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Relationship between Organizational Cultures, Information Technology Involvement, Degrees of Knowledge Management Implementations and Performance of New Product Developments

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Abstract: This study treated the high-tech industry as the subjects and probes into the correlation among organizational cultures, information technology involvement, degrees of knowledge management activities and performance of new product developments. The subjects of this research were Taiwan's high-tech firms in the Hsinchu Science-Based Industrial Park and Southern Taiwan Science-Based Industrial Park. The respondents were the project members or senior managers involved, currently or previously, in the development of new products. The design of the questionnaire items was based on literature review. The results reveal that the higher the degrees of information technology involvement and organizational cultures, the more significant the influence on the implementation of knowledge management activities and performances of new product developments. The better the implementation of knowledge management activities, the stronger the positive influence on the performance of new product developments. Different organization cultural types (i.e., rational cultures, hierarchical cultures, group cultures and developmental cultures) do not report any significantly different levels of influence on the implementation of knowledge management activities or performance of new product developments. This study suggested that to enhance the performance of new product developments, it is necessary to strengthen information technology involvement and the implementation of knowledge management activities, as well as to integrate the characteristics of the four cultural types in the competing values framework and to enhance the implementation under these four cultural types.

Key words: Information technology, competing values framework, knowledge management, industry characteristics, high-tech industry

INTRODUCTION

The high-tech industries have been the economic pillar of Taiwan. According to the classifications of imported and exported commodities published by the Ministry of Finance, products offering high value added and requiring complex technologies, competent manpower and high percentages of R and D expenses are high-tech industries. These industries include the manufacturing of chemicals, machinery, electronics and transportation tools. Given the technological advances and shorter product lifecycles, it is imperative to shorten the development process of new products and time-to-market. In the face of the intense competition, many companies emphasize in their business strategies how to create the right organizational cultures and incorporate information technology involvement into knowledge management (Gold *et al*., 2001; Davenport and Prusak, 1998). The purpose is to quickly launch new products and shorten the lead time for product developments and time-to-market. Relevant studies indicate that the integration of internal and external knowledge and the implementation of knowledge management can enhance the performance of new product developments (Iansiti and Clark, 1994). Organizations can influence employees' behavior and encourage the sharing, creation and utilization of knowledge by fostering the appropriate organizational cultures (De Long and Fahey, 2000). Information technology involvement can drive coordination among organizational members, provide a robust set of

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operational knowledge and assist in the retrieval, classification and storage, search and utilization of knowledge. These are all the key success factors of knowledge management (Duffy, 2000). The application of information technology in new product developments can improve product quality, lower costs and ensure long-term competitive advantages (Sanders and Premus, 2002). Few empirical studies incorporate the concepts of organizational cultures and information technology involvements into knowledge management activities in order to examine their influence on the performance of new product developments. This study explores the correlation among organizational cultures, information technology involvement, degrees of knowledge management activities and performance of new product developments. The purposes of this study are: (1) to investigate the influence of the levels of information technology involvement on the degrees of knowledge management activities; (2) to examine the influence of the levels of organizational cultures on the degrees of knowledge management activities and (3) to study the influence of degrees of knowledge management activities on the performance of new product developments; (4) to analyze the influence of the levels of information technology involvement on the performance of new product developments; (5) to assess the influence of the types of organizational cultures on the performance of new product developments and (6) to provide recommendations on how to improve the performance of new product developments for the high-tech industries based on the research finding.

Knowledge management activities: Desouza (2003) defined knowledge management as the collection of all the activities of knowledge creation, knowledge storage, knowledge diffusion and knowledge applications. Knowledge management was initially defined as the process of applying a systematic approach to the capture, structure, management and dissemination of knowledge throughout an organization in order to work faster, reuse best practices and reduce costly rework from project to project (Mishra, 2009). Applehans *et al.* (1999) suggested that knowledge management is a planned and systematic approach to the establishment, sharing, application and renewable of knowledge, in order to enhance organizational effectiveness and cost benefits. Carlucci *et al.* (2004) indicated that knowledge management is the long-term process of organizing, updating, collating, analyzing and sharing of knowledge based on an understanding of information. Alavi and Leidner (2001) pointed out that knowledge management is a process of organizational and systematic retrievals, organization and communication with other employees concerning implicit and explicit knowledge. The purpose is to create the maximum utilities and productivity by leveraging knowledge of each other. Zack (1999) proposed that knowledge management process consists of five stages: (1) Acquisition: an organization creates information and knowledge or acquires knowledge from a variety of internal and external sources; (2) Refining: before entering the acquired knowledge into a database, it is necessary to go through a refining process in order to enhance the value of knowledge; this includes the procedures of tagging, indexing, classification, summarization and integration; (3) Storage and Searches: this is to connect the database and knowledge delivery as two stages; (4) Communication: this is to establish all kinds of systems and procedures so that organizational members can access databases and (5) Presentation: the contents presented after knowledge has been arranged, selected and integrated; this will influence the scenarios of knowledge utilization and utilization results. Sarvary (1999) indicated that knowledge management consists of three procedures: (1) Organizational learning: this is the process of obtaining information or knowledge; (2) Knowledge generation: this is the process of transforming and integrating raw information into the knowledge enabling business solutions and (3) Knowledge delivery: this is the process that allows organizational members to access and use the shared knowledge throughout a company. Lee and Hong (2002) divided knowledge management into four basic steps, which are knowledge acquisition, knowledge development, knowledge sharing and knowledge utilization. Liebowitz (1999a) stated that knowledge management is a process of identifying, acquiring, storing, sharing, applying and selling knowledge. Bhatt (2001) indicated that knowledge management is a process of creating, validating, presenting, delivering and applying knowledge. This study summarizes the result of the literature review and establishes four dimensions for knowledge management activities. These dimensions are the acquisition and creation of knowledge, storage of knowledge, sharing of knowledge and application of knowledge.

