Assessing the Growth Potential of High-Technology Start-Ups: An Exploratory Study from Hong Kong

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ABSTRACT. This paper seeks to assess the growth potential of new high-technology incubated ventures through analyses of the entrepreneurial characteristics of their founders. The following two objectives are pursued: (1) to provide managers with insights regarding how the success potential of a venture could be increased, and (2) to provide a deeper understanding of how a start-up business could be nurtured on the basis of knowledge concerning the historical origins of incubation. The findings suggest that the following characteristics of the founder significantly influence the success potential of an incubated venture: entrepreneurial personality, motivation for starting the venture, managerial skills, and approach towards innovation.

SOMMAIRE. Cet article tente de déterminer le potentiel de croissance de nouvelles entreprises de haute technologie ayant bénéficié de l'aide de pépinières d'entreprises en analysant les caractéristiques entrepreneuriales de leurs fondateurs. L'article a deux objectifs : (1) donner aux dirigeants d'entreprises une perspective pour améliorer les chances de succès d'une entreprise et (2) permettre une meilleure compréhension de la façon de favoriser le développement d'une jeune entreprise en s'appuyant sur des connaissances au sujet des origines historiques des pépinières. Les résultats démontrent que, pour le fondateur, posséder les caractéristiques suivantes joue un rôle important sur les chances de succès d'une entreprise bénéficiant de pépinières : avoir une personnalité entrepreneuriale, avoir la motivation nécessaire pour démarrer une nouvelle entreprise, avoir des compétences en gestion et avoir une stratégie axée sur l'innovation.

Introduction

Entrepreneurship is a global issue. The creation of business incubation has been one of the tools adopted to foster high-technology entrepreneurial ventures. It is expected to enhance the growth of companies. It can also reduce the risk of failure for small businesses being incubated by institutions such as a science park that provide the supportive environment needed by entrepreneurs during early stages. Such institutions are expected to provide the finance, business, and technical support needed in turning innovative technological ideas into a commercialized product.

It is generally assumed that incubators do actually provide hands-on support to incubatees. However, that the failure rate observed among high-technology start-ups is quite high points to problems related to the incubator and/or incubatee. This paper aims to obtain insights with regard to these problems on the basis of a conceptual model called the Incubatee Hatching Process (IHP). The “chick hatching” metaphor provides many useful insights into how a start-up business could be nurtured. This metaphor was originally developed by Joe Mancuso to study the development of business incubation in the period

1950–57 in New York. The metaphor was utilized to study how the firms were nurtured during the incubation process.

This metaphor is used in the present paper to identify the following six stages: (1) preparation for start-up; (2) incubation process; (3) performance measure of incubatee; (4) exit policies; (5) parental care; and (6) disconnect incubator. Evidence of these stages is obtained through four case studies of incubatees in Hong Kong Science Park (HKSP). It is found that the personality traits of the founding entrepreneur can have a positive impact on the firm's growth performance. In particular, this paper focuses on the following four dimensions: entrepreneurial personality, motivation for starting a new venture, business managerial skills, and approach to innovation.

In Hong Kong, over 98% of the local economy is composed of small and medium-sized enterprises (SMEs). SMEs are defined as manufacturing enterprises with fewer than 100 employees and non-manufacturing enterprises with fewer than 50 employees.[1] The Hong Kong Productivity Council (HKPC) has been conducting a survey on "Business Operating Environment Index of SMEs" that presents an analysis of SMEs' expectations of business growth and profit for the next 12 months.[2] Further, the majority of the SMEs in Hong Kong were originally developed through individual entrepreneurship. Clearly, entrepreneurship plays a key role in Hong Kong's economy, especially in high technology–driven small firms. Thus, the Hong Kong government has established a science park to provide a hub for assisting technology start-up services and supports through a 3-year incubation program.

This paper starts with a review of literature in section three. It describes the linkage among entrepreneurship, technology and business incubation. Four sets of attributes (see Fig. 1) will be used to predict the performance of high-technology ventures in section four. The proposed research framework (see Fig. 2) is based on certain generally accepted notions drawn from the literature (section three). In section five, the notion of what has been learnt from the origins of business incubation will be illustrated by the IHP model (see Fig. 3). Section six describes the case studies of four firms being incubated by the HKSP.[3] Both graduated firms and firms currently being incubated are included. Structured interviews and open-ended questions were used to collect data. The last two sections are dedicated to discussion, and the summary and conclusions.

