its other business like smart grid and renewable energy the EV can play an important role in terms of infrastructure. As show in the figure that is the reason why the boundary of policymaker is fading gradually. Product manufacturer would be at the centre as a platform business provider. With that they not only can provide new value to other stakeholders, but they can also expend market share. Final product provider and components provider would be in tension in term of platform business competition as well as cost reduction completion. In other words market requires cost reduction to gain more market share they would struggle to reduce costs and raise profit as much as possible. Since battery is consisted of major part of electric mobility the cost reduction for manufacturer means the reduction the price of battery.

When EV market transfer into maturity phase without policymaker's role the electric mobility business would persist and the only thing it needs to do is regulating and modulating the market. And it motivate the healthier and diverse market by promoting small-middle size entrepreneurs and emphasizing network among stakeholders. As far as we have learnt from mobile business when market is become mature products are steadily improved and are evolved to a variety version of products and the infrastructure improvement mainly leads to the products improvement as well. In addition service around its products is getting prevalent as its users are increasing. In the same way as EV market has become mature service providers would have a connection to other stakeholders and provide new business opportunity. On top of that like telecommunication infrastructure EV charging system provide new value like fast charging method to customers.

4.1 Dynamic business model research

Generally there are four steps in product life cycle – introduction, growth, maturity and decline. Each phase of product life cycle requires different aspects to make a success in competing with challengers.

At the introduction business has started from the scratch and products are newly developed so there would be few competitors in the market. Less competitive market can lead to high market share but lacking of groundwork can be a barrier. Therefore creating 'ecosystem' is a critical factor for the success. In other word company needs to make a channel to customers (Distribution) and to persuade them to purchase it (Marketing and Pricing). When it comes to electric mobility customers are sensitive to its price but it is uneasy to cut price owing to still high battery price. So as to solve this problem Tesla introduced novel method, like using a large number of inexpensive laptop lithium-ion batteries, but it seems to sacrifice safety. On top that with regard to distribution, EV requires to distribute charging station instead of distributing products themselves. It is necessary for EV user to find charging station easily without feeling range anxiety. In consequence the role of two stakeholders are emphasized, policymaker and EV sharing service provider. Because government can help lower EV price with subsidy or tax benefit until battery technology is developed enough and EV sharing service provider can make a contribution for facilitate public charging station.

Table1: EV dynamic business model analysis

Product life cycle	General important factors	EV business important factors	Key Stakeholders
Introduction	Distribution and Marketing = Easy for a customer to buy and to know, Pricing	For EVs it is not easy to cut price owing to high price of battery, then government policy support is necessary for lowering its price. Plus in order to distribute charging station efficiently and make customers know it, EV sharing service is effective way.	Policymaker Service
Growth	Market share (Cost efficiency / Time-to-market/Pricing / Segmentation)	Target segment customers – From niche to mass (Tesla) EV hardware providers – mobility and components – need to adopt platform business model to reduce developing cost and time period	Mobility and Component provider
Maturity	Differentiation - A full of variations of the basic product and all competitors are presented	Beyond competitor's business model additional value should provide by less charging time . Therefore new charging technologies, such as battery swapping and supercharging, need to be introduced. Service provider would have new business opportunity with the increase customer data	Infrastructure Mobility service
Decline	Withdrawing a product strategy	EVs might be replaced with next environment friendly vehicle such as fuel cell vehicle. Proper transition decision is key preparing next business	New PLC

At the growth phase a plethora of business player would show up and them market is becoming competitive. Hence business players would struggle to gain as much as market share. In order to meet a goal those business strategy are becoming important, increasing cost efficiency, customer segmentation and meeting time-to-market. As long as it is at the growth phase EV products manufacturers – electric mobility and component – would be key players to compete market share. There would be a variety of attempts and strategies to obtain as much market share as possible. At present EV manufacturer also are targeting on segmented customers. While convention vehicle manufacturer like Nissan, General motor and BMW are

targeting on small-sized and low price vehicle customers, Tesla and Fisker are aiming on luxury EV. Anyhow both of them have started their EV business from niche market to mass market. So as to make the transition from niche to volume application the traditional automotive industry value chain is insufficient to the task. Therefore the mass adoption of electric vehicles will bring new ways of creating and capturing added value [15]. In this context one of the strategies would be ‘platform-based businesses’. This can lead not only to reduce development cost but also to meet time-to-market.