Information technology involvement: Yang (2009) defined information technology as the total assets of investments in information technology. Such assets can be hardware, software and manpower. Yang (2009) referred to Dibrell *et al.* (2008) and performed a survey on companies regarding their investments in information technology hardware, software and manpower to evaluate their emphasis on information technology. Mahmood and Mann (1993) suggested that information technology

involvement is the comparison against industry peers in the investments in information technology assets, such as hardware, software and manpower. Sakaguchi and Dibrell (1998) argued that the degrees of information technology involvement can be measured with the investment and training in information technology. Information technology investment is a quantitative indicator to measure budgets, hardware and software. Information technology training refers to the levels of training of the personnel as users of information technology. Chung *et al.* (2010) reviewed relevant literature and group information technology involvement into the following four dimensions: (1) perceptions of employees; (2) investments in hardware and software; (3) personnel training and (4) the degrees of information technology application. Miller and Doyle (1987) suggested that information technology involvement should focus on the three aspects: (1) an understanding of the importance of information technology in a company; (2) returns only possible with a certain level of investments in hardware, software and manpower and (3) personnel training based on the needs of developers and users. This study refers to Chung *et al.* (2010) in the classification of classify information technology involvement into four dimensions, which are perceptions of employees, investments in hardware and software, personnel training and the degrees of information technology application.

Organizational cultures: Scholars have varying definitions of organizational cultures. Harrington and Guimaraes (2005) indicated that organizational cultures are the conviction shared by organizational members. Pekala (2001) suggested that organizational cultures are a set of norms regulating the behavior of organizational members. Siew and Kelvin (2004) proposed that organizational cultures are unique atmosphere or belief created jointly by organizational members. Jones and George (2007) argued that organizational cultures are a set of common values, norms, behavior regulations and expectations that have influence on the interactions and cooperation among individuals, groups and teams in the process of achieving organizational goals. Robbins (2001) pointed out that organizational cultures are a set of key attributes emphasized by organizational members. These attributes include the levels of innovations and adventures, degrees of details required, levels of results orientation, focus on employees' feelings, emphasis on teams, requirements for aggression and stability. The mix-and-match of these attributes becomes organizational cultures. Lee and Yu (2004) suggested that organizational cultures are the unique environment or belief created jointly by organizational members and cannot be imitated easily by others. Tolfo and Wazlawick (2008) pointed out that organizational cultures are the values, beliefs and norms shared and held by organizational members. In terms of the classification of organizational cultures, Wallach (1983) divided organizational cultures into bureaucratic cultures, innovative cultures and supportive cultures. Quinn (1988) suggested that the competing values framework consists of four cultural types, which are rational cultures, hierarchical cultures, group cultures and developmental cultures. Deshpande and Farley (1999) proposed that any description by employees of corporate cultures contains elements of rational cultures, hierarchical cultures, group cultures and developmental cultures, but overall speaking, the description will gear toward one type. This study refers to the four cultures proposed by Quinn (1988), which are rational cultures, hierarchical cultures, group cultures and developmental cultures, for the classification.

Performance of new product developments: Barczak (1995) evaluated new product development performance using four items: profitability level, market share goals accomplishment, sales objectives and overall satisfaction with their firm's new product development efforts. Song and Parry (1997) used four metrics to evaluate the success of new product developments. These metrics are: (1) comparison of new product quality against competition; (2) comparison of new product sales against competition; (3) comparison of new product profitability against competition and (4) percentage of new products successfully launched and meeting expected profit targets. Gruner and Homburg (2000) adopted four dimensions to measure new product development performances: quality of the new product, financial new product success, quality of the new product development process, the inexpensiveness of new product ownership. Dwyer and Mellor (1991) applied four indicators to measure new product development performances: evaluation of overall success/failure, profitability level, sales objectives and opportunity windows on new products or market for the firm. Driva *et al.* (2000) indicated that the top five indicators being used by companies for measuring new product development performance are: (1) total cost of the project; (2) on time delivery of development project; (3) actual project cost compared to budget; (4) actual versus target time for project completion and (5) lead time to market. Bart (1999) defined the performance of new product developments as the difference between the actual achievements and original targets for new products. To sum up the literature review, this paper selects a total of seven indicators to measure the performance of new product developments.

