An Empirical Study on the Correlation among Innovative Strategies, Motivation, Level of Implementing Innovative Activities and Business Performance in Taiwan's High-tech Manufacturers*

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Abstract

This study explores the influence of Taiwan's high-tech manufacturers' innovative strategy and innovation motivation concerning the implementation of innovative activities, as well as the influence of innovative activities implementation on business performance. The two intermediate variables, industry group and enterprise scale are also considered. Through a review of the relevant literature, a theoretical model of the influence relationship is developed, while an empirical analysis is simultaneously conducted on Taiwan's high-tech manufacturers. The research result shows that the internal driving force of innovative activities has a significant impact on the level of implementing technological innovative activities and cultural innovative activities. The external driving force of innovative activities has a significant impact on the level of implementing market innovative activities and management innovative activities. Companies adopting self-developed technology and purchased as well as self-developed technology strategies, perform better than those adopting purchased new technology or those with neither purchased nor self-developed technology strategies, at implementing technological innovative activities and cultural innovative activities. The level of implementing innovative activities has a significant influence on business performance (cost reduction and product/service differentiation). For the intermediate variables of "industry group" and "enterprise scale", it is proven in this study that they have no significant influence on the level of innovative activity implementation or business performance.

Key Words: Business Performance, Driving Force, Innovative Activities

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1. Introduction

High-tech industry has long been an economic pillar of Taiwan. According to the identifying standard in the "Classification of Import/Export Commodities" by the Ministry of Finance, R.O.C., industries with high value-added products, complicated technology, high technical manpower and R&D budget investment rate, encompassing: chemical, mechanical, electronic, and transportation equipment manufacturing, are all included within high-tech industry. The development of Taiwan's high-tech industry has gradually changed to an operational mode driven by innovation. Enterprises no longer depend upon land resources and diligent workforce, but resort to knowledge capital such as wisdom, brainpower and innovative capability. In other words, all successful experiences come from the effective use of human "innovative activities," which are transformed into all sorts of valuable things in an organization. "Innovative activities" have replaced traditional land, human and financial capital to become the driving force of enterprises seeking high level business performance. In recent years, due to the rapid development of information technology, many engineers possessing professional skills have rushed to join the high-tech industry. The evolution of modern industries originates from the innovation of technology. Industries related to logistics, money flow, people flow and information flow have all experienced unceasing breakthroughs and development. In this ever-changing age, industries must keep abreast of the latest innovative technology. The most rapidly expanding enterprises have one thing in common, they all innovate their management approach and technological capability. To understand whether innovative activity implementation by Taiwan's high-tech manufacturers will lead to enhanced business performance, a questionnaire interview is conducted in this study. The major research objectives are: (1) to determine the influence of different innovative strategies and innovative motivations adopted by high-tech manufacturers on the level of implementing innovative activities; (2) to determine the influence of high-tech manufacturers' level of implementing innovative activities on business performance.

2. Literature Review

2.1 Innovative activities

Innovative activities can be described according to the following different dimensions: (1) Product dimension: Blau and Mckinley (1979), Burgess (1989), Kelm *et al.* (1995), Liu and Tsai (2007a/b), Tien *et al.* (2007) and Kochhar and David (1996) emphasized the results generated from innovative activities and assessed innovative activities in terms of specific products; (2) Process dimension: Kimberly (1986), Drucker (1985), Amabile (1988), Kanter

