On the Determinants of Successful Innovative Firms in Thai Manufacturing Sector

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Abstract

This study investigates the determinants of successful product and process innovation comparing between local firms and foreign joint ventures (FJV). Testing on the sample of 310 firms in Thai manufacturing sectors, the study found that contextual variables, business environment condition, firm-internal competencies, strategic variables, and external communication are the determinants of success in innovation activities. The study discovers the different determinants between product-and process-innovative firms. Product-innovative firms maintain a broader range of innovation objectives compared to process-innovative firms. Therefore, product-innovative firms have higher degree of determinants than process-innovative firms. The study finds that FJV have better external communication enjoying the advantage of accessing technology from their parent, associated companies, and suppliers, especially in improving their production process.

Key words: Determinants of successful innovation, Types of innovation, Thai manufacturing

1. Introduction

Technological innovation in manufacturing companies is one of the main reasons for industrial competitiveness and national development (Freeman, 1982; Porter, 1985). Therefore, the questions with regard to why some firms are technologically innovative and others are not, and what factors affect a firm's ability to innovate are essential to management research and practice. The factors influencing a firm's innovation rate often referred to as the determinants of innovation (Duchesneau et al., 1979, Souitaris, 1998).

At the level of the firm, innovation processes can be categorized into three broad and overlapping sub-processes: 'cognitive' (how firms generate and maintain the know-how to conduct their tasks), 'organizational' (how firms 'do things' internally or together with other organizations) or 'economic' (how firms establish internal incentives to ensure innovation proceeds quickly and in the 'right' direction) (Pavitt, 2003). Moreover, innovation processes vary in many dimensions according to sector, field of knowledge, size of firm, corporate strategy and prior experience, type of innovation, historical period and country. Consequently, the determinants of innovation are specific to a number of moderating 'conditions' such as the size of the firm, the industrial sector and the country environment, and the objectives of innovation (Wolfe, 1994; Pavitt, 1984; Souitaris, 1999; Gellatly and Peters, 1999; Park el

at, 1999). The management literature, therefore, has been normally inconclusive concerning the factors which affect innovative firms (Souitaris, 2001a).

Most of the empirical study on the influences of innovation has been carried out in industrialized developed countries. However, a number of research paradigms[1] attempted to explain the international differences in technological development and innovation. Innovation process in different countries depends upon various socio-economic dimension and culture context such as competition and market structure; national institutional structure and networks. Therefore, using the findings of innovation studies in technologically advanced countries to describe the innovative behavior in countries with a less-developed technological base is likely to be inappropriate (Mishra el at, 1996; Nejad, 1997; Souitaris, 2001a).

Rather than discriminate between innovative firms (success) and non-innovative firms (not success), other variations of study are also of interest. Many studies situate the issue of differentiation of product and process innovation (Utterback and Abernathy, 1975; Leo, 1996; Kraft, 1990; Park el at, 1999; and Rosa, 2001). Focusing on the life-cycle model innovations, manufacturing and innovation strategies will differ across the life cycle of a product or industry, with the early stages of the life cycle being driven primarily by product innovation while process innovation becomes relatively more important in the later stages of the product life cycle (Utterback and Abernathy, 1975). Both product and process innovation features the different patterns of products, production processes, organization, competition and market. Moreover, Kim (1997) argued that the process of innovation in developing countries is fundamentally different from that of developed countries. The sequence of innovation processes is 'reversed'. In developing countries, it moves from mature stage to early stage of the innovation process. A comparative analysis between these two types of firms accounts for another important research strand in developing countries, where both types of firms coexist together.

This study wants to answer regarding to the question: 'Do firms in different types of innovation have significant difference in the factors determining innovation?' Main objectives of this article are twofold. First, it attempts to investigate the determinants of innovation in less technological developed countries, Thailand. Second, this study examines the role of innovation type on the determinants of innovation by contrasting product- and process-innovative firms. Moreover, this study compares the determinants of innovation between domestically-owned firms and foreign joint-venture (FJV). This study uses "the Thailand R&D/Innovation Survey 2000" collected by The National Science and Technology Development Agency (NSTDA) as a sample in quantitative analysis.

This paper is structured as follows. Section 2.1 describes the concept of the portfolio model of determinants of innovation. Section 2.2 explains about the role of innovation type on the determinant of innovation. The research methodology is presented in Section 3. The results are presented in Section 4. Finally, Section 5 concludes and identifies the research implications.

2. Theoretical Framework

This section explains about determinant of innovation by applying Souitaris's "portfolio model". After that the effect of innovation types on the determinants of innovation are described and proceeds to the research hypotheses.

2.1 The portfolio model of determinants of innovation

The identification of the distinctive characteristics of highly innovative companies at the firm-level has been the intention of organizational theorists since the late 1960s. The intention of this literature stream was to spot innovative firms based on managerial and organizational indicators. Neito (2003) distinguished three different viewpoints of the process of technological innovation at the firm-level which are operational approach, structure-conduct-performance (SCP) approach, and resource-based approach. First approach, operational approach (1960s and 1970s) assumed that success in the process of innovation is guaranteed if efficient assignment of resources to R&D activities can be achieved. Thus, the central plank in managing innovation in a firm is the selection, evaluation, budgeting, planning, controlling, and the carrying out of R&D projects. Second approach, under the influence of industrial economics, SCP approach (1980s) was assumed that success in the process of technological innovation is guaranteed if a firm was able to formulate a strategy for innovation suited to the characteristic of the industry involved considering the effects of factors in the environment. Third approach, influenced by evolutionary views, resource-based approach (1990s onwards) characterized firms as a set of routines, those are, as a store of technological knowledge applied to the resolution of problems. It considered that the essence of the technological innovation process within a firm consists of the combining of technological resources so as to generate new technological capacities. Therefore, its central aspect is constituted by the formulation of a strategy for innovation that would permit exploitation of a firm's internal technological resources and capabilities and development of new products based on them.