These indicators are: (1) the company's satisfaction with the performance of new product developments; (2) newly developed products meeting with launch schedules; (3) newly developed products achieving the anticipated quality standards; (4) newly developed products reporting expected sales; (5) the company's satisfaction with the percentage of successful launches of newly developed products; (6) cost of new product developments within budgets and (7) customers' satisfaction with the performance of new products.

Information technology involvement and knowledge management activities: Ruiz-Mercader *et al.* (2006) suggested that information technology is beneficial to knowledge management activities and improvement of organization performances. Demarest (1997) proposed that an extensive use of information technology in the process of knowledge management can lower the cost of information utilization and accelerate the speed of knowledge flows. Applehans *et al.* (1999) indicated that information technology provides an appropriate platform to assist knowledge management activities. Duffy (2000) pointed out that information technology involvement can encourage coordination among organizational members and provide a healthy operational environment for the retrieval, classification, storage, searches and utilization of knowledge. It is the key success factor to knowledge management. Meso and Smith (2000) argued that information technology involvement can speed up the delivery and receipt of knowledge and information for organizations. Davenport and Prusak (1998) suggested that information technology can extend the reach of knowledge and expedite the delivery speed of knowledge. Alavi and Leidner (2001) performed a literature review on knowledge management and concluded that information technology involvement plays a pivotal role. Information technology provides a scenario conductive to knowledge creation and encourages cooperation and interactions of organizational members. Gold *et al.* (2001) argued that information technology involvement affects the effectiveness of knowledge management activities. Based on the above literature review, this study proposes H_1: The higher the information technology involvement, the more significant the positive influence on the implementation of knowledge management activities.

Organizational cultures and knowledge management activities: Davenport and Prusak (1998) pointed out that in addition to knowledge characteristics, organizational cultures are also critical to the success of knowledge acquisitions and transfers. De Long and Fahey (2000) indicated that organizations can influence the behavior of employees and encourage the sharing, creation and utilization of knowledge via organizational cultures. Liebowitz (1999b) suggested that different organizations should adopt different approaches to knowledge management according to their own organizational cultures. Martin (2000) argued that organizational cultures are the key to the success of knowledge management. According to Alavi and Leidner (1999), the key success factors of knowledge management are relevant to organizational cultures. Gold *et al.* (2001) proposed that appropriate organizational cultures can promote effective implementations of knowledge management. Based on the above literature review, this study proposes H_2: The stronger the organizational cultures, the more significant the positive influence on the implementations of knowledge management activities.

Knowledge management activities and performance of new product developments: Tiwana(2004) indicated that knowledge integration could lead to product development effectiveness, reduced defect density, lowered warranty defects and increased software development efficiency. Iansiti and Clark (1994) proposed that the integration of internal and external knowledge and good knowledge management can enhance the performance of new product developments. Madhavan and Grover (1998) suggested that the key task of new product developments is to transform the embedded knowledge within the development team into embodied knowledge. Guo *et al.* (2007) argued that knowledge sharing is beneficial to problem definitions and solution identifications. Hence, it is helpful to the improvement of the performance of new product developments. Takeuchi and Nonaka (1986) suggested that by continuous reviewing the stored data and knowledge, the research and development team can improve the performance of new product developments. Koskinen (2000) proposed that the enhancement of knowledge management is the method to improve the performance of new product developments. Based on the above literature review, this study proposes H_3: The higher degree of the knowledge management activities, the more significant the positive influence on the performance of new product developments.

Information technology involvement and performance of new product developments: Tan and Vonderembse (2006) argued that the application of information technology in the development stage can shorten the product development lead time and enhance product quality and design capacities. Hence, information technology involvement reports positive influence on the

performance of new product developments. Hull *et al.* (1996) indicated that information technology involvement plays an important role in the process of new product developments. Sanders and Premus (2002) suggested that the application of information technology in the development of new products can enhance product quality, lower costs and maintain low-term competitiveness. Barkan (1992) proposed that the use of information technology in the development of new products can benefit the design and process and enhance product quality. Based on the above literature review, this study proposes H_4: The higher the information technology involvement, the more significant the positive influence on the performance of new product developments.

Organizational cultures and performance of new product developments: Hsieh (2005) indicated that the companies of different cultures report varying performances of new product developments. Manufacturers with innovative corporate cultures tend to achieve better results for new product developments. Sethi *et al.* (2001) suggested that the encouragement of innovative organizational cultures can enhance innovativeness and improve the performance of new product developments. Kahn (2001) proposed that a market-oriented culture is beneficial to the performance of new product developments. Belassi *et al.* (2007) argued that different organizational cultures report significantly different levels of impacts on the performance of new product developments. Based on the above literature review, this study proposes H_5: Different types of organizational cultures report significantly different levels of influence on the performance of new product developments.

RESEARCH METHODS

This study examines the correlation among organizational cultures, information technology involvement, knowledge management activities and performance of new product developments. Figure 1 shows the research framework.

