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How Industrial Clusters and Regional Innovation Systems Impact the Knowledge Innovation Within the Taiwanese Science-Based Parks Firms?

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1. Introduction

The international competitiveness of science and technology has gradually become more intense in the light of its rapid development and the era of globalization. Governments around the world share a general consensus on seeking national economic progress and reinforcing comprehensive national strengths based on science and technology development. Since the 1970s, western economies have strategically established science-based parks at special regions for developing of cutting-edge technology. This strategy seemed to be adopted in Taiwan, and enabled Taiwan to mark its position in the global computer and optoelectronics industries. For example, Hsinchu Science-based Industrial Park (HSIP, located in northern Taiwan) owns the most integrated and complete industrial chain in the semiconductor field, and it offers a strong industrial model the semiconductor industry. In addition, the campus manufacturers are not only the key original equipment manufacturers for global computer and optoelectronics products, but also the main engines of Taiwan's foreign exchange reserve. Beside the semiconductor, the industries that locate in Taiwan Science-based Industrial Parks, such as liquid crystal display, light emitting diode and green energy seek to develop a globally competitive supply chain.

According to the 2007-2008 Global Competitiveness Report published by the 2009 World Economic Forum (WEF), Taiwan has again taken first place worldwide in the "state of cluster development" index, after integrated effecting the upstream and downstream resources of IT and opto-electronics industry within the Science-based Industrial Park. Its score of 5.7 points (out of a possible 7 points) shows an increase of 0.18 points from 5.52 points the previous year, indicative of its outstanding industrial clusters of Taiwanese Science-based Parks.

In Taiwan, the National Science Council (NSC) of the Executive Yuan (executive branch of the Taiwan) is the highest Taiwan government agency responsible for promoting the development of science and technology, it is also the administration to establish Hsinchu

Science-based Industrial Park (HSIP, located in northern Taiwan), TaiChung Science-based Industrial Park (CSIP, located in central Taiwan), and the Tainan Science-based Industrial Park (TSIP, located in southern Taiwan). Basing on the 2009 annual report of NSC, comparing to other countries, the impact from global financial tsunami was slight to campus manufacturers. These campus manufacturers still contributed 1,586 billion of turnover in 2009 therein the turnover was 951.8 billion NT dollars at the latter half of year, this amount was higher 16.2% when comparing to the corresponding period of 2008 (Table 1). When the turnover was analyzed by the industrial categories, the IC industry devoted 802.5 billion, the Optoelectronics industry also contributed 643.1 billion, and these two industries occupied 91.2% of total turnover at 2009 (Table 2).
In addition, from 1975 to the end of 2009, the Science Park Administration of National Science Council approved the establishment of factories to be constructed by 720 firms in campus. When analyzing by the industrial categories, some 224 firms were in the IC field – the largest category ratified. Second were the 172 firms from the Opto-Electronics industry with 106 Precision Machinery firms (Table 3) being the forth highest category. The campus manufacturers within Taiwanese Science-based Park also offered employment opportunities and boosted the regional economy. There were 200632 campus employees by 2009, with growth 0.6% from the previous year (Table 4). In addition, the current year's graduate from nearby universities such as National Chiao Tung University and National Tsing Hua University are provide substantial numbers of recruits for HSIP (Fig 1).

Location	year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
HSIP	2008	101	81.1	91.3	92.1	31.1	94.8	91.6	90.9	85.4	80.1	52	54.6	1,008
	2009	42.5	49.8	56.1	67.6	66.9	77.5	81.3	85.6	88.2	85.8	82.3	99.9	88.4
CSIP	2008	28	27	28.6	28.1	27.3	28.5	27.9	26.5	24.1	19.7	11.9	8.6	286
	2009	8.6	10.4	13.2	16.3	18	20.8	21.6	25.3	27.7	26.4	25.8	27.1	241.2
TSIP	2008	53.6	46.3	51.4	52.6	48.5	49.1	47.3	46.9	52	43.7	29.7	26.4	547.5
	2009	21.2	23.4	30.4	35	35.2	41	42.2	43.4	47.5	46.1	45.4	50.2	461.0
SUM	2008	182.6	154.4	171.3	172.8	168.9	172.4	166.8	164.3	161.5	143.5	93.6	89.6	1,842
	2009	72.3	83.6	99.7	118.9	120.1	139.3	145.1	154.3	163.4	158.3	153.5	177.2	1,586

Unit: Billion NT

Table 1. Turnovers from Taiwan Science-based Industrial Park at 2008 and 2009

	2008				2009				Growth Rate (%)
Industry	HSIP	CSIP	TSIP	Total	HSIP	CSIP	TSIP	Total	
IC	704	55.1	162.9	922	601.4	50.9	150.2	802.5	-13.0
Opto-Electronics	176.3	223.4	353	752.7	174.3	183.1	285.7	643.1	-14.6
Computer & Accessories	77.6	0.1	1.4	79.1	62.4	0.2	0.8	63.4	-19.8
Precision Machinery	11.1	6.7	22	39.8	11.6	6	15.6	33.2	-16.6
Telecommunications	32.4	0	2.4	34.8	27.1	0	2	29.1	-16.4
Biotechnology	3.9	0.1	3.7	7.7	4.3	0.2	4.7	9.2	19.5
Others	2.7	0.8	2.1	5.6	2.4	0.8	2	5.2	-7.1
SUM	1008	286.2	547.5	1841.7	883.5	241.2	461	1585.7	-13.9

Unit: Billion NT

Table 2. Compare the turnovers between 2008 and 2009 by Industry

Industry	HSIP	CSIP	TSIP	Total	Percentage (%)
IC	204	9	11	224	31.1
Opto-Electronics	97	30	45	172	23.9
Computer & Accessories	51	4	3	58	8.1
Precision Machinery	28	33	45	106	14.7
Telecommunications	46	1	12	59	8.2
Biotechnology	33	15	31	79	11.0
Others	5	8	9	22	3.1
SUM	464	100	156	720	100.0
Percentage (%)	64.4	21.7	13.9	100.0	

Unit: amounts of factory

Table 3. Turnovers at 2009 by the amounts of factory

Location	2008	2009	Growth rate (%)
HSIP	130,577	132,161	1.2
CSIP	20,736	19,845	-4.3
TSIP	48,136	48,626	1.0
Total	199,449	200,632	0.6

Unit: number of employee

Table 4. Comparing the number of employees in Taiwan Science-based Industrial Park between 2008 and 2009

Fig. 1. Geographical position of Hsinchu Science-based Industrial Park

On the other hand, under the continuous progress of the economy, industries in Taiwan have gradually moved from being manufacturing-oriented to investment-oriented. The new capabilities and advantages from these science parks have always been considered an important link to investment development in industrial technology policies. Innovation can strengthen the flexibility of organisations and adaptation towards the environment (Geroski 1994). It is widely held that developing an excellent knowledge innovation capability is unavoidable for enterprises in adapting to globalization and the highly dynamic competitive market environment, making this an important area for research in academia (Shane and Ulrich 2004).

