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Envisages of New Product Developments in Small and Medium Enterprises through Virtual Team

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Abstract

New product development (NPD) in small and medium-sized enterprises (SMEs) virtual team has not been systematically investigated in developing countries. Literatures have shown no significant differences between traditional NPD and virtual NPD in general. New product development especially for SMEs virtual team are somewhat lacking in the literature and constitute a research gap. This paper aims to bridge this gap. This study first reviews the NPD and its relationship with virtuality and then identifies the critical factors in definition of NPD in SMEs virtual team. The statistical method was utilized to perform the required analysis of the data from survey. The results are achieved through factor analysis at the perspective of NPD in some of Malaysian and Iranian manufacturing firms. The 20 new product development factors were grouped into five higher level constructs. It gives valuable insight and guidelines which hopefully will help managers of firms in developing countries to consider the main factors in NPD.

Keywords

Survey Finding, New Product Development, Factor Analysis, Virtual Team

1-Introduction

The product life cycle grows shorter every year and the customer demand dramatically increased. With the needs to respond quickly to dynamic customer needs, increased complexity of product design and rapidly changing technologies, the selection of the right set of NPD is critical to a company's long-term success [1]. Obviously, the situation will be even more severe for small and medium sized enterprises (SMEs) than for large organizations, because of SMEs' limited financial and technical capability [2]. Virtuality has been presented as one solution for SMEs aiming to increase their competitiveness [3]. Forming a virtual team will provide an opportunity to reduce time to market of new product and respond quickly to the market demands. May and Carter [4] in their case study of virtual teams working in the European automotive industry have shown that enhanced communication and collaboration between geographically distributed engineers at automotive manufacturer and supplier sites make them get benefits are better quality, reduced costs and a reduction in the time-to-market (between 20 to 50 percent) for a new product vehicle.

The specialized skills and talents required for the development of new products often reside (and develop) locally in pockets of excellence around the company or even around the world. Therefore, firms, have no choice but to disperse their new product units to access such dispersed knowledge and skills [5]. Successful NPD requires firms to develop routines and practices to collaborate with suppliers, customers, and internal cross-functional employee teams [6]. Virtualization in NPD has recently started to make serious headway due to developments in technology-virtuality in NPD now is technically possible [7]. Virtual NPD in SMEs is in its infancy in developing countries, and limited research has been done on introduction of NPD in the SMEs through virtual team. So we constituted the topic which is somewhat lacking in the literature as a research gap.

The main objective of this paper is to present a model of critical factors of NPD definition in Small and Medium Enterprises (SMEs) of developing countries. The remainder of the paper is organized as follows: Section 2 presents the main concepts of new product development; Section 3 reviews recently study on the relationship between NPD and virtuality, Section 4 explore the importance of SMEs, Section 5 presents the relationship between SMEs and

Virtual Team, Section 6 describe Research Methodology, Section 7 to 9 are presents Data Collection, Data Analysis and Discussion and lastly Section 10 concludes the paper with some perspectives.

2. What is New Product Development (NPD)?

The literature provided a number of definitions for what constitute a new product development (NPD). Product development definition used by different researchers in slightly different ways [8]. Generally, it is the process that covers product design, production system design and product introduction processes and start of production [9]. Loch and Kavadias [10] in “Handbook of New Product Development Management” define NPD “ consists of the activities of the firm that lead to a stream of new or changed product market offerings over time. This includes the generation of opportunities, their selection and transformation into artifacts (manufactured products) and activities (services) offered to customers and the institutionalization of improvements in the NPD activities themselves”. According to The Product Development and Management Association (PDMA) Glossary for New Product Development in The PDMA Tool Book 3 for New Product Development [11], NPD defined as: “The overall process of strategy, organization, concept generation, product and marketing plan creation and evaluation, and commercialization of a new product”. Krishnan and Ulrich [12] defined “product development as the transformation of a market opportunity and a set of assumptions about product technology into a product available for sale”. NPD has been described in general form and there is not any specified definition for new product development of SMEs virtual team in developing countries which means what is NPD in SMEs virtual team supposed to be in developing countries? This paper aims to extract the main factors of NPD in selective cases.

