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Assessing The Impact Of University Technology Incubator Practices On Client Performance

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ASSESSING THE IMPACT OF UNIVERSITY TECHNOLOGY INCUBATOR PRACTICES ON CLIENT PERFORMANCE

by

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ABSTRACT

This research is designed to distinguish and describe or explain incubator practices that affect the performance of incubator clients of university technology incubator programs. The research focuses on understanding which practices significantly contribute to increasing job creation for the firms located in university based technology incubators.

An increasing number of communities are embracing economic development strategies that target the high tech sector with high wage, high value jobs as a way to diversify their economies and boost local and regional economies. New economic development strategies include the notion of a creation strategy or "growing your own" instead of relying on recruiting of existing companies from other regions. In 1999-2000 (according to the most recent data), small businesses created three-quarters of U.S. net new jobs (2.5 million of the 3.4 million total). The small business percentage varies from year to year and reflects economic trends. Over the decade of the 1990s, small business net job creation fluctuated between 60 and 80 percent. Moreover, according to a Bureau of the Census working paper[1], start-ups in the first two years of operation accounted for virtually all of the net new jobs in the economy.

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[1] Sources: U.S. Bureau of the Census; Administrative Office of the U.S. Courts; *Endogenous Growth and Entrepreneurial Activities.*

I dedicate this to my family: To my parents who made college a reality, both by encouraging me to go and making it possible; to my great kids, Cara, Austin, and Erin that had to sacrifice while I worked on this project; and lastly to my wonderful wife, Jamie, for not only filling in the slack for me all those late nights and weekends but for all the hours of editing to make this a reality.

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LIST OF ACRONYMS/ABBREVIATIONS

NBIA National Business Incubation Association

SBA Small Business Administration

USF University of South Florida

UCF University of Central Florida

UCSC University City Science Center

UNIDO United Nations Industrial Development Organization

UTBI University Technology Business Incubator

NSF National Science Foundation

EDC Enterprise Development Center

SBDC Small Business Development Center

R&D Research and Development

TCE Transaction Cost Economics

NASDAQ National Association of Securities Dealers Automated Quotations

UK United Kingdom

SBDC Small Business Development Center

SCORE Service Corps of Retired Executives

ACE Active Corps of Executives

SBI Small Business Institute

MIS Management Information Systems

IRB Institutional Review Board

SBIR Small Business Innovative Research

URP University Research Park

MBA Masters of Business Administration

NASA National Aeronautics and Space Administration

FTE Full Time Employee

CREOL Center for Research and Education in Optics and Lasers

CFIC Central Florida Innovation Corporation

TRDA Technology Research and Development Authority

PR Public Relations

CEO Chief Executive Officer

COO Chief Operating Officer

CFRP Central Florida Research Park

UCFTI University of Central Florida Technology Incubator

HR Human Relations

IST Institute for Simulation and Training

BDM Business Development Manager

STRICOM Simulation, Training, and Instrumentation Command

VC Venture Capitalist

BDM Business Development Manager

MCF Material Characterization Facility

NCIIA National Colligate Inventors and Innovators Alliance

FHTCC Florida High Tech Corridor Council

ROI Return on Investment

CHAPTER ONE: INTRODUCTION

Economic development targeted to the high tech sector is becoming increasingly more appealing to areas interested in boosting local and regional economies. With the higher than average wage and rapid growth potential typically associated with technology-based companies, it is easy to see why. New economic development strategies include the notion of a creation strategy or "growing your own" instead of relying on what is commonly referred to as "smokestack chasing" (Fredrikson, 2001). Smokestack chasing, the recruitment of companies from other regions, can be a very costly strategy.

According to the National Business Incubation Association (NBIA) Survey of Business Incubators (Linder, 2002), there are approximately 950 business incubators operating in the US today, up from 550 in 1997. New incubators have been opening at the rate of about one per week since 1986. In 2001 alone, North American incubators assisted more than 35,000 start-up companies that provided full-time employment for nearly 82,000 workers and generated annual earnings of more than $7 billion (Linder, 2002). That figure is up from 8,000 start-up firms in 1997. One of the most astounding statistics (Molnar et al., 1997) reported by the NBIA is that nearly 90 percent of firms started through an incubator are still in operation. This compares to an overall national average survival rate of less than 50 percent for the first four years of a company (SBA). If the goal is reduction of infant mortality among new ventures, then many incubators are successful. But this average conveys nothing about the practices that differentiate the most successful ones.

This research is designed to distinguish and understand incubator quality and the performance of technology incubator programs. The answers to this question will better inform economic development officials on how to invest scarce resources. It also seeks to understand and overcome problems with previous evaluative research on business incubation: small sample sizes, selection bias, combining the results from different types of incubators, and the failure to control for the environmental context (Allen and Bazan, 1990; Mian, 1996; Bearse, 1998; Lewis, 2001).