Literature Review

Entrepreneurship, Technology and Business Incubation

Entrepreneurship plays an essential role in a modern economy. It is essential for economic growth. According to OECD (1998: 41), entrepreneurship creates jobs and wealth. Hisrich and Peters (2002) note that an entrepreneur is one who brings all kinds of resources into combinations to achieve greater value. The entrepreneur must possess the characteristics needed for withstanding the challenges that come along during the

1. SMEs in Hong Kong, SME Information Centre, http://www.sme.gcn.gov.hk
2. Hong Kong Productivity Council, "Local SMEs Cautious Towards Hong Kong's Business Operating Environment," press release, July 18, 2002, http://www.hkpc.org.hkpc/html/
3. In the Hong Kong government the concept of a business incubation program was introduced in 1992. The project of HKSP establishment is divided into three phases to be completed by 2009. The program aims to encourage and promote innovation-based entrepreneurial activities by providing technology-based service to assist technology start-ups in their early stages. High technology defined by the incubation program in HKSP refers to industries: biotechnology, electronics, IT & telecommunications, precision engineering, and others. http://www.hkstp.org.hk

entrepreneurial process. Entrepreneurs are those people who are ready for changes. They must be capable of exploring new ideas so that their businesses could survive and grow in the modern, constantly changing world. According to Schumpeter (1934: 132), entrepreneurs are defined as individuals who make an effort to "reform or revolutionize the pattern of production by exploiting an invention or untried technical possibility for producing a new commodity or producing an old one in a new way." In other words, entrepreneurs are those people who are ready to bring about changes to explore new ideas on their businesses leading to survival and growth in this changing world. Gartner and Shane (1995: 291) point out that Schumpeter had also argued that variation in rates of technological change drive changes in the rate of entrepreneurship because entrepreneurs take advantage of exogenous technological changes to create new combinations of resources. Further, this technological change is influencing the propensity to engage in entrepreneurial activity.

By encouraging and promoting high technology–based entrepreneurial start-ups, business incubation becomes a tool to foster economic growth. According to OECD (1999: 7–8), business incubators aim to assist entrepreneurs with enterprise start-ups and development by providing financing, business and technical supports. Rice (2002: 165) mentions that incubation offers opportunity to create new industries and enterprises and aims at increasing the formation, survival, and success rates of small and medium enterprises. He concludes that business incubation can be a useful tool in nourishing entrepreneurship. However, there is much evidence of a high failure rate among new high-technology ventures that does not entirely support these views. Wellborn (2001, p. 5) has suggested that the most common causes for small business failure lie in the business incubators' assistance programs. One reason for failure is that the incubatees overestimate their personal strengths while underestimating their weaknesses. A strong intention towards entrepreneurship is an important element influencing the success of their businesses.

The Proposed Conceptual Framework on Entrepreneurship and Incubation

Personal Traits of Entrepreneurs and Motivation of Starting a New Venture

The French term "entrepreneur: was originally directed towards one who "entered and took charge" of royal contracts (Legge and Hingle, 1997). Subsequently the term was used to describe enterprise founders intending to take charge of all business projects in managing business and uncertainty. A successful entrepreneur should have many special qualities since he/she is the final decision-maker (Say, 1971). Therefore, certain kinds of personality traits should be possessed by the entrepreneur. The traits are derivable from theories most commonly applied in research on entrepreneurship, e.g., McClelland's (1961) theory of the need to achieve, and Rotter's (1966) locus of control theory. According to Gray (1998), both entrepreneurs and small business managers tend to score highly on various tests designed to measure both the need to achieve (*n-ach*), and locus of control when compared with most other groups of employees or non-business populations.

An entrepreneur must have the ability to effectively deal with uncertainty while creating a new venture. Risk-taking is an important part of personal growth and is useful in conducting business activities (Wadhaw et al., 1998) An entrepreneur must not only have the risk-taking intention, but also have innovativeness to generate new ideas concerning the product, process, or service being offered. Ward (2003) suggests that a successful entrepreneur must generate valuable ideas for new goods or services that target an identifiable market with potential opportunities. Business founders should also be able to

evaluate themselves honestly (self-evaluation). However, even though someone has demonstrated a high score on entrepreneurial personality, it does not mean that he/she will become an entrepreneur without having a definite intention of becoming one.

During the evaluation process of incubation program applicants to the HKSP, the park requires them to submit solid business plans stating their respective business goals, objectives and missions, etc. It also guides all organizational members in taking responsibility for identifying their respective strategic directions. According to Lipton (2003), a mission is only about what an organization does, while vision is about purpose.

At the same time, a strong internal motivation of the entrepreneur is required to activate the alarm for starting a new business. A positive attitude towards entrepreneurship and personal desire to succeed are essential. As for the long time development of a new business, the business founder is required to invest persistent effort in order to achieve organizational strategic direction and goals. Since business development is full of challenges in contemporary industry, a clearly defined organizational strategy is necessary for accomplishing the firm's goals.

Business Management Skills

A business founder possessing only the needed personal traits and entrepreneurial motivation but not the management skills needed is like a baby bird with wings but still unable to fly. Chell and Allman (2002: 71) mention clearly that management skills assist entrepreneurial success. According to Drucker (2001: 8), not knowing how to manage is the single largest reason for the failure of new ventures. This study will investigate, through case studies, several aspects (see Fig. 1.) related to the management of a new venture including the ability to cope with uncertainty.

