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ON ENTERPRISE PRODUCT INNOVATION ASSESSMENT AND BEST PRACTICES

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Abstract Driven by managers' desire to identify and implement an optimal new product development process, the search for best practices of new product development is ongoing,. This article proposes a methodology to identify best practice enterprises, discovers the best practices in new product development through statistic analyzing the significance of difference of the processes, tools or methods between the best and the rest. Structural Equation Modeling is also used to probe the internal mechnism and path to improve product innovatoin performance. This study can give deep insight that how industry leaders do things and thereby to identify what may have to change for other enterprises to create a sustainable, competitive advantage.

Key word Product innovatoin;Best practice;Structural Equation Modeling

1 Introduction

Product innovation is crucial to the suvival and prosperity of the morden corporations, However, enterprises operate in dynamic environment, both the competitive and internal conditions in which enterprises operate evolve over time. In response, management processes must also change over time so that enterprises can remain effective and competitve through the changing situation, many new processes, techniques, and tools purpoting to improve the practice of product development have been developed by academics, consultants and practitioners over the previous decades[1]. Therefore, It is of importance to study the conduct and performance of new product development. However, developing a steady stream of successful new products is no easy task, many managers, researchers and pundits have sought answers to the age-old question: Why are some businesses so much more successful at product development than the rest? [2]

Quantitative studies of successful products versus unsuccessful ones since the early 1970s[3], best practices represent tactics or methods that have been shown through real-life implementation to be successful, which enable researchers to pinpoint the critical reasons for success. This is accomplished through three phases: (1) performance benchmarks, which provide data that measure the gap between an organization's performance and others; (2) process proficiency, where the respective organization inventories and documents its processes and assigns ownership for process improvement to become proficient; and (3) best practice mastery, where the respective firm incorporates what it sees as best practice. [4]

The purpose of this article is to use the framework of best practice study and proposes the methodology to identify the industry leaders, discovers the best practices in new product development, and probe the internal mechnism and path to improve product innovatoin performance.

2 Methodology

The study focuses on the entire new product development program of an enterprises or division as the unit of analysis rather than any particular new product(s) [5]. The survey covers following issues: (1) Product innovation environemnt and strategy; (2) The fuzzy front end (FFE); (3) Portfolio management; (4) The NPD process and tools; (5) Market research and tools; (6) Organization for NPD; (7) Product innovation outcome or performance; (8) Background information on the respondents.

2.1 Sample and demographics analysis

The technology base (high tech, low tech, or mixed), market (consumer, business, or mixed), product type (goods or service) and sales of the respondents will be collected, the statistically significance of the sample will be analyzed by using ANOVA test.

$F = \dfrac{MS_I}{MS_E}$, test degree of freedom: $v_I = a-1$, $v_E = a \times b - a - b + 1$.

Where, mean square of industry $MS_I = \dfrac{\dfrac{\sum_{i=1}^{a}(T_i)^2}{b} - C}{a-1}$,

mean square error $MS_E = \dfrac{\sum_{i=1}^{a}\sum_{j=1}^{b} x_{ij}^2 - \dfrac{\sum_{i=1}^{a}(T_i)^2}{b} - \dfrac{\sum_{j=1}^{b}(T_j)^2}{a} + C}{(a-1)(b-1)}$,

correction number $C = \dfrac{\sum_{i=1}^{a}\sum_{j=1}^{b} x_{ij}}{a \times b}$, $T_i = \sum_{j=1}^{b} x_{ij}$, $T_j = \sum_{i=1}^{a} x_{ij}$,

x_{ij} is the observation value of respondents in i industry $(i = 1,2,\cdots,a)$ with j factors $(j = 1,2,\cdots,b)$.

2.2 Identifying best practice enterprise

As in previous best practice studies, the sample is split into two groups based on new product performance across multiple criteria. Best Performers are the enterprises that excelled in terms of the overall profitability of their NPD effort; met its business objectives, was successful versus competitors, and had time-efficient initiatives. However, which enterprises are the best performers and which are the worst? It is an important question and lies at the basis of a valid benchmarking study.

