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## Sales Model Selection for Second-hand vehicle E-commerce

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**Abstract:** The online second-hand vehicle sales models now include: auction model, consignment sales model, purchase and sales model, third party evaluation platform model and information consultant platform model. So choose a right sales model is important for sellers. We use AHP method to confirm key factors and built a score model base for different sales models. Though analysis, we can the conclusion that the best order of choice for online second-hand vehicle business model is: auction model, consignment sales model, purchase and sale model, information consultant platform and third party evaluation platform.

**Keyword:** E-commerce, AHP, sales model, second-hand vehicle, decision model

### 1. INTRODUCTION

The market for China's second-hand vehicle since mid 1990s, market capacity of 2013 was 5.2 million cars and sales was reach 291.6 billion RMB. Compare to 2000, it increased 20 times and 46 times<sup>[1]</sup> respectively, the ratio of new car to old car is 4:1<sup>[2]</sup>. Because of the late start and low capacity, even the growth of second hand vehicle in China increases in double times, there is still a big room and we need to figure out a new business model to improve the sales. A benefitting business model will push the China's second hand vehicle market in China to a new level. Reference [1] analyzes the current vehicle market models which include distributors, resellers, vehicle market, vehicle chain park and online business. References [2][3][4] propose online business has the advantage of low cost, high efficiency and transparency standards, it provides a new channel for purchase and sales behavior. It also gives a chance for manufacturer to purchase the component of car online, car dealer can use e-commerce platform to sale online and provide the after-sale service. Reference [7] utilizes the case of “Che Yi Pai” to declare the online second-hand vehicle-selling model, includes showing prices, testing vehicles, auction management and controlling. Reference [8] discusses the price, cost of owner, brand trust and techniques to make a decision that maximizes the profit.

### 2. SALES MODEL OF SECOND-HAND VEHICLE

The current e-commerce sales model for second-hand vehicle in China can be divided into three categories, which includes sales platform, third-party evaluation platform and information consultant platform<sup>[1]</sup>. Sales platform also includes auction model, consignment sales model, purchase and sales model. Third-party evaluation platform focuses on the evaluation part and doesn't involve sales process. The information consultant platform doesn't join the sales process but only for information delivery.

#### 2.1 Auction model

Auction model includes vehicle check, safety payment guarantee, logistics and document service all in one platform and performs as an agency. Auction model includes checking and reporting the status of vehicle based on the measurement technique and relevant service that developed by us. Before auction, the platform will keep the price of vehicle under raps. Vehicle information will been published in our website to let the buyer offer a price, the one who give the highest price will get the car. Profit of this model majorly comes from the vehicle

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test fee, logistic fee and the service fee during the process. This will make the deal of second-hand car become more clearly and speed up, the lower cost become the major advantage of auction model. However, auction model should rely on the reliability of test report, so we need to keep improve the test progress and relevant service, so You XinPai will be more reality for the big city, such as, Beijing, Shanghai & Guangzhou.

## 2.2 Consignment sales model

Consignment sales is based on the online and offline model. Online part supplies the information of vehicle for consumer to browse; on the other hand, the online side will provide a five-star service. The cost of retail store is very high, but consumer will enjoy the high a star service here and enjoy driving. This model has the advantage of good customer experience and good after-sale service includes 7-day free return and 180 days' free care. Because of the consignment sales model is based on the customer service, it has a very high request of talents with a high investment model, and the profit majorly comes from the service commission.

## 2.3 Purchase and sales model

Purchase and sales model can acquire the vehicles from online platform and then sell them again to customers. It is high demanding on cash flow and capital, so it is also a high needed model. Profit major comes from the margin between acquisition and sale. The major weakness is the high demand of capital, it requests the company has very good financial background otherwise the risk is big.

## 2.4 Third-Party evaluation platform

A third party evaluation platform plays the role of the test institution, it doesn't involve the vehicle sales process. Major profit comes from the vehicle evaluation and test service fee. But, third party evaluation platform is also concerning the sales now.

## 2.5 Information consultant platform

Information consultant platform becomes the major news channel for consumers and second-hand car sellers. Sellers can publish the vehicle information on the website and customers can check them based on their needs. This model will use advertisement income as the major profit income. This model doesn't need to invest a lot and have higher level of credit, but sales ability is weak.

