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Full Length Research Paper

Assessing mechanism for pre-development stage of new product development by stage-gate model

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The fast-paced changes in production technology and keen globalization competition have caused product life cycles to be shortened greatly and have appeared to highlight the role of new product development. New product development will not only promote the competitive advantage but will also keep the organization survival. This paper focuses on the pre-development stage of the new product development because each stage input costs will be more than the preceding one. Therefore, this paper uses the scoring model and financial method in stage-gate model, and combined with AHP, ABC and ROI methods, to construct a stage-gate funnel model of pre-development stage for filtering the creative and innovative projects assessment mechanism of new products. This paper suggests that using this integrated, objective and precise mechanism will increase the successful opportunities of new product and promote the operational effectiveness of organizations.

Key words: Stage-gate model, pre-development stage, new product development (NPD), analytical hierarchy process (AHP), activity-based costing (ABC), return on investment (ROI).

INTRODUCTION

The pressure of intense global competition, the sustainability and development of organizations must depend on product diversity, differentiation, and innovation. The rapid shortening of product life cycle (Faure, 2009; Lu and Yang, 2004) and consumers' increasing self- self-awareness, highlight the crucial role played by new product development towards increasing an organization's competitiveness (Cooper, 1996; Cooper and Kleinschmidt, 1991, 1993; Millsona and Wilemon, 2006; Ries and Ries, 2004). The needs for the innovation of product development are also in the service industry (Singh and Singh, 2009). Only 0.25 of development projects succeed commercially, and 0.33 of all new-product launches failed. The critical drivers of success factors are differentiation, filter of pre-development, voice of customer, sharp definition of product, resourced, executed Go/Kill points, project team, strength resources, international orientation, and role of top management (Cooper and Edgett, 2006). Other literature indicates that process features, customer demand, technology features, innovative process, introduce new product are also critical factors of new product development (NPD) (Ebrahim et al., 2010). Nevertheless, the conceptualization, product design, mass production, and launching of a new product require ample materials, human resources and capital investment. Each stage input costs will be more than that of the preceding one (Cooper and Edgett, 2006; Musara and Fatoki, 2010). The search indicates that reduced labor cost, material cost, energy cost are the most important main factors in the developing countries (Ebrahim, 2010). Setting-up an effective screening and assessment mechanism before physical prototype and product design is important that will promote new product development economic benefits.

How might a firm ensure the limited resources of organization achieve operational effectiveness (OE) (Porter, 1996)? What an assessment mechanism for pre-development stage of new product development be able to possess competitive advantage for the organizations? Sixty-eight percent of U.S. product developers now use type of stage-gate process (Griffin, 1997), including

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DuPont, Procter and Gamble, Exxon, Guinness, Unilever, Lego and Royal and Royal Bank of Canada (Cooper, 2006). This paper constructs stage-gate funnel model (Clark, 1993; Cooper and Edgett, 2006) to provide an integrated, objective and precise assessment mechanism for organizations to verify the benefit of new product development (NPD) and practical usage in the industry (Cooper and Kleinschmidt, 1986; Crawford, 1991; McQuarrie and McIntyre, 1986; Parry and Song, 1994).

The stage-gate in this paper includes: first stage is ideas/creativities screening, the second stage is innovation project/case building and third stage is prototype designing. Two gates are: First gate, uses analytical hierarchy process (AHP) (Saaty, 1980) in scoring model of Cooper and Edgett (2001) to evaluate the success factors of human resources competencies, customer relationship, production efficiencies and returns on investment. The second gate, applies activity-based costing theory (ABC) (Cooper and Kaplan, 1988) and targeting costing (Makido, 1989) to calculate the expected return on investment (ROI_{ABC}) in financial method of Cooper and Edgett (2001).

Background

The literature review is separated into two parts, the first part is related with new product development, while the second part is concerned with stage-gate funnel model.

New product development and processes

New product successes factors are: developing organization, proficient marketing, R and D process well executed, functions well interfaced, and coordinated and high level of management support (Cooper and Kleinschmidt, 1987; Globe et al., 1973; Myers and Marquis, 1969; Roberts and Burke, 1974). The factors of failures (Hopkins and Bailey, 1971; Cooper, 1975; Hopkins, 1980); between success and failure (Rothwell et al., 1974; Cooper, 1980; Zirger and Maidique, 1990; Parry and Song, 1994; van der Panne et al., 2003; Cooper et al., 2004b), associates with cooperation, communication, and organizational integration (van der Panne et al., 2003). Parry and Song (1994) discover that the competitive activity and process proficiency in the pre-development stage were significantly correlated with success as the factors that were noted by previous researchers.

New product development processes as Cooper and Kleinschmidt (1986) suggest include a 13-steps sequence, 4-step process as Stefanovitz et al. (2010) propose, or the 8-step process that Thieme et al. (2003) describes. The common new product development process stages are pre-development stage, development and launch stage, and post-launch stage (Cooper and Kleinschmidt, 1986; Crawford, 1991; McQuarrie and McIntyre, 1986; von Hippel, 1986).

Based on the aforementioned review of related literature, the steps and tasks for new product development processes are summarized in Table 1 (Mariona and Simpson, 2009;Ye and Zhang, 2006).

