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A Study on the Difference Between Radical Innovation and Incremental Improvement in Pre-Development Practices of NPD Projects

Noor Hidayah Abu[a*], Baba Md Deros[a], Dzuraidah Abd Wahab[a], Mohd Nizam Ab Rahman[a], Norani Nordin[a]

[a]*Department of Mechanical and Materials Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, Bangi, Selangor*

*Corresponding author: dayah@uum.edu.my

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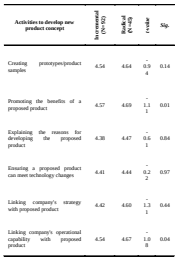
Graphical abstract



Activities to develop new product concept	Incremental (N=92)	Radical (N=48)	t-value	Sig.
Creating prototypes/product samples	4.54	4.64	-0.94	0.14
Promoting the benefits of a proposed product	4.57	4.69	-1.11	0.01
Explaining the reasons for developing the proposed product	4.38	4.47	-0.61	0.84
Ensuring a proposed product can meet technology changes	4.41	4.44	-0.22	0.97
Linking company's strategy with proposed product	4.42	4.60	-1.31	0.44
Linking company's operational capability with proposed product	4.54	4.67	-1.08	0.04

Abstract

This paper presents an exploratory study of pre-development practices in Malaysian food and beverage manufacturing SMEs. A questionnaire survey is used to explore the difference in pre-development implementation practices between radical and incremental new product development (NPD) projects. The survey was performed at 164 food and beverage manufacturing SMEs. The respondents were chosen from those who are directly involved with pre-development practices, such as the owner/CEO of the SMEs. The analysis was conducted using Statistical Package for Social Science (SPSS) software version 17. Descriptive statistics and independent-samples t-test were carried out to generate and validate the results observed. The significant difference values for independent-samples t-test is less than .05 ($p \leq 0.05$). Survey results revealed the differences in pre-development implementation practices between radical and incremental NPD projects for several activities in pre-development phases. Incremental NPD projects considered listening to customer needs ($p=0.00$) is an important activity during idea generation phase, however radical NPD projects emphasis that analysis of competitors' products ($p=0.02$) and continuous product improvement ($p=0.00$) are crucial. Mean while during development of new product concept phase, and project evaluation phase radical NPD projects were more innovative compared to incremental NPD projects in several activities such as creating prototypes/product samples, linking company's operational capabilities with proposed product, and conducting a formal risk analysis. The significant values of the activities were between 0.00 and 0.04 which is lower than significant level 0.05.

Keywords: Pre-development implementation; radical innovation; incremental improvement; SMEs

Abstrak

Kertas kerja ini membentangkan satu kajian penerokaan berkenaan amalan pra-pembangunan produk di kalangan organisasi PKS. Kajian tinjauan yang menggunakan soalan selidik dilaksanakan untuk mengenal pasti perbezaan amalan di antara PKS yang mencapai tahap inovasi produk radikal dengan penambahbaikan terhadap pelaksanaan aktiviti-aktiviti dalam proses pra-pembangunan produk. Kaji selidik ini merangkumi 164 organisasi PKS yang terlibat dalam proses pengeluaran produk makanan dan minuman. Responden terdiri daripada mereka yang terlibat secara langsung dengan amalan pra-pembangunan seperti pemilik syarikat/CEO. Analisis telah dijalankan dengan menggunakan Pakej Statistik untuk Sains Sosial (SPSS) versi 17. Statistik deskriptif dan statistik sampel-bebas ujian-t telah dijalankan untuk menjana dan mengesahkan keputusan yang diperolehi. Nilai perbezaan yang signifikan bagi statistik sampel-bebas ialah kurang daripada .05 ($p \leq 0.05$). Hasil keputusan kaji selidik menunjukkan wujudnya perbezaan amalan dalam pelaksanaan proses pra-pembangunan produk di kalangan PKS radikal dengan penambahbaikan. PKS penambahbaikan menganggap mendengar keperluan pengguna ($p=0.00$) merupakan sumber maklumat terpenting bagi fasa penjanaan idea, namun begitu PKS radikal menekankan bahawa analisis produk pesaing ($p=0.02$), dan penambahbaikan produk berterusan ($p=0.00$) merupakan sumber penting dalam fasa berkenaan. Pada masa sama sepanjang fasa pembangunan konsep produk baharu dan penilaian projek, PKS radikal lebih inovatif jika dibandingkan PKS penambahbaikan dalam beberapa aktiviti seperti pembangunan prototaip/produk sampel, menghubungkan tahap kemampuan organisasi dengan produk yang dicadangkan, dan melaksanakan analisis risiko yang formal. Nilai signifikan bagi setiap aktiviti berada di antara 0.00 dan 0.04 yang mana nilainya lebih rendah daripada nilai signifikan 0.05.