# 3. SECOND-HAND VEHICLE SALES AND SELECTION SYSTEM

## 3.1 Model selection

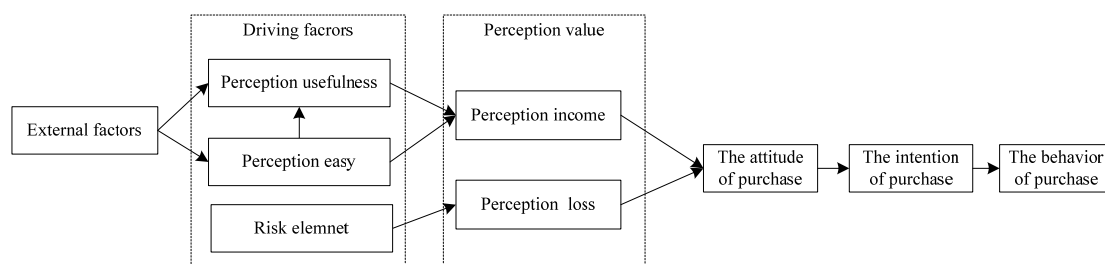


Figure1. Improved TAM model

According to the consumer perception theory and the model of “Study on word-of-mouth network influence on College Students' online shopping behavior”<sup>[9]</sup>, we improve the technical model Tam and show as Figure 1 below, the element that perception of useful and easy will affect the purchase behavior of second hand vehicle, the risk element will make negative affection of the purchase behavior. The result of balance will affect the consumer's behaviors and the final buying decision.

### 3.2 Selection system

According to the Figure1, selection system has two major directions of achieve and lose, these build up the business model of second-hand vehicle market. Perception achieve is make of mental value, function value, economic value and service value, perception lose is made of economic risk, safety risk and time risk, will decompose to a second level element, shows as Table 1.

**Table1. The selection index system of E-commerce sales model**

First-level index	Second-level index	The manifestations second level index
Psychologica l value (A)	Business reputation (A1)	How does businesses deal with problems during purchase
	Web Design (A2)	Is the second-hand vehicle's web design beautiful or convenience
	Sales records (A3)	The second-hand vehicles model's quality of sales in the past
	Brand models (A4)	Whether the second-hand vehicle models see the brand cars as the primary sales
Function value (B)	Physical store experience(B1)	Whether the second-hand vehicles models own a physical store
	Logistics and distribution(B2)	Whether the second-hand vehicles sales model contain the logistics and distribution
	The age of the vehicle(B3)	How old is the cars which the second-hand vehicles model sales
Economic value (C)	The margin of preference(C1)	The bargain space of the second-hand vehicle
	Price(C2)	The price of the second-hand vehicles model's sales
Service value (D)	A testing through the third party(D1)	Whether second-hand car sales mode have the third party test platform
	Train service(D2)	Whether second-hand car sales model provide coordinated-process service after sale
	QA(D3)	Whether second-hand car sales model provide quality assurance
Economic risk (E)	Extra fee(E1)	The customer buy a car through such second-hand car sales mode if they need to pay extracharges
	the payment of third-party(E2)	Whether second-hand car sales mode adopt the third party payment in order to ensure the security of payment
Safety risk (F)	Privacy(F1)	Whether second-hand car sales mode take r the protection of consumer privacy statue
	potential hazard(F2)	The security of the second-hand vehicles model
Time risk (G)	The time of purchase(G1)	How long is the time a customer take to buy a car through second-hand vehicles models
	Transaction processing timeG2)	Consumers through the purchase of second-hand car second-hand car sales mode in the time required to handle the transfer transaction

## 4. SALES MODEL AND SELECTION MODEL OF SECOND-HAND VEHICLE MARKET

Analytic Hierarchy Process (AHP) was from T.L.Saaty in 1970s. AHP splits the element that make decision into target layer, basic layer, plan layer and use qualitative analysis to give the result<sup>[10]</sup>.

