A Study of Innovative Ideas Screening Model Applied to Bicycle Industry

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Abstract: Product innovation is a key factor for organization's sustainability. Idea screening largely determines the fate of a new product. If the probability of successful ideas can be enhanced effectively, enterprises would be more willing to invest in new products. Innovative Ideas Screening Model (IISM) can measure success potential of new products, objectively and effectively. Green products are trendy and bicycle is one with great potential. Bicycle industry contributes considerable revenue to Taiwan and the innovation of which is vital. Sponsored by Cycling and Health Center in Taiwan, the goals of this research are three folds: to examine whether IISM is feasible for bicycle industry, to define a threshold that can identify ideas with success potential, and to suggest a screening procedure for bicycle industry. As a result, IISM is feasible and effective, and through the suggested procedure, a threshold can be established accordingly.

Keywords: Innovative Products, Innovative Ideas Screening Model, Bicycle Industry

1. Introduction

Bicycle industry is one of the representative conventional industries in Taiwan, which ever honored Taiwan the reputation of "Kingdom of Bicycle" and with NT$16 billion dollars output value each year. However, adjustment of industry structure induces the products which are low-priced and less innovative to gradually migrate to other countries with cheaper labor cost, such as China and Vietnam. Therefore, continuous innovation and own brand are the competitive advantages and key points for business continuity.

Hass (1989) indicated that 32% profits of the American manufacturing industry come from the contribution of new products. Griffin (1997) also pointed out that, on average, 30% of the enterprises' profits come from the new products which were launched in the last five years. Tidd (2000) claimed that the enterprises can earn great profit, market share and financial performance by successfully developing new products and services. Ragatz et al. (2002) also indicated that new product development (NPD) is a core process that is instrumental for success in the new global economy. Adopting innovative knowledge and technique in commercialization and industry promotion would make the enterprise keep growing and expanding.

For bicycle industry, innovative products can bring in numbers of profits and increase the enterprise's market share in the developing bicycle market as well. However, many SMEs in bicycle industry are passive and conservative to product innovation, mainly because that most of the SMEs consider the benefit of innovation is less than what they expected. Study of Hollins and Stuart (1990) showed that, on average, the success rate of new product commercialization is merely 4.75%. Kotler (1996) statistically verified that the success rate of industry innovation is less than 20%. Besides, James Burly et al (1997) pointed out that the failure rate of new product is quite high, and only one idea can be successfully commercialized among three thousand ideas on average. With the relatively low success rate, most of the managers and stakeholders are afraid of and reluctant to invest in innovation. Bicycle industry has limited scale of capital and is confronted with a keen competition recently, and thus any incorrect investment of a new product might bring hazard to the enterprise. Therefore, for the conventional bicycle industry, how to estimate the future development of new products and to increase the success rate are extremely important and imperative.

The research of PDMA (1996) indicated that while numbers of new ideas would be generated during the product innovation process, only one or few ideas can be commercialized due to the limited resources and market demand. Having a precise and correct screening of potential ideas is the key factor in the new product development process for any modern enterprise. Cooper (1990) claimed that the idea assessment process during and between NPD can be divided into two elements. One is "Stage Screening" which aims to develop and improve ideas in a project, normally the best would be selected in the end; the other is "Gate Screening," which focuses on reducing the number of projects or innovative ideas for a more significant development or investment. Assessment tools for performing stage screening have been developed for years and are effective; however, objective tools for the gate screening are limited, whilst the subjective judgments of managers are mostly adopted (Luh, 2000). Moreover, during the gate screening process, if the manager or decision maker cannot analyze the market correctly or make the decision precisely, the mistake would not only be hardly discovered in the following process but also increase the market failure risk of new product. An effective assessment tool of gate screening is essential for decision maker, and is also a key factor to increase the success rate of new product.

According to previous discussion, the NPD process lacks of the assessment tool for gate screening. Luh (2002) proposed Innovative Idea Screening Model (IISM), which is effectively applicable to more innovative industries. Furthermore, Zheng (2004) successfully verified that IISM is suitable to evaluate the NPD in the conventional industry. The model could not only have qualitative description, quantitative measurement but also evaluate the innovation in different levels. There are three objectives of this study: (1) To understand that whether the IISM is suitable for bicycle industry; (2) To build up the threshold of bicycle industry based on IISM, and; (3) To develop the procedure and guideline of IISM for the bicycle industry.