3-NPD and Virtuality

Given the complexities involved in organizing face-to-face interactions among team members and the advancements in electronic communication technologies, firms are turning toward employing virtual NPD teams [13-15]. Information technology (IT) improve NPD flexibility [16]. The internet facilitates and improves collaborations and thus increases the performance of new products [17]. Furthermore, Ozer [18] conclude that IT undoubtedly has the potentials to significantly improve the new product development activities of industrial companies. In addition, the pressure of globalization competition companies faces increased pressures to build critical mass, reach new markets, and plug skill gaps , NPD efforts are increasingly being pursued across multiple nations through all forms of organizational arrangements [19]. Given the resulting differences in time zones and physical distances in such efforts, virtual NPD projects are receiving increasing attention [20]. The use of virtual teams for new product development is rapidly growing and organizations can be dependent on it to sustain competitive advantage[21]. On the other hand, competitive strategies are forcing companies to deploy their NPD resources globally, thus making collocated NPD teams prohibitively expensive and logistically difficult to manage [22]. Several recent studies deal with the development of new technologies and their impact on new product development among globally dispersed teams [20, 23].

Some studies emphasized the challenges and difficulties experienced by virtual and conventional for new product development teams were not significantly different, although they were greater than the challenges and difficulties experienced by in-house teams [24]. NPD in SME’s virtual team has not been systematically investigated in literature. Only literatures have shown no significant differences between traditional NPD and virtual NPD in general. This paper aims to bridge this gap.

4-Small and Medium Enterprises (SMEs)

SMEs are a major part of the industrial economies [25, 26]. Their survival and growth have therefore, been a prominent issue. The contributions of SMEs to employment and the countries’ gross domestic product (GDP) are significant [27]. Acs et al. [28] argued that small firms are indeed the engines of global economic growth. Small and Medium Enterprises (SMEs) play an important role to promote economic development. Many economists believe that the wealth of nations and the growth of their economies strongly depend upon their SMEs’ performance [29]. In many developed and developing countries, small and medium-sized enterprises (SMEs) are the unsung heroes that bring stability to the national economy. They help buffer the shocks that come with the boom and bust of economic cycles. SMEs also serve as the key engine behind equalizing income disparity among workers [30]. SMEs seem to be appropriate units to behave like network nodes because of their lean structure, adaptability to market evolution, active involvement of versatile human resources, ability to establish a sub-contracting relations and good technological level of their products [31]. In light of the above, SMEs have advantages in terms of flexibility, reaction time, and innovation capacity that make them central actors in the new economy [32].

4-1-SMEs Definition

There are many accepted definitions of SMEs and the classifications vary from industry to industry and from country to country [33]. Table 1 illustrates a summary of SMEs definition in manufacturing sector of the selected countries. Different countries adopt different criteria such as employment, sales or investment for defining small and medium enterprises [34]. At present, there seems to be no consensus on the definition for SMEs [35]. In the absence of a definitive classification, an agreement has developed around the European Commission (EC) criteria for SME classification [33]. This definition adopts a quantitative approach emphasizing “tangible” criteria, employee numbers up to 250 employees, turnover and balance sheet statistics [36]. The case studies employed here are SMEs in the Malaysian and Iranian manufacturer sector are chosen according to the EC definition of SMEs.

