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Toward a ranking strategy for e-commerce products in an e-alliance portal using Primitive Cognitive Network Process

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Abstract

E-alliance is the platform of promoting e-commerce products. An efficient approach to evaluate and rank the suitable e-commerce products is essential for the business value of an e-alliance portal, where the business partners or consumers efficiently search the best fit e-commerce products for their transaction in internet. This paper proposes the Primitive Cognitive Network Process for the ranking strategy considering multiple criteria and alternatives.

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Keywords: Multiple Criteria Decision Making; Cognitive Network Process; E-commerce; E-alliance; Ranking Strategy

1. Introduction

The E-alliance portal attracts the company to shift their marketing into internet as e-commerce form. E-commerce is any form of business transaction in internet rather than by physical contact. Generally, transaction types of e-commerce can be classified as business-to-business (B2B), business-to-consumer (B2C), consumer-to-consumer (C2C), consumer-to-business (C2B).

Many e-commerce websites are established in the internet, but the process finding right products in the e-commerce websites based on web search engines such as Google and Yahoo could requires tedious work and be time-consuming. Besides, most SME e-commerce websites are difficult to complete with the large-scale e-commerce firms. One useful approach is to join E-alliance which is the platform to promote e-commerce product transactions. Product and services information of e-commerce websites can be marketed in the form of e-alliance.

How information of e-commerce products is researched, ranked and displayed is challenging in e-alliance portal, as multiple factors and alternatives have to be considered in balance. The Analytic Hierarchy Process [1-2] is one of the solutions, for example, [3-10]. This paper proposes the primitive cognitive network process (P-CNP) [11-13] to address this issue.

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The P-CNP is the ideal alternative of the popular decision technique, Analytic Hierarchy Process (AHP). The P-CNP uses paired interval/differential scale instead of AHP's paired ratio scale potentially producing misapplications. The P-CNP addresses the fundamental problem of the AHP regarding the perception and cognition toward the semantic representation (or numerical form) for the syntactic form (or linguistic form) in the rating scale. The P-CNP is introduced for ranking strategy in E-alliance portal in the next section.

2. Ranking strategy in E-alliance portal

The Primitive Cognitive Network Process [11-13] is proposed for the ranking strategy of e-commerce products in E-alliance portal, and is presented as follows.

Step 1: Problem Cognition Process

The ranking strategy problem is constructed as the measurable structural assessment network shown in Fig 1. It is assumed that three E-commerce products T_1, T_2, T_3 should be evaluated from the search results in the E-alliance portal, and four criteria are used: price (C_1), quality (C_2), fitness (C_3), services (C_4). The rating scale is set to be $\left\{\frac{-8\kappa}{8},\ldots,\frac{-1\kappa}{8},0,\frac{1\kappa}{8},\ldots,\frac{8\kappa}{8}\right\}$, representing {"extremely less important than", …. , "weekly less important than", "equal to", "weekly more important than", … , "extremely more important than"}, and $\kappa = 8$ is set. The objective is to evaluate and rank the e-commerce product in the E-alliance portal.

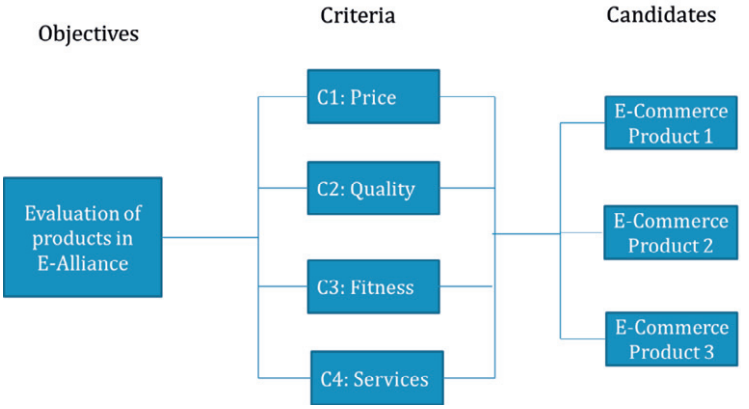

Fig. 1. *E-Alliance Evaluation Model*

Step 2: Cognitive Assessment Process

Cognitive Assessment Process includes two main activities: assessing criteria weights, and evaluating alternatives of each criterion.

The criteria importance is assessed by a form presented in Fig.2, and then cognitive pairwise comparisons for the criteria importance are formed in Table 1. For example, if we say C_1 is more moderately plus than C_2, the mathematical expression is $C_1 - C_2 = 3$. Similarly, other factors in the upper triangle of the Table 1 are compared, and then the opposite values (negation of the upper triangle) are shown in the lower triangle of the table correspondingly.