2. Literature Review

2.1 Innovative Product

The definition of innovation is different from the products and markets. Betz (1998) considered innovation is to lead a new product, form or service into market. Afuah (1998) pointed out that innovation is an activity of combining new thing and market. Veryzer (1998) defined the innovation as the creation of a product, service or process. Innovation can be thought of as falling on a continuum from evolutionary or "continuous" to revolutionary or "discontinuous." The definitions of innovative product are many. Kolter (1996) indicated that

no matter what kind of product, service or idea, as long as people consider it is new, it can be regarded as innovative product. Lai (1990) indicated that the innovative product is the product which is relatively different from existing ones, whether it is a worldwide new product or merely an improvement of the existing one. Cooper (1998) issued the innovative product in two dimensions: "New to the Company," meaning that the innovative product has never been produced or sold by a company, and "New to the Market," the innovative product has never been launched in a specific market. As long as it has never been launched in the market or proposed by any enterprises, tangible and intangible products, such as creativity and service, can be defined as an innovative idea. The range of innovation includes incremental or disruptive, which is relative to person, enterprise, organization, market or region.

2.2 Bicycle Industry

Bicycle industry in Taiwan began in 1940s and went through the ebb and flow. Zhou (2002) generalized six development stages of bicycle industry in Taiwan, which are the stage of assemblage and production, domestic production of components, flourish of small factories, export expanding, industry transformation, and industry upgrading. From OEM (Original Equipment Manufacture) to OBM (Own Branding & Manufacture), bicycle industry in Taiwan has a comprehensive industrial chain, and shows great potential.

However, the production departments of bicycle industry have gradually migrated to mainland China in recent years, seriously affecting the industrial ecology. To maintain the competitive advantage of Taiwan bicycle industry, Giant and Merida appealed other enterprises to establish an alliance of bicycle industry- "A Team," which aims to integrate the global market, upgrade innovative capability and develop international brand. Lately, the trend of bicycle sport makes the domestic market undergo a keen competition. To attract customers and increase market shares, new design and new product should be developed constantly. Most of the bicycle companies are SMEs with limited budget for innovation, it is important to ensure that the new product has high market potential and beneficial result.

2.3 Innovative Ideas Screening Model

Innovative Ideas Screening Model (IISM) was proposed by Luh in 2000 and verified feasible for explaining new product decisions and effective in establishing threshold for idea selection during the gate screening process. Besides, IISM can assist managers in decision making between different project ideas by providing objective statistic data. Following is the framework of IISM (Figure 1).

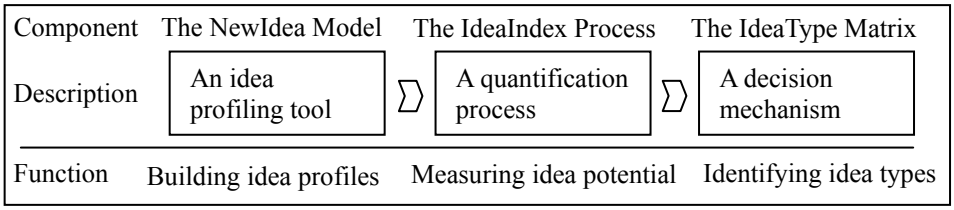

Figure 1 IISM Framework

IISM has three components: a measurement tool (the NewIdea Model) for building qualitative idea profiles, a quantification process (the IdeaIndex Process) for measuring idea potential, and a decision mechanism (the IdeaType Matrix) for idea classification and selection. The three components can be further expanded to four systematic procedures (Luh, 2000, Zheng, 2005):

(1) Building idea profiles: The NewIdea Model is a typical checklist scoring model. It functions to interpret descriptive new project ideas into standardized idea profile format which contains sixteen questions or screening criteria, eight for producer concerns and eight for user concerns. According to the whole innovation process, eight key activity components are identified: on producer's side, developments related to technology, product, production (or process), marketing, and assessment of the above producer-related innovation processes; on the user's side, activities of purchase (or decision), of use (or implementation) and of continuance (or confirmation), and evaluation of the above user-related innovation processes. For each evaluation criterion, five "criteria status" are suggested, representing five distinct characteristics in relation to the evaluation criterion. Criteria status are simply denoted by assigned "status indexes", 1 indicates least, and 5 means most, relative potential to achieve commercial success in a given evaluation aspect. An idea profile is generated after finishing the NewIdea Model, which consists of a product profile (Pr[IP]) and a user profile (Ur[IP]), which could be illustrated by Pr[IP]= [A1, B2, C3, D4, E5, F4, G3, O2] and Ur[IP]= [H5, I4, J3, K2, L1, M2, N3, P4] as examples.

