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# THE CHOICE BEHAVIOR ANALYSIS ON THE PICK-UP POINT FOR THE E-COMMERCE RETAILING DELIVERY

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**Abstract:** In Taiwan, the e-commerce with the logistics system of convenience stores has a new retail delivery model: "On-line shopping in an electronic store and pick-up goods in a convenience store". The major purpose of this study is to examine what kind of improved services strategies can capture more market share and customer loyalty for the convenience stores. The results indicate that the short-term promotion strategies do significantly affect the consumers' choice behavior on the pick-up point, however this is weak in the long term because of customer loyalty. Finally, a catastrophe model of customers, is used to analyze the linkages between customer satisfaction and transaction cost on pick-up point services loyalty.

**Key Words:** retailing delivery, choice behavior, catastrophe theory

## 1. INTRODUCTION

The Taiwan's electronic commerce is entering a new period. Due to the rapid development of the Internet technologies and applications, electronic stores emerge as a popular retail channel. In Taiwan, convenience stores provide a 24-hour purchasing environment for consumers and are distributed everywhere. Convenience stores in Taiwan have integrated the e-commerce with the logistics system of convenience stores to a new retail delivery model: "On-line shopping in an electronic store and pick-up goods in a convenience store", and have made many remarkable successes. In the present day, over 400,000 orders have been complete by the electronic commerce of the retail delivery model. Because of the short development history and the data collection difficulty of E-commerce retail delivery, there are few studies about the E-commerce retail delivery. Besides, due to the similarity of retail delivery service from various convenience stores, the location of the convenience store becomes a major factor for a consumer to decide the pick-up point. Since customers are the main resources of gaining profits, how to develop the differentiate strategies to maintain the existing customers and obtain more new customers becomes an important issue for convenience stores.

Due to the difficulty for retailing delivery provider to make difference on the operation process, the customer loyalty has become an important issue for marketing practitioners. According to Oliva et al. (1992) and Sethi et al. (1998), the relationship between satisfaction and loyalty is both linear and nonlinear, in order to investigate system with respect to transitional, discontinuous behavior, we need a powerful mathematical tool to analyze the nonlinear system. Catastrophe theory can be of great importance for the purpose. The catastrophe model itself is not new, but in the past few studies have used it on the choice behavior on the pick-up point of convenience stores. This paper had two aims: one is to examine the factors influencing the loyalty; the other is to describe a way in which a cusp catastrophe model is used to develop a loyalty strategy for a pick-up point choice behavior in the EC market.

## 2. RESEARCH BACKGROUND

### 2.1 Profile of the Taiwan e-commerce retailing delivery

In Taiwan, the electronic commerce delivery system can be divided by the type of services provided into home delivery (HD) and retailing delivery (RD). In comparison with other countries, the logistic major difference between Taiwan and other countries is the RD system. The 7-11.com is the RD provider, which began service at the beginning of 2000, while the Cvs.com (Cvs.com is a joint venture by four convenience stores including Family.com, HiLife.com, Okcvs.com and Nikomart.com) joined the market at the end of year 2000. Because of the safe payment way and the quickly delivery, the RD service became the important and popular delivery service in the electronic commerce in Taiwan. The major e-retailings in Taiwan (e.g., www.books.com.tw, www.payeasy.com.tw, www.yahoo.com.tw, www.pchome.com.tw) all provided the retailing delivery service to their customers. The convenience stores have become a substantial provider of the electronic commerce logistics in Taiwan, which can be seen from the business volume (or orders) for different delivery type in Table 1.

Table 1. The Business Volume (or orders) for Different Delivery Type in Taiwan (May, 2004)

| Home delivery | | Retailing delivery | |
|---|---|---|---|
| E-retailing | Business volume (hundred million NT/month) | RD provider | Orders / month |
| shopping.pchome.com.tw | 1.8 | 7-11.com | 300,000 |
| buy.yahoo.com.tw | 0.8 | Cvs.com | 200,000 |

The RD system has two special features. First, consumers can shop on-line even without credit card, it is important for a young people who has no credit card, or for those who concern the safety of the other pay way in the on-line shopping. The second special feature is the RD service provides consumers with a self pick up approach on convenience stores. It's popular for two different types of consumers, one is the female who worry about the safety issue of HD system and the other is the students who want shopping but don't want the delivery to home to avoid their parents know it.