Third phase of electric vehicle business is maturity, which a full of variations of the basic product and all competitors are presented. More intense competition would be expected and market is close to full. Since most products looks similar product should provider new value for differentiating with its competitors. Therefore electric mobility also would need to seek differentiation aspects on its product. However electric vehicle technology is so simple relatively that it is effortful to find that. One thing for that would be other aspect like charging. Compared to gas station EV charging time require longer time up to full. Then if charging time can be shorter it would be competitive aspects. In addition service provider can find new business opportunity with its increased customer. The more customers the more information can be gathered and this information open to the new market.

Last phase, decline is also important since company should decide when it withdraw from the market and when new product should introduce to the market. Without the proper strategy for the decline phase, company would gain a loss and lose competitiveness for next product life cycle. Electric mobility business stakeholder would need to prepare for the next environmental friendly vehicle, for example, fuel cell vehicle. In this study the decline phase research is not included.

Product Life Cycle	Policymaker	Infrastructure provider	Mobility provider	Components provider	Service provider
	Government	Charger provider	Manufacturer from E-bike to EV	Battery and electric components	EV sharing Service
Introduction phase	Ecosystem modeling	Public charging Standardization	Niche market approach	Component improvement	Service-based BM I (EV sharing)
Growth phase	Engaging with smart grid and renewable energy	Home charging Wireless charging	Segment varieties Chassis-based platform BM	Battery-based platform BM	Service-based BM II (P2P EV sharing)
Maturity phase	Enhancing and modulating EV network	Time saving technology (Bat. swap / Supercharger)	Differentiation with ICEV	Cost reduction (Recycle or reuse battery)	Data-based BM Service-based BM III (Autonomous EV sharing)
Decline phase	Next environmental friendly mobility				

Figure3: EV dynamic business model

4.2 EV business models for each phase of PLC

A business model defines how a firm delivers value to target customers to make payments and convert them to profits [16]. A business model can be a blueprint for the EV business stakeholders with respect to the business environment changes. On top of that Teece [16] suggested the process of business model design

Business models for an important stakeholder at the certain product life cycle are suggested. At first the technologies and features are selected to be embedded in the product or service. Afterward the benefit is determined to the customer for consuming and using the product or service and then the targeted market is identified and segmented. The cost structure and revenue streams are confirmed and lastly the mechanism to capture value is designed. In this paper with following the business model design process of Teece [16], nine bolcks business model of Osterwalder [17] is used to express the results.

Business model for Policymaker at the Introduction phase

While in the business sector it defines a business creates value for its customers and private-sector stakeholders, in the public sector a business model describe how an organization creates value for its customers, the citizens of the country and fulfils its mandate [18]. Especially, at the initial phase of EV industry policymaker can play a significant role for establishing its ecosystem, thus its customers can be considered individual as well as product and service providers. In terms of business customer policymaker can lower initial investment burden, especially charging provider in order to overcome EV short driving range and its range anxiety. Unlike gas station, which had naturally become prevalent owing to high energy density and cheap price [19], the EV charging stations would have less chance to survive on their own. While the surge in ICEV ownership and the increase of gas station went hand in hand, the EV ownership and the charging station have dragged each other down and have taken a wait-and-see policy until others take the action at first. In this circumstance government can cut the Gordian knot in order to make a start on electric mobility business. Plus individual customer can revive the direct and indirect value such as affordable EV and usage price and clean environment respectively.

Key partners	Key Activities	Value Proposition	Customer Relationship	Customer Segments
EV international initiative National research institution and university Environmental activist and Green party EV product and service provider	Standardization Subsidy and Tax benefit Investment in RD&D Key Resources National budget Infrastructure Public parking Renewable energy	Lower initial investment burden Charging provider Reduce EV business risk Lower EV product and usage price Clean environment	Policy, Legislation and Budget Stewardship of infrastructure Communication Community & Education Channels National initiative EV technology Development Product / Service Provider Demonstration	Product / Service provider EV & component manufacturer EV charging provider EV service provider Individual Customer EV buyer EV sharing service user
Cost Structure Infrastructure investment Charging station EV demonstration program Technology R&D investment Subsidy and Tax reduction		Revenue Streams Tax increase Carbon tax, Penalty for Fuel economy credit Social benefit Quality of life ↑ Social cost reduction Health cost ↓		