Stage-gate funnel model

The purpose of the stage-gate funnel model is to construct a consistent and structural innovation screening processes. The stage-gate funnel model aims to improve or control the efforts of new product development operations as well as enable managers to make appropriate choices and decisions in the development and management of new products, thus avoiding the unnecessary dispersion of limited resources within the organization and preventing the reduction of organization competitiveness (Clark, 1993; Cooper, 2006, 2008; Cooper et al., 2001; Cooper and Edgett, 2006; O'Connor, 1994; Samperi et al., 2002; Yazdani and Holmes, 1999). Traditional development screening in Figure 1 is aimed at forecasting and evaluating market and technical changes (Clark, 1993).

Clark (1993) proposes the further managing stage-gate funnel model where it is suggested that in order for an organization to have excellent development capabilities, the organization must have a comprehensive development framework to help increase its new product screening ability. The framework in Figure 2 indicates the following points:

1. Innovation, definition and selection of development projects create optimal products and processes.
2. Integrate and coordinate work and technical tasks, and participate in the development activities of organizational units for a period of time.
3. The effect achieved by managing development help to realize the organization's high efficiency operation.
4. The competitiveness provided by innovation and improvement will enable product development to have a long-term competitive advantage.

Cooper et al., (2001) indicate that each stage is designed to match the process of new product project, and each gate or a go/kill decision point is an entry between each two stages. "Stage-gate five state innovation processes"is shown in Figure 3. Effective gates will cause the success of new product process, and should be met with senior managers from different functions, who are usually project leader or team members. Gates have a common format such as inputs, criteria, and outputs for deliverables gate review, project judgment standard and results gate review (Cooper and Edgett, 2006).

Cooper et al., (2001) also mention that the most popular assessment methods for the gates are:

1. Financial methods: include different level of profitability and return metrics, such as NPV, ROI, and ROA, ROE or payback period.

Table 1. New product development process.

Process steps	Tasks
Ideas/Creativities	Ideas/Creativities are proposed based on market needs or factors in technical developments. Identification of new product idea sources and methods for obtaining new product concepts from idea sources are done in this stage. The ideas proposed in this stage must pass verification or else they should be rejected.
Preliminary assessment	Preliminary market, design, manufacturability assessment ideas/creativities that are proposed should pass through preliminary assessment criteria. The purpose is to search and collect related product information and at the same time market and technology assessments are done. Technology feasibility and resources acquirement are also the basic requirement for evaluating for the product ideas that have passed verification.
Innovation project	Detailed market study, financial/business analysis are done in this stage to identify product concepts are an ‘‘Ideal’’ products and to affirm their uniqueness characteristic in the market, these are done to further define product type and product functions. Assessment on the final formed innovation projects should be done to help decide whether the product development plan will be processed further or not.
Prototype design and testing	Product prototype and pilot model are designed based on product concept, and at the same time market planning is carried out, merging with the aforementioned market selection in the predevelopment stage. The market detailed pricing, distributing, advertising, promoting and customer service strategies are determined based on overall market planning. Finally the product prototype and market planning results are further evaluated in order to decide whether projects will be continued or not.
Product testing and validation	This stage conducts testing and validation on product prototype and product design function. In-House product and customer product testing are should be done to check for design deficiencies. Test market and trial sale should be hold at the same time, that will verify whether the product functions need to be improved or not. New product development activity is now ready to enter the pre-production final testing stage, a final revision and prelaunch business analysis are done and assessed.
Mass production	Final correction on production facilities and production methods are analyzed before commercialization is done. Production start-up with materials, human resources and all other necessaries should be readied for mass-producing.
Market launching	Finally the new product actual overall market strategies and plans will be implemented. Based on different control benchmarks market share, sales volume, unit product cost, customer satisfaction tracking information are collected and analyzed to evaluate the strengths and weaknesses. Observe product usage and track product maintenance should be redesigned that ensured the key factors are in the success of new products.

2. Business strategy: allocating resources across different types of projects.
3. Bubble diagrams or portfolio maps.
4. Scoring models: rated or scored on a number of questions or criteria from 1-5 or 0-10 scales.
5. Check lists: evaluated on a set of Yes/No questions, and must achieve either all or a certain number of Yes answers.
6. Others: are variants or hybrids of the above models and methods.

RESEARCH METHODOLOGY

Assessment mechanism frame structure of pre-development stage is based on stage-gate model as shown in Figure 4.