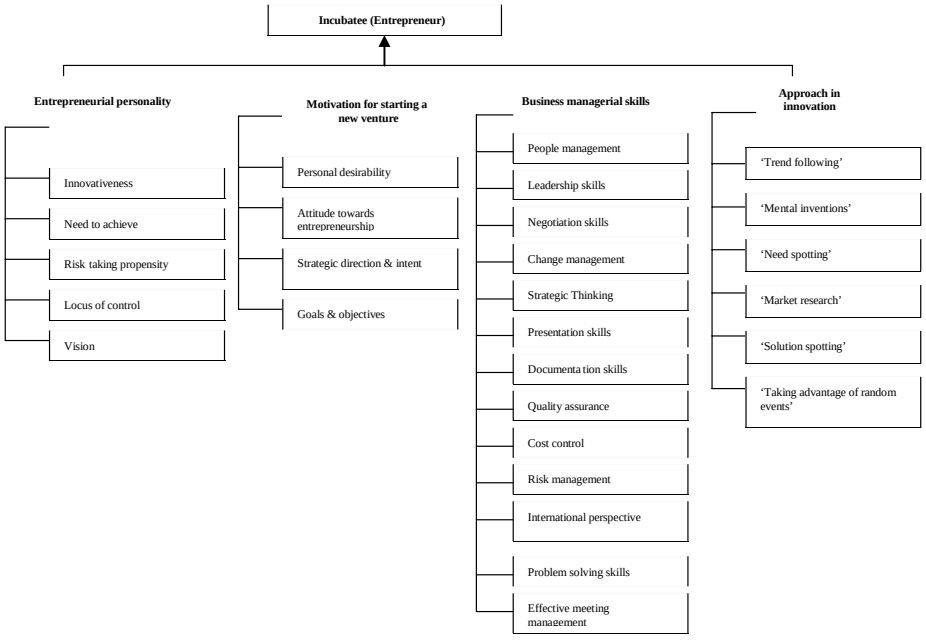

Figure 1. Four dimensions to be investigated in this study.

Lehmann et al. (2003) have recently plotted the success-to-failure rate of six different idea factors from 197 product innovations, of which 111 were successes and 86 failures: (1) trend following ("me-too" approach); (2) mental inventions; (3) need spotting; (4) market research; (5) solution spotting; and (6) taking advantage of random events. They observe that successful innovation is usually associated with the following features: they were moderately new to the market, based on tried and tested technology, saved money, met customers' needs and supported existing practices. In contrast, the products that failed were based on cutting-edge or untested technologies, followed a "me-too" approach, or were created with no clearly defined solution in mind. Among these six different idea factors, the two worst features were trend following and mental inventions. Both these were associated with just twice as many successes as failures whereas market research generated four times more, and solution spotting seven times more successes than failures. The winner was "taking advantage of random events," which generated 13 times more successes than failures. These six types of approaches are applied in the present case studies.

Performance Measurement of Start-up

Neely (1998: 1–6) mentions that measuring performance is essential for business because managers want to know how well their organizations are performing. This helps to determine what to do next. In other words, one needs to go beyond the past and present performance of the firm by examining the purpose of perceiving improvement during business development. As Drucker (2001: 22) has mentioned, it is not necessary for a business to grow bigger but it is necessary that it constantly grow better. Vause (2002: 231) also points out "growth is often seen as a good measure of corporate success." But, the problem is that an entrepreneurial start-up has little history to rely upon. For example, one does not have access to profit histories from the initial years of existence due to large initial capital investments (i.e., one still is in the phase of negative cash flow). However, since the new product is launched to market, one does have access to data on sales and employment growths. Thus, growth of sales is generally used to measure the growth of business start-ups (Cooper, 1993; McGee et al., 1995; Mian, 1997; Robinson, 1998; Covin, 1999; Laitinen, 2002; Kakati, 2003) as well as employment growth (Cooper, 1993; Smallbone et al., 1995; Mian, 1997; Watson et al., 1998; Löfsten et al., 2002; Laitinen, 2002).

The research presented in this paper are based on the framework shown in Fig. 2. Note

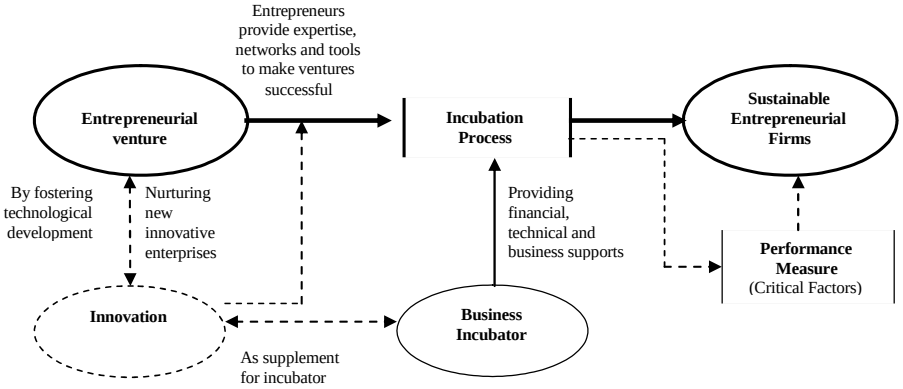

Figure 2. A proposed research framework for business incubation.

that the framework includes the various crucial elements identified in literature related to business incubation. The incubator provides financial, technical and business supports as well as the expertise, networks and tools needed for ensuring the success of a start-up venture. In addition, it fosters technological development through the creation of an environment conducive to innovation.

