# Research on product characteristics affecting the transformation of B2B E-commerce

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**Abstract**

With the explosive growth of B2C and C2C Electronic Commerce (EC) in recent years, B2B EC has been tried in many fields, especially many traditional industries with little permeation into B2B EC, were transformed into B2B EC. However, the key factors influencing B2B EC transformation have not been fully investigated. On the basis of relevant literature analysis, product characteristics affecting B2B e-commerce transformation were divided into seven parts in this paper, namely, the product standardization, differentiation, tangibility, intangibility, time sensitivity, substitutability and complexity. Then, the proposed seven aspects were analysed using the method of the objective index weight, so as to obtain the mathematical model for product characteristics affecting B2B EC transformation. Finally, model test was conducted by taking Shanxi Pingyang Industry Machinery Co., Ltd. as an example, hoping the relevant research conclusion can provide references in decision-making for managers and other researches.

*Keywords:* B2B electronic commerce transformation, product characteristic, objective index weight

## 1 Introduction

Electronic commerce (EC) has experienced 20 whole years since 1994 [1], during this period, earth-shaking changes have taken place in various industries, enterprises transform from traditional business way to e-commerce gradually. As one mode of e-commerce, the most one difference for B2B EC to distinguish from other electronic modes is that its application range is between enterprises. In recent years, with the advantages of B2B e-commerce are more and more obvious, large amount of B2B online trade becomes a trend gradually. Under the circumstances, various enterprises, especial, which have little permeation into B2B EC, also begin to seek the way of B2B e-commerce transformation.

Product, as the fundamental source for enterprise profit, is the 'face' facing market. There has few scholars about the topics which kind of product is suitable for enterprise B2B e-commerce transformation, and what affect the transformation from traditional mode to B2B EC are seldom studied systematically at present stage. B2B e-commerce transformation present situation and product characteristics elements were in-depth analysed in the paper, then building decision-making model about product characteristic affecting B2B e-commerce to decomposes and measures various product characteristic, hoping the relevant research conclusion can provide references in decision-making for enterprises.

## 2 Related work

### 2.1 RELATED REVIEW ABOUT B2B E-COMMERCE TRANSFORMATION

The existing literature about e-commerce transformation offers a fairly substantial theoretical basis for this paper. Davison (2005) [2] defines enterprise transformation as a way to improve traditional business efficiency and effectiveness through the application of information and communication technologies; Winter (2001) [3] et al. argue that enterprise e-commerce transformation can be caused by the innovation of information technology and the emergence of new business model; Cuixiao Fu, Min Qin, Lihua Huang (2011) [4] et al. combine e-commerce transformation with trilogy of e-commerce model, hold that e-commerce transformation also need to experience the process of 'unfreeze-change-refreeze'.

About the literature about B2B e-commerce transformation, Cuixiao Fu, Lihua Huang and Qingfeng Zeng (2010) [5] suggest it a transform process for enterprises from current operation mode to B2B e-commerce mode; Qingfeng Zeng (2005) [6] also suggests it a process that reshapes enterprise organization behaviour in order to adapt new environment and achieve sustainable advantage, strategic, dynamic, systematic, gradation and innovative; Lei Nie, Cuixiao Fu, Lihua Huang hold enterprise transformation to B2B platform type will be affected by IT ability, B2B electronic service ability and B2B EC transformation ability when considering from enterprise ability perspective. Among

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these abilities, IT ability including IT infrastructures, IT management and IT match ability with business; B2B EC transformation ability are divided into enterprise and vision transformation ability, organization structure transformation ability, product and market transformation ability, business process transformation and cultural transformation ability.

In conclusion, the research is about the influence on B2B e-commerce transformation in the exploratory stage, the majority of which consider from ability perspective, so as to unable to provide effective theoretical guidance and method support for enterprise B2B e-commerce transformation adequately.