For an on-line shopper, the e-map website provides consumers with a friendly way to choose one convenience store to pay the money and pick-up goods, and then the RD system will deliver the good to the convenience store according your choice. RD system supplies an easy on-line shopping process, safe pick-up point and quick delivery service for the e-retailing. For a RD system provider, the business volume of the RD service almost is based on the location, therefore it's difficult for him to make different services for consumers. Figure 1 shows the structure of the RD system.

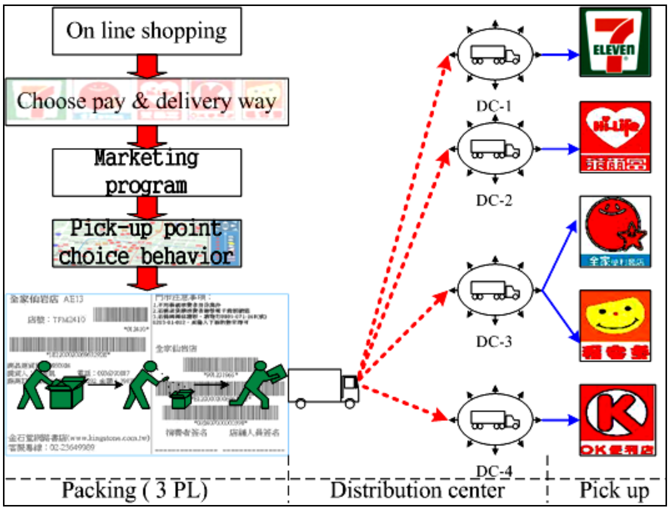


Figure 1. The Structure of the Retailing Delivery

## 2.2 The research objectives

The electronic commerce has been widely studied in the past; however, there are few studies concerning the EC delivery. Especially, the EC retailing delivery almost has not been investigated yet. Besides, an intensive promotional activity allows the convenience store to maintain/increase its patronage to achieve a higher penetration rate in the market area. Retailing delivery service has become a more and more important service for increasing the business volume, it can increase the frequency of visits, and the average amount spent in the store. The major purpose of this study is to examine what kind of improved services strategies can capture more market shares for the convenience stores, and investigate the factors affecting customer loyalty in an online business-to-consumer (B2C) pick-up point. To accomplish the objective, we use a cusp catastrophe model to show the nonlinear choice behavior of consumers.

**2.3 Relevant literature**

Not every process in the world is continuous and slowly changing, especially in the field of the consumer behavior. There is an increasing emphasis on customer satisfaction as a means of affecting store-choice behavior (e.g., Weir, 2001). One of the problems about the consumer behavior of loyalty is that consumers' responses to service increments can be nonlinear. Behaviors usually lag behind satisfaction, and the dissatisfaction with a single transaction is unlikely to cause consumers to switch loyalties (i.e. the satisfaction and the dissatisfaction threshold may not occur at the same point.). In an electronic commerce environment, customer preferences are very diverse and their loyalty level is very low. Companies should acknowledge the changes in customer demand patterns quickly and respond to consumer's behavior appropriately. Thus, an important issue is why consumers vary in how they divide their purchases across outlets and how outlets can gain a greater share of consumer expenditures. It is necessary to use management experience and research results to create an overall picture of the relationships between loyalty and satisfaction.

Several researchers have proposed that the relationship between loyalty and satisfaction is both linear and nonlinear. Their studies also indicated that satisfaction and dissatisfaction thresholds may not occur at the same point. That is, not all consumers respond equally to increases in satisfaction (Oliva et al., 1992; Vikram et al., 1998; Rense et al., 2000; Byrne et al., 2001; Sean et al., 2001). Recently, catastrophe theory has become a popular method to describe the dynamic system (e.g., choice behavior; economic growth; physical phenomena). Catastrophe theory was developed and popularized in the early 1970's. Initially, it attracted attention very quickly and by 1978, an entire issue of Behavioral Science was devoted to the approach. After a period of criticism, catastrophe theory is well established and widely applied. Today catastrophe theory is very much alive. Numerous nonlinear phenomena that exhibit discontinuous jumps in behavior have been modeled using catastrophe theory, for instance in the field of chemistry (e.g., Wales, 2001), physics (e.g., Aerts et al., 2003; Tamaki et al., 2003), psychology (Stewart et al., 1983; Newell et al., 2001; Mass et al., 2003), and in the social sciences (e.g., Holyst et al., 2000; Oliva et al., 1992). The models' strengths include that they can capture complex behavior by using significantly fewer nonlinear equations than the number of linear equations needed to describe the same phenomena.

