Analysis of Influencing Factors on the Development of C2c e-Commerce Model Based on Ism and Ahp

Qianqian Xu

School of Management Science and Engineering, Anhui University of Technology Ma'anshan, 243002, China

ahutxqq@163.com

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Abstract: After C2C e-commerce was introduced into China, it has not only opened up new shopping channels for online consumers in China, but also makes China's e-commerce market developed rapidly. However, with the continuous development of the e-commerce industry, the C2C e-commerce model continues to weaken in the entire e-commerce market due to the lack of trade credit and the difficulty in guaranteeing product quality. In order to explore the causes of the above problems, 17 factors influencing the development of C2C e-commerce were identified based on literature research and expert interviews, and the three-level hierarchical structure of those factors influencing the development of C2C e-commerce model was built by using the Interpretive Structure Model (ISM). After that, the Analytic Hierarchy Process (AHP) was used to calculate the weight of each factor. Finally, it was concluded that product factors had a greater impact on the development of C2C e-commerce, and corresponding suggestions were put forward according to the relationship and weight of each influencing factor.

1. Introduction

E-commerce refers to the activities of transactions and related services carried out in the form of electronic transactions on the Internet, Intranet, and VAN. It digitalizes every segment of traditional business activities, encompassing supply chain management, electronic currency exchange, network marketing, inventory management, electronic data exchange and automatic data collection system, etc [1]. Since the birth of e-commerce, the three major models of C2C, B2C, and B2B have been the mainstream, among which the C2C model is the earliest model of China's e-commerce. In 1998, the first C2C trading platform was eBay, which created a precedent for C2C websites in China. In 2003, Alibaba established Taobao, a C2C website. The C2C model has soared in China by virtue of low product prices, the use of third-party payment platform and its flexible shopping.

However, with the development of B2C e-commerce model in recent years, C2C e-commerce model gradually entered a bottleneck period. Compared with B2C model in which businesses are sellers, individuals are sellers in C2C models, which lead to a lack of payment guarantees, quality control, after-sales service and other issues. In recent years, C2C platform retail sales have been declining.

In order to explore the reasons for the above problems and better promote the development of the C2C model, this article analyzes the factors that consumers consider when making online shopping choices based on interviews with relevant experts and questionnaires. Then use ISM to establish a C2C e-commerce model development influencing factor hierarchical model, in-depth analysis of the internal relations of each influencing factor, and finally adopt the AHP to determine the weight of each influencing factor, find out the bottlenecks and key factors restricting the development of the C2C e-commerce model, and provide suggestions for the later development of it.

2. C2c Analysis of the Influencing Factors of the Development of e-Commerce Model

After searching for literature and analysis, this text sorts out the main factors affecting the

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development of C2C e-commerce model. Then, 17 influencing factors were finally determined through interviews with relevant experts. The factors are divided into five dimensions: product factors, logistics factors, website factors, payment factors and service factors. The index system of influencing factors is shown in Table 1.

Dimension	Influence Factors		
Product factors A ₁	Product price S ₁		
	Product brand S ₂		
	Product quality S ₃		
	Product category S ₄		
	Product discount S ₅		
Logistics factors A ₂	Logistics speed S ₆		
	Logistics quality S ₇		
	Receiving goods convenience S ₈		
	Logistics costs S ₉		
Website factors A ₃	Website attraction S_{10}		
	Website convenience S_{11}		
	Website promotion S_{12}		
Payment factors A ₄	Fast payment method S ₁₃		
	Payment channel diversity S ₁₄		
Service factors A ₅	After-sales service S ₁₅		
	Service attitude S ₁₆		
	Service response speed S_{17}		

Table.1. Index System of Influencing Factors for the Development of C2c e-Commerce Model

2.1 Product Factors

Wang Hexiang[2] believes that product factor is the primary factor that consumers consider in online shopping. Product factors include product price, product brand, product quality and product category.Compared to the B2C model, the C2C e-commerce model has some advantages such as richer product categories and lower price.

