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INCUBATORS WITHIN UNIVERSITY AND CLUSTERED CONTEXTS: CASES OF NATIONAL CHIAO TUNG UNIVERSITY (NCTU) AND NATIONAL TSING HUA UNIVERSITY (NTHU) INCUBATORS IN HSINCHU, TAIWAN

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ABSTRACT

Research literature on business incubators has highlighted the significance of clustered locational contexts and networking as key to an incubator's success. Using the case study approach, this study aimed to test the validity of this framework for explaining the level of success of the National Chiao Tung University (NCTU) and National Tsing Hua University (NTHU) Incubators in Hsinchu, Taiwan – both of which are highly-networked, cluster-centric and university-based. In-depth interviews were conducted with the managers of both incubators, and these were followed by information gathering on university patents and knowledge transfers from the research and development (R&D) office at each university. Analysis found that the incubators' locational contexts determined the degree and manner of their networking, but their profitability and growth potential were influenced by many other factors working in combination. Satisfying their sponsors' requirements and serving their core functions through sound management and strategic planning appeared to be the key to achieving profitability and sustainability, with benefits for all stakeholders. These constructs provide directions for more research on the performance of incubators and other business entities that are located within university and clustered contexts.

Keywords: business incubator, university-based incubator, business cluster, NCTU Innovation Incubator, NTHU Innovation Incubator, Hsinchu, Taiwan

INTRODUCTION

The new-venture-development-phase literature (Churchill & Lewis, 1983; Hamermesh, Heskett, & Roberts, 2005; Greiner, 1998; Kazanjian, 1988; Kroeger, 1974; Sullivan, 2000; Timmons, 1994: 207–233) suggests that entrepreneurs require a number of capabilities to move their new ventures from the fledgling state to a stabilized stage. Entrepreneurs must acquire these capabilities either by building them in-house, or, as suggested by social networks theorists (e.g. Ulhoi, 2005; Greve, 1995), by accessing the resources through their own social networks, and/or through other networks such as those available via a business

incubator. Building upon these assumptions, a business incubator ideally should serve as the platform to provide resources necessary to fulfill the developmental needs of new ventures – either directly or indirectly (Hansen, Chesbrough, Nohria, & Sull, 2000).

In doing this, literature suggests that incubators should be highly networked, i.e. the incubator has simultaneous, organized multiple relationships with key collaborators, and helps connect entrepreneurs to them (Hansen et al., 2000). These collaborators could include portfolio firms of the incubator's investor companies (Hansen et al., 2000), and other organizational entities from within the incubator's context, such as universities (Mian, 1994a; 1994b; 1996a; 1996b; 1997).

The literature also highlights that incubators within a clustered setting operate in an "insulated" environment, which are important to its own and its tenants' success (e.g. Hsu, Shyu, Yu, Yuo, & Lo, 2003). Hsu et al. (2003) found that tenants in the Industrial Technology Research Institute (ITRI) incubator benefited from their locational context in Hsinchu, Taiwan. This region is a host location for a well-developed business cluster that is often referred to as the Hsinchu business cluster. Such locational benefits include having more efficient accesses to needed resources, experiencing higher demands for their products, and receiving greater supports from related companies, in comparison to entrepreneurs who are located outside of the cluster. This study defined a business cluster as a community of "interconnected" companies and institutions, which usually emerged unplanned or was planned for the specific purpose of facilitating development of businesses, their related knowledge generators and service providers. Often this community is specifically focused on developing and marketing certain products or services (Porter, 1998).

Hsu et al. (2003) also showed that numerous companies that "graduated" from the ITRI Incubator had then entered the Hsinchu Science Park (HSP) and its surrounding areas. These new companies provided new sources of growth to the Hsinchu business cluster by creating new jobs, attracting venture capital and a highly-skilled and educated labor pool, and possibly influencing the formation of more international partnerships. Similar findings are also observed in the case of universities that are host to incubators. These incubators have helped enhance the image of, and provided other intangible benefits to the host university (Mian, 1996b; 1997). In short, highly beneficial reciprocal relationships exist between the incubators and other business entities in their settings, and with their overall locational contexts.

Based on these reviewed studies, a networked-incubator framework for university and clustered contexts can be described. In this model, an incubator gains expected benefits from its contexts, and the incubator forms and establishes relationships with business entities within and outside its locational context, with the initial intent to serve the needs of its tenants, but with eventual reciprocal benefits for all concerned.

The main aim of the study was to test the validity of this framework in its application to two business incubators that meet the above described criteria: (1) the NCTU Incubator, and (2) the NTHU Incubator. Because these two university-based incubators are located in Hsinchu (the other incubator located in the same vicinity is the ITRI Incubator, but it is not hosted by a university), they stand to benefit from being located within a clustered business environment, which accords a highly efficient innovation system (Hsu et al., 2003; Hu, Lin, & Chang, 2005), and from being part of their respective university settings, which offers preferential access to hard-to-obtain resources (Mian, 1994a; 1994b; 1996a; 1996b; 1997; Grimaldi & Grandi, 2005; Westhead & Storey, 1995). These two incubators theoretically would be expected to capitalize on their relations with the host university and the clustered environment in serving their tenants' needs, and to gain reciprocal benefits from these relations.

Because of the need to establish a fit between an incubator's objectives and its operating models and outcomes (Bergek & Norrman, 2008), the study first examined the business objectives of these incubators and the support services they offered to their tenants. This would help to understand the important resources and corresponding linkages necessary for these incubators while building the study's internal validity (Bergek & Norrman, 2008). Second, this study analyzed the degree and manner in which these two incubators acted as networked incubators (What business linkages do the incubator forms with the host university and with the larger clustered setting? How are such links established and by whom, and how do they help the incubator tenants? What mutual/reciprocal benefits are resulted from these linkages?). Third, this study examined the incubators' performance, using measures that address the degree of consistency between the incubators' stated objectives and their operating policies with their achievements (Bergek & Norrman, 2008; Mian, 1996a; 1996b; 1997; Phan, Siegel, & Wright, 2005; Markman, Phan, Balkin, & Gianiodis, 2005; Phillips, 2002).