## 3. CATASTROPHE THEORY

### 3.1 Review of catastrophe theory

Catastrophe theory are said to occur when dynamics systems exhibit sudden discontinuities or divergent behavior. The theory is originated by Rene Thom in the 1975s. It is a topological branch of mathematics developed to studies and classifies phenomena characterized by sudden shifts in behavior arising from small change in circumstance. Catastrophe theory specifies that a small change in control parameters across critical thresholds will cause stable equilibria either to disappear, or to bifurcate into multiple equilibria, some of which are stable. Catastrophe theory may be viewed as a modeling technique which attempts to account for the discontinuous causes in system (Oliva, 1987). In substance, catastrophe theory is a theory of great generality that can provide useful insights as to how behavior may radically changes as result of smoothly varying control variables.

Tom has demonstrated through his classification theorem that all discontinuous phenomena that can be expressed in terms of four or fewer independent variables (also called control dimensions) which exit in many branches of science can be modeled accurately using one of only seven elementary catastrophes. Of these elementary forms, the cusp catastrophe has been frequently used to model attitude formation and change. Since the cusp catastrophe model is considered in this paper, the cusp model will be discussed in greater detail.

### 3.2 The cusp catastrophe model

Since catastrophe structure widely applied in the past is the cusp model (Gresov, Haveman, & Oliva 1993), this study will use this model. Figure 2 shows the basic form of the deterministic cusp model. Each catastrophe model can be formalized by potential or gradient structures, a potential function $F(x, c)$ is a function of both the system state $x$ and the control parameter(s) $c$. The cusp catastrophe model consists of one behavior variable ($x$) and only two control variables ($u$, $v$), the potential function represented in Eq. (1),

$$F(u,v,x) = -\frac{1}{4}x^4 + \frac{1}{2}ux^2 + vx \tag{1}$$

the equilibria of Eq. (1) is three dimensional. Where the state variable $x$ is determined by $u$ and $v$, $u$ and $v$ are environmental control parameters. As a stable equilibrium state $x$ for this potential function gives relative value x of a function $F(u, v, x)$, a set of point $(u, v, x)$ is defined as Eq. (2),

$$\begin{aligned} &\frac{\partial F}{\partial x} = -x^3 + ux + v = 0 \\ &M_F : \{(u,v,x) \mid -x^3 + ux + v = 0\} \end{aligned} \tag{2}$$

where $M_F$ is said to be cusp catastrophe manifold. The values of $x$ in correspondence to which attains a local maximum or minimum satisfying the condition,

$$3x^2 + u = 0 \tag{3}$$

Eliminating $x$ from Eq. (2) and Eq. (3), the bifurcation set express by Eq. (4).

$$4u^3 = 27v^2 \tag{4}$$

A switch in topology takes place at the values of $u$ and $v$ satisfying Eq. (4), which constitutes the catastrophe set. In the equation Eq. (3) $x$ is the state variable, and $u$, $v$ are control parameters. In Zeeman's terminology $u$ is a 'splitting factor' and $v$ is 'normal factor'. The parameter $u$ determines whether the system has one or can have two stable equilibria. When $u$>0 only one stable equilibrium can exit whatever the value of $v$. When $u$<0 it depends upon the value of $v$ whether the system has a single low level stable equilibrium, or a low level and a high level equilibria, or a single high level equilibrium elevaters.