A Conceptual Model of Incubatee Hatching Process (IHP)

A Historical Review of Business Incubation

The notion of business *incubation* was originally proposed by Joe Mancuso in 1952 from chick incubation in Batavia, New York (Hayhow, 1996). Since the heavy-equipment manufacturing was pulled out of Batavia, Mancuso tried to fill the shell left behind by people who would hire other people. A Connecticut-based chicken hatchery happened to be one of the first businesses he had recruited. Thus was born the Batavia Industrial Center (BIC). The resources and services provided by the center included low market rent real estate, shared office services, capital raising, and business advice. The idea was to foster the growth of new small businesses that would in turn create new jobs and reinvigorate the local economy. Eventually, this work led to the new concept called *business incubation*. The chick-hatching process is used in this paper as a metaphor leading to the Incubatee Hatching Process (IHP) model.

Metaphorization

The word "metaphor" comes from the Greek *metapherein*, meaning "to carry over," "to transfer." Metaphors are used in literature to clarify a situation or notion. However, they cannot tell the whole story. According to Lakoff and Johnson (1980), a metaphorical concept could keep us from focusing on other aspects of the concept that are inconsistent with that metaphor. However, according to them, "if we are right in suggesting that our conceptual system is largely metaphorical, then the way we think, what we experience, and what we do every day is very much a matter of metaphor." Schön (1963) explains that a metaphor works by treating something unfamiliar as something familiar, thereby changing our understanding of both in the process. These observations suggest that employing metaphors is a useful way of interpreting complex concept into simpler understanding.

Schön also thinks that a metaphor can contribute by generating new concepts: "a way of treating the new as old, neither comparison, nor error, nor the application of concepts to instances, but a displacement of old concepts to new situations resulting in extension of the old." This implies that new concepts can be developed from our daily life experience. Likewise, Zikmund (1982) proposes that a "metaphor is a figure of speech in which one thing is likened to another.' Hunt and Menon (1995) use metaphor-writing to describe marketing strategies. They explain that a metaphor may be used to "stimulate the kinds of creativity that will lead to long-term, systematic, programmatic research." One of the metaphor sources they suggest is organism. They mention that many writers use "firm is organism" metaphor because this metaphor is capable of describing a company's growth in terms of life-cycle, growth, adaptation, nutrition, niche, environment, resources and progress, etc.

This paper follows the metaphorical approach by examining what can be learnt from the artificial chick hatching process—a kind of biological process. It will be shown that the metaphor is capable of yielding a conceptual model (called IHP in this paper) that provides insights into how a start-up business could be nurtured from its pre-startup stage until entering the competitive world.

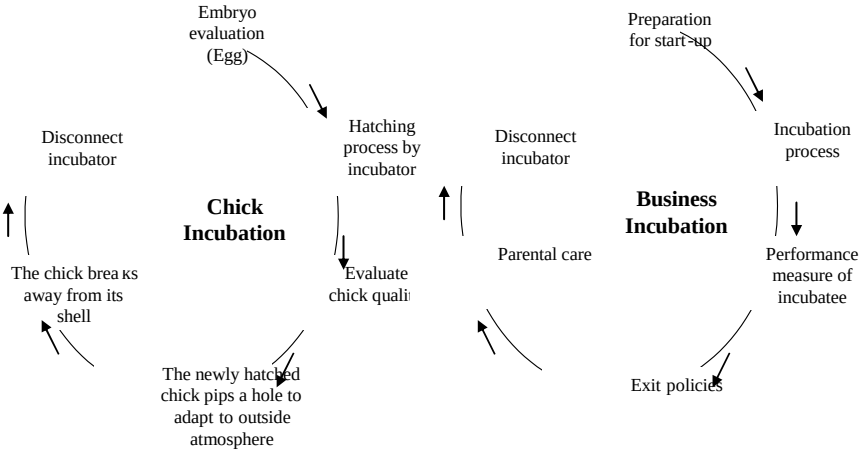

Figure 3. Six stages of chick incubation and business incubation.

Chick Hatching Process and Business Incubation Metaphor

The Oxford Dictionary defines hatching as a process by which "a young bird, fish, or reptile emerge[s] from its egg" (Pearsall, 1998). In zoology, chicks are categorized as oviparous animals, i.e., they are produced by means of eggs which are hatched after they have been laid by the parent, as in birds. There are two distinct types of chick hatching or incubation processes: natural and artificial. Artificial chick hatching is a well-understood process involving a series of complex steps. The metaphor of artificial chick-hatching is therefore used in this paper to model business incubation.

The degree of success in chick-hatching is indicated by the proportion of eggs laid that eventually hatch (Ainley, 2002). With respect to natural incubation, Ainley claims that assuring hatching success is not a simple task because of the need to prevent freezing and maintain warmth. Natural incubation is not capable of reducing eggs lost owing to variations in the natural environment. The variations determine whether the embryo lives or dies. In contrast, artificial incubation provides an indoor stable environment for hatching with optimal physical factors such as temperature, ventilation and humidity control.