Afuah (1998) suggested that although innovation introduces and applies new products and processes, the important thing is for firms to connect the innovation with market demands in order to achieve a favorable performance. Theories of successful innovation have always stressed the strategic behavior and alliances of firms, as well as the interaction between research institutes, universities, and other institutions (Freeman 1987; Lundvall 1992). According to James (2002), innovation activities have evident regional differences and their effects in various regions are diverse, perhaps resulting from dissimilarities in methods and weights attached to composite elements.

In Taiwan, government and agencies at all levels and regions seek to stimulate innovation, and consequently innovation policy is located at the centre of policies for promoting regional and national economic development. At the regional level, clusters and regional innovation systems have been looked upon as policy frameworks or models for the implementation of long-term, development strategies that facilitate learning-based processes of innovation, change, and improvement (Asheim 2001; Asheim and Isaksen 2002; Cooke 1998). Fernandez-Ribas and Shapira (2009) also argue that policy formulation for regional innovation systems must consider multiple impacts; the systemic measures of innovation must tally enterprise objectives with policy formulation. Meanwhile, Fernandez-Ribas and Shapira (2009) provided an interesting theory; that if either the regional or public policy was integrated into the innovation system, these policies could directly influence the behavior and strategy making for innovation partnerships while at the same time indirectly influencing the knowledge innovation capability of enterprises.

Thus, this study will investigate the impact of the knowledge innovation capability, industrial clusters, and regional innovation systems on operational efficiency by examining the cases of the Hsinchu Science-based Industrial Park (HSIP, located in northern Taiwan) (Fig. 1), TaiChung Science-based Industrial Park (CSIP, located in central Taiwan), and the Tainan Science-based Industrial Park (TSIP, located in southern Taiwan). Findings from this study should inform policy for developing countries when plotting for Science-based Industrial Parks to create either clusters or regional innovation systems, and give recommendations to the campus manufacturers concerning the innovation operations.

2. Literature review

2.1 Knowledge innovation capability

Gilbert and Cordey-Hayes (1996) took an organisational viewpoint and classified knowledge into instrumental knowledge and developmental knowledge. Instrumental knowledge means the basic knowledge is owned to complete a task including the operational procedures and related process. Developmental knowledge means the knowledge is raised above the level of operational knowledge such as technological innovation and commercialization. Schulz (2001) thought the organisation-oriented knowledge may be influenced by various properties, which cannot be sufficiently described by tacit knowledge and explicit. He proposed three groups - technological knowledge, marketing knowledge and strategic knowledge - to supplement the coverage. Technological knowledge relates to the information system, and engineering and R&D jobs; marketing knowledge relates to the market, advertisement and product delivering, and strategic knowledge includes the acts of government, competitors, suppliers and policy issues.

Therefore, to be able to meet the expressed and potential needs of customers, firms must be able to not only use existing knowledge, technology, and capability; more importantly, they must possess knowledge innovation capability. Cervantes (1997) pointed out that given the competitive conditions in the global economy, knowledge innovation capability is a determining factor in the ability of firms and countries to adapt to new constraints and take advantage of new opportunities. Knowledge innovation capability not only involves individual proposals and implementations, but involves the commitment and support of the entire organization.

Benn and Danny (2001) considered knowledge innovation capability in organizational procedures as the capacity to integrate key abilities and business resources to introduce innovation successfully. From a dynamic perspective, knowledge innovation capability in organizations can also be defined as continuously transforming knowledge and ideas into new products, processes and systems to achieve benefits for firms and their shareholders. The essence of innovation is to recreate frontiers according to the distinctive visions or missions of firms. Once individuals in the firms make a commitment towards this vision of innovation, they will naturally participate actively in the innovation of new knowledge, term as the organizational knowledge innovation capability. Adler and Shenbar (1990) defined knowledge innovation capability as the ability to develop and respond and identified its four dimensions: (1) ability to develop new products that meet market needs; (2) ability to apply appropriate process technologies to producing these new products; (3) ability to develop and adopt these new products and process technologies to satisfy future needs; and (4) ability to respond to related technology activities and unexpected activities created by competitors. From this definition, it can be observed that the aim of knowledge innovation capability is to apply a set of appropriate process technologies to producing new products that meet market needs and at the same time, to be able to respond to unexpected technology activities and competitive conditions. In other words, knowledge innovation capability not only resolves present problems relating to products and processes of enterprises, but must also be able to respond to changes in the external environment.

Several researchers consider that knowledge innovation capability plays a key role in introducing competitive strategies. The differentiation that should ensure that product ranges are more diversified than those of competitors and provide consumers with product and service choices in order to maintain long-term competitive advantages (Cho and Pucik 2005; Damanpour 1996; Jayanthi and Sinha 1998). Drucker (1994) suggested developing a superior knowledge innovation capability as an important market strategy. That is, firms transform competitive threats derived from changes in the environment into profits in the face of highly uncertain market environments. The study of Tidd and his colleagues (1997) concluded that firms with a high degree of knowledge innovation capability are on average twice as profitable as other firms.

Various researchers have offered different views on the categories of knowledge innovation capability. Moore (2004) distinguished knowledge innovation capability into disruptive,

applicative, product, process, marketing, structural, and business model capabilities as he connected these with the market development life cycle. In a study on high-tech firms in Taiwan, Chuang (2005) categorized technological innovation as product and process innovations and administrative innovation as staff's innovation, marketing innovation, and organization structure innovation. Tsai and his members (2001) believed knowledge innovation capability must be the administrative innovation of business activities such as planning, organization, employment, leadership, and control and technological innovation of products, processes and facilities obtained by firms from the outside and produced within. In addition a China study group, Lin and colleagues (2004) proposed that aside from the technical aspect of products and processes, innovation must also refer to changes or breakthroughs in administrative procedures and management skills.
Therefore, on the basis of these distinctions and classifications, this study seeks to discriminate between technology innovation and knowledge innovation, two innovation capabilities with direct correlation with business decisions of firms and their knowledge innovation capability.

