New Paradigm for Business Model Design and Innovation: An Insight of Product Lifetime Value Based on Electric Vehicle

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Abstract. The business model is an effective and well-structured management tool that helps organizations acquire and hold onto a competitive edge over their competitors. This paper proposes a framework called “The Product Lifetime Value Business Model” for business model design and innovation of electric vehicle company. The framework consists of four layers, the innermost layer represents the business model, followed by the Product Lifetime Value layer and 6V model, the outermost layer comprises 17 additional dimensions that provide a more detailed and in-depth analysis. The concept of Product Lifetime Value is proposed and can be categorized into six distinct stages: planning, production, delivery, revenue generation, application, and recycling in this paper. In addition, a “6V” model is also proposed based on electric vehicle industry which contains value proposition, value creation, value delivery, value capture, value of after-sales services, and value of residual.

1. Introduction

The business model is a valuable and structured management tool that supports companies in gaining and maintaining a competitive advantage over their rivals [1-2]. Although the term “business model” was introduced in a scholarly publication in 1957, it gained significant attention only in the late 1990s [3]. Since the early 2000s, it has experienced substantial growth and widespread adoption across various business and management disciplines [1, 4]. To stay ahead in the dynamic corporate landscape, companies must proactively adapt or transform their existing business models through innovation [5]. Recently, there has been an increasing focus on business model innovation within the field of business model analysis [6].

As widely acknowledged, the strategic interplay between business models and innovation plays a pivotal role in effectively commercializing new technologies. This symbiotic relationship is crucial for fostering the sustainable growth of electric vehicle companies. To design and innovate business models, an electric vehicle brand company should consider various aspects. This article aims to develop a comprehensive framework for business model design from the perspective of product lifetime value. The proposed framework not only provides practical guidance for electric vehicle brand companies in their business model design or innovation but also contributes to advancing theoretical research on business models and innovation.

Section 2 of the article furnishes theoretical groundwork pertaining to business models, innovation, and Product Lifetime Value. The proposed Framework is expounded upon in Section 3, with a detailed discussion of its constituent elements in Section 4. A succinct summary is presented in Section 5, accompanied by suggestions for prospective research directions.

2. Underlying Concepts

2.1. Business Model

Business model is a conceptual framework that can assist in strategically taking into account the specifics of how the business operates [8]. It outlines a series of actions designed to meet the demands of the end-user and explains how the operating company plans to generate...
revenue through the value-added component of the business [9-10].

As Magretta argued that: A good business model answers Peter Drucker’s age-old questions: Who is the customer? And what does the customer value? It also answers the fundamental questions every manager must ask: How do we make money in this business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost [11]?

To be more precise and in line with academic rigor, a business model should provide satisfactory responses to the following questions: 1) What offerings does a company provide that are perceived as valuable by customers? 2) How does a company’s system create these values? 3) How are these created values effectively communicated and transmitted to customers? 4) How can these generated values be captured as revenues for the company? 5) How are these created values distributed internally within the organization and externally among stakeholders.

Business models are critical to a company, and a good business model can fully utilize the company’s strengths for better firm performance. As Soh and partners argued that for two companies that provide the similar products in the same industry can adopt two different business models would have very different firm performance [12]. Hence, there is a key managerial question is that how do different business models affect firm performance. Actually, in order to maintain well performance, business model should be constantly evaluated critically from a dynamic viewpoint, keeping in consideration that internal or external changes over time may necessitate business model innovation or evolution [10].

2.2. Business Model Innovation

Business model can be viewed as a tool for creating a competitive advantage and improving performance of company [2]. Business model innovation (BMI) is considered as “designed, novel, and nontrivial changes to the key components of a company’s business model or the framework connecting these components” [5, 13]. Hence, business model innovation research can be considered in terms of the process and content of innovation [5].

The research on business model innovation process has increased [5], include the antecedents, moderator, and outcomes [13-14]. Timo Böttcher and Jörg Weking identified six categories of antecedents and seven potential outcomes of business model innovation [15]. Evers et al. identified antecedents and outcomes of BMI in firm internationalization though systematic literature review [16]. It can be found that most researcher take business model innovation as a whole or main body to research.

However, there is a very critical issue in the actual management. It is difficult to carry out the overall business model innovation in a short period of time for an incumbent firm. They need to know how many aspects of the business model innovation. Then they can decide which one should be started first, and gradually derived to all aspects. Darek. M. Haftor and Ricardo Climent Costa give five dimensions of BMI for industrial incumbent firm through multi-case exploration, they are exchangeable, actor, activity, transaction mechanism and governance [5]. Some scholars proposed BMI with the components of value proposition innovation, value creation, and value delivery innovation and value capture innovation [17-19]. Therefore, researchers have not formed a unified view for the specific aspects or components of business model innovation.