### 2.2 RELATED REVIEW ABOUT PRODUCT CHARACTERISTICS

Product characteristics point to the external and internal features which form product final quality, every feature affects its performance [8]. Early studies about product mainly focus on three points of view. Firstly, research about supplier selection, T.M.Laseter & K.Ramdas [9] find product characteristics have significant effect on supplier selection; secondly, research about the match between product characteristics and supply chain, Fisher, as the typical representative researcher, put forward classical matching model, mainly explored the most important obstacle for product characteristics and supply chain match smoothly is low enterprise performance level; thirdly, research about how product characteristics affect sales level, R.G.Javalg, I.D.S.White & O.Lee [11] hold product characteristics have big influence on export way and then affect sale capacity.

With the development of e-commerce, some scholar literature of the relationship between product characteristics and e-commerce focus on B2C EC. Qixiang Jin (2007) [12] find the degree of digitization, information content, product characteristics, time-sensibility affect accepting different operating mode under e-commerce sales environment; Zhenhua Wang & Huanchen Wang (2002) argue consumers purchase product mainly considering from its 14 features including descriptive, absolute value et al.

To sum up, product characteristics have important influence between enterprises, however the topic mainly focus on B2C and C2C e-commerce, thereby lacking of in-depth study in B2B e-commerce. The paper analyses the influence on B2B EC transformation from product characteristics perspective, in order to provide theory and method references for enterprises.

## 3 Product characteristics analysis and indicators construction

### 3.1 PRODUCT CHARACTERISTICS ANALYSIS

*Standardization and differentiation.* Product having strict specification and unified standard can be fully showed through information such as standardization and specification, so that standard product have low cognitive uncertainty risk for customers. Product which satisfy specific need belongs to personalized products and have high degree of differentiation in B2B e-commerce transaction, leading to communication between enterprises is still a must under Internet trading mechanism for transaction cost of B2B EC don't reduce effectively based on network mechanism but little profit for enterprises. Now, the research about enterprise information are still at primary stage, standardization and differentiation affect the transformation of B2B e-commerce transformation. In 2003, Sculley & Woods investigated different industries transformation, the result indicated automotive industry, information electron industry, pulp and paper industry are the most successful three industries, the product of which are physical and available for bulk production; on the other side, the most lowest industries are health care etc., which has poor standard, customer different demand becomes the driving force to transform in these enterprises. Therefore, standardization and differentiation are two of the most important characteristics affect B2B e-commerce transformation.

*Tangibility and intangibility.* Tangible product mainly mean visible physical product like coal, steel etc., while intangible product mean invisible product like information, service, electronic and products etc., the two parts both have own strength in e-commerce field. First, risk aversion type enterprises hold conservative attitude toward network transaction considering from the perspective of transaction, leading to tangible product become the first choice for enterprise transaction; secondly, information flow and cash flow can be conveyed through Internet for tangible product from logistics perspective, but product delivery process need logistics support. Comparing with tangible product, the superiority of intangible product reflects on the channel convenience, product can be conveyed by network directly so that shorten logistics time and reduce cost greatly. Therefore, tangibility and intangibility are two of the most important characteristics affect B2B e-commerce transformation.

*Time sensitivity.* The influence on B2B e-commerce transformation from time sensitivity perspective mainly embodies on two aspects, namely, the product life cycle and update speed. First of all, short life cycle product are suitable for close deals in the same market in general considering from the perspective of market range, small market scope and relatively stable customer group give priority to shorten logistics time-consuming; secondly, large range of market and customers scope are needed for low update-speed product to sale in short time, so as to finding customers through Internet becomes important, leading to B2B e-commerce become an option in this case for its advantage that gather customers quickly and enhance the effectiveness of transaction. Therefore, time

sensitivity is one of the most important characteristics affect B2B e-commerce transformation.