2.2 Industrial clusters

Clusters encompass an array of linked industries and other entities important to competition. These task-oriented clusters include suppliers of specialized inputs such as components, machinery and services, and providers of specialized infrastructure (Asheim 2007). The term 'industrial cluster' refers to the firms and institutions in close proximity to each other in a particular field and area maintaining an interactive relationship, influencing and supporting each other, where production efficiency is achieved and externalities are created through a fine division of labor. From this, small firms are also able to achieve economies of scale in production as enjoyed by large firms; and at the same time these production networks encourage mutual learning and collaborative innovation as well as forming more flexible production systems (Porter 1998; Rosenfeld 1997; Swann and Prevezer 1996).
Hu (2007) thought while scholars discuss the cluster effect within Science-based Industrial Park, the initial concept "cluster economy" should be reviewed. In Hu's article, the "cluster economy" emphasizes that external economies and economies of scale produced from the proximity of firms within an area reduce production and transaction costs through the sharing of infrastructures, technology, labor, and resources. Thus, external economies and reduction of transaction costs are the main factors driving industrial clustering. Aside from these economic reasons, much literature has also stressed the importance of social and culture factors. Clusters are formed when actors or communities possessing innovation and management capabilities exchange uncodified knowledge which results from the need to frequently interact face-to-face in order to solve technology and management problems during industrial development in an environment where collaborative relationships among firms. These collaborative relationships occur when local firms having common development goals, common views, values, norms, and support; and social structures supporting local industry development termed as institutional thickness (Amin and Thrift 1995; Storper and Salais 1997) exist. Some scholars also believe clusters result from the coincidence of several events. Once specialized clusters are formed, external economies of scale are generated while promoting or maintaining the sources of external economies like the labor market, specialized suppliers, and technology spillovers (Boschma and Lambooy 1999; Cooke 1998).

Furman and Porter (2002) indicated that industrial clusters are advantageous for industrial innovation. The competitive pressures and market opportunities experienced by geographically proximate firms within the cluster are more visible and the rapid flow of information and human resources is beneficial to introducing industry knowledge spillovers and strengthening the advantage of industrial innovation. Isaksen's (2005) analysis, based on results from a European comparative cluster survey, showed that regional resources and collaboration are of major importance in stimulating economic activity within clusters. Moreover, within regional clusters, firms can benefit from agglomeration economies and spillover effects stimulated, for example, through labor force training or mobility, paid access to market information, collaborative relationships with nearby research institutions, or the exchange of tacit knowledge (Shapira 2008).

Porter (1998) argued that inter-firm competition is the greatest motivation for innovation. As a result of competition, firms monitor each other and reproduce products and processes of nearby firms gained from learning, while exerting efforts to improve and aiming to surpass their competitors. Under this competitive environment, several firms observe, learn from and imitate each other, striving to identify any innovation that will give them a lead over competitors, and help them to achieve overall innovation and learning. Porter integrated these elements to develop the competitive diamond model. For this model, four forces that drive cluster development of firms were identified: (1) factor conditions, which are production inputs such as labor, capital, natural resources, specialized resources and physical, administrative, information, and technological infrastructures; (2) demand conditions, which refers to the highly sophisticated and demanding domestic consumers; (3) related and supporting industries, which refers to the numerous viable local suppliers and support firms or industries; and (4) firm strategies and rivalry of firms. These are strengthened and integrated by governments to promote development of local industrial clusters. Science-based Industrial Parks in Taiwan have followed this trend in their development.

With regards to measuring the effects of industrial clusters, Anderson (1994) outlined three types of industrial clusters The first category of industrial clusters is buyer-supplier relationships. This industrial cluster is characterized by collaborative vertical relationships of upstream suppliers and downstream buyers. Many scholars have acknowledged its importance as value chain cluster (Anderson 1994; Brenner 2005; Fester and Bergman 1999; Porter 1998) comprised of suppliers of materials, related industries, locations, and customers. In many senses it can be regarded as critical, since innovation carries much additional technical, production and marketing cost, it is essential that a well integrated value chain eliminates cost drivers to restore a profitable margin to the innovator. Under the second category, competitor and collaborator relationships, industrial clusters are formed from firms producing identical or similar products and services. Here, relationships exist because competitors frequently share information concerning products and production processes to innovate opportunities in the market (Anderson 1994; Fester and Bergman 2000; Kim 2003). The third type refers to shared-resource relationships. Here, industrial clusters are referred to as social entities composed of firms within a region where various resources such as technology, knowledge, stock of product, infrastructure, and place are shared (Anderson 1994; Morosini 2004; Porter 1998; Rosenfeld 2002). From these, this study focused on three categories for evaluating industrial clusters: value chain clusters, competition clusters, and shared-resource clusters.

2.3 Regional innovation systems

The concept of the regional innovation system is relatively new, having first appeared in the early 1990s (Asheim and Isaksen 1997; Cooke 1992, 1998, 2001). The regional innovation system (RIS) is defined in more general terms as, "the institutional infrastructure supporting innovation within the production structure of a region" (Asheim and Coenen 2005). Cooke and Morgan (1998) viewed regional innovation systems as a concept of systems. They defined RIS as a system in which firms and other organisations systematically engaged in interactive learning through an institutional milieu, characterized by embeddedness.

With this definition, three aspects require more explanation: first, "interactive learning" refers to the interactive processes by which knowledge is combined and made into collective asset of different actors within the product system; second, "milieu" regarded as an open, territorialized complex, which involves rules, standards, values, and human and material resources; and third, "embeddedness" includes all of the economic and knowledge processes created and reproduced inside and outside firms. After undergoing social interaction, these different forms of creation and production processes arrive at a hard-to-copy state (Maskell and Malmberg 1999). From the 1990s onwards, regional innovations have become an important policy tool and have been operated successful in developed countries. Through the systematic promotion and application of localized learning processes, several countries and areas have thus been referred to as innovative economies.

