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A Model of Customer Lifetime Value Consider with Word-of-mouth Marketing Value

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ABSTRACT

With the rapid development of IT technology and fierce competition of market, the customer relationship management(CRM) has gained its importance in the market. Companies have attached importance to acquiring and retaining the most profitable customers. So calculating customer's value is a significant segment for every effective CRM. Many researches have been performed to calculate customer's value based on customer lifetime value (LTV). But, these calculations can't effectively include the whole customer value, especially for the word-of-mouth marketing value. This paper proposes a new LTV model which considers the customer's past profit contribution, potential value and word-of-mouth marketing value, and gives a more reasonable LTV value in CRM for the company to make a decision.

Keywords: Customer Relationship Management, Customer Lifetime Value, Word-of-Mouth Marketing Value

1. INTRODUCTION

Customer Relation Management（CRM）is a strategy used to comprehend and influence customers' behaviors through effective communication in order to improve the customers' acquisition, retention and loyalty and achieve profitable growth ultimately [1].One hot topic in CRM research is how to measure customer value, as the accurately calculating of customer value is the groundwork of identifying and classifying target customers effectively, and it is also the key factors of success of CRM. Customer value is studied through customer equity, customer profitability and lifetime value. In this paper we consider the customer values as the total benefit for corporation during customers' lifetime, namely, LTV—Customer Lifetime Value [2]. There are already several definitions of LTV, we take Frederick Newell's [3] here and amend it as:

LTV is, which follows along with the time continuing, the revenues gained from the customers (individual, family or middleman) after the deduction of the total cost of attracting, selling, and servicing customers, and discounted to the present.

It was generally accepted that customer value comprises customers' present value, potential value and loyalty, but we do think the value of world-of-mouth communication is an important component of customer value. Corporations can be benefited as customers recommend productions or services to their friends or family members through world-of-mouth communication way, considering that customers depend more on informal information sources such as acquaintances during decision-making of purchasing [4-5]. According to a tailed survey to retailing conducted by a Japanese investigating company, 80% saleroom is from present customers, and 60% new customers are from commends of present customers [3]. Google is a good example: it holds a great deal of users with few commercial advertisements [6], showing the effectiveness of world-of-mouth communication. Therefore, considers the customer value from four aspects includes current value, potential value, customer loyalty and communication value would be better to indicate the true connotation of LTV.

So, based on the Hyunseok Hwang's conceptual framework of CRM [7], a CRM conceptual framework based on LTV is shown in Fig.1.
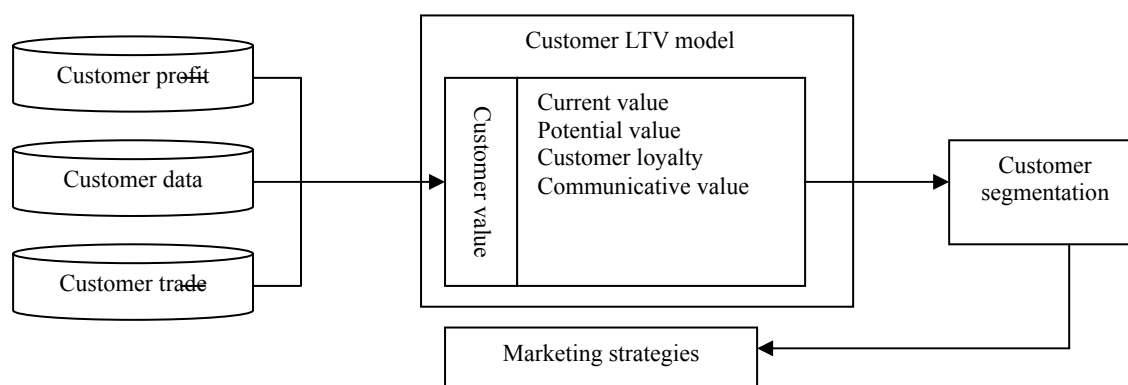

Fig.1. CRM framework based on LTV

Fig. 1 reflects main flow of CRM and the important roles of customer value composing and measure in CRM. Although the measure of LTV is a key factor of CRM, but most corporations haven't got LTV data so far. One important reason of this situation is the complexity of factors, which can influence calculating of LTV. This paper reviewed past LTV models and analyzed factors which influence LTV, proposed a new LTV model considers the customer's past profit contribution, potential value and word-of-mouth marketing. This model can gives a more reasonable LTV value in CRM for the company to make a decision, and provide an academic foundation for corporations to manage customer relation better.

2. RELATED RESEARCHES ABOUT LTV

There are a lot of researches on calculating customer value, some researches, such as Huang Yixiao, try to establish an evaluation system by using neural network [8], but most researchers follow Frederick FR.'s net present value (NPV) evaluation system [3]. However most LTV models based on NPV evaluation system exist various limitations, it's difficult for them to reflect the true customer value. The basic LTV model [9] formed based on revenues of loyal customers as follows:

$$LTV = \frac{In\left\{1 - \left[\frac{1}{(1+r)^n}\right]\right\}}{r} \quad (1)$$

Where In are revenues that the corporation gain from the loyal customers, r is interest rate, n is the number of years that the customer is loyalty for the corporation. The virtue of the model is its simple calculation, and the disadvantage is that it based on the future revenues' calculation. The measure didn't consider the cost and tend to lead LTV to crossroad.