Constitute the fuzzy mapping from factor set to evaluation set:

$f : U \to W$,

$f(u_i^k) = (r_{i1}^k, r_{i2}^k, \cdots, r_{im}^k) \in F(W) \qquad \forall i,k$

Where, $U = \{u_i \mid i = 1,2,\cdots,n\}$ is the factor set, $W = \{w_j \mid j = 1,2,\cdots,m\}$ is the evaluation set. The fuzzy set of enterprise product innovation performance $b^k = a \cdot R^k = (b_1^k, b_2^k, \cdots, b_m^k)$ is obtained by transformation of the fuzzy relationship matrix of sample enterprise is $R^k = (r_{ij}^k)_{n \times m} \quad \forall k$. By making use of the method of dualistic contrast compositor, the fuzzy relationship matrix $R'([r_{ij}']_{n \times n})$ is determined. The best practice enterprises are discriminated by the value $b_j^k = \sum_{i=1}^{n}(\frac{1}{n}\sum_{j=1}^{m} r_{ij}')r_{ij}^k$ $\forall i, j, k$.

2.3 Comparison of the best practice enterprises and the rest

Afte identifying the best practice enterprises, comparing the practices used in Best Performers versus the average or low performers from six dimensions: (1) Product innovation environemnt and strategy; (2) The fuzzy front end (FFE); (3) Portfolio management; (4) The NPD process and tools; (5) Market research and tools; (6) Organization for NPD.

The processes, tools or methods, which has significance of difference in statistic analysis between the best and the rest by using Chi-square test, are the best practices in new product development.

Chi-square test (χ^2 test) $\chi^2 = \sum_{i=1}^{R}\sum_{j-1}^{C} \dfrac{(O_{ij} - E_{ij})^2}{E_{ij}}$,

Where, E_{ij} is the expected frequency: $E_{ij} = \dfrac{R_i \times C_j}{N}$, R_i is the summation of the i column of the sample, C_j is the summation of the j line of the total number of the sample; degree of freedom is $v = (R-1)(C-1)$.

As in previous studies, the best enterprises are significantly more effective than the rest across multiple performance measures. According to the Product Development and Management Association (PDMA) best practice benchmarking study, more than 75% of the products they have commercialized in the last five years were successful, with 47% of sales and 49% of profits accounter for by those products. This comparing with a 54% success rate for the rest of the enterprises, with only 21% of either profits or sales generated by their new products[1]. The best also need fewer ideas for one new product success, one in four ideas results in a commercial success versus one in nine for the total, which means that the best generate much less fall-out and failure during the development life cycle. The mortality curve of the best and the rest is shown in figure 1.

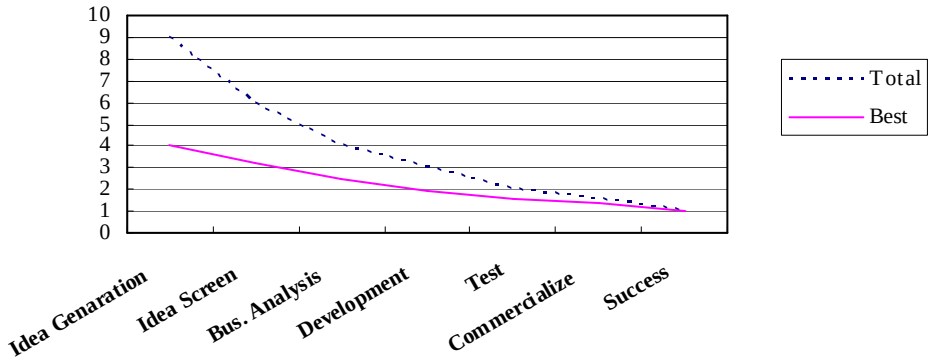

Figure 1 Mortality Curve of the Best versus the Total

The best drive their success through several fundamental principles, linking their new product strategy to overall business strategy, enforcing that strategy through the idea generation and the project selection processes, and using the latest tools to improve the outcome.[6]The gap between the best and the rest is widening, the best have not adoped a more conservative strategy, the key challenge remains really knowing your customer and integrating that insight into the new product development process, starting with a clear strategy and dedicated effort to create powerful ideas, then driving these better ideas into the process.

3 The Iternal Mechanism and Path to Improve Product Innovation Performance

The internal mechnism and path to improve product innovatoin performance is studied by using Structural Equation Modeling (SEM)[7], SEM is a statistical technique for testing and estimating causal relationships using a combination of statistical data and qualitative causal assumptions.