SYNTHESIS OF LITERATURE

New High-Tech Firm Development; Entrepreneurs' Need for Networks and Supportive Contexts; Building Incubator Networks from its Business Contexts; Reciprocal Contributions of Incubator to its Locational Contexts; and Incubator Performance

The development of new high-tech firms typically advances through four main phases: starting-up, commercializing of products/services, growing, and stabilizing, although most of the time, certain functions are performed across them (Churchill & Lewis, 1983; Hamermesh et al., 2005; Gartner, 1985; Greiner, 1998; Kazanjian, 1988; Kroeger, 1974; Sullivan, 2000; Timmons, 1994: 207–233). Building upon social networks (e.g. Ulhoi, 2005; Bollingtoft & Ulhoi, 2005; Greve, 1995) and developmental networks (Hill & Kamprath, 1998; Higgins & Kram, 2001) theories, it appears that developing a new venture from the start-up phase to the stabilized stage depends on successful integration of abilities of those within the internal team with those of outside experts.

Entrepreneurs need these networking relationships to help bring vital information and resources more swiftly into their ventures (Bhide, 1996; Champion & Carr, 2000; Colombo & Delmastro, 2002; Kazanjian, 1988; Ulhoi, 2005), and to help initiate and maintain important relationships with key suppliers and buyers (Venkataraman & Van de Ven, 1998). Access to such networks must be obtained by the entrepreneurs themselves or through intervention platforms designed to support their development, such as incubators. Such assistance can be provided directly by the incubator staff and/or through the incubator functioning as a networked incubator, in which it creates links between its tenants and key collaborators (Hansen et al., 2000).

Additionally, the entrepreneurs must know or quickly learn about the specific technological aspects of their own products and services to build their core-competencies. This requires entrepreneurs to be actively seeking knowledge from the experts and socializing with members of the communities-of-practice, making sense of the information they receive from them, and converting this information into something that is useful to their businesses. This could be greatly facilitated when the experts and entrepreneurs find it convenient and relatively easy to interact and exchange information and ideas (Hendry, 1996; Palmer & Hardy, 2000: 197–227; Peters, Rice, & Sundararajan, 2004).

Therefore, firms within an incubator which is located within a well-developed cluster with efficient technology-transfer mechanisms (such as having experts, suppliers and buyers, or their agents, in close proximity) could become more efficient producers and are more likely to survive (Porter, 1998; Hsu et al., 2003).

Such an ideal "incubating" environment usually exists in the university and clustered business environment, or one which is purposely designed to use locational context as a key source of its networks (e.g. Mian, 1994a; 1994b; 1996a; 1996b; 1997; Chen, Chang, Chiou, & Yu, 2004; Rothaermel & Thursby, 2005; Westhead & Storey, 1995).

Interestingly, these conditions would result in a spiraling upward effect of increasing success for all the players within the cluster. Being in a cluster improve the chances of tenant firms' survivability and increase their high surviving rate. This in turn contributes to their incubator's success as a business entity, and this enhances the viability of the whole business cluster (Hsu et al., 2003). Such reciprocity in the relationship between an incubator and its location usually has a positive effect on the public image of the university or other sponsors (Mian, 1996b; 1997). In the case of a university, it also tends to strengthen the perceived validity and credibility of its research, which enhances the reputations of its researchers (Rothschild & Darr, 2005).

An incubator's networks should also be extended beyond its locational contexts when such assistance is needed by its tenants (Hansen et al., 2000; Higgins & Kram, 2001; Hill & Kamprath, 1998). This would help improve tenants' performance, which in return, would contribute to the success of the incubator operations. As a whole, they would help ensure that the cluster itself continues to survive and thrive (Koh, Koh, & Tschang, 2005).

Given the highly reciprocal relationships between an incubator with its tenants, an incubator with its host university, and an incubator with its clustered contexts, its performance measures should include:

(a) its profitability level (Lalkaka, 2002);

(b) the numbers of its profitable graduated companies and their survival rates (Mian, 1994a; 1996b; 1997);

(c) the extent to which its programs help its tenants to develop into successful companies (Hansen et al., 2000);

(d) its growth potential and sustainability;

(e) degree of consistency between its stated objectives with its operating policies and achievements;

(f) its reciprocal contributions to its locational contexts, including the general impacts on the university and the larger community (Mian, 1996b; 1997; Phan et al., 2005); and

(g) the number of technology commercialization cases among its tenant firms, which involved technologies developed within the host university labs (Markman et al., 2005; Phillips, 2002).

METHODOLOGY

In achieving the study's objectives, case research method approach was selected and the primary data collection was from in-depth interviews. By 2005, there were about 60 business incubators in Taiwan; out of this number, only NCTU and NTHU incubators, met the main criteria of the study. The selection of these two incubators allowed controlling of three important variables: the *types of the incubators* (there were only two university-based incubators in Hsinchu), *their location* (both were located within the same community setting – university and clustered contexts) and the *starting date of their operation* (both started operation in the late 1990s) (Yin, 1994: 1–53; Eisenhardt, 1989).

Both incubators were visited, and interviews were conducted with the incubator manager of NCTU Incubator, and the director of NTHU Incubator, using an interview protocol that has three main sections, which corresponds to the study objectives. These interviews were then followed up by information gathering on the university patents and knowledge transfers from the universities R&D offices to the incubators. These were done to verify the relationships between the host universities and the incubators. All interviews were conducted in July and August 2005 and were followed up by e-mail communications. Additional information were also gathered from the NTHU Innovation Center website (http://ii007.ii.nthu.edu.tw/english/index.html) and the Taiwan's Small and Medium Enterprise Administration (SMEA) website (http://www.moeasmea.gov.tw) (The NCTU Incubator did not yet have a website).

