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Operation Management-Identification of New Product Development Improvement Opportunity

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Abstract: New Product Development (NPD) plays a vital role within the context of operation management. Businesses must continuously enhance their products design, enrich products market value and improve products quality in order to stays competitive in the market. Hence, this research aims to analyze NPD implementation effectiveness within a R&D based organization with the ultimate objective to identify the potential NPD improvement areas within the context of operation management. Data collected from quantitative surveys was analyzed via descriptive analysis tools. Analysis results suggested that NPD processes that perceived by management team as important were not translated into actions by operational staff. The research outlined a step by step process on identification of importance level, implementation level and implementation effectiveness of NPD processes. The methodology proposed in this research carries a value for the identification of operation management improvement opportunity.

Key words: New product development, improvement, research and development, effectiveness, organization, opportunity

INTRODUCTION

New Product Development (NPD) plays a vital role within the context of operation management. An organization that continuously introduces new products or services to the marketplace stands higher opportunity to growth more rapidly than competitors (Bhuiyan, 2011). Business must be able to continuously enhance the products design, enrich products market value and improve products quality within the expeditious revolutionize technology world in order to compete with their competitors (Ulrich and Eppinger, 2011). Hence, the mechanize used to identify improvement opportunity in NPD is crucial to the business.

Research background: According to Barczak *et al*. (2009), the percentages of sales volume and profits accounted for new launching products shows a declining trend in last 20 years. In overall, 49% of new products failed to introduce to market. In addition, products that successfully introduced to marketplace is only generating less than one third of organizations total sales and profits. The same phenomenon was observed in the R&D based organization that under study in this research, namely X-center.

X-center is a multi-purpose Research and Business Development center specializes on the development of biochemical products and processes. In the past 10 years, X-center had successfully developed number of outstanding award winning products at varies local and international competition. Few of the products had successfully introduced to the market. However, majority of products either ended prior to market launch or failed to generate expected sales and income. This reflected that perhaps X-center had focused on incorrect elements along the new product development cycle where NPD elements that perceived as important by the top management team might not implemented by the operational staff (i.e., scientist, researchers, designers) up to the expected levels. As such this research is carried out with the objectives to identify the important elements of NPD within thebusiness setting of X-center operational environment, to assess the implementation levels and implementation effectiveness of the important element for NPD with the ultimate aims to analysis and identify the required NPD improvement areas within the context of X-center operation management. In line with this four Research Objectives (RO) are developed:

- RO1: to identify the important level of new product development elements perceived by the management team of X-center
- RO2: to assess the implementation level of new product development elements perceived by the operational staffs of X-center

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- RO3: to analyse the implementation effectiveness of new product development elements within X-center
- RO4: to identify NPD improvement areas for X-center

Literture review

NPD elements: Prior researchers viewed NPD from a variety of research streams and disciplines with the ultimate aim to identify the elements that leading to the successful of new products at the difficult level of task (Balachandra and Friar, 1997). In general, NPD elements consist of two main aspects which are NPD process elements and NPD management elements. NPD process refers to the step-by-step NPD process to transform new product's idea to commercial product. While NPD management refers to managerial activities throughout the NPD process such as technology management, human resource management and financial management, Kowang and Rasli, 2012).

NPD process plays an important role within an organization. An effective NPD process enable an organization to continuously survive in the competitive market (Trott, 2012). According to Barclay *et al.* (2000), an effective NPD process has become a fundamental focus by most of the organizations especially for organizations in the high technology industry. An effective NPD processes enable an organization to sustain in the competitive global market (Barclay *et al*., 2000). As such this research focuses on the improvement area within the context of NPD process.

NPD process elements: NPD process is risky and might causes uncertainty to an organization (Robert, 2001). Study conducted by Balachandra and Friar (1997) revealed that there have been many attempts over the last 30 years by prior researchers to discover the important elements in NPD process that influent the success or failure of R&D projects and the introduction of new product. Some of the research focused on important element in new product introduction, while some have looked into elements that causing failure.

Study done by Barczak *et al.* (2009) revealed that most of the companies adopted a formal step-by-step NPD process to facilitate new product development. In a formal NPD process, a new product's idea needs to go through several phases and decision making points prior to commercialization (Cooper, 2002).

A formal NPD process is structured by dividing the overall NPD process into few distinctive phases or stages. The approach or criteria used for the division of NPD process are dependent on the complexity of the product and the management structure of the organization (Aw, 2005).

Booz and Hamilton (1982) suggested a 7 stages NPD process framework that made up of new product strategy, idea generation, screening, business analysis, development, testing and commercialization. The framework emphasized on the matching of product development strategy with company objectives as first NPD step. Meantime, business opportunity analysis is only done post idea generation and screening. As consequence, there is possibility that product that matching company strategy might not contribute to any of the business gains.