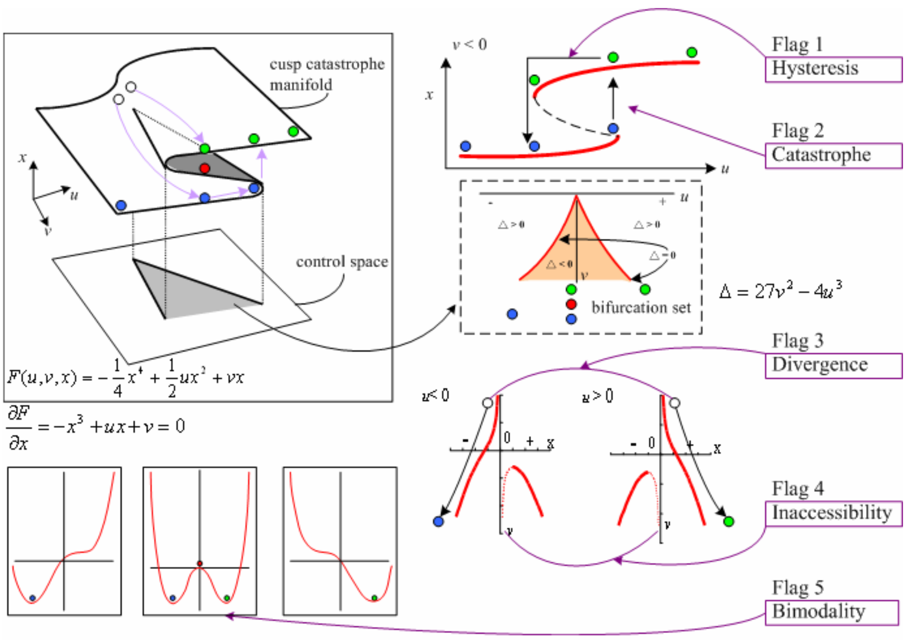


Figure 2. Cusp Catastrophe Model

The first important step in an experimental research concerned with catastrophe systems is to get some strong indications that the system under survey indeed shows catastrophic transitional behavior. The folded area in Figure 2 illustrates the five types of behavior, complex behavior is captured by movement in and around the folded area, which is characterized as one of the following five types (Zeeman, 1976).

(1) Bimodality
Over some part of the range of phenomenon, the behavior is ambiguous; that is , bimodality indicates that either of two stable but distinctly different behaviors can occur.

(2) Divergence
The divergence indicates a small difference in starting position can result in vastly different and opposite ending positions. In short, a small initial difference can bring about totally different behavior.

(3) Catastrophe (sudden transitions)
If change in the normal and splitting factor produce a path which crosses the bifurcation set, an abrupt, catastrophe change in the value of the dependent variable will occur. At that point, an abrupt transition is made from the lower to the upper surface.

(4) Hysteresis
After the sudden transitions, although the path is returned, the hysteresis phenomena shows the abrupt change from one mode of behavior to another takes place at different values of the control factors depending on the direction of change.

(5) Inaccessibility
Over part of the range of the phenomenon, there is a middle region between the two types of behavior that is inaccessible.

Catastrophe theory is a special topic within the nonlinear dynamical system. In a cusp model, when the normal and splitting variable are correctly identified, and the underlying system dynamics are give by catastrophe theory, this often provides surprisingly elegant insights that cannot be obtained from simple linear models.

It is not possible to give a complete introduction to catastrophe theory here. For a more detailed explanation and mathematical description of catastrophe theory may be readily found elsewhere (see for example, Zeeman, 1977; Gastrigiano & Hayes, 1993; Poston & Stewart 1978; Gilmore, 1981). In the following, we will ignore the issue of statistically fitting a catastrophe model to empirical data; instead, we will focus on the creative aspects of defining appropriate control variables and the qualitative testing of the cusp model using the catastrophe flags.

## 4. QUESTIONNAIRE OF ON-LINE SURVEY AND RESULTS

### 4.1 Research model and questionnaire design

As mentioned above, the cusp catastrophe model needs one behavior variable and two controllable variables. In this study, we define customer's loyalty on pick up convenience stores as our behavior variables. To find what the appropriate controllable variables are, we adopt the recently widely used Structural Equation Model (SEM), which can incorporate the conventional factor analysis and path analysis. In the SEM, there are many latent variables and many manifest variables corresponding to each latent variable. The advantage of using SEM is to deal with some behavior concepts (or constructs) which are not quantified explicitly. The research methods included in this study have two: one is using SEM to find the two controllable variables which can used in the cusp catastrophe model later, the other is to use cusp catastrophe model to examine the effects of the proposed strategies for the Cvs.com . The research framework can be seen in Fig. 3.