Pre-development stage procedure of new product development

Why in pre-development stage? Cooper and Edgett (2006) indicate that the further stage of the NPD process, the more input cost of NPD will incur. The pre-development stage activities of NPD standard operation procedure in Figure 5 points out the activities in

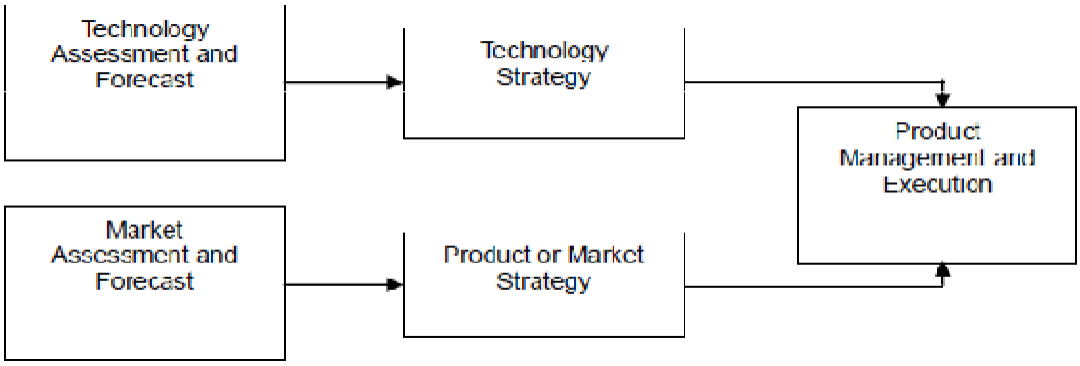

Figure 1. Traditional development screening process.

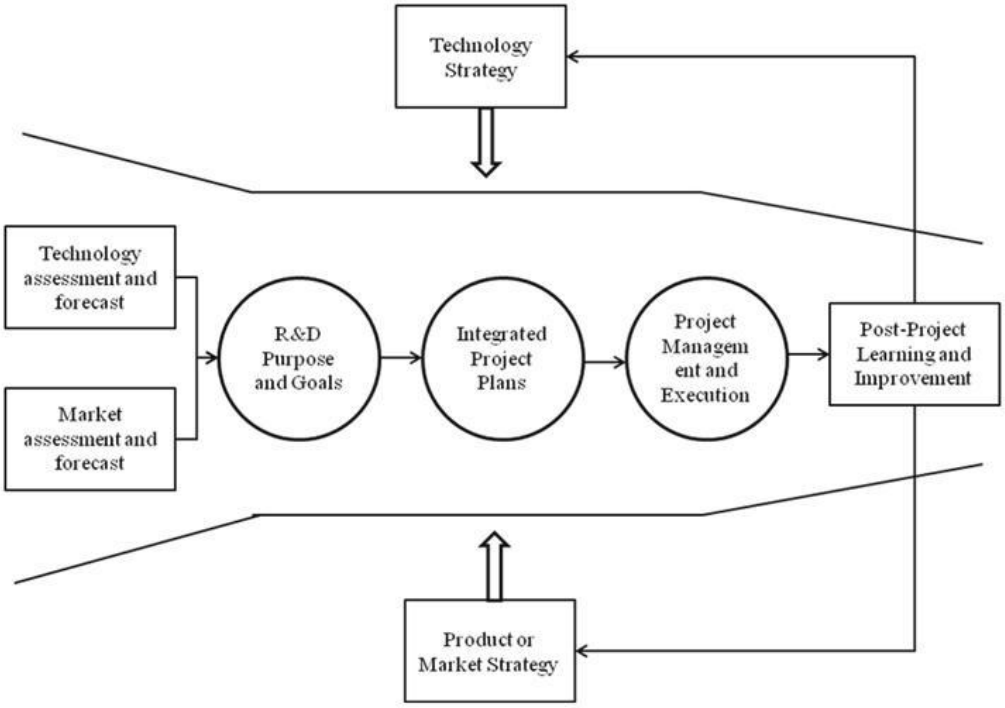

Figure 2. Managing development screening process.

stage one, two and three are doing, and which resources will be used in the process. Bases on those activities and resources usage, the input cost and profitability of pre-development stage will be examined.

Establishing the first screening gate criteria

For insuring the success of NPD, the key components, such as market pull, technology push, sources of information, proficient internal R and D management and ample development funds need to be considered (Myers and Marquis, 1969; Globe et al., 1973; Roberts and Burke, 1974). This paper integrates the key components with expert questionnaire on AHP design, interview managers of functional departments, applies expert choice software to calculate the weight of components, organizes NPD committee, and use scoring model (Cooper and Edgett, 2001) to establish assessment mechanism for the first gate. Because different types of NPD stage focuses on different important level of components, the paper divides new product into six new product types (Booz et al., 1982) for assessing accurately. The steps of establishing the first assessment mechanism are:

Step 1: Organization must set up a new product development committee. The participating members came from the organization itself the members are professionals who came from top-management teams or consulting groups.

Step 2: The members used the chart and based on their own opinions as experts carefully assess the six types of each of the creative projects of new product development.