(2) Measuring idea potential: In the IdeaIndex Process, qualitative idea profiles are translated into quantitative representations and their success potentials are measured. It consists of two major steps, the first is to translate idea profiles (Pr[IP] and Ur[IP]) into quantitative representations, and then to interpret the quantitative representations into meaningful success potential indexes, which can be further revealed by two indexes: "Initial Adoptability Index (IAI)" and "Average Diffusibility Index (ADI)." The former indicates an idea's initial success potential (potential for short-term success) and the latter shows an idea's overall success potential (potential for long-term success). Key factors in innovation adoption process and characteristics of adopter types in early innovation diffusion processes are analyzed, the form focuses on artifact or product and the latter on people or adopters. Through which, Weights and Weights Sets for Early Diffusion Phases are developed (Table 1). Based on the weights sets, the weighted profile points distribution of a producer profile and that of a user profile can be obtained, simply expressed as Pw[IP] and Uw[IP], respectively, in which Pw[IP]=(Qin[Pr], Qea[Pr], Qem[Pr]) and Uw[IP]=(Qin[Ur], Qea[Ur], Qem[Ur]).

Table 1 Weights and Weight Sets for Early Diffusion Phases

Criteria codes (Producer's concerns)	**Weight Sets**			**Criteria codes (User's concerns)**
	Innovators	Early Adopters	Early Majority	
	Qin[IP]	Qea[IP]	Qem[IP].	
A (system change)	0.0714	0.1000	0.0833	H (competition status)
B (technology status)	0.0714	0.1000	0.0833	K (behavioral change)
C (product advancement)	0.0714	0.1500	0.2501	L (use status)
D (product newness)	0.0714	0.1000	0.0833	N (adopter status)
E (design specification)	0.0714	0.1000	0.0833	M (product wholeness)
F (production basis)	0.0714	0.1500	0.2501	J (need status)
G (distribution channel)	0.0714	0.1000	0.0833	I (merchandise status)
O (producer benefit)	0.5002	0.2000	0.0833	P (user benefit)
Total	1.0000	1.0000	1.0000	Total

A commercial success implies "the money returned is greater than all the money invested in creating that product". Hence, an idea's adoptability (ability for adoption) in various phases, or an idea's success potential distribution (Sw[IP]), can be defined as: SW[IP] = Uw[IP]/Pw[IP] = (Sin[IP], Sea[IP], Sem[IP]). For facilitating analysis, Sw[IP] can be further expressed by a linear model (Figure 2): SLR[IP] = r＋sX, in

which s = (Sem[IP]－Sin[IP])/2, r = (Sin[IP]＋Sea[IP]＋Sem[IP])/3－s*2} and X stands for phase index, P(H[IP])= P(H5, H4, H3, H2, H1) = [0, 0.5, 1, 2, 3].

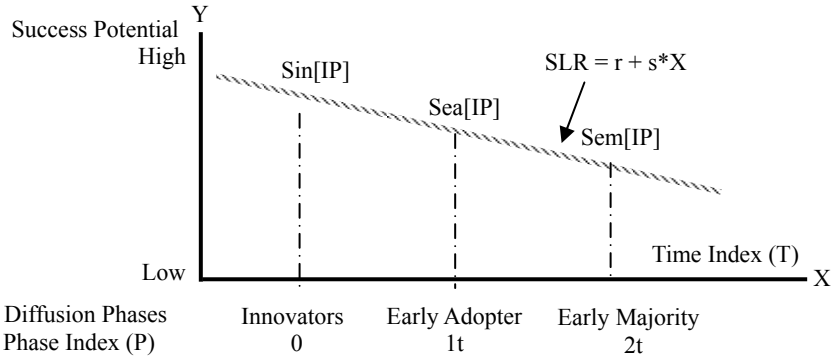

Figure 2 Linear Model for Success Potential Distribution

An SLR model refers to an idea's success potential distribution in earlier diffusion phases. "Average Diffusibility Index (ADI)" and "Initial Adoptability Index (IAI)" represent long-term and short-term success potential of the specific innovation, respectively, where ADI[IP] = s/T[IP] and IAI[IP] = r+ ADI*P(H[IP])
(T [IP] = H[IP]/I[IP], where "T" stands for estimation of a normalized time span of an idea in early diffusion phases; "I[IP]" and "H[IP]" represent status index of an idea's merchandise status criterion and that of its competition status criterion).