Research hypotheses: Based on the above literature review, this study proposes the following hypotheses:

- **H_1:** The higher the information technology involvement, the more significant the positive influence on the implementation of knowledge management activities

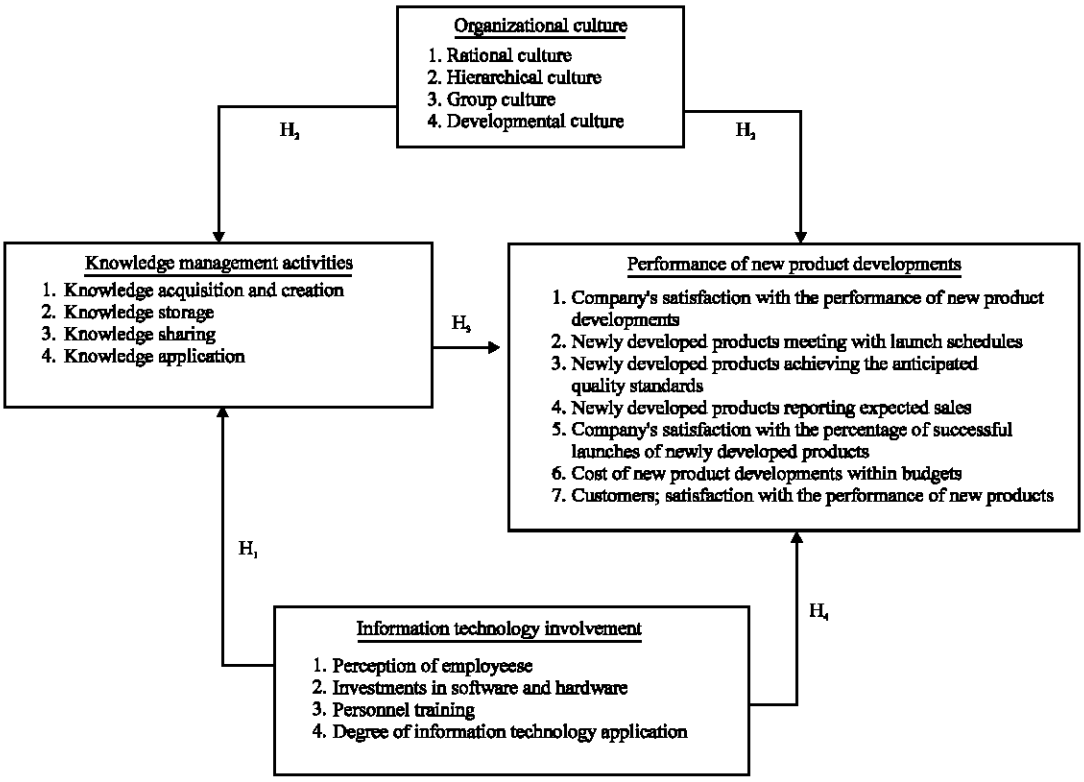

Fig. 1: Research framework

- **H_2:** The stronger the organizational cultures, the more significant the positive influence on the implementations of knowledge management activities
- **H_3:** The higher degree of the knowledge management activities, the more significant the positive influence on the performance of new product developments
- **H_4:** The higher the information technology involvement, the more significant the positive influence on the performance of new product developments
- **H_5:** Different types of organizational cultures report significantly different levels of influence on the performance of new product developments

Questionnaire collection and data analysis: The subjects of this research were Taiwan's high-tech firms in the Hsinchu Science-Based Industrial Park and Southern Taiwan Science-Based Industrial Park. The questionnaires were anonymous and distributed to 563 companies at the beginning of February 2010. The respondents were the project members or senior managers involved, currently or previously, in the development of new products. A total of 76 effective samples were collected by April 2010. The design of the questionnaire items was based on literature review (Table 1) and it consisted of five sections. The first four sections are measured with the Likert 5-point scale. Section 1 evaluates the degrees of information technology involvement, including four dimensions, which are: (1) perceptions by employees; (2) levels of investments in hardware and software; (3) levels of personnel training and (4) degrees of information technology applications. Section 2 measures the types of organizational cultures, which are: (1) rational cultures; (2) hierarchical cultures; (3) group cultures and (4) developmental cultures. Section 3 assesses the levels of implementation of knowledge management activities. They include (1) knowledge acquisition and creation; (2) knowledge storage; (3) knowledge sharing and (4) knowledge applications. Section 4 evaluates the performance of new product developments. The seven measurements are (1) satisfaction with the overall performance of new product developments; (2) newly developed products meeting the launch schedules; (3) newly developed products achieving the anticipated quality standards and (4) newly developed products reporting expected sales; (5) satisfaction with the percentage of newly developed markets successfully introduced to the market; (6) newly developed products with costs within budgets and (7) customers' satisfaction with the overall performance of new products. Section 5 gathers the basic data of the companies receiving the questionnaires. There are two indicators: (1) industry group and (2) enterprise scale. Nunnally (1978) suggested that in an exploratory study, reliability of over 0.7 is acceptable. All the reliability variables of this study are above 0.7 so the results carry sufficient reliability. Table 2 shows the reliability values. The collected data were analyzed by SPSS and the method of data analysis was Analysis of Variance (ANOVA).

Variable measurements: This study measures variables such as information technology involvement, organizational culture, degrees of knowledge management activities, performance of new product developments, enterprise scale and industry group. The variables are measured as follows:

Information technology involvement: The measurements for information technology involvement are modified from Chung *et al.* (2010). This study divides information technology involvement into four dimensions, which are perception of employees, investments in hardware and software, personnel training and degree of information technology application.