SEM module is consisted of the following 3 matrix equations.

$$X = \wedge_x \xi + \delta$$

$$Y = \wedge_y \eta + \varepsilon$$

$$\eta = \mathrm{B}\eta + \Gamma\xi + \zeta$$

Where, the first and second equation is called measurement model, which describes the relations between latent variables and manifested variables, $\wedge_x$ is the component matrix of exogenous manifested variables on exogenous latent variables, δ is the error vector of exogenous; $\wedge_y$ is the component matrix of endogenous manifested variables on endogenous latent variables, ε is the error vector of endogenous variables; the third equation is called construct model, which describes the linear relations between latent variables, both B and Γ are path coefficient, B represents the effect between endogenous latent variables, Γ represents the effect of exogenous latent variables to endogenous latent variables, ζ is the error of construct model.

The initial SEM model can be established according to the factors in questionnaire, there are 7 latent variables and 34 manifested variables, where fuzzy front end, market research and tools, strategy are 3 exogenous latent variables, organization for NPD, processes and tools, portfolio management, product innovation performance are 4 endogenous latent variables. There are still 34 residual variance of manifested variables $e_1 \sim e_{34}$, and 4 residual variance of endogenous latent variables $u_1 \sim u_4$.

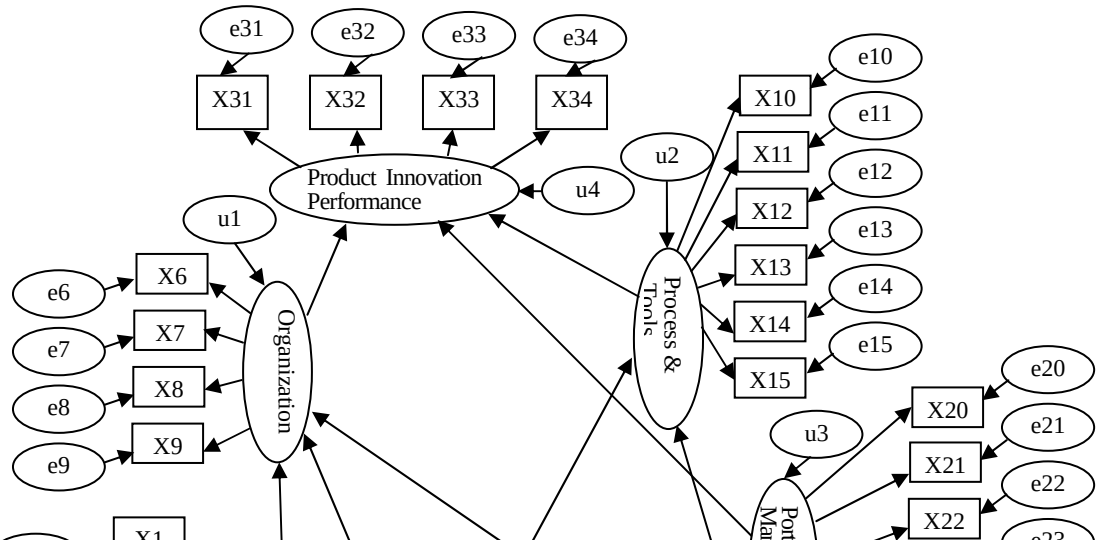

Fig. 2 Path Figure of Initial SEM Model

The path hypothesis of initial SEM model is tested and adjusted by using software AMOS 4.0, assessment of fit between model and data, fitting optimization index (χ^2 , $\chi^2 / d.f.$, GFI, AGFI), (NFI, TLI, CFI, IFI) , (PNFI), Root Mean Residual (RMR) and Root Mean Square Error of Approximation (RMSEA). The model may need to be modified in order to improve the fit, thereby estimating the most likely relationships between variables.

4 Conclusion

After stepping into the new century, the internal and external environments of the enterprises are making huge changes, the theory and practice of product innovation management is also developing over time[8]. It is clear that the best are indeed different from the rest, and much can be learned from their practices. Best practices study is an invaluable tool which provides a standard set of descriptions and characterizations and a basis of evaluation for complex functional processes, it also provides understanding because it evaluates performance, identifies keen challenges, and suggests directions for process improvement.

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