Table 1 Definition of SMEs in manufacturing sector of selected countries

Country	Category of enterprise	Employee numbers	Turnover	Other measures	Source
European Commission (EC) criteria	Small	10-50 employees	Less than €10 million turnover	Balance sheet total :Less than € 10 million balance sheet total	[37]
	Medium	Fewer than 250 employees	Less than €50 million turnover	Balance sheet total :Less than € 43 million balance sheet total	[37]
Iran	Small	Less than 10* Less than 50**			[38] [39]
	Medium	10-100* 50-250**			[38] [39]
Malaysia	Small	Between 5 & 50 employees	Between RM 250,000 & less than RM 10 million		[40]
	Medium	50-150 employees	Between RM 10 million & RM 25 million		[40]

*Definition of SMEs according to “The Central Bank of Iran [38]”

**Definition of SMEs according to “Iran Small Industries & Industrial Parks Organization [39]”

5-SMEs and Virtual Team

Past literature often hypothesized that SME did not innovate in formally recognized ways, and that they made much more extensive use of external linkages [41-43]. The SME is not a scaled-down version of a large company. It has different characteristics that distinguish them from large corporations and that can of course change across different countries and cultures; they are generally independent, multi-tasking, cash-limited and based on personal relationships and informality, as well as actively managed by the owners, highly personalized, largely local in their area of operation and largely dependent on internal sources to finance growth [44]. To survive in the global economy SMEs have to improve their products and processes exploiting their intellectual capital in a dynamic network of knowledge-intensive relations inside and outside their borders [45]. So if small firms want to make a step change in their technological and innovation base, they may have to rethink their approach to cooperation [46]. SMEs need to focus on core competences for efficiency matters; they need to cooperate with external partners to compensate for other competences and resources. This is especially the case in the field of new product development, where SMEs face specific problems in comparison to large firms [47].

Despite the widespread publicity of information technology, the application of Internet technology to upgrade and enhance the product design and business operation by most enterprises, especially for the small and medium sized enterprises, is still at its infancy [48]. The SMEs are one of the sectors that have a strong potential to benefit from advances in Information and Communication Technologies (ICTs) and the adaptation of new business modes of operation [49]. The use of ICTs can be considered as key factors for innovation and entrepreneurship. ICTs are a must for SMEs to innovate [50]. It is especially urgent for SMEs to construct a service platform of networked to speed up the product development process [51]. Collaboration is particularly critical when SME's are involved with the aim of developing new products [52].

The success of developed countries can be attributed to factors relating to the emergence of new business technologies and cultures, such as, virtual technology. This constituted the soft-technology complex that provided

the environment for innovation and the effective application of technologies [53]. Developing countries are, on the other hand, characterized by the absence of soft technology and limited abilities to make effective and efficient use of the technologies they obtain through a variety of transfer mechanisms, and to innovate and compete in the global market. Many SMEs have difficulties achieving successful innovation, despite having significant investment in research and development [54]. Gassmann and Keupp [55] found that managers of SMEs should invest less in tangible assets, but more in those areas that will directly generate their future competitive advantage (e.g., in R&D to generate knowledge, and in their employees' creativity to stimulate incremental innovations in already existing technologies). Moreover, the Web-because of its easy access to large numbers of potential customers at reasonable cost may especially aid smaller companies that have not enjoyed the same national reach or financial resources as larger companies for market research [56]. Levy et al. [57] state that SMEs are knowledge creators but are poor in knowledge retention. They need to be proactive in knowledge sharing arrangements to recognize that knowledge has value and the value added is derived from knowledge exchange [58].

6-Research Methodology

This research has been applied a statistical approach based on the factor analysis and research framework. Factor analysis is a technique attempts to identify underlying variables, or factors, that explain the pattern of correlations within a set of observed variables. Factor analysis is often used in data reduction to identify a small number of factors that explain most of the variance that is observed in a much larger number of manifest variables. Factor analysis is also suitable for analyzing the patterns of complex, multidimensional relationships encountered by researchers [37]. An online questionnaire was designed and base on main factors in NPD, 20 questions derived from literature review. To help disentangle the concepts of new product development in virtual teams of SMEs, 20 individual criteria asked from respondents. These criterions have been grouped together through factor analysis to form the critical factors in the definition of NPD in virtual teams. The respondent asked a series of questions such as NPD1: "Based on your (organization's) what is the definition of a new product/process development? Is the use of things already known (reverse Engineering)?"