Kata kunci: Pelaksanaan process pra-pembangunan; inovasi radikal; inovasi penambahbaikan; PKS

1.0 INTRODUCTION

Today's business environment is dynamic and changing extremely. In order to compete and sustain in business, an organizations have to introduce innovative product continuously. SMEs (Small and Medium-sized Enterprises) is an important component of the Malaysian's economic growth and development. SMEs provided employment opportunities, generate export opportunities, and providing goods and services to large enterprises [1]. However, Madrid-Guijarro et al. [2] in their study have emphasized the need for SMEs to introduce success products that correspond with customer requirements, and technology changing in order to survive.

A review of current literature shows that, the number one determinant success product in organization is effective implementation of a high quality business process to generate new product ideas, and launch the product into market [3]. The business process is defined as the new product development process (NPD). Meanwhile, Backman et al. [4] in their study have stressed that success or failure of the NPD process depends very much on the performance in the earliest phase of the NPD process, or known as pre-development. Subsequently, pre-development is a key element in shaping the outcome of the entire new product innovation in organization. Innovation of new product development can be divided into radical innovation and incremental improvement. The objective of this paper is to identify the different pre-development implementation practices between radical and incremental NPD projects in manufacturing SMEs. The research addresses issues of pre-development implementation practices such as sources of idea generation, development of new product concepts, and project evaluation. There is a need to identify the practices of pre-development implementation in SMEs due to their role in the growth of the Malaysian's economy.

After conducting an empirical review of recent studies, it was noticed that most of the pre-development implementation studies were conducted in larger organizations, rather than SMEs. According to McAdam et al. [5], SMEs cannot apply the same direct pre-development implementation practices and approaches that large organisations implement due to different characteristics.

The pre-development process refers to the earliest stage of the NPD process. Murphy and Kumar [6] distinguished the fact that pre-development consists of three main stages: idea generation, development of new product concepts, and finally, project evaluation. The stages play an important role in determining which projects will be executed in the manufacturing process. Backman et al. [4] believed, successful management of pre-development stages make it possible for an organisation to reduce manufacturing cost, increased customisation, and improve quality of new product. There is a lot of literature available that deals with the pre-development in large-scale industries [7-9]. However, there is a lack of empirical research to identify the pre-development implementation practice for product development in SMEs. SMEs have different characteristics compared to large organizations. SMEs have limitations in terms of knowledge, resources, experience, and skills to become more innovative. New product innovation is defined by Linder et al. [10] as "... implementing new ideas that create value". This description refers to the adoption of new products based on customer needs and requirements to increase organizational competitiveness and profitability. Classifications of product innovation can be divided into radical innovation, and incremental improvement.

Nord and Tucker [11] identified radical innovation as producing a new product that is very different from anything previously to penetrate a new target market. For radical product innovation, the activities required more time and effort from management and employees. Besides that, the need for information is higher. Booz et al. [12] have been categorising radical projects as producing new to the world product concepts, and extended new product line.