However, although more than three decades of empirical research designed to determine 'the determinants of innovative firms' and 'the factors associated with success or failure in innovation', there still exists no precise prescription for successful innovation (Rothwell, 1992). Different researchers have tested similar variables but discovered differing degrees of association with innovation rate (Wolfe, 1994; Souitaris, 1999). Using "the successful innovation routines categories"[2], Souitaris (1999) developed a working "portfolio model" of potential determining variables which is meant to operate as a platform for the selection of the appropriate variables, depending on the particular circumstances. Following Souitaris's portfolio model of determinant of innovation, this study hypothesizes that contextual variables, strategic variables, internal competencies and external communication determine firms' success in innovation. Details of each variable are described as the followings.

(I) Contextual variables. A number of theoretical perspectives suggest that contextual variables have a causal influence on strategy and structure (Souitaris, 2002). The literature indicated factors such as size (Manfiled, 1963), age (Nejad, 1997), growth rate (Smith, 1974), profitability (Manfield, 1971), earnings from exports (Calvert et al., 1996) and foreign capital involvement as determinants of innovation. They are repeatedly found to be associated with innovation (Duchesneau et al., 1979 and Souitaris, 1999). This study, therefore, hypothesizes that contextual variables determine firms' success in innovation.

In this study, two types of contextual variables were incorporated in the portfolio model. First is firms' profile. It indicates the firm's general demographic profile. The literature associated innovation with factors such as firm's age, growth rate, foreign capital ratio and export ratio. Second is business environment condition including human supply in labor market, market conditions, and technological infrastructure. According to firms' profile, this study expects that innovative firms are older, larger, and more export-intensive. They rely more on foreign capital and have higher proportion of OBM (Original Brand-name Manufacturing) and ODM (Original Design Manufacturing) products. For the business environment, this study expects that innovative firms are in open and competitive market condition. They can recruit technological personnel from labor market and can access public technological infrastructure

easily.

(II) Internal competencies. Competencies are the technical and organizational skills behind each firm's end products (Prehalad and Hamel, 1990). Internal competencies may frustrate or stimulate innovation. Moreover it can be modified as a function of strategy to enhance the innovative potential of firms (Miller and Blias, 1992). Many researches attempted to classify the firm-internal competencies (such as technological competencies, skills and knowledge embodied in people, human resources competencies, managerial system, organizational competencies, values & norm, and market competencies) as the determinant of innovation (Leonard-Barton, 1992; Tidd, 2000; and Souitaris, 2002). This study hypothesizes that the internal competencies determine firms' success in innovation.

The internal competencies incorporated in the portfolio model were classified in four subsets including technical competencies (the infrastructure of R&D in the firm and information on R&D and technology), market competencies, human resource (education of personnel and training), and Internal process variables (internal resistance to innovate). We expect that innovative firms have more technological human resources, financial resources, technological infrastructure, and have less internal resistance to innovate. According to technical competencies and marketing competencies, innovative firms have more information on R&D opportunities, technology, and marketing.

(III) Strategic variables. The management field views strategy as a network of choices to position the firm vis-à-vis its environment and to design organizational structures and processes (Souitaris, 2002). Many researches identified association between corporate strategy and innovation performance (Cooper, 1984; Souitaris, 1999; Souitaris, 2001a). The literatures indicated strategy-related variables such as innovation budget (Khan, 1990), business strategy (Rothwell, 1992; Khan and Manopichetwattana, 1989), management attitude (Miller et al. 1982), and CEO's profile (Khan and Manopichetwattana, 1989) as the determinant of innovation. This study hypothesizes that strategic variables determine firms' success in innovation.

Three subsets of strategy-related indicators including innovation budget, business strategy and management attitude are incorporated in this study. We expect that innovative firms concern novelty of product as factor of sale success. In innovative firms, management sees need importance of R&D. They include R&D strategy in business strategy. They have more R&D expenditure than non-innovative firms. They can accept high cost and risk to operate innovative activities.

(IV) External communication. It measures the ability of the company to interact with and to receive information from external partner. The role of external communication practices as the determinant of innovation has been emphasized repeatedly in the management literature (Allen, 1986; Alter and Hage, 1993) and the importance of networking is increasing in the modern information era (Bidault and Fischer, 1994). Rothwell (1992) argued that collaborative product development is a key issue for the new generation of innovation models. Tidd et al. (1997) reviewed a large number of empirical studies and suggested that innovative companies establish linkages with customers, markets, suppliers, competitors and other external sources of knowledge. This study hypothesizes that the external communication determines firms' success in innovation.

This study incorporates three subsets of innovation-related communication variables in consideration. First, the communication with the firms' stakeholders includes customers, parent and associate firms, and suppliers of machinery and equipment. Second, the collection and scanning of information includes various sources such as public agencies, professional associations, scientific and trade journals, trade fairs, competitors and internet as search for new technology. Third, the co-operation of the firm with

third parties includes universities and research institutions, public and private consultants and other firms. This study expects that innovative firms have more external communication than non-innovative firms especially the communication with the firms' stakeholders. They can access sources of innovation easier than non-innovative firms.

Table 1 shows list of hypotheses of the determinants of innovation on innovative firm and non-innovative firms in Thai manufacturing sector.

Table 1: List of hypotheses on innovative versus non-innovative

Category	Hypothesis
Main	"Contextual variables, strategic variables, internal competencies and external communication determine firms' success in innovation"
Contextual Variables	H1: Innovative firms are old and large firms. H2: Innovative firms are export-intensive firms. H3: Innovative firms rely more on foreign capital. H4: Innovative firms have more proportion of OBM and ODM products. H5: Innovative firms can recruit qualified personnel from labor market easily. H6: Innovative firms are in open and competitive market condition. H7: Innovative firms can access public technological infrastructure easily.
Strategic Variables	H8: Innovative firms include R&D strategy in business strategy. H9: In innovative firms, management sees need importance of R&D. H10: Innovative firms accept high cost and risk in operate innovative activities. H11: Innovative firms concern novelty of product as factor of sale success. H12: Innovative firms have more R&D expenditure than non-innovative firms.
Internal Competencies	H13: Innovative firms have more human resources. H14: Innovative firms have more financial resources. H15: Innovative firms have less internal resistance to innovate. H16: Innovative firms have more information on R&D opportunities and technology. H17: Innovative firms have more information on marketing. H18: Innovative firms have more technological infrastructure.
External communication	H19: Innovative firms have more external communication than non-innovative firms. H20: Innovative firms can access source of innovation easier than non-innovative firms.