*Substitutability*. Product substitutability includes function alternative, performance substitutability, stability substitutability, relevance substitutability and experience substitutability. Now traditional marketing channel can meet enterprises' demand in a vast extent, making B2B e-commerce shelved but reduce interests due to various input of B2B EC. Comparing with low substitutability product have relatively small but stable customer group, high substitutability product have large market demand because of relative low price. B2B e-commerce provides a method to expand customer group for high substitutability product to realize small profits but quick returns. Therefore, substitutability is one of the most important characteristics affect B2B e-commerce transformation.

*Complexity*. Product complexity embodies in two aspects: firstly, the complexity of product attributes, including system complexity, interaction complexity with outside enterprise, product technology complexity, manufacturing process complexity and project management complexity. Secondly, high product function complexity. In the process of B2B electronic trading, the question whether product can be accepted quickly by customers regardless of the unalterable fact that reflecting different aspects of complicated product fully is hard to address. The higher enterprises product complexity, the higher barrier into the industry, and the less competitors, in this condition, outside pressure fails to lead to B2B e-commerce transformation for enterprises fully; Conversely, the lower product complexity, the lower barrier into industry, the more competitors for enterprises. Enterprises have to transform to B2B e-commerce due to outside pressure. Therefore, complexity is one of the most important characteristics affect B2B e-commerce transformation.

In short, product characteristics determine industry characteristics and have large influence on enterprises B2B e-commerce transformation, the proposed seven aspects are analysed hoping to get further results of B2B e-commerce transformation.

### 3.2 INDICATORS CONSTRUCTION

It is hard to measure the seven parts of product characteristics above affecting B2B e-commerce transformation directly these factors accurately, the research indicates higher market share and striving for more customers are the direct and fundamental purpose of B2B e-commerce transformation based on relative reference, therefore, measuring item considering from two perspectives of market and customers are designed in the paper to measure product characteristics, as shown in Table 1.

TABLE 1 Measurement Index System of Product Characteristics Affecting B2B E-commerce Transformation

| Product characteristics (level indicator) | Order number | Measuring number |
|---|---|---|
| standardization | $x_{11}$ | The internal information(such as function, style, material, etc.) of the same type product has unified standard |
| | $x_{12}$ | The external information(such as price, color, etc.) of the same type product has unified standard |
| differentiation | $x_{21}$ | The main product have high concept differentiation |
| | $x_{22}$ | The main product have high prosperity (such as features, quality, function and style, etc.) differentiation |
| | $x_{23}$ | The main product have high consumption (such as personnel and consumption process) differentiation |
| | $x_{24}$ | The main product have high brand (such as personality and users) differentiation |
| tangibility | $x_{31}$ | The main product is tangible, easy to see and touch |
| | $x_{32}$ | The main product need to be delivered by the third logistics |
| intangibility | $x_{41}$ | The main product is intangible, including digital product, information and service, etc. |
| | $x_{42}$ | The main product need to be delivered through online service |
| time sensitivity | $x_{51}$ | The main product has long product life cycle |
| | $x_{52}$ | The main product has faster update speed |
| substitutability | $x_{61}$ | The main product has high function substitutability |
| | $x_{62}$ | The main product has high performance substitutability |
| | $x_{63}$ | The main product has high stable substitutability |
| | $x_{64}$ | The main product has high associated substitutability |
| | $x_{65}$ | The main product has high experience substitutability |
| complexity | $x_{71}$ | The main product has complex components and diversified forms |
| | $x_{72}$ | The main product has complex function |
| | $x_{73}$ | Enterprise trades main product via the Internet, the process is complex |

## 4 The decision-making model of product characteristics affecting B2B EC transformation

Based on previous analysis, decision-making model of product characteristics affecting B2B EC transformationare designed combining with Table 1, as shown in Figure 1.