As illustrated in Fig. 3, there are six development stages in artificial chick-hatching: embryo evaluation, hatching process by incubator, evaluation of chick quality, the process where the chick pips a hole to adapt to the outside atmosphere, the process by which the chick breaks away from the shell, and disconnection of the incubator. This paper applies the artificial incubation as a metaphor for business incubation under the oversight of an organization such as a science park providing incubating facilities. In addition, we consider the value provided by the process. Increasing the return of profit is the key value for the artificial chick hatching process. It extends the related notion of hatchability to business incubation.

The Six-stage IHP model

Stage 1: Preparation for Start-up

Before incubation starts, we must evaluate whether the egg is fertilized. Unfertilized eggs are not ready for incubation. Similarly, entrance evaluation could be provided to assess the incubation program applicants on the basis of the desirable personal traits of the business founders with regard to entrepreneurship (see Table 1.).

Table 1. Background information of the four cases

	Firm A	Firm B	Firm C	Firm D
Incubation background: Firm history	Sustaining business over 5 years after incubation program			Now being incubated
Field of industry	IC Design	Software & System	Video electronic technology	Software Development
Sector categorized by HKSP	Electronics	IT & Tele-communi-cations	Electronics	IT & Tele-communi-cations
Personal data:				
Family business background	Self-employed	Others	Self-employed	Self-employed
Management exper ience	26 years	12 years	20 years	5 years
Education level	Master's Degree	Tertiary School	Master's Degree	Bachelor's Degree

Generally, it is expected that an incubator supports the incubatees in commercializing their products or services. However, in practice, some incubates succeed while many others fail. We will present case studies to understand this phenomenon and to present information on enhancing business performance growth.

Stage 2: Incubation Process

Once they have started their operations, the successful applicants will attempt to progress towards graduation. Here, it is important that the pace of progress is not too fast. A rushed incubation process can turn out to be harmful in terms of performance. In artificial chick-hatching, normal embryonic development is possible only within a narrow range of temperature. Overheating will damage chick growth. Just as different poultry species need different incubation times and optimum conditions, different types of high-technology start-ups need different conditions.

Stage 3: Incubatee Performance Measures

During chick-hatching, the eggs are tested at specific times to determine whether the embryo will live or die. With respect to business incubation, performance measures can be used as a means of control (Neely, 1998). Incubatee performance measures help understand where their incubatees are now and how their performance could be improved.

Stage 4: Exit Policies

The purpose of incubation is to ensure proper management of as many offspring as possible. Owing to the high sensitivity of hatched eggs to temperature variation, the incubator must have sufficient knowledge about the hatching process. Likewise, an experienced business incubator should be capable of providing professional knowledge and experience to nurture incubatees towards graduation.

Stage 5: Parental Care

Young birds pip their way through the shell in two stages: piping a hole to acclimatize its lung to the outside atmosphere; and then freeing themselves from the shell by a

vigorous shove. A short rest is taken between the two stages for energy storage. Analogously, not every graduated incubatee may have gained sufficient maturity to operate its business independently. An extended period of parental care can make them stronger in competing with others.

Stage 6: Disconnect Incubator

After the parental period, the chick keeps chipping at the shell to break off the eggshell and emerge as an independent chick. Finally, the business incubatees are ready to become an independent firm to enter the competitive world.

Case Studies on Sustainable Hong Kong Incubatees

Methodology and Samples

Exploratory cases on sustainable Hong Kong incubatees were conducted during the pilot test phase of the study. Data were collected through in-depth interviews based on structured questions. A structured interview is suggested as a method of collecting data by asking the selected participants with preset closed or fixed alternative questions (Dwivedi, 1997: 101; Hussey, 1997: 156). The data collected from the interviews consisted of direct quotations from the business founders about their experiences, opinions, feelings, and knowledge (Bryman and Burgess, 1999). The questions queried the interviewees about how they would sustain their respective businesses. All interviewees were business founders of high technology–based incubated firms under the incubation program provided by the HKSP. Founders of both graduated firms and of firms currently under incubation were interviewed. Firms belonging to the following four categories were included: electronics, information technology & telecommunication, biotechnology, and precision engineering. However, in this paper, we focus on two cases belonging to the electronics sector and two belonging to the IT and telecommunications sector. A common set of open-ended questions were presented to the interviewees to elicit discussions on the natures of the incubated firms. All conversations during the interviews were either taped or written down for later transcription.

The structured interviews aimed to identify the critical factors for sustaining an entrepreneurial venture in four dimensions: entrepreneur's personality, motivation for starting the entrepreneurial venture, management skills, and approach on product/service/market/process innovation. Respondents indicated on a 7-point scale the degree of disagreement or agreement to each item, where 1 represents "strongly disagree" and 7 as "strongly agree." Certain statements were negatively phrased to prevent respondent fatigue. The scores for related items were added up to arrive at a summated score for each attribute of entrepreneurs' characteristics. To avoid the problem of different numbers of items in each attribute, we normalized the scores of all attributes for easy comparison. Then, we used unfolding analysis to distinctly identify the strengths and weakness of the four business founders. In the 7-point scale in this study, "4" represents a neutral disagreement or agreement to the statement. We subtracted all the normalized scores by 4, either negative or zero or positive results were shown finally (see Table 2.). As seen in Table 2, we simplified the data by using "+" to indicate a stronger intention of the entrepreneur than the neutral, "N" to indicate a neutral response, and "-" to indicate a weaker than neutral intention. This evaluation matrix idea is inspired by a technique used elsewhere with regard to product design specification activity (Institution of Production Engineers, 1984). The technique enables a preliminary comparison of the cases. Thus, scores represented as +'s, -'s,

