



B2B Customer Value Evaluation System Based TOPSIS with the Integrated Weight by AHP and Entropy

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ABSTRACT

Proper customer value evaluation is one of the foundations of Customer Relationship Management (CRM). It is a hot and challenge topic to design a good workable evaluation system. So far, most of the customer value evaluation is not quantitative, but qualitative based on manager experience and judgment. This paper designs a new value evaluation system based on TOPSIS, with the integrated weight by AHP subjective weighting and Entropy objective weighting. Customer value is measured and ranked by TOPSIS method, which presents the importance of the customer. This evaluation system is helpful for the supplier company to find out the proper key accounts and do good customer segmentation. In addition, an empirical case study is used to exemplify the approach, which shows this system is efficient and its procedure is workable.

Keywords: B2B market, Customer value evaluation system; AHP; TOPSIS, Entropy.

1. INTRODUCTION

Customer relationship management is an important part of modern business management, and customer value evaluation is one of its foundations. Customer Value (CV) refers to the value of this customer to the supplier within its whole lifetime, including not only financial revenues but also other benefits to the supplier. Customer value evaluation and customer segmentation accordingly is the core base of customer relationship management. Scientific customer value evaluation and proper customer segmentation, will help the company optimize the allocation of limited resources, and enhance the company competitiveness. So it is so important for a company to have a good customer value evaluation system.

(Millman 1996) defined key accounts in B2B market, as important customers with an important strategic benefit to the suppliers [1]. In B2B market, there are much fewer customers for every supplier, and each customer contributes a big amount of turnover to the company. So it is necessary to deeply study them, and work out the proper management strategy to maximize the value of key accounts. At the same time, compared with B2C market, B2B market has fewer customers. So research on customers individually is possible and valuable.

Besides traditional financial indexes, this paper introduces Strategic Fit (or called: Strategic match), then suggests a new Customer value evaluation system. The weight of each index is integrated from both AHP subjective weight and Entropy objective weight. Then TOPSIS methodology is used to measure the quantitative value of each customer, which will be ranked in the end, to show the importance of each customer.

In addition, an empirical case study is used to exemplify the approach, which shows this system is efficient and its procedure is workable.

2. LITERATURE REVIEW

2.1 Customer value evaluation based on customer lifetime valueon

Gupta et al. (2003) pointed out, Customer Lifetime Value (CLV) of a customer, is all the profits the company gets from this customer during the whole customer lifetime. Customer lifetime is the whole period from the customer is pursued by the company, build up formal business cooperation, till the end of this cooperation. This evaluation method is widely used in finance, insurance, retail, IT and other industries, in order to segment the customers the offer proper products and services [2, 3].

There are several methods to calculate Customer Lifetime Value (CLV), and RFM model is one of the most common one. This model is based on customer past purchasing behavior, purchase potential amount, frequency, amount, and the time value of money. The future income will also be discounted into current net value. Customer lifetime value is the sum of current net value of all the potential profit (profit = income – cost) in the whole customer lifetime [4]. The formula is as follows,

Among them:

CLV:Customer Lifetime Value

i: index in lifetime period

d: discount rate

n: the length of whole lifetime

Ri: Income at period (i)

Ci: Cost at period (i)

In theory, companies can calculate the CLV of each customer, and bigger CLV represent higher importance. However, in practice, the cost of business is difficult to be objectively allocated to each customer. So it is not workable to accurately calculate the CLV value of each customer. In addition, the model assumes no change on the cooperation and relationship with the customers. However, in fact, the market is always changing, which is not considered into this customer value evaluation method.

2.2 Customer value evaluation based on customer current value and potential value

Chen Mingliang (2001) argued that what companies really care about is future profit, and believed CLV should be total net value of all the future profits. Customer's current value and potential values reflect this future profit from different aspects [5]. Based on Customer lifetime profits, Jin Leifa (2010) divided customer value into two parts, Customer current value (Net value of all the profits the customer will create under current purchasing behavior) and Customer potential value (Net value of additional value the customer will create if the customer change its purchasing behavior affected by the supplier's proper customer relationship maintaining strategy) [6].