2.2 Logistics Factors

Li Ping[3] believes that the cost of logistics transportation and the distance between delivery points will affect consumers' shopping behavior. Pingjun and Bert[4] studied the influence of previous delivery satisfaction on consumers' repeated online shopping behavior from the perspective of shopping process. Zeng Qi et al. [5] believe that problems existing in C2C e-commerce logistics distribution mode include high logistics distribution cost and backward distribution system.

2.3 Website Factors

Ye Gaoping [6] constructed a model of influencing factors in consumer online store choice with customer perceived value as an intermediary variable. From the perspective of retail, he analyzed that the main influencing factors for the operating results of online stores are the store interface, while the service of online stores have no significant influence on the operating results. Liang and Lai [7] studied the influence of website design factors on consumers' repeated online shopping behavior from the aspects of website navigation, search engine, shopping help, etc.

2.4 Payment Factors

Cai Jinwei [8] believes that the problems existing in the development of C2C e-commerce include third-party payment, and the countermeasures are bringing the third-party payment platform into the financial supervision field and strengthening the internal fund supervision of the third-party payment platform.Based on Servqual.Gefen and Devine[9] studied the factors affecting consumers' continuous online shopping behavior from the perspective of the characteristics of third-party institutions.

2.5 Service Factors

Zhou Tao et al. [10] believe that the core component of service quality -- service level (including reliability, responsiveness and assurance) is an important factor that affects consumers' satisfaction with websites.Wu Rongmei [11] believes that the quality of after-sales service, to a large extent, determines whether online consumers can have repeated shopping behavior, and can protect the consumers' rights and interests, improve the loyalty of online consumers, and increase business opportunities for merchants.

3. Explanation Structure Model

ISM technology was developed by Professor J.N. Warfield in the United States in 1973 as a method which use directed graphs and matrices to analyze the structural problems of complex socio-economic systems [12]. The specific analysis process is as follows:

3.1 Build Adjacency and Reachability Matrixs

The adjacency matrix is a square matrix that represents the basic binary relationship between system elements. It is stipulated that when the element S_i has a certain binary relationship with the element S_j , the value of the matrix element a_{ij} is 1, and when the element S_i does not have a certain binary relationship with the element S_j , the value of the matrix element a_{ij} is 0. It is expressed as formula (1):

$$a_{ij} = \begin{cases} 1, S_i \text{ has a certain dual relationship with } S_j \\ 0, S_i \text{ has no binary relationship with } S_j \end{cases}$$
(1.)

According to the determined indicators of influencing factors, through reading related literature, discussion and research, and interviews with experts, the correlation between the 17 influencing factors was finally determined, and the adjacency matrix A was established as shown in Figure1-A, then calculate the reachable matrix based on the adjacency matrix. The reachable matrix is calculated by adding the adjacency matrix A to the identity matrix I of order A to perform Boolean algebraic operations. When $(A + I) \neq (A + I)^2 \neq (A + I)^3 \neq \cdots \neq (A + I)^{k-1} = (A + I)^k$, the reachable matrix can be obtained: $R = (A + I)^r$, $r \leq n$ (n is the matrix order). Use Matlab software to perform Boolean algebraic operations on the matrix A+I, and the result of k is 3. The matrix R can be reached as shown in Figure1-B.