(1988), Johannessen and Dolva (1994), Chen *et al.* (2008) and Scott and Bruce (1994) stated that innovative activity is a process, emphasizing the assessment of innovation by using a series of procedures and stages; (3) Product and process dimension: Tushman and Anderson (1986), Dougherty and Bowman (1995), and Lumpkin and Dess (1996) suggested that a dual dimension taking both products and processes into consideration should be adopted to define innovative activities, which should combine the results and the process; (4) Multiple dimension: Damanpour (1991), Russell (1995), Robbins (1996) indicated that innovative activities cannot focus only on the "technological level", while neglecting the "managerial level." Therefore, they proposed that innovative activities should include: technological innovation in the products, processes and equipment, as well as managerial innovation in the system, policies and services. Knight (1967) classified innovative activities into: (1) Product and service innovative activities: refer to the production or sales of new products or new services; (2) Production process innovative activities: refer to innovation in work tasks, decision making and information system, or adoption of new methods in production work or technology; (3) Organizational structure innovative activities: refer to changes in the delegation of work, authority-responsibility relationship, communication system and rewarding system, in an organization; (4) Personnel innovative activities: refer to changes in the behaviors and beliefs of the members of an organization. Daft (1978) classified innovative activities into: (1) Management structure innovative activities: include the innovation of strategies and organizational constituting factors; (2) Technological innovative activities: include innovation of products, technologies, work flow and product creativity. Holt (1983) divided innovative activities into: (1) Technological innovative activities: the use of existing technology or the creation of new technology. The result may be product innovation or production process innovation; (2) Management innovative activities: the use of new management methods or systems; (3) Organizational innovative activities: the use of new organizational structure to build a new form of interpersonal interaction; (4) Routine innovative activities: innovative activities are based on existing technology, and mainly target existing customers. Chacke (1988) classified innovative activities into: (1) Product innovative activities: research and development of new and novel products; (2) Procedural innovative activities: adoption of new production methods; (3) Organizational innovative activities: development of new organizational structure and form. To summarize the above literatures, innovative activities are classified into: management innovative activities, technological innovative activities, market innovative activities and cultural innovative activities, constituting the four major dimensions in this study.

2.2 Innovative motivation and innovative activities

According to El Sway (1985) and Porter and Millar (1985), the motivation of implementing innovative activities can be distinguished as external driving force or internal driving

force. Internal driving force comes from the support of high management, as well as the initiative of employees in various departments to promote and find opportunities for innovation. Sources of external driving force may include the demand of suppliers, pressure from competitors, and demands of customers. Different innovative motivations will have different influences on the level of implementing innovative activities. Drury and Farhoomand (1999) suggested that motivation for innovation includes technological-push and demand-pull types. Technological push emerges when a new technology is introduced to the market, and the company has to adopt a corresponding strategy in response to the demand of suppliers, pressure from competitors or demands of customers. Demand pull comes from the innovative activities initiated by high management and employees in various departments. Ahituv (1980) pointed out that high level managers of a company may take the lead in introducing new technology when such technology appears, based on the demands of suppliers, pressure from competitors or demands of customers, urging the upgrade of the company's system to avoid losing ground in the highly competitive environment. Of course, high level managers may take a more conservative attitude towards introducing new technology or new equipment, for economic reasons. To make up for this, the company may make innovative changes to the existing operational model, making it more efficient, in order to respond to the threats that may be brought about by the new innovative technology. According to Ahituv (1980), enterprises are more likely to introduce innovative activities because of external driving forces such as the demands of suppliers, pressure from competitors and demands of customers. Based on the above deduction, the following hypothesis is proposed:

H_1: Enterprises with different innovative motivations will exhibit significant differences in the level of implementing innovative activities.

2.3 Innovative strategies and innovative activities

Arrow (1962) concluded that when an enterprise faces the need to innovate, the innovative strategies that it undertakes have an impact on the level of implementing innovative activities. Managers should make an across-the-board consideration of the company's economic interests and business performance, in order to determine the strategic decision concerning whether to purchase new technology or develop the technology by the companies themselves. According Allen (1986) and Cohen and Levinthal (1990), enterprises should commit themselves to internal R&D activities. Activities of self-developed technology are more favorable to the implementation of innovative activities. Radnor (1991) pointed out that enterprises which adopted different innovative strategies (self-developed technology or purchased technology) experienced different levels of innovative activity implementation. Veugelers and Cassiman (1999) selected 734 Belgian manufacturers as the research samples. They found that 60% of the manufacturers engaged in innovative activities, and among these manufacturers, 17% devel-

oped their own technology, 10% purchased new technology, and 73% used both self-developed and purchased technology, while 40% of the manufacturers had not engaged in any innovative activities in two years or more. Veugelers and Cassiman (1999) found that when competitors are engaged in innovative activities, managers of an enterprise must devise suitable innovative strategies to enhance the company's level of implementing innovative activities to respond to the threat posed by competitors. They may choose to self-develop their own technology or purchase new technology from external source as their innovative strategies, or they may choose not to engage in any innovative activities for such reasons as cost, risk or technological difficulty. Based on the above deduction, the following hypothesis is proposed:

H_2: Enterprises adopting different innovative strategies will have significant differences in the level of implementing innovative activities.