### 4.1 Build the hierarchy structure model

According to the Table 1, five major sales models of second-hand vehicle build an available layer structure

model. As Showed in Figure2, the target is to find out the best e-commerce model to improve the sales of second-hand vehicle. Target layer (highest level, describe the problem target), basic layer (mid level, achieve the target), index layer (third level, specific evaluation element) and plan layer (bottom level, include action model, consignment sales model, purchase and sales model, third-party evaluation platform and information consultant platform).

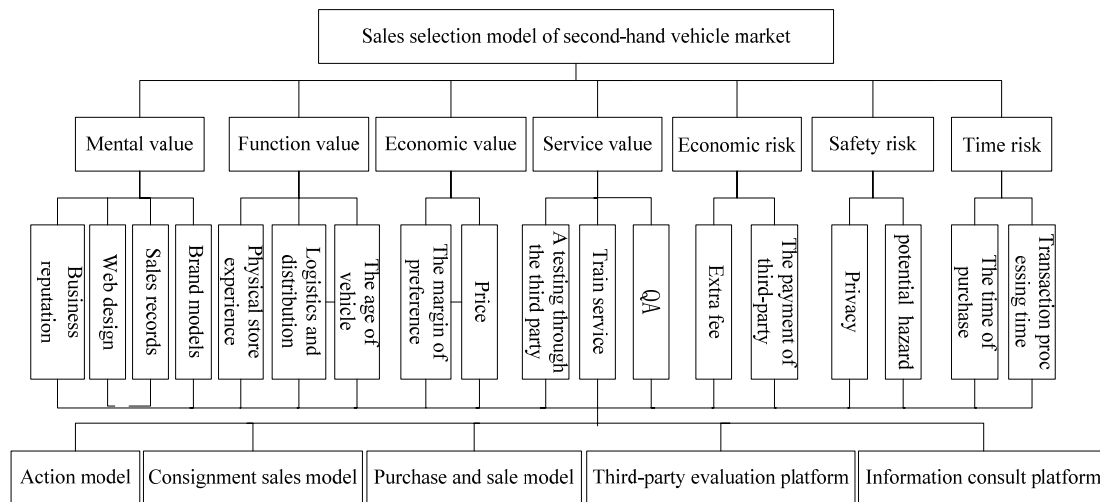


Figure2.Hierarchy structure model of second-hand vehicle of e-commerce sales model selection

## 4.2 Build matrix according to the survey result

### 4.2.1 Survey results

In order to confirm the weight of different index, we designed a survey paper including 18 questions about the e-commerce model of second-hand vehicle market. We utilized WJX to do the online survey and collected 394 feedbacks. Most of the candidates participated in survey are young people, age between 20 and 23 that bring us 273 questionnaires, occupies 69.29%, we also receive 76 questionnaires from age over 30, occupied 19.29%. All shows that the youth are major group actively on the internet. 231 questionnaires from the people who live in countryside which occupies 58.63%, the other 163 from people who live in downtown, which occupies 41.37%. The income level of survey family are mainly below the middle class, 309 candidates annual income are below 100,000 RMB, which occupies 78.43%, the lower price of second-hand vehicle and fast replace rate become a good choice for these people. The education backgrounds of candidates in this survey are relatively high, 243 of them hold the bachelor degree which occupies 61.67%, the half of the people in this survey has the willing to buy second-hand vehicles. From the result of survey, people answers that what is the most safest way to deal with second-hand vehicles: 38.83% of the people think is second-hand vehicle market, 42.89% think is the car dealer, 13.96%, such as the deal between the individuals, second-hand vehicles sales website only have the share of 4.31%. From this result we find that offline deal is still the major form, online deal for second-hand vehicles are still in the beginning stage.

We use the Likert scale to evaluate the important level of each element and shows as Table 2 and Table 3.

Table 2. The average value of each factor basic layer

Influence factors	Mental value	Function value	Economic value	Service value	Economic risk	Safety risk	Time risk
Average value	4.013	4.040	4.155	4.273	3.925	4.310	3.950

**Table 3. The average value of each factor index layer**

Index	Business reputation	Web design	Sales records	Brand models	Physical store experience	Logistics and distribution
Average value	4.48	3.45	4.33	3.79	3.91	3.89
Index	The age of vehicle	The margin of preference	Price	A testing through the third party	Train service	QA
Average value	4.32	4.06	4.25	4.23	4.3	4.29
Index	Extra payment	Third-part payment	Privacy	Potential hazard	The time of purchase	Transaction processing time
Average value	4.14	3.71	4.13	4.49	3.91	3.99

#### 4.2.2 Basic layer matrix

In order to evaluate the impotency level of each index, we use the 1-9 to check rule of Satty to evaluate the relatively impotency of each two index<sup>[11]</sup>.