2.2 The Role of Innovation Type on the Determinants of Innovation

The notion of product innovation and process innovation is quite common in innovation research[3]. The product-process life cycle theory provides a useful model helping to understand the pattern of industrial innovation processes (Utterback and Abernathy, 1975). This model shows that innovation is stimulated or inhibited by different forces changing over time. By identifying, and then separating process and product innovations, the industrial innovation pattern is related to three different stages: fluid, transition, and specific stage. In the fluid stage, when a new technological paradigm emerges, product innovation is strongly driven by the demand of new product features. In transition stage, after the emergence of a dominant design and increasing market demand, process innovations are stimulated by increasing in output while product innovation activity diminishes. In specific stages, production processes are more specific for particular products (Utterback and Abernathy, 1975). Moreover, Kim (1997) argued that

the process of innovation in developing countries is fundamentally different from that of developed countries. The sequence of innovation processes is 'reversed'. In developing countries, it moves from mature stage to early stage of the innovation process.

The evolutionary model together with the life cycle claims that both product and process innovation feature different patterns and, thus, necessitate different approaches in terms of management principle and competitive edge (Utterback and Abernathy, 1975; Koberg et al., 1996). Rosa (2002) found that factors encouraging innovation are different depending on the type of innovation engaged in each type of innovation has a corresponding business strategy in term of objectives, technological opportunities, acquisition and information sources. This study hypothesizes that considering contextual variables, strategic variables, internal competencies, and external communication, product innovative firms have some different determinants of innovation from process innovative firms.

The relationship between innovation activity and economic contextual variables such as firm size, market structure, and industrial differences has been subject to theoretical speculation and particularly to empirical investigation for a number of decades (Pavitt et al., 1987; Arvanitis, 1997; Link, 1982; Cohen, 1995). However few studies observe about the effects of other contextual variables on pattern of innovation activities. This study hypothesizes that product innovative firms have different contextual variables from process innovative firms. This study expects that product-innovative firms are older age and larger size, export-intensive and rely more on foreign capital. They have more proportion of OBM and ODM products. According to business environment variables, product-innovative firms can recruit technological personnel from labor market easily. They are in open and competitive market condition and easily access public technological infrastructure.

Product and process changes are highly interdependent which must be taken into consideration by management. Further product innovation activities inhibit the stability of manufacturing operations and put at risk process flow and production efficiency (Abernathy and Clark 1983). While the product innovation rate decreases, further process innovations are mainly cost driven. The identified stages can be related to the strategies performance maximization, sales maximization, and cost minimization. This study hypothesizes that product-innovative firms have different strategic variables from process-innovative firms. Product-innovative firms are expected to incorporate innovation strategy in business strategy. They see need of importance of R&D. Therefore, they have more R&D expenditure than process-innovative firms especially in basic and applied R&D. They perceive high cost and risk in operate innovative activities. Product-innovative firms aim to introduce new products, new market, increase market share, or replace old ones, while process innovative firms aim to reduce cost, delivery time, or enhance production productivity, quality and flexibility.

Product-innovative firms relative to process-innovative firms tend to manage a wider spectrum of innovation process: from obtain innovative ideas to managing innovative outcomes (Park et al. (1999). This study hypothesizes that product-innovative firms have more internal competencies than process-innovative firms. Product-innovative firms are expected to have more human resources, financial resources, and technological infrastructure. Product-innovative firms have less internal resistance to innovate. Product-innovative firms have more information on R&D opportunities, technology and marketing.

Product innovation activities relate to many participants than in process innovation activities. This study hypothesizes that product-innovative firms are expected to have more external communication than process-innovative firms. Product-innovative firms rely more on internal R&D function and

customers. In contrast, process-innovative firms rely more on production function and supplier.

Table 2 shows list of hypotheses on product innovative firms and process innovative firms in Thai manufacturing sector.

Table 2: List of hypotheses on product innovative versus process innovative

Category	Hypothesis
Main	"Considering contextual variables, strategic variables, internal competencies, and external communication, product innovative firms have some different determinants of innovation from process innovative firms"
Contextual Variables	H1: Product-innovative firms are old and large firms. H2: Product-innovative firms are export-intensive firms. H3: Product-innovative firms rely more on foreign capital. H4: Product-innovative firms have more proportion of OBM and ODM products. H5: Product-innovative firms can recruit qualified personnel from labor market easily. H6: Product-innovative firms are in open and competitive market condition. H7: Product-innovative firms can access public technological infrastructure.
Strategic Variables	H8: Product-innovative firms include R&D strategy in business strategy. H9: In Product-innovative firms, management sees need of importance of R&D. H10: Product-innovative firms perceive high cost and risk in operate innovative activities. H11: Product-innovative firms aim to introduce new products, new market, increase market share, or replace old ones, while process innovative firms aim to reduce cost, delivery time, or enhance production productivity, quality and flexibility. H12: Product-innovative firms have more R&D expenditure than process-innovative firms. H13: Product-innovative firms have more basic and applied R&D.
Internal Competencies	H14: Product-innovative firms have more human and financial resources. H15: Product-innovative firms have less internal resistance to innovate. H16: Product-innovative firms have more information on R&D opportunities and technology. H17: Product-innovative firms have more information on marketing. H18: Product-innovative firms have more technological infrastructure.
External communication	H19: Product-innovative firms have more external communication than process-innovative firms. H20: Product-innovative firms rely more on internal R&D function and customers. H21: Process-innovative firms rely more on production function and supplier.

3. Methodology

3.1 Data and Measurement

This study use "the Thailand R&D/Innovation Survey 2000" collected by The National Science and Technology Development Agency (NSTDA). A total of 2,166 firms were selected from the top 13,450 companies by revenues in 1999. Of the 2,166 firms sampled, a total of 1,019 completed questionnaires were received representing approximately a 50% response rate including 9 industrial sectors. Of these, 154 carried out R&D and 220 other innovation activities. This study uses 310 firms which have

R&D activities or other innovative activities as a sample. The survey invoked some fundamental clauses from the Oslo Manual, which sets out to standardize the collection process of innovation data (OECD, 1997). In this context, technological innovations are defined as significant improvements in business performance. They are attributed to the introduction of technologically new products and/or the implementation of technologically new processes. The definitions of each type of innovation are described as the followings:

- Product innovation: Either the development of a new product whose technological determinants or intended uses differ significantly from those of previously produced products.
- Process innovation: Adoption of technologically new or significantly improved production methods through introducing new process equipments or re-engineering of operational processes.
- Innovative firm: A firm that achieves to introduce any product or process innovation (or both) developed in Thailand into the market during the reference period.

