

A RESEARCH ON THE COMMUNICATION EFFECT OF CUSTOMERS' POSITIVE WORD-OF-MOUTH BASED ON LOGISTICS MODEL

Pan Jia-xin

School of Management, Guangdong University of Technology, Guangzhou, Guangdong, China
223805711@qq.com

Abstract

The phenomenon that customers communicate the information about products or service on the Internet is widespread because people rely on Internet to issue and obtain information more and more. Entrepreneurs and scholars immediately pay attention to the value of WOM communication. In the complex and changeable environment, how to enhance the communication effect of positive WOM and increase the speed of positive WOM communication becomes the problem needed to be solved in this study. Therefore, this study builds a model of customers' positive word-of-mouth communication based on logistic model. According to the model results, this study simulates the process of positive WOM communication by applying MATLAB, discusses the relationship between the communication effect of positive WOM and the time of communication, and explores the main influence factors of the process of WOM communication. Finally, this study proposes the corresponding management suggestions on the basis of analysis results.

Keywords: Customer; Positive WOM Communication; Time of Communication; Communication Effect; Logistics Model

INTRODUCTION

The rapid development of Internet makes people's word-of-mouth (hereinafter, simply referred to as "WOM") communication more convenient. Social platforms, such as Twitter, microblog, Wechat, on-line brand community and so on, which provide platforms for customers to communicate their consumption expression or product experience with enterprises or other customers. Meanwhile, these social platforms also provide ways for potential customers to

search products or service information through the Internet. Idea Storm community of Dell, brand community of Harley-Davidson, the MIUI community of Mi in China and the Sydney WOM network (that is socialreview.com.au), which are successful examples that enterprise provide platforms for customers to spread WOM.

Customers' WOM plays a more and more important role in enterprise marketing activities. Therefore, enterprises pay more attention to customers' WOM, in addition, scholars also launch a series of researches on WOM communication. First of all, Amdt (1967) firstly defined that WOM was a non commercial communication behavior among people in social interaction. Based on the defining of WOM, Tax (1993) proposed that WOM consisted of positive WOM and negative ones. Secondly, academia carried on a lot of theoretical discussions and experimental researches on the role of customers' WOM from different perspectives. Scholars not only found that WOM could impact on customers' attitudes and behaviors (Brown and Reingen, 1987), also found that WOM could affect people's choices on products or service (Ennew et al., 2000). See-To and Ho (2014) noted that electronic WOM had a direct impact on purchase intention, and had an indirect impact on purchase intention which is moderated by consumers' trust on the underlying product. Subsequently, scholars studied the value of customers' WOM. Herrmann and Fürderer (1997) initially introduced that the value of customers' WOM was sum cash value caused by customers' WOM communication. Bauer (2005) established a mathematical model to estimate the value of customers' WOM. From the perspective of social impact theory, Zhang et al. (2014) indicated that premium ability, growth of the purchases, reduction of customer acquisition costs, and reduction of customer retention costs were the main constituent elements of the value of customers' WOM. Finally, in contrast to the second part on the role of customers' WOM, scholars carried on the researches on what impacting on WOM. Kim et al. (2014) investigated how consumers' relationships with brands influenced their engagement in retreating brand messages on Twitter. Luo and Zhong (2015) found that existing social relationships had an impact on electronic WOM communication. Aliosha et al. (2013) studied the influences of social motivation and self motivation on WOM. Chu and Kim (2015) believed that tie strength, trust, normative and informational influence had positive impacts on users' electronic WOM behavior, moreover, homophily had a negative impact on users' electronic WOM behavior.

By reading the literatures, author found that scholars have studied the definition, role, value of WOM and the factors that influence WOM. But existing researches lack the researches that how to effectively and scientifically improve the communication effect of WOM. As mentioned earlier, the WOM includes positive WOM and negative ones, but only positive WOM is conducive to spreading products or service. In addition, massive and frequent positive WOMs

among customers have certain guides on customers, and make contribution on customers' purchase behavior (See-To & Ho, 2014; Qiu, 2013). However, customers rarely spread information of products or service actively after purchasing or using related products or service. Consequently, in the complex and changeable environment, it becomes a problem that how to effectively enhance the communication effect of positive WOM and increase the speed of positive WOM communication, which needs to be solved in the process of WOM communication.

