

Combining various trust factors for e-commerce platforms using Analytic Hierarchy Process

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Abstract—E-commerce has grown rapidly worldwide over the course of the past five years. Despite appearance, e-commerce industry is faced with many challenges, among which trust is the biggest issue. In this paper, we take China's largest C2C e-commerce platform—Taobao— as an example and focus on two disadvantages of current trust model: trust is easily manipulated by defrauders and trust dimensions prove insufficient. We propose to integrate various trust factors and build a dynamic trust model to deter trust fraud. In this paper, we identify the factors that affect trust in e-commerce platforms and make use of the Analytic Hierarchy Process (AHP) to determine the weights of the above factors for the trust model. We utilize concrete survey results of Taobao buyers rather than experts' knowledge to determine the relative importance of these trust factors. Therefore, our proposed method will yield a practical solution to the trust problem of e-commerce industry.

Index Terms— trust factors, e-commerce, Analytic Hierarchy Process, trust model

I. INTRODUCTION

IN recent years, China's e-commerce market has developed at an unprecedented pace. China's e-commerce sales totaled 5.88 trillion yuan in 2011, 29.2% more than that in the previous year, and contributed 12.5% to the nation's gross domestic product [1]. Online shopping has become an indispensable part of people's daily life. On the surface, China's e-commerce market appears to be

flourishing, however, it faces many challenges, among which the trust problem is the biggest issue [2].

Trust score on e-commerce platform is a complex function of many variables: the environment, the nature of the market served, the growth stage of the sellers, the types of products and services offered, and the quality of organization management. However, current Taobao regard a seller's trust score as a static accumulated amount. A positive rating raises a seller's trust score by one point. A negative rating lowers a seller's trust score by one point. A neutral rating does not affect a seller's trust score. The overall trust score is simply accumulated by adding these feedback ratings together. There are two main problems with the current trust model:

- **Trust is easily manipulated:** since the trust score is simply calculated by adding all the positive ratings, it is very easy for sellers to boost their reputation by fake transactions. According to Taobao's research report, the highest percentage of trust fraud transactions accounted for about 47% of all the rated transactions and even the lowest percentage is nearly 9% during the period from Oct 2008 to June 2009 [3].
- **Trust dimensions prove insufficient:** since the trust model only concerns the accumulated positive ratings, much trust related information is ignored, such as detailed review, sellers' service, price, etc.

In this article, we mainly focus on a variety of trust related information obtained from C2C e-commerce platforms. We cooperate with Taobao and have a deep understanding of trust factors. Taobao now is the largest e-commerce platform in China's C2C market, standing out as the giant of retail platform in the world. In the year 2011, the total amount of business transactions in the Taobao market is about 600 billion Yuan. The highest

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transaction amount of a single day in 2011 is 43.8 billion Yuan.

Taobao adopted a feedback system similar to eBay to manage trust of the online community. The higher the trust score, the more reliable of the seller. Except for a general trust score, Taobao also provides a lot of information about sellers and past transactions for buyers to make purchase decisions. Figure 1 shows a snapshot of trust related information provided by Taobao. On a seller's homepage, buyers are able to obtain a variety of information about the seller, including DSRs, comparisons among sellers in the same category, sellers' service situation, product price, sales volume, positive feedback rate, detailed reviews, trust level and general information about the seller, etc. Although Taobao has published all the above information on sellers' homepage, it has not made use of any of these factors to evaluate sellers' trust status.



Figure 1. A snapshot of trust related information on Taobao.

It is very difficult for buyers especially new buyers to understand the above information. It is the e-commerce platform's responsibility to combine all the above factors and provide a more reasonable evaluation about sellers. Therefore, in this article, we mainly discuss how to integrate all these trust factors for trust evaluation.

In this article, we utilize two survey results from Taobao. One survey concerned Taobao's trust framework. The survey was conducted during the period from Aug. 26th 2010 to Sep. 17th 2010. There were 402 valid questionnaires, among which 296 were from buyers, 27 were from sellers and another 79 were from the members who both purchase and sell on Taobao [4]. The other survey was about buyers' experience on reviews. The survey was conducted during the period from Jan. 11th 2011 to Jan. 17th 2011. There were 4150 valid questionnaires obtained from this survey [5].