Quan MingFu et al. (2004), not only studied Customer value (including Customer current value and Customer potential value), but also further studied the measure methodology of Customer current value and Customer potential value. Since direct calculation method is not that workable, they raised the new indirect method to evaluate Customer value [7]. Its evaluation system is shown in Figure 1

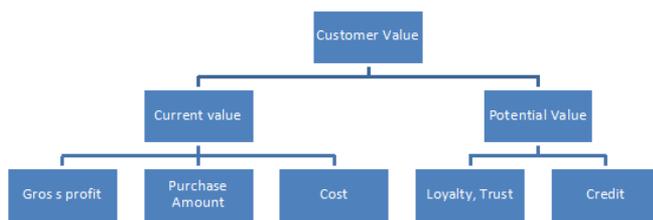


Figure 1. Quan Mingfu et al. Customer Value Evaluation system

2.3 Customer value evaluation based on Current value, Potential value and Loyalty

Hyunseok Hwang, Taesoo Jung, Euiho Suh (2004) added "Customer loyalty" into the Customer value evaluation system, and argued that the customer with higher loyalty had more customer value [3]. Xia Wei and Wang Qingsong (2006) improved the "Customer current value" in above Customer value evaluation system. Considering the changing market surroundings, they divided the Customer Lifetime into two parts, certain past and uncertain future. Accordingly, Customer value was divided into two parts as well, historical value in the past and expected value in future [8].

2.4 B2B Customer value evaluation based on Current value, Potential value and Strategic Fit

Xu Yafu (2015) compared B2B market and B2C market, and pointed out that Strategic Fit between the customer and the supplier, in B2B market, is one of a key element for the customer value. The more the customer's strategy fit the supplier's strategy, the more value of this customer for the supplier. He replaced Customer loyalty with Strategic fit for customer value evaluation in B2B market [9].

3. B2B CUSTOMER VALUE EVALUATION SYSTEM (B2B CVES)

Based on the study of Xu Yafu (2015) on B2B Customer value Evaluation, this paper raised the new B2B Customer value Evaluation System (abbreviated name: B2B CVES). This evaluation system is built up with three main dimensions, Customer current value, Customer potential value and Strategy Fit, to evaluate the customer value. The main procedure is shown as follows in Figure 2,



Figure 2. Procedure of B2B Customer Value Evaluation System

3.1 Build up index system

(1) Customer current value

Customer Current value refers to customer Past Profit Contribution (PPC), which is total net value of the profits this customer contribute to the company till now [8]. In principle, direct calculation is possible to just discount all the past profits to now. However, it is difficult to allocate the cost accurately to each customer, so the actual profit is also hard to accurately get. In this paper, Customer current value is measured by two elements, Purchase amount and Gross margin. Purchase amount represents the size of the customer's purchase. Gross margin is the ratio of gross profit of total purchase amount, reflecting the contribution of the enterprise customer profitability. Management costs jointly shared by all customers are essentially the same for each customer. Normally, the management cost on each customer should be different but the difference should be not big. To make the evaluation simple, we ignore this small difference on management cost among customers. Therefore, the two indicators, Purchase amount and gross margin, are able to indicate the customer current value.

(2) Customer potential value

Customer potential value is customer's Expect Future Profit Contribution (FPC), referring to the total future profit of the customer will bring to the company [8]. In future, Customer may increase the quantity of existing products, may use existing products into more areas, may introduce their products to other new customers, and also may help the company (supplier) to increase the reputation in the industries. Customer potential value can also be obtained from both direct and indirect way. However, direct calculation is not that workable because it is hard to forecast the future business

accurately. In this paper, market share and business growth rate are used to measure Customer potential value. Among them, the market share refers to the share of customers in their industry, which represents customer's position and its influence in the industry. The customer with higher market share will have more potential value for the supplier. Annual business growth rate represents the customer's business prospects and possible future cooperation opportunities.