According to measurement and Table 2, we build matrix A of the affluence element average result of mental value, function value, economic value, service value, safety value and time value.

$$A = \begin{pmatrix} 1 & \frac{1}{3} & \frac{1}{5} & \frac{1}{7} & 5 & \frac{1}{9} & 3 \\ 3 & 1 & \frac{1}{2} & \frac{1}{3} & 6 & \frac{1}{7} & 4 \\ 5 & 2 & 1 & \frac{1}{5} & 7 & \frac{1}{5} & 6 \\ 7 & 3 & 5 & 1 & 8 & \frac{1}{3} & 8 \\ \frac{1}{5} & \frac{1}{6} & \frac{1}{7} & \frac{1}{8} & 1 & \frac{1}{9} & \frac{1}{2} \\ 9 & 7 & 5 & 3 & 9 & 1 & 9 \\ \frac{1}{3} & \frac{1}{4} & \frac{1}{6} & \frac{1}{8} & 2 & \frac{1}{9} & 1 \end{pmatrix}$$

#### 4.2.3 Index layer matrix

Based on the five sales model in Table 3 and 18 index, we decided the weight of five models (action model, consignment sales model, purchase and sale model, third-party evaluation platform and information consultant platform) and 7 elements. The 7 matrix below B1, B2, B3, B4, B5, B6, B7 in each row shows the comparative weight of five models.

$$\text{mental value } B_1 = \begin{pmatrix} 1 & 5 & 7 & 9 & 9 \\ \frac{1}{5} & 1 & 3 & 5 & 5 \\ \frac{1}{7} & \frac{1}{3} & 1 & 3 & 3 \\ \frac{1}{9} & \frac{1}{5} & \frac{1}{3} & 1 & 1 \\ \frac{1}{9} & \frac{1}{5} & \frac{1}{3} & 1 & 1 \end{pmatrix}$$

$$\text{function vale } B_2 = \begin{pmatrix} 1 & 1 & 3 & 3 & \frac{1}{3} \\ 1 & 1 & 3 & 3 & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & 1 & 1 & \frac{1}{5} \\ \frac{1}{3} & \frac{1}{3} & 1 & 1 & \frac{1}{5} \\ 3 & 3 & 5 & 5 & 1 \end{pmatrix}$$

$$\begin{aligned}
 \text{economic value } B_3 &= \begin{pmatrix} 1 & 5 & 5 & 5 & 1 \\ \frac{1}{5} & 1 & 1 & 1 & \frac{1}{5} \\ \frac{1}{5} & 1 & 1 & 1 & \frac{1}{5} \\ \frac{1}{5} & 1 & 1 & 1 & \frac{1}{5} \\ 1 & 5 & 5 & 5 & 1 \end{pmatrix} & \text{service value } B_4 &= \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{2} & 5 & 5 \\ 2 & 1 & 1 & 3 & 3 \\ 2 & 1 & 1 & 3 & 3 \\ \frac{1}{5} & \frac{1}{3} & \frac{1}{3} & 1 & 1 \\ \frac{1}{5} & \frac{1}{3} & \frac{1}{3} & 1 & 1 \end{pmatrix} \\
 \text{economic risk } B_5 &= \begin{pmatrix} 1 & 1 & 1 & \frac{1}{3} & \frac{1}{5} \\ 1 & 1 & 1 & \frac{1}{3} & \frac{1}{5} \\ 1 & 1 & 1 & \frac{1}{3} & \frac{1}{5} \\ 3 & 3 & 3 & 1 & \frac{1}{2} \\ 5 & 5 & 5 & 2 & 1 \end{pmatrix} & \text{safety risk } B_6 &= \begin{pmatrix} 1 & 1 & 1 & 1 & 3 \\ 1 & 1 & 1 & 1 & 3 \\ 1 & 1 & 1 & 1 & 3 \\ 1 & 1 & 1 & 1 & 3 \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & 1 \end{pmatrix} \\
 \text{time risk } B_7 &= \begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{2} & 3 & 5 \\ 2 & 1 & 1 & 5 & 7 \\ 2 & 1 & 1 & 5 & 7 \\ \frac{1}{3} & \frac{1}{5} & \frac{1}{5} & 1 & 3 \\ \frac{1}{5} & \frac{1}{7} & \frac{1}{7} & \frac{1}{3} & 1 \end{pmatrix}
 \end{aligned}$$