According to these survey results from real Taobao members, we exploit the Analytical Hierarchy Process (AHP) to determine the relative importance of a variety of trust factors. The analytical hierarchy process was proposed by Thomas L. Saaty in the 1970s and has been extensively developed since then [6]–[8]. AHP is

a structured technique for analyzing complex decisions and is used around the world in a wide variety of fields such as government, business, industry, education, energy, health and transportation, etc [9]–[12]. AHP helps people to make a decision that best suits their goal and their understanding of the problem. AHP provides a comprehensive framework for evaluating alternative solutions.

The analytic hierarchy process provides a logical framework to determine the ranking of each alternative. The procedure consists of the following five basic steps:

- 1) Decompose a decision problem into a hierarchy of components and identify their criteria;
- 2) Set weight of the criteria by pairwise comparison of decision components;
- 3) Check consistency of the comparison matrix. If it does not pass, then go back to the second step;
- 4) Determine the weight for each component;
- 5) Obtain the overall score and make the final decision based on the alternatives.

The organization of this paper is as follows: Section II presents the related works. Section III introduces our proposed method to determine trust factors. Section IV presents the detailed determination process of trust factors for China's e-commerce platforms. Section VI concludes this paper and outlines the future work.

II. RELATED WORKS

There has been some research on trust factors in a business. In [13], research found that customers would not generate an inquiry or buy from a shopping website if they did not trust it. They identified a series of factors that improve customers' trust, such as post to customer reviews, money back guarantees, video testimonials, etc.

In [14], they discuss the factors that impact trust in business. There are 40% of customers that regard that company's reputation for honesty and fairness as extremely important, while 53% of customers regard it as very important. There are 34% of customers think that company's reputation for being both dependable and reliable is extremely important, while 57% of customers regard it as very important.

In [15], Moore presents 10 tips to increase credibility and trust factors. She claimed that trust was invaluable in the online market.

There are also some researchers who apply analytic hierarchy process to deal with trust management in e-commerce platforms. Xia et al. utilize AHP to construct a hierarchical trust model that incorporates detailed factors [16]. Li et al. propose the AHP-based approach, which takes all the dynamic factors that buyers are concerned. They also find that the trust level of buyers and the transaction amounts have great impact on sellers' trust [17]. Cami et al. apply AHP technique to weigh and combine various factors for trust evaluation, including Semantic Web metadata, recommendation and reputation [18].

Radcliffe and Schniederjans make use of AHP and multi-objective programming to determine which trust

factors will best achieve the goals [19]. Nilashi et al provide a theory-based framework to determine the factors that affect on trust in mobile commerce, and then evaluate these factors using AHP method [20]. Nilashi et al. also develop an application of expert system on trust in e-commerce. They make use of AHP to determine the priority of trust factors. They find that trust in e-commerce transactions is strongly mediated by perceived security [21].

Compared with previous work, the contribution of this paper is two-fold: first, we focus on various dimensions of trust and try to integrate these trust related factors into trust evaluation on e-commerce platforms. These trust factors were more or less ignored before. Second, most previous research evaluates trust from e-commerce platforms' perspective rather than from the customers' perspective. In this paper, we make use of the concrete survey results of Taobao buyers rather than experts' knowledge to determine the relative importance of trust factors. Therefore, our proposed framework is more practical and specific for helping buyers to make purchase decisions.

III. METHODOLOGY

The goal of the trust system is to help customers to make right purchase decisions. It should be able to recommend trustworthy sellers. There are a variety of criteria from a broad perspective that need to be considered during the process. We identify three main criteria and their corresponding subcriteria according to the two survey results on Taobao members (See Section I for description about the two surveys):

- **Detailed review:** there are four subcriteria under detailed review: quality, item as described, experience after using the product, authenticity of product.
- **Product information:** there are three subcriteria under product information: price, image and text description, sales volume.
- **Seller information:** there are four subcriteria under seller information: positive feedback rate, trust level, comparison in the same category, DSRs (detailed seller ratings).

The above criteria and subcriteria are arranged into a hierarchy tree for selecting a trustworthy seller (See Figure 2 for details).