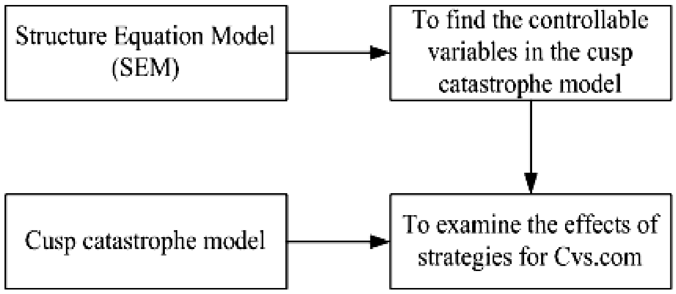


Figure 3. Research Framework

Based on the literature review (Oliva et al., 1992; Gerrard et al., 1997; Pierre et al., 2001; Venkatesh et al., 2003; Lindsay et al., 2001), the hypotheses have been conceptualized in the SEM structures. Since the focus of this paper is on finding the controllable variables for cusp catastrophe model, the detail of the SEM analysis will not be discussed here. However, it can be seen more details in the literature of Feng and Huang (2004).

The questionnaire of this survey consists of three parts. The first part contains two sets of questions: the importance of pick-up point service attributes and satisfaction level of each respective attribute for different companies. Both sets of questions are measured by five-point Likert scale, in which 1 represents the least important/satisfied, and 5 represents the most important/satisfied. The second part of the questionnaire collects attitudinal measures of consumer loyalty. The third part of the questionnaire collects soci-demographic information of the respondents.

### 4.2 Data and sample

The data for our study are collected from an on-line survey. During the survey of six-week period, we collect from 11462 respondents through on-line questionnaires. The respondents who completed questionnaires are given a cellular phone announcement coupon of 100NT equivalent. We select 9278 respondents who have the experience of on-line shopping and pick-up goods in convenience store. Table 2 summarizes the other demographics of the samples in our data. As shown in Table 2, more than half of the respondents are unmarried, 72.4% are females, 84.9% are in the 19-39 age groups, and 62.4% of the respondents indicate that 7-11.com is their main pick-up point.

Table 2. Demographic Profile

| Classification | Number of respondents | Percentage | Classification | Number of respondents | Percentage |
|---|---|---|---|---|---|
| Sex | | | Martial status | | |
| Male | 2560 | 27.6% | Unmarried | 6324 | 68.2% |
| Female | 6718 | 72.4% | Married | 2954 | 31.8% |
| Age | | | Location of Taiwan | | |
| Under 14 | 35 | 0.4% | North | 5570 | 60.0% |
| 15-18 | 562 | 6.1% | Middle | 1621 | 17.5% |
| 19-24 | 2470 | 26.6% | South | 1778 | 19.2% |
| 25-30 | 3083 | 33.2% | East | 303 | 3.3% |
| 31-39 | 2329 | 25.1% | Others | 6 | 0.1% |
| 40-49 | 652 | 7.0% | Purchasing on-line experience (year) | | |
| 50-59 | 129 | 1.4% | Over 3 | 1183 | 12.8% |
| Over 60 | 18 | 0.2% | 2-3 | 2076 | 22.4% |
| Purchasing on-line frequency (month) | | | 1-2 | 3184 | 34.3% |
| 1/6 | 217 | 2.3% | 0.6-1 | 1877 | 20.2% |
| 1/3 | 882 | 9.5% | Under 0.6 | 958 | 10.3% |
| 1-2 | 2295 | 24.7% | The main pick-up point | | |
| Over 3 | 1057 | 11.4% | 7-11.com | 5791 | 62.4% |
| Uncertain | 4827 | 52.0% | Cvs.com | 3487 | 37.6% |

**4.3 Results**

In the SEM, all of the proposed hypotheses are tested and eventually supported at 0.05 significance level. The first step in model testing is to estimate the goodness-of-fit of the hypothesized research model. Empirical support for the model is assessed by examining five indices including the ratio of chi-squire to degrees of freedom, goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative-fit index (CFI) and root-mean-square error of approximation index (RMSEA). Structural equation model (SEM) was conducted using LISREL 8.2 edition with maximum-likelihood (ML) estimation. The different indices of model fit are computed and included in Table 3. As suggested by the fit indices, our model generally met the standards of a good-fitting model.