Table 2 20 criteria of the NPD definition

Question	Criteria
NPD1	Whole R&D activities
NPD2	The use of things already known (Reverse Engineering)
NPD3	Making use of existing technologies (Adaptation)
NPD4	Increase efficiency of product
NPD5	Meet the role and regulation
NPD6	Improvement in product functionality/quality
NPD7	Improvements in elements of product technologies
NPD8	Major innovation in product technologies
NPD9	Major innovation in products as a whole
NPD10	Creation of new product concepts
NPD11	Improvement in product process
NPD12	Reduction in quality problems
NPD13	Surprise or delight customers
NPD14	Replacing products are being phased out
NPD15	Extending product range
NPD16	Reducing production lead times
NPD17	Gaining new markets or market share
NPD18	Reducing labor costs
NPD19	Reducing materials consumption
NPD20	Reducing energy consumption

7-Data Collection

The research target was manufacturing SMEs in Malaysia and Iran that were using virtual teams in their organization. In order to understand the viewpoints of SMEs on NPD definition an on line questionnaire has been sent to relevant SMEs in both countries. The rapid expansion of Internet users has given web-based surveys the potential to become a powerful tool in survey research [59]. Denscombe [60] findings encourage social researchers to use web-based questionnaires with confidence and the data produced by web-based questionnaires is equivalent to that produced by paper-based questionnaires. Other authors emphasized that the data provided by Internet methods are of at least as good quality as those provided by traditional paper-and-pencil methods [61, 62].

The main sampling target was managing director, R&D manager, the new product development manager, project and design manager and appropriate people who were most familiar with the NPD in the firm. For better understanding the questionnaire has been prepared in two different languages English and Persian. The Iranian respondents were able to select either English version or Persian version of the questionnaire. 3625 emails have sent to relevant SMEs and 686 of them clicked the online web page and answered the questionnaire. Out of 686 respondents 190 SMEs responded completely and the rest answered partially. Table 3 summarized online survey data collection. Only 121 firms were met the criteria of SMEs definition in this research so the rest of responded deducted from factor analysis. A cross-tabulation descriptive statistics employed to find the frequency and relationship between the country and virtuality as illustrate in Table 4.

Table 3 Summarized online survey data collection

Numbers of emails sent to Malaysian (M) SMEs	Numbers of emails sent to Iranian (I) SMEs	Total of emails sent to SMEs	Total Responses (Click the online web page)	Total Responses/Sent (%)	Total Completed	Total Completed/Sent (%)	Total Completed/Received (%)
2068	1557	3625	686	18.9	190	5.2	27.7

Table 4 Cross-tabulation between country and virtuality

		Virtual NPD		Total	
		Yes	No		
Country	Iran	N (% within Country)	50 (73.5)	18 (26.5)	68 (100.0)
	Malaysia	N (% within Country)	19 (35.8)	34 (64.2)	53 (100.0)
Total		N (% within Country)	69 (57.0)	52 (43.0)	121 (100.0)

8-Data Analysis

In the case of reliability analysis, Cronbach's Alpha [63] was employed to measure internal consistency of the 20 factors. A reliability test was carried out to ensure that the research finding have the ability to provide consistence results. Cronbach's alpha for the 20 NPD factors was found within acceptable limits and to be 0.926, which means there was a high reliability for designed questions. An exploratory factor analysis was conducted on 20 NPD factors. Using a Principle Component Analysis with a Varimax Rotation and an Eigenvalue of 1 as the cut-off point [64] and an absolute value of the factor loading greater than 0.5 [37]. The items and their factor loadings after Exploratory Factor Analysis, Eigenvalue, and percentage of variance explained, appear in Table 5. The 20 factors were grouped into five higher level constructs, which had an Eigenvalue greater than one.