In this paper, we need to determine the weights $b_1 \sim b_3$ for the main criteria, and $c_{11} \sim c_{14}$, $c_{21} \sim c_{23}$, $c_{31} \sim c_{34}$ for the corresponding subcriteria. Thomas L. Saaty had demonstrated mathematically that the eigenvector solution is the best approach. The determination process should be accomplished in the following five steps:

First, we build a pairwise comparison matrix **B** of the main criteria with respect to the goal. Using pairwise comparisons, the relative importance of one criterion over another criterion can be described. In this article, we make use of the survey results on buyers to determine the relative importance of the criteria. Both qualitative and quantitative criteria can be compared to derive weights.

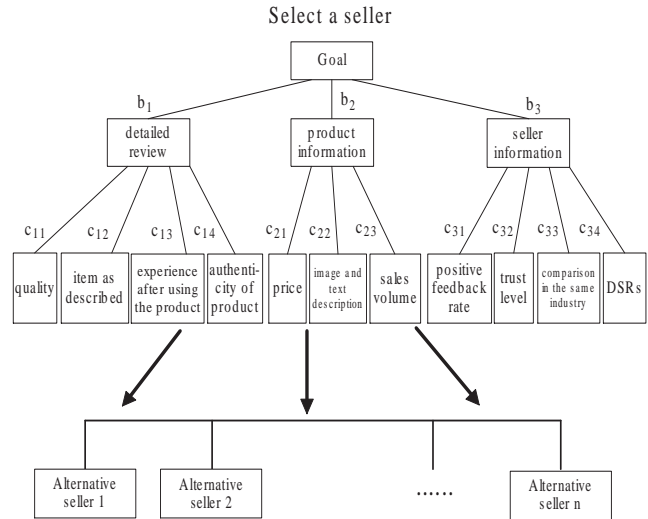


Figure 2. Seller Decision.

To make pairwise comparisons, we utilize a scale of numbers defined by Satty to identify how many times more important one criterion is over another criterion [8]. Table I exhibits the scale of absolute numbers.

TABLE I. THE SCALE OF ABSOLUTE NUMBERS

Importance	Explanation
1	two activities contribute equally to the objective
3	slightly favour one activity over another
5	strongly favour one activity over another
7	very strongly favour one activity over another
9	extremely strongly favour one activity over another
2, 4, 6, 8	median between the above adjacent two values
1.1-1.9	if two activities are very close
Reciprocals of above	if factor i is a_{ij} times over another factor j , then factor j is $1/a_{ij}$ times over the factor i .

In the two surveys of the Taobao trust system, buyers were asked to rank the importance of a variety of criteria from “very important” to “very unimportant”. The criteria includes: sellers’ trust level, positive feedback rate, DSRs, comparisons with other sellers in the same category, detailed reviews and distribution of buyers feedback scores. We set the scale of one criterion over another based on the statistics distribution of survey results on Taobao members.

Firstly, we construct a set of pairwise comparison matrices for main criteria and their subsequent subcriteria. Take main criteria for example, if there are n main criteria for determining the goal, then we will have a $n \times n$ comparison matrix **B**.

Secondly, we normalize each column vector of the matrix:

$$\tilde{w}_{ij} = b_{ij} / \sum_{i=1}^n b_{ij} \tag{1}$$

In the above formula, b_{ij} denotes the value in the i th row and the j th column of matrix **B**, while \tilde{w}_{ij} denotes

the corresponding value after normalization. The symbol n denotes the size of matrix \mathbf{B} .

Next, we sum each row of \tilde{w}_{ij} :

$$\tilde{w}_i = \sum_{j=1}^n \tilde{w}_{ij} \quad (2)$$

Then, we normalize \tilde{w}_i and obtain w_i :

$$w_i = \tilde{w}_i / \sum_{i=1}^n \tilde{w}_i \quad (3)$$

Thus, we can have $w = (w_1, w_2, \dots, w_n)^T$, where w is the approximate eigenvalue;

Thirdly, we obtain the approximation of the largest eigenvalue λ_{max} and verify the consistency of the comparison matrix. The value of λ_{max} can be calculated using the following formula:

$$\lambda_{max} = \frac{1}{n} \sum_{i=1}^n \frac{(\mathbf{B}w)_i}{w_i} \quad (4)$$

Then, we can employ a Consistency Index(CI) to measure matrix consistency as shown below:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (5)$$

We compare the computed CI with the Random Consistency Index (RI) in Table II.

