Research on the Innovation of Electric Vehicle Time-sharing Rental Business Model in Beijing

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**Abstract.** Electric vehicle time-sharing is for the users’ travel and distance which is short, and for improving the efficiency of the traffic. Based on questionnaire survey, interview and the Analytic Hierarchy Process (AHP), this paper constructed an analysis model of three hierarchies (vehicles, operators and transaction) to identify the difference between several business models, so as to evaluate the innovation of electric vehicle time-sharing rental business model. At last, suggestions and measurements are provided to improve electric vehicle time-sharing rental.

**Introduction**

Electric vehicles promoting is a significant measure to alleviate environmental pollution because of emission reducing\(^1\). From 2009, China launched a Ten City& Thousand Units Plan to promote the commercialization and marketization of electric vehicles. Up to now, the electric vehicles have been promoted in 89 cities. According to China Association of Automobile Manufacturers, China achieved the 517 thousand production and 507 thousand sales in 2016, with the growth of 51.7% and 53% respectively. With the rapid development of electric vehicles, a variety of new business models emerged\(^2-3\), the most typical one is electric vehicle time-sharing rental business model. It is a diversified system of many elements (Fig. 1), as well as a new exploration of the business model in the field of electric vehicles.

![Figure 1. Time-sharing Rental Business Model.](image)

In the business system, rental companies provide consumers with electric car rental service and charge in hours, which meant to encourage short trip in the crowded cities and alleviate the parking problems in the city center, as well as to lower travel costs\(^4,5\). And there has been more than ten platforms for car sharing in Beijing, eg. GreenGo, Gofun, TOGO, Leshare, Yidu, etc. All the car sharing companies are trying to construct rental stations and charging network. However, there are still a lot of problems in the operation of time-sharing rental, including unperfect technology and service, insufficient charging infrastructure and unreasonable layout.
Based on questionnaire survey, interview and the Analytic Hierarchy Process (AHP), this paper constructed an analysis model of three hierarchies to identify the difference between several business models, so as to evaluate the innovation of electric vehicle time-sharing rental business model.

**Data Collection and Analysis**

This paper selected 32 time-sharing rental stations to do further investigation from December 1, 2016. Totally, 131 questionnaires were issued to users and 131 questionnaires were received, including 122 valid questionnaires.

**Analysis of Electric Vehicles**

In terms of key factors of selecting the electric vehicles, the time-sharing rental users are more concerned about the range of the vehicles and charging convenience, accounting for 43% and 22% respectively (Fig. 2), which is closely related to the current performance and technology of electric vehicle batteries and the construction of charging infrastructures.

![Figure 2. Key Factors of the Electric Vehicles Selection.](image)

Currently, there are four charging ways for electric vehicles time-sharing rental. Totally, there are 61 users like wireless charging, and 29 users like wired charging, as shown in Fig. 3. The user's preference for the wireless charging is consistent with results of convenience survey, which influence the selection of electric vehicles.

![Figure 3. Preference of BEV in Time-sharing Rental Business Model in Beijing.](image)

**Analysis of Operation**

There are several well preferred operators of time-sharing rental business model in Beijing, including Leshare, GreenGo, TOGO, Yidu, and the car sharing types include BAIC EV200, BAIC EV160, Geely Dihao EV, Chery EQ and so on. Users prefer returning in different points of fixed location and free floating to other sharing types, accounting for 54% and 37% respectively (Fig. 4). In addition, the preference of rental channel implicate that most of the operators have their own APP, and 80% of users will choose the operator's own APP rather than a third-party rental platform.

![Figure 4. Preference of Time-sharing Rental Types in Beijing.](image)
As for payment way and mobile application in rental process, the survey shows that modern information technology, electronic technology and GPRS technology have been applied to the electric vehicles in time-sharing rental. 41% of the respondents will choose the operator providing GPRS and 21% will choose the function of information searching. Besides, there are 18% of the users will choose the emerging function of QR code scanning.

Figure 5. Preference of Mobile Application Service of Time-sharing Rental in Beijing.