Table 2. Evaluation matrix for the cases

	Firm A	Firm B	Firm C	Firm D
Entrepreneur's characteristics				
Global innovativeness	-	+	+	+
Need to achieve	+	+	+	+
Risk-taking propensity	+	+	+	+
Locus of control	-	-	+	+
Vision	+	+	+	+
Motivation for starting a new venture				
Personal desirability	+	+	N	+
Attitude towards entrepreneurship	-	+	N	+
Strategic direction and intent	+	+	N	+
Goals and objectives	+	+	+	+
Summation of "+"	**6+**	**8+**	**6+**	**9+**
Summation of " -"	**3-**	**1-**	**0-**	**0-**
Management skills	Risk taking (-)	Negotiation skill (-); Cost control (-); Risk taking (-)	Cost control (-)	Negotiation skill (-); Cost control (-); Documentation skill (-)
Approach applied on product/service/market/process innovation (From the study of Franklin, 2003)	"me-too" approach	Random events	Doing market research but not following the trend	Doing market research and following the trend
Success-to-failure rate on six idea factors of innovation from Franklin	3 times as many failures as successes	13 times more successes than failures	Not mentioned	4 times more successes than failures
Business Performance: Sales growth *(during 3-year incubation period)*	High -> Low (dramatic drop)	Low -> High	NA	Low -> High
Number of employment *(between the time entered the HKSP and currently employed)*	Increased from 2 to 5	Increased from 10 to 53	Decreased from 3 to 2	Increased from 3 to 7

and N's are used for evaluating the business founders and predicting their business success or failure during the early start-up periods.

Entrepreneurial personality was measured by five scales, which pertained to global innovativeness (5 items) from Goldsmith and Freiden (1995); need to achieve (3 items) from Diochon et al. (2002); and risk-taking propensity (3 items), locus control (2 items) and attitude towards entrepreneurship (3 items) from Lüthe and Franke (2003).

Motivation for starting a new venture was measured by items from four scales, which

referred to personal desirability of starting a business (4 items) from Diochon et al. (2002); and strategic direction and intents (3 items), goals and objectives (5 items), and vision (5 items) from (http://www.denisonculture.com).

Case Studies of Four Incubatees in Hong Kong

To investigate the influencing factors for enhancing new high-technology entrepreneurial venture performance, four incubated firms were chosen to represent different fields of industries including IC design, software and system and video electronic technology. An incubation manager from the HKSP was asked to provide a contact list of incubation applicants; the participants include graduated firms and non-graduated firms and discontinued firms. As a result, only four of them were willing to conduct the in-depth interviews. The case studies included analyses on their growth histories from inception to recent years. The graduated cases have been established over five years. One of them has been in the program since 2001.

This exploratory case study investigated new small venture performance growth as influenced by the entrepreneur's personality, management skills as well as approach on product/service/market/process innovation. The entrepreneur's personality is measured by global innovativeness, need to achieve, risk-taking propensity, locus of control, and vision. Motivation to start the venture was measured by personal desirability, attitude towards entrepreneurship, strategic direction and intent, goals and objectives. Business management skills were measured by people management, leadership skills, negotiation skills, change management, strategic thinking, presentation skills, documentation skills, quality assurance, cost control, risk management, international perspective, problem solving skills and effective meeting management. Approach to product/service/market/process innovation was measured in accordance with the work of Franklin (2003) incorporating six levels: (1) "I am a trend follower, followed a 'me-too' approach"; (2) "I always have many things dreamed up in the head with little reference to the outside world"; (3) "I am often actively looking for an answer to a known problem"; (4) "Most of my ideas have resulted from market research"; (5) "I usually find a new way of using an existing piece of technology"; and (6) "I always immediately recognize the significance of random events at serendipitous moments." Finally, business performance was measured by sales growth and employment growth from the time the founder had entered the incubation program until the current time (the time of the structured interview) as well as expectations for the next three years.

Cases and Analysis

Case 1: Graduated Firm A (IC Design)

Business founder A was educated in the US with 26 years of managing experience in industry. He started his new business of IC design through the incubation program of HKSP. To be a successful entrepreneur and to let his business go public defined his initial motivation for starting his entrepreneurial venture. Analysis of the data obtained through structured interviews showed that founder A had the lowest score with respect to innovativeness among the four cases. He is reluctant about adopting new ways of doing things until he sees them working for people around him. He rarely trusts and is generally cautious about accepting new ideas and new innovations before he sees the vast majority of people around him accept them. He tends to feel that the old way of living and doing things is the best way. He tends to be a trend follower and follows the "me-too" approach towards product/service/market/process innovation. That may be one of the reasons why

his sales dropped dramatically in recent years. He doesn't seem to realize that improved, new or innovative ideas cannot be neglected in the contemporary competitive environment. Further, he shows a positive intention to direct his own business towards a long-term strategic plan rather than to pursue another promising career. His self-evaluated result shows that, except with regard to risk management, he is generally capable of managing business. Interestingly, although he gets full score on risk-taking propensity, he has a problem on managing risk.