2.3. Product Lifetime Value

The concept of Product Lifetime Value (PLV) encompasses both the duration of a product’s existence and its inherent worth. While the definition of value remains consistent across academic research, it will not be reiterated in this article. However, it is important to note that the interpretation of product lifetime in this study different from the conventional understanding and will be expounded upon subsequently.

The concept of Product Lifetime, also known as Product Life Cycle (PLC), is a well-researched and established theoretical framework in the field [20]. The PLC encompasses the four distinct stages - introduction, growth, maturity, and decline - that characterize the evolution of a product throughout its manufacturing and sales processes [21]. During the introduction stage, a new product is launched into the market; subsequently, in the growth stage, markets embrace and accept it [21]. As it progresses to the mature stage, sales and profits reach their peak before entering a declining phase where sales gradually decrease [21]. Therefore, the PLC primarily focuses on marketing aspects as an extensive long-term model. However, it does not elucidate how enterprises derive benefits from value-added processes or explain specific enterprise-specific product life cycle value addition.

Life Cycle Assessment (LCA) serves as a valuable tool for analyzing the potential environmental impacts of products and processes from a comprehensive life cycle perspective [22], encompassing the entire journey from raw material utilization to system recycling or disposal [23]. Verma and partners contend that an electric vehicle’s life cycle can be divided into three primary stages, one of which is referred to as "Cradle to grave" LCA, signifying the complete lifespan of an electric vehicle starting from raw material processing (cradle) until its ultimate disposal stage (grave) [23]. Consequently, when evaluating business models or fostering innovation in the realm of electric vehicles, adopting an LCA approach that encompasses the entire PLC - spanning from raw materials through recycling or disposal - proves highly beneficial.

PLV can be regarded as the comprehensive process of delineating a product’s lifecycle, encompassing its inception, raw material processing, and eventual disposal phase, all from the perspective of value. This article categorizes PLV into six distinct stages: planning, production, delivery, revenue generation, application, and recycling.
3. A proposed Framework- Product Lifetime Value Business Model

Business models delineate the manner in which companies generate economic benefits for themselves by providing value to their consumers [24]. Lüdeke-Freund et al. have further categorized business models into four dimensions, namely: (1) value proposition encompassing products and services; (2) value delivery involving target customers and processes of delivering value; (3) value creation comprising partners, stakeholders, and processes of creating value; and (4) value capture entailing revenues and costs [24]. However, it is imperative to acknowledge that repair, maintenance, re-exchange, and reuse also significantly influence customers' choices within the automobile industry. Consequently, business models for electric vehicles should incorporate not only those dimensions but also consider the values associated with after-sales services as well as residual worth. This comprehensive approach can be referred to as the "6V" model, they are value proposition to customer, value creation, value delivery, value capture, value of after-sales services, and value of residual.

Therefore, the PLVBM framework is proposed based on the concept of the business model from a value flow perspective to analyse business models and drive innovation of electric vehicles. The model consists of four layers, which are progressively subdivided from the innermost to the outermost layer. The innermost layer represents the business model, followed by the PLV layer. The third layer is the 6V model, and the outermost layer comprises 17 additional dimensions that provide a more detailed and in-depth analysis based on the 6V model. The framework form can be expressed as the figure 1.

Figure 1. A Proposed Product Lifetime Value Business Model Framework.

Business model design and innovation of electric vehicle contain six aspects base on product lifetime value in this paper. It can be expressed as the formula 1.

\[
\text{Business model} = \text{Plan} + \text{Production} + \text{Delivery} + \text{Income} + \text{Application} + \text{Recycle} \quad (1)
\]

Then, it can be further written base value perspective as the following formula 2.

\[
\text{Business model} = \text{Value Proposition} + \text{Value Creation} + \text{Value Delivery} + \text{Value Capture} + \text{Value of After-Sales Services} + \text{Value of Residual} \quad (2)
\]

Both Formula 1 and Formula 2 indicate that electric vehicle company should consider the content involved six factors at the right of Formula when design and innovate its business model.

4. Discussion

4.1. Value Proposition to Customer

A value proposition refers to an ensemble of goods and services that are provided to customers, aimed at meeting their requirements and generating value to them, whether that value is symbolic or actual [25-26]. Value proposition to customer in PLVBM means what the firm will deliver to its customers, why customers will be willing to pay for it, and the firm’s basic approach to competitive advantage [8], include: the offering, the target customer, and the basic strategy to win customers [8], as well as market.

Market in PLVBM means refers to market segment, represents a group of individuals or businesses who have
certain commonalities that differentiate them from other segments. Target customers are mainly come from market segment, who are most likely to find value in what the company provides. The offering in PLVBM is means what the company plans to offer to the target market and customer, such as offer product, or service, or product and service. Basic strategy in PLVBM refers to product or service price, quality, technology, brand, etc.