Building upon Eisenhardt's (1989) research process, each case was first written up individually, focusing on the aspects identified earlier as important to success – business objectives, support programs, networks, and incubator performance indicators. These constructs were mainly adapted from research literature (Mian, 1994a; 1994b; 1996a; 1996b; 1997) and some were self-designed. The extent and types of the incubator networks were analyzed using the social-networks analysis tool (Cross & Prusak, 2002; Cross, 2003; Tichy, Tushman, & Fombrun, 1979) and the effect of locational contexts and other variables on each incubator's performance was also evaluated. Finally, a cross-case comparison was conducted to compare similarities and differences between the two cases to establish construct validity and identify the constructs that have an influence on the incubator performance. The study's findings were also compared with findings of similar research elsewhere, to establish their internal validity.

FINDINGS

The study's findings are summarized in Table 1 (general information, management, income, tenant profile, operational policies, support programs and networks, and reciprocal contributions) and Table 2 (achievements, consistency of operational policies and achievements with business objectives, prospects for sustainability)

Table 1
General information, management, income, tenant profile, operational policies, support programs and networks, and reciprocal contributions (as of mid-2005)

	NCTU INCUBATOR	NTHU INCUBATOR
Incubator's General Information		
Initial Operation Year	Started operation in July 1997	Began operation in early 1999
Location	Operated at two locations: • One building near NCTU old campus, located few kilometers away from main campus; • Another one in Hsinchu Science Park (HSP), situated adjacent to main campus.	Operated a 3-story modern building within NTHU main campus
Rentable Space	• Building near old campus:1,200 sq. meter (approx. 3,600 sq. ft.) with 32 office spaces (each room measuring about 40 sq. meter), for rent by entrepreneurial teams (operated at full capacity, with 16 tenants occupying all 32 rooms) • HSP building:1,800 sq. meter, had only 3 tenants, considerable rental space available	• Total spaces: 35,000 sq. ft., with 30 office spaces for rent by entrepreneurial teams • Had shared spaces, including one auditorium, one conference room, five discussion rooms, one copy room which also served as a lounge, and one kitchen • Operated at full capacity, had plans to construct a new building within campus
Type of Incubator (pure landlord, space & services, etc.)	Value-added incubator. Services included: • Office spaces with utilities, shared spaces, plus value-added services • Provide spaces for design areas of business, not for production-related activity which required large areas	Value-added incubator. Services included: • Office spaces with utilities, shared spaces, plus value-added services • Provide spaces for design areas of business, not for production-related activity which required large areas

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Table 1 *(continued)*

	NCTU INCUBATOR	NTHU INCUBATOR
Objectives of Incubator (as stated in their website/ promotional brochure)	Aimed at supporting growth of new ventures, including helping them access global markets and appropriate partnerships: • Make Incubator 'friendly' to foreigner buyers and investors; • Allow tenants more smoother access to global markets; • Generate synergy among tenants—tenants could benefit each other; • Seek out opportunities for merger and acquisition of the tenants' business if there is mutual fit; • Introduce tenants to venture capital community.	Aimed at supporting growth of new ventures and transferring the host university academic research to the industries, while also contributing to the host university: • Help decrease pecuniary risks and cost in the process of investment and innovation; • Assist in the development of new products and new technology as well as transforming academic research into products; • Provide opportunity for academic and industry cooperation; • Assist in business management, information collection and professional training; • Pursue Incubator continual growth and consolidate the feedback mechanism from the incubated enterprises to benefit NTHU.
Reporting Structural Relationship between Incubator and Host University	• Incubator was managed under NCTU R&D Office, which reported directly to the offices of NCTU two vice presidents, who in turn worked directly under NCTU president. • Through university R&D office, tenants could initiate collaborative relationships with NCTU faculty in supporting their technology and business development, and to gain access to technology developed in NCTU labs. • Incubator director and staff members reported to and had their performance appraised by R&D Office.	• Incubator was managed by R&D Office, and had Technology Licensing Office as a sister unit. R&D Office in turn was directly managed under the offices of NTHU two vice presidents, who in turn directly reported to NTHU president. • Incubator had a close relationship with College of Technology Management at NTHU, in which faculty offered consultations to tenants periodically. • Incubator director and staff members reported to and had their performance appraised by R&D Office.

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Table 1 *(continued)*

	NCTU INCUBATOR	NTHU INCUBATOR
Incubator Management		
Operations and Maintenance	NCTU paid for both buildings' renovations and for their continued maintenance with incubator rental income and SMEA funding.	• Seed money for renovating the incubator building was given by host university. • Day-to-day operations and staff salaries were funded by SMEA funding. • Incubator paid 20% of rental income to host university as management fees. • Maintenance of building was paid for by funding from SMEA and rental income.
Decision Making	• No board of advisors; Incubator director and manager made decisions about incubator strategy and operational policies. • Incubator director (appointed by the NCTU President's Office) was in charge of recruiting and hiring of Incubator manager and the two staff. • Incubator manager was responsible for formulating business objectives of the incubator. • SMEA was responsible for monitoring Incubator performance, and based on their evaluation, SMEA would decide on the amount of funds to be given to the incubator for the next fiscal year.	• Board of advisors included Dean and Associate Dean of R&D Office, and Incubator director. • Dean of R&D Office hired Incubator director; and the director in turn hired Incubator manager and other staff members. • Incubator manager was responsible for incubator operations. • SMEA gave guideline every year, but Incubator formulated its own objectives. • Host university and SMEA monitored Incubator performance; based on their evaluation, SMEA would decide on amount of funds to be given to incubator for next fiscal year.
Staffing	• Four staff members: 1 director (part-time) and 3 full-time staff (1 manager and 2 support staff members). • Incubator director was a professor from the Telecommunications Department of NCTU.	• Five staff members: 1 director (part-time) and 4 full-time staff (1 project manager, and 3 support staff). • Incubator director was a faculty member of the Department of Materials Science and Engineering at NTHU.