(3) Strategic Fit

Strategic Fit, or called Strategic Match, refers to the strategy consistency between the customer and the supplier when they go for competition advantage [10]. In B2B market,

buyers and sellers are both organizations, so the strategy consistencies between both have serious effect on their cooperation. In B2C market, Customer loyalty is used to present the wish of the customer to buy from the supplier. In B2C market, Strategic Fit is more suitable to represent customer's wish for further cooperation with the supplier [9]. This paper follows the definition of the strategic fit of Fred R. David. Strategic fit will be measured by two parts, Strategy fit on management policies and Strategic Fit on operation procedure. Strategic fit determines the depth of cooperation between the customer and the supplier.

Figure 3 shows the indexes of above B2B Customer Value Evaluation,

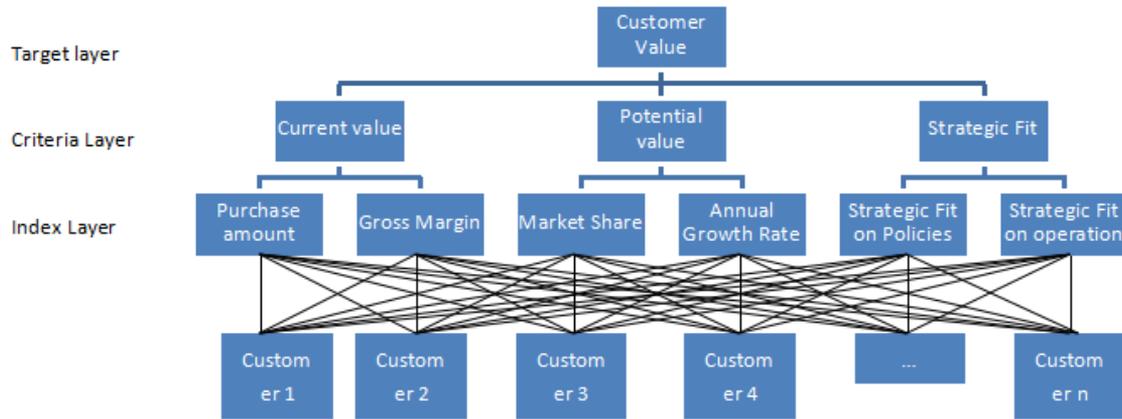


Figure 3 B2B Customer Value Evaluation Index system

3.2 Collect data

Criteria, including Current value, Potential Value and Strategic Fit cannot be measured directly. So they must be measured indirectly by the related indexes in the next layer (Index Layer).

1) Purchase amount: The total amount of a certain customer purchases from the company, which reflects the purchase scale. This kind of data will be recorded in each company normally, in financial or sales department.

2) Gross Margin: Gross margin out of total purchase amount, which presents the profits situation. This data is kept in the company, in financial or sales department.

3) Market Share: The percentage of the customer's sales turnover out of the total amount of their industry, which presents the position and influence of this customer in their industry. This data might be in industry analysis report or internal/external market survey.

4) Annual business growth: Year to year business growth rate, which presents the sustainability of the business. This data should be in internal report or industry analysis report.

5) Strategic Fit on management policies: Strategy consistency on policies between the customer and supplier. Higher fit means more opportunities for future cooperation. This data could be scored by experts or managers based on the policies of both the customer and the supplier.

6) Strategic Fit on operation: Strategy consistency on operation procedure of both the customer and the supplier. Higher fit means more smooth cooperation between both companies. This data could be scored by experts or managers based on the operation procedures of both the customer and the supplier.

3.3 Determine index weight

To avoid human subjective impression and too much impact by some obvious untrue objective data, this paper determines the index weight through both AHP and Entropy method. The average of AHP weight and Entropy weight will be the Comprehensive weight of the indexes in this new Three-dimension Customer value evaluation system.