4.2. Value Creation

Value creation is frequently referred to as a critical component of the business model since it serves as the foundation for meeting customer interests [9]. It is the core of business model research, highlight the value generated for the company and its customers together with its underlying procedures and operations [25]. Value creation encompasses the method by which value is created both inside and outside, through collaboration with suppliers and consumers [27]. Value creation in PLVBM could answer the question as Thomas Clauss et al. said “What operational processes and resources will be necessary to create the services and products offered”, mainly include key resource, mode of production, and supplier partners [28].

Key resources in PLVBM means are companies’ critical assets, capabilities, and elements that are necessary for the company to operate, create value, and achieve its business objectives. Production mode refers to how company produce vehicles’ main part such as body, battery, battery manage system, electric motor and so on, including self-made, cooperation, entrusting others, and others. Supplier partners refers to the cooperation with suppliers because there are lots of part in a vehicle and most of them are purchased by company. The suppliers are very important for an electric vehicle brand company.

4.3. Value Delivery

Value can be perceived in various forms, such as quality, price, convenience, innovation, and customer service. It is crucial to deliver value to customers. Customer value is the result of balancing the benefits and utilities a customer derives from a product (such as quality, advantages, worth) against any costs or losses incurred in acquiring and utilizing it [29].

Value delivery refers to the process of providing value to customers through the delivery of products, services, or solutions. It involves aligning business activities with customer needs and preferences to create a positive and memorable customer experience. Value delivery comprises the procedures and actions required to deliver the finished product or service [30].

Customer value is totally unrelated to price, which is a distinct advantage [31], especially industrial field. Good value delivery can enhance the cognition of consumers and promote the purchase of products or services by consumers. The customer’s perception of value is not only at the delivery stage of a product or service, but throughout the entire stage of a company’s operations. Hence, value delivery in PLVBM include: pre-purchase value delivery, product diversion, and post-purchase value delivery.

Pre-purchase value delivery refers to the processes and activities through which a company delivers its cultural and product values to potential consumers, enabling them to become aware of, recognize, and follow them in advance. Product diversion, like other scholars, encompasses the processes and activities required to deliver the final offering. Post-purchase value delivery means that the product and company values should continue to be delivered even after the consumer has made the purchase, thereby reinforced their decision, and enabled them to experience the additional value that the product brings.

4.4. Value Capture

Value capture, often known as monetization refers to the means, by which an organization gets paid by its customers and is able to keep operating commercially [32], explain how the organization getting its profit to cover the fees that have been paid [33]. Value capture, more specifically, is the process of securing revenues from value creation and distributing those gains across participating parties, including suppliers, clients, and partners [34].

Value capture in PLVBM include elements such as cost structure, potential revenue stream, and revenue model [28, 30]. Cost structure refers to the composition and breakdown of the costs that company incurs in its business operations, is importance for managers to assessed profitability, make pricing decisions, and other actions. Revenue stream refers to the various sources of income or revenue that a company generates as a result of its business activities, identify potential revenue stream is important for company's financial stability and growth. Revenue model describes how an organization makes money from its goods, services, and other offerings, put into another context, it describes how money enters the organization and should include strategies like direct sales, leasing, charging fees, or other revenue generated from value-added services in the electric vehicle industry.

4.5. Value of After-Sales Services

After-sales services, which are the actions provided by a manufacturer or dealer following the purchase of a product or service, with the objective of supporting customers during their utilization of the acquired product or service, are an essential component of any successful strategy to gain a competitive edge over peers [35]. The provision of after-sales services has grown in significance as a means of generating additional income [36]. In the automotive industry, customer emphasis is particularly pronounced on enhanced after-sales services as a determinant of value for money. It is widely acknowledged that after-sales services have evolved into a pivotal element of the marketing strategy for automobile companies, owing to the manifold benefits and enduring rewards they confer on the organization in both the immediate and extended time frames [35]. It is essential
to change the after-sales business model paradigm in order to benefit from the additional revenue stream [37].

Value of After-Sales Services in PLVBM refers to the benefits and advantages that customers and companies gain from the services provided to customers after a product has been sold, include product maintenance and repair, quality and manner of services, and customer relationship maintenance. Product maintenance and repair refers to provide maintenance services, regular check-ups, and repairs to ensure the longevity and optimal performance of electric vehicles, plays an important role in after-sales services [35], has intrinsic value [38]. Quality and manner of services refers to the level of excellence, professionalism, and customer-centric approach that company demonstrates when delivering its services to customers, encompasses the overall experience that customers have while interacting with the company. Customer relationship maintenance refers to the ongoing efforts and strategies that company employs to nurture, sustain, and enhance its relationships with existing and potential customers, is crucial for building customer loyalty, maximizing customer lifetime value, and creating a positive brand perception.