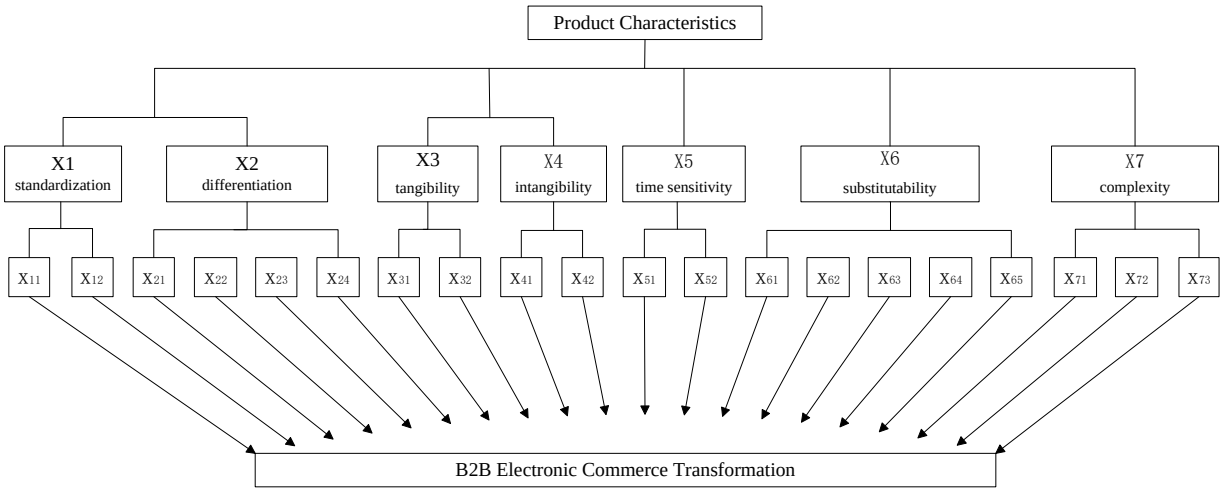


FIGURE 1 Decision-making model chart

The most common method to affirm target weight is Analytic Hierarchy Process (AHP), but in the paper, the weight of product characteristics indicator cannot be confirmed by experience. Therefore, the article adopts the determination method of objective index weight.

## 4.1 MODEL STRUCTURE

Setting $X$ as product characteristics, $x_1, x_2, \cdots, x_7$, are 7 evaluation objects, meet relationship $X = \{x_1, x_2, \cdots, x_7\}$, $x_i \in X$, $1 \le i \le 7$. In order to quantitative describe the certain degree of $x_i$, need to measure $m$ indicators, setting $I$ as index space, meet relationship: $I = \{I_1, I_2, \cdots, I_m\}, I_j \in I, 1 \le j \le m$.

Setting $x_{ij}$ as measure values for evaluation object $i$ on indicator $j$. Each measure values has 5 evaluation degree $C_1, C_2, C_3, C_4, C_5$. Setting $U$ as evaluation degree space, satisfying relationship:

$$U = \{C_1, C_2, C_3, C_4, C_5\}, C_p \in U, 1 \le p \le 5$$

## 4.2 JUDGMENT METHOD

Setting $w_j$ as the relative importance of the evaluation index $j$ on the whole index space. Meeting condition $0 \le w_j \le 1$.

1) Setting $u = u_{ijk}$ as the level of $x_{ij}$ belonging to $c_k$, meet unitary and additivity, assuming each index has the same importance, that is said:

$$w_j = \frac{1}{m}. \tag{1}$$

2) Defining matrix:

$$\left(u_{ijk}\right)_{m\times p} = \left(u_{ijk}\right)_{m\times 5} = \begin{pmatrix} u_{i11} & u_{i12} & u_{i13} & u_{i14} & u_{i15} \\ u_{i21} & u_{i22} & u_{i23} & u_{i24} & u_{i25} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ u_{im1} & u_{im2} & u_{im3} & u_{im4} & u_{im5} \end{pmatrix}, \tag{2}$$

as single index measure evaluation matrix of $x_i$, defining

$$u_{ik} = \sum_{j=1}^{m} w_j u_{ijk}. \tag{3}$$

Combing Equations (2) and (3), getting Equation (4) and call it multi-index comprehensive evaluation matrix.