The second step in model estimation is to examine the path significance of each association in our model and variance explained by each path. Figure 4 presents the standardized path coefficients (the significance for all path coefficients: $p<0.001$). For example, the coefficient of 0.22 represents the relationship between satisfaction and store images. From these coefficients, we know that the most tow significant relationships (0.34) are service quality and loyalty, and the relationships (0.36) are switching cost and loyalty. In other words, the switching cost and the service quality are the two major factors that can influence the loyalty of a pick-point, and the service quality and the switching cost could be changed as we change the marketing program. In cusp catastrophe model, the state parameter is determined by two control variables, we confirm these control variables via the analysis of SEM. In addition, in the analytical method of SEM, express the great result as the path coefficient is greater than 0.5, this is why only 2 variables are selected. Therefore, we will use service quality and switching cost as two controllable variables in the cusp catastrophe model.

Table 3. Evaluation of Model Fit

| Fit statistics | Value |
|---|---|
| $X^2/df$ | 1.19 |
| Goodness-of-fit index (GFI) | 0.97 |
| Adjusted goodness-of-fit index (AGFI) | 0.95 |
| Comparative-fit index (CFI) | 1.00 |
| Root-mean-square error of approximation index (RMSEA) | 0.026 |

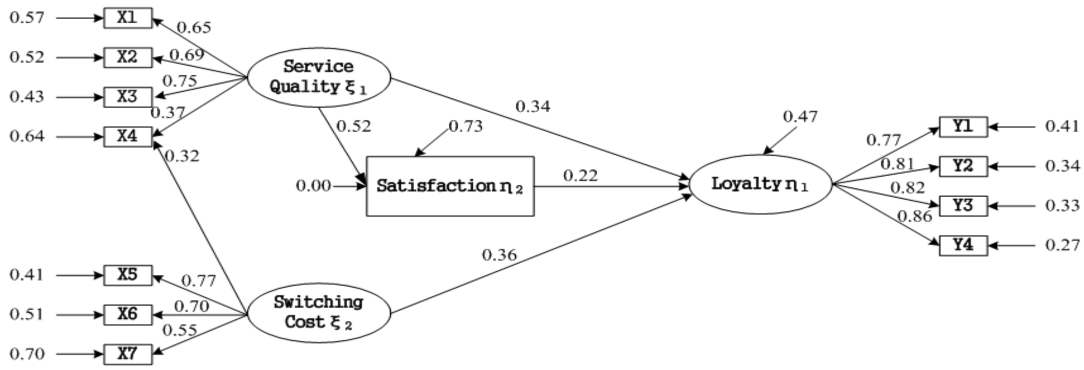


Figure 4. Results of Structural Equation Model.

## 5. CUSP CATASTROPHE MODEL ANALYSIS

### 5.1 The dependent variable and the independent variable

Numerous researchers used the catastrophe model in Fig. 6, which is given by Eq. (5).

$$Z^3 - X - YZ = 0 \tag{5}$$

Where the dependent variable is $Z$, and the independent variables are $X$, $Y$. Unlike most standard approaches, the model has an area where bimodal response is possible from a given independent variable pair.

Fig. 5 shows the general form of the cusp catastrophe model. In our study, the variable (Z) is on the vertical axis and represents the pick-up point loyalty dimension. Movement occurs on the surface is driven by two independent variables. According to our previous structural equation model (SEM), we choose the service quality and the switching cost as the two independent variables in the cusp catastrophe model. Switching costs (splitting factor), the Y axis, controls back/front movement; service quality (normal factor), the X axis, controls right/left movement. Consider our cusp model in Fig. 5, for a certain conditions of the two control factors, there are two possible stable states, one is on the lower surface (loyalty to the Cvs.com) of the pleat and the other one is on the upper surface (loyalty to the 7-11.com). When the value of the splitting factor is high, the relationship between service quality and loyalty is nonlinear. If we choose an appropriate value of the normal factor, as the switching cost increases, the prior nearest two points will follow different path to different situation (see Fig. 6, point A and B).