4.6. Value of Residual

The value of residual for a vehicle is a projection of its future market value—indicating the anticipated price at which the user or another entity could sell the vehicle after a suitable period of use [39], it refers to its predicted worth at a certain point in the future [40]. Value of residual related to the depreciation of vehicle. The simplest way to understand depreciation is as the difference between a new vehicle's purchase price and its residual value after a certain period of time [41]. Given that the majority of new-car buyers do not retain ownership of their vehicles throughout the entirety of its lifetime, the depreciation of a vehicle emerges as a crucial factor influencing the overall cost of vehicle ownership and shaping consumer purchasing behavior [41].

For EV customers, they express concerns about diminished battery performance leading to a shorter electric range, the rapid evolution of technologies, and swift model upgrades—all of which contribute to the lower residual values associated with EVs [42]. Low residual values may be a critical market obstacle to the broad adoption of new EVs and should therefore be considered into the vehicle adoption evaluation to better represent the overall cost of vehicle ownership [42].

Value of residual in PLVBM refers to the anticipated value of an electric vehicle after a certain period of ownership, and be influenced by second-hand products trading and end-of-life product recycling. Second-hand products trading refers to the buying and selling of used or pre-owned EV in the marketplace, and involves transactions where individuals or businesses sell EV they no longer need or use to others who are interested in acquiring them at a lower cost compared to buying new items. End-of-life product recycling refers to the process of collecting, disassembling, and reprocessing EV that have reached the end of their usable life or have become obsolete, is an essential practice in promoting sustainability, resource conservation, and responsible waste management.

5. Conclusion

Most of article research on business model design and innovation focus on value proposition, value creation, value delivery, and value capture [18, 24]. However, there is limited research that considers business model design and innovation of after product sales. With the increasing consumer awareness of environmental protection and their growing emphasis on after-sales service quality, business model design and innovation after product sales have become increasingly important for companies, particularly in the electric vehicle industry. Therefore, this paper proposes a framework for business model design and innovation from the perspective of product lifetime value. This article contributes both theoretically and managerially.

5.1. Theoretical Contributions

The first contribution is proposed the conception of Product Lifetime Value (PLV). This article argue that Product Lifetime Value (PLV) is different from Product Life Cycle (PLC). Product Lifetime Value (PLV) can be seen as the process of defining a product from conception, raw material processing to the disposal phase from the perspective of value, and can be divided into six stages: plan, production, delivery, income, application, and recycle.

A second contribution of this article is considered the business model design and innovation after product sale in proposed framework. The business model design and innovation can be divided into 6 aspects from value chain perspective, contain value proposition, value creation, value delivery, value capture, value of after-sales services, and value of residual, this can be called “6V” model.

5.2. Managerial Implications

In addition to its theoretical contribution, this article has several important implications for companies in the electric vehicle industry regarding their business models and innovation.

First, for start-up electric vehicle brands, managers can utilize the Product Lifetime Value Business Model (PLVBM) as a tool to develop business models that are grounded in the concept of product lifetime value. This approach can help them create sustainable and customer-centric business models from the outset, considering the entire lifecycle of the product.

Second, for existing electric vehicle brands, managers can leverage the PLVBM framework to innovate their company's business model. By adopting this approach, they can identify opportunities to enhance their competitive advantage and improve their overall competitiveness in the market. This could involve rethinking value proposition, value creation, value
delivery, and value capture strategies, with a particular focus on after-sales services and customer satisfaction.

Overall, the PLVBM framework provides valuable guidance for both start-ups and established companies in the electric vehicle industry, enabling them to develop and innovate their business models to thrive in a rapidly evolving market.

5.3. Future Research

There are several potential areas for future research based on the PLVBM.

First, researchers can analyze the business models of different enterprises across various industries using the PLVBM framework. This comparative analysis can shed light on how different industries approach and integrate the concept of product lifetime value into their business models. It can also provide insights into the effectiveness and applicability of the PLVBM across different contexts.

Second, empirical research can be conducted in different industries to validate and test the various elements and components of the PLVBM. This research can help to establish the validity and reliability of the framework and provide empirical evidence of its effectiveness in different industry settings.

Third, researchers can explore the relationship between business models based on the PLVBM and enterprise performance. This research can investigate how the adoption and implementation of the PLVBM framework impact key performance indicators such as profitability, market share, customer satisfaction, and sustainability. It can provide valuable insights into the potential benefits and outcomes of incorporating product lifetime value into business models.

By addressing these research areas, scholars can further advance our understanding of the PLVBM and its implications for business model design and innovation across industries.

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