Case 2: Graduated Firm B (Software & System)

The business of firm B is to design customized software and system development. It is a tailor-made business style since each product development is served for a specific customer. From the structured interview, it became apparent that he has a moderate intensity of entrepreneurial personality—especially in innovativeness. He is always trying new things and new ways of doing something. From his self-evaluation of approach to innovation, it appears that he usually finds a new way of using an existing piece of technology and always immediately recognizes the significance of random events at serendipitous moments. Recall the observation of Franklin (2003) that those who had taken advantage of random events had generated 13 times more successes than failures. Founder B said that his motivation for starting his business had come from his interest in changing the industry to suit the new era.

On the other hand, he has obtained comparatively lower scores with respect to negotiation, cost control and risk management skills. He said he only needs a personal computer when starting his new venture. The basic investment in his venture is low in comparison with the investments required in other industries. Thus, cost control is not a key concern for his business. However, as his business becomes bigger, one can expect that cost control will become a critical factor in predicting final costs of each project, establishing contract price and budgets and revising the cost estimates periodically.

Founder B identified the key concern for his business success to be people management since his is growing bigger both in Hong Kong and mainland China. He uses a variety of performance tools to measure his employees' current working performance with respect to whether they can meet their target goals on time and in accordance to the stipulated strategic direction. Further, he wishes to put effort into effective communications and feedback, instilling trust, promoting open and honest communication, and providing clear job assignments to subordinates.

Case 3: Graduated Firm C (Video Electronic Technology)

Founder C obtained a moderate score with respect to entrepreneurial personality attributes. His intention to start his entrepreneurial venture stemmed from his desire to do something related to his expertise. Among the four founders, he obtained relatively low scores with respect to personal desirability and attitude towards entrepreneurship. He strongly believes that being self-employed is not the only way to make big money.

Although he evaluates himself at the highest level of generating new ideas by immediately recognizing the significance of random events at serendipitous moments, the fact that his company exhibited the least growth in number of employees among cases studied does not support his evaluation. Further, although founder C invested relatively heavily in market research, he does not appear to be fully satisfying customers' needs. He likes to do something different from what the trend demand suggests.

Case 4: Being incubated Firm D (Software Development)

Firm D is now being incubated in the HKSP. Among the four attributes of entrepreneurial personality, founder D obtained the highest score with respect to locus of control and vision. On the other hand, he obtained the lowest score with respect to need to achieve. This indicates that he is able to do his best in whatever work he undertakes to meet his long-term strategic direction and goals. He welcomes criticism from others. He strongly feels that his long-term viewpoint and his vision create excitement and motivation for his employees. Further, he is confident that he would succeed if he started a firm with highly personal desire and attitude towards entrepreneurship. He uses market research to identify market trend and uses this information to define his approach towards product/service/market/process innovation.

Furthermore, since founder D has comparatively shorter management experience (just one year), he has opportunities to improve his management skills by exploiting incubator support—especially with respect to negotiation, documentation, and cost control skills. One cannot be good at making decisions, costing, scheduling, and managing legal matters without good documentation support. Further, documentation skills can be very useful while resolving disputes with people such as customers and business partners through negotiation. As his business grows through incubator support, founder D will have control costs through the adoption of weighting-scale, cash flow, and cost-benefit analyses.

Discussion

The results of this study indicate that entrepreneurial dimensions influenced incubated firm performance. The study initially established that better firm performance is positively associated with incubated firms' founders possessing entrepreneurial personality such as need to achieve and risk-taking propensity. This is not surprising within the domain of entrepreneurship research on new venture development, because it confirms what other scholars have discovered (e.g., Carsrud and Krueger, 1995; Crant, 1996; Elfring and Hulsink, 2003; Littunen, 2000; and Deshpande et al., 1993). However, absence of studies have demonstrated an ability to explain variation in incubation outcomes. Most important, such findings have made a great contribution regarding the objectives of business incubation, in particular, development of incubatees.

We can see from Table 2 that firms B and D are comparatively high-potential firms having positive performance growth. They have exhibited rapid growth of employment and positive sales growth. Although founder B's initial motivation of starting an entrepreneurial venture is not to be an entrepreneur, he expects to make money by pursuing his interests. He has a dominant and innovative personality combined. He recognizes random events while defining his approach towards product/service/market/process innovation. He wants to do something different from the existing competitive world. His innovative thinking can be his asset.

According to Franklin (2003), successful innovations exhibit some, or all, of the following features: they are moderately new to the market, they are based on tried-and-tested technology, they save money, they meet customer's needs, and they support existing practice. When Franklin's team plotted the success-to-failure rates corresponding to each of the idea factors, they found that "taking advantage of random events" had generated 13 times more successes than failures. However, founder A has a comparatively low score on innovativeness. He is a "me-too" follower, who created products or services with no clearly defined solution in mind. Franklin (2003) defines trend following and mental inventions as

the two worst factors from the viewpoint of success-to-failure rates. Both produced three times as many failures as successes (*The Economist*, September 6, 2003: 3). Herein might lie the reason for the dramatic drop in sales exhibited by founder A's firm.