2.4 Innovative activities and business performance

Based on literature review, innovative activities are classified into four dimensions in this study: (1) management innovative activities; (2) technological innovative activities; (3) market innovative activities; and (4) cultural innovative activities. Ettlie *et al.* (1984) suggested that enterprises will achieve better business performance because of the changes brought about by managing innovative activities. Damanpour (1991) indicated that enterprises with higher levels of management innovative activities will be more able to reduce uncertainty when they engage in innovation, and hence promote business performance. Cooper and Kleinschmidt (1996) found that comprehensiveness in preparatory work will directly affect the success of innovative activities, and that preparatory work includes such management innovative activities as: assessment, analysis and application of technology. The level of implementing management innovative activities will clearly affect business performance. Brentani (2001) indicated that the level of implementing management innovative activities by an organization's members is positively related to the organization's innovative performance. Burgelman *et al.* (1988) and Nonaka (1991) pointed out that technology is a tool that an enterprise may use to develop and improve its products. When enterprises come across a problem, those with higher levels of management innovative activities will be more able to solve the technology-level problems, and achieve better business performance. Schumpeter (1934) suggested that innovative capability can be improved by learning and training; relevant experiences such as the accumulation of technology; experience of service; and communication, application and storage of technological knowledge, which may help with the implementation of management innovative activities. The level of implementing management innovative activities has a significant influence on business performance. Based on the above deduction, the following hypothesis is proposed:

$H_{3\text{-}1}$: The level of implementing management innovative activities has a significant influence on business performance.

Rosenberg and Frischtak (1985) suggested that enterprises' technological innovative capability is acquired through the problem-solving experience over a long period of time, by engaging in such activities as design and production. Enterprises having better collection and storage of information will have higher levels of implementing technological innovative activities, and hence the business performance will also be better. Youssef (1991) indicated that technological innovative activities can promote company quality, reduce costs, as well as increase flexibility and responsiveness, so that it can achieve the goal of enhancing business performance. Among these, the promotion of company quality includes: promoting product quality, supplier quality, design and engineering quality; reduction of costs includes reducing: quality cost, product R&D cost, material unit cost, unit human cost and indirect costs; increases in flexibility and responsiveness include: increasing the R&D capability of new products, speeding up R&D and production of new products, and promoting the production ability to respond to customers' needs. Based on the above deduction, the following hypothesis is proposed:

$H_{3\text{-}2}$: The level of implementing technological innovative activities has a significant influence on business performance.

Cooper and de Brentani (1991) pointed out that the result of implementing market innovative activities is an important factor affecting the success of an enterprise's innovative activities. Raudsepp (1987) suggested that market innovative activities are related to the product's market share. Enterprises with a higher level of implementing market innovative activities are more likely to develop more new products, attract customers to purchase their products, and hence achieve better business performance. Tatikonda and Stock (2003) stated that market innovative activities help the achievement of market goals, and will affect business performance. Raudsepp (1987) argued that when enterprises are engaged in innovative activities, they must consider factors that affect the market innovative activities (including the cost, technology, production flow, market share, market satisfaction, product design and quality), in order to improve business performance. Based on the above deduction, the following hypothesis is proposed:

$H_{3\text{-}3}$: The level of implementing market innovative activities has a significant influence on business performance.