Perception of employees: This consists of four metrics: the support for information technology involvement; full utilization of information technology by employees; shared acknowledgment of the importance of information technology; acceptance of information technology by employees.

Investments in hardware and software: This consists of three metrics: sufficient budgets in information technology; sufficient investments in hardware; sufficient investments in software.

Personnel training: This consists of four metrics: sufficient personnel training and education in information

Table 1: The list of the citations of questionnaire items

Questionnaire dimensions	Literature reviewed
Information technology involvement	Yang (2009), Dibrell *et al.* (2008), Mahmood and Mann (1993), Sakaguchi and Dibrell (1998), Chung *et al.* (2010), Miller and Doyle (1987)
Organizational culture	Quinn (1988), Parker and Bradley (2000) Al-Khalifa and Aspinwall (2001), Zammuto and Krakower (1991), Snn (2002)
Knowledge management activities	Desouza (2003), Mishra (2009), Applehans *et al.* (1999), Carlucci *et al.* (2004), Alavi and Leidner (2001), Zack (1999), Sarvary (1999), Lee and Hong (2002), Liebowitz (1999a), Bhatt (2001)
Performance of new product developments	Barczak (1995), Song and Parry (1997), Gruner and Homburg (2000), Dwyer and Mellor (1991), Driva *et al.* (2000), Bart (1999)

Table 2: Cronbach's α coefficients for all variables

Questionnaire dimensions	Cronbach's α
Information technology involvement	
Perceptions of employees	0.801
Investments in software and hardware	0.939
Personnel training	0.857
Degrees of information technology application	0.880
Organizational culture	
Rational culture	0.823
Hierarchical culture	0.793
Group culture	0.904
Developmental culture	0.924
Knowledge management activities	
Knowledge acquisitions and creation	0.892
Knowledge storage	0.939
Knowledge sharing	0.877
Knowledge applications	0.954
Performance of new product developments	0.945

technology; skilled utilization of information technology by employees; sufficient professional staff supporting information technology; comprehensive teaching materials and users' manuals.

Degree of information technology application: This consists of five metrics: application of information technology to assist new product developments; application of information technology to assist operations; delivery of key information to employees by using information technology; application of information technology to establish a comprehensive communication network with clients and suppliers; processing of data with information technology into useful information.

The measurement is based on Likert 5-point scale, where Strongly agree is 5 points, Agree is 4 points, Fair is 3 points, Disagree is 2 points and Strongly disagree is 1 point.

Organizational culture: The competing values framework proposed by Quinn (1988) is representative of organizational culture classifications. He constructs four cultures: rational cultures, hierarchical cultures, group cultures and developmental culture. By referring to these four cultures classified by Quinn (1988), this study designs the questions based on the measurements developed by Quinn (1988), Parker and Bradley (2000), Al-Khalifa and Aspinwall (2001), Zammuto and Krakower (1991) and Sun (2002). Organizational cultures are divided into four types and 24 measurements.

Rational culture: the measurements are (a) focus on performance achievements; (b) senior managers providing guidance and pushing employees to achieve company goals; (c) solidarity based on the achievement of performances and tasks; (d) company atmosphere gearing toward mutual competitiveness and achievement focus; (e) incentives based on the achievement of targets; (f) success meaning leadership in the industry.

Hierarchical culture: the measurements are (a) specific regulations and systems in place; (b) a clearly hierarchical organization, with everybody's tasks described in details; (c) incentives based on the hierarchical levels; (d) focus on stability and efficiency supported with smooth operations; (e) solidarity based on regulations and policies and a focus on smooth workings within the organization and (f) managers expecting employees to work by the rule book.

Group culture: the measurements are (a) a human organization emphasizing the autonomy of employees; (b) solidarity based on loyalty and mutual trust; (c) mutual trust among employees, with a focus on teamwork and cooperation; (d) supervisors acting as teachers and friends in order to assist employees to fulfill their potential; (e) equal treatment to all employees and (f) emphasis on human resources and team spirits.

Developmental culture: the measurements are (a) employees willing to take risks and take on challenges; (b) encouraging employees to seek innovations and pursue new ideas; (c) encouraging employees to think in order to provide innovations or solutions; (d) focus on growth and new resources, always ready for new challenges; (e) solidarity based on innovations and R and D and targeting to be a market leader and (f) a lively and vibrant atmosphere.

The measurement is based on Likert 5-point scale, where Strongly agree is 5 points, Agree is 4 points, Fair is 3 points, Disagree is 2 points and Strongly disagree is 1 point.

Degree of knowledge management activities: Based on the literature review, this study divides the activities of knowledge management into the following four dimensions:

Knowledge acquisition and creation: the measurements are (a) systematic approach to the collection of internal and external knowledge; (b) encouraging employees to come up with innovative proposals; (c) encouraging employees to create and acquire new knowledge via learning, research or development; (d) offering employees training and education to acquire new knowledge and (e) continuous collection of valuable knowledge.