Incremental innovation was recognized by Ettile et al. [13] as introducing relatively minor changes to existing products. Incremental innovation incorporates product improvement into innovations toward existing market. The activities in producing new products are executed using existing technologies, resources, skills, and prior knowledge. Booz et al. [12] have been categorising incremental projects based on cost reduction, repositioning in the market, and product modifications. In this study, the authors adjust past definition on radical innovation, as new to the world products concept and extended product line. Incremental innovation process is defined as positioning in the market, and modification of existing products.

2.0 METHODOLOGY

The survey questionnaire developed in this research consisted of two main sections. The first section comprises questions about the company background, and the second section consists of questions about pre-development activities. Generally, the first section attempts to obtain information about the organizational profile and background, such as: general information about the respondent, number of years the company has been in business, number of employees, annual sales revenue, type of food or beverage produced, and level of product development within the organization. Questions in the second section were designed to assess pre-development activities for implementing the pre-development process in SMEs. The variable was divided into three major factors, namely (1) idea generation phase, (2) concept development phase, and (3) project evaluation phase.

2.1 Research Design

In order to establish the reliability and validity analysis a pilot study was conducted involving 100 SMEs. A total of 100 firms were chosen but only 55 of them were committed and returned the completed survey questionnaire. The list of SMEs was obtained from the Federation of Malaysian Manufacturing Directory (FMM), and the SME Corp directory. A large-scale survey was conducted randomly among CEO/owners of food and beverage manufacturing SMEs. Of the 687 questionnaires mailed, a total of 171 were returned giving a response rate of 25%, seven of which were non-usable. The responses were entered into the SPSS database. Respondents were asked to rate the level of importance of the activities for the organization on a five-point Likert scale from '1' 'Not important at all' to '5' 'Very important'.

3.0 RESULTS AND ANALYSIS

3.1 SMEs Profile

The aspects to be investigated were the general background of the respondents, company size. Based on the classification of SME Corp. directory [14], 6% of the respondents in this study consisted of micro enterprises; 57% were small-sized enterprises; and 16% were medium-size enterprises.

3.2 SMEs Project Characteristic

The respondents were also asked to rate the degree of innovativeness of new products brought to market. Table 1 shows that the majority of the small-size enterprises release incremental improvements in new product development rather than from radical innovation. Forty percent (40%) of small-size enterprises released new products with 'repositioning in the market' compared to 29% of medium-size enterprises. Besides that, 29% of the respondents for small-size enterprises released new products with modification of existing products compared to 24% for medium-size enterprises. In terms of radical innovation, medium-size enterprises appeared to be more aggressive in product innovativeness compared to small-size enterprises. Fourteen percent (14%) of medium-size enterprises release new products with introduction of new to the world product concepts compared to 6% of small-size enterprises. Thirty-three percent (33%) of medium-size enterprises released new products with extended new product lines compared to only 25% for small-size enterprises.

Table 1 Comparison between incremental improvement and radical innovation projects

Size of respondents' organization	Radical innovation		Incremental improvement		Total %
	New to the world product concept	Extended new product line	Product Modification	Repositioning in the market	
Medium-size enterprise (N=21)	14%	33%	24%	29%	100 %
Small-size enterprise (N=109)	6%	25%	29%	40%	100 %

3.3 Results of Pre-development Practices between Radical and Incremental NPD Projects

In order to examine the differences between the pre-development practices of incremental and radical NPD projects, the authors had used the independent-samples t-test. Comparisons have been made between incremental and radical NPD projects with regard to the different aspects of pre-development practices. The pre-development involved three main stages such as: idea generations, development of new product concepts, and project evaluations.

Table 2 present the result independent-samples t-test for different aspects of the degree importance activities for SMEs to generate new ideas. The result revealed that there was a significant difference between radical NPD project, and incremental NPD project for three activities such as listening to customer needs, analysis of competitors' products, and continuous product improvement. The significant values for the three activities were between 0.00 and 0.02 which is lower than significant level 0.05. The result also indicated that incremental NPD project received and required more information from listening to customer needs. However radical NPD project considered analysis of competitors' products, and continuous product improvement were perceived as important activities to generate new innovative products ideas. The findings have support by Garcia and Calantone [15] who believed that radical innovations are often more competitive in developing new products with the latest technology for new target markets. Mean while, there was no significant difference between incremental and radical NPD project for several activities such as market analysis; identify new opportunities; and forecasting of new technology as a sources of idea generations activities. Both types of projects required similar amounts of information from all three activities. The significant values for the activities were $p \geq 0.05$.