Analytic Hierarchy Process (AHP) was developed by T.L Saaty from the University of Pittsburgh USA in the 1970s, which is used to turn qualitative analysis into quantitative calculation, considering the experiences of the experts.

The principle of Entropy method is to evaluate the information of each unit then determine the importance (Weight) of each unit. Together with AHP, Entropy method will be introduced in detail during the case study in the next paragraph.

3.4 Measure customer value by TOPSIS method

TOPSIS method is the abbreviation of Technique for Order Preference by Similarity to Ideal Solution. The core idea of TOPSIS method is to find out the best option and the worst option from various options of a question, to check the distance from each option to the best option and the worst option, and then to rank all the options comparing individual distance to the best option. The option in the front will be better than those behind [11].

In this paper, each Customer value will be calculated and ranked by TOPSIS method. The customer in the front (with higher Topsis value) will have more customer value than the customer afterwards.

3.5 Analyze and finalize customer value evaluation system result

According to TOPSIS calculation result, all the customers will be ranked based on their customer value, from high score to low. At the same time, there might be some facts are not considered into this Customer value evaluation system. So it is

worthwhile to compare the result with the real business situation, then work out the most reasonable Customer value rank. The key accounts will be in the front.

Figure 4 shows the whole procedure of above-mentioned of this Customer Value Evaluation System,

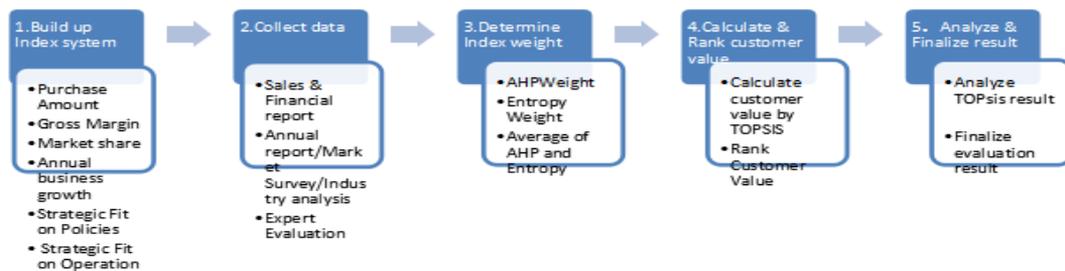


Figure 4. Procedure of Customer Value Evaluation

4. CASE STUDY

E Company is one of a key supplier in Personal care industries, whose products are widely applied for cosmetics manufactures like P&G, L’Oreal, and so on. E company has more than 100 regular customers, so it is worthwhile to check the value of each customer and find out the key accounts. The new B2B Customer Value Evaluation System is used in this case study.

4.1 Build up index system

E Company supplies chemicals raw material for cosmetics manufactures, and the market is typical B2B Market. So, B2B Customer Value Evaluation Index System in Figure 3 is

suitable for this case study. E company has more than 80 customers in personal care industry. Top 20 customers, in terms of market share (according to the data source from Euromotior 01st Aug 2015), are selected into this study.

4.2 Collect data

The data on Purchase amount and Gross margin are from E Company. Business growth rate is from annual report of each customer and public industry report. Market share is from Euromotior data base. Strategic Fit on Management policies and on Operation are scored by 5 experts in E company, who know this market and those customers very well.