MNC have an advantage in undertaking innovative activities in host countries because they can easily transfer technology to their affiliates at lower costs than domestically owned companies (Reis, 2001). Firm-specific assets (FSAs) (like special know-how on production processes, reputation for high quality or simply a well known brand) and their transfer to and from affiliates seem to be an important source of difference (Caves, 1996). This study defines foreign ownership in the sense of an affiliate being part of and having access to FSAs of the MNC network. In case of Thailand, Thai entrepreneur receives technical support from foreign company through joint venture. Moreover, although foreign firms hold minor capital share but in fact they can control that joint-ventures (Pornavalai, 1989). According to the ability accessing to the FSA of MNC network, this study defines the domestically-owned firms as wholly Thai-owned firm without foreign capital.

In the present study, however, only a selective set of variables are employed which can be obtained from the original innovation survey. The selected variables are then assigned to several categories based on the portfolio model of innovative determinants.

As independent variables, the general profiles of firms are investigated in terms of factors such as the age of firm (years from establishment), the size of the firm (number of employees), export intensity (the portion of export to total sales), ownership (the portion of foreign capital) and production categories (percentage of sale according to subsidiary, OEM, ODM and OBM categories). The objectives of the innovation, the sources of innovation, factors limiting R&D/innovation, external communication, human resources, and the expenditures of the innovation are employed. The first denotes the primary motives for firms to conduct innovative activities. The second indicates the sources from which firms obtain innovation ideas or technical knowledge. The third indicates factors limiting R&D/innovation. These factors are composed with internal factors (strategic variables and internal competencies) and external factors (external labor supply, market condition, and technological infrastructure). Strategic variables are composed with business strategy, management attitude, and innovation budgeting. Internal competencies are composed with human resources and internal process. The fourth indicate external communication. The external communication is classified into communication with the stakeholder, networking-scanning external information, and co-operation with external organization. These four groups of variables are qualitative and are measured on the Likert scale of one (not important) to five (very important). The fifth describes the intensity and composition of R&D expenditure. The sixth describes the composition of human resources. These later two groups of variables are quantitative and gauged as a percentage. List of variables, description and measurement is show in Appendix A.

3.2 Quantitative analysis

Testing hypotheses shown in Table 1 and 2, this study examines whether an ordinal or interval variable measured in each of two independent samples can be assumed to come from the same underlying population. A finding of significant difference indicates that the two samples differ on the variable of interest. For numeric variable which take the forms of number, amount or percentage, T-test or one-way analysis of variance (ANOVA) are preferable to compare mean differences however the study found that numeric variables used in the study have no normal distribution. Consequently, the test using in this study is non-parametric test, which not assume the normal distribution for both numeric and ordinal data. The Mann-Whitney U-Test was applied to contrast the rank differences.

The analysis begins from compare innovative and non-innovative firms after that we analyze by separating case into foreign-owned and domestically-owned firms. From the sample, there are 310 firms which carry out R&D or/and Innovation activities, only 153 firms success in innovation, 87 innovative Thai-owned firms and 76 innovative FJV (See Table 3). Second step, we compare product-innovative and process-innovative firm by excluding those firms which reported both product and process innovations after that we analyze by separating case by ownership. From the sample, 60 firms are product-innovation firms, 62 firms for process-innovative firms, and 41 firms for both innovations. Finally, we contrast innovative foreign-owned firms against domestically-owned subsequently we analyze by separating case by type of innovation.

To the investigate the difference of mean rank of each variable between two groups, the statistical program SPSS v.12 was used for the estimation of Mann-Whitney U asymptotic significant value. If the significant value is less than 0.05, we will reject the null hypothesis that the mean ranks of the variable between two groups are statistically equal. In the other words, they are different. If the direction of mean ranks of the variable between two groups follows the hypothesis, it means that the variable is the determinant of innovation.

In accordance with the Mann-Whitney U-Test, sample size must be the same in the two samples so that each has the same range of rank values, from 1 to n. However, if small deviations from this requirement usually do not affect substantive conclusions, populations need not be of equal size (Tabachnick and Fidell, 2001). From the sample, the imbalance in sample size between innovative and non-innovative firms; product-innovative and process-innovative firms; and Innovative Thai firms and FJV are not much different, therefore we applied the Mann-Whitney U-Test on the sample without data reduction.

Table 4: Classification of Sample

	Non-innovative	Innovative			Total
		Product	Process	Both	
Domestically-owned	77	33	34	20	164
Foreign-owned	70	27	28	21	146
Total	147	60	62	41	310

4. Results of the Study

4.1 Comparison between innovative firms and non-innovative firms

Table 4 summarizes the results of hypothesis testing between innovative and non-innovative firms. In terms of contextual variables, the hypothesis about the age and size of firms are considered. The results show that innovative firms are older in age and larger in size compared to non-R&D firms. However, it is not statistically significant for firm size since the variations are too large to support the hypothesis. This finding implies that innovative firms, relative to non-innovative firms range more widely firm those which are small, young and technology-intensive to those that are large, old and multi-product. In fact, the industrial structure of innovative firms in Thailand is quite scattered, ranging from large, old MNCs to small, young SMEs. These hypotheses require a sector-wise analysis since the pattern may depend on sectoral characteristics (Pavitt, 1984; Park et al. 1999). Contrary to expectation, no evidence exists that innovative firms are more export-intensive and foreign capital-dependent. In fact, though not statistically significant, the opposite seems true. This finding indicates that the majority of export-oriented firms in developing countries still concentrate on OEM products or labor-intensive goods, having recognized little incentive to innovate. Therefore, there is no evidence that export-oriented firms are more innovative. The impact of foreign capital is also marginal. This is because foreign firms make inroads into the developing countries mainly for marketing or assembly operations, rather than due to innovation. These findings have an important implication for the trade and foreign direct investment (FDI) policies in developing countries. Furthermore, it is interesting to examine whether the same pattern is found in the developing countries. For Business environment condition, non-innovative firms face the problems of insufficient supply of R&D personnel in labor market, lack of competition in the domestic market and lack of customer interests in innovation.