In the analytical framework for regional innovation, strategic policy measures are formulated based primarily on concentrating resources, improving local business environment, and strengthening convenient connections of firms within the RIS in order to intensify business capability and performance and regional competitiveness. Innovation within an RIS is a process dependent on the gradually evolving factors within and outside the firm. This not only relies on the knowledge assets and systems created by firms, but also includes interactive patterns among firms and with their environment. An innovation environment can be regarded as a network of actors and a reservoir where firms which engage in interactive learning transform into agglomeration economies (Asheim 2007).

Cooke and colleagues (1997) believed that firms clustered in an innovative region possess characteristics of learning and innovation systems: (1) a formal or informal network of relationships, such as with customers, suppliers, and collaborators, serving as part of a firm; (2) knowledge centers, such as universities, research institutes, cooperative research organisations, and technology transfer intermediaries; and (3) governance structure of private business associations, chambers and public economic development, training and promotion intermediaries and government departments.

From the perspective of researchers, discussion on RIS focuses on technology, people, and money and the main actors include firms, research institutes, the financial sector, and governments (Sternberg 1996). Fukugawa (2008) pointed out that it is important for regional innovation policymakers to design incentive mechanisms for knowledge transfer according to the characteristics of the regional innovation systems.

Development of certain regional innovation systems has been spontaneous, such as Emilia-Romagna in Italy where there is no major participation of national or the provincial governments; and instead experience in industrial novelty was adopted as strategic guideposts. Some others, such as Northern Italy, developed through the network of firms, associations, and locally-organized design and technology transfer centers. Wales in the United Kingdom was intended as a catalyst by government and non-government organisations (Cooke and Morgan 1998; Perry 1999). Regarding Taiwan, which forms the basis of our study, the development of its regional systems of innovation is similar to that of Wales where the government planned Science-based Industrial Parks within which firms, research institutes, universities, intermediaries, and government-related organisations are located. For example the research institutes such as National Instrument Technology Research Center, National Center for High-performance Computing, National Nacho Device Laboratories, National Chip Implementation; universities such as National Chiao Tung University and National Tsing Hua University; and NSC's Science Park Administration locate in HSIP area to offer high-end experimental facilities, academic achievements and governmental supports for HSIP campus manufacturers (Fig 1). Asheim (2007) also highlighted Taiwan's Science-based Industrial Park as a regionalized national innovation system, in the form of an exogenous development model, an innovation system incorporating mainly the R&D functions of universities, research institutes and corporations.

There have been many attempts to study the effectiveness of regional innovation policies, and using diverse methods and conflicting measures of effectiveness. Several studies considered RIS as a group of firms, knowledge centers, research institutes, and technology transfer intermediaries clustered in a region promoted by government institutions through regional technology policies and where technological capability development and technology transfer and diffusion are conducted through technology alliances to build a specific specialised technology within the region (Asheim 2007; Cooke et al. 1997; Sternberg 1996; Walter 1997). This study termed it as the 'regional technology effect'. Still another group believed that for firms to strengthen or maintain their advantages, an emphasis on continuous improvement and innovation needs substantial and sustained investments which include venture capital and government subsidies to promote technology upgrade, share risks in industrial innovation, and nurture emerging technology-based industries; this is an important financial resource for industrial innovation (Asheim 2007; Maskell and Malmberg 1999; Porter 2000; Walter 1997). For this study, this resource is termed as 'finance injection for innovation.' Lastly, another group of scholars viewed those firms within the region which have a risk-taking and entrepreneurial spirit with a focus on potential opportunities and insistence on innovation, as building a mechanism for cooperation and sharing using the integration of resources; thus, firms can mutually and closely link these resources, bravely accept challenges and fully pursue financial opportunities (Asheim 2007; Baptista and Swann 1998; Cooke et al. 1997; Porter 2000). This is termed as 'innovation culture climate' for the purposes of this study. This has employed these three constructs, regional technology effect, finance injection for innovation, and innovation culture climate, to examine the operations of regional innovation systems.

2.4 Business performance

Performance is an indicator of business competitiveness as viewed by the firm. In businesses, performance measurement or performance evaluation is a measure or evaluative system using quantified standards or subjective evaluations usually employed in order for firms to understand the performance of their daily operational activities. Measuring business performance can help firms know whether strategies and organisational structures they adopted achieve target goals (Grady 1991). The management literature recognises numerous concepts and variables to measure performance. For example, March and Sutton (1997) mentioned profits, sales, market share, productivity, debt ratios, and stock prices. Ittner and Larcker (1997) differentiated between financial and non-financial measures of performance. Miranda (2004) argued that business performance management is one of the hottest topics in industry today.

Traditional performance assessment systems often stress on the 'outcome' and not on the 'process', easily overlooking conflicts caused by changes in the external environment. Key factors for business success are not grasped, firms thus failing to achieve the ultimate goal of performance assessment and losing its significance in management. Thus, the concept of balanced scorecard has been increasingly employed for performance assessment. The balanced scorecard (BSC) is both a performance framework and a management methodology. It was developed by Robert Kaplan and David Norton after an extensive research project in 1990 (Voelker et al. 2001). The BSC is essentially a customized performance measurement system that goes beyond conventional accounting and is based on organisational strategy. Kaplan and Norton (1996) performed a study on future performance assessment system in all kinds of industry by gathering the opinions from researchers and workers. Eventually, they came up with the framework of the balanced scorecard. This is a suite of new methodologies measuring firms' short- and long-term achievements and a tool that can be used for planning strategies and management decisions to measure performance in order to meet the demands of performance measurement and management and improve weaknesses caused by traditional performance assessment.