Founder D had a strong entrepreneurial motivation while starting his venture. For him, starting a business was much more desirable than pursuing other career opportunities available to him. He believes that he can make big money only by being self-employed. He is confident in his ability to face challenges and he is ready to undertake whatever is necessary to establish his own business. His approach to product/service/market/process innovation is based on ideas generated through market research. Recall the observation of Franklin (2003) that market research can generate four times more successes than failures. The result from market research gives one an idea about customer needs and the trend. Thus, market research has helped founder D in coming up with new ideas for developing customer-oriented products within two years from start up.

Cost control skill, risk taking skill and negotiation skill are the weakest business management skills exhibited by all four firms studied. Not only young are firms like firm D not doing well with respect to cost control skills, but so too are mature and sustaining firms like firms B and C. These firms are weak in predicting final costs of a project, establishing contract price and budgets, and revising the cost estimates periodically. Founder C in particular needs to pay greater attention to cost control skills since he has a tendency to develop products in the absence of due market research. In the absence of a customer-oriented concept, it is difficult to create a new market for products or services. Surely, an entrepreneur must have a risk-taking propensity, but the skills needed for handling risk are also important. However, firms A and B have exhibited low scores with respect to risk management. They need to strengthen their risk management skills through quick and intuitive identifications, or through risk analyses and prioritization.

Summary and Conclusions

This paper has provided a framework for a business incubator from the viewpoint of assessing the business potential of applicants entering an incubation program. The IHP model illustrates the life cycle of business incubation and provides valuable insights regarding how a start-up can be nurtured by an incubator. In this paper, four sustainable Hong Kong firms incubated by Hong Kong Science Park have been studied to assess their growth performances. It is found that different performance growth patterns of incubated firms vary according to (1) entrepreneurial personality, (2) motivation to start a venture, (3) management skills, and (4) approach towards product/service/market/process innovation of the business founder. The proposed research framework has enabled the measurement of the performance of new entrepreneurial ventures during and after the incubation process. Performance measurement is becoming an essential and globalized issue in contemporary industry. The new framework and the associated evaluation matrix have been able to explain the survival of the firms studied within the local market. They have also explained the differences in business growth. It is found that the more '+'s the founder has obtained, the more positive is his firm's business performance, and vice versa (see Table 2). These four case studies have provided preliminary evidence that an analysis of the founder's personality traits can be of great help in assessing the performance of an incubatee. The findings should be useful to incubator institutions in evaluating applicants for the purpose of granting entry to the incubation program. The proposed framework also provides the incubator institutions with a diagnostic method that can identify the weakest of the incubatees. Having identified the weakest, the incubator can take the actions (such

as providing the necessary training) necessary to make the incubatee become strong and, thus, enhancing its sustainability.

Some broad implications of the study are as follows:

- For entrepreneurs who only possess a positive attitude towards entrepreneurship but lack significant innovativeness, their business growth will tend to drop.
- The six different idea factors with respect to product/service/market/process innovation approach (Franklin, 2003) constitute an important aid in assessing the innovative personality of the entrepreneur or incubation program applicant. For instance, if the applicant exhibits a higher propensity to take advantage of random events and a higher positive score with respect to innovativeness, one can expect that the business has a higher potential to grow.
- Practical skills related to risk taking, negotiation and cost control are important in enhancing the business growth of new ventures.
- An understanding of what innovation is and how it is useful in developing customer-oriented products or services has significant bearing on a new venture's business success. Market research is a way for a venture founder to get information about the market trend and customer needs so that he/she is able to generate new ideas while delivering customer value.

The findings from this paper seem to lead to the following preliminary but generalizable propositions with respect to incubated high-technology start-ups:

P1: Personality traits such as innovativeness, need to achieve, risk-taking propensity, locus of control and vision of the founding entrepreneur will be positively related to the business performance.

P2: Pre-founding entrepreneurial potential of incubation program applicants may enhance the number of sustainable new entrepreneurial ventures.

P3: The approach towards product/service/market/process innovation exhibited by the founding entrepreneur will significantly affect the business performance.

P4: Well-developed managerial skills of the business founder will enhance the business performance particularly at the beginning of the start-up.

*P5: Products and services derive*d from a greater customer-oriented culture will enhance the business performance.

Several problems and limitations associated with this admittedly preliminary study need to be noted. Firstly, the study is based on just four case studies. Hence the statistical significance of the findings is not clear. Further work involving more case studies should therefore be welcome. Secondly, all cases studied pertain to firms being incubated by HKSP. Hence the generality of the findings can be questioned. Future studies involving other incubating organizations should therefore be helpful. However, it must be noted that researching these issues is complex mainly because of the paucity of previous work examining business performance in the specific context of business incubation. Finally, with regard to the conceptual metaphorical IHP model, we have explored only a part of the first stage: start-up preparation. The next five stages will need to be studied through further research. It may also be noted that the respondents in this study commented that the questionnaire supplied to them was overly long. Future researchers could consider a shorter but equally effective questionnaire.

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