Applying Fuzzy Set Theory on New Product Launch Decisions for Internet Commerce

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Abstract

Many articles have investigated new product development success and failure. However, the existing literature offers little decision-making guidance to managers on how to successfully introduce a product that exhibits network effects. In this article we discuss the factors affecting new product launch success for internet commerce. The study uses the fuzzy logic to develop a fuzzy decision making model to implement evaluation of each factor, which can help decision-maker to get a better judgment. Via implementing this system, we not only can understand the main factors affecting new product launch, but also the internet commerce companies can assess themselves to adjust factors associated with higher success.

1. Introduction

In the past, many studies pointed out that a successful launch of new product is the key to the financial growth and survival of a corporation. Furthermore, under an environment of growing intensively competition, launching new products could bring competitive advantage for a corporation [1, 2]. Thus, the development of success factors for new products launch has been a critical topic in researches.

The risk of launching new products is very high. According to a survey by Product Development and Management Association (PDMA), the average rate of failure of new products could reach 41% and averagely only 1 in 6.6 creative could be commercialized and successfully launched in markets [3].

Because a corporation needs to spend much more time, money and management resources in the stage of new product launch than in other stages [4], choosing a right launching strategy is significant to the corporation. So the purpose of the study is to facilitate internet managers to find out the main factors that might affect new product launches by using fuzzy decision making with the database of opinions provided by internet commerce experts, and properly provide recommendations to enhance their competitive advantages.

According to the explanation by Crawford [5], strategic launching activities were the part of internal strategy of company. The difference between strategic and tactical launching activities was that strategic activities were usually held before tactical launching activities, or even before developing new products. Once strategic launching activities were decided, it was difficult to be changed in the process of product commercialization.

Guiltinan [6] argued that in the stage of product development, a company could consider following three strategic activities for new product launch, they were: target markets, leadership in markets, relative innovativeness. On choosing target markets, a company could adopt niche market strategy or target market strategy.

According to the views from Hultink *et al*. [7], the strategic launching strategy should be defined as product strategy, marketing strategy, competitive stance and firm strategy of New Product Development (NPD). The product strategy included product innovativeness, product newness and NPD cycle time; marketing strategy included targeting strategy, the stage of the product life cycle and introduction into which growth rate of market.

Beard and Easingwood [8] mentioned in their research that in new product launching strategy, targeting customer should be the first step, followed by position of product and then used the product to attack target markets. They said that there were five strategic approaches in targeting customer: targeting new-users, targeting early-users, targeting late-users, targeting customers of current market and targeting customers of competitors.

An effective decision support can assist internet commerce companies to perform appropriate assessments of the factors of NPD. Use of such a support can reduce NPD risk and increase the likelihood of success. In evaluating the rate of factors affecting new product launch, most decision-makers, project-managers or evaluators, in fact, viewed those factors as linguistic values (terms), e.g., very high, high, middle, low, very low, etc. After fuzzy sets theory was introduced by Zadeh [9] to deal with problem in which vagueness was presented, linguistic value could be used for approximate

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reasoning within the framework of fuzzy sets theory [10] to effectively handle the ambiguity involved in the data evaluation and the vague property of linguistic expression, and normal triangular fuzzy numbers were used to characterize fuzzy values of quantitative data and the linguistic terms used in approximate reasoning.

In this study, we propose a fuzzy assessment model to rank the factors order of judgment of experts. The authors also used the fuzzy theory on various applications for assessments [11-12].

In the study, we reorganize factors related to new product launch from second-handed materials including related literature and empirical researches collected in Taiwan and abroad. Then we induct and develop questionnaires for experts and conduct interviews through questionnaire survey among the core members who involved in new product launching processes of internet commerce in e-commerce industry. We file and integrate materials obtained from questionnaire interviews with experts and transform the semantic values of experts' opinions into triangular fuzzy numbers. After obtaining fuzzy values, we conduct integral calculations and rank the fuzzy numbers. Finally we decode fuzzy numbers and transform them back into semantic values to complete the whole calculation.

2. Questionnaire design for the assessment of experts' opinions

According to the above research, we compile the factors in Table 1 that experts thought might affect new product launch as follows: product itself, R & D of product, customer satisfaction, after-sale services, company objectives and market sales. After decoding fuzzy numbers, we could understand which factor is the most important in the eyes of experts.

In traditional policy-decision, you have to find out accurate information. But if the information is uncertain, ambiguous or subjective judgment that cannot be described with accurate values, there are many situations that we could not have accurate information, particularly when the information comes from experiences or subjective judgment, so the information itself has uncertainty and ambiguity. Therefore, the study firstly inducted factors that might affect new product launch and developed questionnaire for experts based on the factors.