Traditional accounting-based performance measures evaluate business performance from a financial viewpoint. However, in addition to a financial perspective, the balanced scorecard also incorporates three other perspectives: customers, business processes, and growth and learning. Aside from measuring tangible and intangible assets, the balanced scorecard also evaluates whether strategies are effective and executes strategies against these dimensions and goals. The four perspectives are described in detail as follows:

i. Financial Perspective

The financial perspective typically considers analysis of certain lagging indicators, usually financial ratios and data that report on past performance. These include return on equity, return on assets, net income, revenue, and cash flow information. Consideration of this information has been a long-standing tradition in management of a firm (Bible et al. 2006). For firms, the financial perspective involves performance measure indicators discussed in finance such as reducing costs, improving efficiency, and enhancing productivity.

ii. Customer Perspective

Businesses must first distinguish between markets and customers and measure their performance in these areas. Indicators include market share ratio, customer satisfaction, continuation of customers, acquirement of customers, and profitability of customers. The balanced scorecard can assist firms in clearly identifying these indicators, seeking measuring standards, and exerting control over these. Kaplan and Norton (1996) believed that these five core measures are applicable to all types of organisations.

iii. Internal Business Process Perspective

Management needs to control essential internal processes to provide value and attract their customers in the target market. Kaplan and Norton (1996) considered that management from this perspective must establish the firm's important internal processes which - through improvements in internal procedures - assist them in creating customer value and reaching the financial returns expected by shareholders. Indicators include innovation process, operation process, and customer service process.

iv. Learning and Growth Perspective

Kaplan and Norton (1996) believed that the learning and growth perspective identifies infrastructure that must be built to create long-term growth and improvement of innovative companies. The balanced scorecard proposes that focus should not be only on investing in new products and new facilities; organisations must also invest in people, systems, and processes. Based on experience with the BSC, Kaplan and Norton (1996) categorised this perspective into three aspects: ability of employees, ability of information systems, and incentive, authority and fitness. Later in 2007, Kaplan and Norton (2007) validated that several well-known global companies using the balanced scorecard to measure performance which have surpassed the concepts put forth by the theory and derived more value. Thus, this study draws upon elements of the above perspectives to measure the performance of respondent firms.

3. Hypotheses - The relationship between knowledge innovation capability, regional innovation systems and industrial clusters on business performance

This study primarily examined the degree of knowledge innovation capability in campus firms and its impact on business performance in regional innovation systems and industrial clusters. First, on the matter of knowledge innovation capability and business performance, Garcia-Morales (2007) and team members pointed out that a technological organisation with greater organisational knowledge innovation capability achieves a better response from the environment, obtaining more easily the capabilities needed to increase organisational performance and consolidate a sustainable competitive advantage. Moreover, many systematic studies seem to reveal a positive relationship between innovation and performance in businesses (Garcia-Morales et al. 2007; Koellinger 2008; Zangwill 1993). From the above findings, the following hypothesis can be derived:

Hypothesis 1: Knowledge innovation capability has a positive effect on Business Performance.

On the aspect of industrial clusters and business performance, Morosini (2004) believed that if firms located in advanced country regions can be effective in promoting cooperation, this has a significant performance-enhancing effect on their performance. Moreover, he also viewed that the cluster’s underlying social fabric has a potential for innovation and knowledge creation; and at the same time, elements such as competitive factors, geographic closeness, and degree of knowledge integration within industrial regions have a positive impact on the economic performance of industrial clusters. Lai and his colleagues (2005) argued that innovative activity comes from direct contact with a variety of sources (e.g. suppliers, customers, competitors, and providers of different kinds of services). Industrial clusters that accumulate high levels of innovative success have assembled information that facilitates the next round of innovation, since the ability to innovate successfully would be a function of the technological levels already achieved. Porter (2000) pointed out that the existence of a cluster has positive effects on the competitive advantage of firms in a number of ways, one of them being a positive impact on the innovation capabilities of the cluster firms. From the above findings, the following hypothesis can be derived:

Hypothesis 2: Industrial Clusters have a significant moderating effect between Innovation Capability and Business Performance.

On the aspect of regional innovation systems and business performance, many scholars believed that innovation nowadays is seen as a socially and territorially embedded process and the regional level is recognized as being the best context for the development of

innovation-based learning economies (Asheim and Isaksen 1997; Cooke and Morgan 1998; Isaksen 2001). According to the Regional Innovation Systems theory, regions can play a central role in economic coordination, especially with respect to innovation, evolving into a "nexus of learning processes" (Cooke and Morgan 1998). In addition, Asheim (2007) considered that regional innovation systems have played and will continue to play a strategic role in promoting the innovativeness and competitiveness of regions. From the above findings, the following hypothesis can be derived:
Hypothesis 3: Regional Innovation Systems have a significant moderating effect between knowledge innovation capability and business performance.
Finally, on the difference impact of industrial clusters and regional innovation systems on business performance, Kyrgiafini and Sefertzi (2003) argued that theory of industrial clusters referring to enterprises connected directly with the production chain in a particular field focuses on the links developed within a group of firms and analyses modes of collaborating and networking between enterprises which constitute a spatial cluster. Kyrgiafini and Sefertzi (2003) also considered that the concept of regional innovation systems places emphasis on acquiring the necessary knowledge for the innovation venture through inter-firm collaborations and interactive behaviors, while generating of regional innovation policies to build a favorable environment for innovation. Several scholars have categorised industrial clusters using transaction behaviors among firms to examine how to reduce transaction costs and enhance external economies of scale in order to increase competitiveness of industrial clusters (Amin and Thrift 1995; Anderson 1994; Morosini 2004; Porter 1998; Rosenfeld 2002; Storper and Salais 1997).
On regional innovation systems, several scholars have classified these on the basis of the interaction between actors of the specific region where an innovation environment is created through learning mechanisms to conduct technological innovation or knowledge-value adding activities (Asheim 2007; Baptista and Swann 1998; Cooke et al. 1997; Freeman 1987; Lundvall 1992; Nelson 1993; Porter 2000; Walter 1997). It can be known that industrial clusters emphasize strengthening business competitiveness, while regional innovation systems focus on knowledge-value adding and innovation activities. From the above findings, the following hypothesis can be derived:
Hypothesis 4: Regional Innovation Systems and Industrial Clusters have different moderating effects on business performance.

4. Method

This study aims to examine the impact of knowledge innovation capability, regional innovation systems, and industrial clusters on business performance. It also observes whether the two moderating variables, regional innovation systems and industrial clusters, produce different effects on business performance. Thus, the conceptual framework developed for this study is presented in Figure 2.