Customer 1 to Customer 20 stand for those 20 selective customers. All the data about those customers are collected in Table 1eprent,

Table 1. Top 20 Personal Care Customers in terms of market share 2014

Index	Purchase Amount 2014	Gross Margin	Business growth rate 2014 v.s.2013	Market Share 2014	Strategic fit on Management policies	Strategic Fit on Operation
(Unit)	1, 000 CNY	(%)	(%)	(%)	(1-9)	(1-9)
Customer 1	11, 000	10	1.6	16.8	5	4
Customer 2	13, 500	18	13.5	12.7	8	7
Customer 3	300	25	6.5	4.8	3	1
Customer 4	5, 200	9	0.01	4.4	5	7
Customer 5	7, 200	25	17.7	4.1	7	7
Customer 6	900	30	7.3	3.7	3	5
Customer 7	800	30	0.01	3.3	3	7
Customer 8	12, 000	17	0.01	2.8	7	9
Customer 9	400	35	9	2.6	1	5
Customer 10	18, 000	16	3.7	2.6	7	9
Customer 11	1, 300	21	15.1	2.5	5	5
Customer 12	1, 200	25	14.8	2.1	7	5
Customer 13	1, 300	25	12.9	2.0	7	5
Customer 14	900	26	25.1	1.9	7	3
Customer 15	400	35	12.5	1.6	3	3
Customer 16	15, 000	28	14.9	1.5	9	7
Customer 17	23, 000	19	16	1.5	7	9
Customer 18	800	28	18.5	1.4	7	5
Customer 19	1, 200	21	0.2	1.4	7	5
Customer 20	1, 200	27	4.3	1.4	5	3

Data source:

Purchase Amount & Gross Margin: From Sales department of E Company.

Annual Business growth & Market Share: From Euromonitor (download: 01st August 2015 Strategic fit on Management policies & Strategic Fit on Operation: Score from experts and managers of Evonik. (1-low fit, 9-high fit)

1) Index weight by AHP

Five experts compare the importance of each index with all the other five, and decide the comparison scores, shown in Table 2. $M(j)$ equals the multiply result of the total score in one certain row. $W(j)$ is sixtic root of $M(j)$. AHP weight will be got from the normalization of $W(j)$. The comparison score from the experts and the calculation results are shown in Table 2.

4.3 Determine index weight

Table 2. Index Score from experts and the calculation result of AHP Weight

Index	Purchase amount 2014	Gross Margin	Market Share	Annual growth 2014 v.s. 2013	Strategic Fit on Policies	Strategic Fit on Operation	M(j)	W(j)	AHP weight
Purchase amount 2014	1	3	1	2	2	3	36.000	1.8171	0.2737
Gross Margin	1/3	1	1/2	1/2	1/2	1	0.042	0.5888	0.0887
Market Share	1	2	1	2	2	3	24.000	1.6984	0.2559
Annual growth 2014 v.s. 2013	1/2	2	1/2	1	1/2	1	0.250	0.7937	0.1196
Strategic Fit on Policies	1/2	2	1/2	2	1	2	2.000	1.1225	0.1691
Strategic Fit on Operation	1/3	1	1/3	1	1/2	1	0.056	0.6177	0.0931

Note: CR=0.018, <0.1. Pass consistency check.

2) Index weight by Entropy Method

Entropy weight of each index will be there after a series of calculation on the data of Table 1, for example

Standardization, Normalization, and so on. The Entropy weight is shown in Table 3.

Table 3. Calculation result of Entropy Index Weight

Index	Purchase amount 2014	Gross Margin	Market Share 2014	Annual growth 2014 v.s. 2013	Strategic Fit on Policies	Strategic Fit on Operation
E(j)	0.7812	0.9840	0.8807	0.8823	0.9743	0.9730
D(j)	0.2188	0.0160	0.1193	0.1177	0.0257	0.0270
Entropy Weight	0.4172	0.0305	0.2275	0.2244	0.0490	0.0514

3) Comprehensive weight of each index is the average of AHP and Entropy weight, from Table 2 and Table 3 individually, shown in Table 4.

Table 4. Comprehensive Weight from AHP and Entropy Weight

Index	Purchase amount 2014	Gross Margin	Market Share 2014	Annual growth 2014 v.s. 2013	Strategic Fit on Policies	Strategic Fit on Operation
AHP Weight	0.2737	0.0887	0.2559	0.1196	0.1691	0.0931
Entropy Weight	0.4172	0.0305	0.2275	0.2244	0.0490	0.0514
Comprehensive Weight	0.3455	0.0596	0.2417	0.1720	0.1090	0.0722

4.4 Measure customer value by TOPSIS method

After Standardization, Normalization, the data in Table 1 will multiply the Comprehensive weight in Table 4, to get the

result in Table 5. A^* is the maximum data of each column, and A^- is the minimum data of each column, as shown in Table 5.