TABLE II.
RANDOM CONSISTENCY INDEX (RI)

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Finally, we utilize Consistency Ratio (CR) to determine whether the judgement is consistent or not.

$$CR = \frac{CI}{RI} \quad (6)$$

If the value of CR is smaller or equal to 10%, the inconsistency of the comparison matrix is acceptable, or else, we need to revise the value in the comparison matrix.

For each subcriteria under the main criteria, we need to go through the whole procedure as illustrated above to determine the weights for those subcriteria. Therefore, we will have the local weights which represent the relative weights of the subcriteria within a group of siblings with respect to their parent criterion.

After determining the local weights, we can compute the global weights. The global weights of subcriteria are obtained by multiplying the local weights of the siblings by their parent's global weight.

Suppose for the m elements in the $(k-1)_{th}$ layer, the global weight is:

$$W^{(k-1)} = (W_1^{(k-1)}, W_2^{(k-1)}, \dots, W_m^{(k-1)})^T \quad (7)$$

For the n elements in the k_{th} layer, their local weights to the j_{th} element is:

$$p_j^k = (p_{1j}^k, p_{2j}^k, \dots, p_{nj}^k) \quad (8)$$

We let $P^k = (p_1^k, p_2^k, \dots, p_n^k)$ denote the local weight of the k_{th} layer elements to the $(k-1)_{th}$ layer. The global weight of the k_{th} layer to the goal is:

$$W^k = (W_1^k, W_2^k, \dots, W_n^k)^T = P^k W^{(k-1)} \quad (9)$$

IV. DETERMINING THE WEIGHTS OF TRUST FACTORS

In this section, we present how to determine the weights of trust factors for C2C e-commerce platforms. We first present how to determine the relative importance of main criteria, then we illustrate how to determine the relative importance of corresponding subcriteria. Next, we introduce how to measure the consistency of these judgements. In the end, we describe how to compute the global weights of these subcriteria.

A. Determine the importance of main criteria

According to the survey results of Taobao members, we make the following judgements:

- Detailed review is slightly important over Product information;
- Detailed review is strongly important over Seller information;
- Product information is slightly important over Seller information;

According to Table I, the pairwise comparison matrix of the main criteria with respect to Taobao trust system is shown below¹:

$$\mathbf{B} = \begin{matrix} & \begin{matrix} \text{Review} & \text{Product} & \text{Seller} \end{matrix} \\ \begin{matrix} \text{Review} \\ \text{Product} \\ \text{Seller} \end{matrix} & \begin{bmatrix} 1 & 3 & 5 \\ 1/3 & 1 & 3 \\ 1/5 & 1/3 & 1 \end{bmatrix} \end{matrix}$$

We normalize each column vector of \mathbf{B} :

$$\left\{ \begin{matrix} 15/23 & 9/13 & 5/9 \\ 5/23 & 3/13 & 1/3 \\ 3/23 & 1/13 & 1/9 \end{matrix} \right\}$$

Then we sum each row of the above matrix and obtain the following result:

$$\left\{ \begin{matrix} 5113/2691 \\ 701/897 \\ 857/2691 \end{matrix} \right\}$$

After normalization, we can obtain $w_{\mathbf{B}}$:

$$w_{\mathbf{B}} = \left\{ \begin{matrix} 0.633 \\ 0.261 \\ 0.106 \end{matrix} \right\}$$

Then we will have the following result:

$$\mathbf{B}w_{\mathbf{B}} = \left\{ \begin{matrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{matrix} \right\} \times \left\{ \begin{matrix} w_{B_1} \\ w_{B_2} \\ w_{B_3} \end{matrix} \right\}$$

¹In matrix \mathbf{B} , "Review" is short for "Detailed review", "Product" is short for "Product information" and "Seller" is short for "Seller information".