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Table 1 *(continued)*

	NCTU INCUBATOR	NTHU INCUBATOR
	• Manager has MBA from a US university; was hired from NTHU Incubator. • Only manager had had direct entrepreneurship experience. • Staff mainly functioned as integrator of services between the university and the tenants and external parties.	• Incubator manager has an Economics degree and previously worked in banking industry; No incubator staff had direct entrepreneurship experience. • Staff mainly functioned as integrator of services between the university and the tenants and external parties.
Incubator Income		
Types of Sources	Grant from SMEA, rental income and some money from tenant alumni financial payback.	Grant from SMEA, rental income and some money from tenant alumni financial payback.
1. *SMEA grant***	• NT$3 Million for 2005 (approx. US$91,000)	• NT$5 Million for 2005 (approx. US$152,000)
2. *University Contribution*	• Allocated building and helped renovate building. • Assigned one faculty as director.	• Allocated building and helped renovate building. • Assigned one faculty as director.
3. *Rental Income**	• NT$1 Million for 2004 (approx. US$30,000)	• NT$4 Million for 2004 (approx. US$121,000)
4. *Tenant alumni donations/ financial payback*	• Incubator chose either NT$100K in cash or 10K in stocks per company per year for each tenancy year. • Had accumulated about US$30,000 in royalty income; shares were given to university, cash went into incubator fund.	• Incubator chose either NT$100K in cash or 10K in stocks per company per year for each tenancy year plus about NT$212-278/square meter/month for the space they had occupied. • Had accumulated a total of 181, 000 shares, US$20,000 of cash, and products valued at US$460,000; all were given to NTHU.
Incubator Tenant Profile		
Tenants' business focus	• Product/technology development and commercialization; Majority were involved in the designing stage of their business field.	• Product/technology development and commercialization; Majority were involved in the designing stage of their business field.

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Table 1 *(continued)*

	NCTU INCUBATOR	NTHU INCUBATOR
Total no. of tenants (since operation began)	44	60
Total no. of tenants (as of mid-2005)	19	23
Tenants' origination	• In 2005, only 1 tenant; that was started up by a group of existing NCTU students; technology was originated from one of NCTU research labs. • Origination of incubator's tenants had been evenly distributed among: NCTU alumni; existing NCTU students; ITRI scientists; NCTU alumni (who were engineers from companies located in HSP); non-NCTU alumni engineers (from companies located in HSP and those located in Hsinchu and its surrounding areas, but outside of the HSP); and others. • Geographically, majority of tenants were from Hsinchu and surrounding areas.	• In 2005, 4 tenants originated from technology developed in NTHU labs. • 50% of current tenants had certain relations with host university (fresh grads, alumni, or their technology originated from the university). • Majority of tenants were started by experienced engineers from companies in HSP. • Geographically, majority of tenants were from Hsinchu and surrounding areas.
Incubator Operational Policies		
Tenant Selection and Performance Review	• All tenants must be SMEs (as defined by SMEA, having capital under NT$80M or number of employees under 200). • Tenants' business focus needed to be on government-emphasis technology so that they could benefit from government subsidies. • Review Committee for tenant selection included the Incubator's director and manager (as permanent members), a faculty member, an industry expert, and/or a venture capitalist, depending on the tenants' business and technology types.	• All tenants must be SMEs (as defined by SMEA, having capital under NT$80M or number of employees under 200). • Tenants technology needed to have close connection with R&D focus of NTHU faculty. • Tenant candidate business plan would be screened first by Incubator manager and then assessed by an evaluation committee comprised of experts in technology (with faculty representation) and venture capitalists, depending on the kind of technology and business involved.

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Table 1 *(continued)*

	NCTU INCUBATOR	NTHU INCUBATOR
Tenant Selection and Performance Review	• Potential synergy among fellow tenants was not used as a basis of consideration for tenant selection. • About 80% of applications were rejected, mainly because the selection committee believed that the applicant's business model would not allow them to succeed as a viable business. • Incubator manager performed tenant performance review.	• Incubator director and manager were permanent members of the selection committee, but they could not vote. • Synergy among fellow tenants was not considered as the basis for tenant selection. • About 10% of applications were rejected, because of lack of a market for applicant's product or service, lack of linkage with NTHU, misalignment with Incubator technology focus, or when survival of the enterprise was in doubt. • Tenant performance reviews were performed every quarter by Incubator director, with consultation from faculty when necessary.
Exit/graduation (minimum or maximum tenant period; tenant removal policy)	• Maximum of 4 years; no minimum stay • Had a tenant removal policy, which was spelled out in the tenant contract. • Had evicted tenants for damaging the facility, for failure to pay rent and to adhere to incubator policies.	• Maximum of 4 years; no minimum stay • Incubator had a tenant removal policy, which was included in the tenant's contract, but so far had never had to remove any tenant.
Incubator Support Programs and Networks		
Tenants Support and Networking Relationships Program	• Incubator programs had been developed based on an analysis of assistance needed by actual tenants over a period of time. • Numbers and skills/knowledge of Incubator staff were limited. Thus, they need to establish and take advantage of linkages to support tenants' selection, development, and performance review.	• Support programs were created, and modified as needed, based on the needs that were communicated by tenants. • Numbers and skills/knowledge of Incubator staff were limited. Thus, they need to establish and take advantage of linkages to support tenants' selection, development, and performance review.