Some of these shortcomings can be addressed by focusing on a specific type of incubator and surveying the entire technology segment of the business incubator industry. A recent survey conducted by the Department of Commerce did just that, focusing on technology business incubators in the United States. Data from this survey will be analyzed to help understand the differences between technology incubator programs with respect to both the size and age of the program, as well as to ensure sufficient distribution across regions.

In the case of technology incubator research, other obstacles exist, including their nascent nature and their limited number (Mian, 1996). The growth of this segment of the industry in the 1990's has increased their numbers, and as we entered the twenty-first century, they have begun to mature.

Communities have three basic economic development strategies:

- Attract existing or expanding companies
- Retain companies
- Grow new companies

To better understand the differences between these economic development stategies, consider the following examples.

In the first case, local communities compete for a new plant, where extravagant baskets of incentives are not unusual in what is often referred to as “smokestack chasing.” In the 1993 Mercedes sports utility vehicle plant bidding war, Alabama out-dueled 34 other states with an incentive package that totaled $300 million, of which infrastructure development, job training, tax concessions, and other perks were included. Similar deals had been struck in Tennessee, where, in 1982, the state offered an incentive package for a Nissan automobile manufacturing plant that totaled approximately $11,000 per created job; in 1987 Tennessee offered Saturn a package more than double Nissan’s package in terms of dollars per created job: $26,000 per job. Both Nissan and Saturn gladly accepted the offers and chose the Volunteer State as their new homes.[1]

Retention can also be very expensive. Consider the example involving Lucent Technology Inc.’s Orlando semiconductor fabrication facility. Lucent employed over 1,500 high tech workers in this facility and was looking to expand. The King of Spain became aware of this and offered Lucent $300 Million to move its entire operation to Spain. Even with the locally rooted manager’s resistance to move, the money on the table was too much to ignore. A counter offer had to be made to keep the company here, even if the offer fell short of the $300M offer.
The State of Florida, local government, and two universities (USF and UCF) pulled together to make Lucent a long term offer that included tax relief on all major equipment, matching funds for equipment purchases if bought through a state university, millions in research at the

universities with liberal intellectual property terms, and the creation of and access to specialized laboratories at UCF and USF such as UCF's Material Characterization Facility.[2]

The offer was good enough to keep Lucent in the Orlando area. Subsequently, the telecom bubble burst and they laid off over 800 employees but are now on the rebound. The interesting part is that they do not have any plans to expand or upgrade the facilities. They are running three shifts now but will most likely close the plant once this product line completes its life cycle.[3]

On the other hand, the cost of creating jobs via a creation strategy that incorporates an incubation program averages $1,100 per job created (Molnar et al., 1997). These companies also establish local roots and are less likely to be recruited out of the area by the next incentive package. The rationale for this practice is that homegrown companies develop the roots and loyalties to communities lacking in transplanted companies. The same study (Molnar et al., 1997) reported that 84% of incubator graduates remain in the area they were incubated in. As these companies go through their ups and downs, it is hoped that they will keep their corporate headquarters in these communities intact during down periods and that other regions will be first in line for cutbacks, layoffs, and other negative actions.

Different tools, strategies, and practices have been developed across the U.S. and the modern world to stimulate or catalyze new company creation. Efforts concentrate on increasing the number of new companies formed as well as increasing the success rate of these ventures. The technology oncubator has gained popularity in recent times as a major tool for increasing the number of successful "homegrown" companies (DeGiovanna and Lewis, 1998).

Technology incubators are found in many places, provide differing levels of services, and achieve varying levels of effectiveness. The number of technology incubators has doubled to nearly 300 since 1997 (Lewis, 2003). However, there has been limited work conducted on how to assess the quality of incubation programs relative to regional development goals. The goal of this dissertation is to develop a framework to assess incubator quality. As will soon become apparent, the quest for a universal set of indicators has not been successful. The variety of incubator goals has thwarted such efforts. To understand the issue, this dissertation will review the developmental history of incubators.

Brief History of Incubation

Webster's Dictionary defines the term incubator as**:**

> "an apparatus by which eggs are hatched artificially b**:** an apparatus with a chamber used to provide controlled environmental conditions especially for the cultivation of microorganisms or the care and protection of premature or sick babies."

The dictionary dates this entry as 1857. Starting in the mid-1980's, editors of the journal, *Frontiers of Entrepreneurship Research*, dedicated a session to business incubation each year at their conference. It is from these sessions that the definition of business incubator used by much of the industry began to emerge. In 1985, three papers presented at the conference asserted that that an incubator must have a physical plant with below market rents, shared services, logistical support, and business consulting services (Gatewood et al., 1985; Allen, 1985; Peterson, 1985).