 $S_{1} S_{2} S_{3} S_{4} S_{5} S_{6} S_{7} S_{8} S_{9} S_{10} S_{11} S_{12} S_{13} S_{14} S_{15} S_{16} S_{17} - S_{1} S_{2} S_{3} S_{4} S_{5} S_{6} S_{7} S_{8} S_{9} S_{10} S_{11} S_{12} S_{13} S_{14} S_{15} S_{16} S_{17} - S_{1} S_{2} S_{3} S_{4} S_{5} S_{6} S_{7} S_{8} S_{9} S_{10} S_{11} S_{12} S_{13} S_{14} S_{15} S_{16} S_{17} - S_{1} S_{2} S_{3} S_{4} S_{5} S_{6} S_{7} S_{8} S_{9} S_{10} S_{11} S_{12} S_{13} S_{14} S_{15} S_{16} S_{17} - S_{1} S_{2} S_{3} S_{4} S_{5} S_{6} S_{7} S_{8} S_{9} S_{10} S_{11} S_{12} S_{13} S_{14} S_{15} S_{16} S_{17} - S_{1} S_{2} S_{3} S_{4} S_{5} S_{6} S_{7} S_{8} S_{9} S_{10} S_{11} S_{12} S_{13} S_{14} S_{15} S_{16} S_{17} - S_{1} S_{2} S_{3} S_{4} S_{5} S_{6} S_{7} S_{8} S_{9} S_{10} S_{11} S_{12} S_{13} S_{14} S_{15} S_{16} S_{17} - S_{1} S_{1}$ \mathbf{S}_{1} 0 S₁ 1 0 0 0 0 0 0 0 0 0 1 0 1 1 0 1 1 0 0 0 0 1 1 1 1 1 S_{2} S₂ 1 1 S_3 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 S_4 1 0 1 0 1 0 S_5 S_5 1 0 \mathbf{S}_{6} S₆0 S₇ S₇ 0 S_8 S₈ 0 S_9 S, $S_{10}|_{0}$ 0 0 0 0 $S_{10} | \stackrel{\text{\tiny def}}{0}$ S₁₁ 0 S₁₁ 0 $S_{12} 0 0$ S₁₂ 0 $S_{13}^{12} | 0 | 0$ $0 \ 0 \ 1$ 0 0 0 0 0 S₁₃ 0 0 S₁₄ 0 0 $0 \ 0 \ 1$ S₁₄ 0 0 $\mathbf{S}_{15} \mathbf{0} \mathbf{0} \mathbf{0} \mathbf{0}$ 0 0 0 0 0 S₁₅ 0 0 0 $S_{16} | 0 0 0$ $S_{16} 0 0 0 0$ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 $S_{17}|_{0}$ 0 s₁₇ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 A В

3.2 Divide Hierarchical Relationships According to Reachable Matrix

Calculate the reachable set $R(S_i)$ and antecedent set $A(S_i)$ of each factor according to the reachable matrix. $R(S_i)$ means that the reachable set of system element S_i is a set composed of the elements reachable by S_i in the reachable matrix or directed graph, and $A(S_i)$ represents The antecedent set of system element S_i is the set of system elements that can reach S_i in the reachable matrix or directed graph. The definition formulas are (2) and (3):

$R(S_i)\!=\!\{S_j S_j\!\in\!S,m_{ij}\!=\!1\}$	(2)
$A(S_i)\!=\!\{S_j S_j\!\in\!S,m_{ji}\!=\!1\}$	(3)
$\alpha(\alpha)$: α α	6 9 1

 $C(S_i)$ indicates that the common set of system element S_i is the common part of S_i in the reachable set and the antecedent set. The definition formula is (4):

$C(S_i) = \{S_j S_j \in S, m_{ij} = 1, m_{ji} = 1\} $ (4))
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If $C(S_i)=R(S_i)$, then S_i is the highest-level element. After finding the highest-level element of the entire system element set, remove the corresponding rows and columns from the reachable matrix, and then find the highest-level element of the remaining element set. And so on, until the lowest level element set is determined.

The final results are shown in Figure 2:



Fig.2 C2c e-Commerce Model Development Influencing Factors Explained Structure Model

The results of the C2C e-commerce model influencing factor interpretation structure model are divided into five-level hierarchical structure models. This paper divides the five levels into surface factors, middle factors and deep factors. Surface factors include first-level factors $\{S_1, S_8, S_{10}, S_{15}, S_{16}\}$, middle-level factors include second-level factors and third-level factors $\{S_5, S_9, S_{11}, S_{17}, S_3, S_6, S_{12}, S_{13}\}$, and deep-level factors include fourth-level factors and fifth-level factors $\{S_4, S_7, S_{14}, S_2\}$.