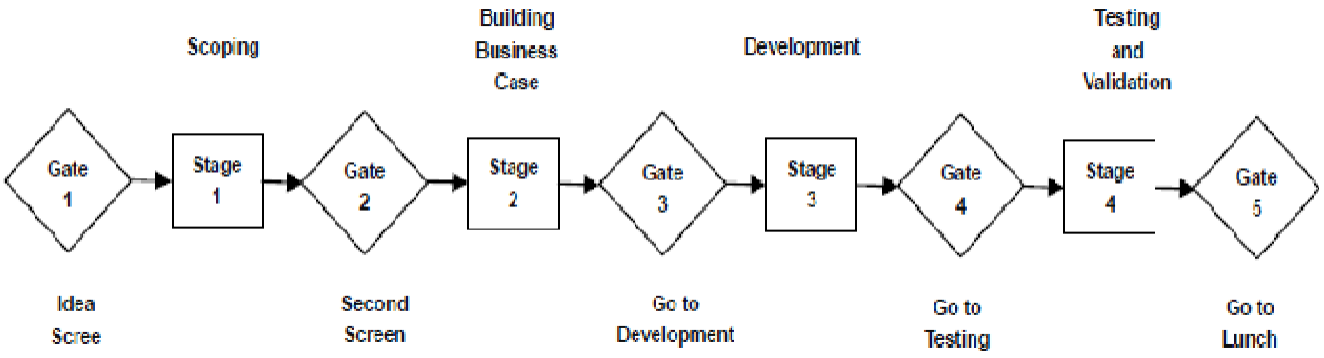

Figure 3. Stage-gate innovation processes.

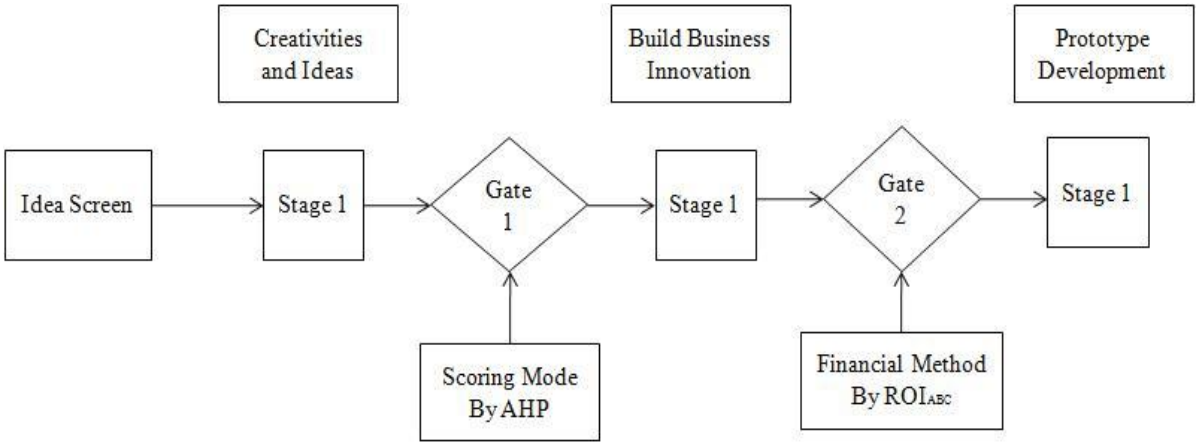

Figure 4. Assessment mechanism of pre-development stage.

Step 3: The four dimensions are assessed and scored.

Equations (1),(2) and (3) and expert choice software were used to calculate each total performance score (S). The following equations are AHP geometric average method:

$$A_I = \sqrt[4]{1 \cdot (A/B) \cdot (A/C) \cdot (A/D)}$$
$$B_I = \sqrt[4]{1 \cdot (B/A) \cdot (B/C) \cdot (B/D)}$$
$$C_I = \sqrt[4]{\cdot (C/A) \cdot (C/B) \cdot (C/D)}$$
$$D_I = \sqrt[4]{1 \cdot (D/A) \cdot (D/B) \cdot (D/C)} \quad (1)$$

The further step to calculate weight ratio are:

$$W_A = A_i / (A_i + B_i + C_i + D_i)$$
$$W_B = B_i / (A_i + B_i + C_i + D_i)$$
$$W_C = C_i / (A_i + B_i + C_i + D_i)$$
$$W_D = D_i / (A_i + B_i + C_i + D_i) \quad (2)$$

A: Experts' rating on return on investment
B: Experts' rating on customer orientation and market demand
C: Experts' rating on human resources competencies
D: Experts' rating on production efficiencies
A_i: Experts' degree of importance of return on investment
B_i: Experts' degree of importance of customer relationship and market demand
C_i: Experts' degree of importance of human resources competencies
D_i: Experts' degree of importance of production efficiencies
i: New product type
W_A : Weight of return on investment (ROI)
W_B : Weight of customer orientation and market demand
W_C: Weight of importance of human resources competencies
W_D: Weight of importance of production efficiencies

Filter chart of Ideas/creativities projects in the paper shows in Table 2. The members of NPD will assess the value of projects bases on their expert opinions, and give the scores to each factor for each new product types. The purpose of the chart is to certify the benefits from each project of new product types that will help contribute to the overall NPD of the organization development strategy through score assessment.

$$S = X_1 \times W_A + X_2 \times W_B + X_3 \times W_C + X_4 \times W_D \quad (3)$$

X_A : Score of return on investment
X_B : Score of customer orientation and market demand
X_C: Score of human resources competencies
X_D: Score of production efficiencies