$$\mathbf{B}w_{B_1} = b_{11} \times w_{B_1} + b_{12} \times w_{B_2} + b_{13} \times w_{B_3}$$

$$\mathbf{B}w_{B_2} = b_{21} \times w_{B_1} + b_{22} \times w_{B_2} + b_{23} \times w_{B_3}$$

$$\mathbf{B}w_{B_3} = b_{31} \times w_{B_1} + b_{32} \times w_{B_2} + b_{33} \times w_{B_3}$$

$$\mathbf{B}w = \begin{Bmatrix} 1.946 \\ 0.790 \\ 0.3196 \end{Bmatrix}$$

Next, we calculate the approximation of the largest eigenvalue λ_{max}^B using formula (4):

$$\lambda_{max}^B = \frac{1}{3} \left(\frac{1.946}{0.633} + \frac{0.790}{0.261} + \frac{0.3196}{0.106} \right) = 3.039$$

The computed eigenvector shows the relative ranking of the main criteria:

$$\mathbf{B} = \begin{matrix} \text{Review} & [0.633] & \leftarrow \text{The most important criterion} \\ \text{Product} & [0.261] & \leftarrow \text{The 2nd most important criterion} \\ \text{Seller} & [0.106] & \leftarrow \text{The least important criterion} \end{matrix}$$

Therefore, we can tell that ‘‘Detailed review’’ is the most important criterion among all the three main criteria, followed by ‘‘Product information’’. ‘‘Seller information’’ is the least important criterion among the three. The corresponding weights of the three criteria are 0.633, 0.261 and 0.106 respectively.

B. Determine the importance of subcriteria

After determining the weights of main criteria, we utilize the same method to determine the importance of subcriteria. According to the two survey results, we make the judgements about the subcriteria under main criterion ‘‘Detailed review’’ and construct the comparison matrix C_1 as shown below²:

$$C_1 = \begin{matrix} & \text{Quality} & \text{Item} & \text{Experience} & \text{Genuine} \\ \text{Quality} & \begin{bmatrix} 1 & 2 & 3 & 5 \\ 1/2 & 1 & 2 & 4 \\ 1/3 & 1/2 & 1 & 3 \\ 1/5 & 1/4 & 1/3 & 1 \end{bmatrix} \end{matrix}$$

Using the same method illustrated above, we can obtain the $\lambda_{max}^{C_1}$ and w_{C_1} as follows:

$$\lambda_{max}^{C_1} = 4.051$$

$$w_{C_1} = (0.471, 0.284, 0.171, 0.074)^T$$

From the above result, we can tell that Quality is the most important criterion among all the four subcriteria, followed by ‘‘Item as described’’ and ‘‘Experience after using the product’’. ‘‘Genuine product or not’’ is the least important criterion among the four. The corresponding weights of the four subcriteria are 0.471, 0.284, 0.171 and 0.074 respectively.

²Note that ‘‘Item’’ is short for ‘‘Item as described’’, and ‘‘Experience’’ is short for ‘‘Experience after using the product’’, and ‘‘Genuine’’ is short for ‘‘Genuine product or not’’

Similarly, we can also construct the comparison matrix C_2 of the subcriteria under main criterion ‘‘Product information’’. The matrix C_2 is shown as follows³:

$$C_2 = \begin{matrix} & \text{Price} & \text{Description} & \text{Volume} \\ \text{Price} & \begin{bmatrix} 1 & 3 & 5 \\ 1/3 & 1 & 3 \\ 1/5 & 1/3 & 1 \end{bmatrix} \\ \text{Description} & & & \\ \text{Volume} & & & \end{matrix}$$

Then, we can also obtain the result of $\lambda_{max}^{C_2}$ and w_{C_2} :

$$\lambda_{max}^{C_2} = 3.039$$

$$w_{C_2} = (0.633, 0.261, 0.106)^T$$

As can be seen from the above result, ‘‘Price’’ is the most important criterion among all the three subcriteria, followed by ‘‘Image and text description’’. ‘‘Sales volume’’ is the least important criterion among the three. The corresponding weights of the three subcriteria are 0.633, 0.261 and 0.106 respectively.