4.1 Sample and data collection

Questionnaires were distributed to firms located in either Hsinchu Science-based Industrial Park (HSIP, locates in northern Taiwan) or TaiChung Science-based Industrial Park (CSIP, locates in central Taiwan), or the Tainan Science-based Industrial Park (TSIP, locates in southern Taiwan), while sampling was performed on the managers from these campus manufacturers. In the sampling design, this study sampled from IC, Optoelectronics, Precision Machinery and Computer & Accessories campus firms. Companies were first contacted by phone in July 2011 to obtain their willingness to participate in the study. Upon confirmation, questionnaires were then distributed by post. A total of 131 questionnaires were collected until the end of 31, August, 2011, 126 of which were valid, giving a response rate of 77%.

4.2 Measurement scales

A seven-point Likert's scale was used to measure each of the constructs in the research model (1=strongly disagree, 7=strongly agree), except basic information about the respondents. This study constructed the questionnaire based on previous research on knowledge innovation capability, industrial clusters, regional innovation systems, and business performance and modified for adaptation to the context. SPSS17.0 was employed to conduct tests on the hypotheses. The questionnaire of this study was tested with a high reliability and validity, as shown in Table 5.

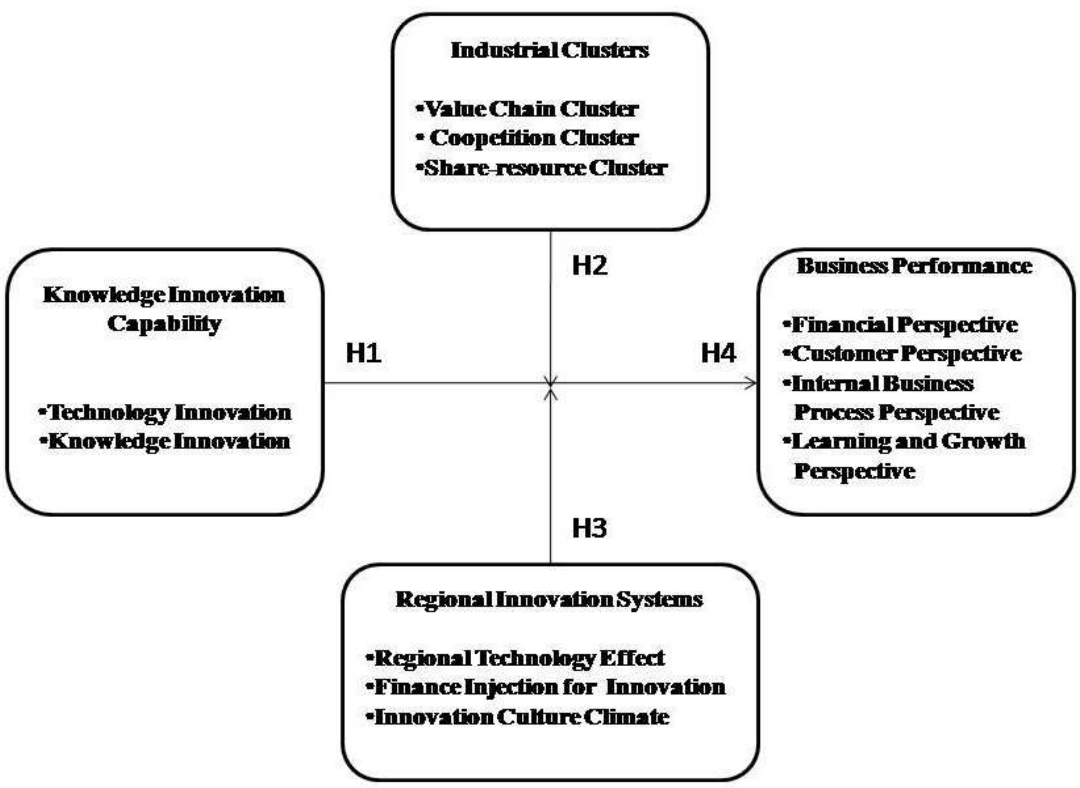

Fig. 2. Conceptual framework for this study

To ensure that the survey design has a high degree of reliability and validity, this study conducted reliability, validity and factor analysis tests. This study employed construct validity and criterion validity to evaluate the validity of the questionnaire. Zaltman and Burger (1975) and Kerlinger and Lee (2000) proposed a method of selecting factor dimensions using principal components analysis. Factors selected must conform to these conditions: (1) factor loadings must be greater than 0.5; (2) rotation sums of squared loadings must be more than 50%; and (3) the Kaiser-Meyer-Olkin measure of sampling adequacy must be greater than 0.7. When these conditions have been met, the test is considered stable. Table 5 shows that the validity value of this study exceeded that of the standard value. In measuring reliability, Nunnally (1978) proposed Cronbach's α coefficient as a measure of reliability; α coefficient greater than 0.7 is high reliability while less than 0.35 is low reliability. From Table 5, it can be seen that the composite reliability values are larger than 0.7, showing that this study has high reliability.

	Construct Validity		*Criterion validity*	***Reliability***
	KMO[a]	Rotation Sums of Squared Loadings	Factor Loading	
Knowledge innovation capability	0.931***	83.23%	0.707~0.901	0.948
Industrial Clusters	0.821***	74.97%	0.621~0.864	0.912
Regional Innovation Systems	0.878***	78.42%	0.643~0.875	0.929
Business Performance	0.924***	82.38%	0.684~0.892	0.937

Note:
a. Kaiser-Meyer-Olkin (KMO) is measure of sampling adequacy.
b. *** denote significance at the 0.1% level.

Table 5. Summary of validity and reliability analysis

4.3 Date Analysis and results

4.3.1 Knowledge innovation capability and business performance

Table 6 shows the results of multiple regression analyses. It can be seen here that the knowledge innovation capability of sample firms has a positive effect on business performance. Within this, technology knowledge innovation capability and management knowledge innovation capability have a positive impact on performance perspectives such as financial, customer, internal business process, and learning and growth. Thus, Hypothesis 1 is confirmed.

	Business Performance			
	Financial	Customer	Internal Business Process	Learning and Growth
Knowledge innovation capability				
Technology Innovation	0.417***	0.362***	0.252***	0.229***
Knowledge innovation	0.205**	0.298***	0.387***	0.322***
Adj. R^2	0.260	0.279	0.265	0.192
F	24.044***	26.317***	24.580***	16.573***

Note: 1. ** and *** denote respectively significance at the 0.5% and 0.1% level.
2. The regression coefficients in the table are standardised.