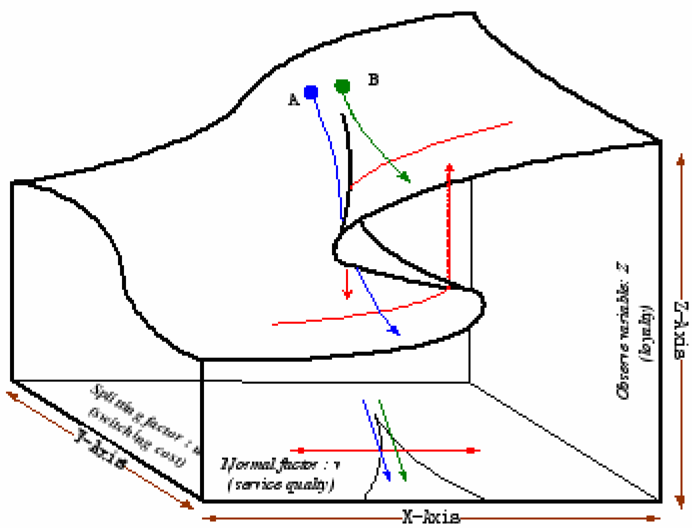


Figure 5. Response Surface for Switching Cost and Service Quality

### 5.2 Empirical study of different service strategies

According to Zeeman, 1977; Brian, 1078; Setwrt, 1982; Oliva, 1992; Vikram, 1998 and Byrne, 2001, their researches indicated that the consumer loyalty depending on one control variable (e.g., switching cost), and the relationship between consumer behavior (e.g., loyalty) and the other control variable (e.g., service quality) can be nonlinear. This finding has important implications for us to develop service satisfaction or loyalty strategies. The cusp catastrophe model have two important features: bifurcation and divergence, we use these characters developing five different types of strategies (high premium program; low premium program; free gift; quick ordering; exclusive goods and compassion promotion), Table 4 shows the details of the five strategies.

Table 4. The Different Type of Marketing Strategies

| Strategy | Type | Details |
|---|---|---|
| Strategy A | High Premium Program | A consumer choosing the Cvs.com as a pick-up point will get a 500 point to exchange premium |
| Strategy A’ | Low Premium Program | A consumer choosing the Cvs.com as a pick-up point will get a 200 point to exchange premium |
| Strategy B | Free Gift | A consumer choosing the Cvs.com as a pick-up point will get a free-gifts |
| Strategy C | Quick Ordering | The e-retailing supplies the quick ordering system, different from of the 7-11.com |
| Strategy D | Exclusive Goods | All of the goods are the Cvs.com exclusive |
| Strategy E | Compassion Promotion | Cvs.com will donate 2NT to a non-profit organization when a consumer chooses Cvs.com as a pick-up point |

Data to test the effect of different strategies is collected from two e-retailing: one is the payeasy.com and the other is the payeasy.com. The business volume data of 287 days (41 weeks) are recorded in 2004. For the case payeasy.com, the strategies of high and low premium program, free gift and quick ordering are used, while the other case of pchome.com , the strategies of exclusive goods and compassion marketing are applied. Fig. 7 and Fig. 8 show the performance for different strategies on the two cases. The frame implies the Cvs.com implementing some strategies. For example, the left frame in figure 7. represents that Cvs.com is using strategy D.

In the case1, the feature (catastrophe and hysteresis) of cusp model appears because of the strategy D. Using the strategy D, the difference of orders between 7-11.com and Cvs.com reduced 20% because of the hysteresis feature occurred. The feature of divergence played an important role in case 2. In the case 2, using strategy A and B, the business volume of the Cvs.com exceeds that of the 7-11.com because of the feature of divergence occurred by strategy A. Fig. 9 shows the paths applying different strategies on the cusp model’s control space.

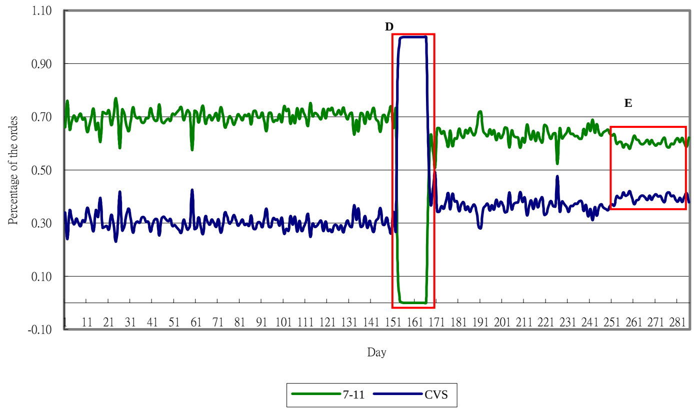


Figure 7. Case1 Analysis: pchome.com (http://shopping.pchome.com.tw/)