Considering this situation, Berger and Nasr（1998）have proposed LTV calculation model [7], which reflect the fluctuation of sales and costs.

$$LTV = \sum_{i=0}^{n} \pi(t) \times \frac{1}{(1+r)^i} \quad (2)$$

Where i is the period of cash flow customer transactions, n is total number of periods of projected life of the customer under consideration, and r is interest rate, $\pi(t)$ is the function of customer profits according to time t. Formulating precise $\pi(t)$ is the most important factor in calculating LTV precisely. LTV models evaluate the long-term value of customers focused on the entire lifetime of customers, however, the long-term value does not fit for the industry having stiff competitions and rapid changes of market environments, the wireless communication industry is good example, which are very sensitive to the external environments and the customer defections. Customer defection is also a critical issue of LTV model because it affects the length of service period and the future profit generation.

Therefore, Hyunseok Hwang suggest a LTV model considering churn rate [7]:

$$LTV_i = \sum_{t_i=0}^{N_i} \pi_p(t_i)(1+r)^{N_i-t_i} + \sum_{t_i=N_i+1}^{N_i+E(i)+1} \frac{\pi_f(t_i)+B(t_i)}{(1+r)^{t_i-N_i}} \quad (3)$$

t_i : service period index of customer i
N_i : total service period of customer i
r : interest rate
$E(i)$: expected service period of customer i
$\pi_p(t_i)$: past profit contribution of customer i at period t_i
$\pi_f(t_i)$: future profit contribution of customer i at period t_i
$B(t_i)$: potential benefit from customer i at period t_i

This model ignored the importance word-of-mouth marketing value from customers, especially in cybereconomy era, so it is also limitation for calculating the customer's value.

3. A MODEL OF LTV CONSIDERED THE WORD-OF-MOUTH MARKETING VALUE

3.1 A New LTV Model

The word-of-mouth communication has been concerned by people, for the word-of-mouth communication can increase corporations' profits by attracting the new customer for corporations. Suppose the customer i has a little profit for a corporation, but he (she) can attract many more profitable customers for the corporation by word-of-mouth communication. So the customer i should have high customer value. However the models above can't consider this situation, and therefore we propose a model as follows:

$$LTV_i = \sum_{t_i=0}^{N_i} \pi_p(t_i)(1+r)^{N_i-t_i} + \sum_{t_i=0}^{N_i} S_p(t_i)(1+r)^{N_i-t_i}$$

$$+ \sum_{t_i=N_i+1}^{N_i+E(i)+1} \frac{\pi_f(t_i)+B(t_i)}{(1+r)^{t_i-N_i}} + \sum_{t_i=N_i+1}^{N_i+E(i)+1} \frac{S_f(t_i)}{(1+r)^{t_i-N_i}} \quad (4)$$

Compare with Eq.(3), Eq.(4) adds two parts $\sum_{t_i=0}^{N_i} S_p(t_i)(1+r)^{N_i-t_i}$ and $\sum_{t_i=N_i+1}^{N_i+E(i)+1} \frac{S_f(t_i)}{(1+r)^{t_i-N_i}}$, they denote the net present value(NPV) of customer's past word-of-mouth communication and the future word-of-mouth communication respectively, where $S_p(t_i)$ is past word-of-mouth communication value of customer at period t_i, and $S_f(t_i)$ is future word-of-mouth communication value of customer at period t_i.

3.2 Calculating $S_p(t_i)$ And $S_f(t_i)$

In order to calculate the customer's word-of-mouth marketing value, we divide it into direct and indirect word-of-mouth marketing value. Suppose there is a customer i, then we define direct word-of-mouth marketing value S_0 as a profit contributed by customer i attracting new customer for corporation directly; indirect word-of-mouth marketing value S_1 means a portion profit contributed through attracting new customers for corporation by the customers those who directly attracted by customer i. Then we have:

$$S_p(t_i) = S_{p0}(t_i) + S_{p1}(t_i) \qquad (5)$$

$$S_f(t_i) = S_{f0}(t_i) + S_{f1}(t_i) \qquad (6)$$

Where $S_{p0}(t_i)$ and $S_{p1}(t_i)$ mean direct and indirect word-of-mouth marketing value of customer i at the past period t_i respectively. $S_{f0}(t_i)$ and $S_{f1}(t_i)$ mean direct and indirect word-of-mouth marketing value of customer i at the future period t_i respectively. We can calculate S_0 and S_1 as follows:

$$S_0(t_i) = m(t_i) \times c \qquad (7)$$

$$S_1(t_i) = \left\{ \left(E(X_{t_i}) - E(X_{t_{i-1}}) \right) \times p(t_i) - m(t_i) \right\} \times c \times \lambda \qquad (8)$$