(3) Identifying idea types: The IdeaType Matrix functions to identify the ideas worthy of further development, which consists of two steps, the first is to test an idea's IAI and ADI measures against the threshold empirically established and then classify the ideas in accordance with the test results. Based on the IAI and ADI measures and through the idea classification matrix (thresholds for short-term success and long-term success), ideas fall into one of the four "idea type" (Figure 3). "Questionable Ideas" with inadequate IAI and ADI values, are essentially poor ideas that should be removed from the process. "Developable Ideas," with satisfactory IAI and ADI readings, are potentially viable ideas worthy of further development. "Improvable (I) Ideas" with superior IAI but inferior ADI measures, can be viewed as good ideas when shot-term profits are emphasized. "Improvable (II) Ideas" with good ADI and poor IAI scales, can be seen as good ideas when long-term benefits are focused.

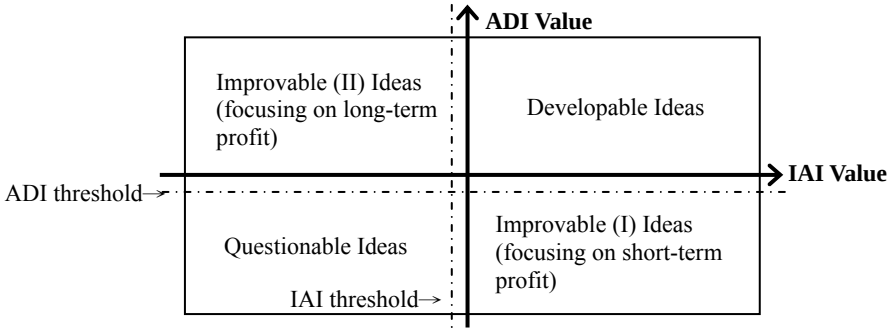

Figure 3 The IdeaType Matrix

(4) Forecasting the new product: An appropriate, or less arguable, estimate for evaluating innovative ideas, "Om Point", is applied. An "Om Point" refers to the middle point between the IAI and ADI measure of an idea(IP) with a criteria status of IAI(O5), ADI(O5) and IAI(O1), ADI(O1), which can be illustrated by

[IAI(05)＋IAI(01)] /2 and [ADI(05)＋ADI(01)] /2. With the estimated benefit result, new product can be measured accordingly.

3. Research Design

This study is an empirical study which aims to verify the feasibility of IISM for bicycle industry. Three hypotheses are proposed.

Hypothesis 1: IISM can successfully quantify the new products and separate them into successful or failed groups.

Hypothesis 2: The threshold of bicycle industry is different from other industries.

Hypothesis 3: IISM can forecast the success potential of new product to a satisfactory extent.

According to the procedures adjusted by Zheng (2004), the research is deployed. The interviewers together with the managers of target companies adjust the questions of the NewIdea Model into meaningful descriptions to the interviewees, so that they can answer the questions easily and correctly. The companies provide enough amount of NPD samples as studied cases, each case consists of a failure experience at the outset and finally a successful one. The case samples are then divided into two groups, pretest and posttest groups for verification purpose. Qualified interviewees are asked to answer the NewIdea Model to see whether they can answer all relevant questions. After enough amount of cases are collected, the data is then input into the IdeaIndex Process for quantification. As a result, IAI and ADI measures for each project case can be obtained.

The T-test method is adopted to examine IAI and ADI measures of the product cases. Hypothesis 1 sustains if the measures of the successful cases can be explicitly separated from the ones of the failures. Hypothesis 2 sustains if the thresholds for bicycle industry can be successfully defined for idea categorization, which should be distinct from the ones for other industries. These thresholds are then applied to examine the product cases in the posttest group. In accordance with the formula for predicting an idea in development, the IAI and ADI values of the posttest group cases are calculated. If the cases can be effectively categorized, Hypothesis 3 can be verified.