4. Based on Ahp to Determine the Weights of Influencing Factors of C2c e-Commerce Model

AHP is a subjective empowerment method proposed by American operations researcher Sadie in the 1970s. It can hierarchize the complex system and get the weight of the importance of different schemes, which provides a basis for the selection of the best scheme [13-14]. The steps are as follows:

4.1 Establish Hierarchical Structure Model of the System

According to the ISM model constructed above, the various factors in the model are stratified as

the index system of the analytic hierarchy process.

4.2 Build a Judgment Matrix

Use the nine-level evaluation scale of the analytic hierarchy process to evaluate the importance of the two elements. The nine-level evaluation model is to score the importance of the two from 1-9. If the evaluator thinks that the influencing factor S_1 is "obviously important" compared to the influencing factor S_2 , then the relative importance of S_1 to S_2 is 5; compared with factor S_2 , factor S_3 is between "obviously important" and "strongly important", so the relative importance of S_2 to S_3 is 1/6.

4.3 Determine the Weight of Each Factor

Use the square root method[15] to find the corresponding weight vector W_i of the judgment matrix $A=\{a_{ij}\}$ by row. The definition of W_i is shown in (5), and then normalize W_i to calculate the relative importance vector.

$W_i = \left(\prod_{i=1}^n a_{ii}\right)^{\frac{1}{n}}$	(5)
$\begin{pmatrix} \mathbf{I} & \mathbf{I} \\ j=1 \end{pmatrix}$	

4.4 Consistency Check

In order to ensure the rationality of the weight coefficients, it is necessary to check the consistency of the judgment matrix of each layer.

First, calculate the consistency index C.I as formula(6), λ_{max} is the largest characteristic root of the judgment matrix, then find the corresponding average random consistency index R.I., and finally calculate the consistency ratio C.R. as formula (7).

$ ext{C.I.}=rac{\lambda_{ ext{max}}- ext{n}}{ ext{n}-1}$	(6)
$ m C.R. = rac{ m C.I.}{ m R.I.} < 0.1$	(7)

If the consistency ratio C.R.=0, it means that the judgment matrix is completely consistent; if C.R.<0.1, then the judgment matrix is considered to have satisfactory consistency and can pass the consistency test. Take the surface factor as example, after calculation the judgment matrix and results are shown in Table 2.The consistency ratio is 0.0537<0.1, which passes the consistency test. The consistency ratios of the judgment matrices for the middle and deep factors are 0.0360 and 0.0246, which meet the consistency requirements.

Table.2. Surface Factor Judgment Matrix and Results

Variable	\mathbf{S}_1	S_8	S_{10}	S ₁₅	S_{16}	\mathbf{W}_{i}^{0}	Result
\mathbf{S}_1	1	6	9	3	2	0.4352	$\lambda_{max} = 5.2404$
S ₈	1/6	1	5	1/4	1/4	0.0758	C.I.=0.0601
S ₁₀	1/9	1/5	1	1/7	1/8	0.0286	C.R.=0.0537
S ₁₅	1/3	4	7	1	1/2	0.1864	
S ₁₆	0.5	4	8	2	1	0.2739	

4.5 Determine the Order of Each Influencing Factor

Through the above steps, the total weight of the factors affecting the development of the C2C e-commerce model is finally determined, and then the importance ranking of each influencing factor can be obtained. The results are shown in Table 3.

Table.3. Sort of Each Factor

Variable	Factors	Weights	Variable	Factors	Weights
S ₄	Product category	0.4756	S ₆	Logistics speed	0.1069
S_1	Product price	0.4352	S ₁₇	Service response speed	0.0980
S ₃	Product quality	0.4031	S ₈	Receiving goods convenience	0.0758
S ₇	Logistics quality	0.2903	S ₁₄	Payment channel diversity	0.0587

S ₁₆	Service attitude	0.2739	S ₁₁	Website convenience	0.0450
S ₁₅	After-sales service	0.1864	S ₁₃	Fast payment method	0.0450
\mathbf{S}_2	Product brand	0.1754	S_{10}	Website attraction	0.0286
S ₉	Logistics costs	0.1562	S ₁₂	Website promotion	0.0186
S ₅	Product discount	0.1271			

5. Analysis of Influencing Factors and Countermeasures for the Development of C2c e-Commerce Model

C2C e-commerce model development influencing factors The ISM model is a five-level hierarchical structure system, which clearly reflects the relationship between the various influencing factors. According to the relationship between the various factors, the five-level hierarchical structure model is divided into surface, middle and deep levels analyze the model structure[16].

