

Exploring Innovation Model Combine with the Green Marketing to Consumer's Behavior Influence – a Case Study of a TFT-LCD Company

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Abstract - Taiwan is an area with highest TFT-LCD industry density around the world, even exceed Japan and Korea, with anticipating, Taiwan will continue occupying leading position of the whole world in the following several years. Because of economy grows vigorously, the issue seriously damages our environment from day to day, advocating the green industrial revolution becomes one of the main trends in the 21st century, green marketing becomes the crucial operational policy of scientific and technological industry. This research plans to use Bass diffusion model as the foundation structure, putting into the price parameter, setting up the model of revising, regard A company LCD as the case. The result of study finds out the model of this research both right ability and predicts ability is weak signification; demonstrate the sale of influence LCD that green marketing will be ineffective at the same time.

Keywords - TFT-LCD; Diffusion Innovations; Bass model; LCD; Green marketing

I. INTRODUCTION

In recent years, the rapid development of the industry can be divided into three major projects: Telecommunication, Information and Visual, the three projects are the development of focus industry in Taiwan now, it is apparent that human life has been filled with messages in the environment. However, Display industry of the image (Flat Panel Display, FPD) is one of the efficient industries in Taiwan, it's produces value occupies the first place of the top ten photoelectric products, relevant investment projects have already accumulated and exceeded one trillion NT dollars, for its tremendous scales of industry promoted our government prompted 'The national overall plan of six years,' listed it in 'Two-Trillion' (the semiconductor and image show the industry) and 'Two-star' (digit content and biotechnology), this industrial policy anticipated to recreate Taiwan's economic miracle, and Thin Film Transistor - Liquid Crystal Display (TFT-LCD) which output value is the highest in Taiwan's flat panel display (FPD) industry. It has become the important development of domestic industry at present.

Thin Film Transistor - Liquid Crystal Display (TFT-LCD) industry is another industry visual significant breakthrough in the 21th century, particularly in the TFT-LCD industry is rising to power through in Asia, expanding, competition, and cooperation in Asia. Japan, Korea and Taiwan are the global TFT-LCD main

productive base. Overall, The Taiwan TFT-LCD industry development began with 1,990s. Taiwan Industrial Technology Research Institute started to launch TFT-LCD the related research project in 1988, but most of the production is mainly of the medium-and-small-sized manufacturer of TFT-LCD panels. According to relevant information, Taiwan LCD GDP of 126 billion NT dollars which 90.5% came from contributions to the TN-LCD and 9.5% came from STN-LCD after 1988. It came from the technology of Japan's companies, and technology transfer through the introduction of the way to Taiwan.

Because of economy grows vigorously, the issue seriously damages our environment from day by day, advocating the green Industrial Revolution becomes one of the main trends in the 21st century, green marketing becomes the crucial operational policy of scientific and technological industry. Such as TFT-LCD for high-tech products caused by environmental issues that it becomes particularly important.

After the general scientific and technological products are put out, those would face the harsh keen competition of market, especially the high-tech products have some characteristics, such as life cycle is short, renew fast, furthermore, the topic spread in technological innovation seems very important. A Company, makes TFT-LCD as the major product, in order to cope with the Green Time, the company implemented a lot of green policies. For those reasons, this research plans to use Bass diffusion model as the foundation structure, putting into the price parameter, setting up the model of revising, regard A Company liquid crystal display as the case. This research focus on the influence that to sale liquid crystal displays of Taiwan for green marketing, probe into consumer's viewpoints on green marketing.

II. LITERATURE REVIEW

A. The Definition Of Innovation Diffusion

According to Roger [1] was defined innovation diffusion model as: 'Innovation diffusion is constituted with innovation, communication channels, social systems and time four important factors. Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system.' Roger [1] stated that adopters of any new innovation or idea could be categorized as innovators (2.5%), early adopters (13.5%), early majority (34%), late

majority (34%) and laggards (16%), based on a bell curve in Figure 1.

From Roger's study can be seen when a new products to enter the market, usually only a few people were willing to try, use, and this group of consumers is called innovators. Most of the potential consumers were not immediately accepted new products at this time, so the original products will not be immediately replaced by new products on the market. Diffusion of innovation is actually a gradual replacement process.