Knowledge storage: the measurements are (a) collation, screening and elimination of the gathered knowledge for the use of employees; (b) integration of knowledge in different domains for the use of employees; (c) conversion of gathered knowledge into easy-to-grasp and usable knowledge for employees; (d) storage of

knowledge in the database for the inquiries by employees; (e) regular updates and maintenance of databases; (f) storage of knowledge into the heads of employees via training and education and (g) a comprehensive system in place to preserve work knowledge.

Knowledge sharing: the measurements are (a) knowledge sharing and exchanges among divisions; (b) a comprehensive system in place to facilitate acquisition and sharing of the knowledge required for tasks; (c) encouraging employees to share knowledge; (d) internal meetings to facilitate sharing of knowledge and thoughts and (e) employees able to freely come up with proposals and make comments.

Knowledge applications: the measurements are (a) appropriate utilization of knowledge to enhance work efficiency; (b) appropriate utilization of knowledge to facilitate operations; (c) appropriate utilization of knowledge to gain an understand of customers' needs; (d) appropriate utilization of knowledge to solve problems and (e) appropriate utilization of knowledge to assist in development of new products.

The measurement is based on Likert 5-point scale, where Strongly agree is 5 points, Agree is 4 points, Fair is 3 points, Disagree is 2 points and Strongly disagree is 1 point.

Performance of new product developments: Based on the literature review, this study selects seven metrics to evaluate the performance of new product developments, which are: (1) satisfaction with the overall performance of new product developments; (2) newly developed products meeting the launch schedules; (3) newly developed products achieving the anticipated quality standards; (4) newly developed products reporting expected sales; (5) satisfaction with the percentage of newly developed markets successfully introduced to the market; (6) newly developed products with costs within budgets; (7) customers' satisfaction with the overall performance of new products.

The measurement is based on Likert 5-point scale, where Strongly agree is 5 points, Agree is 4 points, Fair is 3 points, Disagree is 2 points and Strongly disagree is 1 point.

Industry group and enterprise scale: This study examines industry characteristics with two metrics, which are industry group and enterprise scale.

Industry group: According to the classification published in 2010 Directory of Manufacturers in Science Park, these industries are integrated circuits, computers and peripherals, communication, optical electronics, delicate machinery and biotechnology.

Enterprise scale: In accordance with the standards set forth by the Ministry of Economic Affairs, this study classifies high-tech manufacturers into large ones (with over 200 employees) and small-and-medium ones (with less than 200 employees). Both industry group and enterprise scale are measured with nominal scales.

VALIDATION RESULTS

Correlation between information technology involvement and knowledge management activities: This study divides the degree of information technology involvement (perception of employees, investments in hardware and software, personnel training, information technology application) into high and low groups. By referring to the average scores of knowledge management activities (knowledge acquisition and creation, knowledge storage, knowledge sharing and knowledge application) of these two groups, this study examines whether there are significant variances. Table 3 summarizes the ANOVA results on the influence of information technology involvement on the implementations of knowledge management activities. The research finding supports H_1: The higher the information technology involvement, the more significant the positive influence on the implementation of knowledge management activities.

Correlation between organizational cultures and knowledge management activities: This section explores the influence of organizational cultures on knowledge management activities. This study divides organizational cultures (i.e., rational cultures, hierarchical cultures, group cultures and developmental cultures) into two groups (high and low). By referring to the average scores of knowledge management activities (knowledge acquisition and creation, knowledge storage, knowledge sharing and knowledge application) of these two groups, this study examines whether there are significant variances. Table 4 summarizes the ANOVA results on the influence of organizational cultures on the implementations of knowledge management activities. The research finding supports H_2: The stronger the organizational cultures, the more significant the positive influence on the implementations of knowledge management activities.

Deshpande and Farley (1999) suggested that any description by employees of corporate cultures contains elements of rational cultures, hierarchical cultures, group cultures and developmental cultures, but overall speaking,

Table 3: Variance analysis of the influence of the degrees of information technology involvement on the degrees of implementation of knowledge management activities

	Knowledge acquisition and creation				Knowledge storage				Knowledge sharing				Knowledge application			
Source	Low#	High#	F-value	p-value	Low#	High#	F-value	p-value	Low#	High#	F-value	p-value	Low#	High#	F-value	p-value
Perceptions of employees	3.00	3.64	11.41	0.001*	2.71	3.48	13.54	0.000*	2.75	3.48	14.01	0.000*	3.18	3.70	5.98	0.017*
Investments in hardware and software	3.32	3.86	15.55	0.000*	3.11	3.72	15.61	0.000*	3.15	3.68	13.43	0.000*	3.40	3.94	13.06	0.001*
Personnel training	3.25	3.91	25.97	0.000*	3.05	3.75	23.28	0.000*	3.02	3.79	36.50	0.000*	3.35	3.95	17.28	0.000*
Application of information technology	3.12	3.75	19.88	0.000*	2.77	3.65	37.47	0.000*	2.85	3.62	30.78	0.000*	3.26	3.79	11.57	0.001*

#Low: the average score in information technology involvement lower than 3.50; High: the average score in information technology involvement higher than 3.50; *p<0.05