Table 1: Development of research framework

Research framework	Prior research frameworks	Researchers
S1: opportunity identification	Concept testing new product strategy discovery stage/scoping	Ozer, Booz and Hamilton 1982, Cooper (2002)
S2: concept development	Idea generation/screening and evaluation/business analysis built business case	Booz and Hamilton (1982) Cooper (2002)
S3: design and development	Design and development development	Booz and Hamilton (1982) Cooper (2002)
S4: testing	Prototype testing/pre-test market/test market test testing and validation	Ozer, Booz and Hamilton (1982) Cooper (2002)
S5: commercialisation	Launch commercialisation launch/ post launch review	Ozer Booz and Hamilton (1982) Cooper, 2002

Tzokasa *et al.* (2004) developed a dynamic "testing" based NPD process framework that consist of five major stages which are concept testing, prototype testing, pretest market, test market and launch. The framework focused on consumer's reaction toward the new product concept and product design throughout the NPD cycle.

A stage-gate NPD process proposed by Cooper (2002) acts as a template or roadmap for driving new product projects from product's idea to product's launch and beyond. A typical stage-gate process consist of 7 stages which are discovery stage, scoping, build business case, development, testing and validation, launch and post launch review. Each stage is made up of a set of prescribed or mandated parallel, cross-functional activities. Between stages are go/kill decision points or "gates". The gates act as the quality control check points throughout the NPD process by ensuring that the development team does the right projects and also do project right. Gates must have clear and visible criteria so that senior managers can make go/kill and prioritization decisions objectively.

Research framework: Base on the literature review, the NPD process framework used in this research consist of 25 elements that form the five main NPD stages which are opportunity identification, concept development, product design, product testing and commercialization as show on Table 1.

MATERIALS AND METHODS

Research design: The research is carried out following the sequences shown in Fig. 1. As refer to Fig. 1, the research began with literature review on important NPD process elements where 25 NPD process elements were identified. Subsequently, in survey Cycle 1, survey questionnaires was used as research instrument to check the degree of importance placed by the management team on the 25 NPD process elements in order to identify the top-10 important NPD process elements perceived by the management team. Next, during survey Cycle 2, the top ten important NPD elements were assessed by operational staffs of X-center from implementation level perspective. Next, descriptive analysis was applied to analyse the implementation effectiveness of the top 10 important NPD elements with the ultimate aim to identify NPD improvement areas from operational point of view.

Population: The population for the first survey involved 10 management team members of center while the population for the second survey is the researchers, scientist, designers, project leaders of I-center, there are 25 of them.

Research instruments: The research used quantitative tool via survey questionnaires. A questionnaire is designed based on the 25 important NPD process attributes that identified from the extensive literature review. Respondents are asked to rate the level of importance and implementation they placed on each NPD process elements based on the five point scale of (1) "Not important" or "No implementation" to (5) 'Extreme important' or "Fully implemented".

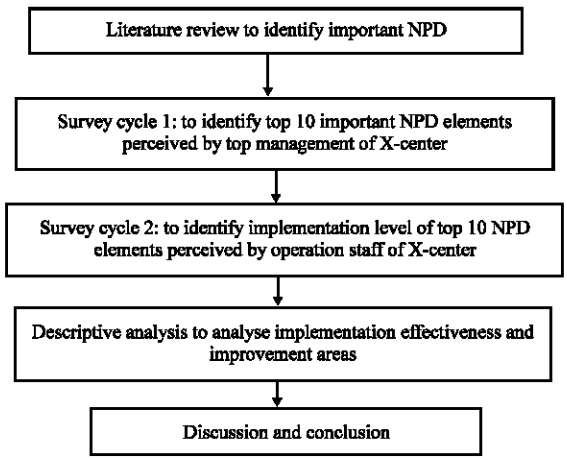

Fig. 1: Research design

Analysis tools: Descriptive statistical analysis tool "mean" or "average" is used in this research to measure the central tendency of response from survey questionnaire in terms of important and implementation level.

RESULTS AND DISCUSSION

Data analysis

Response rate: The response rates for both survey Cycle 1 and 2 are 100%. All the 10 management team members and 25 operational staffs had responded questionnaires of Cycle 1 and 2, respectively.

Reliability test: Cronbach's alpha test was conducted on data collected from survey Cycle 1 and 2 to assess the reliability data. Table 2 shows the Cronbach's alpha of perceived important level by the management team (i.e., survey Cycle 1) is 0.944 while Cronbach's alpha for survey Cycle 2 is 0.900 as shown in Table 3.

Result of Table 2 and 3 implies that the data from both survey Cycle 1 and 2 are statistically significant to proceed for further analysis. A Cronbach, Alpha reliability value of >0.7 is suggested to be adequate for testing the reliability of factors (Rasli, 2006).