Table 6. Multiple regression results of Business Performance on Knowledge innovation capability

4.3.2 Moderating role of industrial clusters

To address changes in the impact of knowledge innovation capability, industrial clusters, and regional innovation systems on business performance due to firm age and size, this study employed a firm's history and number of employees as control variables proposed by several researchers (Bharadwaj and Menon 2001; Li and Atuahene-Gima 2001) to examine the moderating effect of industrial clusters and regional innovation systems.

Before conducting moderating effect analysis, this research considered the question of collinearity between these independent variables which possibly have significant correlations between them. Therefore, before hierarchical regression analysis is performed, this research separately subtracts each arithmetic mean from the factors of the knowledge innovation capability and the industrial clusters and contains the interaction items between them. The scholars, Neter and team members (1996), suggested the collinearity examination by Variance Inflation Factors and the path of the VIF. If the VIF value is greater than 10, collinearity exists in the model. Otherwise, non-collinearity exists. Table 7 shows the hierarchical regression results of Business Performance on Knowledge innovation capability and Industrial Clusters and the moderating role is Industrial Clusters. Several models are estimated in this set of analyses. Model 1 includes control variables only. Model 2 reports the direct effects of knowledge innovation capability on business performance. Model 3 tests the moderating effects of industrial clusters. Model 4 tests the moderating effects of both industrial clusters and interaction items. In addition, each VIF value of the Model 4 on Table 7 was discovered smaller than 10 and demonstrated non-collinearity on this level of hierarchical regression.

	Model 1	Model 2	Model 3	Model 4	Model 4 VIF
Control variables					
Company's History	0.079	0.054	0.028	-0.021	1.263
Number of Employees	0.191*	0.163	0.109	0.029	1.291
Independent variables					
Innovation Capability(IC)		0.294**	0.264**	0.228**	2.355
Moderating Variables					
Value Chain Clusters			0.267**	0.195*	2.039
Coopetition Clusters			0.011	0.103	1.836
Shared-Resource Clusters			0.109	0.042	1.754
IC×Value Chain Clusters				0.302**	1.913
IC×Coopetition Clusters				-0.068	1.972
IC×Shared-Resource Clusters				0.082	1.765
R^2	0.185	0.283	0.359	0.476	
F	19.277***	23.129***	17.864***	11.237***	
ΔR^2	0.185	0.098	0.076	0.117	
ΔF	19.277***	11.957***	8.147***	6.681**	

Note: 1. *, ** and *** denote respectively significance at the 0.1%, 0.5% and 0.01% levels, respectively.
2. The regression coefficients in the table are standardised.

Table 7. Hierarchical regression results of Business Performance on Innovation Capability and Industrial Clusters

From the Model 4 in Table 7, it can be seen that the interaction items of knowledge innovation capability and value chain clusters have a positive moderating effect (β=0.302, $p<0.05$) on business performance. In other words, if firms have a high degree of knowledge innovation capability and highly concentrated value chain clusters within the industry, then these can be effective on the firms' performance. Thus, Hypothesis 2 offers partial support.

4.3.3 Moderating role of regional innovation systems

Table 8 indicates the hierarchical regression results of Business Performance on Knowledge innovation capability and Regional Innovation Systems and the moderating role is Regional innovation Systems. Model 1 only contains control variables, and Model 2 indicates the direct effects of knowledge innovation capability on business performance. Model 3 tests the moderating effects of regional innovation systems while Model 4 tests the moderating effects of both regional innovation systems and interaction items. We found each VIF value of the Model 4 on Table 8 was smaller than 10 however the non-collinearity still exists in this level of hierarchy regression. This evidence is not consistent with Neter's (1996) suggestion on Variance Inflation Factors (VIF); and the reason behind, and algorithm relating to, this phenomenon will be explored in our future studies.

	Model 1	Model 2	Model 3	Model 4	Model 4 VIF
Control variables					
Company's History	0.069	0.074	0.023	-0.035	1.279
Number of Employees	0.191*	0.163	0.129	0.092	1.280
Independent variables					
Innovation Capability(IC)		0.294**	0.317**	0.253**	2.450
Moderating Variables					
Regional technology effect			0.234**	0.179*	1.524
Finance injection for innovation			0.152	0.051	1.984
Innovation culture climate			-0.087	0.103	1.980
IC×Regional technology effect				0.217**	2.450
IC×Finance injection for innovation				-0.074	1.897
IC×Innovation culture climate				0.186*	2.128
Adj. R^2	0.185	0.283	0.377	0.512	
F	19.277***	23.129***	18.520***	13.565***	
ΔR^2	0.185	0.098	0.094	0.125	
ΔF	19.277***	11.957***	9.089***	8.681***	

Note: 1. *, ** and *** denote respectively significance at the 0.1%, 0.5% and 0.01% levels, respectively.
2. The regression coefficients in the table are standardised.

Table 8. Hierarchical regression results of Business Performance on Innovation Capability and Regional Innovation Systems

In addition, Model 4 in Table 8 shows that the interaction items of knowledge innovation capability and regional technology effect have a positive moderating effect (β=0.217, $p<0.05$)

on business performance. In other words, if firms have a high degree of knowledge innovation capability and great regional technology effect within Science-based Industrial Parks, then these can be effective on the firms' performance. On another aspect, the interaction items of knowledge innovation capability and innovation culture climate have a positive moderating effect (β=0.186, $p<0.1$) on business performance. That is, if campus firms have a high degree of knowledge innovation capability and rich innovation culture climate in Science-based Industrial Parks, then these can be significant on the firms' performance. Thus, Hypothesis 3 offers partial support.

4.3.4 The comparison of moderating effect

Finally, from the comparison of the moderating effect on regional innovation systems and industrial clusters (Table 9), it can be observed that the moderating effect of RISs on knowledge innovation capability and business performance is greater than that of industrial clusters. Thus, Hypothesis 4 is confirmed. Hence, at present, the benefits provided by RISs concerning business performance are more evident than those by industrial clusters in Taiwanese HSIP, CSIP and TSIP.

Construct / **Index Items**	**Industrial Clusters**	**Regional Innovation Systems**
F	11.237	***13.565***
R^2	0.476	***0.512***
Number of significance on moderating variables	2	***3***
Mean/paired t-test	4.6685	***4.9701***
	5.411***	
Moderating effect	Low	***High***

Note: *** denote respectively significance at the 0.01% level, respectively.