Figure4: Business model for policymaker at introduction phase

The communication channels between policymaker and stakeholders can be national initiative for business agencies and public business and product or service provider for individuals. National initiative is the organization of government and entrepreneur for promoting EV business by sharing business experience and investing EV technology innovation. Even though EV business agencies lie on between the government and the individuals mostly, the government can contact with individuals with EV demonstration business, which offer the EV usage experience or education. The UK government, for example, have commenced the ‘cluster’ of a nationwide EV charging project, which provide the charging facility in the residential streets in order to stimulate EV business (<http://myelectricavenue.info>).

The ways to enhance relationship are proper legislation and consistent policy fundamentally. Currently, however, the government is required to move one step further from that by improving its service quality. For delivering government service seamlessly and the enhancing the relationship with its customer, the government is required to evolve from silo-based approaches to collaborated agencies to networked service delivery [20]. In this context it can start to support EV business by a single agency e.g. private-sector agencies respectively. Afterward it needs to promote the collaboration between agencies and share the infrastructure. Lastly networked relationship among each stakeholder can be achieved by standardization and stewardship of information, infrastructure and business processes. Also, Duggan and Moon [18]

emphasized integrating citizen information so as to improve service quality, therefore if the number of electric vehicle is enough to obtain the user information the service of government would increase. This evolution of the government business model would have progressed along with EV business life cycle.

The key activities of the policymaker in EV business are standardization for EV and charger technology, providing subsidy and tax benefit and investing in EV research, development and demonstration (RD & D). Its key resources are national budget and existing infrastructure (public parking for EV charger, Integration with renewable energy). Since establishing EV ecosystem from the scratch requires considerable effort and attempt, the government can partner with EV international initiative, research institution, environmental politician or group and private-sector agencies. With them it can share experiences and lessons learned from other EV deployment demonstration and evoke EV technology innovation.

Cost structure is consisted with infrastructure, RD&D investment, subsidy and tax reduction. On the other hand it would reap benefit from tax increase if it adopts environment friendly policy such as carbon tax on vehicle and fuel economy credit for manufacturer. Not immediately it would be able to receive the social revenue by decrease health insurance costs nationwide improve the quality of people's life.

Business model for Service provider at the Introduction and Maturity phase

Service providers would have further business opportunity in the EV business in many ways. Firstly, the ownership of vehicle could replace with other type of service like subscription [4], sharing and mobility guarantee [3]. Secondly, EV requires different type of charging system far from conventional gas station. EV users will use charging station more frequently and differently as home charging, wireless charging, private charger or battery swapping. Thirdly, but not least, electric mobility is more suitable for 'information-based' business. EVs require and produce much data in order to evaluate the left driving range accurately and to provide proper information to drivers. Moreover the frequently usage of charging station equate with frequently connection to network. In this point of view electric mobility business is similar to mobile business with regard to current revenue stream. Mobile business has evolved from mobile hardware to expended application to information-base business. After mobile hardware became prevalent its application business like mobile banking, mobile transaction was getting ubiquitous as well. Afterwards mobile user information has brought new business opportunity for advertiser and marketer. As shown in previous chapter, hardware manufacturer might start platform business providing additional service and value like Apple. On the other hand, as Google has done in mobile business, new entrants could come into EV business by providing service-based business. While EV products have little differentiation with each other compared to the conventional vehicle what can be the appealing point to the customers? That may be the other value rather than product itself. For example the currently developing vehicle operating system would be applicable to electric mobility as well. The EV-specified operating system would bring novel opportunity for software developer and service provider. Among those possible businesses above, in this study we are going to focus on first type of service provider, electric mobility sharing service provider. Because at the introduction phase of EV business it can play a critical role for overcome the EV barrier, or lacking of charging station.