Building on knowledge from the practice of incubation, Allen and Weinberg (1988) incorporated empirical evidence to show that the industry had shifted its focus to value added business services, away from site development and subsidized rents. In the case of technology entrepreneurs, entrepreneurial training programs and networking opportunities are valued higher than a reduced cost of services or rent (Lichtentein, 1992).

Hackett and Delts (2004), based on insights they acquired from reviewing the literature as well as from conducting fieldwork in Asia and North America, offer the following definition: A business incubator is a shared office space facility that seeks to provide its clients (i.e. ‘‘portfolio’’ or ‘‘client’’ or ‘‘tenant companies’’) with a strategic, value-adding intervention system (i.e. business incubation) of monitoring and business assistance. The incubator can control and link resources that assist in the development of its clients’ new ventures. It simultaneously helps contain the cost of their potential failure. Additionally, they offer the following corollary: When discussing the incubator, it is important to keep in mind the totality of the incubator. Specifically, as a firm is not just an office building, infrastructure and articles of incorporation, the incubator is not simply a shared-space office facility, infrastructure and mission statement. Rather, the incubator is also a network of individuals and organizations including the incubator manager and staff, incubator advisory board, client companies and employees, local universities and university community members, industry contacts, and professional services providers such as lawyers, accountants, consultants, marketing specialists, venture capitalists, angel investors, and volunteers. This suggests that an incubation system better describes how an effective incubator fits into this context.

The National Business Incubator Association website (www.nbia.org) currently defines a Business Incubator as:

> "A dynamic process of business enterprise development. Incubators nurture young firms, helping them to survive and grow during the start-up period when they are most vulnerable. Incubators provide hands-on management assistance, access to financing and orchestrated exposure to critical business or technical support services. Most also offer entrepreneurial firms shared office services, access to equipment, flexible leases and expandable space — all under one roof."

This definition focuses on the "process" of incubation rather than on the incubation facility. It captures the notion of providing a supportive environment for new companies, much in the same context as the original biology based incubator has done in the life sciences. The difference being that the nurturing environment necessary to hatch new companies depends more on a process and services that on the physical environment.

Thus metrics like floor space and space utilization miss the point. The act of mentoring or helping a new company get started has likely been going on for as long as companies have been in existence. The most commonly accepted birth date for formal Business Incubation in the U.S. is 1959, when Joseph L. Mancuso of Batavia, New York opened an 850,000 square feet incubator in a Massey-Furguson facility that had been closed a year earlier (Allen and Bazen, 1990). More incubators followed on a limited scale until 1984 when the U.S. Small Business Administration (SBA) released a study that concluded that the majority of new jobs were being creating by small business. This created a boom for incubator development. At that time there were 20 incubators in operation. In the 1960's and 1970's incubation programs diffused slowly, and typically as government sponsored responses to the need for urban/Midwestern economic revitalization. Notably, in the 1960's interest in incubators-incubation was piqued by the development of University City Science Center (UCSC), a collaborative effort at rationalizing the process of commercializing basic research outputs (Adkins, 2001).

Incubator Trends

The rapid growth of the incubator industry was accompanied by a shift in the relative size of its different segments, with technology incubators rapidly ascending to become the dominant segment of the industry, growing to 40 percent of the population, while mixed-use incubators have declined to 30 percent (Loftus, 2000). Public support for technology business incubators, in terms of funding, is widespread. Over 65 percent of technology incubators receive public funding for operating expenses from the federal, state, and/or local government. If one includes assistance from public universities, the figure rises to 71.2 percent (Quittner, 1999).

Business incubators have a wide variety of structures and supportive mechanisms. Some of the most common are classifications of business incubators defined by sponsors include:

Sponsor Arrangement	%
Nonprofit, public or private	51
Academic related	27
Hybrid: joint effort among government, nonprofit agencies and/or private developers	16
Private, for profit	8
Other sources such as art organizations, private industry councils, church group, chambers of commerce, etc.	5

Source: National Business Incubator Association (Molnar, 1997)

The most common types of firms using business incubators are light manufacturing, technology and service firms, and those developing new products or engaged in research and development. There are a limited number of construction-related, sales and marketing, or wholesale and distribution firms using incubators. A retail operation is considered a poor fit for incubation (Molnar, 1997).

There are a wide variety of reasons for operating an incubator. There may be a need for job creation in the community, promotion of economic self-sufficiency for a selected population group, diversification of the local economy, transfer of technology from universities and corporations, or sharing venture experiences with new companies by successful entrepreneurs and investors. There is no question that whatever the motivation behind the incubator, it is an economic boon for the community, providing jobs and an expanded business base (Molnar, 1997).

Another key ingredient for home grown economic development is entrepreneurship. A pool of entrepreneurial venture starters with the ability to take an idea and turn it into a company is vital. The question many communities face is: is there an entrepreneurial talent-base in their specific region? The effective integration of entrepreneurship, technology transfer, and incubation programs is the goal of many university and community economic development efforts (O'Neal and D'Cruz, 2003).