Table 5. TOPSIS Calculation Result

Index	Purchase amount 2014	Gross Margin	Market Share	Annual growth (2014/2013)	Strategic Fit on Policies	Strategic Fit on Operation
(Unit)	1, 000 CNY	(%)	(%)	(%)	(1-9)	(1-9)
Customer 1	0.0329	0.0013	0.0020	0.0384	0.0048	0.0026
Customer 2	0.0403	0.0023	0.0168	0.0290	0.0077	0.0046
Customer 3	0.0009	0.0032	0.0081	0.0109	0.0029	0.0007
Customer 4	0.0155	0.0011	0.0000	0.0101	0.0048	0.0046
Customer 5	0.0215	0.0032	0.0221	0.0094	0.0068	0.0046
Customer 6	0.0027	0.0038	0.0091	0.0084	0.0029	0.0033
Customer 7	0.0024	0.0038	0.0000	0.0075	0.0029	0.0046
Customer 8	0.0359	0.0022	0.0000	0.0064	0.0068	0.0059
Customer 9	0.0012	0.0044	0.0112	0.0060	0.0010	0.0033
Customer 10	0.0538	0.0020	0.0046	0.0059	0.0068	0.0059
Customer 11	0.0039	0.0027	0.0188	0.0058	0.0048	0.0033
Customer 12	0.0036	0.0032	0.0185	0.0049	0.0068	0.0033
Customer 13	0.0039	0.0032	0.0161	0.0046	0.0068	0.0033
Customer 14	0.0027	0.0033	0.0313	0.0043	0.0068	0.0020
Customer 15	0.0012	0.0044	0.0156	0.0036	0.0029	0.0020
Customer 16	0.0448	0.0036	0.0186	0.0035	0.0087	0.0046
Customer 17	0.0687	0.0024	0.0200	0.0033	0.0068	0.0059
Customer 18	0.0024	0.0036	0.0231	0.0033	0.0068	0.0033
Customer 19	0.0036	0.0027	0.0002	0.0032	0.0068	0.0033
Customer 20	0.0036	0.0034	0.0054	0.0032	0.0048	0.0020
A*	0.0687	0.0044	0.0313	0.0384	0.0087	0.0059
A-	0.0009	0.0011	0.0000	0.0032	0.0010	0.0007

Calculate the Customer value of each customer, according to the distance to the maximum (A*) and the minimum (A-). And the importance of each customer will be ranked according to the value of each customer (Ci), from high to

low. The formula is as follows, and the result is shown in Figure 6.

- : Customer Value of Customer(i)
- : The distance from Customer(i) to the A-
- : The distance from Customer(i) to the A*

Table 6. Customer Rank list according to TOPSIS Result (from high to low)