There are four types of customers for sharing service – individual customers, advertisers and marketer, local government and product providers. First of all, at the introduction phase sharing service provider can offer individual customers, who are mostly carless, city dwellers or commuters, freedom to own. With this new value, they release from own and maintain vehicle, but just own the user-ship. So customers are devoid of maintenance and insurance fee, vehicle tax. Service providers channel it business through website and mobile phone. And network effects can enhance the customer relationship, which means the more service users the easier customers can access to sharing mobility.

Secondly, local government, especially city, can reap the benefits of EV sharing service. It can lead to decrease the number of vehicle in the city and hence will cause less congestion. This turns to social benefits for its dweller. Furthermore sharing mobility can fill the gap between private owned car and public transportation. Consequently, the user can benefit improved connectivity and fast speed rather than public transportation and lower price compared to private car. In the local government's shoes, connecting EV sharing service with existing public systems seamlessly and efficiently is the key factor for the persistent relationship with service providers. The channels could be partnership or initiative. For example the

‘Branché project’, which is the electric carsharing project in Canada, started from a partnership between service provider, provincial and city government (Montreal), manufacturer and charging provider [21].

Thirdly, EV sharing service can provide advertisers and markets new value, reaching to the target customers. In order words EV sharing service collects the user data and with that advertisers can contact with target customers easily. Therefore the channels for them would be the display in EV such as GPS or tablet. The relationship can be maintained by cross-side network effects similar to mobile business. Then the more they acquire service users the more benefits markets and advertisers can obtain [22].

Lastly, at the maturity phase when the number of service users increases enough, service provider could make a profit from big data analysis of their users. They can collect data of users – who they are, how they use, where and when they go to. This would be a great means for product and other service providers, advertiser and markets and even government. For instance, if electric mobility developers know the average driving range and driving characteristic they can select the more proper size of battery and can produce more driving range products.

The key resources of sharing service providers are electric mobility, charging station and its user information. And their key activities would install and maintain charging station as well as user data analysis for other business opportunity. In addition they can parent with charging providers, EV manufacturers, public transportation provider (or car rentals) or government. Mainly, they spend on large amount of money for purchasing electric mobility and installing charging station, and the daily costs would be operating cost such as maintenance and distribution evenly of electric mobility. EV sharing service can make revenue from subscription of users and commission on its information.

Key partners	Key Activities	Value Proposition	Customer Relationship	Customer Segments
EV international initiative	Standardization	Lower initial investment burden	Policy, Legislation and Budget	Product / Service provider
National research institution and university	Subsidy and Tax benefit	Charging provider	Stewardship of infrastructure	EV & component manufacturer EV charging provider EV service provider
Environmental activist and Green party	Investment in RD&D	Reduce EV business risk	Communication Community & Education	
EV product and service provider	Key Resources	Lower EV product and usage price	Channels	Individual Customer
	National budget	Clean environment	National initiative EV technology Development	EV buyer EV sharing service user
	Infrastructure Public parking Renewable energy		Product / Service Provider	
			Demonstration	
Cost Structure		Revenue Streams		
Infrastructure investment	EV demonstration program	Tax increase	Social benefit	
Charging station	Technology R&D investment	Carbon tax, Penalty for Fuel economy credit	Quality of life ↑	
	Subsidy and Tax reduction		Social cost reduction	
			Health cost ↓	

Figure4: Business model for service provider at introduction and maturity phase

Business model for Mobility and Components provider at the Growth phase

In the growth phase of EV industry more business players, not only the convention car manufacturer but also new entrants, would show up. The more EV manufacturers would appear the more competition would exist. In other word it would happen to be critical for them to earn high market share and then in order to achieve this goal, the electric mobility provider and battery provider could start to consider ‘Platform business’, which means they provide electric component and powertrain platform except for exterior and interior of EVs.

There can be two types of customer in this business model, new entrants and incumbents. At first new entrants would want to start up EV business but they would be lack of resources, technology and

experience in electric mobility industry. Therefore to this new customer the conventional battery or electric mobility manufacturer could provide EV platform. With that new entrants could reap benefit from less technology barrier as well as lessened business risks.

On top of that the platform providers can offer value for incumbents as well, in that they can propose value in terms of reducing EV business risks and helping produce EVs in time. As the competition is getting more harsh 'time to market' has a major role in determining an organization's success over competitors and its ability to create value [18]. Namely instead of putting much time and effort for developing new product on their own conventional vehicle manufacturer could more focus on core and competitive areas, for example vehicle design, marketing and manufacturing. Moreover electric mobility is more suitable for platform business than conventional vehicle since the technology difference among its product could be trivial compared to internal combustion engine vehicle.