Table 2 Idea generation phase of incremental and radical NPD projects and independent-samples *t*-test

Idea generations activities	Incremental (N= 92)	Radical (N= 45)	*t - value*	*Sig.*
Listening to customer needs	4.82	4.71	1.32	0.00
Analysis of competitors' products	4.40	4.68	-2.40	0.02
Market analysis of consumer behavior	4.67	4.51	1.48	0.58
Continuous product improvement	4.59	4.64	-0.54	0.00
Identify new opportunities in the marketplace	4.68	4.67	0.15	0.55
Forecast of technology changes	4.31	4.33	-0.19	0.63

Note: p < 0.05; 1= *Not important at all*; 5=*Very important*

Table 3 illustrates that radical NPD project was more innovative rather than incremental NPD project in several activities in development new product concept phase. The activities are: promoting the benefits of a proposed product and linking company's operational capabilities with proposed product. The significant values of the activities were between 0.01 and 0.04 which is lower than significant level 0.05. Besides that the result also indicated that the mean value for each activities in development new product concept phase such as: creating prototypes/product sample; explaining the reasons for a proposed product; ensuring a proposed product can meet technology

changes; and linking company strategy with proposed product were higher than mean value for incremental NPD project. The result obviously revealed that the development of totally new products in radical NPD project required a different approach from incremental new products. Radical NPD project require new technical knowledge, technical component, product lines, and production processes [15].

Table 3 Development new product concepts phase of incremental and radical NPD project and independent-samples *t*-test

Activities to develop new product concept	Incremental (N= 92)	Radical (N=45)	*t-value*	*Sig.*
Creating prototypes/product samples	4.54	4.64	-0.94	0.14
Promoting the benefits of a proposed product	4.57	4.69	-1.11	0.01
Explaining the reasons for developing the proposed product	4.38	4.47	-0.61	0.84
Ensuring a proposed product can meet technology changes	4.41	4.44	-0.22	0.97
Linking company's strategy with proposed product	4.42	4.60	-1.31	0.44
Linking company's operational capability with proposed product	4.54	4.67	-1.08	0.04

Note: p < 0.05; 1= *Not important at all*; 5=*Very important*

Table 4 shows three main elements in project evaluation phase. There are performing business analysis, performing business study, and conducting a formal risk analysis. A radical NPD project was more innovative rather than incremental project in terms of conducting a formal risk analysis. The significant value for the element was 0.00 which is lower than significant value 0.05. No significant difference between incremental and radical NPD project for performing business analysis, and performing business study elements. The significant values for the elements were between 0.08 and 0.62 which is higher than significant level 0.05.

Table 4 Project evaluation phase of incremental and radical NPD project and independent-samples *t*-test

Project evaluation	Incremental (N= 92)	Radical (N=45)	*t-value*	*Sig.*
Performing business analysis				
Evaluating development cost	4.52	4.62	-0.77	0.41
Evaluating potential revenue	4.60	4.73	-1.24	0.08
Evaluating production cost	4.65	4.78	-1.2	0.09
Performing feasibility study				
Determine potential market	4.52	4.60	-0.68	0.60
Determine management capabilities	4.40	4.58	-1.4	0.37
Determine if organization can meet those requirement	4.47	4.53	-0.51	0.62
Conducting a formal risk analysis	4.38	4.73	-2.81	0.00