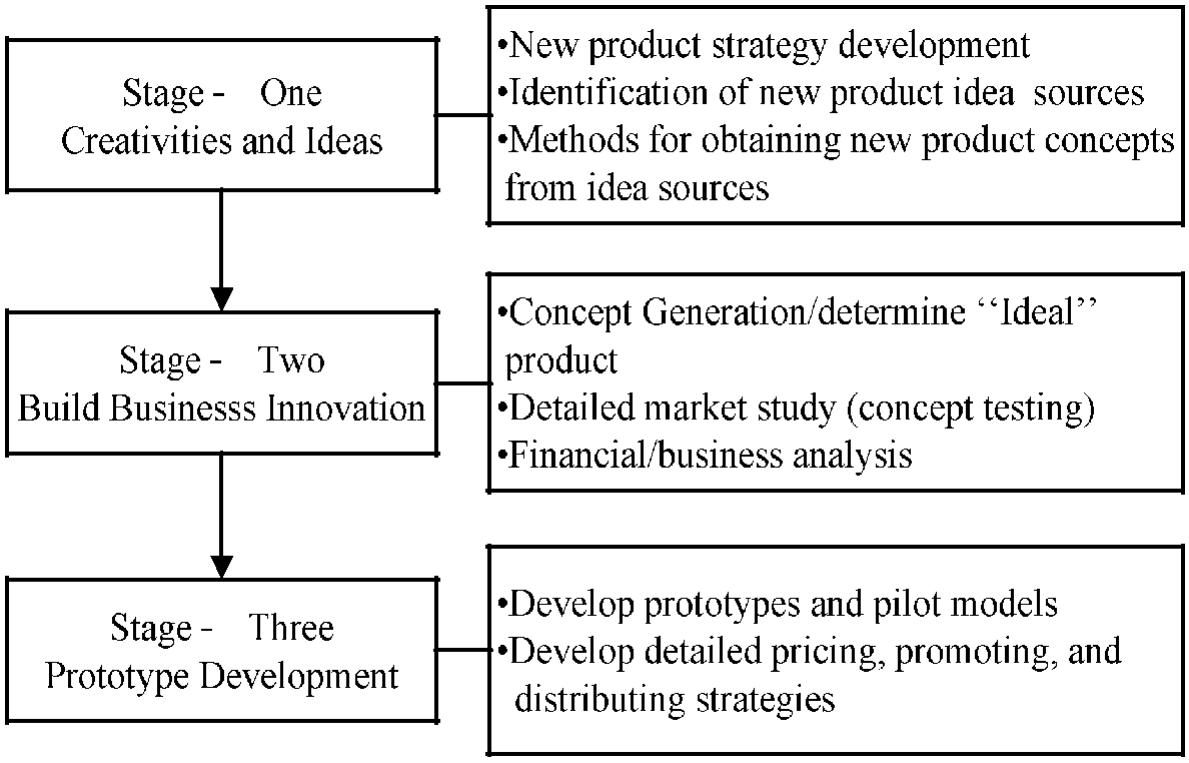

Figure 5. Product development standard activity process.

Step 4: Finally, all the members of the committee must discuss those projects scores and must achieve at a consensus to set the screening gate criterion and decided which project will go or be killed in first gate.

Establishing the second screening gate criteria

The second screening gate is founded on profitability standpoint that is based on financial method from Cooper and Edgett (2001). This paper involves using activity-based cost database that established by historical data to calculate the expected returns on investment (ROI_{ABC}) to assess profitability of the organization. The second gate filter criteria are comparing expected returns on investment (ROI_{ABC}) with organization's given target profit rate *(*ROI*)* to sort and to decide which projects will go or be killed in the second gate. The assessment procedures of the second screening gate are:

Step 1: The organization must set up and collect the standard operation procedures data, including R and D, manufacturing, distributing process, and cost information from historical and current data.

St**ep 2:** Built up an activity-based cost database based on the data collected in Step 1.

Step 3: Calculate and forecast the expected activity-based profit that the organization will gain from the new product project. The equation for calculating the expected ROI_{ABC} is composed of three parts:

First part is manufacturing costs, second part is marketing costs and the final part is new product development costs.

The equation for expected unit profit for new products is shown;

$$\pi = P - DM + DL + \sum_{j=1}^{m} \cdot - \sum_{i=1}^{n} MCD_i \cdot MCDR_i - \sum_{k=1}^{L} RCD_k \cdot RCDR_K \quad (4)$$

π: Expected activity-based profit per unit
P: Unit sales price of new product
DM: Unit cost of direct materials
DL: Unit cost of direct labor
CD_j: Manufacturing activity cost driver
CDR_j: Manufacturing activity cost driver rate
J: Manufacturing activity item MCD_i:
Marketing activity cost driver $MCDR_i$:
Marketing activity cost driver rate i:
marketing activity item
RCD_i: Developing activity cost driver
$RCDR_i$: Developing activity cost driver rate
K: Developing activity item
Step 4: Use Equation (5) to calculate the ROI_{ABC} and sequencing order by value.

$ROI_{ABC} = \pi/P$
Step 5: The members of NPD committee must still discuss and establish a consensus on what the target ROI of the project is, and be able to designate a second screening criterion.
Step 6: Finally, members of NPD committee will compare target ROI with expected ROI_{ABC}, and then decide whether the project should go into the next stage or be killed in this gate.