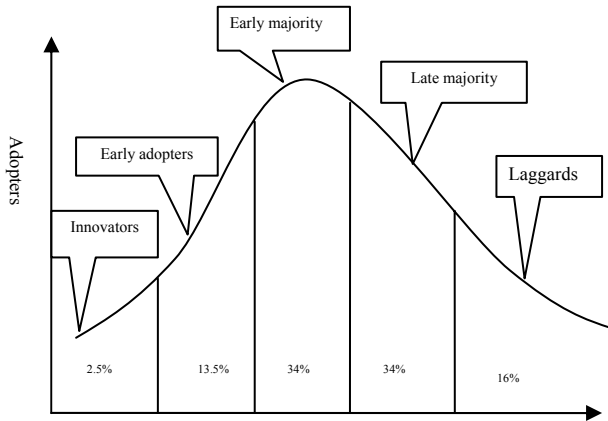


Fig. 1. Adopter categorization on the basis of innovativeness. (Source: Rogers, Everett M. (1983), Diffusion of Innovation, 3rd ed. New York: Free Press.)

B. The Basic Diffusion Models

The best-know first-purchase diffusion models of new product diffusion in marketing are pointed out by Fourt and Woodlock [2] and Mansfield [3]. These early model attempted to describe the penetration and saturation aspects of the diffusion process. Fourt and Woodlock [2] assumes that the diffusion process primarily by the mass-media communication or the external influence. As follows:

$$n(t) = \frac{dN(t)}{dt} = p[m - N(t)] \tag{1-1}$$

Among, $n(t)$: The number of adopters of an innovation at time;

$N(t)$: The cumulative number of adopters of an innovation at time;

p : External influences;
 m : Likely potential adopters, or market potential.

The model proposed by Mansfield [3] assumes this process is driven by word of mouth. As follows:

$$n(t) = \frac{dN(t)}{dt} = bN(t)[m - N(t)] \tag{1-2}$$

Among, $n(t)$: The number of adopters of an innovation at time;

$N(t)$: The cumulative number of adopters of an innovation at time;

b : Internal influences;
 m : Likely potential adopters, or market potential.

Subsuming the models proposed by Fourt and Woodlock and Mansfield [3], the Bass model [4] assumes that potential adopters of an innovation are influenced by two means of communication - mass media and word of mouth. Figure 2 is a plot of the conceptual and analytical structure underlying the Bass model. The Bass model conceptually assumes that 'Innovators' or buyers who adopt exclusively because of the mass-media communication or the external influence are present at any stage of the diffusion process.

The Bass model derives from a hazard function the probability that an adoption will occur at time t even that it has not yet occurred. Bass innovation diffusion model is:

$$\frac{f(t)}{1 - F(t)} = p + qF(t) \tag{1-3}$$

Among, $f(t)$: The probability of adopters of innovative products at time;

$F(t)$: The cumulative probability of adopters of innovative products at time;

p : Innovation coefficient;
 q : Diffusion coefficient.

If m is the potential number of circulation, the number of circulation at time t will be:

$$mf(t) = n(t) \tag{1-4}$$

And the cumulative number of circulation at time t will be:

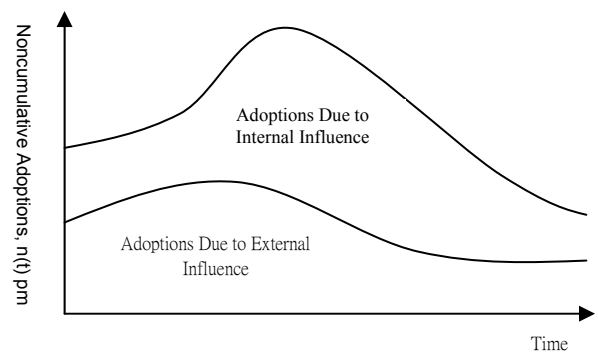


Fig. 2. Adoptions Due to External and Internal Influences in the Bass Model

(Source: Mahajan, V., E. Muller, and F. M. Bass (1990), "New Product Diffusion Models in Marketing: A review and Directions for Research", Journal of Marketing, Vol.54)

$$mf(t) = N(t) \tag{1-5}$$

The basic premise of the Bass model can be manipulated:

$$\frac{f(t)}{1-F(t)} = p + qF(t) = p + q \frac{N(t)}{m} \quad (1-6)$$

Among, $N(t)$: The cumulative number of circulation at time;
 m : Potential market.