Cooper and Kleinschmidt (1996) conducted a study with 161 American business units as their research sample. The research result shows that the level of implementing cultural innovative activities is an important factor that affects business performance. Kanter (1988)

found that managers with better innovative spirit and who are more encouraging of employees' innovative activities, will obtain a higher level of implementing cultural innovative activities in the company, and hence business performance will also be better. McGrath (1993) pointed out that enterprises may encourage employees to develop products that attract customers through cultural innovative activities to promote business performance. Damanpour (1991) showed that when people become too familiar with certain work habits, too much experience may cause learning obstacles, which will create resistance to new things. At such time, business performance must be enhanced through the implementation of cultural innovative activities. Woodman *et al*. (1993) suggested that a company's cultural and environmental factors will affect the level of implementing cultural innovative activities, and the level of implementing cultural innovative activities will, in turn, affect business performance. Thomas (1993) stated that an open, participative, growth-seeking and relatively free organizational atmosphere will motivate the organization's cultural innovative activities, leading to better business performance. Based on the above deduction, the following hypothesis is proposed:

$H_{3\text{-}4}$: The level of implementing cultural innovative activities has a significant influence on business performance.

Veugeler and Cassiman (1990) suggested that enterprise scale is an important factor that affects the business managers' adoption of different innovative strategies (self-developed technology, purchased technology or both). The larger the scale of an enterprise, the more likely it will gradually give up a unitary strategy of self-development or the purchase of new technology, but turn to a strategy that emphasizes both self-developed technology and purchased technology. Adoption of different innovative strategies will have an impact on business performance. McDermott and O'Connor (2002) indicated that in most larger-scale companies, a breakthrough type of innovative activity is less likely to gain support. The culture and pressure inside the company will push resources towards gradual-type innovative activities which have lower risk and faster return. However, most studies show that businesses adopting the breakthrough type of innovative activities will experience better business performance. Cohen and Levinthal (1990) suggested that the scale of an enterprise will affect the business performance of its innovative activities. Schumpeter (1934) stated that the breakthrough type of innovative activities is mostly concentrated in small companies, while the gradual type of innovative activities are mostly concentrated in large companies. Enterprises in different industry groups also adopt different forms of innovative activities, and hence differ in their business performance. Porter (1980) pointed out that enterprises in different industry groups and different enterprise scales will opt for different innovative strategies to promote their business performance. Based on the above deduction, the following hypotheses are proposed:

$H_{4\text{-}1}$: For firms with different industry groups, the level of implementing innovative activ-

ities has significant influence on business performance;

H_{4-2}: For firms with different enterprise scales, the level of implementing innovative activities has significant influence on business performance.

3. Research Method

This study aims to determine the correlation between innovative strategies, motivation, level of implementing innovative activities and business performance of high-tech manufacturers. The research framework is shown in Figure 1.

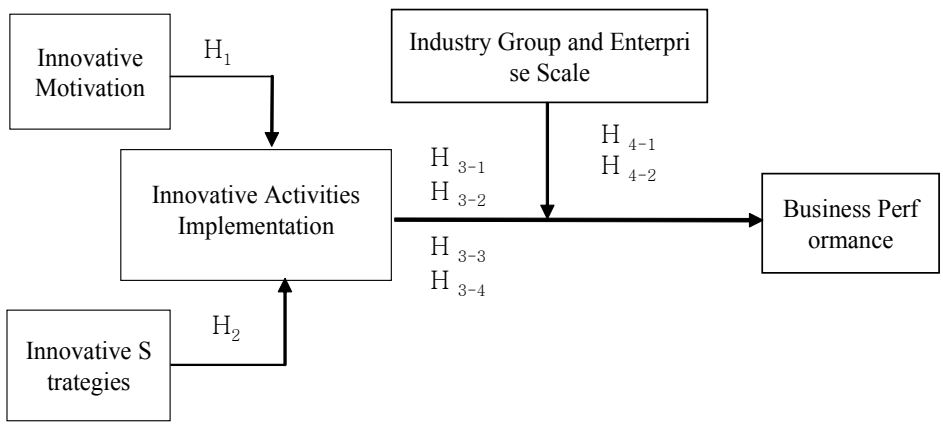

Figure 1. Research framework

3.1 Research hypotheses

Based on the literature review, the following research hypotheses have been deduced for this study:

H_1: Enterprises with different innovative motivations will exhibit significant differences in the level of implementing innovative activities.

H_2: Enterprises adopting different innovative strategies will have significant difference in the level of implementing innovative activities.