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Table 1 *(continued)*

	NCTU INCUBATOR	NTHU INCUBATOR
	• Tenants' access to faculty was assisted based on request. • Incubator staff members acted as 'middlemen' to help tenants access resources by linking up with: (1) host university to enable tenants to access labs, equipment and other facilities, faculty expertise and business advice; (2) external business service providers, such as legal and accounting services, and payroll management; (3) experts in specific industries for consultation on product development and marketing; (4) providers of specialized services; (5) financiers; and (6) international partners, to enable its tenants to have access to foreign capital, expertise, cooperation, markets, and to integrate those resources into a network of reciprocal relationships. In making these connections, Incubator staff used their personal connections. • Most of Incubator partner companies were from the Hsinchu-Taipei corridor area. • Because of Incubator partnerships with service providers, tenants received better rates from the providers, and their projects often received immediate priority for completion. • Incubator helped review tenants' applications for government subsidies, created a monthly Entrepreneur Roundtable, in which tenants meet industry experts to discuss business-related topics, but Incubator had not yet institute structured links between current and graduated tenants.	• Each tenant was allowed to select at least one faculty advisor. • For business management services, tenants benefited from Incubator's strategic partnerships with accounting companies, legal firms, and banks—all of whom were eager to form relationships with tenants, with the opportunity in doing more business after the tenants' businesses were successfully launched. • Incubator staff members acted as 'middlemen' in helping tenants access both generic services, specialized resources and knowledge/expertise—from the university and service providers mainly from the areas of Hsinchu-Taipei corridor. • Providers offered their services to tenants free or at greatly reduced prices. There were even accounting firms who sponsored some Incubator activities in return for being allowed to work with certain tenants. • In making connections with service providers, Incubator staff used their own personal networks. • Incubator helped tenants in recruiting employees, provided tenants with information about government subsidies, organized classes on intellectual property rights, and formed alliances with patent offices (who offered consultations to tenants for free).

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Table 1 *(continued)*

	NCTU INCUBATOR	NTHU INCUBATOR
	• Tenants considered interactions among themselves as major source of knowledge exchanges about their businesses, markets, and technology. There were cases of tenants having business dealings with each other, and tenants providing direct. assistance to fellow tenants. • Tenants had to supplement incubator's networks with their own personal networks.	• There was much interaction among tenants, and they considered those interactions important for information exchange about their businesses, markets, and technology. There were cases of tenants collaborating with each other to apply for government subsidies. • Incubator had established Incubatee Club, which comprised of alumni tenants, in which current tenants could receive help from graduated tenants. • Tenants had to supplement incubator's networks with their own personal networks.
Host University Contributions to Incubator		
Description of Contribution	• Having the NCTU name and being located within a clustered setting had been important for Incubator in making the necessary connections. • Access to faculty consultation was granted only when requested by tenants and this was brokered by Incubator staff. Tenants were allowed to rent, sometimes at discounted rates, the needed labs and equipment from university. • Not many tenants were making use of student employees. • Tenants did not have privilege access to the university's general facilities, were not allowed to check out books from the library, and were not given privilege to attend courses at NCTU. • Neither the incubator nor the university had invested in any tenant companies.	• The NTHU name and being located within a clustered setting had helped Incubator in making needed connections. • Tenants had access to faculty consultation and university labs and equipment, and student employees. But not many tenants were making use of student employees. • Tenants did not have any special privileges to register for courses, and they were not permitted to check out books from the library or use other university facilities. • Neither the incubator nor the university had invested in any tenant companies.

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Table 1 *(continued)*

	NCTU INCUBATOR	NTHU INCUBATOR
Incubator Contributions to Locational Contexts		
Incubator Contributions to Host University	• Very few cases of host university's graduates being employed by Incubator tenants and very few university students being trained in entrepreneurship. • Number of graduated companies was low, and had yet to achieve profitability, thus, Incubator had yet to contribute to university income or significantly enhancing the university's public image.	• Incubator major contributions to the university are management fee, financial payback from tenant alumni, and enhanced university's public image. • Only one or two cases of student employment in Incubator, and these were cases related exclusively to faculty projects. • Incubator did not serve as a labor market for graduated students, as most of the NTHU graduates sought employment in large companies in the HSP and surrounding areas.
Incubator Contributions to Hsinchu business cluster	Had eight companies that had graduated from the incubator and remained in Hsinchu. Of the eight, four were located in the smaller HSP, and the rest remained in the larger Hsinchu areas.	• Had high number of graduates who joined HSP and its surrounding areas. • Having good candidates, and being a successful incubator attracted Vice-Chancellors (VCs) to invest within the cluster. • Because the overall range of its graduate companies were in similar industries, mainly information, semiconductors, and materials-related fields, incubator indirectly helped strengthen those specific clusters of companies. All contributed to enhancing university's public image and provided new sources of growth to the cluster.

Notes:
*Rates as of August 2005: 100NT = 33USD;
**The amount of funding received by an incubator under the SMEA programs was based mainly on the number of tenants supported by the Incubator during the previous year. That number counts for 50% in measuring Incubator performance. Other criteria for measuring performance were usually worked out between the incubator management and SMEA.