In the process of WOM communication, there are two roles: one is WOM sender, and the other one is WOM receiver. The purchase quantity of potential customer or the rate of WOM communication is generally used to measure the communication effect of WOM, this study uses the rate of WOM communication to describe the communication effect of WOM. In order to solve the problem that how to effectively enhance the communication effect of customer's positive WOM and increase the speed of positive WOM communication, this study describes the process of WOM communication, then builds the model of customers' positive WOM communication based on logistics model. According to the model results, this study discusses the relationship between the communication effect of WOM and time of communication, moreover, explores the main influence factors of the process of WOM communication. Finally, some corresponding management suggestions are proposed on the basis of analysis results.

RESEARCH METHODOLOGY

Process Descriptions

The goal of this study is to explore the communication effect of positive WOM, so we don't consider the situation of negative WOM communication. To facilitate the discussions, WOM what is mentioned below in this study refers to the positive WOM.

The process of customers' WOM communication consists of main participants and the specific activities. Among them, the participants of customer WOM communication include existing customers and potential customers, where existing customers are WOM senders and potential customers are receivers. The process of WOM communication is the process that senders transform their product experience into the useful information according to receivers' demand of products/service, and spread these useful information to receivers through various avenues. The rate of WOM communication can be used to describe the communication effect of WOM. In addition, it isn't successful to spread WOM for senders and receivers until the environment is favorable to communicate. The communication environment mainly refers to the avenues or the ways that senders spread information to receivers, which include communication platform and language. People use different communication platforms or language in line

accordance with different property of information, which greatly enhance the communication effect of WOM.

Model Hypotheses

This study only considers that senders spread WOM with their own ability, but doesn't consider the impact of other exogenous variables (i.e. enterprise strategy and so on) on WOM senders. To describe the process of WOM communication, the following hypotheses are presented:

Hypothesis 1: To regard WOM communication as the process that the communication effect of WOM continuously changes, this study uses continuously-differentiable function $S(t)$ represents the rate of WOM communication, which describes the communication effect of WOM.

Hypothesis 2: The process of WOM communication obeys the Markov Process, namely, the communication effect of $t + \Delta t$ just is relevant to the effect of t , but that isn't relevant to the effect before t . In the beginning of WOM communication, the initial communication effect of WOM, which refers to the reputation of product itself, that is $S(t_0 = 0) = \delta_0$.

Hypothesis 3: In the process of WOM communication, the max communication effect of WOM is m , so the condition is satisfy with $S(t) < m$. m mainly depends on the ability that senders process information. The stronger the ability that senders process information is, the bigger m is.

Hypothesis 4: The transfer coefficient of senders is λ , which is relevant to the environment of WOM communication, such as the avenues and ways of WOM communication. When senders find that the more favorable the environment of WOM communication is, the bigger λ is.

The Model of Positive WOM Communication

Model Building

At first, the model of WOM communication about the communication effect is built based on logistics model, the communication effect of WOM $S(t)$ will enhance with the increase of time and its maximum value is m , so Eqs.(1) is given by

$$\begin{cases} \frac{dS(t)}{dt} = \lambda S(t) \left[1 - \frac{S(t)}{m} \right] \\ S(t=0) = \delta_0 \\ S(t) < m \end{cases} \quad (1)$$

Where $S(t=0) = \delta_0$ is the initial communication effect of WOM, which refers to the reputation of product itself.