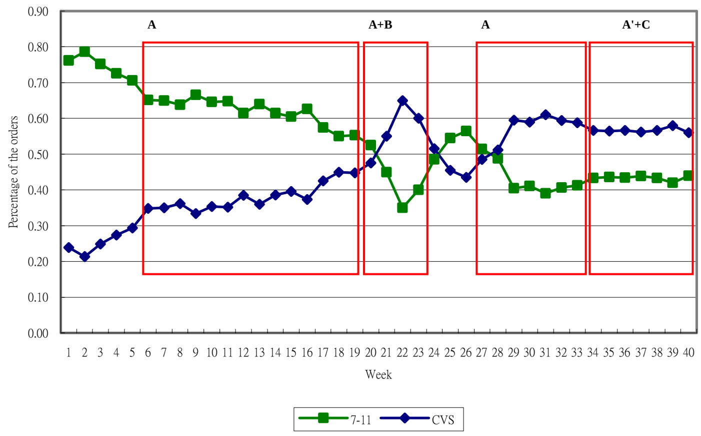


Figure 8. Case2 Analysis: payeasy.com (http://www.payeasy.com.tw)

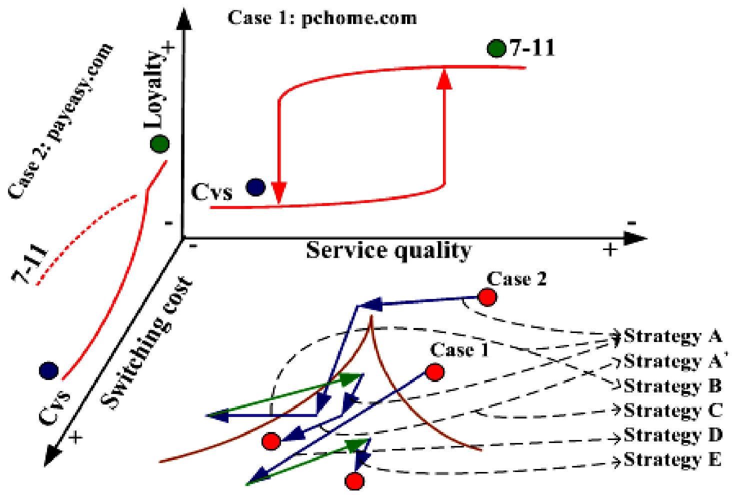


Figure 9. The Effects of Different Strategies on Cvs.com and 7-11.com

## 6. CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

Catastrophe Theory (CT) is a theory of great generality that can provide useful insights as to how behavior may radically changes as a result of smoothly varying control variables. CT theory provides qualitative descriptions of phenomena which may exhibit continuous behavior, discontinuous behavior, or both. When the normal and splitting variables are correctly identified, and the underlying system dynamics are given by catastrophe theory. In this paper, we express the dynamic behavior of the consumer's loyalty when switching cost is present. In order to investigate systems with respect to transitional, discontinuous behavior, a catastrophe theory in the paper is used to analyze the linkages between customer satisfaction and transaction cost on the loyalty of pick-up points.

We develop six different marketing strategies to maintain the loyalty of the retailing delivery. Besides, we describe the nonlinear behavior of the pick-up point services loyalty by changing the customer satisfaction and the switching cost. The results indicate that all testable hypotheses are justified as follows:

- According to the SEM, we suggest that researchers who interested in estimating catastrophe model can consider the service quality and switching cost as two controllable variables.
- When increasing the value of the retailing delivery services through some marketing strategies, such as high premium program, low premium program, free gift, quick ordering, exclusive goods, and compassion promotion, the loyalty relationship between customer and convenient stores will be enhanced.
- The short-term promotion strategies (Strategy B) do significantly affect the consumers' choice behavior on the pick-up point; however this is weak in the long term because of customer loyalty.
- The cusp catastrophe model shows that the feature of catastrophe, hysteresis and divergence exist in case 1 and case 2.
- Improving consumer relationship is more important than developing new customers.

The catastrophe model used in this paper can help us to evaluate the marketing strategies which aim to change consumer's choice of the pick-up point of convenience store. An equally important issue is to develop an appropriate approach to estimate the cusp catastrophe model. Currently, several cusp fitting procedures have been proposed, there are the maximum likelihood method of Cobb (1978), the regression method of Guastello (1982) and GEMCAT of Oliva et al. (1987), but none is completely satisfactory. We hope that our future research will estimate the catastrophe model and examine changes in loyalty due to a changing consumer environment.

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