Table 2. New product creativity project screening evaluation chart.

Type project				
Performance score of components				
Return on investment	Customer orientation and market demand	Human resources competencies	Production efficiencies	Overall performance total
X_1	X_2	X_3	X_4	S
Components weight				Total
W_A	W_B	W_C	W_D	1.0

Table 3. Performance evaluation chart for A type new product.

Product A	Return on investment	Customer relationship and market demand	Human resources competencies	Production efficiencies	Overall performance total
Project A1	70.5	70.75	73	70.25	70.894
Project A2	82.5	84.5	82.25	81.25	83.077
Project A3	81.5	71.5	74.25	81.5	76.86
Weight	0.397	0.369	0.131	0.103	1

EMPIRICAL STUDY AND FINDINGS

This paper uses case study method of terminal parts electronic manufacturing firm as sample. All of the data were collected by interviewing 10 functional managers, 10 engineers and 10 senior staffs in organization with expert questionnaire. The empirical case studies verify the process of establishing mechanisms and ensure the feasibility of the assessment criteria of two gates. The analysis and discussion of empirical results are presented in this section.

Empirical findings for the first gate

This paper separates new terminal parts product into six types (Booz et al., 1982), they include:

Type A: A new product that has yet to be launched by the market or by firms in the same industry.

Type B: An extension of existing product line, the products has the same functions but the new product has different specifications with the existing product.

Type C: Expanding the existing product line, product functions and specifications differ from the existing product.

Type D: Improving the existing products, such as adding more auxiliary functions for the new product.

Type E: A product having high market growth that is, the organization is expecting to enter emerging markets with the existing product.

Type F: Reducing product cost, a new product that is made up of new materials or uses a new production process.

Step 1: Designs AHP experts' questionnaire based on each pair of two components, then proceeds to compare the two components and scored the level of importance from a scale of 1 to 9. Interviews 30 persons who may be concerned in new product development to collect the data in the case study firm. After collecting data, the paper uses expert choice software to calculate the weights of four components, the empirical steps studies for the first screening gate are: Organizes the new product development committee, and hold the NPD meeting on Monday afternoon in the 1st week for each month. New product creativities projects ten days before the end of the month. Screening evaluation chart of different product types will be given to members of the committee on the meeting and members will be asked to score each chart based on their experts' opinions.

Step 2: Re-collect the evaluation chart from members of the committee, tallied scores for the same project and calculate the mean of each dimension scores.

Step 3: The mean scores will be filled in Table 2 so as to calculate and summarize the total value. The performance evaluation chart of the innovative projects of the new product A is shown in Table 3 S**tep 4**: After considerable discussion from the members

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Table 4. Manufacturing, marketing, and developing costs ratios and ROI_{ABC} chart.

Project	Developing cost ratio	Manufacturing cost ratio	Marketing cost ratio	Expected ROI_{ABC}	Total revenues
A2	6.7%	70%	20%	3.3%	100%
B1	4%	68%	26%	2%	100%
C1	5.2%	61%	33%	0.8%	100%
D2	2.6%	65%	31%	1.4%	100%
E3	1.7%	55%	37%	6.3%	100%
F2	12.7%	53%	33%	1.3%	100%

of NPD committee, they set the performance scores of the first gate which must reach and above 80 points. Therefore, only innovative project A2 of new product Type A has an excellent performance score of 84.5 points and has passed the assessment criteria to go further to the next stage.

Empirical study for the second gate

The innovative projects for the case firm that have passed through the first gate assessment criteria are projects A2, B1, C1, D2, E3 and F2. The members of the NPD committee point out that any innovative project that has passed through the first gate, the expected activity-based return on investment (ROI_{ABC}) for the said innovative project must surpass the 3% target ROI which are set by the committee.

The steps for examining the second screening gate are:

Step 1: Construct an activity-based costing (ABC) database based on developing, manufacturing and marketing standard operation procedure (SOP) and financial/cost information collected from case firm.

Step 2: Calculate the expected ABC profits and ROI_{ABC} based on SOP for each innovative project that has passed the first gate.

Step 3: The members of the NPD committee discuss and set the ROI level which should be 3% for any innovative projects of the current product types, basing the projects on market competitiveness and future developments, and then decide whether the projects should go to further stage or be killed in this gate.

The case firm calculation for each cost ratios and ROI_{ABC} are summarized in Table 4. In Table 4 project A2 is a completely new developed product, new facilities and hiring of labor is necessary, the manufacturing costs expense ratio is the highest at 70%; while project E3 takes an existing product and introduces it into a new market such as the Eastern European market, the overall manufacturing cost ratio is lower, nevertheless due to new market entrance, the marketing expense cost ratio is higher, thus it has the highest marketing cost ratio at 37%.

Project F2 is a new product that can decrease manufacturing cost, and its development cost ratio is highest at 12.7% while its manufacturing cost ratio is the lowest at 53%. The summarized expected ROI_{ABC} of each project are 3.3, 2, 0.8, 1.4, 6.3 and 1.3%, respectively.