$$\left(u_{ik}\right)_{n\times p} = \begin{pmatrix} u_{11} & u_{12} & \cdots & u_{1p} \\ u_{21} & u_{22} & \cdots & u_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ u_{n1} & u_{n2} & \cdots & u_{np} \end{pmatrix}, \tag{4}$$

at the same time, getting comprehensive evaluation vector for each evaluation object

$$A_i = \left(u_{i1}, u_{i2}, u_{i3}, u_{i4}, u_{i5}\right). \tag{5}$$

3) Defining $Y_i^+$ as the ideal solution for the evaluation result 'evaluation objects $i$ have positive influence on B2B e-commerce transformation', on the contrary, defining $Y_i^-$ as the ideal solution for the evaluation result 'evaluation objects $i$ have negative influence on B2B e-commerce transformation'.

$$Y_i^+ = \max u_{ik},\ Y_i^- = \min u_{ik},\ k \in (1,5), \tag{6}$$

At last, defining variables $E_i^+ = 1 - \frac{1}{k}\sum_{k=1}^{5}\left|u_{ik} - Y_i^+\right|$ and

$$E_i^- = 1 - \frac{1}{k}\sum\left|u_{ik} - Y_i^-\right|. \tag{7}$$

So drawing the paper conclusion 1, if $E_i^+ \succ E_i^-$, it shows that evaluation objects $i$ have positive influence on B2B e-commerce transformation, if $E_i^+ \prec E_i^-$, it shows

that evaluation objects *i* have negative influence on B2B e-commerce transformation.

4) Because evaluation space $U$ has its order, that shows $C_1 \prec C_2 \prec C_3 \prec C_4 \prec C_5$, making the score for $C_k$ is *k*, defining:

$$q_{xi} = \sum_{k=1}^{5} k u_{ik} \ . \tag{8}$$

So drawing the paper conclusion 2, the scoring ranking of 7 product characteristics.

## 5 Case study

Shanxi Pingyang Industry Machinery Co., Ltd. a company which produces various kinds of advanced precision machinery, is one of 156 key construction projects during the period of 'One Five'. The reasons choose Shanxi Pingyang Industry Machinery Co., Ltd. are as follows: first of all, due to the limitation of traditional business model, it takes a long time to trade between upstream suppliers and downstream customers. In today's market, with competition become more fierce, enterprise need to looking for new suppliers and customers constantly. Shanxi Pingyang Industry Machinery Co., Ltd. has established internal website and adopt CAD electronic procurement, OA management system etc.. In the condition, the company urgent hope to B2B e-commerce transform; Secondly, enterprise product contain both large machinery like hydraulic press machine, hydraulic valve etc. and universal product such as support controller etc., because of the limitation of product characteristics, the way for B2B e-commerce transformation is always rough; Thirdly, Shanxi Pingyang Industry Machinery Co., Ltd. is representative for many large type energy and mechanical state-owned enterprises in China, due to large size and number of employees, leading to heavy enterprise pressure. In the case, B2B e-commerce transformation is a must. Therefore, the paper taking Shanxi Pingyang Industry Machinery Co., Ltd. for example in order to analyse product characteristics affecting B2B E-commerce transformation, at the same time, hoping to provide reference for this type of enterprises.

To sum up, the paper designs questionnaire first according to product characteristics, then distributes the questionnaire to several senior executive $E_i$ . The questionnaire use Likert 5 scale method, with number 1-5 represent very disagree, less agree, general, comparative agree, strongly agree. The number of questionnaire is 14, in last, distributed all. The enterprise comprehensive evaluation matrixes are shown in Table 2.