Model Estimation

Solving Eqs. (1), $S(t)$ is as follow

$$S(t) = \frac{m}{1 + \left(\frac{m}{\delta_0} - 1 \right) e^{-\lambda t}} \quad (2)$$

According to initial condition $S(t) < m$, $\frac{dS(t)}{dt} > 0$ is known. Then, to take the partial derivative of

$\frac{dS(t)}{dt}$ with respect to t , $\frac{d^2S(t)}{dt^2}$ is gotten as follow

$$\frac{d^2S(t)}{dt^2} = \lambda \left[1 - \frac{2S(t)}{m} \right] \frac{dS(t)}{dt} \quad (3)$$

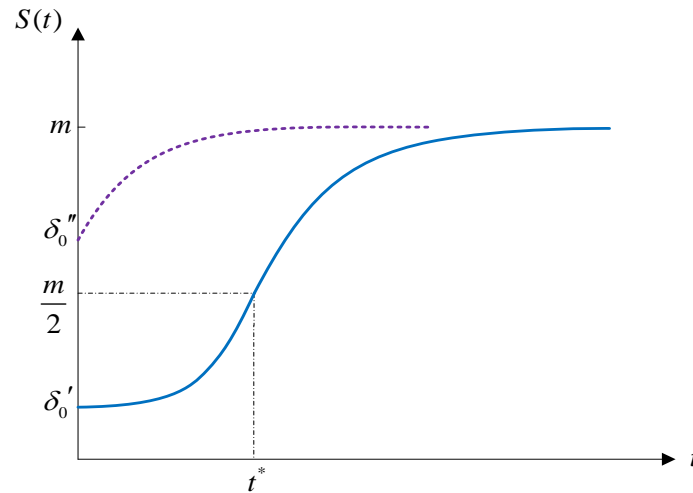
According to Eq.(3), some results are displayed below:

when $1 - \frac{2S(t)}{m} > 0$, that is $S(t) < \frac{m}{2}$, we have $\frac{d^2S(t)}{dt^2} > 0$;

when $S(t) = \frac{m}{2}$, we have $\frac{d^2S(t)}{dt^2} = 0$;

when $S(t) > \frac{m}{2}$, we have $\frac{d^2S(t)}{dt^2} < 0$.

The graph shape of $t - S(t)$ can be known in accordance with the sign of $\frac{dS(t)}{dt}$ and $\frac{d^2S(t)}{dt^2}$. And the figure about the relationship between t and $S(t)$ is drawn as shown in Fig.1.

Figure 1: The Change of $S(t)$ with the Increase of t 

From Fig.1, the situation of WOM communication is different with the difference of the initial communication effect of WOM.

① When $0 < \delta_0 < \frac{m}{2}$, the initial communication effect of WOM is less than half of m , the WOM shows weak communication property. These products are belong to products with low reputation. In contrast to products with high reputation, products with low reputation are needed senders to spend more time to spread WOM. Moreover, in different stage of WOM communication, the speed of WOM communication is different: In the initial stage, the speed of communication increases slowly. Then the speed of communication increases rapidly. Finally, the speed of communication reduces to zero, and the communication effect of WOM achieves maximum.

② When $\frac{m}{2} < \delta_0 < m$, the initial communication effect of WOM is more than half of m , the WOM shows strong communication property. It represents that these products are belong to products with high reputation. If the goal is to maximize the communication effect, it takes senders less time to spread WOM because of products with high initial communication effect of WOM.

Inference 1

In the process of WOM communication, the higher the initial communication effect of WOM is, the shorter the time of spreading WOM is. To the contrary, the lower the initial communication effect of WOM is, the longer the time of spreading WOM is.

To raise the efficiency of WOM communication, the decision-making goal of senders is spreading products information rapidly and maximizing the communication effect of WOM. So this decision-making problem can be expressed by

$$\begin{cases} \max S(t) = \frac{m}{1 + \left(\frac{m}{\delta_0} - 1\right) e^{-\lambda t}} \\ \min t \\ t > 0 \end{cases} \quad (4)$$

To take the second order partial derivative of $S(t)$ with respect to t , the inflection point of communication effect of WOM is given by $S(t) = \frac{m}{2}$, and its homologous time is $t^* = \frac{1}{\lambda} \ln\left(\frac{m}{\delta_0} - 1\right)$. To take the third order partial derivative of $S(t)$ with respect to t , $\frac{d^3 S(t)}{dt^3}$ is given by

$$\frac{d^3 S(t)}{dt^3} = \frac{\lambda^2}{m^2} [m^2 + 6S(t)^2 - 6mS(t)] \frac{dS(t)}{dt} \quad (5)$$