Bass referred to p as the “coefficient of innovation.” And Bass referred to q as the “coefficient of imitation.” The basic premise of the equation 1-6 can be manipulated, along with the definitions just provided, to yield:

$$n(t) = p[m - N(t)] + \frac{q}{m} N(t)[m - N(t)] \quad (1-7)$$

Among, $p[m - N(t)]$ in (1-7) represents adoptions due to buyer who are not influenced in the timing of their adoption by the number of people who already have bought the product. In (1-7) $\frac{q}{m} N(t)[m - N(t)]$, represents adoptions due to buyers who are influenced by the number of previous buyers, so when $t = 0$, $n(0) = pm$.

C. Green Marketing

The limitation resources are reducing which is unable to withstand by a kind of the strength fast consumption on the earth. It will be allowed to forecast that the environmental protection crisis will be able to be more serious in the future. The forecast prompted manufacturers active in efforts to improve development on environmental protection. In years ago, business goals and environmental protection seems to be impossible to draw an equal sign. But in recent years, many companies think that economic development and environmental protection will be final mutual influence, coupled with the rise of green awareness, so beginning to implement the green marketing.

Green marketing as a strategic management process, whose objective is appeasing business relationships (Stakeholder) demand for products, and the market is defined as a wide range of conditions [5]. Products made from raw materials, production, sales, consumption, and scrap the entire product life cycle, are to minimize the environmental impact of the degree [6]. To develop a product that can function in the quality of convenience prices on the meet consumer demand, but also mutual coordination and the environment is the environmental impact of the minimum. Products must be created from high-quality image, and include caring for the environment. These will not only manifested in the nature of products, but also reflected in the long-term record on environmental protection [7]. The Green marketing is

not only recognition consumer demand, but also can be profitable and sustainable operation of the management process [8]. Enterprise makes the attitude of the environment manager to carry out marketing activities, and environmental thinking and decision-making with the existing marketing [9]. Manufacturers to develop security products, recyclable packaging is also easy to decomposition, better pollution control and more efficient use of energy operations [10].

Therefore, the above definition of scholars, products made from the original materials, design, manufacture, packaging, consumer, and abandoned in the entire product life cycle, we must constantly review, assess and improve, to avoid wasting resources and harm the environment. And its demands on consumers, create business, consumer, environmental win-win-win opportunity for the marketing practices, or able to 3R (Reduce, Reuse, Recycle) and 3E (Economic low energy consumption, Ecological damage is not Ecological, and Equitable respect for human rights) in order to consider. That can be called green marketing.

III. RESEARCH METHOD

A. Case framework

This research plans to use Bass innovation diffusion model as the fundamental structure, putting into the price parameter (Robinson & Lakhani, 1975) [11], setting up the model of revising, utilizing A Company liquid crystal display as the case. This study predicts the green marketing sales for Taiwan’s LCD market. Therefore to explore consumer’s views on green marketing. The Figure 3 is this research framework.

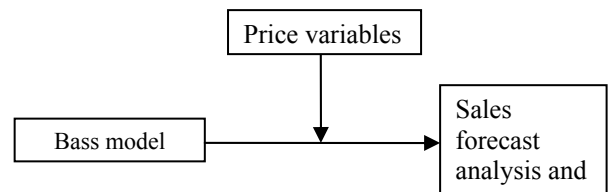


Fig. 3 Research framework

B. Amendments to the proliferation of innovative

The spread of the assumption in basic model of Bass innovative model in order to simplify the model, but its assumption that differentiate from the real situation, resulting in the diffusion of basic Bass innovative model of predictability, the results do not meet the real situation, however, reduced ability to forecast, then gradually to join other scholars’ studies of different price variables to explore the model, variables such as price, advertising expenditures, access roads, and this study, Robinson & Lakhani (1975) will join Bass basic price variables model

of innovation-proliferation point of view, increase their ability to forecast, this study model is as follows:

$$n(t) = \left\{ p[m - N(t)] + \frac{q}{m} N(t)[m - N(t)] \right\} \times \exp(-d \times pr(t)) + \varepsilon(t)$$

Among them, for the price variables is $Q = \exp(d \times pr(t))$

- n (t): The time of the liquid crystal display sales;
- N (t): The time of the cumulative sales of liquid crystal display;
- m: Liquid crystal display of the potential sales;
- p: Time in the innovative factor;
- Q: Liquid crystal display sales;
- d: Price-sensitive factor;
- pr (t): The sales' price after t periods;
- ε (t): errors.