Table 9. Comparison of moderating effect on Regional Innovation Systems and Industrial Clusters

5. Discussion

This study examined the moderating effect of regional innovation systems and industrial clusters on knowledge innovation capability and business performance from the perspective of innovation systems using Taiwan's HSIP, CSIP and TSIP parks as samples. Both concepts of industrial clusters and regional innovation systems emphasize that through the close social networked systems composed of actors from campus manufacturers, internal and external resources and information are easily obtained, diffused, and gathered to build innovation and other capabilities in campus manufacturers (Asheim 2007; Morosini 2004). Empirical results show a positive relationship existing between knowledge innovation capability and business performance, corresponding to arguments of a number of researchers (Garcia-Morales et al. 2007; Koellinger 2008; Zangwill 1993).

Further analysis from this study shows that when knowledge innovation capability is distinguished between technological and knowledge innovations; the technological and knowledge innovation capabilities of the sample firms have a significant positive relationship as Kaplan and Norton 's (1996) contributions such as financial, customer, internal business process, and learning and growth. This demonstrates that if campus firms can focus on each aspect of knowledge innovation capability, improvements in performance of firms are evident.

On the moderating effect of industrial clusters, this study observed that the interaction of knowledge innovation capability and value chain clusters has a positive moderating effect on business performance. This result consists with the finding of Morosini (2004) that individual firms having high knowledge innovation capability and, when clustered in a specific geographical region, create a social fabric where a high degree of cooperative effectiveness within vertical value chains leads to significant improvements in business performance. However, the interaction of knowledge innovation capability with coopetition clusters and shared-resource clusters did not demonstrate a significant level in our study. From these results, this study infers that the social fabric of campus manufacturers locate in the Science-based Industrial Parks have only achieved integration among vertical value chains. It has not yet evolved to that of horizontal coopetition fabric and of shared-resource clusters spanning a wide range of interactive dimensions.

On the moderating effect of regional innovation systems, this study observed that the interaction of knowledge innovation capability and regional technology effect has a positive moderating effect on business performance. This shows that high knowledge innovation capability along with high regional technology effect raises effectiveness in business performance. The interaction of knowledge innovation capability and the innovation culture climate has a positive moderating effect on business performance, illustrating that high knowledge innovation capability, coupled with a climate rich in innovation culture in Science-based Industrial Parks, enhances effectiveness in campus business performance. These findings confirm views from other researchers; that regional innovation systems can promote innovation while strengthening business competitiveness (Asheim and Isaksen 1997; Asheim 2007; Cooke 1998; Isaksen 2001).

In addition, the interaction of knowledge innovation capability and finance injection for innovation did not reach a significant level, implying that respondents consider that the lack of innovation incentives and subsidies in government policies do not significantly improve campus business performance. As a synthesis of the moderating effect of RIS, this study suggests that regional and local governments should provide a technological platform for the various research and development departments in industrial clusters, in order to strengthen technology flow and collaboration, and enhance the overall technology standards of the region. Furthermore, this study believes that knowledge innovation capability stems from attainments in culture; when technology has been developed to its peak, then promotion at the cultural level is needed. In other words, combining technology with humanities can improve overall living standards and create a high-value society. Thus, government policies should actively bring about an environment that supports an innovation culture.

Finally, after comparing the moderating effect of regional innovation systems and industrial clusters, it is observed that the moderating effect of RIS on knowledge innovation capability and performance is greater than that of industrial clusters to Taiwanese Science-based Industrial Parks. Thus, when looking at the assistance knowledge innovation capability brings to improving the performance of campus firms at present, the focus is on nurturing a favorable environment for regional innovation systems; this should be more beneficial than a good social fabric in industrial clusters. Under the concept of innovation systems, if campus manufacturers are able to make no distinction between themselves and focus on the sharing, transfer, and spread of technology, information, and knowledge among themselves, they can go so far as to create technological alliances in the park; this definitely has several positive contributions to make to business performance among firms. These findings offer evidence to support developing countries with the strategies and administration of regional Science-based industry by emphasizing coopetition effects to replace zero-sum effects among campus manufacturers, and at the same time, strengthen the effectiveness of resource-sharing among industries so that the whole industry and national economy becomes more robust.

6. Conclusion

Clarity on the relative advantages of industrial clusters and regional innovation systems (RISs) to enhance industrial innovations is critical for development policy that includes science-based industrial parks. This study concentrates on the Taiwanese IC, opto-electronics, precision machinery and computer & accessories campus industries to enumerate, compare and contrast the impact of knowledge innovation capability, regional innovation systems, and industrial clusters on business performance. Through empirical study of business performance of firms at three science parks, it is revealed that the knowledge innovation capability has a significant, positive effect on business performance. A comparison of the moderating effects of regional innovation systems and the fabric of industrial clusters shows that regional innovation systems have a greater moderating effect than the fabric of industrial clusters on knowledge innovation capability and business performance for campus manufacturers. Finally, from the perspective of assistance given by Taiwanese science-based industrial parks to promote business performance, a focus on the construction of regional innovation systems should be more beneficial than the promotion of industrial clusters.

7. Implications and limitation

A limitation of this study is the focus on campus industry IC, Opto-Electronics, Precision Machinery and Computer & Accessories in Taiwan only for its research sample. This sample is not enough for an overall representation. Therefore, it is suggested that future research widens its scope, such as to national innovation systems among countries or continents in the world. This study employed only industrial clusters and regional innovation systems as moderating variables for examining knowledge innovation capability and business performance. Future research can include more concepts such as knowledge-sharing mechanisms, organisational learning effectiveness, and innovation performance as intervening variables to allow for a more comprehensive study.

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Due to the development of mobile and Web 2.0 technology, knowledge transfer, storage and retrieval have become much more rapid. In recent years, there have been more and more new and interesting findings in the research field of knowledge management. This book aims to introduce readers to the recent research topics, it is titled "New Research on Knowledge Management Applications and Lesson Learned" and includes 14 chapters. This book focuses on introducing the applications of KM technologies and methods to various fields. It shares the practical experiences and limitations of those applications. It is expected that this book provides relevant information about new research trends in comprehensive and novel knowledge management studies, and that it serves as an important resource for researchers, teachers and students, and for the development of practices in the knowledge management field.