Table 2
Achievements, consistency of operational policies and achievements with business objectives, prospects for sustainability (as of mid-2005)

	NCTU INCUBATOR	NTHU INCUBATOR
Incubator Achievements		
Current Level of Profitability	• Completely utilized rental income of NT$1 million (approx. US$30,000) and SMEA grant of NT$3 million (approx. US$91,000) to support current operations. • By 2005, operated at breakeven.	• By 2005, profitable.
Number of Graduated Tenants and their Survival Rates	• From 44 tenants that had been incubated, only 8 had graduated. • Of the 8, 7 had made progress in sales or had moved out to seek larger office space, but 1 had later failed; 1 had merged with a public listed company in 2005.	• Out of 60 incubated companies, 37 graduated (with 33 still operating).
Tenants Location After Graduation	• 4 companies have relocated to HSP. • 1 had merged with public listed company. • All graduated companies remained in Hsinchu.	• 7 companies have relocated to HSP. • 7 companies became public-listed companies. • Majority had remained in Hsinchu and surrounding areas.
Consistency of Operational Policies with Business Objectives	• Yes	• Yes
Consistency of Achievements with Business Objectives	• Yes	• Yes
Prospects for Sustainability		
Details of Future Prospects (+): positive prospect (–): negative prospect	• (+): With new management, had potential to succeed; • (+): When achievements and operating policies were evaluated against its objectives, (refer to stated objectives in Table 1), it had expended much effort to achieve these stated objectives.	• (+): Had a very good future prospects. • (+): Could survive on its rental income alone, without the SMEA funding; it gave 20% of all rental income to the host university in form of management fees with remaining rental income was

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Table 2 *(continued)*

	NCTU INCUBATOR	NTHU INCUBATOR
	• (+): Future plans included expanding its office rental business and further building up of strategic alliance networks, especially with international partners, and continually integrating the resources of all alliance members into its operations (including creating more connections between alliance members and outside service providers (accountants, lawyers, venture capital and marketing channels, etc.). • (–): Required to contribute 50% of its rental income to university but it had only submitted 10% of its rental income so far. • (–): Did not have any accumulated savings to fund future expansion. • (–): Faced the possibility of its public funding (esp. from SMEA) being stopped in future. • (–): Needed more money to further renovate its building in Hsinchu Science Park. • (–) Needed to build reputation as good incubator.	being put into a university fund allocated exclusively for incubator development and future contingencies that might arise. • (+): Had savings available in its incubator fund. • (+): By 2005, all alumni tenant financial payback was remitted to the university, but it had plans to put some portion of the amount into the incubator fund. • (+): Had a good reputation (ranked "Excellent" in Taiwan for the past several years), which enhanced its public image and made it attractive to potential tenants, investors, and partners. • (+): Had a high number of graduates (37), in which 89% (33) survived as businesses. • (+): Had paid back to the host university all the initial seed money. • (–): Faced the possibility that public funding (esp. from SMEA) being cut-off. • (–): Already operating at full capacity, but (+) had gain approval to construct a new building, and was in the process of constructing a new building, (+) more rental income could be expected.

Incubator Locational Contexts –University and Clustered Settings

The two incubators were hosted by universities and were located within or near a university setting; both of which in turn were located in Hsinchu, Taiwan. This location, particularly the areas of HSP and its surrounding areas (including the Hsinchu City, the Hsinchu County and the entire Hsinchu-Taipei corridor) collectively hosts the Hsinchu business cluster (Rosenberg, 2002: 1–37). It has been described as one of the most well-developed technology business clusters in

the Eastern Hemisphere and has been ranked among the world's top performing business clusters (Mathews, 1997; Rosenberg, 2002: 168–189).

The combination of technology and business development was the core function of the Hsinchu business cluster. The development of this cluster took place in 1973, when the Taiwanese government funded a research think-tank, which was named the ITRI and was located in the newly-created Hsinchu business cluster site. ITRI's reason for existence was to support research that had direct useful applications and facilitate their diffusion to specific industries (Mathews, 1997; see also ITRI website). Many of these applications became the core of ITRI spin-off businesses and these businesses further developed their competitive advantage in the market-place by locating within the HSP. This park was established in 1980, located near ITRI, and was specifically designed to receive tenancy from the ITRI spin-off companies. NCTU and NTHU, the two top technical universities in Taiwan, which were already located in Hsinchu at that time, quickly became important parts of this new cluster (Hsu et al., 2003).

Over the years, the growth of HSP attracted more investments to Hsinchu and its surrounding areas from financing and business communities. They wanted to capitalize on its locational advantage. HSP rapidly became a primary host to businesses linked to/or supporting the ITRI spin-off companies, particularly new start-up companies involved in the semi-conductor technology and other related businesses. Hsinchu business cluster continued to evolve as more companies "clustered" together, initially within the park, but later on, spreading into the surrounding areas.

Today's HSP is the most important part of Hsinchu business cluster, comprising over 300 companies – mainly specialized producers, particularly in the semi-conductor industry, but also in other major industries including optoelectronics, precision machinery, and biotechnology (see HSP website). Operating in close proximity to one another, they become parts within a given industry value chain. These companies usually specialize in either design or manufacturing. They outsource other parts of a job, preferably to other companies within the HSP itself or within the surrounding areas of Hsinchu. This makes them heavily dependent on one another and thus highly supportive of each other's existence and operational efficiency. Such a dense organizational network promotes rapid product and business development, allowing each individual company to gain a competitive advantage and giving these companies as a group a decided advantage when they compete against those located elsewhere (Ku, Liau, & Hsing, 2005; Jou & Chen, 2001).

In the late 1990s, SMEA, a unit under the Ministry of Economic Affairs, suggested the formation of business incubators at these two universities. This seemed to be a logical and natural step, in light of the locational and situational factors already described above (see SMEA website). By 2002, SMEA had sponsored not only the incubator operations hosted by NCTU and NTHU, but also over 50 university-based incubators throughout Taiwan.

SMEA sponsorship included providing funds for incubator operations and training of incubators' staff members. The amount of funding received by an incubator under the SMEA programs was mainly based on the number of tenants supported by the incubator during the previous year. This figure carried the most weight in the formula they used and accounted for 50% of an incubator's measured performance. This suggested that SMEA's main objective in sponsoring the incubator projects was to increase the numbers of new successful firms in Taiwan. Other criteria for measuring performance were usually jointly decided between the incubator management and SMEA. SMEA also held seminars and conferences to link the incubators under its management with industries and financing communities.