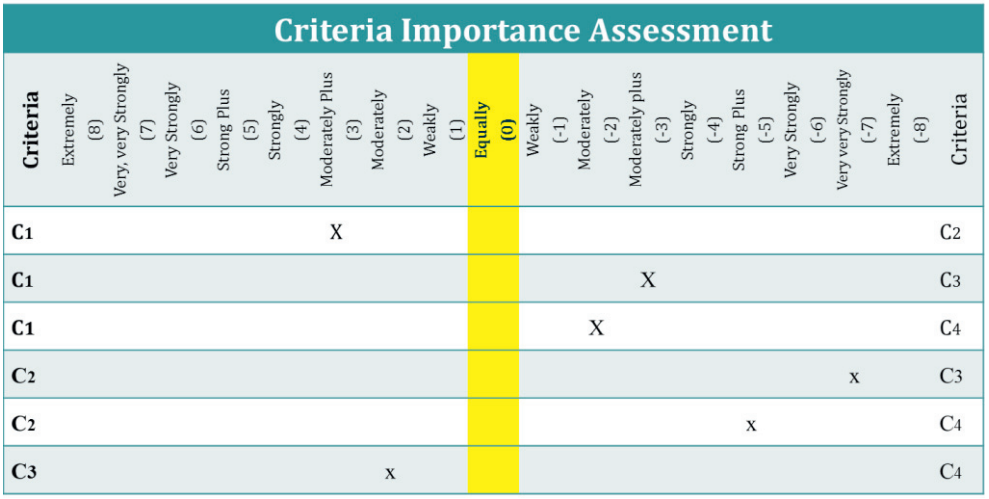

Fig. 2. Criteria Importance Assessment

Table 1. Cognitive pairwise matrix for the importance of criteria

Importance of Criteria				
	C_1	C_2	C_3	C_4
C_1	0	3	-3	-2
C_2	-3	0	-7	-5
C_3	3	7	0	2
C_4	2	5	-2	0
		AI=0.0422		

The validity of cognitive pairwise matrix B is checked by the Accordance Index (AI) of the below form.

$$AI = \frac{1}{n^2}\sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n} d_{ij}}\ ,$$

$$d_{ij} = \sqrt{Mean\left(\left(\frac{1}{\kappa}\left(B_i + B_j^T - b_{ij}\right)\right)^2\right)},\ i, j \in (1,\ldots,n) \quad (1)$$

$AI \geq 0$, and κ is the normal utility, and equal to 8 in this case. If $AI = 0$, then B is perfectly accordant; If $0 < AI \leq 0.1$, then B is satisfactory. If $AI > 0.1$, then B is unsatisfactory . AI of Table 1 is 0.0422 and is within the acceptable range.

The next step is to rate each e-commerce product for each criterion. Fig. 3 shows how e-commerce product 1 under each criterion is evaluated. The rating scores for each product with respect to each criterion are shown in Table 2.

E-commerce Product 1	Missing (1)	Very Weak (2)	Weak (3)	Fair (4)	Good (5)	Very Good (6)	Excellent (7)
C1 : Price							X
C2 : Quality			X				
C3 : Fitness		X					
C4 : Services						X	

Fig. 3. Direct Rating for E-commerce product 1 for each criteria

Table 2. Rating scores for each product with respect to each criterion

	C_1	C_2	C_3	C_4
E-Commerce Product 1	7	3	2	6
E-Commerce Product 2	5	5	5	5
E-commerce Product 3	6	4	6	6

Step 3: Cognitive Prioritization Process

Several prioritization methods have been proposed in [11-13]. Row Average plus the normal Utility (*RAU*) is chosen as the prioritization method due to its simplicity. *RAU* is given by:

$$RAU(B,\kappa)=\left[v_i : v_i=\left(\frac{1}{n}\sum_{j=1}^{n} b_{ij}\right)+\kappa, \forall i \in \{1,\ldots,n\} \right] \quad (2)$$

The individual utility v_i from POM is rescaled (or normalized) as a normalized priority vector by the rescale function of the normalization function, and has the form.

$$W=\left\{ w_i : w_i=\frac{v_i}{n\kappa}, \forall i \in \{1,\ldots,n\} \right\}, \text{ which } \sum_{i\in\{1,\ldots,n\}} v_i = n\kappa \quad (3)$$

W is the special case of V such that $n\kappa=1$.

Table 3. Cognitive Prioritization results by RAU

	C_1	C_2	C_3	C_4	Average	RAU (or V)	W
C_1	0	3	-3	-2	-0.5	7.5	0.234
C_2	-3	0	-7	-5	-3.75	4.25	0.133
C_3	3	7	0	2	3	11	0.344
C_4	2	5	-2	0	1.25	9.25	0.289

The prioritization result of the cognitive pairwise matrix of Table 1 is presented in Table 3. Product fitness (C_3) is of the highest weight and product quality (C_2) is of lowest weight. Product services (C_4) has more

importance than price attraction (C_1).

Step 4: Granular fusion and ranking

The aggregation and ranking results are shown in Table 4. The aggregation method uses the popular weighted arithmetic mean, given by $wam(W,V) = \sum_{i=1}^{n} w_i v_i$. W is the weight vector of all criteria, and V is the utility vector of a candidate with respect to each criterion. According to the ranking result, the search engine displays the search result in order: product 3, product 2, and product 1.

Table 4. Granular fusion and ranking result

	Price attraction	Product Quality	Product Fitness	Product Services	Granular Fusion	Rank
Weight	0.234	0.133	0.344	0.289		
Product 1	7	3	2	6	4.461	3
Product 2	5	5	5	5	5	2
Product 3	6	4	6	6	5.734	1

3. Conclusion and Future study

This article proposes ranking strategy for e-commerce products in an e-alliance portal using Primitive Cognitive Network Process. The future study will extend with four core components: collective evaluation, rich number of candidates, comprehensive criteria, and the hybrid approaches with fuzzy theory, TOPSIS, ELECTRE, PROMETHEE, or Data Envelope Analysis.

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