As for strategic variables, innovative firms believe that success in sales is from price and quality rather than from novelty of products. The results contradict the hypothesis that the inclusion of new technology plans in the business strategy was a variable with strong association with innovation rate. This finding suggests that most firms in Thai manufacturing sector still compete on the basis of price/quality leadership rather than product leadership. Concerning the expenditure on innovation, innovative firms have more spending on R&D activities. Formal R&D effort can usefully complement process thrown-back-from-the-work innovation. R&D teams can play a crucial role as the firm's 'learners' of knowledge produced elsewhere (Forbes and Wield, 2000). However, there is no different in proportion of experimental, applied and basic R&D between innovative and non-innovative firms.

Considering internal competencies, the results show that non-innovative have less internal competencies than innovative firms. They lack of R&D strategy at the firm level; lack of in-house R&D personnel; lack of internal infrastructure; and have limited in financial resources. In contrast, innovative firms have higher proportion of university graduates and technical worker than non-innovative firms. Surprisingly, non-innovative firms have higher proportion of scientists. It is possible that non-innovative firms are in the process of product innovation (fluid stage). However there is no statistically different in the proportion of engineers and training.

According to external communication, Innovative firms, especially joint ventures, have good communication with the stakeholder while non-innovative, Thai firms, still need networking-scanning external information and co-operation with external organizations. Souitaris (2000) found that in an information- poor, newly developed country, gathering firm-specific information and co-operating

with partnering organizations are much more important practices than collecting general long-term information and co-operating with assisting organizations. With respect to the source of innovation, locally-owner supplier, university and technical services providers are the sources of innovation for non-innovative firms. Innovative firm can access innovative information from internet effectively.

Table 4: Results of Testing: Innovative versus Non-Innovative firms

	Mean/Rank Sum (All)			Mean/Rank Sum (Pure Thai)			Mean/Rank Sum (JV)		
	Non-Innov.	Innov.	Sig.	Non-Innov.	Innov.	Sig.	Non-Innov.	Innov.	Sig.
CONTEXTUAL VARIABLE									
YEARS	19.65	21.34	*0.051*	20.58	23.05	*0.107*	18.63	19.39	*0.211*
EX_HR1	165.46	146.52	*0.058*	88.19	77.46	*0.140*	77.76	69.58	*0.233*
EX_MKT1	166.71	145.39	*0.032*	91.44	74.59	*0.020*	76.08	71.13	*0.467*
EX_MKT2	146.79	163.36	*0.093*	76.77	87.57	*0.134*	70.44	76.32	*0.385*
STRATEGIC VARIABLES									
IN_STR1	170.30	142.16	*0.005*	91.38	74.64	*0.022*	79.61	67.87	*0.085*
IN_FN1	169.52	142.85	*0.007*	91.76	74.30	*0.016*	78.54	68.86	*0.154*
RDEXP01	5,737,739	7,020,042	*0.000*	4,927,396	6,319,112	*0.001*	6,629,117	7,822,422	*0.001*
APPLIE	31.46	33.99	*0.086*	31.57	33.70	*0.058*	31.34	34.32	*0.461*
BASIC	15.63	14.20	*0.392*	16.90	15.18	*0.518*	14.23	13.09	*0.472*
SUCCES1	143.22	166.58	*0.016*	77.91	86.56	*0.217*	65.67	80.71	*0.024*
SUCCES2	147.95	162.31	*0.020*	76.27	88.01	*0.016*	72.08	74.81	*0.472*
INTERNAL COMPETENCIES									
IN_ORG1	166.81	145.30	*0.031*	91.06	74.93	*0.026*	76.38	70.85	*0.419*
IN_ORG3	165.41	146.56	*0.059*	84.82	80.44	*0.546*	81.37	66.25	*0.027*
IN_ORG4	163.46	148.32	*0.128*	84.60	80.64	*0.585*	79.63	67.86	*0.085*
IN_INFRA	169.86	142.55	*0.006*	90.26	75.63	*0.044*	80.26	67.28	*0.058*
IN_HR1	168.26	143.99	*0.015*	88.33	77.34	*0.132*	80.47	67.08	*0.050*
PHD	0.62	0.65	*0.000*	0.32	0.49	*0.004*	0.96	0.83	*0.027*
TECH	4.59	4.97	*0.061*	4.12	4.29	*0.175*	5.11	5.74	*0.193*
SCIENTIS	1.58	0.97	*0.063*	1.90	0.48	*0.005*	1.22	1.53	*0.852*
EXTERNAL COMMUNICATION									
INDUCT_1	141.19	168.41	*0.002*	78.58	85.97	*0.221*	63.19	82.99	*0.001*
INDUCT_2	147.23	162.95	*0.068*	80.32	84.43	*0.497*	67.62	78.91	*0.065*
INDUCT_3	146.18	163.90	*0.039*	84.18	81.01	*0.600*	62.79	83.37	*0.001*
INDUCT_4	151.91	158.74	*0.426*	89.03	76.72	*0.042*	63.97	82.28	*0.003*
INDUCT_8	168.43	143.84	*0.004*	91.29	74.72	*0.006*	77.71	69.63	*0.183*
INDUCT_9	166.06	145.98	*0.019*	88.12	77.53	*0.080*	78.46	68.93	*0.117*
INCESS_2	150.75	159.79	*0.339*	85.45	79.89	*0.421*	65.97	80.43	*0.026*
INCESS_3	147.70	162.53	*0.117*	84.43	80.79	*0.599*	64.04	82.22	*0.005*
INCESS_4	158.70	152.61	*0.519*	91.40	74.62	*0.015*	67.54	78.99	*0.076*
INCESS_5	158.11	153.15	*0.600*	90.62	75.32	*0.027*	67.97	78.59	*0.101*
INCESS_6	163.82	148.00	*0.094*	91.45	74.58	*0.015*	72.99	73.97	*0.879*
INCESS_9	170.68	141.81	*0.002*	95.19	71.27	*0.001*	76.07	71.13	*0.444*
INCES_10	165.59	146.40	*0.042*	91.22	74.78	*0.017*	74.82	72.28	*0.695*
COLLA3	152.19	158.49	*0.510*	85.72	79.65	*0.387*	67.01	79.48	*0.056*
COLLA4	165.12	146.83	*0.064*	90.76	75.19	*0.031*	74.88	72.23	*0.695*
COLLA6	167.66	144.53	*0.021*	88.51	77.18	*0.122*	79.62	67.86	*0.087*
COLLA9	165.38	146.59	*0.058*	91.18	74.82	*0.024*	74.91	72.20	*0.688*
COLLA13	161.66	149.94	*0.234*	82.38	82.60	*0.976*	79.70	67.79	*0.078*
COLLA15	141.66	167.98	*0.008*	75.22	88.94	*0.058*	66.80	79.67	*0.056*