Key Comparisons of the Two Incubators

The two university-based Taiwanese business incubators appeared to have many similarities. Revenue streams of both incubators were generated from SMEA funds, tenants' rents, and tenants' repayments after leaving the incubator. Tenant rental rates in these two incubators were higher than the rates for similar facilities outside the incubators. Both incubators were under the oversight of the university's R&D office, and had directors who were also faculty members. The majority of their tenants were from the Hsinchu areas and almost all their graduated firms chose to remain within the areas as well.

The developmental programs at these two incubators were found to be designed based on an ongoing examination of the tenants' needs. In addition to providing direct help to their tenants, the incubators functioned as liaisons and integrators of service, helping to create networks that tied together their tenants, host university and business entities, regardless of their geographical locations. Both incubators formed constellations of relationships on their own, thus, the extent of their networks was determined by their staff members' personal networks.

The incubators did not provide jobs to their host university's graduates or on-the-job training for university students. These findings were not surprising, given that only small tenant companies could be accommodated in the incubators, and they did not require many employees. Furthermore, the university graduates were more likely to be recruited by larger and better established companies located in

the nearby HSP and throughout Hsinchu and surrounding areas. For these reasons, creating employment was not an important goal of either incubator.

The incubators were not very successful in bringing forth new technologies developed in the host university labs, or nurturing entrepreneurship among faculty members or students. The low rate of technology transfer from university labs into the incubator tenants' ventures, even though this was a focus of the NTHU incubator, might be explained by several factors, which were related to the types of technologies developed within the university labs and the stage of their development. When the patented technologies of these two universities were examined, most were enhancements of existing technologies, and many were still in an embryonic stage that requires further time and more investment before they would be ready for the commercialization stage. This was the reason for the low transfer rate as incubator tenants and investors would be unlikely to spend time on technologies that were slow to reach commercialization stage. Most of the patented technology enhancements were transferred to large firms as their applications were more suitable for such companies. Only a few patented technologies, mostly in Information Technology, were suitable for use in startup companies. The existing rules and laws that keep faculty members from turning into entrepreneurs may also be the reason for the low technology uptakes (see Phillips, 2002).

However, there were key differences between the incubators in terms of location, size, type of networking relationships in tenant selection, and overall objectives. These differences in turn influenced, or were related to, the variations in:

(a) networking priorities,
(b) relationship with their respective host universities,
(c) profitability,
(d) percentage of tenants graduated; and
(e) contributions to the host university and Hsinchu business cluster (Tables 1 and 2 show a detailed summary of these findings, allowing for a side-by-side comparison of the two incubators).

The slightly larger and older NCTU Incubator was located off-campus, and was divided into two sites. In comparison to the other incubator, NCTU Incubator stated objectives, tenant selection procedures, and overall management appeared to function more independently from its host university, and it also focused more on facilitating its tenants' entry into the global marketplace. Additionally, it concentrated more on aligning with government interests, e.g. getting government subsidies for tenants, and establishing ties with the SMEA. The NCTU Incubator appeared less successful overall, in terms of:

(a) profitability (it just broke-even in mid-2005),
(b) percentage of graduated companies and those that were still operating (18% of 44 had graduated, but only 11% were still operating as businesses), and
(c) financial base (little savings to support future development).

However, in most other respects, it was on par with the NTHU Incubator, having the same advantages that come with being located within the Hsinchu business cluster and having a top university as host. In addition, its new manager had direct experience as an NTHU Incubator manager, so the future of the incubator was expected to be better.

The NTHU Incubator presented an even more positive picture, showing reasons to expect a brighter future. It was located on-campus, in a modern building, and plans were being made to construct an additional building on campus. It had very close ties to its host university, having the university officials as its board of advisors and faculty staff as tenant selection and performance review committee members. In addition, its tenants were more likely to be connected to research projects being carried out by faculty members, and each tenant was required to have at least one faculty advisor. The incubator's objectives were focused more on transforming university research into useful products and, in general, facilitating collaborative efforts between academia and the world of business and industry. It was operating at capacity, had a higher rate of successful graduates (62% of 60, with 55% still operating), was profitable, had paid back all seed money to its host university, and had earned high rankings (in the top 4 for the past four years). Thus its reputation, overall performance, and financial stability reflected well on its host university, and this in turn contributed to the strength of the Hsinchu business cluster, which enhanced the status of the tenants and their enterprises as well.

DISCUSSION

These two cases were examples of how being in a good location – the university and clustered contexts of Hsinchu – seemed to help an incubator to succeed. Their location allowed them to have access to a pool of potential high-quality entrepreneur applicants, influenced the degree and manner in which they could be networked to help the tenants connect with key resources, and gave them a ready platform for receiving graduated companies. These factors in turn appeared to help provide an environment conducive for startups to survive. Having experts in close proximity and service providers who were willing to invest in reciprocal relationships also helped tenants navigate through important milestones in their venture development.

Nevertheless, analysis revealed the existence of several other factors that may have an even greater bearing on the profitability and growth potential of these incubators. As demonstrated by the NTHU Incubator case, its profitability appeared to be a result of a combination of having:

(a) a large amount of government financial support;
(b) a high level of rental income;
(c) high-quality tenants;
(d) a stringent procedure for selecting tenants; and
(e) an established name as a reputable incubator.

Each of these elements was also influencing each others in their effect on the profitability. For example, substantial financial supports from the government were the result of the incubator having a high number of tenants and a good overall track record, while having a large number and high quality tenants produced a high rental income. On the other hand, the high quality of tenants was resulted from the incubator's stringent selection and review policy, reputation, track record and services provided, which attracted a larger number of applicants with a high level of ability, motivation, and perhaps readiness to accept assistance (see Rice, 2002). The incubator's total environment encouraged tenants to recognize and take advantage of opportunities in the industries in which they did business, and to access numerous networks of resources – funding, knowledge and expertise, and markets. This in turn resulted in a larger number of graduated companies. These graduated companies in turn strived to meet the requirements of other stakeholders (the SMEA, host university, and clustered contexts, including both VCs and faculty experts). As a result, while making profit, the incubator "grew" closer connections with its host university and clustered locational contexts, with reciprocal benefits for all involved.