Rank	Customer	Ci	Purchase amount 2014	Gross Margin	Market Share 2014	Annual growth 2014 v.s. 2013	Strategic Fit on Policies	Strategic Fit on Operation
			1, 000 CNY	(%)	(%)	(%)	H-L	H-L
1	Customer 17	0.6580	23, 000	19	16.00	1.45	7	9
2	Customer 2	0.6033	13, 500	18	13.50	12.65	8	7
3	Customer 10	0.5458	18, 000	16	3.70	2.59	7	9
4	Customer 16	0.5233	15, 000	28	14.90	1.52	9	7
5	Customer 1	0.5059	11, 000	10	1.60	16.75	5	4
6	Customer 8	0.3927	12, 000	17	0.01	2.79	7	9
7	Customer 5	0.3602	7, 200	25	17.70	4.08	7	7
8	Customer 14	0.3007	900	26	25.10	1.89	7	3
9	Customer 18	0.2417	800	28	18.50	1.44	7	5
10	Customer 11	0.2121	1, 300	21	15.10	2.54	5	5
11	Customer 12	0.2107	1, 200	25	14.80	2.13	7	5
12	Customer 4	0.2007	5, 200	9	0.01	4.40	5	7
13	Customer 13	0.1917	1, 300	25	12.90	2.02	7	5
14	Customer 15	0.1714	400	35	12.50	1.59	3	3
15	Customer 9	0.1364	400	35	9.00	2.62	1	5
16	Customer 6	0.1309	900	30	7.30	3.68	3	5
17	Customer 3	0.1304	300	25	6.50	4.77	3	1
18	Customer 20	0.0880	1, 200	27	4.30	1.38	5	3
19	Customer 19	0.0808	1, 200	21	0.20	1.41	7	5
20	Customer 7	0.0790	800	30	0.01	3.27	3	7

4.5 Analyze and finalize customer value evaluation system result

The evaluation result in Table 6 is very close to actual situation, so this new B2B Customer Value Evaluation System is reasonable and workable. At the same time, there are also some small deviation, which seems not be line with the actual situation. In fact, this is the additional value of this new system, which will remind the managers to further investigate the reason behind then finally decide the proper rank. For example,

1) In fact, Evonik defines six key accounts according to their own method and experience, Customer 17, Customer 2, Customer 10, Customer 1, Customer 4, and Customer 8. Five customers of them are also in the Top 6 list according to B2B Customer Value Evaluation System. This proves this new system is quite close to the real business situation. At the same time, Customer 4 belongs to actual key accounts of E company but is in the No. 12 according to Evaluation system result, mainly due to its low market share (only 0.01% in the industry) and low Strategic Fit on management policy with E-Company. After communication and further investigation, E Company also agrees on the result of this evaluation system, and will decrease the importance of customer 4.

2) Customer 16 is not the key account of E company, however it ranks no. 4 according to this B2B Customer Value Evaluation System. Main reason is that high Strategic Fit between Customer 16 and E Company. In addition, its growth rate is high (14.9%) and the gross margin from this customer is also quite high (28%). E Company has realized the more value of this Customer 16 and will allocate more resource to develop the cooperation with this customer.

Comparing the result through this new B2B Customer Value Evaluation System and real situation of E Company, we might find out more valuable clue to improve the customer management. This new evaluation system makes it possible to work out the quantitative value then rank them easily and properly. This is very helpful for the company to find out the key accounts with more customer value and allocate proper resource on focus customers.

5. CONCLUSIONS, IMPLICATIONS AND PROSPECT

This paper points out the importance of Strategic Fit and raises the new customer value evaluation system, B2B Customer Value Evaluation System. This new evaluation system makes it possible to work out the quantitative value of each customer, and to rank them easily. This is very helpful for the company to find out the key accounts with more customer value and allocate proper resource on focus customers.

In this B2B Customer Value Evaluation System, Customer current value, Potential value and Strategic Fit are three dimensions of this system, which are measured by six indexes, Purchase amount, Gross Margin, Business growth, Market Share, Strategic Fit on policies and Strategic Fit on operation. This paper also introduces a new way for the comprehensive weight of each index, through both AHP and Entropy method, to avoid human subjective impression and too much impact by some obvious untrue objective data. In addition, an empirical case study is used to exemplify the approach, which shows this system is efficient and its procedure is workable.

Customer value evaluation is one of a hot and hard topic in

both academic and business world, because there are many facts affecting the customer value. Moreover, some facts seem very reasonable but difficult or even impossible to get the related data. Just due to this kind of reason, this paper ignores the cost difference on various customers and assumes the cost ratios of each business is the similar for all customers. In fact, this assumption is not accurate in real business situation. Further study is necessary to improve this customer value evaluation system.

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