Note: p < 0.05; 1= *Not important at all*; 5=*Very important*

■4.0 CONCLUSION

The purpose of this paper is to explore the differences in pre-development activities between incremental improvements and radical innovation NPD projects in Malaysian food and beverage manufacturing SMEs. The survey results showed that the radical NPD projects need to more significantly innovative than the incremental NPD projects in several factors in idea generation phase, development new product concept phase, and finally project evaluation phase. The greatest difference between radical and incremental NPD projects are related to six factors: listening to customer needs; analysis of competitors' products; continuous product improvement; promoting the benefits of proposed product; linking company strategy with proposed product; and finally conducting a formal risk analysis. The incremental NPD project required more information from listening to customer

needs compare than radical NPD project. In the mean time radical NPD project considered analysis of competitors' products; continuous product improvement; promoting the benefits of proposed product; linking company strategy with proposed product; and finally conducting a formal risk analysis were important in order to achieve successful pre-development process implementation. The survey results have revealed differing pre-development practices in radical compared with incremental NPD projects. These findings may provide a proper guideline in NPD projects for SME by considering all important activities involved in this project and subsequently avoiding from implementation failure.

References

[1] Ramayah, T. & Koay, P. L. 2002. An Exploratory Study of Internet Banking in Malaysia. In: The 3rd International Conferences on Management of Innovation and Technology (ICMIT '02 & ISMOT '02), Hangzhou City, PR China.

[2] Madrid-Guijarro, A., Garcia, D. & Auken, H. V. 2009. Barriers to Innovation Among Spanish Manufacturing SMEs. *Journal of Small Business Management*. 47: 465–488.

[3] Kleinschmidt, E. J. & Cooper, R. C. 1997. The Winning Formula. *The Quality Magazine.* 59–66.

[4] Backman, M., Borjesson, S. & Setterberg, S. 2007. Working with Cocepts in the Fuzzy Front End; Exploring the Context for Innovatin for Different Typesof Concept at Volvo Cars. *R&D Management*. 37: 17–28.

[5] McAdam, R., Keogh, W., Reid, R. S. & Mitchell, N. 2007. Implementing Innovation Management In Manufacturing SMEs: A Longitudinal Study. *Journal of Small Business and Enterpreneur Development*. 14: 385–403.

[6] Murphy, S. A. & Kumar, V. 1997. The Front End of New Product Development: A Canadian Survey. *R&D Management*. 27: 1–16.

[7] Verworn, B., Herstatt, C. & Nagahira, A. 2008. The Fuzzy Front End of Japanese New Product Development Projects Impact on Success and Differences Between Incremental and Radical Projects. *R&D Management*. 31: 1–19.

[8] Herstatt, C. & Verworn, B. 2004. The Fuzzy Front End of Innovation. In: Bringing Technology and Innovation into the Boardroom (EITIM, ed.). Houndmills and New York: Palgrave MacMillan, 347–373.

[9] Kim, J. & Wilemon, D. 2002. Focusing the Fuzzy Front-end in New Product Development. *R&D Management.* 32: 269–278.

[10] Linder, J. C., Jarvenpaa, S. & Davenport, T. H. 2003. Towards an Innovation Sourcing Strategy. *MIT Sloan Management Review*. 44: 43–52.

[11] Nord, W. R. & Tucker, S. 1987. *Implementing Routine and Radical Innovations*. Lexington: MA: Heath and Company.

[12] Booz, Allen & Hamilton. 1982. *New Product Development For The 1980s*. New York: Booz Allen Hamilton Consultants.

[13] Ettile, J., Bridges, W. & O'Keefe, R. 1984. Organization Strategy and Structured Diffrences for Radical Versus Incremantal Innovation. *Management Science*. 30: 682–695.

[14] SMECORP. 2011. *Definition of SMEs*. SMECORP Malaysia.

[15] Garcia, R. & Calantone, R. 2002. A Critical Look at Technological Innovation Typology and Innovativeness Terminology: A Literature Review. *Journal of Product Innovation Management*. 19: 110–132.

[16] Song, X. M. & Montoya-Weiss, M. M. 1998. Critical Development Actibvities for Really New Versus Incremental Products. *Journal of Product Innovation Management*. 15: 124–135.