The NTHU Incubator's profitability and overall success further allowed it to invest more in planning for future development and sustainability of the incubator itself, and to enhance its capability for nurturing new profitable ventures, thus contributing to its growth potential. Profitability also helped create good public relations, which brought in other benefits, such as:

(a) attracting more high-quality tenant applicants;
(b) obtaining more preferential treatment from service providers and venture capitalists;
(c) continually reinforcing mutual benefits accruing from the university-incubator relationship; and
(d) obtaining reciprocal benefits in which the university faculty and the incubator tenants exchange ideas and knowledge that lead to technological and business innovations.

In short, success for the NTHU Incubator appeared to be not only due to one factor by itself, but also to the mutually reinforcing combination of numerous factors that created an upward spiral of success that began with government support and led to profitability and growth.

In contrast, the current financial status of the NCTU Incubator was clearly the opposite. Its government subsidy amount in 2005 was much lower than that received by the NTHU Incubator. This was mainly because, historically, it had lower number of tenants and several cases of evicted tenants (and thus small amounts of rental income). It had yet to achieve profitability due to the lower amount of income, while its reputation was perhaps only beginning to build up. It had taken some efforts to achieve profitability, growth, and a stronger reputation, but such progress would take time.

In noting the differences between the two incubators, even though both were located in the same well-established business cluster, and had the same potential for networking within its locational contexts, NTHU incubator was generally more successful than NCTU incubator. This suggests that locating in a clustered setting, are not alone sufficient for business success and this concurs with previous literature conclusions (e.g. Locke, 1999).

While being a university-based incubator and located in clustered contexts helped to determine the degree and manner in which each incubator had networks, this would not guarantee the incubators to have a high number of profitable graduating companies; nor would it automatically result in achieving profitability and growth, as these outcomes also appear to be influenced by many other factors working together.

IMPLICATIONS FOR ENTREPRENEURS, INCUBATOR PROGRAM SPONSORS/MANAGERS, AND FUTURE RESEARCHERS

Given that they are hosted by a university and located within the Hsinchu business cluster, both incubators were fortunate to have, close at hand:

(a) faculty experts who are nurtured within a community-of-practice,
(b) platforms that foster business continuity,
(c) an efficient technology-transfer mechanisms (Hu et al., 2005),
(d) an overall cultural/social/professional environment built on connected, trusting relationships – in which those who have received help expect to reciprocate later, and
(e) in general a cumulative, agglomerative set of effects that are specific to this particular clustered academic and business setting.

However, adaptation is required in applying the networked incubator model implemented by NCTU and NTHU as each university and incubator context is also unique.

The incubator staff's ability to provide assistance depended on their ability to quickly learn about their tenants' needs and about resources available for meeting those needs. They are required to assist in establishing linkages for the tenants, including tapping into their own networks for this purpose. Therefore, recruiting highly capable and experienced incubator staff and instituting a structured way of managing their networks, including developing a structured system for capturing information about experts (Lu & Wann, 2004).

Given the differences of tenants' needs, it is more efficient that the entrepreneurs actively participate in their own venture developmental process. By understanding and communicating about their specific needs, becoming aware of what help is currently available, being willing to receive help, being able to access and benefit from the help that is available, and being aware of the importance of and being ready to involve themselves in relationships that are pertinent to their venture development, the tenants thus are able to benefit more from the assistance offered by the incubator staff. Incubator staff and others that may be directly or indirectly involved in the new ventures' development, on the other hand, must be aware of each entrepreneur's level of readiness to participate in forming and managing the needed relationships (Rice, 2002; Ulhoi, 2005).

Depending on their networking requirements, new entrepreneurs need to identify the structured linkages already established by the incubator, and examine their own personal networks, and determine what pertinent linkages may be missing. If significant network connections are indeed missing, the entrepreneurs must establish their own developmental networks to supplement those of the incubator, or – if that seems unrealistic – they may decide to apply to an incubator that can offer more help in accessing those linkages.

For new entrepreneurs who want to benefit from close interactions with faculty and existing communities-of-practice within the university environment, it is important that they choose an incubator located on a university campus, and one that has an organized system for promoting such collegial relationships. Also entrepreneurs should be informed about the particular technology focus of the incubator they are considering, to make sure that as applicants they are well-qualified to meet the tenancy selection requirements, and to gain optimum benefit from that focus if they are accepted into the incubator.

CONCLUSION

The networked-incubator in a framework of university and clustered contexts served as a vehicle for exploring the role of contexts and networking relationships, and of the mutual/reciprocal benefits that can result from those linkages. Central nodes in the incubator networks were identified, along with others that were more peripheral. This study found that many variables working in combination influenced the performance indices for the two incubators studied, although certainly having a first-rate location and being heavily networked with other organizations were key elements. Findings highlighted the importance of developing incubator competencies in serving its core functions – selecting promising entrepreneurs and helping them to develop their new ventures and satisfying the requirements of their core sponsors. Only in carrying out these functions effectively can the incubator be successful on behalf of all its stakeholders. Incubator's future growth and ability to support itself and those under its care were influenced by its profitability. In turn, profitability was determined by the incubator's ability to select promising entrepreneurs and help them to develop their new ventures, while also satisfying the requirements of their core sponsors, i.e. the SMEA and their host universities. These constructs provide useful actionable points for managers who are concerned with the development of incubators and the tenants under their care and for more research on the performance of incubators and other business entities, located within university and clustered contexts.

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