4.2 Comparison between product-innovative firms and process-innovative firms

Table 5 presents the results of the hypothesis testing between product-innovative and process-innovative firms. In terms of contextual variables, none of the firm profiles succeed in differentiating between the two types. Firm age, firm size, export intensity and foreign capital exert a significant impact on the type of innovation. These results imply that the distinction between product-innovation and process-innovation is not due to the generic profiles of firms, but is due to the strategic direction and industry-specific characteristics of firms (Utterback, 1996; Park el at, 1999). It also implies that in developing countries, the export-oriented strategy and the inducement of foreign capital may not result in R&D intensity and product innovation. Although being FJVs do not have strong relationship with R&D and innovation activity but their production seem to have higher quality and productivity since they have to reach the world production standard. Moreover, they can access production techniques and know-how from such as their parent or partner firms more easily than local firms.

Product-innovative firms have more proportion of OBM products. Product-innovative and process innovative firms have no differences in human resources. Product-innovative firms have more technological human resources. Technologies used in product-innovation and process innovation are not much different. Regardless of the firm types, the innovative patterns are unequivocally associated with neither firm size nor firm age. Instead, the pattern seems to depend on the strategic direction and industrial characteristics of the firms. It is also observed that both product-innovative firms and process-innovative firms range more widely from small and young ones to large and old ones. The results are consistence with Park el at. (1999). They found that the dichotomy between product-innovative firms and process-innovative firms is not so clear in reality. This point is especially true in the developing countries, where both R&D-based product innovation and reverse engineering-based process innovation take place simultaneously. For Business environment condition, product-innovative firms confront with lack of human supply in labor market and lack of competitive market condition.

As for strategic variables, product-innovative and process-innovative firms have different objective in doing innovation. Product-innovative firms give priority to introducing new products. However, no positive evidence is found that process-innovative firms lay more stress on cost reduction or quality enhancement. This result suggests that product-innovative firms maintain a broader range of innovation objectives compared to process-innovative firms. That is product innovation not only pursues the introduction of the new product itself but also the reduction in production cost and the enhancement of quality. Kraft (1990) also concluded that product innovation led to process innovation but not vice versa. Product-innovative firms relative to process-innovative firms tend to manage a wider spectrum of innovation process: from obtain innovative ideas to managing innovative outcomes (Park et al. 1999). Therefore, product-innovative firms have more problems about management attitude. The main problems are that they not see importance of R&D and have bad attitude toward risk. Concerning the expenditure on innovation, there is no difference in R&D expenditure between product-and process-innovative firm. The proportion of R&D spending on experimental, applied and basic R&D is not different significantly. However innovative Thai firms spend more proportion on personal and capital in process innovation more than innovative FJV.

Product-innovative FJVs concern more on production process efficiency, quality and flexibility than product-innovative Thai firms. FJV try to reach global standard in cost, quality and delivery. Moreover, this study found that Thai product-and process-innovative firms have different objectives of doing innovation but in case of FJV, product-and process-innovative firms have not much different in

objectives of doing innovative activities. This result suggests that innovative FJV maintain a broader rage on innovation objectives compared to Thai firms. Innovative FJV not only pursues the introduction of the new product itself, but also the reduction in production cost and the enhancement of quality. Price and quality are crucial factors in competing in the global market.