Next, we construct the comparison matrix C_3 of the following subcriteria under the main criterion ‘‘Seller information’’: Positive feedback rate, Trust level, Comparison in the same category, DSRs. The comparison matrix C_3 is shown as follows⁴:

$$C_3 = \begin{matrix} & \text{Rate} & \text{Level} & \text{Comparison} & \text{DSRs} \\ \text{Rate} & \begin{bmatrix} 1 & 2 & 6 & 7 \\ 1/2 & 1 & 5 & 6 \\ 1/6 & 1/5 & 1 & 2 \\ 1/7 & 1/6 & 1/2 & 1 \end{bmatrix} \\ \text{Level} & & & & \\ \text{Comparison} & & & & \\ \text{DSRs} & & & & \end{matrix}$$

The values of $\lambda_{max}^{C_3}$ and w_{C_3} are shown below:

$$w_{C_3} = (0.516, 0.337, 0.089, 0.058)^T$$

$$\lambda_{max}^{C_3} = 4.070$$

It is obvious that ‘‘Positive feedback rate’’ is the most important subcriteria under main criterion ‘‘Seller information’’, and followed by ‘‘Trust level’’ and ‘‘Comparison within the same category’’. ‘‘DSRs’’ is the least important subcriteria among the four. The corresponding weights of the four subcriteria are 0.516, 0.337, 0.089 and 0.058 respectively.

C. Measure the consistency of the judgement

The above judgements about the main criteria and subcriteria may be inconsistent. Therefore, we need to measure inconsistency and improve the judgements if possible.

³Note that ‘‘Description’’ is short for ‘‘Image and text description’’, and ‘‘Volume’’ is short for ‘‘Sales volume’’.

⁴Note that ‘‘Rate’’ is short for ‘‘Positive feedback rate’’, and ‘‘Level’’ is short for ‘‘trust level’’, and ‘‘Comparison’’ is short for ‘‘Comparison in the same category’’.

For the main criteria, we have $\lambda_{max}^B = 3.039$ and the size of comparison matrix $n_B = 3$, thus the Consistency Index CI_B is:

$$CI_B = \frac{\lambda_{max}^B - n_B}{n_B - 1} = \frac{3.039 - 3}{3 - 1} = 0.0195$$

For the above obtained comparison matrix B , we have $CI_B = 0.0195$ and RI for $n_B = 3$ is 0.58 (The value of RI can be obtained from Table II), then we have:

$$CR_B = \frac{CI_B}{RI} = \frac{0.0195}{0.58} = 0.034 < 0.1$$

Thus, our evaluation about the importance of main criteria is consistent.

Using the same method, we can also verify the consistency of subcriteria under the three main criteria. According to above computed result, the approximation of the largest eigenvalue $\lambda_{max}^{C_1}$ of matrix C_1 is 4.051. The size of comparison matrix $n_{C_1} = 4$, therefore the Consistency Index CI_{C_1} is:

$$CI_{C_1} = \frac{\lambda_{max}^{C_1} - n_{C_1}}{n_{C_1} - 1} = \frac{4.051 - 4}{4 - 1} = 0.017$$

As a result, we will have:

$$CR_{C_1} = \frac{CI_{C_1}}{RI} = \frac{0.017}{0.9} = 0.019 < 0.1$$

Since $CR_{C_1} < 0.1$, we can tell that the judgements in comparison matrix C_1 are consistent.

Similarly, we have $\lambda_{max}^{C_2} = 3.039$ and $n_{C_2} = 3$, so we obtain the following result:

$$CI_{C_2} = \frac{\lambda_{max}^{C_2} - n_{C_2}}{n_{C_2} - 1} = \frac{3.039 - 3}{3 - 1} = 0.0195$$

$$CR_{C_2} = \frac{CI_{C_2}}{RI} = \frac{0.0195}{0.58} = 0.034 < 0.1$$

The value of CR_{C_2} is smaller than 0.1, therefore the judgements in matrix C_2 are consistent.