9-Discussion

The authors attempted to identify and named the confirmed factors based on the principle of being concise without losing clarity of meaning. After extracting the factors, Variables with higher loadings are considered more important and have greater influence on the name of selected reduced factors. The names and contents of five higher level constructs derived are:

- Factor 1: It consists of NPD17 to NPD20, which are "Gaining new markets or market share", "Reducing labor costs", "Reducing materials consumption" and "Reducing energy consumption" respectively. This factor is named "Process Features"

Table 5 Rotated Component Matrix sorted by size

Component (Cronbach's Alpha)					
	1 (.850)	2 (.821)	3 (.749)	4 (.790)	5 (.735)
NPD19	.792	.134	.248	.218	.019
NPD18	.762	.287	.232	.103	.227
NPD20	.715	.250	.325	.142	.135
NPD17	.515	.364	-.052	.282	.343
NPD12	.278	.794	.313	.155	.203
NPD4	.238	.784	.135	.288	.069
NPD5	.203	.754	.345	.105	.237
NPD13	.379	.462	.280	.275	.453
NPD7	.144	.141	.721	.512	.089
NPD2	.372	.218	.706	.148	-.002
NPD3	.169	.258	.670	.165	.219
NPD15	.130	.296	.653	.220	.457
NPD10	.149	-.059	.322	.721	.228
NPD8	.186	.205	.332	.710	.040
NPD6	.206	.393	.136	.668	.041
NPD11	.528	.308	-.016	.580	.171
NPD14	.126	.117	.542	.267	.649
NPD9	-.016	.237	.180	.546	.604
NPD16	.569	.034	.090	.170	.591
NPD1	.380	.335	.114	-.133	.569

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

- Factor 2: It consists of NPD4, NPD5, NPD12 and NPD13, which are “Increase efficiency of product”, “Meet the role and regulation”, “Reduction in quality problems” and “Surprise or delight customers” respectively. Since NPD12 has been higher loading (0.794) this factor named “Customer demand”.
- Factor 3: It consists of NPD2, NPD3, NPD7 and NPD15, which are “The use of things already known (Reverse Engineering)”, “Making use of existing technologies (Adaptation)”, “Improvements in elements of product technologies” and “Extending product range” respectively. This factor is named “Technology Features”.
- Factor 4: It consists of NPD6, NPD8, NPD10 and NPD11, which are “Improvement in product functionality/quality”, “Major innovation in product technologies”, “Creation of new product concepts” and “Improvement in the product process” respectively. This factor is named “Innovative process”.
- And lastly factor 5: It consists of NPD1, NPD9, NPD14 and NPD16, which are “Whole R&D activities”, “Major innovation in products as a whole”, “Replacing products are being phased out” and “Reducing production lead times” respectively. Because NPD14 has been higher loading (0.649) this factor named “Introduce New Product”.

All above mentioned factors were summarized in Figure 1. This new conceptual model is based on data analysis of survey findings. The conceptual model provides an overview of NPD understanding in SMEs (the ones which are familiar with virtuality) of selected developing countries. Although more than half respondents are working on virtual team bases for new product developments but virtual team application in SMEs is still in infancy. Slightly more than 80% of SMEs have not responded to an email invitation for participating in an online survey (Table 3).