With the national support for electric vehicles promotion, the existing car sharing business models are generally led by State-owned enterprises, Rental operators, Private enterprises, Energy companies, or Internet companies. Among them, the business models led by state-owned enterprise, like Gofun, are more popular in the public, selected by 35% of the respondents (Shown in Fig. 6).

Figure 6. Types of Rental Companies for Time-sharing Business Model.

Analysis of Transaction

Transaction way is the approach for the time-sharing rental companies to create profit through various revenue flows, based on the premise of cost control.

According to the collected data, there is no obvious difference in the perception of different charge ways, and the percentage of Rental deposit, Charge by fixed percentage and Only charge for using are all about 33% (shown in Fig. 7). As for cost structure of operators, 39% of the respondents believe that construction of charging infrastructure will be the main cost, 35% think that will be vehicles purchasing and 26% think that will be R&D investment. In terms of revenue source, 45% of the users believe that the operators’ revenue mainly comes from the rental business of electric vehicles, and 37% and 30% of the users believe that will be big data and charging respectively.

Figure 7. Perception of Charge way, Cost Structure and Revenue Source.

Evaluation of Electric Vehicles Time-Sharing Rental Business Model

Analytic Hierarchy Process (AHP) decomposed the target into multiple goals or criteria and then decomposed into multiple indicators (criteria, constraints) of several hierarchies. Divided into four
steps, AHP is applicable to decision analysis of multi-criteria, multi-objective or unstructured problems, so it can effectively evaluate complex business model[6,7].

Based on the data statistics and the Analytic Hierarchy Process (AHP), this paper constructed an analysis model of three hierarchies to identify the difference between different business models. According to the basic principles of AHP, there can be four steps to evaluate the electric vehicles time-sharing rental business model: (1) to establish the hierarchical analysis model (Fig. 8). (2) to construct the judgment matrix for comparing in pairs. (3) to solve the judgment matrix and test its consistency. (4) to determine the weight of different evaluation indicators.

Figure 8. Indicator System of Electric Vehicle Time-sharing Rental Business Model Evaluation.

Firstly, comparing the indicators of car sharing in pairs by 1-9 scale method of AHP to identify the relative importance of these indicators, and attach different scores for them. Then, to construct all the judgment matrix in each hierarchy, and to calculate the weight vector and do a consistency test. The result is shown in Table 1.

Table 1. Random Consistency Indicators (RI).

<table>
<thead>
<tr>
<th>n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0.00</td>
<td>0.00</td>
<td>0.58</td>
<td>0.89</td>
<td>1.12</td>
<td>1.26</td>
<td>1.36</td>
<td>1.41</td>
<td>1.46</td>
<td>1.49</td>
</tr>
</tbody>
</table>

Comparing Hierarchy A (Target) and B (Criteria) to generate a judgment matrix between A and B, as shown in Table 2.

Table 2. Judgment Matrix between A and B.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
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<tbody>
<tr>
<td>B1</td>
<td>1</td>
<td>6/5</td>
<td>3/2</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>5/6</td>
<td>1</td>
<td>5/4</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>2/3</td>
<td>4/5</td>
<td>1</td>
<td></td>
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Wight vector: \( W = (\omega_1, \omega_2, \omega_3) = (0.4, 0.3333, 0.2667) \)

\[ \lambda_{max} = 3. \]

\[ CI = \frac{\lambda_{max} - n}{n-1} = \frac{3-3}{3-1} = 0. \]  \hspace{1cm} (1)

\[ RI = 0.58. \]  \hspace{1cm} (2)

\[ CR = \frac{CI}{RI} = 0 < 0.1. \]  \hspace{1cm} (3)

The consistency of the judgment matrix between A and B is acceptable. Therefore, the weight of vehicles, operators and transactions are 0.4, 0.3333 and 0.2667 respectively.