Where $m(t_i)$ is the number of customers that directly attracted by customer i at period t_i, $E(X_{t_i})$ is the expect number of customers from period 0 to period t_i. And c is the cost that the corporation attracts a new customer by itself. λ is a parameter represents profit sharing ratio of indirect word-of-mouth marketing value (λ can fix on by consulting percentage take from sell profit and relational experience). $p(t_i)$ is ratio that the new customers attracted by customers in the whole new customer at period t_i, namely the ratio of attracting new customers by word-of-mouth communication，generally speaking, for different commodities, the word-of-mouth communication have different effects [10]. To calculate $S_1(t_i)$, we simplified $p(t_i)$ by p, which is a certain constant. Then $S_1(t_i)$ can be calculate by

$$S_1(t_i) = \left\{ \left(E(X_{t_i}) - E(X_{t_{i-1}}) \right) \times p - m(t_i) \right\} \times c \times \lambda \qquad (9)$$

Word-of-mouth communication has the same characters as virus spread, as a result, word-of-mouth communication marketing has been called virus marketing [11]. So we use the epidemic model [12-13] to calculate $E(X_{t_i})$, and also discrete mathematics [14] model is used to build the word-of-mouth communication model. Now we consider a group of consumers with N people in a certain region, then N means the maximum consumers can be attracted as new customers for a corporation (attracted by either customers or corporation itself). We number the group consumer with a_1, a_2, ..., a_N, and define set

$A = \{ a_1, a_2, ..., a_N \}$. The word-of-mouth communication among consumer is very complex, we simplified it here and define it as a binary relation on A, i.e. $R_A = \{ < a_i, a_j > \mid a_i, a_j \in A, i \neq j, a_i$ transmits information to $a_j \}$, we call a_i transmitter and a_j receiver in the binary relation. Then we define set $C = \{ a_i \mid a_i \in A, a_i$ has been the customer of corporation $\}$. Research is start from the beginning of the production(or service) come into group consumer A, at this time，there is a people a_i among the group consumer who buy the production(or service) and become the first customer of the corporation. Then the condition that another people a_j among the group consumers is attracted by the first people a_i can be described as:

$(< a_i, a_j > \in R_A) \cap (a_i \in C) \cap (a_j \notin C)$;

Let X_{t_i} be the number of customers of the corporation in A at period t_i, then $\{ X_{t_i}, t_i \geq 1 \}$ forms a discrete stochastic process. And $E(X_{t_i})$ is the number of the corporation's customer at period t_i, $(N - E(X_{t_i}))$ is the number of potential customers of the corporation. Then during the M times transmissions between period t_i and period $t_i + 1$, $\frac{M}{N} \times E(X_{t_i})$ is the expected number of people who are not only the transmitter but also the customer of the corporation, $M - \frac{M}{N} \times E(X_{t_i})$ is the expected number of people who are receivers but not belong to set C. According to the hypothesis and stochastic process of transmission, after the series of transmissions, $\frac{M}{N} \times E(X_{t_i}) \times \left(1 - \frac{E(X_{t_i})}{N} \right)$ is the expect number of new customer of corporation that attracted by the customer. Then we have:

$$\left(E(X_{t_i+1}) - E(X_{t_i}) \right) \times p$$
$$= \frac{M}{N} \times E(X_{t_i}) \times \left(1 - \frac{E(X_{t_i})}{N} \right)$$
$$= \frac{M}{N^2} \times E(X_{t_i}) \times \left(N - E(X_{t_i}) \right)$$

$$(10)$$

Let

$$k = \frac{M}{N^2 p} \qquad (11)$$

Then

$$E(X_{t_i+1}) - E(X_{t_i}) = k \times E(X_{t_i}) \times \left(N - E(X_{t_i}) \right) \qquad (12)$$

So

$$\frac{E\left(X_{t_{i+1}}\right) - E\left(X_{t_i}\right)}{(t_i + 1) - t_i} = k \times E(X_{t_i}) \times \left(N - E(X_{t_i})\right) \quad (13)$$

Regard $E\left(X_{t_i}\right)$ as a discrete value of a continuous function $f(x)$ at $x = t_i$, according to Eq.(13), the differential equation of $f(x)$ is:

$$\frac{\mathrm{d}f(x)}{\mathrm{d}x} = k \times f(x) \times [N - f(x)] \text{ and } f(0) = 1 \quad (14)$$

Solve the equation, we can get

$$E\left(X_{t_i}\right) = \frac{N}{1 + (N - 1)e^{-t_i \times k \times N}} \quad (15)$$

4. CONCLUSION

This paper analyzes factors which influence LTV and their methods of influencing at first, points out that, among all researches on calculating LTV of a customer, no one of them considered about the word-of-mouth marketing value. And then the paper suggests a new LTV model considering the past profit contribution, potential profit, customer loyalty and word-of-mouth marketing value. The model gives a more complete calculation of customer LTV and can be used for customer segmentation especially in the market which word-of-mouth marketing can make good effects.

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