The channels between platform providers and customers could be outsourcing research and development (R&D) or supplier-buyer relationship. In addition the platform provider can keep the customer relationship by providing reliable, flexible and state-of-the-art technology. Key activities of platform providers are developing the platform of electric mobility, which can be applicable to a variety of vehicle segment in order to sustain low price. Moreover they could provide as a product as well as engineering service. They possess not only electric vehicle technology and R&D ability but they also own manufacturing facility beforehand as key resources.

Their key partners could be other components provider such as electric motor or gearbox, together with research institute or universities, which can develop up-to-date technology. Electric mobility platform providers need to invest and spend for R&D, manufacturing and components purchase. On the other hand their revenue stream can come from platform sales, technology transfer contract and patents licensing.

Key partners	Key Activities	Value Proposition	Customer Relationship	Customer Segments
Other components Provider Electric components Mechanical components	Develop EV platform Manufacture EV platform Engineering service	Lower initial technology barrier for EV entrants Reduce EV business risks Time-to-market	Technology State-of-the-art & Reliable & Flexible technology Channels R & D outsourcing Supplier - Buyer	New EV manufacturer Conventional vehicle manufacturers
Research institute and university	Key Resources EV technology and R&D ability Manufacturing facility			
Cost Structure Research & development Platform manufacturing cost Components cost		Revenue Streams Platform sales Technology transfer contract Patents Licencing		

Figure5: Business model for mobility & components provider at growth phase

5 Conclusions

In this study dynamic electric mobility business model has suggested along with its product life cycle. The reason why this study is necessary at this moment, is that even though electric vehicle technology has improved rapidly its business model research is still insufficient. Moreover the most current researches about EV business model solely consider one business player's point of view or short-term business model. For this reasons dynamic business model in the product life cycle point of view can contribute to see EV business as whole.

From previous product life cycle study the critical characteristics for the success are found, and with that EV market has been analysed. As a result at the introduction phase policymaker would play an important role to establishing EV business ecosystem while service provider like EV sharing service can contribute to expand its infrastructure and promote to customers. At the growth phase as the market would become more competitive mobility and components providers struggle to gain more market share with cost saving and proper product strategy. One possible solution for them is platform-based business. With they can not only save its cost but also can expand its market share. At the maturity phase while the market would be full with a plethora of business players and a variety version of electric mobility, differentiation would be a key word for EV stakeholders. Hence instead of products themselves infrastructure technology could be a differentiation factor. For example battery swapping technology or supercharging technology can reduce charging time significantly and wireless charging system can provider convenience to customers as well. When it comes to service provider they would reap benefits of increased its user. The increased user data would offer a new business opportunity like big data industry. From EV product life cycle analysis business models for critical stakeholders are suggested.

Even though this study is focusing on the future business status based on the current market environment, but market is always unpredictable and there might be some entity which could bring the breakthrough in EV market from inside or outside like Apple. As Apple, which is from outside of mobile industry, has led mobile business new entrants from other industry can change its market status.

Even though EV has been developed since 1800s its business model has barely developed yet. In fact its business has just commenced and a plethora of business models is testing even at this moment. Therefore it may be too early and lack of basis to predict future of EV business. However the automotive business and mobile business development have suggested insights for them. The infrastructure development and automotive market growth provide a lesson for electric charging station utilization. And information based business model in mobile industry help understand new opportunity in the information-based EV business opportunity. However there is possibility that EV business would have different characteristic with convention vehicle industry and mobile industry. In other word electric mobility business is open to novice entrepreneurs and incumbents as well.

This study can be a guideline for policymaker and business entities to plan their business strategy. While incumbents in EV industry can find the way of transforming its business strategy new entrants can find new business opportunities. Furthermore since this study has focused on network among EV stakeholders it also provides vision for policymaker in a whole view. However every country and company would have different internal and external environment therefore it is difficult to determine which phase in the product life cycle they are situated in. Therefore the market status analysis for electric vehicle industry is necessary to implement dynamic EV business model.

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