Similarly, weight of all the indicators can be generated. By ranking the Hierarchy C indicators, the importance of different elements was generated as Fig. 9, which can be applied to evaluate the innovation of electric vehicle time-sharing rental business model.
Problems and Causes of Electric Vehicle Time-Sharing Rental Business Model

Firstly, there are still some shortages in vehicles and batteries of different time-sharing rental platform in Beijing. On the one hand, there just are a few vehicle types available which are not special for car sharing but general in electric vehicle market. On the other hand, the range of the most sharing electric vehicles is within 150km, which needs charging several times for long distance driving.

Secondly, there are two bottlenecks of operations: (1) a few rental stations limit the development of car sharing; (2) low using rate of electric vehicles results in wasting of resources. The higher cost, caused by increasing rental stations, operating more vehicles and constructing charging infrastructures, makes it difficult for the car sharing operators to develop scale economies.

Thirdly, most of the operators just provide point-to-point rental service or different point service in fixed area, which cause troubles on returning vehicles. Although the rental stations are mostly built in city center or residential area, there are still many respondents complaining that they have to take a public transport to go home after returning. In addition, charging piles constructing is a key part for electric vehicles time-sharing rental business model, which needs fund support by government.

Electric vehicle time sharing business model is no doubt a big success in business model innovation, while there are still some problems in operation to be solved, which can be caused by three reasons: (1) the technology of production is not perfect; (2) policy issued by government focus more on private purchasing; (3) the public have low recognition of electric vehicles.

Conclusion and Discussion

Based on the survey and interview data in Beijing, this paper verified the effectiveness of the evaluation system of business model, which is practiceable and can also be applied to analysis electric vehicle time-sharing business model in other city. Additionally, compared to the traditional car rental and public transportation, electric vehicle time-sharing rental business model has a stronger flexibility. To improve the promotion of electric vehicle time-sharing rental and efficiency of operating, there are four measures may be effective as below.

To Increase Government Support and Guidance

To form scale economy, electric vehicle time-sharing rental business model need a lot of participants and rental points. So the government should publish more policies on that, especially when the public are not willing to buy an EV but interested to experience them. At an early stage, the government should not only limit on subsidies providing, but also focus on propaganda of environmental protection and infrastructures constructing, such as providing special spaces for sharing electric vehicles parking and charging.

To Develop Diversified and Complex Services

The users of electric vehicle time-sharing rental are always those without private cars for now. To provide the diversified and complex services is a significant measure to attract those with fuel cars, so
as to expedite the users group. For example, combining preferential policy in parking with time-sharing rental in the core center will be effective. In addition, the industry nature of shared economy requires investing a large number of funds in early stage. Therefore, to integrate social idle vehicles instead of buying new electric cars is a good way to reduce the capital takes up.

**To Strengthen the Cooperation among Different Platforms**

As a typical representative of shared economic, only when fully meet the requirements of the convenience of travel, can electric vehicle time-sharing rental attractive more consumers. At the initial period, users’ willingness to choose electric vehicle time-sharing rental is seriously influenced by the inconvenience, which is due to the limited operating area. Besides, the number of currently operating electric vehicles is an important factor that determines whether an operator get profit or not.

Therefore, the integration between enterprises and platforms is of great importance and data and sources sharing will be more conducive to electric vehicle sharing.

**To Raise the Public Awareness of Environmental Protection**

It is still difficult to promote electric vehicle time-sharing rental business model due to some problems: (1) rental point layout is not perfect; (2) both government propaganda and consumer cognition are low; (3) consumers’ attitudes on car sharing will not change in the short term.

The promotion can be started from two aspects. (1) Cooperating with the environmental protection department to change consumers’ cognition. To invest more on advertising, media and lectures to promote the concept of green travel, so as to let consumers accept electric car sharing. (2) Diversifying promotions to attract potential consumers. For individuals, operator can provide free driving experience service. For enterprise, a rental package of more favorable price will be attractive.

This paper analyzed the users’ feelings of vehicles, operations and transaction of time-sharing rental business model, and generated an evaluation system of this model. However, there are still two limitations in this study. Firstly, our respondents answered the questionnaire subjectively, but the limited size of our sample is not so representative. Further study should conclude more participants. Secondly, this paper just evaluated the business model from customers’ perspective, further study can think about environment and economic benefits.

**References**