Based on the expected ROI_{ABC} in Table 4, projects E3 and A2 had surpassed the 3% target ROI of terminal new products, therefore two innovative projects go to further stage and B1, C1, D2, and F2 are killed in this stage. This paper examined the efficiency for rejecting projects B1, C1, D2 and F2. The study results showed that the developing and marketing costs of C1 and F2 projects are too high to pass the second gate, and the manufacturing cost of project B1 was too high to pass also. Finally, the manufacturing and marketing costs of project D2 are too high to pass this gate.

According to Table 4, the cost ratio of three procedures indicate that development and launch stage costs, manufacturing cost, were greatest, while post-launch stage costs, marketing cost, were the second one and pre-development costs, R and D cost, were the least. The empirical results indicate that the pre-development stage is the most important stage to filter the projects for new product in order to increase the operational efficiency of NPD for the firm.

DISCUSSION

Three-stage two-gate funnel model developed in this study is suitable not only to the manufacturing industry but also to the service industry as well. The empirical study only limits the experiment and discussion on the terminal parts manufacturing only, hence, two points must be discerned. Firstly, when proceeding with the first gate screening assessment of the new product projects, the weighted values in the performance evaluation chart is based on the experts' opinion of those in the manufacturing industry. If the service industry will use this assessment mechanism to evaluate their new product creativities projects, they must collect experts' opinions from experts in the service industry; they need to re-calculate for the four components weights that are appropriate for the service industry. Furthermore, setting

the threshold criteria must be considered based on the overall organization profitability, the product development committee members must discuss and decide this within themselves.

Secondly, the second screening gate is based on the organizations' profitability viewpoint, using target ROI as decision making criteria. Give careful attention to two aspects in the second screening gate. First one, the task of determining the reasons for using target ROI as filtering criteria must be handed over to the NPD committee members to consider whether the assessment mechanism were fitted to the organization's product strategy. Secondly, gate often occurs on the market viewpoint to construct a screening mechanism, that is, using a market share or market growth as targets to set assessment mechanism criteria.

In reality, both entrepreneurs in the manufacturing and service industries are devoted to develop new products and services for sustaining organizational survival. In order to reduce uncertainty as well as utilize limited resources in the pre-development stage of new product development, careful screenings of new product creativity and innovation projects are imperative. This paper provides assessment mechanism to assist in the successful opportunities of new product development that will help increase core competitiveness and operational efficiencies of organizations.

Conclusion

Firms have been affected by the recent financial crisis, not only did the market revenue decreased greatly causing firms to have difficulty in acquiring resources. New product development often involves risks and at the same time with the huge amount of resources needed for input; the benefits that can be produced from the new product will be hard to estimate. Hence, in the pre-development stage of the new product development, the creativities and innovations projects of the new product must be carefully monitored; firms should proceed with caution in each step of the new product development procedure.

Cooper (2003) indicates eight to ten success factors that impact the performance of new product development. This study breaks through from previous researches by providing methods and processes to integrate all of them into criteria for filtering the creativities and ideas projects. The methodologies of this paper are scoring model, and financial method, questionnaire, interview approach and also organized a NPD committee to discuss and make Go/Kill decisions.

Each creativity and ideas of new product development must assessed each threshold based on criteria very carefully. In the empirical study of this paper, the first gate filtering criterion must surpassed 80 points, and the second gate filtering criterion also must exceed 3% target ROI for each new product projects to go further stage.

REFERENCES

Abhijeet S, Vibha S (2009). Innovation in services: Design and management. Afr. J. Bus. Manag., 3 (12): 871-878.

Ansari B, CAM-I Target Cost Core Group (1997). Target Costing: The New Frontier in Strategic Cost Management. Burr Ridge, IL; Irwin.

Baback Y, Christopher H (1999). Four Models of Design Definition: Sequential, Design Centered, Concurrent and dynamic. J. Eng. Design, pp: 25-37.

Booz-Allen H (1982). New Products Management for the 1980s. New York: Booz-Allen and Hamilton Inc.

Cooper K (1988). How Cost Accounting Distorts Products. Manage. Account., pp. 20-27.

Cooper RG (1975). Why new industrial products fail. Ind. Mark. Manag., 4: 315–326.

Cooper RG (1980). Project New Prod: What Makes a New Product a Winner? Quebec Industrial Innovation Center, Montreal, Quebec, Canada.

Cooper RG (1996). Overhauling the new product process. Ind. Mark. Manage., 25: 465–482.

Cooper RG (2003). Profitable Product Innovation: The Critical Success Factors. The international Handbook on Innovation, Edited by Larisa V. Shavinina.

Cooper RG (2006). Doing it Right: Winning with New Products. Working paper, pp. 1-10

Cooper RG (2006). Formula for success. Product Development Institute, March/April.

Cooper RG (2008). The Stage-Gate Idea-to-Launch Process–Update, What's New and NexGen Systems. J. Prod. Innov. Manag., 25 (3): 213-232.

Cooper K (1986). An investigation into the new product process: steps, deficiencies, and impact. J. Prod. Innov. Manag., 3: 71–85.

Cooper K (1987). What separates winners from losers? J. Prod. Innov. Manage., 4(3): 169–184.