Through the above procedures, the feasibility and effectiveness of IISM for bicycle industry can be reckoned. To expand the application of this study, products from different categories are also included and analyzed accordingly to propose a universal evaluation tool for conventional bicycle industry. Companies with production abilities and marketing departments are qualified as subjective. Based on the requirements and the recommendation of Cycling and Health Center in Taiwan, three representative companies producing bicycle products and baby carriage products are selected. The managers who are responsible for production, R&D or marketing strategy would be interviewed with the NewIdea Model to have the descriptive analysis of each case.

4. Result Analysis

All of the interviewed managers considered the questions of NewIdea Model are suitable for bicycle and baby carriage industries and understandable for the producers and users, no specific terms or descriptions need to be adjusted. Three targeted companies provided 14 products in total for the pretest group cases, which included 7 successful products and 7 failed developments. With the provided formula, success potential of each idea was obtained and marked in the IdeaType Matrix (Figure 4). The result shows that points of successful and failed

products were distributed separately. Most of the successful ideas are located towards the quadrant of "Developable Ideas", while the failed ideas are located close to the areas of "Questionable Ideas" and "Improvable (I) Ideas".

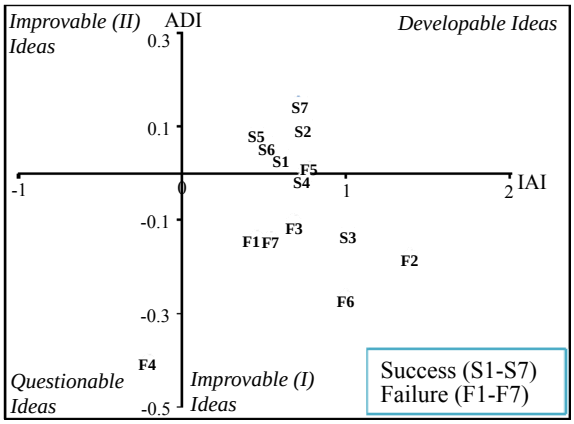

Figure 4 Distribution of pretest group

To further confirm the difference between the successful and failed products, T-test is adopted to analyze measures of IAI and those of ADI of all product cases (Table 2). After grouping the successful and failed ideas, the null hypothesis and alternative hypothesis could be set ($\alpha = 0.05$).

IAI dimension: H0: There is no difference. H1: There is a significant difference

ADI dimension: H0: There is no difference. H1: There is a significant difference

Table 2 T-test result

Dimension	Product	Average	Standard Deviation	P-value
IAI	Successful Product	0.6781	0.1831	0.4651
	Failed Product	0.7214	0.3864	
ADI	Successful Product	0.0482	0.0919	0.0018
	Failed Product	-0.1706	0.1316	

The p-value of IAI dimension is 0.4651, greater than 0.05, which indicates the alternative hypothesis (H1) is rejected. The p-value of ADI is 0.0018, smaller than 0.05, which indicates the alternative hypothesis is accepted.

According to the result, it seems that the significant difference of IAI cannot be identified by T-test. In consideration of the characteristics of bicycle and baby carriage industries, the narrow price band and similar targeted profit make the difference of IAI dimension less significant. On the contrary, the ADI dimension is verified to be significantly different. However, the distribution of IAI and ADI shows the successful and failed products separate apparently. Therefore, the Hypothesis 1, the IISM can successfully quantify the new products and separate them into successful or failed groups, still can be verified.

The threshold of the bicycle industry should be deduced to examine the Hypothesis 2. According to the definition of Luh (2000), the formula for threshold is the average of IAI/ADI minus the standard deviation of IAI/ADI. By applying this formula, the threshold of IAI is 0.4950 and the threshold of ADI is －0.0437. The IdeaType Matrix for bicycle industry can then be established (Figure 5).