TABLE 2 Comprehensive evaluation matrix

| Measure values / Investigator / Measure item | $E_1$ | $E_2$ | $E_3$ | $E_4$ | $E_5$ | $E_6$ | $E_7$ | $E_8$ | $E_9$ | $E_{10}$ | $E_{11}$ | $E_{12}$ | $E_{13}$ | $E_{14}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $x_{11}$ | 5 | 5 | 3 | 4 | 5 | 5 | 4 | 4 | 3 | 5 | 4 | 4 | 3 | 3 |
| $x_{12}$ | 4 | 5 | 2 | 2 | 5 | 5 | 4 | 2 | 4 | 5 | 4 | 5 | 2 | 5 |
| $x_{21}$ | 5 | 1 | 3 | 1 | 2 | 1 | 5 | 1 | 2 | 1 | 3 | 5 | 3 | 1 |
| $x_{22}$ | 5 | 1 | 1 | 1 | 3 | 1 | 5 | 1 | 2 | 1 | 3 | 1 | 4 | 1 |
| $x_{23}$ | 4 | 1 | 2 | 1 | 2 | 5 | 5 | 1 | 2 | 5 | 1 | 2 | 3 | 1 |
| $x_{24}$ | 5 | 1 | 2 | 1 | 4 | 5 | 5 | 1 | 4 | 1 | 1 | 3 | 3 | 1 |
| $x_{31}$ | 5 | 1 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 2 | 1 | 4 | 4 | 1 |
| $x_{32}$ | 5 | 1 | 5 | 2 | 5 | 5 | 3 | 4 | 1 | 1 | 1 | 3 | 1 | 1 |
| $x_{41}$ | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 3 | 1 | 2 | 3 | 3 |
| $x_{42}$ | 2 | 1 | 3 | 1 | 2 | 3 | 2 | 2 | 1 | 3 | 1 | 3 | 2 | 1 |
| $x_{51}$ | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 1 |
| $x_{52}$ | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 5 | 3 | 1 | 1 |
| $x_{61}$ | 4 | 3 | 5 | 4 | 4 | 3 | 5 | 3 | 4 | 5 | 3 | 4 | 5 | 5 |
| $x_{62}$ | 5 | 5 | 4 | 3 | 4 | 2 | 4 | 5 | 4 | 5 | 3 | 3 | 5 | 4 |
| $x_{63}$ | 5 | 4 | 3 | 2 | 4 | 3 | 4 | 5 | 5 | 4 | 3 | 5 | 3 | 3 |
| $x_{64}$ | 3 | 3 | 2 | 5 | 4 | 5 | 4 | 5 | 3 | 4 | 5 | 5 | 4 | 3 |
| $x_{65}$ | 4 | 3 | 5 | 5 | 4 | 3 | 2 | 3 | 5 | 4 | 3 | 4 | 4 | 5 |
| $x_{71}$ | 5 | 1 | 1 | 1 | 1 | 1 | 5 | 4 | 5 | 1 | 5 | 1 | 4 | 3 |
| $x_{72}$ | 3 | 1 | 1 | 1 | 1 | 1 | 5 | 4 | 3 | 1 | 5 | 3 | 5 | 3 |
| $x_{73}$ | 3 | 1 | 1 | 1 | 2 | 2 | 5 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |

Single index measure evaluation matrix are as follows: Single index measure evaluation matrix of standardization:

$$\left(u_{ijk}\right)_{2\times 5} = \begin{pmatrix} u_{111} & u_{112} & u_{113} & u_{114} & u_{115} \\ u_{121} & u_{122} & u_{123} & u_{124} & u_{125} \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0.28 & 0.36 & 0.36 \\ 0 & 0.28 & 0 & 0.36 & 0.36 \end{pmatrix}.$$

Single index measure evaluation matrix of differentiation:

$$\left(u_{2jk}\right)_{4\times5}=\begin{pmatrix}u_{211}&u_{212}&u_{213}&u_{214}&u_{215}\\u_{221}&u_{222}&u_{223}&u_{224}&u_{225}\\u_{231}&u_{232}&u_{233}&u_{234}&u_{235}\\u_{241}&u_{242}&u_{243}&u_{244}&u_{245}\end{pmatrix}=$$

$$\begin{pmatrix}0.43&0.14&0.21&0&0.21\\0.57&0.07&0.14&0.07&0.14\\0.36&0.28&0.07&0.07&0.21\\0.43&0.07&0.14&0.14&0.21\end{pmatrix}.$$