Table 5: Results of Testing: Product Innovative versus Process Innovative firms

	Mean/Rank Sum (All)			Mean/Rank Sum (Pure Thai)			Mean/Rank Sum (JV)		
	Product	**Process**	***Sig.***	**Product**	**Process**	***Sig.***	**Product**	**Process**	***Sig.***
CONTEXTUAL VARIABLES									
ODM	8.92	16.21	*0.194*	9.58	16.91	*0.082*	8.10	15.36	*0.894*
OBM	49.56	29.19	*0.006*	57.73	35.59	*0.033*	39.59	21.43	*0.049*
CAPITAL	34.57	36.23	*0.336*	30.63	35.72	*0.071*	39.39	36.85	*0.772*
EX_HR1	67.26	55.93	*0.068*	35.32	32.72	*0.576*	32.31	23.84	*0.041*
EX_HR2	66.81	56.36	*0.095*	35.02	33.01	*0.668*	32.22	23.93	*0.049*
EX_MKT1	66.65	56.52	*0.099*	34.86	33.16	*0.709*	32.15	24.00	*0.049*
EX_INFR1	65.97	57.18	*0.153*	32.86	35.10	*0.625*	33.54	22.66	*0.009*
EX_INFR2	62.70	60.34	*0.702*	31.20	36.72	*0.232*	32.06	24.09	*0.054*
STRATEGIC VARIABLES									
IN_MA1	66.62	56.55	*0.092*	34.03	33.97	*0.989*	32.76	23.41	*0.020*
IN_MA2	67.05	56.13	*0.080*	36.21	31.85	*0.348*	31.20	24.91	*0.133*
PERSONAL	27.44	29.73	*0.043*	27.60	31.04	*0.086*	27.24	28.15	*0.240*
TECH	5.36	4.08	*0.441*	4.42	4.25	*0.562*	6.50	3.87	*0.094*
INNOB1	71.34	51.98	*0.002*	38.35	29.78	*0.066*	33.44	22.75	*0.011*
INNOB3	67.71	55.49	*0.043*	38.71	29.43	*0.040*	29.43	26.63	*0.489*
INNOB4	72.03	51.31	*0.001*	39.18	28.97	*0.026*	33.22	22.96	*0.014*
INNOB5	72.13	51.21	*0.001*	39.85	28.32	*0.012*	32.87	23.30	*0.021*
INNOB7	52.70	70.02	*0.005*	28.82	39.03	*0.025*	24.28	31.59	*0.076*
INNOB8	54.63	68.15	*0.027*	28.56	39.28	*0.020*	26.30	29.64	*0.409*
INNOB9	58.97	63.95	*0.394*	30.24	37.65	*0.095*	29.19	26.86	*0.540*
INNOB10	57.87	65.02	*0.246*	29.71	38.16	*0.066*	28.72	27.30	*0.731*
INNOB13	56.47	66.37	*0.090*	30.89	37.01	*0.159*	26.02	29.91	*0.319*
INTERNAL COMPETENCIES									
IN_ORG1	66.98	56.20	*0.081*	35.06	32.97	*0.649*	32.20	23.95	*0.046*
IN_ORG3	66.44	56.72	*0.117*	34.03	33.97	*0.990*	32.67	23.50	*0.027*
EXTERNAL COMMUNICATION									
COLLA5	56.73	66.11	*0.132*	29.89	37.99	*0.080*	27.41	28.57	*0.781*
COLLA7	67.30	55.89	*0.068*	37.61	30.50	*0.126*	30.17	25.91	*0.312*
COLLA10	65.00	58.11	*0.274*	39.20	28.96	*0.029*	25.96	29.96	*0.336*
INDUCT_1	69.73	53.53	*0.006*	38.21	29.91	*0.062*	32.06	24.09	*0.045*
INDUCT_2	67.28	55.91	*0.058*	36.73	31.35	*0.228*	31.20	24.91	*0.118*
INDUCT_3	66.73	56.44	*0.085*	35.94	32.12	*0.391*	31.37	24.75	*0.099*
INDUCT_4	70.44	52.85	*0.003*	35.33	32.71	*0.555*	36.07	20.21	*0.000*
INCESS_4	56.85	66.00	*0.139*	33.24	34.74	*0.747*	23.85	32.00	*0.047*
INCESS_6	68.39	54.83	*0.029*	38.95	29.19	*0.035*	29.83	26.23	*0.384*
INCESS_8	76.11	47.36	*0.000*	42.08	26.16	*0.001*	34.41	21.82	*0.002*
INCESS_9	68.81	54.43	*0.020*	42.47	25.78	*0.000*	26.41	29.54	*0.449*
INCES_10	66.49	56.67	*0.112*	37.73	30.38	*0.110*	29.26	26.79	*0.550*

Considering internal competencies, product-innovative firms need more internal competencies in innovation more than process-innovative. Especially in the case of FJV since they have internal competencies in process-innovation technology due to support from parent and associated firms and suppliers.

With respect to the external communication, product-innovative firms acquire more innovative ideas from client through internal marketing department while process-innovative firms resort more to the internal production department, parent and associate firms and external suppliers.

5. Conclusions

This study investigates the determinants of successful product-and process-innovative firms comparing between local firms and foreign joint ventures (FJV) in developing country. Testing on the sample of 310 firms in Thai manufacturing sectors, the study found that contextual variables, business environment condition, internal competencies, strategic variables, firm-internal variable and external communication are the determinants of success in innovation activities. The results are consistent with the previous studies. Souitaris (2000; 2001a; 2001b; 2002) found that in newly developing country, gathering firm-specific information and co-operating with partnering organizations, the proportion of university graduates of engineers and scientists, of managers and of professional staff, and the inclusion of new technology plans in the business strategy are variables strongly associated with innovation. To put their innovative ideas into practice, firms rely on a combination of internal and external sources for technological competence. In the developing country, like Thailand, the availability of technological human resources, R&D intensity, competitive market condition, accessing to technology information, and good external communication are the determinant of innovative success. Providing technological infrastructure, technology information, human resource, and financial resource will encourage firms' success in innovation. Government should create competitive environment, stimulate and support firms' awareness for technology development and response capabilities; and open market opportunities.

The study discovers the similarities and differences in the determinants of product-and process-innovative firms. Consistent with Park et al (1999), this study discovers that the innovative patterns are unclearly associated with contextual variables. Instead, the pattern seems to depend on the strategic direction, industrial characteristic of the firms, and stages in technological development. Product-innovative firms maintain a broader range of innovation objectives compared to process-innovative firms. Therefore, product-innovative firms need higher degree of innovative determinants than process-innovative firms. The successful product- and process- innovative firms pay more attention on production process improvement. Innovative firms see competitive price and quality as the keys of sale success. The results show that incremental innovation is the primary source of long-run competitiveness in technology-followers. Process innovation will often be more important than product innovation. Technology-follower firms will be more mature when the innovation drivers change to cost competition where process innovation matters more (Forbes and Wield, 2000). The relationship between design and technology provides opportunities for technology-follower firms to move up the value-chain.

The study finds that FJV have better external communication enjoying the advantage of accessing technology from their parent, associated companies, and suppliers, especially in improving their production process. Innovative firms, especially FJV, have good communication with the stakeholders. In contrast, Thai-owned companies lack of information about technology especially production

process technology. They do not have the luxury of using internal resources that are available within a multinational network and generate their own technological expertise through research and experimental development. Government should use MNCs already based in country to support efforts that will enhances the innovation and technological capabilities of the domestically-owned firms. The government should promote cooperation among firms in innovation and technology developing activity to avoid the problem of scale in developing technological capabilities.

This study has some limitations. First, the results are based country-specific and period-specific survey data. Thus, the results have limited generality. Second, this study does not analyze the effect of technology activities. Moreover, the definition of innovative firms used in this study does not include on-going project. Finally, the sector-specific characteristics are neglected. Comparison among different industries and different countries should provide different results. Investigating such differences should be an interesting area for further studies.