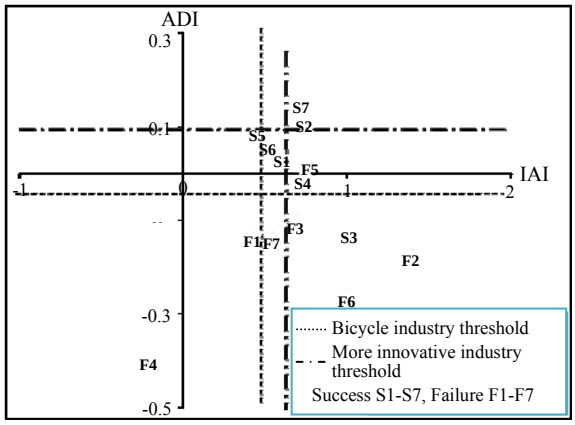

Figure 5 Threshold of the bicycle industry and more innovative product industry

Compared with the thresholds of more innovative industries, the thresholds of IAI and ADI of bicycle industry are low, indicating that the thresholds of bicycle industry are indeed different from those of more innovative industries. Hence, Hypothesis 2 can be verified.

According to the thresholds for more innovative industries, most of the products of bicycle industry are located in the second, third or fourth quadrant, and the IAI and ADI threshold of bicycle industry are both lower. The result reveals that the bicycle industry belongs to less innovative industry. The products of assigned number S2 and S7 are only two successful bicycle products which are located in the first quadrant of more innovative industry's IdeaType Matrix. Reviewing the data of S2 and S7 products, original design and creative functions of these two products could be found, implying that the thresholds for more innovative ideas should be greater then the less innovative ones.

After establishing the threshold of bicycle industry, the posttest group cases, consisting of 7 successful products and 7 failed developments, are examined in the assumption of not knowing success or failure. By adopting the "Om Point" concept, the distribution of the posttest ideas can be identified (Figure 6). The result shows that six ideas are located in the first quadrant, five of which are successful products. The accuracy rate for prediction of the successful products is 71%. Among the eight ideas located in the other quadrants that are related to failed developments, six are failed products and the prediction rate of accuracy for failed products is 86%. On averaging, a prediction rate of accuracy for bicycle industry is 79%, which achieves a middle-high level and is significantly greater than any success rate of failure rate reported by any scholar. Hence, the Hypothesis 3 is verified.

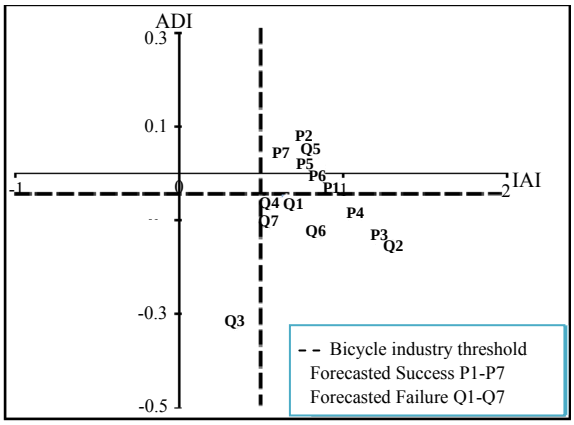

Figure 6 Distribution of the posttest group

To assist enterprises in applying the IISM for self-evaluation, a specific procedure for bicycle industry is

proposed (Figure 7):

(1) Pre-procedure: To confirm that the interviewees can completely understand the NewIdea Model, adjustment should be made in accordance with the characteristics of the products in the adopting industry. Explanation of evaluation process and training of questions answering should be given to the interviewees before testing.

(2) Establishment of the threshold (Stage 1): Before analyzing the new products, the interviewer should collect the history data of existing products and adopt the NewIdea Model and IdeaIndex process to build up the threshold of the industry.

(3) Analysis of new products (Stage 2): Applying "Om Point" to analyze the new products for estimation. Although the new products are still being developed, the marketing strategy after launching should be taken into account in the measuring process. With such consideration, the result of the NewIdea Model could be more precise and reliable.

(4) Evaluation of ideas (Stage 3): Developable ideas refer to the ideas with greater success potential, it would not be a success without continuous efforts and further refinement. With the measures of IAI and ADI and the framework of idea profiles, directions for refinement and further development can be gained less strenuously. The revised ideas can be re-assessed to confirm improvement. With the process, the product can be measured and refined effectively to increase the opportunity for success whilst decreasing the risk of failure.