Single index measure evaluation matrix of tangibility:

$$\left(u_{3jk}\right)_{2\times5}=\begin{pmatrix}u_{311}&u_{312}&u_{313}&u_{314}&u_{315}\\u_{321}&u_{322}&u_{323}&u_{324}&u_{325}\end{pmatrix}=$$

$$\begin{pmatrix}0.21&0.07&0&0.21&0.5\\0.43&0.07&0.14&0.07&0.28\end{pmatrix}.$$

Single index measure evaluation matrix of intangibility:

$$\left(u_{4jk}\right)_{2\times5}=\begin{pmatrix}u_{411}&u_{412}&u_{413}&u_{414}&u_{415}\\u_{421}&u_{422}&u_{423}&u_{424}&u_{425}\end{pmatrix}=$$

$$\begin{pmatrix}0.36&0.36&0.28&0&0\\0.36&0.36&0.28&0&0\end{pmatrix}.$$

Single index measure evaluation matrix of time sensitivity:

$$\left(u_{5jk}\right)_{2\times5}=\begin{pmatrix}u_{511}&u_{512}&u_{513}&u_{514}&u_{515}\\u_{521}&u_{522}&u_{523}&u_{524}&u_{525}\end{pmatrix}=$$

$$\begin{pmatrix}0.79&0.14&0.07&0&0\\0.79&0&0.14&0&0.07\end{pmatrix}.$$

Single index measure evaluation matrix of substitutability:

$$\left(u_{6jk}\right)_{5\times5}=\begin{pmatrix}u_{611}&u_{612}&u_{613}&u_{614}&u_{615}\\u_{621}&u_{622}&u_{623}&u_{624}&u_{625}\\u_{631}&u_{632}&u_{633}&u_{634}&u_{635}\\u_{641}&u_{642}&u_{643}&u_{644}&u_{645}\\u_{651}&u_{652}&u_{653}&u_{654}&u_{655}\end{pmatrix}=$$

$$\begin{pmatrix}0&0&0.28&0.36&0.36\\0&0.07&0.21&0.36&0.36\\0&0.07&0.36&0.28&0.28\\0&0.07&0.28&0.28&0.36\\0&0.07&0.28&0.28&0.36\end{pmatrix}.$$

Single index measure evaluation matrix of complexity:

$$\left(u_{7jk}\right)_{3\times5}=\begin{pmatrix}u_{711}&u_{712}&u_{713}&u_{714}&u_{715}\\u_{721}&u_{722}&u_{723}&u_{724}&u_{725}\\u_{731}&u_{732}&u_{733}&u_{734}&u_{735}\end{pmatrix}=$$

$$\begin{pmatrix}0.5&0&0.07&0.14&0.28\\0.43&0&0.28&0.07&0.21\\0.64&0.21&0.07&0&0.07\end{pmatrix}.$$

Combining Equations (2) and (3) multi-index comprehensive evaluation matrix is obtained:

$$\left(u_{ik}\right)_{7\times5}=\begin{pmatrix}u11&u12&u13&u14&u15\\u_{21}&u_{22}&u_{23}&u_{24}&u_{25}\\u_{31}&u_{32}&u_{33}&u_{34}&u_{35}\\u_{41}&u_{42}&u_{43}&u_{44}&u_{45}\\u_{51}&u_{52}&u_{53}&u_{54}&u_{55}\\u_{61}&u_{62}&u_{63}&u_{64}&u_{65}\\u_{71}&u_{72}&u_{73}&u_{74}&u_{75}\end{pmatrix}=$$

$$\begin{pmatrix}0&0.14&0.14&0.36&0.36\\0.45&0.14&0.14&0.07&0.19\\0.32&0.07&0.07&0.14&0.39\\0.36&0.36&0.28&0&0\\0.79&0.07&0.11&0&0.04\\0&0.06&0.28&0.31&0.34\\0.52&0.07&0.14&0.07&0.19\end{pmatrix}.$$