The contents of questionnaire for experts' opinions are divided into two parts. The first part was the basic information of corporation that the experts were working with and included five questions. The second part was 29 items of factors under six categories (attributes) that might affect new product launch.

The criteria ratings of the degrees of importance are linguistic variables with five-point scale of linguistic values V_1, V_2, V_3, V_4, V_5, where V_1 = very unimportant, V_2 = unimportant, V_3 = middle, V_4 = important, V_5 = very important. These linguistic values are treated as triangular fuzzy numbers as shown in Table 2.

Table 1. Hierarchical structure model of the overall factors affecting new product launch

Attribute	Item
X_1: Product Itself	X_{11}: Specification X_{12}: Quality X_{13}: Function X_{14}: Price X_{15}: Characteristics X_{16}: Market Survey before Launch X_{17}: Brand X_{18}: Package
X_2: R & D	X_{21}: Innovative Technology X_{22}: Patent X_{23}: Launch Time X_{24}: Design
X_3: Customer Satisfaction	X_{31}: Customer Valuation X_{32}: Customer Satisfaction
X_4: After-Sales Services	X_{41}: The Length of Guarantee Period X_{42}: Any Trial Product or Grace Period
X_5:Company Objective	X_{51}: New Products Expand on Internet X_{52}: Meet Sales Goal of Company X_{52}: Enhance Company's Image X_{53}:Consistent with Company's Strategic Goal X_{54}:Whether New Product Achieve Specific Goal X_{55}:Whether the Cost of Advertisement on Internet for New Product Is Achieved Within Original Budget X_{56}: Whether the Cost Incurred in Each Stage Is Controlled within Original Budget
X_6: Market Sales	X_{61}: The Share of New Product Sales in Total Sales X_{62}: Profitability of New Product X_{63}: New Product Sales Comparing with Competitors' Sales X_{64}: Market share of New Product

Table 2. Fuzzy numbers of grade of importance

Grade of importance	Linguistic values	Normal triangular fuzzy number
1	V_1 =Very unimportant	$\widetilde{V}_1$ =(0.0, 0.0, 0.25)
2	V_2 =Unimportant	$\widetilde{V}_2$ =(0.0, 0.25, 0.5)
3	V_3 =Middle	$\widetilde{V}_3$ =(0.25, 0.5, 0.75)
4	V_4 =Important	$\widetilde{V}_4$ =(0.5, 0.75, 1.0)
5	V_5 =Very important	$\widetilde{V}_5$ =(0.75, 1.0, 1.0)

According to Table 1, and Table 2, we represent the contents of questionnaire for the assessment of expert's opinions as shown in Table 3. In Table 3,

$\tilde{A}_{il}^{(j)}$ is either $\tilde{V}_1$, or $\tilde{V}_2$, $\tilde{V}_3$, $\tilde{V}_4$, or $\tilde{V}_5$.

Table 3. Contents of questionnaire for the assessment of expert's opinions, named E_j

Attributes	Items	Grade of importance
X_1		
	X_{11}	$\tilde{A}_{11}^{(j)}$
	X_{12}	$\tilde{A}_{12}^{(j)}$
	:	:
	X_{18}	$\tilde{A}_{18}^{(j)}$
X_2		
	X_{21}	$\tilde{A}_{21}^{(j)}$
	:	:
	X_{24}	$\tilde{A}_{24}^{(j)}$
X_3		
	X_{31}	$\tilde{A}_{31}^{(j)}$
	X_{32}	$\tilde{A}_{32}^{(j)}$
X_4		
	X_{41}	$\tilde{A}_{41}^{(j)}$
	:	:
	X_{44}	$\tilde{A}_{44}^{(j)}$
X_5		
	X_{51}	$\tilde{A}_{51}^{(j)}$
	X_{52}	$\tilde{A}_{52}^{(j)}$
	:	:
	X_{57}	$\tilde{A}_{57}^{(j)}$
X_6		
	X_{61}	$\tilde{A}_{61}^{(j)}$
	:	:
	X_{64}	$\tilde{A}_{64}^{(j)}$

3. Algorithm

In this Section, we present the algorithm for the assessment of experts' opinions.

We let *h(k)* be the number of items for the attribute X_k, k=1, 2, …, 6. From Table 1, we have $h(1)=8$, $h(2)=4$, $h(3)=2$, $h(4)=4$, $h(5)=7$, $h(6)=4$.

Let

$$\tilde{A}_{il} = \frac{1}{n} \otimes (\tilde{A}_{il}^{(1)} \oplus \tilde{A}_{il}^{(2)} \oplus \ldots \oplus \tilde{A}_{il}^{(n)}) \quad (1)$$

Then, the $\tilde{A}_{il}$ is the average of the importance for the item X_{il}.