Table 4: Variance analysis of the influence of the degrees of organizational cultures on the degrees of implementation of knowledge management activities

	Knowledge acquisition and creation				Knowledge storage				Knowledge sharing				Knowledge application			
Source	Low#	High#	F-value	p-value	Low#	High#	F-value	p-value	Low#	High#	F-value	p-value	Low#	High#	F-value	p-value
Rational culture	3.21	3.76	16.02	0.000*	2.97	3.62	18.51	0.000*	3.00	3.60	17.84	0.000*	3.33	3.80	9.73	0.003*
Hierarchical culture	3.27	3.94	25.79	0.000*	3.05	3.82	28.95	0.000*	3.07	3.79	29.95	0.000*	3.39	3.95	14.35	0.000*
Group culture	3.21	3.89	28.98	0.000*	2.97	3.78	35.26	0.000*	3.02	3.72	28.70	0.000*	3.31	3.94	19.22	0.000*
Developmental culture	2.99	3.94	83.52	0.000*	2.85	3.73	44.83	0.000*	2.89	3.71	43.75	0.000*	3.09	4.00	56.41	0.000

#Low: the average score in organizational cultures lower than 3.50; High: the average score in organizational cultures higher than 3.50; *p<0.05

the description is toward one type. This study refers to the higher value of the average scores for the four cultures (i.e., rational cultures, hierarchical cultures, group cultures and developmental cultures) for the classification, as the representative organizational culture. Table 5 summarizes the ANOVA results on the influence of organizational cultures on the implementations of knowledge management activities. The research finds that different cultural types (i.e., rational cultures, hierarchical cultures, group cultures and developmental cultures) do not have any significant influence on the implementation of knowledge management activities. It is suggested that manufacturers can integrate the attributes of these four cultures and enhance the implementation results under these four cultural types.

Correlation between implementations of knowledge management activities and performance of new product developments: This study divides knowledge management activities (i.e., knowledge acquisition and creation, knowledge storage, knowledge sharing and knowledge application) of these two groups (high and low). By referring to the average scores of the performance of new product developments, this study examines whether there are significant variances. Table 6 summarizes the ANOVA results on the influence of knowledge management activities on the performance of new product developments. The research finding supports H_3. The higher degree of the knowledge management activities, the more significant the positive influence on the performance of new product developments.

Table 5: Variance analysis of the influence of the type of organizational culture on knowledge management activities

	Knowledge management activities		
Source	F-value	p-value	LSD
Representative organizational culture	0.997	0.401	--

Table 6: Variance analysis of the influence of the degrees of implementations of knowledge management activities on the performance of new product developments

	Performance of new product developments			
Source	Low#	High#	F-value	p-value
Knowledge acquisition and creation	2.83	3.64	39.60	0.000*
Knowledge storage	3.02	3.73	26.59	0.000*
Knowledge sharing	2.99	3.70	26.92	0.000*
Knowledge application	2.87	3.60	29.00	0.000*

#Low: the average score in implementations of knowledge management activities lower than 3.50; High: the average score in implementations of knowledge management activities higher than 3.50; *p<0.05

Correlation between information technology involvement and performance of new product developments: This study divides the degree of information technology involvement (perception of employees, investments in hardware and software, personnel training, information technology application) into high and low groups. By referring to the average scores of the performance of new product developments of these two groups, this study examines whether there are significant variances. Table 7 summarizes the ANOVA results on the influence of information technology involvement on the performance of new product developments. The research finding supports H_4: The higher the information technology involvement, the more significant the positive influence on the performance of new product developments.

Table 7: Variance analysis of the influence of the degrees of information technology involvement on the performance of new product developments

	Performance of new product developments			
Source	Low#	High#	F-value	p-value
Perceptions of employees	2.67	3.42	14.44	0.000*
Investments in hardware and software	3.07	3.64	14.91	0.000*
Personnel training	3.03	3.64	18.53	0.000*
Application of information technology	3.03	3.43	6.03	0.016*

#Low: the average score in information technology involvement lower than 3.50; High: the average score in information technology involvement higher than 3.50; *p<0.05

Table 8: Variance analysis of the influence of the degrees of organizational culture on the performance of new product developments

	Performance of new product developments			
Source	Low#	High#	F-value	p-value
Rational culture	2.88	3.58	25.28	0.000*
Hierarchical culture	3.05	3.66	17.53	0.000*
Group culture	2.95	3.67	29.20	0.000*
Developmental culture	2.85	3.63	35.25	0.000*

#Low: the average score in organizational cultures lower than 3.50; High: the average score in organizational cultures higher than 3.50; *p<0.05

Relationship between organizational cultures and performance of new product developments: This study divides the levels of rational cultures, hierarchical cultures, group cultures, developmental cultures into two groups (of high and low degrees of implementations), in order to examine whether there are any significant variances based on the average scores of the performance of new product developments of these two groups. Table 8 summarizes the ANOVA analysis results concerning the influence of organizational cultures on the performance of new product developments. The study finds that the stronger organizational cultures, the more significant their positive influence on the performance of new product developments. This study refers to the higher value of the average scores for the four cultures (i.e., rational cultures, hierarchical cultures, group cultures and developmental cultures) for the classification, as the representative organizational culture. Table 9 shows the results of ANOVA analysis. The finding indicates that different organizational cultures (i.e., rational cultures, hierarchical cultures, group cultures, developmental cultures) do not have any significant influence on the performance of new product developments. Hence, H_5 is rejected. To enhance the performance of new product developments, it is suggested that manufacturers can integrate the attributes of these four cultures and enhance the implementation results under these four cultural types.