Setting $\frac{d^3 S(t)}{dt^3} = 0$, the inflection points of the acceleration to enlarge the communication effect has two, which are $S(t_1)$ and $S(t_2)$ as follow

$$S(t_1) = \frac{3 - \sqrt{3}}{6} m \approx 0.211m \quad (6)$$

$$S(t_2) = \frac{3 + \sqrt{3}}{6} m \approx 0.789m \quad (7)$$

Respectively setting Eq.(6) and Eq.(7) into Eq.(2), the inflection points of the acceleration to enlarge the communication effect, whose homologous time are given by

$$t_1 = \frac{1}{\lambda} \ln \frac{6(\delta_0 - m)}{(\sqrt{3} + 3)\delta_0} \quad (8)$$

$$t_2 = \frac{1}{\lambda} \ln \frac{6(\delta_0 - m)}{(\sqrt{3} - 3)\delta_0} \quad (9)$$

Inference 2

In the process of WOM communication, when the goal is to effectively improve the communication efficiency, it needs to follow “80 rule”, instead of maximizing the communication effect of WOM. In other words, the homologous communication speed of 80% communication

effect is optimal, and the homologous times is
$$t_2 = \frac{1}{\lambda} \ln \frac{6(\delta_0 - m)}{(\sqrt{3} - 3)\delta_0} .$$

To take the partial derivative of $S(t)$ with respectively respect to m , δ_0 and λ , this study explores the influence of m , δ_0 and λ on t_2 .

$$\frac{\partial t_2}{\partial m} = \frac{1}{\lambda(m - \delta_0)} > 0 \quad (10)$$

$$\frac{\partial t_2}{\partial \delta_0} = -\frac{m}{\lambda \delta_0 (m - \delta_0)} < 0 \quad (11)$$

$$\frac{\partial t_2}{\partial \lambda} = -\frac{1}{\lambda^2} \ln \frac{6(\delta_0 - m)}{(\sqrt{3} - 3)\delta_0} < 0 \quad (12)$$

Inference 3

The stronger the ability that senders' process information is, the longer the time of spreading WOM is. The higher the initial communication effect of WOM is, the shorter the time of spreading WOM is. The more favorable the environment of WOM communication is, the shorter the time of spreading WOM is.

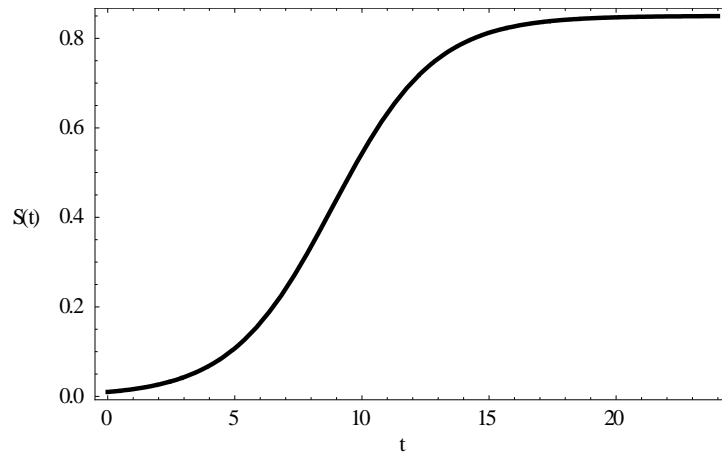
Numerical Example

To better explore the impacts of parameters on WOM communication, this study uses the method of simulation through the tool named MATLAB. By changing the value of each parameter, we simulate the process that customer spread positive WOM and explore the influence of parameters on the related factors of WOM communication. Parameters are randomly generated: $m = 0.85$, $\delta_0 = 0.01$, $\lambda = 0.50$.