Descriptive analysis: Descriptive analysis in term of mean is used to analyze the mean importance level derived from survey Cycle 1 and the mean implementation level retrieved from survey Cycle 2. In addition, implementation effectiveness was calculated bases on following formula:

$$\text{Impl eff.} = \frac{\text{Imple level}}{\text{Impo level}} \times 1000\%$$

Where:
Impl level = Implementation level
Impo level = Importance level
Impl eff. = Implementation effectiveness

A low implementation effectiveness percentage means the importance placed by the X-center management

Table 2: Reliability test for survey Cycle 1

Reliability statistics

Cronbach's alpha	Cronbach's alpha based on standardized items	No. of items
0.943	0.944	25

Table 3: Reliabilty test for surrey Cycle 2

Reliability statistics

Cronbach's alpha	Cronbach's alpha based on standardized items	No. of items
0.899	0.900	10

Table 4: Summary of analysus result

NPD elements	Impo	Impl	Eff.%
Understand the market and its dynamics	4.30	3.97	92.2
Retain team skills and experience to design the product	4.20	4.07	96.8
Product testing at the early stage	4.20	4.07	96.8
Apply lesson learned from past project	4.17	3.87	92.8
Flexibility and responsiveness to change at the product testing stage	4.17	3.93	94.4
Clear and share vision, strategy, and policy	4.10	3.87	94.3
Top management commitment and involvement	4.07	4.03	99.2
Seek differentiated and superior products	4.07	3.97	97.5
Structured and planned NPD process	4.03	3.73	92.6
Long-term commitment to major project	3.93	3.87	98.3

team has not been successfully translated into practice. However, an effectiveness level of higher than 100% can be seen as an indication of over-focus.

The top ten important NPD process elements were identified from survey Cycle 1. The analysis result of the importance level, implementation level and implementation effectiveness for the top 10 important NPD process elements are shown in Table 4.

Importance level: The high level of important placed by respondents across all NPD process elements suggests that all the elements are important. NPD process elements "Understand the market and its dynamic" is regarded by the management team of X-center as the most important NPD process elements, followed by "Product testing at early stage" and "Retain team skills and experience to design product". This finding is in line with the study done by Hertenstein *et al.* (2005) and Huang *et al.* (2004) which suggested that thorough market study is a most important step to ensure NPD success. In addition, according to Thomke (2008), it is important to place product testing process in the early step of NPD in order to iron out potential improvement according to market needs (Thomke, 2008).

Implementation level and effectiveness: There are two noticeable finding from the viewpoints of NPD implementation level and effectiveness within X-center. First, analysis result of implementation level as well as implementation effectiveness suggested that the implementation level across all the top 10 important NPD process elements are lower than the importance level or with the implementation effectiveness of <100%. NPD process element "Understand the market and its dynamic" was regarded as element with the lowest implementation effectiveness of 92.2% while "Top management commitment and involvement" was suggested by respondents implemented at the highest effectiveness of 99.2%.

Table 5: NPD improvement priority

Improvement priority	NPD process elements
1	Understand the market and its dynamics
2	Structured and planned NPD process
3	Apply lesson learned from past project
4	Clear and share vision, strategy and policy
5	Flexibility and responsiveness to change at the product testing stage
6	Retain team skills and experience to design the product
6	Product testing at the early stage
7	Seek differentiated and superior products
8	Long-term commitment to major project
9	Top management commitment and involvement

The second interesting observation is the most important NPD process element perceived by X-center management team, i.e., "Understand the market and its dynamic" was perceived by operational staffs of X-center as the least effectively implemented element. Both findings reflected that the importance of NPD process elements that placed by X-center management team was not transform into action by the operation staffs of X-center.

Bases on the analysis result of Table 4, NPD improvement area and improvement priority for X-center were identified and presented in Table 5. As refer to Table 3, the top three improvement areas within the context of NPD in X-center are "understand the market and its dynamics", "Structured and planned NPD process" and "Apply lesson learned from past projects".

These finding echoes finding of prior researchers (Trott, 2012; Miguel, 2007). According to Trott (2012), organizations that success in NPD demonstrated a common set of characteristic which are sensitive to market change and demand, strong commitment from top management, right product development strategy, took serious action on lesson learned from past projects. This set of characteristic enable an organization to develop and introduce new innovative product to fulfill the changes of market demand. In addition, Miguel (2007) suggested that a well-planned NPD strategy and NPD process are the only way for the organization to facing the market challenges and to success in new product development in this highly competitive market.

CONCLUSION

Some organizations focused improvement attempt on incorrect new product development elements as the result improvement effort was not able to reflect in NPD performance measure (Tzokasa *et al*., 2004). Therefore, it is important for organizations to focus on correct NPD elements throughout the new product development process. As such, the methodology of identify area that

require improvement is vital for a company to ensure improvement effort is placed on correct area. The research had demonstrated a systematic quantitative approach on identifying NPD improvement within a R&D based organization, namely X-center. Furthermore, the research also outlines a step by step process on identification importance level, implementation level and implementation effectiveness of NPD process element in X-center. The methodology proposed in this research carries a value for further validation. Hence, the continuation for this study is to validate the framework and methodology in on different business setting.

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