Once more, we can repeat the above computation and get the following result for matrix C_3 :

$$CI_{C_3} = \frac{\lambda_{max}^{C_3} - n_{C_3}}{n_{C_3} - 1} = \frac{4.070 - 4}{4 - 1} = 0.0233$$

$$CR_{C_3} = \frac{CI_{C_3}}{RI} = \frac{0.0233}{0.90} = 0.026 < 0.1$$

The value of CR_{C_3} is also smaller than 0.1, therefore the judgements in matrix C_3 are consistent too.

D. Computing the global weights

Now for each subcriteria, we have already obtained the local weight to its parent node, now we can utilize formula (6) to get the global weight. For subcriteria under main criterion ‘‘Detailed review’’, the global weights can be calculated as follows:

$$WC_1 = w_{B_1} \times w_{C_1} = 0.633 \times \begin{pmatrix} 0.471 \\ 0.284 \\ 0.171 \\ 0.074 \end{pmatrix} = \begin{pmatrix} 0.298 \\ 0.180 \\ 0.108 \\ 0.047 \end{pmatrix}$$

Similarly, we can obtain the global weights for sub-criteria under main criterion ‘‘Product information’’ and ‘‘Seller information’’ as follows:

$$WC_2 = w_{B_2} \times w_{C_2} = 0.261 \times \begin{pmatrix} 0.633 \\ 0.261 \\ 0.106 \end{pmatrix} = \begin{pmatrix} 0.165 \\ 0.068 \\ 0.028 \end{pmatrix}$$

$$WC_3 = w_{B_3} \times w_{C_3} = 0.106 \times \begin{pmatrix} 0.516 \\ 0.337 \\ 0.089 \\ 0.058 \end{pmatrix} = \begin{pmatrix} 0.055 \\ 0.036 \\ 0.009 \\ 0.006 \end{pmatrix}$$

Therefore, the global weights of all the subcriteria are:

$$WC_1 = (0.298, 0.180, 0.108, 0.047)^T$$

$$WC_2 = (0.165, 0.068, 0.028)^T$$

$$WC_3 = (0.055, 0.036, 0.009, 0.006)^T$$

Figure 3 shows AHP hierarchy with the global criteria weights. With this criteria ranking, we are able to evaluate the trust status of alternative sellers and make recommendations.

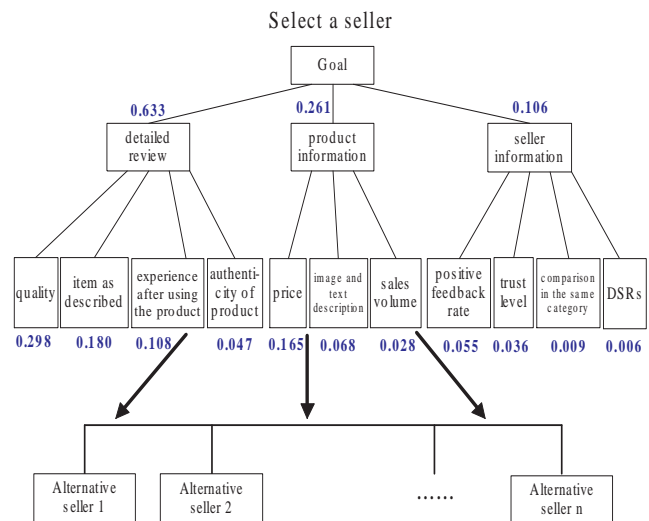


Figure 3. AHP hierarchy with the final criteria weights.

V. IMPLEMENTATION

In this section, we present the implementation of determining the importance of a variety of trust factors using analytic hierarchy process. We take China’s largest C2C e-commerce platform as an example to show the process. First, users can log in the system and specify the importance of the three main criteria: ‘‘Detailed review’’, ‘‘Product information’’ and ‘‘Seller information’’. In this

demo, the scale of absolute numbers is from 1 to 9 in the integer form. Users can specify the relative importance of one criterion over another criterion by clicking the drop-down list. After entering all the weights, we are able to obtain the relative ranking of the main criteria (See Figure 4).