The influence of the executive degree of organizational culture, knowledge management activities and information technology involvement of the manufacturers with different industry characteristics on new product development performance: This section explores the influence of executive degree of organizational culture, knowledge management activities and information technology involvement of the manufacturers with different industry characteristics (enterprise scale and industry group) on new product development performance. The results in Table 10 show that industry characteristics do not have a significant influence on the executive degree of organizational culture, knowledge management activities and information technology involvement. Table 11 reveals that the manufacturers from different industry groups and enterprise scale do not reveal a significant influence on their new product development performance. As seen above, for the manufacturers with different industry characteristics, the executive degree of organizational culture, knowledge management activities and information technology involvement do not reveal significant impact on new product development performance.

The results show that the hypotheses H_1, H_2, H_3 and H_4 are accepted, but the hypothesis H_5 is rejected (Table 12).

Table 9: Variance analysis of the influence of the type of organizational culture on the performance of new product developments

	Performance of new product developments		
Source	F-value	p-value	LSD
Representative organizational culture	1.72	0.175	--

Table 10: ANOVA of industry characteristics (enterprise scale and industry group) and executive involvement in each phase of organizational culture, knowledge management activities and information technology involvement

	Enterprise scale		Industry group	
Source	F-value	p-value	F-value	p-value
Organizational culture				
Rational culture	0.63	0.678	0.04	0.834
Hierarchical culture	0.49	0.782	1.02	0.316
Group culture	0.51	0.767	1.47	0.229
Developmental culture	1.74	0.137	0.58	0.450
Knowledge management activities				
Knowledge acquisition and creation	0.82	0.543	0.11	0.744
Knowledge storage	0.37	0.866	0.87	0.354
Knowledge sharing	0.82	0.540	0.37	0.543
Knowledge application	1.59	0.174	0.57	0.454
Information technology involvement				
Perceptions of employees	1.95	0.097	0.09	0.762
Investments in hardware and software	2.40	0.045	1.02	0.315
Personnel training	1.27	0.285	0.97	0.327
Application of information technology	1.64	0.160	0.31	0.578

Table 11: ANOVA for industry characteristics (enterprise scale and industry group) and new product development performance

	Enterprise scale		Industry group	
Source	F-value	p-value	p-value	F-value
New product development performance	1.53	0.192	0.35	0.557

Table 12: The test results of research hypotheses

Item	Research hypotheses	Results
H_1	The higher the information technology involvement, the more significant the positive influence on the implementation of knowledge management activities	Accepted
H_2	The stronger the organizational cultures, the more significant the positive influence on the implementations of knowledge management activities	Accepted
H_3	The higher degree of the knowledge management activities, the more significant the positive influence on the performance of new product developments	Accepted
H_4	The higher the information technology involvement, the more significant the positive influence on the performance of new product developments	Accepted
H_5:	Different types of organizational cultures report significantly different levels of influence on the performance of new product developments	Rejected

DISCUSSION AND CONCLUSIONS

Few empirical studies have incorporated the concepts of organizational cultures and information technology involvement into knowledge management activities in the examination of its influence on the performance of new product developments. This study examines the correlation between organizational cultures, information technology involvements, degrees of knowledge management activities and the performance of new product developments. A theoretical model was developed for the correlation based on literature research. Empirical analysis was conducted into Taiwan's high-tech firms in the Hsinchu Science-Based Industrial Park and Southern Taiwan Science-Based Industrial Park.

The results reveal that the higher the degrees of information technology involvement and organizational cultures, the more significant the influence on the implementation of knowledge management activities and performance of new product developments. The better the implementation of knowledge management activities, the stronger the positive influence on the performance of new product developments.

However, different organization cultural types (i.e., rational cultures, hierarchical cultures, group cultures and developmental cultures) do not report any significantly different levels of influence on the implementation of knowledge management activities or performances of new product developments. Meanwhile, to manufacturers with different industry characteristics, the execution degree of organizational culture, knowledge management activities and information technology involvement do not reveal significant impact on new product development performances. The reason might be that the manufacturers with different industry characteristics have recognized the important of organizational culture, knowledge management activities and information technology involvement and their implementation reached a certain level which does not different because of the different industry characteristics. Hence, this study suggests that to enhance the performance of new product developments, it is necessary to strengthen information technology involvement and the implementation of knowledge management activities, as well as to integrate the characteristics of the four cultural types in the competing values framework (i.e., rational cultures, hierarchical cultures, group culture and developmental cultures) and to enhance the implementation under these four cultural types.

This study only examines the high-tech manufacturers in Taiwan. Future studies can perform an empirical analysis on other industries, to investigate the influence of organizational cultures, information technology involvement and implementation of knowledge management on the performance of new product developments in different sectors.

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