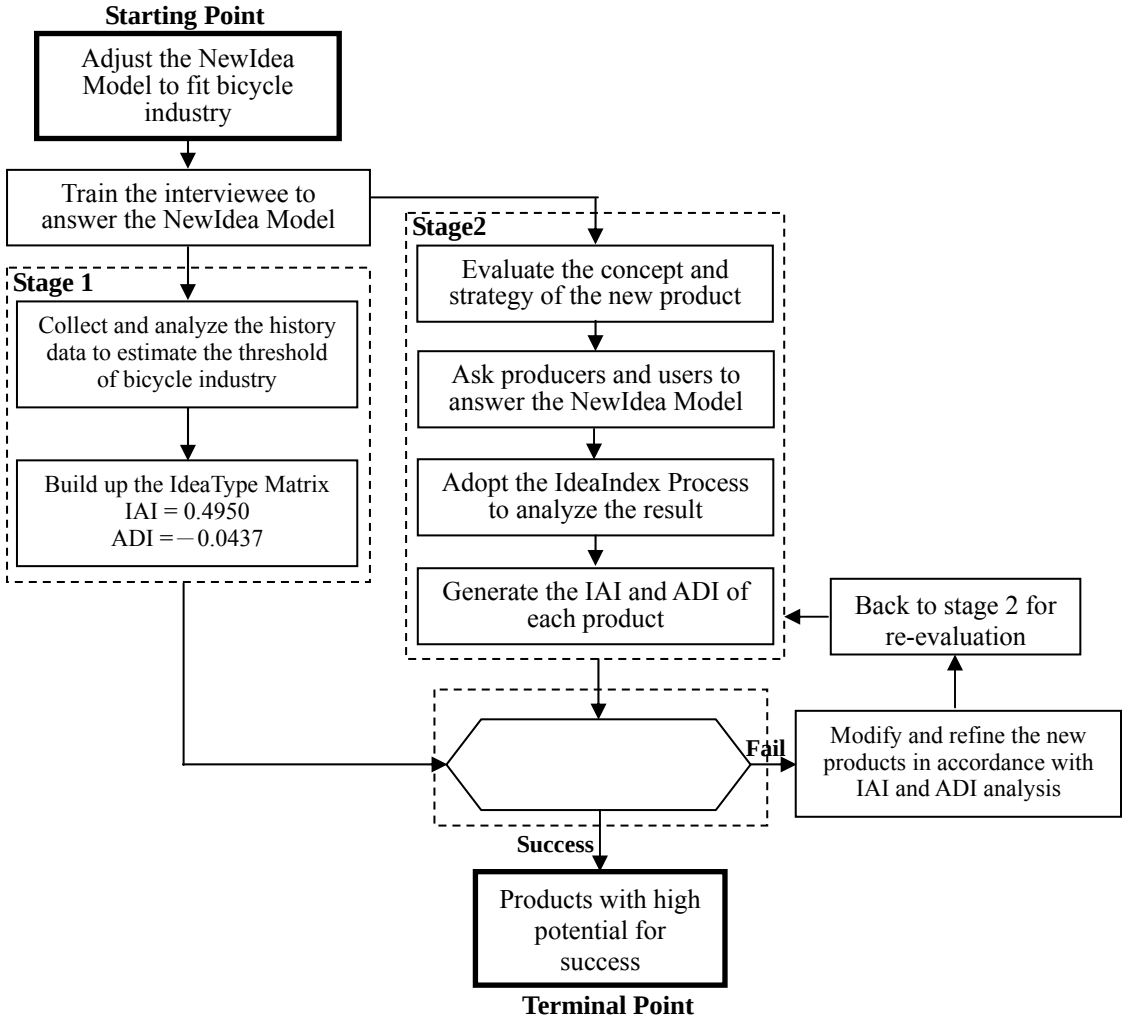

Figure 7 Procedure of IISM for the bicycle industry

5. Conclusions

From the above discussions, the following conclusions can be drawn:

(1) IISM is a feasible and effective tool for analysis of the bicycle industry.

(2) Thresholds of IISM are different among industries. A threshold for the bicycle industry is established (0.495, -0.0437), with an estimated accuracy rate of 79%, gained from the limited sample size.

(3) With the measures of IAI and ADI and the framework of idea profiles, directions for refinement and further development can be gained less strenuously.

(4) The IISM procedure for bicycle industry is suggested to consist of four elements, namely Pre-procedure, Establishment of the threshold, Analysis of new products, and Evaluation of ideas.

(5) To expand the effectiveness of IISM, it can be applied to intangible products, such as service, intellectual property development for further study and research.

Acknowledgement

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