H_3: The level of implementing innovative activities has a significant influence on business performance.

H_{3-1}: The level of implementing management innovative activities has a significant influence on business performance.

H_{3-2}: The level of implementing technological innovative activities has a significant influence on business performance.

$H_{3\text{-}3}$: The level of implementing market innovative activities has a significant influence on business performance.

$H_{3\text{-}4}$: The level of implementing cultural innovative activities has a significant influence on business performance.

H_4: For firms with different industry characteristics the level of implementing innovative activities has a significant influence on business performance.

$H_{4\text{-}1}$: For firms with different industry groups, the level of implementing innovative activities has a significant influence on business performance.

$H_{4\text{-}2}$: For firms with different enterprise scales, the level of implementing innovative activities has a significant influence on business performance.

3.2 Collection of questionnaires and data analysis

A total of 406 manufacturers in the Hsinchu Science Park of Taiwan were selected as the targets of interview in this study, including those in the semiconductor industry, computer and peripheral industry, communication industry, optic-electronic industry, precision machinery industry and bio-technology industry, and data were collected by means of interviews with the employees. Questionnaire respondents were required to have a thorough understanding of the company's entire innovative activity process. Supervisors responsible for innovative activities in the companies were the target respondents to increase validity of the questionnaire responses. A total of 185 manufacturers were successfully interviewed. The interview time was from March 2007 to June 2007. Questions in the questionnaire were designed based on scholarly and expert opinions and the literature review. Scoring for the answers were used to calculate the Cronbach's α coefficient of each question in each dimension and to test the reliability for each question in the questionnaire. The larger the Cronbach's α value, the larger the correlation among various questions in that dimension, i.e., the higher the internal consistency. Nunnally (1978) suggested that in fundamental research, the acceptable reliability must reach at least 0.8 while in exploratory research, acceptable reliability must reach at least 0.7. In this study, the reliability values are all above 0.8, and therefore are reliable.

Table 1. Cronbach's α coefficients for all variables in this study

Questionnaire dimensions		Cronbach's α
Innovative activities	Management innovative activities	0.841
	Technological innovative activities	0.807
	Market innovative activities	0.819
	Cultural innovative activities	0.803
Business performance	Cost reduction	0.835
	Product/service differentiation	0.824

Cronbach's α coefficients for all variables in this study, are shown in Table 1. SPSS statistical software is used in this study to analyze and process data. Methods of data analysis include ANOVA analysis and multiple-regression analysis.

3.3 Measurement of variables

According to the research structure, the variable measurement involved can be divided into five groups as described below:

3.3.1 Measurement of innovative motivation

From the review of relevant literature (El Sway, 1985; Portor and Millar, 1985), motivation for carrying out innovative activities is classified into: (1) internal driving force: sources include: the support of high management, self-initiated promotion of various departments, and suggestions of employees; (2) external driving force: sources include: the demand of suppliers, threat from competitors, and demands of customers. Nominal scale was used for measuring the strength of the internal and external driving forces. Sources of internal driving force include: the three options of support of executive managers, self-initiated promotion of various departments, and suggestion of employees. One mark was given for choosing one option, two marks for choosing two options, and three marks for choosing three options, while 0 is given for companies having none of these motivations. Sources of external driving force include: the three options of demand of suppliers, threat from competitors, and demands of customers. One mark was given for choosing one option, two marks for choosing two options, and three marks for choosing three options, while 0 is given for companies having none of these motivations.

3.3.2 Measurement of innovative strategies

Referring to the study by Veugelers and Cassiman (1999), four innovative strategies are suggested in this study,: purchased new technology, self-developed technology, both purchased and self-developed technology, and neither purchased nor self-developed technology. Measurement is made by means of nominal scale.