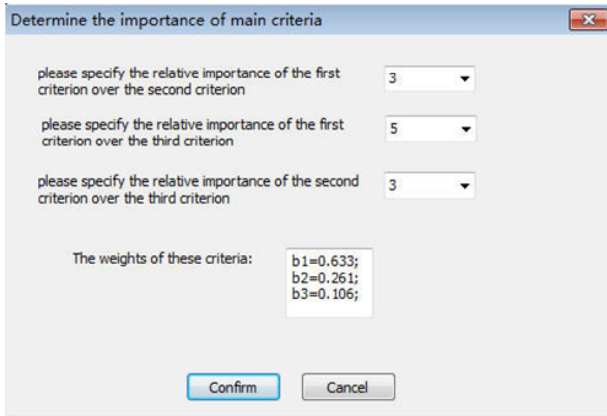


Figure 4. Determine the importance of main criteria.

Afterwards, we need to obtain the weights of each sub-criterion. According to the survey results, there are four subcriteria under the main criteria “Detailed review”, and there are three subcriteria under the main criteria “Product information”, and there are four subcriteria under the main criteria “Seller information”. Similarly, users can specify the relative importance of one sub-criterion over another sub-criterion. The system will return the corresponding weights of each sub-criterion. Figure 5 shows the interface of determining the importance of subcriteria under the main criteria “Detailed review”.

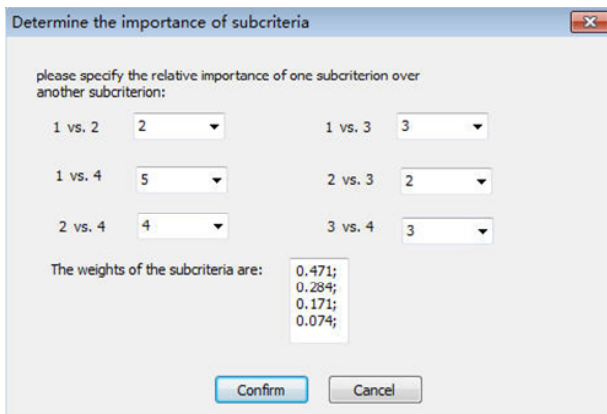


Figure 5. Determine the importance of subcriteria.

Then the system will measure the consistency of the judgement and calculate the global weights. The final results are showed in Figure.

VI. CONCLUSIONS AND FUTURE WORK

In this article, we mainly focus on two urgent problems of current C2C e-commerce platforms in China: trust is easily manipulated by defrauders and trust dimensions

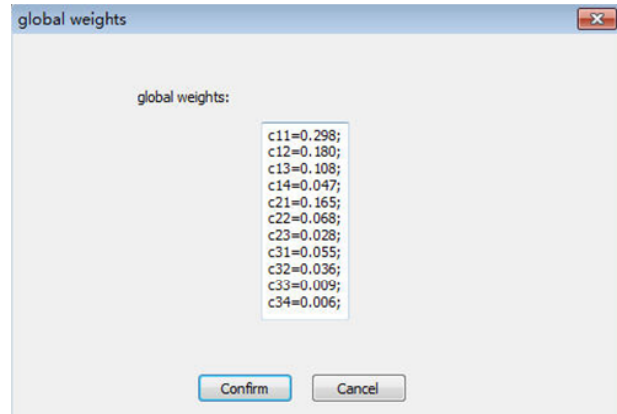


Figure 6. The results of global weights.

prove insufficient. To solve these problems, we propose to build a dynamic trust model which integrates a variety of trust factors to replace current static accumulated trust model. In this paper, we concentrate on how to integrate various trust factors of C2C e-commerce platforms and determine their corresponding weights. The general idea is to provide a more comprehensive trust evaluation method and deter trust fraud to the greatest degree. Using this method, e-commerce platforms manage to offer reliable recommendations for buyers to make purchase decisions. Compared with previous work, we combine a variety of trust factors which were more or less ignored before. We also make use of concrete survey results of Taobao buyers rather than experts’ knowledge to determine the relative importance of these trust factors. Therefore, our proposed method yields a practical solution to the current trust problems.

In the future, we will conduct thorough research on other factors of the dynamic trust model, such as time decay coefficient, transaction amount weight, and buyers’ trust status, etc. We will perform complete tests on the dynamic trust model using large scale data from Taobao to verify its effectiveness and efficiency.

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