Let

$$\tilde{A}_i = \frac{1}{h(i)} \otimes (\tilde{A}_{i1} \oplus \tilde{A}_{i2} \oplus \ldots \oplus \tilde{A}_{ih(i)}) \quad (2)$$

Then the fuzzy number $\tilde{A}_i$ is the average of the importance of the attribute X_i for the group experts' opinions.

Let $C(\tilde{A}_i)$ be the defuzzification of $\tilde{A}_i$ by the centroid method [12]. Then, we can have that the $C(\tilde{A}_i)$ is the group of experts' opinions for the attribute X_i.

4. Empirical implementation

According to the list of collection of questionnaire for expert's opinions, most of the experts in the list are those who have personally participated in new product launching activities of Internet shopping in e-commerce industry for more than two years. Total 107 questionnaires are issued, 71 of them are retrieved and 59 are effective questionnaires. The actual valid rate of the questionnaires is 55.41%. The questionnaires might be determined as ineffective while the surveyed expert did not select an option or selected more than one options or blank options.

Followings are general statement of statistics of the first part of retrieved questionnaire:

(1) On the statistics of status of the surveyed: in terms of departments: 19% are from R & D departments, 3% are from production departments, 14% are from marketing departments, 17% are from purchase departments, 12% are from sales departments, 23% are from other departments; in terms of title, 20% are engineers, 7% are designers, 36% are specialists, 2% are inspectors generals, 12% are managers, 8% are section chiefs, 3% are vice presidents, 7% are general managers, 3% are planning personals, 2% are assistant managers.

(2) As to the number of years the experts working on internet shopping related departments the surveyed results as follows: less than one year, 8%; 1-3 years, 41%; 3-5 years, 37%; 5-10 years, 12%; more than 10 years, 2%.

(3) In terms of last year's turnover volumes of the companies that the surveyed results as follows: less than 5 millions, 15%; 5.01millions to 10 millions, 30%; 10.1 millions to 50 millions, more than 100 millions, 20%.

(4) In terms of numbers of employees the companies that the surveyed were working with, 10 or less than 10 employees, 17%; 11-50, 30%; 51-100, 22%; more than 100, 31%.

(5) On how the company acquires product, OEM, 7%; design and processing, 20%; private label, 19%; wholesale, 21%; overseas purchase, 14%; others, 19%.

Assume that we have the attributes, items, and grade of importance of factors for each evaluating item as shown in Table 3.

By the evaluating process shown in Section 3, we have

$$(C(\tilde{A}_1), C(\tilde{A}_2), C(\tilde{A}_3), C(\tilde{A}_4), C(\tilde{A}_5), C(\tilde{A}_6), C(\tilde{A}_7))$$

= (0.72, 0.63, 0.77, 0.75, 0.70, 0.68)

Finally, we could get from the defuzzified results of the order of six factors that may affect new product launch as follows:

1st. X_3: Customer Satisfaction
2nd. X_4: After-Sales Services
3rd. X_1: Product Itself
4th. X_5: Objectives of Company
5th. X_6: Market Sales
6th. X_2: R & D

The most important factor that might affect new product launch is customer satisfaction, followed by after-sales services, company's objective and finance. The score of after-sales services was close to customer satisfaction. The least effect was R & D of product.

5. Conclusion

Because new product launch plays a very important role in the entire launching process, how to find out key factors of success and failure with the past solutions in business management is a matter of success and failure for enterprise owner. Under many situations, it will be difficult to find out accurate information, particularly, if the information comes from subjective judgment that the information itself has uncertainty and ambiguity. Therefore, the research team recommends the adoption of fuzzy theory to solve the problem and meet practical needs.

The study aims to explore the factors that may affect new product launch. After hypotheses establishment and analyses of fuzzy theory, as the literature mentioned, the strategy for launching new product had significant effect on the success of new product. From the empirical research, promotions may attract internet shoppers as they are more likely to make impulsive purchase decisions and the launch of a new product may be of particular interest to Internet shoppers as they are always looking for new things. The analysis results show that the experts care very much about customer satisfaction because if the customers satisfied new products, that means the new products are good to use and customers may like to buy them again. Customer satisfaction would spread to others, particular on internet that facilitates customers with availability of the new products. It could raise sales and enhance the effects of sales to double the rate of success of the new product launch. Furthermore, the experts think that R & D of products is less important for new product launch because after successful launch of new products, the seller might continue to marketing the product and feel unnecessary to develop new products because the process of R & D is much more time and cost consuming than original products.

The results may not react to the real market, since we only take some examples of experts of internet commerce industry. In the future study, we may divide the experts into different groups by their working department or title. Thus, we can give the weight for various groups of experts and extend our study with more comprehensive analysis.

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