3.3.3 Measurement of the innovative activities implementation level

According to the discussion of local and foreign researchers and the review of relevant literature, this study summarizes the activities needed to be conducted when enterprises are implementing innovative activities: (1) management dimension: including implementing a new management system to enhance the capability of handling more orders, training the employees to use new technology or equipment, improving operating processes to meet customers' demands, cultivating employees to accept new operating concepts, and investing efficiently to

utilize the R&D effect; (2) technological dimension: including developing new technology or equipment to enhance the product quality and lower production cost, improving the production process to enhance product quality and lower production cost, developing new raw materials to enhance the product quality and lower production cost, introducing new technology or equipment to enhance the product quality and lower production cost, and developing new product functions; (3) market dimension: including utilizing new technology to enhance customer satisfaction, improving the service process to enhance customer satisfaction, using new raw materials to enhance customer satisfaction, designing new products or services to enhance customer satisfaction, and developing different types of products to enhance customer satisfaction; (4) cultural dimension: including supporting employees to engage in innovative activities, paying attention to employees' opinions, encouraging employees to express their opinions or make suggestions, allowing supervisors and employees to discuss methods or technologies in order to improve work, encouraging colleagues to exchange their work reviews, and helping employees to obtain the resources or assistances they need. The five-point Likert scale was applied for measuring the degree of executive involvement in innovative activities of the measured firms, where 1 represents never implemented, 2 rarely implemented, 3 occasionally implemented, 4 frequently implemented, and 5 always implemented.

3.3.4 Measurement of business performance

From the review of relevant literature, the business performances for carrying out innovative activities are classified into: (1) cost reduction: the measuring indexes for cost reduction proposed in this research include: reduction in cost due to poor quality, decrease in procurement cost of raw materials, decrease in manufacturing and operation cost, decrease in product use and maintenance cost, decrease in inventory and handling cost, decrease in transport and distribution cost, reducing product/service R&D cost, and (2) product/service differentiation: the measuring indexes for product/service differentiation proposed in this research include improvements with respect to: product/service security and reliability, product/service quality, product/service design, and work conditions, while reducing time to market for new or revised products/service, promoting the production ability to respond to customers' needs, acquisition of new competencies with respect to marketing, increasing the ratio of new products/services successfully entering the market. The five-point Likert scale was applied to measure business performance of the measured firms in implementing innovative activities. When the respondents chose "strongly agree", they received 5 points; 4 points for "agree"; 3 points for "no comment"; 2 points for "disagree"; and 1 point for "strongly disagree."

3.3.5 Measurement of industry group and enterprise scale

In terms of business characteristics, industry group and enterprise scale are the major areas of discussion in this study: (1) Industry group: manufacturers in the Hsinchu Science Park

are classified according to the 2006 directory of the science park manufacturers: semiconductor industry, computer and peripheral industry, communication industry, optic-electronic industry, precision machinery industry and bio-technology industry; and (2) enterprise scale: according to the identifying standard for domestic industries adopted by the Ministry of Economic Affairs, manufacturers in the Hsinchu Science Park are divided into three classes of scale based on their capital and number of employees. They are large-scale manufacturers: with a capital above NT$80 million and number of employees exceeding 200; medium-scale manufacturers: with a capital below NT$80 million and number of employees from 20 to 199; small-scale manufacturers: with a capital below NT$80 million and number of employees under 20. The measurement of industry group and enterprise scale was based on nominal scale.

4. Result of verification

4.1 Relationship between innovative motivations and executive degree of innovative activities

This section explores if the executive influence on the different innovative motivations showed significant influence on the four innovative activities dimension. Table 2 shows the

Table 2. ANOVA of innovative motivation and the innovative activities implementation level

	Management innovative activities		Technological innovative activities		Market innovative activities		Cultural innovative activities	
	F value	P value	F value	P value	F value	P value	F value	P value
External driving force	7.403	0.000***	1.216	0.305	5.568	0.001**	1.437	0.233
LSD test	A, B, C < D		−		A <B, C, D; C < D		−	
Internal driving force	2.522	0.059	3.337	0.021**	2.206	0.112	6.202	0.000***
LSD test	−		A, B, C < D; A < B		−		A < B, C, D; B < C	

Note: (1) *p < 0.05; **p < 0.01; ***p < 0.001; (2) Sources of internal driving force included the three options of support of executive managers, self-initiated promotion of various departments, and suggestion of employees. Sources of external driving force included the three options of demand of suppliers, threat from competitors, and demand of customers. A was given for companies having none of these motivations, B was given for choosing one option, C was given for choosing two options, and D was given for choosing three options.