To explore the relationship between the communication effect of WOM and time, we set the parameters m , δ_0 , λ into Eq.(2) and get Fig.2. The relationship curve between the communication effect of WOM and time is S type curve from Fig.2. Moreover, the process of WOM communication can be divided into three stages: In initial stage, the communication effect

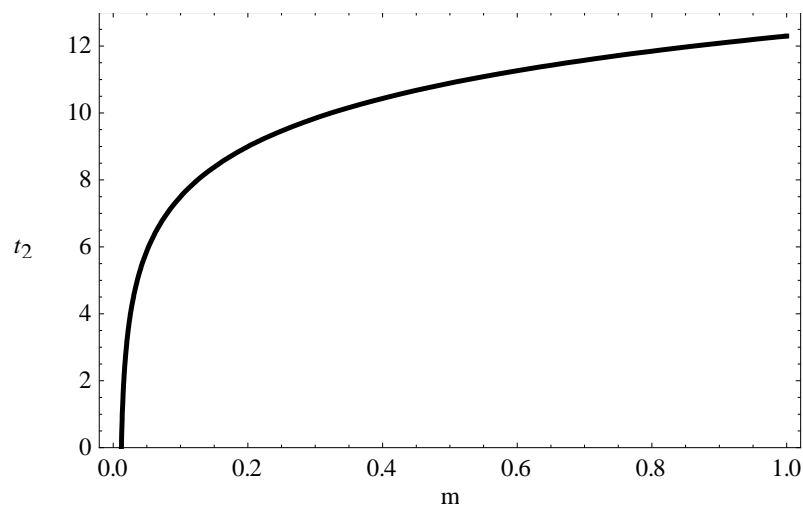
of WOM increases very slowly. In middle stage, the communication effect of WOM increases rapidly. In final stage, the communication effect of WOM achieves maximum.

Figure 2: The Relationship between t and $S(t)$



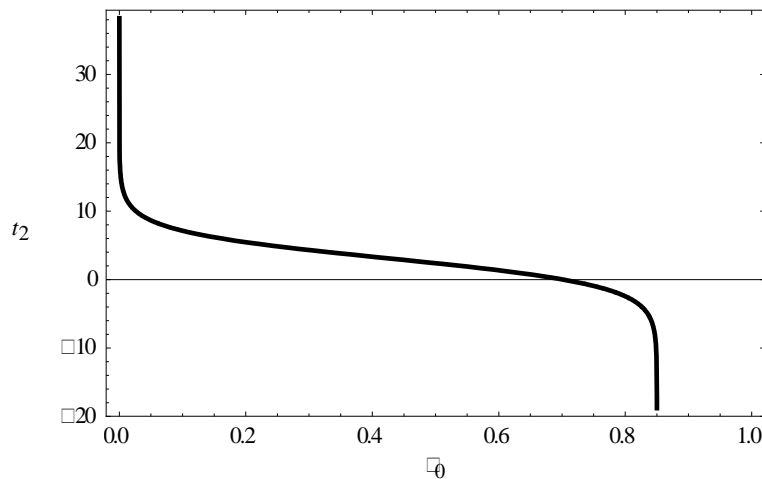
To explore the relationship between t_2 and max communication effect of WOM, we set the parameters δ_0 , λ into Eq.(9) and get Fig.3. t_2 increases with the increase of max communication effect of WOM. Namely, if enterprises hope to enhance the communication effect of WOM, they need to give more time for customers to spread WOM. When $0 < m < 0.2$, t_2 increases rapidly, when $m > 0.2$, t_2 increases slowly and tends to achieve maximum.

Figure 3: The Relationship between t_2 and m



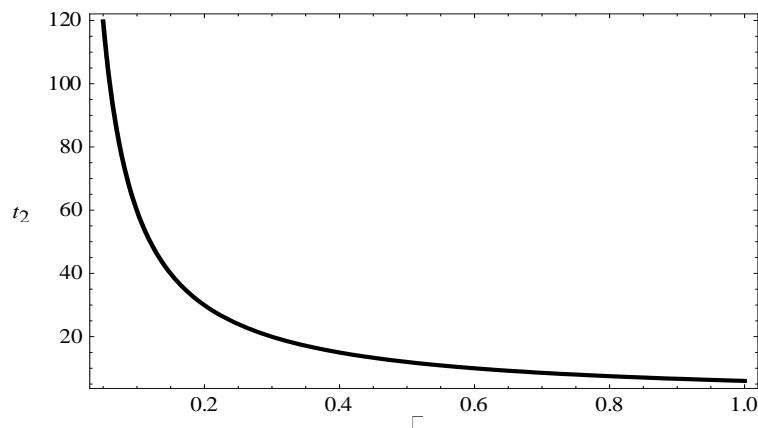
To explore the relationship between t_2 and the initial communication effect of WOM, we set the parameters m, λ into Eq.(9) and get Fig.4. t_2 decreases with the increase of the initial communication effect of WOM. Namely, if the initial communication effect of WOM is lower, the time that communication effect of WOM achieves 80 % is longer, on the contrary, if the initial communication effect of WOM is higher, the time that communication effect of WOM achieves 80 % is shorter.