Note:

1. Including neo-classical economics, national innovation system paradigm, neo-contingency school of thought, and neo-institutional theory.
2. Tidd et al. (1997) categorize the routines associated with successful innovation into four themes which are: building and maintaining effective external linkages, developing and using effective implementation mechanisms, developing and extending a supportive internal context, and taking a strategic approach to innovation.
3. Product innovation is defined as a new product whose performance differs significantly firm that of previous products (major innovation) or an existing product whose performance has been enhanced substantially (incremental innovation). Process innovation is defined a new or improved production method, either hardware or software, that significantly increases production efficiency, reduces production cost or upgrades the composition of production factors (OECD, 1997).

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Appendix A: List of variables and measurement

Variable	Description	Measurement
CONTEXTUAL VARIABLES		
Profile of firms:		
YEARS	Age of firm	Years
EMPLOY01	Number of total employment in 2001	Number
EXPORT01	Percentage of export sales 2001	Percentage
SUBSIDIA	%Manufacturing arm of parent company	Percentage
OEM	%Original equipment manufacturing or OEM	
ODM	%Original design manufacturing or ODM	
OBM	%Original brand manufacturing or OBM	
Business Environment Condition		1-5 Likert scale
Labor Supply:		
EX_HR1	Insuffificent supply of R&D personnel of external factors	
EX_HR2	Lack of qualified personnel of external factors	
Market Condition:		
EX_MKT1	Lack of competition in the domes of external factors	
EX_MKT2	Lack of customer interests in inovation of external factors	
EX_MKT3	Lack of competition in the domestic market of external factors	
Technological Infrastructure:		
EX_INFR1	Lack of government R&D incentives of external factors	
EX_INFR2	Inadequate support services of external factors	
EX_INFR3	Inadequate support services of external factors	
EX_INFR4	Lack of government support of external factors	

Variable	Description	Measurement
STRATEGIC VARIABLES		
Business Strategy:		
IN_STR1	Lack of R&D strategy at the firm level of internal factors	1-5 Likert scale
Management Attitude:		
IN_MA1	Management sees no need for R&D of internal factors	1-5 Likert scale
IN_MA2	Perceived riskd too high of internal factors	
IN_MA3	Perceived cost too high of internal factors	
Innovation Budgeting:		
IN_FN1	Limited financial resources of internal factors	1-5 Likert scale
IN_FN2	Limited financial resources of internal factors	
RDEXP01	R&D expenditure in 2001 (Baht)	Number
EXPERI	Percentage of experimental development	Percentage
APPLIE	Percentage of applied research	
BASIC	Percentage of basic research	
Source of Sale Success:		
SUCCES1	Sales success: Price	1-5 Likert scale
SUCCES2	Sales success: Quality	
SUCCES3	Sales success: On time fulfillment	
SUCCES4	Sales success: Flexibility upon customer request	
SUCCES5	Sales success: Novelty of products/services	
SUCCES6	Sales success: Capital to services a number of customers at the same time	
SUCCES7	Sales success: Short delivery time	
SUCCES8	Sales success: Quality standard certified	
SUCCES9	Sales success: Services patterns	
SUCCES10	Sales success: One Stop Services	
Objective of Innovation:		
INNOB1	Replace products being phased out	1-5 Likert scale
INNOB2	Improved product quality	
INNOB3	Extend product range	
INNOB4	Open up new market	
INNOB5	Increase market share	
INNOB6	Fulfill regulations & standards	
INNOB7	Improve cycle time	
INNOB8	Improve product flexibility	
INNOB9	Reduce production cost	
INNOB10	Reduce energy consumption	
INNOB11	Reduce environment effects	
INNOB12	Improve work conditions	
INNOB13	Learn about new technology	
INTERNAL COMPETENCIES		
IN_INFRA	Lack of infrastructure of internal factors	1-5 Likert scale
Internal Process:		
IN_ORG1	Internal resistance to innovate of internal factors	
IN_ORG2	Lack of information on R&D opportunities of internal factors	
IN_ORG3	Lack of information on technology of internal factors	
IN_ORG4	Lack of information on markets of internal factors	
Human Resources:		
IN_HR1	In-house lack of R&D personnel of internal factors	1-5 Likert scale
PHD	Percentage of PhD researchers	Percentage
TECH	Percentage of technicians	
SCIENTIS	Percentage of Scientists	
ENGINEER	Percentage of Engineers	
TRAIN	Training expenditure 2001 (%)	

Variable	Description	Measurement
EXTERNAL COMMUNICATION		
Source of Innovation:		
Communication with the stakeholder:		
COLLA1	Sources within the enterprise	1-5 Likert scale
COLLA2	Parent/ associate companies	
COLLA3	Clients	
COLLA4	Locally-owned suppliers	
COLLA5	Foreign-owned suppliers	
Co-operation with third parties:		
COLLA6	Universities or other higher education institutes	
COLLA7	Government or private non-profit research institutes	
COLLA8	Business Services Providers	
COLLA9	Technical services providers	
COLLA10	Competitors	
Networking-Scanning of external information:		
COLLA11	Patent disclosures	
COLLA12	Fairs and exhibitions	
COLLA13	Professional conferences & meetings	
COLLA14	Specialist literature	
COLLA15	Internet	
Product Innovation		
Communication with the stakeholder:		
INDUCT_1	Customers, buyers in product innovation	1-5 Likert scale
INDUCT_2	Locally-owned suppliers in product innovation	
INDUCT_3	Foreign-owned suppliers in product innovation	
INDUCT_4	Parent/ associate companies in product innovation	
Co-operation with third parties:		
INDUCT_5	R&D institutes/ universities in product innovation	
INDUCT_6	Business Services Providers in product innovation	
INDUCT_7	Technical services providers in product innovation	
INDUCT_8	Other government agencies in product innovation	
INDUCT_9	Competitors in product innovation	
INDUC_10	Other firms in product innovation	
Process Innovation		
Communication with the stakeholder:		
INCESS_1	Customers, buyers in process innovation	1-5 Likert scale
INCESS_2	Locally-owned suppliers in process innovation	
INCESS_3	Foreign-owned suppliers in process innovation	
INCESS_4	Parent/ associate companies in process innovation	
Co-operation with third parties:		
INCESS_5	R&D institutes/ universities in process innovation	
INCESS_6	Business Services Providers in process innovation	
INCESS_7	Technical services providers in process innovation	
INCESS_8	Other government agencies in process innovation	
INCESS_9	Competitors in process innovation	
INCES_10	Other firms in process innovation	