ANOVA results of driving force and the degree of executive influence at each innovative activity dimension. Internal driving force shows a significant difference on the level of implementing technological innovation (P = 0.021) and cultural innovative activities (P = 0.000), while external driving force shows a significant difference on the level of implementing management innovation (P = 0.000) and market innovative activities (P = 0.001), The above research results confirm the research hypothesis H_1: Enterprises with different innovative motivations will exhibit significant differences in the level of implementing innovative activities. A further analysis through LSD showed that the stronger the internal driving force, the higher the level of implementing technological innovation and cultural innovative activities. The stronger the external driving force, the higher the level of implementing management innovation and market innovative activities.

4.2 Relationship between innovative strategies and executive degree of innovative activities

This section discusses whether there was a significant influence of the implementation of different innovative strategies on the implementation of four dimensions of innovative activities. Table 3 shows the ANOVA result of the innovative strategies and the degree of executive implementation at each innovative activities dimension. A further analysis through LSD showed that enterprises adopting self-developed technology and both purchased and self-developed technology strategies, are better than enterprises that adopt purchased new technology and those with neither purchased nor self-developed technology strategies, at implementing technological innovative activities and cultural innovative activities. The research result in Table 3 shows that the following research hypothesis is partially validated. H_2: Enterprises adopting different innovative strategies will exhibit significant difference in the level of implementing innovative activities.

Table 3. ANOVA of innovative strategies and the innovative activities implementation level

	Management innovative activities		**Technological innovative activities**		**Market innovative activities**		**Cultural innovative activities**	
	F-value	**P-value**	**F-value**	**P-value**	**F-value**	**P-value**	**F-value**	**P-value**
Innovative strategies	0.779	0.540	4.190	0.003**	1.169	0.326	4.297	0.002**
LSD test	−		A, D < B, C		−		A, D < B, C	

Note: (1) ** $p < 0.01$; (2) A = purchased new technology; B = self-developed technology; C = both purchased and self-developed technology; D = neither purchased nor self-developed technology.

4.3 The relationship between executive involvement in innovative activities and business performance

This section explores if the implementation of each dimension of innovative activities significantly affects the two dimensions (cost reduction and product/service differentiation) of business performance. We divided executive involvement into two levels (high and low), according to the average values for each factor, to test the significance of executive influence. Table 4 reveals the ANOVA results for the correlation between executive involvement in each innovative activity dimension and business performance. The research result in Table 4 shows that the following research hypotheses are supported, $H_{3\text{-}1}$: The level of implementing management innovative activities has a significant influence on business performance. $H_{3\text{-}2}$: The level of implementing technological innovative activities has a significant influence on business performance. $H_{3\text{-}3}$: The level of implementing market innovative activities has a significant influence on business performance. $H_{3\text{-}4}$: The level of implementing cultural innovative activities has a significant influence on business performance.

Table 4. ANOVA of executive involvement in innovative activities and business performance

Implementation of innovative activities	Cost reduction		Product/Service differentiation		Business performance	
	F-value	P-value	F-value	P-value	F-value	P-value
Management innovative activities	10.023	0.002**	16. 834	0.000***	18.540	0.000***
Technological innovative activities	11.730	0.001**	17.129	0.000***	20.176	0.000***
Market innovative activities	22.340	0.000***	12.414	0.001**	24.401	0.000***
Cultural innovative activities	11.518	0.001**	5.372	0.022*	11.499	0.001**

Note: *p < 0.05; ** p < 0.01; ***p < 0.001.