**4.3 Matrix Consistency test**

Judgment matrix is based on the analysts' knowledge and experience, so there is unavoidable exiting of errors. People need consistency checking to coincide with reality. The formula of judgment matrix's consistency checking as shown in equation (1) :

$$CR = \frac{CI}{RI} = \frac{(\lambda_{\max} - n)/(n - 1)}{RI} \tag{1}$$

Among them: CI is consistency test index,  $CI=(\lambda_{\max} - n) / n-1$ ; n is the order of the judgment matrix; RI is average random consistency index of judgment matrix, the values are showed as Table4.

**Table4. Average random consistency index of judgment matrix**

Order of judgment matrix	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	14.51

If  $CR < 0.1$ , we think that the consistency is accepted, or need to modify judgment matrix until meeting up the consistency test<sup>[12]</sup>.

**4.3.1 Matrix consistency test of basic layer**

By using MATLAB, get the maximum eigenvalue of the matrix A,  $\lambda_{\max} = 7.7118$ . Consistency detection coefficient  $CI = \frac{\lambda_{\max} - n}{n - 1} = 0.1186$ . According to Table4, if  $n=7$  then  $RI = 1.32$ , and  $CR = \frac{CI}{RI} = 0.0899 < 0.1$ . We think that consistency test is accepted, and matrix pass consistency test.

**4.3.2 Matrix consistency test of layer**

By using MATLAB, get the maximum eigenvalue of the matrix B1,B2,B3,B4,B5,B6,B7 for  $\lambda_{\max}$ . Consistency detection coefficient CI and CR are showed by Table 5, Matrix B1,B2,B3,B4,B5,B6,B7 are all

pass consistency test<sup>[12]</sup>.

**Table5. The characteristics of index layer matrix table**

Characteristic values	Mental value	Function value	Economic value	Service value	Economic risk	Safety risk	Time risk
$\lambda_{\max}$	5.1558	5.0556	5.0000	5.2381	5.0040	5.0000	5.0742
$CI$	0.0490	0.0139	0.0000	0.0595	0.0001	0.0000	0.0185
$CR$	0.0437	0.0124	0.0000	0.0532	0.0001	0.0000	0.0166

#### 4.4 Determine the weight according judgment matrix

**Table6. Plan layer matrix weight vector table**

Matrix	B1	B2	B3	B4	B6	B6	B7
$W_2$	0.61	0.19	0.38	0.24	0.09	0.23	0.20
	0.21	0.19	0.08	0.30	0.09	0.23	0.34
	0.10	0.07	0.08	0.30	0.09	0.23	0.34
	0.04	0.07	0.08	0.08	0.26	0.23	0.08
	0.04	0.48	0.38	0.08	0.47	0.08	0.04

By using MATLAB, get vector of matrix A,  $W_1 = (0.05, 0.09, 0.13, 0.26, 0.02, 0.43, 0.03)^T$ , weight vector values of Matrix B1, B2, B3, B4, B5, B6, B7 are showed as Table6.

According to  $W = W_2 * W_1$ , the result is  $W = (0.27, 0.23, 0.21, 0.15, 0.16)$ . So we can get the order by AHP. The first one is auction model, the second one is consignment sales model, the third one is purchase and sale model, the forth one is information consultant platform and the last one is third-party evaluation platform.

## 5. CONCLUSION

The results of level shows that the order of consumer's choice for second-hand vehicle e-commerce model is: action model, consignment sales model, purchase and sale model, information consultant platform and third-party evaluation platform. When dealer sale the second-hand vehicle online, they should use the action model, give the detail describe of brand, age and other information, especially the test report of relevant institution will help the customer to make the decision in purchase.

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