Cooper K. (1991). New product processes at leading industrial firms. Mark. Manag., 20: 137–148.

Cooper K (1993). Major New Products: What Distinguishes the Winners in the Chemical Industry? J. Prod. Innov. Manag., 10: 90–111.

Cooper EK (2004). Benchmarking bets NPD practices III. Res. Technol. Manag., 47: 43–55.

Cooper EK (2001). Portfolio Management for New Product Development. RD Manag., 31(4): 361-380.

Cooper E (2006). Stage-Gate and the Critical Success Factors for New Product Development. Product Development Institute, July.

Corinne F (2009). Attribution Biases in the Evaluation of New Product Development Team Members. J. Prod. Innov. Manag., 26: 407–423.

Crawford CM (1991). New Products Management. Richard D. Irwin Inc., Homewood, Ill.

Griffin BMM (1997). Drivers of NPD Success. The 1997 PDMA Report.

Huang CL (2007). The benefits study of new product by using activity-based costing and target costing method. Department of Industrial Engineering and Systems Management, Feng Chia University, Taichung, Taiwan.

Hopkins B (1971). New Product Pressures. Conf. Board Record 8(6): 1624.

Hopkins D (1980). New-Product Winners and Losers. The Conference Board.

James S, Bill H, Robert H (2002). Finding tomorrow today. International Design Conference – Design. pp. 14 - 17.

Juliano PS, Marcelo SN, Fernando CAS (2010). Influence of the technological innovation degree on knowledge creation: Evidence from a Brazilian firm. Afr. J. Bus. Manag., 4(5): 631-643.

Kane CL (1983). New product development: a systematic approach. J. Consum. Mark., 1: 53–57.

Kaplan RS, Norton DP (1996). The Balanced Scorecard: Translating Strategy into Action. Harv. Bus. School Press, 52.

Kim BC, Fujimoto T (1991). Product Development Performance. Harvard Business School Press, Boston, Massachusetts.

Kim BC (1993). Managing New Product and Process. Harv. Bus. School, 88-91.

Levy S (1973). Key factors and events in the innovation process. Res. Manag., 16: 8–15.

LiQB (2008). Parametric cost estimation based on activity-based costing: A case study for design and development of rotational parts. Int. J. Prod. Econ., 113: 805–818.

Lu, Yang, (2004). The R&D and marketing cooperation across new product development stages: An empirical study of Taiwan's IT industry. Ind. Mark. Manage., 33: 593– 605.

Makido T (1989). Recent Trend in Japan's Cost Management, Practices. Irwin.

Mariona S (2009). New product development practice application to an early-stage firm: the case of the PaperPro® StackMaster™", Design Stud., 30: 561-587.

McQuarrie M (1986). Focus groups and the development of new products by technologically driven companies: some guidelines. J. Prod. Innov. Manag., 1: 40–47.

Millson W (2006). Driving new product success in the electrical equipment manufacturing industry. Technovation, 26: 1268-1286.

Musara M, Fatoki O (2010). Has technological innovations resulted in increased efficiency and cost savings for banks' customers? Afr. J. Bus. Manag., 4(9): 1813-1821.

Myers S, Marquis DG (1969). Successful industrial innovations. National Science Foundation, Technical Report NSF, pp. 69–17; 1– 117.

Nader AE, Shamsuddin A, Zahari T (2010). Critical factors for new product developments in SMEs virtual team. Afr. J. Bus. Manag., 4(11): 2247-2257.

O'Connor P (1994). Implementing a Stage-Gate Process: A Multicompany Perspective. J. Prod. Innov. Manag., 11(3): 183–200.

Parry ME, Song XM (1994). Identifying new product successes in China. J. Prod. Innov. Manag., 11: 15–30.

Porter ME (1996). What Is strategy? Harv. Bus. Rev., 74(6): 61-78.

Ries A, Ries L (2004). The Origin of Brands: Discover the Natural Laws of Product Innovation and Business Survival. Harper Business, New York.

Roberts B (1974). Six new products—what made them successful. Res. Manag., 16: 21–24.

Rothwell R, Freeman C, Horlsey A, Jervis VTP, Robertson AB, Townsend J (1974). SAPPHO updated—project SAPPHO phase II. Res. Pol., 3: 258–291.

Saaty TL (1980). The analytic Hierarchy Process. McGraw-Hill, New York.

Saaty TL, Vargas LG (1984). The Ligimacy of Rank Reversal. OMEGA, pp. 513-516.

Thieme SS (2003). Project management characteristics and new product survival. J. Prod. Innov. Manag., 20: 104–119.

Van der Panne G, van Beers C, Kleinknecht A (2003). Success and failure of innovation: a literature review. Int. J. Innov. Manag., 7: 309–338.

von Hippel E (1986). Lead users: a source of novel product concepts. Manage. Sci., 32: 791–805.

von Hippel E (1989). New product ideas from 'lead users'. Res. Technol. Manag., 32: 24–27.

Yeh C (2005). Technology Management. Taipei, Taiwan: Gao Li Inc.

Zirger BJ, Maidique M (1990). A model of new product development: an empirical test. Manag. Sci., 36: 867–883.