4.4 The influence of executive involvement in innovative activities at firms with different enterprise characteristics on business performance

This section explores the influence of executive involvement in innovative activities at firms with different enterprise characteristics (industry group and enterprise scale), on business performance. The research result of Table 5 reveals that enterprise characteristics did not have a significant influence on the implementation of four dimensions of innovative activities. The research result in Table 6 reveals that the companies with different industry groups and enterprise scales did not have significant influence on their business performance (cost reduction and product/service differentiation). From the analysis results in Table 5 and Table 6, both hypotheses $H_{4\text{-}1}$ and $H_{4\text{-}2}$ were not supported: $H_{4\text{-}1}$: For firms with different in-

dustry groups, the level of implementing innovative activities has a significant influence on business performance; $H_{4\text{-}2}$: For firms with different enterprise scales, the level of implementing innovative activities has a significant influence on business performance. The reason might be that companies with different industry groups or enterprise scales have recognized the importance of implementing innovative activities and their implementation reached a certain level that is not different because of industry groups or enterprise scales.

Table 5. ANOVA of enterprise characteristics and executive involvement in each dimension of innovative activities

	Industry group		Enterprise scale	
	F-value	P-value	F-value	P-value
Management innovative activities	0.762	0.578	0.499	0.777
Technological innovative activities	0.540	0.746	0.767	0.575
Market innovative activities	1.798	0.115	0.759	0.581
Cultural innovative activities	0.698	0.626	1.633	0.153

Table 6. ANOVA of enterprise characteristics and business performance

	Industry group		Enterprise scale	
	F-value	P-value	F-value	P-value
Cost reduction	1.177	0.322	1.346	0.263
Product/service differentiation	0.855	0.513	0.365	0.694

4.5 The multiple-regression analysis for the innovative activities implementation on business performance

Multiple-regression analysis is a simple and extended application used mainly for understanding the linear relationship between a group of forecast variables and a valid variable.

Table 7. The multiple-regression analysis for the innovative activities implementation on business performance

Variables	Model One		
	B	t-value	P-value
Management innovative activities	0.070	2.223	0.027
Technological innovative activities	0.133	3.146	0.002
Market innovative activities	0.153	3.429	0.001
Cultural innovative activities	0.026	2.163	0.032
Adjusted R^2	0.679		

The multiple-regression analysis used in this research is shown in Table 7. Model One was $\hat{y}_1 = 0.070\ X_1 + 0.133\ X_2 + 0.153\ X_3 + 0.026\ X_4 + \varepsilon_1$ (among which $\hat{y}_1$ is business performance, X_1 management innovative activities, X_2 technology innovative activities, X_3 market innovative activities and X_4 cultural innovative activities). All showed a positive significant relation. The adjusted R^2 was 0.679, and the explicability for all variables were higher. Therefore, the correlation between innovative activities implementation and business performance can be validated.

5. Conclusion

Innovative activities include four dimensions: management innovative activities, technological innovative activities, market innovative activities, and cultural innovative activities. The influence of innovative strategies and motivation on the level of implementing innovative activities, and the influence of the level of implementing innovative activities on business performance were explored in this study The two intermediate variables, industry group and enterprise scale, were considered. From the review of literature, the theoretical model of the influencing relation was developed, and at the same time, an empirical study was conducted on Taiwan's high-tech manufacturers. The research result shows that the internal driving force of innovative activities has a significant impact on the level of technological innovative activities and cultural innovative activities implementation. External driving force of innovative activities has a significant impact on the level of market innovative activities and management innovative activities. In terms of innovative strategies, enterprises adopting self-developed technology and both purchased and self-developed technology strategies perform better than enterprises adopting purchased new technology, or those with neither purchased nor self-developed technology strategies, at implementing technological innovative activities and cultural innovative activities. In addition, the level of implementing innovative activities has a significant influence on business performance (cost reduction and product/service differentiation). The research hypothesis of "the higher the level of implementing innovative activities, the better the business performance" is supported with statistical significance. In addition, concerning the two intermediate variables of "industry group" and "enterprise scale", it is found in this study that they did not have significant influence on the implementation level of innovative activities and business performance. Enterprises enhancing their business performance should first strengthen their implementation of innovative activities. Enterprises may enhance the result of overall innovative activities by strengthening self-developed technology and self-initiated implementation of innovative activities. This study focuses only on high-tech enterprises; other industries (e.g., traditional industries) may also be included in future empirical analyses, in order to explore the influence of the level of implementing in-

novative activities in different industries, on business performance, and obtain a more comprehensive research result.

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