C. Parameter estimation methods

In this study we use SAS / ETS in the three-stage process nonlinear least squares (3SLS Nonlinear Least Square) estimated parameters, to provide simulation and prediction.

D. Assessment criteria

The model fit the ability to determine coefficient (R-square) as the standard, and the ability of the model forecasts range from a revised Theil coefficient (u*) and Mean Absolutely Percentage Error (MAPE), as measured. This study will be from October 2007 to February 2008 five-stroke observation of test range forecast capabilities.

E. Data Source

The source of information for the Company A liquid crystal display of secondary data, the sales volume of its liquid crystal display and sale prices from company A made. Data for analysis will collect From January 2004 to February 2008.

IV. THE RESULTS OF ANALYSIS

A. The empirical results

SAS software used in the three-stage process nonlinear least squares (3SLS Nonlinear Least Square) estimated parameters, the results in **Table 1**.

TABLE 1

To join the proliferation of price variables innovative model of TFT-LCD parameters estimated

Parameter	Estimate	Approx Std Err	t-value	Approx Pr> t	1 st Stage R-Square
Q	-0.01291	5.1683	-0.00	0.9980	1.0000
P	0.012442	5.2762	0.00	0.9981	1.0000
M	4889036	2.0705E9	0.00	0.9981	1.0000

Parameter	Estimate	Approx Std Err	t-value	Approx Pr> t	1 st Stage R-Square
N	-0.23	3.25E-13	-708E9	<.0001	1.0000
R-Square	0.2727				

Can be seen from **Table 1**, by adding the prices after the spread as model variables, t none of significant value. The innovative model of the spread of the R-Square = 0.2727, this study shows that model less relevant. Because R-Square of 0 to 1 the best.

B. Model with an appropriate analysis

After adding the price as the model, the spread of the Mean Absolutely Percentage Error (MAPE), results in **Table 2**.

TABLE 2

After adding the price as the model, the spread of the Mean Absolutely Percentage Error (MAPE)

Date/Month	Actual quantity	Forecast quantity	Error quantity	MAPE
Oct-07	2431238	2254928	176310.2	7.25187045
Nov-07	3044783	2284756	760027.4	24.9616272
Dec-07	773968	2314117	-1540149	-198.99388
Jan-08	1003088	2343023	-1339935	-133.58096
Feb-08	309865	2371483	-2061618	-665.32784

Table 2 can be calculated by the MAPE=-193.1378356.

After adding the price of the amendments to the proliferation of models ranging from Theil coefficient (u*), estimates from January 2004 to September 2007, the estimated results of .378884753.

MAPE and the revised factors ranging from Theil (u*) with two more modest targets was close to zero, the higher ability to forecast models. However, we can see that this research model of its ability to predict not obvious from this study fit the model values.

Synthesizes the above main point, namely this research. This research plans to use Bass diffusion model as the foundation structure, putting into the price parameter, setting up the model of revising, regard A Company liquid crystal display as the case. But R-Square and MAPE are less relevant or not fit. The price variables may be not the main reason that it affects green marketing. Although price is an influential variable, it is a little impact.

V. CONCLUSION

As the population is continuing to increase, economic is going on to boom, the economical harm brought about by consumers increasingly serious, when the green revolution has become the mainstream movement of the 21st century, the green marketing will certainly become an important business strategy of the operation.

Green marketing enterprises need to arouse the conscience, in the design, production, packaging, that we can reduce environmental fatal causes by products, the products of green production would plan to recycle, regenerate and reuse to establish the kinds of service orientation, shaping public enterprises' image and outlining the blueprint for business continuity. Summary, green marketing can guide consumers to join the mainstream of green consumption.

According to the institute to do the empirical results show that this study Bass model by adding the price factor, looking at green factors will not be affected TFT-LCD prices, leading to the proliferation of cases generated innovation. Possible causes include the following points: (1) green factors for the spread of innovation only from the dimensions to the price of slightly less than other factors may need to join the comparative analysis; (2) whether the lack of data, the period required paying more for data analysis. Suggestion, the future studies can be further identifying the extent and impact of the factors, and other industries can also be compared to identify differences of the two. In addition, future studies can also use the subject of green marketing to conductive more in-depth study and understanding.

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