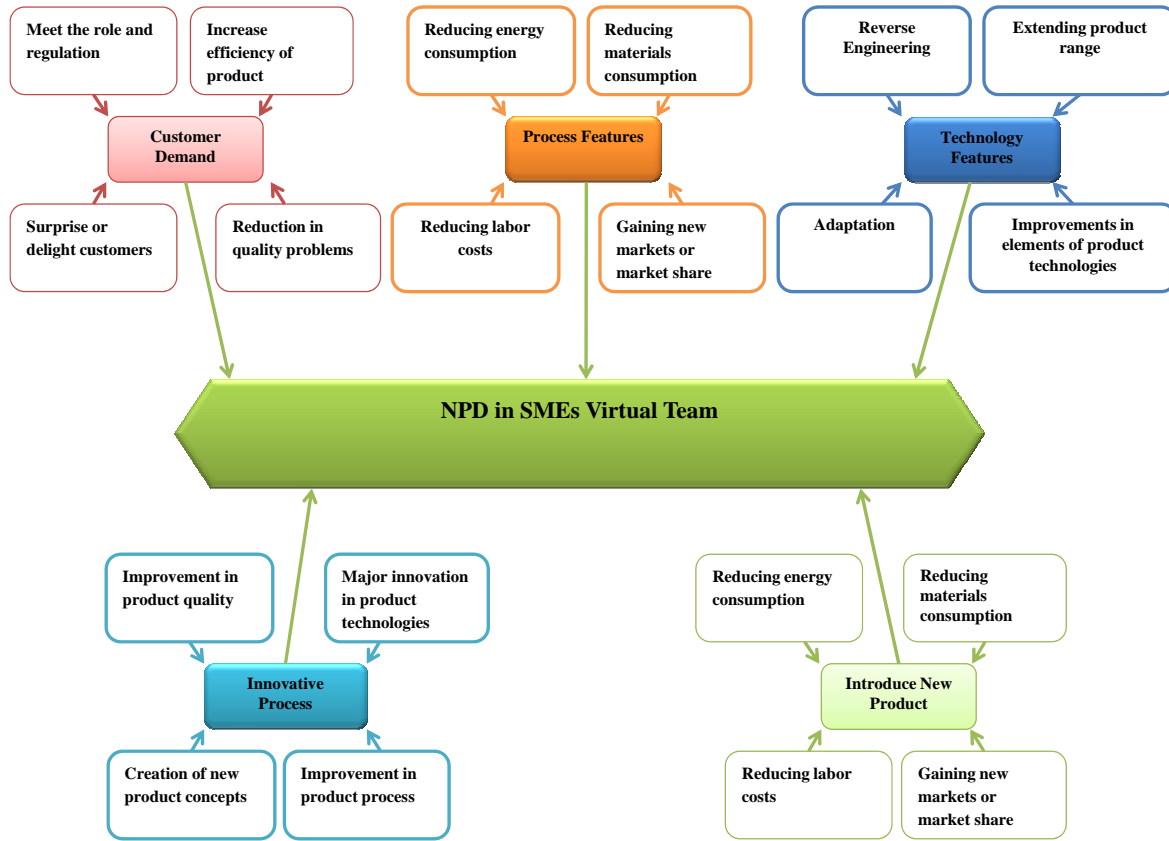


Figure 1 a Conceptual Model of NPD in SMEs Virtual Team (based on research results)

10-Conclusion

Factor Analysis provides direct insight into the interrelationships between 20 variables and reduced to five components. First factor which is “Process Features” and it is a combination of “Gaining new markets or market share“, “Reducing labor costs“, “Reducing materials consumption” and “Reducing energy consumption”, is more important than the rest four factors. So managers of firms in developing countries should consider the main factors in NPD. Customer demand (people) and technology features are respectively important after process issues. Therefore, along with Ale Ebrahim et al. [65] recent research people and process are more important in virtual teams than about technology.

Table 3 shows slightly above 18% of SMEs have been received the online survey email invitation. So it can conclude that most SMEs in selected developing countries are still developing a new product in the traditional way, and they are not adopted with new information and communication technologies. As virtual NPD in SMEs is in its infancy in developing countries, it seems to be a necessary start the introduction of virtual teams in the SMEs. The first step is perceived NPD in this new environment, which is explored in this study.

This study is probably the first to present a conceptual model for NPD issue in SMEs in selected developing countries. The future research needs to be investigated the model and verify it by a larger sample of SMEs from different sectors since this study was limited to manufacturing sector. In a larger sample, it is possible to compare the results between Iran and Malaysian SMEs.

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