Figure 4: The Relationship between t_2 and δ_0



To explore the relationship between t_2 and transfer coefficient of senders, we set the parameters m, δ_0 into Eq.(9) and get Fig.5. t_2 decreases with the increase of senders' transfer coefficient, namely, if senders think that the communication environment is more favorable to spread WOM, they are more willing to carry on WOM communication actively.

Figure 5: The Relationship between t_2 and λ



SUGGESTIONS FOR MANAGEMENT

This study builds the model of customers' WOM communication based on logistics model. Then MATLAB is used to simulate the process of WOM communication. Figures drawn by MATLAB describe the relationship between t and $S(t)$, as well as the relationships among m , δ_0 , λ and t_2 . On the basis of the model results, several management suggestions are put forward as follow.

At first, enterprises need to attach importance to middle stage of WOM communication. Because the communication effect of WOM enhance rapidly in middle stage, enterprises should seize the opportunity and vigorously encourage existing customers to spread WOM, which can further enhance the communication effect of WOM. For instance, enterprises could design the suitable reward program of WOM communication for senders or receivers. Especially, in middle of stage of WOM communication, enterprises could organize activities that attract customers to spread information of products or service, and apply new media to launch these activities which enclosed by the reward program of WOM communication.

Secondly, the process of WOM communication follows "80 rule". Generally speaking, if the goal is to raise the speed of customers' WOM communication, enterprises could shorten the time of WOM communication. In addition, if the goal is to increase the communication effect of WOM, it needs more time to spread WOM. Obviously, the solutions of two goals is contradictory, it is important to find the optimal time of WOM communication that is satisfied with

the two goals. The result of this study indicates that $t_2 = \frac{1}{\lambda} \ln \frac{6(\delta_0 - m)}{(\sqrt{3} - 3)\delta_0}$ is the optimal time. Namely, instead of maximizing the communication effect of WOM, the time that communication effect of WOM achieves 80% is more optimal.

Thirdly, enterprises could raise the reputation of products/service in the initial stage of WOM communication, which is help to shorten the time that communication effect of WOM achieves maximum. Aim to maximize the communication effect of WOM, it takes enterprises with high reputation less time to spread WOM. In other words, compared with enterprises with low reputation, customers would more easily get the products/service information of enterprises with high reputation. Therefore, enterprises always need to focus on how to improve the reputation of their products or service, for example, they could create the advertisement to attract people's attention, or participate in public welfare activities to promote enterprise image.

Finally, enterprises could create the environment that is conducive to spreading WOM. The favorable communication environment is helpful for customers to carry on WOM communication frequently. When customers find that enterprises provide them with platforms

which are used to spread WOM, they are more willing to share their product experience on the platforms with other customers. So enterprises could build up brand community on the social platform and guide customers to share information freely on community. Enterprises also organize the collection activities of product opinion, and motivate customers to spread product information by means of these activities. In addition, enterprises in specific area, such as computer, mobile phone and so on, could lead customers who are familiar with the corresponding area to use technical terms to spread information, it's helpful to shorten the time of WOM communication.

LIMITATIONS

However, this study still has limitation. In this paper, we mainly study the process of positive WOM communication and explore the main factors in the process of positive WOM communication. But we ignore the main influence factors of negative word of mouth communication. It is widely known that negative WOM communication has an negative impact on customers' impression of the products or service. Thus, it is meaningful to study what would influence the communication effect of negative WOM and how to decrease the time of communication or the communication effect of negative WOM. Future researches can launch the related studies from this aspect.

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