(1)Surface factors

Surface factors are the direct reasons that affect the development of the C2C e-commerce model. Product price is the primary consideration for consumers in the process of online shopping. The biggest advantage of the C2C e-commerce model compared to other e-commerce models is its low price. However, with the rise of the B2C model, large and medium-sized enterprises have obtained the same simple sales threshold as small and medium-sized sellers by staying in the electronic mall[2]. Nowadays, the product level of logistics enterprises is becoming more and more abundant. Most logistics companies choose to cooperate with post stations to save time. Mass consumers prefer faster and more convenient delivery. The design and layout of the website are more reasonable, which will attract consumers to continue browsing. In terms of online store services, consumers pay more attention to after-sales service and service attitudes. In the C2C e-commerce model, due to low profits, it is very easy to create friction with consumers in the process of return and exchange [17].

(2)Middle factors

Middle factors indirectly affects the development of C2C e-commerce model by influencing surface factors. Good-quality products will be repurchased by consumers, and product discounts will indirectly affect consumers' shopping by affecting product prices. In terms of logistics choices, companies in the B2C e-commerce model mainly adopt self-operated logistics, and the C2C e-commerce model mainly chooses third-party logistics distribution. With the upgrading of mass consumption, consumers' requirements for logistics speed and logistics costs have increased to a certain extent. Although the cost of third-party logistics distribution is relatively low, the distribution speed is relatively slow. The high efficiency and accuracy of self-operated logistics and distribution can better meet the diverse consumer needs of customers. With the rapid development of "Internet +", website publicity will also become an important factor affecting consumers' shopping.

(3)Deep factors

The deep factors are the fundamental factors affecting consumption. include four aspects: S_2 , S_4 , S_7 and S_{14} . With a rich variety of products, it can quickly respond to the individual needs of customers. In the context of the ever-increasing trend of product homogeneity, product brands have gradually become a major factor affecting consumer behavior. After the brand status is established in the minds of consumers, it is independent and lasting, and it is difficult to be imitated and replaced by competitors. Brand awareness affects product quality to a certain extent and is the fundamental factor that affects users' purchases.

5.1 Impact Analysis

From the comprehensive weight ranking table of the factors affecting the development of the C2C e-commerce model, it can be seen that the development level of the C2C e-commerce model is mainly affected by S_1 , S_3 , S_4 . Product types, product prices, and product quality have a much greater impact on the development level of C2C e-commerce models than other factors. Based on the ISM structure model and AHP weight analysis results, it can be seen that commodity factors are

the main factors considered by consumers in online shopping. Factors such as website promotion, website convenience, and payment methods have little impact on the development of the C2C model.

In summary, C2C sellers should pay attention to product quality and introduce preferential policies, improve service quality and focus on after-sales service.....

6. Conclusion

In order to explore the influencing factors of the development of C2C e-commerce model, this article first uses the ISM method to construct a structural model that affects the development of C2C e-commerce model, and analyzes the relationship between the various influencing factors. The surface factors that affect the development of the C2C e-commerce model include S_1 , S_8 , S_{10} , S_{15} and S_{16} ,middle-level factors include S_3 , S_5 , S_6 , S_9 , S_{11} , S_{12} , S_{13} and S_{17} ; deep-seated factors include S_2 , S_4 , S_7 and S_{14} . After that, the AHP method was used to determine the weight coefficients between the various influencing factors, and the influence of each influencing factor was clarified. Among them, the influence of product type, product quality and product price was much higher than other factors. This shows that the C2C e-commerce model should focus more on the product itself in the future development process.

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