At the same time, get comprehensive evaluation vector for each evaluation object:

$$Ai=\left(u_{i1},u_{i2},u_{i3},u_{i4},u_{i5}\right).$$

If $i=1$, $E_1^+=0.84$, $E_1^-=0.8$, so $E_1^+\succ E_1^-$, it shows that evaluation objects product standardization have positive influence on B2B e-commerce transformation;

If $i=2$, $E_2^+=0.75$, $E_2^-=0.87$, so $E_2^+\prec E_2^-$, it shows that evaluation objects product differentiation have negative influence on B2B e-commerce transformation;

If $i=3$, $E_3^+=0.81$, $E_3^-=0.87$, so $E_3^+\prec E_3^-$, it shows that evaluation objects product tangibility have negative influence on B2B e-commerce transformation;

If $i=4$, $E_4^+=0.85$, $E_4^-$=0.79, so $E_4^+\succ E_4^-$, it shows that evaluation objects product intangibility have positive influence on B2B e-commerce transformation;

If $i=5$, $E_5^+=0.41$, $E_5^-=0.8$, so $E_5^+\prec E_5^-$, it shows that evaluation objects product time sensitivity have negative influence on B2B e-commerce transformation;

If $i=6$, $E_6^+=0.86$, $E_6^-=0.8$, so $E_6^+\succ E_6^-$, it shows that evaluation objects product substitutability have positive influence on B2B e-commerce transformation;

If $i=7$, $E_7^+=0.68$, $E_7^-=0.87$, so $E_7^+\prec E_7^-$, it shows that evaluation objects product complexity have negative influence on B2B e-commerce transformation;

Combining Equation (8) and relative data, the paper obtains $q_{x1}=3.94$, $q_{x2}=2.38$, $q_{x3}=3.18$, $q_{x4}=1.92$, $q_{x5}=1.46$, $q_{x6}=3.9$, $q_{x7}=2.31$ and then arrive at the conclusion two as follows:

$$q_{x1} \succ q_{x6} \succ q_{x3} \succ q_{x2} \succ q_{x7} \succ q_{x4} \succ q_{x5}$$

It is said the result arrange in score order is standardization, alternative, tangibility, differentiation, complexity, intangibility, time sensitivity.

From the two results, it has been confirmed the model product characteristics affecting the transformation of B2B E-commerce has high applicability.

## 6 Conclusions

On the basis of combing with the existing related literature and theory about product characteristics and B2B e-commerce transformation, the paper extracts seven factors affecting B2B e-commerce transformation that product characteristics contained, namely standardization, differentiation, tangibility, intangibility, time sensitivity, substitutability, complexity. Standardization and differentiation as a pair of analysis variables, affect B2B e-commerce transformation by influencing product transaction cost; tangibility and intangibility are also a pair of analysis variables, affect B2B e-commerce transformation by embodying at two points, namely transaction risk and logistic cost; time sensitivity of product affecting B2B e-commerce mainly reflects on the product life cycle and update speed; product substitutability and complexity affect B2B e-commerce transformation by influencing enterprise earning and bearing pressure intensity outside.

At the same time, the paper put forward the mathematical model of product characteristics affecting B2B EC transformation by combining with the method of the objective index weight, including the way seven aspects of product characteristics affecting B2B e-commerce, as well as the influence degree. In the last, the example of Shanxi Pingyang Industry Machinery Co., Ltd. tests the feasibility of the model.

The theory of B2B e-commerce is infancy, further research can proceed from three aspects as follows:
1) Research from other sides of product characteristics;
2) Research by refering to existing relative cases;
3) Research from external environment, such as suppliers, competitors, partners, customers, etc.

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