Business incubation is also increasing on a global scale. The United Nations Industrial Development Organization (UNIDO) actively monitors and promotes the development of business incubators worldwide. They estimate that there are at 500 incubators in developing and transition countries.

The key point is that, given the varied motivations and interest, support structures, and objectives of individual incubation programs, the question of how you measure the quality or success of an incubation program becomes complex. From a purely economic development perspective, the number of new jobs created and the amount of revenue generated by client companies are excellent metrics. If the stated goals of an incubator differ from pure economic development however, these measures may only capture one dimension that may or may not meet the strategic purpose of the program.

The Role of Universities in Incubators

As noted in previous sections, many incubators are sponsored by academic institutions. Others have established close relationships with universities and colleges. Technology incubators, in particular, use universities as a technology source and as a means to provide opportunities for their tenant firms to leverage university research in their commercialization efforts.

In a recent study on the relationship of firm performance and its link to academic institutions, researchers found that growth companies with university ties have productivity rates almost two-thirds higher than their peers (Coopers and Lybrand, 1995a). This result was based on interviews of some 424 product and service companies. Companies that used university resources also project higher annual revenues (21 percent higher), more recent bank loans (32 percent more), and more major capital investments (23 percent more). Of the companies interviewed, 59 percent indicated no relationship with the university.

Growth companies used students as resources. Some 70 percent hired student interns, while 40 percent recruited their employees directly from the student population. Additionally, 44 percent of the firms indicated that they employed faculty as technical resources. In addition to these resources, the growth companies utilized university laboratories and facilities. While the growth companies were satisfied with their relationships, certain barriers existed, including faculty culture, lack of active support for coordinating programs, inappropriate technology or research for business, and lack of expertise in working with growing companies. Overall, approximately 29% of the growth companies indicated that their relationship with a university had been extremely helpful to their company's growth.

Gibson (1988) focused on the role of universities with respect to the commercialization of technology. In this context, he suggested four categories of activities: (1) evaluation of innovations and patent policies; (2) commercialization, innovation and technology transfer; (3) entrepreneurship; and (4) incubator activities and research parks. With respect to incubator activities, Gibson suggests that incubators offer not only general business services, but also direct assistance such as business advisory services, seed money, and assistance in securing venture capital.

Mian (1996) examined six university technology business incubators (UTBI) with respect to their role in the development of new technology based firms and their value-added dimensions of services along with university-related inputs. The study concludes that several UTBI services, specifically some of the university-related inputs such as university images (credibility), laboratories and equipment, and student employees, added major value to the client firms, making the UTBI a viable strategy for nurturing new, high-technology firms.

Mian (1994) examined some 30 university-sponsored technology incubators to assess their performance along organizational, design, tenant performance review, funding sources, targeted technologies, strategic operational policies, services and their value-added components, and growth of the client firms. This study was a comparative assessment of private versus state university-sponsored incubators. The results found that there were no significant differences based on the type of sponsorship, state or private. It concludes that the UTBI's appear to provide an environment conducive to the development of new firms.

Summary

Nearly all researchers emphasize that incubators serve multiple purposes. The question of what factors or conditions are necessary for success is difficult to answer. The real question then is "What is meant by incubator success" and "What is it that the incubator sponsors are trying to achieve?"

Incubator success should be measured against what is trying to be achieved. For example, investment opportunities of tenant firms will not be the same for all types of incubators. Similarly, job creation will not occur at even rates; perhaps the focus of an incubator on new firms in manufacturing versus services may be the main determinant of job creation. To evaluate incubator quality or success, especially in their early stages, one must look more at what milestones have been achieved rather than only at quantitative indicators. Many people, especially in the media, have a tendency to "count jobs," that is, how much employment is created at the incubator. This simplistic approach ignores the fact that employment gains primarily occur if and when the firm graduates from the facility and assumes a more mature market stance. The existence of a graduate is, in fact, an important incubator performance milestone, possibly the most important success measure. Other milestones that Campbell and Allen (1987) proposed examining are: creation of a responsive business consulting network, participation of financial intermediaries in tenant capitalization, the point at which the majority of tenants are start-up firms as opposed to previously existing small businesses, and the synergism that occurs when tenants develop trade relations with one another such as subcontracting and joint purchasing. These types of conditions must exist before success can truly be claimed.

CHAPTER TWO: LITERATURE REVIEW

During the progression through the introspection and preliminary study of incubators, three distinct issues emerged. First, much of this research will be exploratory in nature. Second, this research will focus on technology incubators and third, the research will focus on ascertaining the impact that external relationships have on the success of an incubation program. Thus the literature review consisted of (1) a general review of research concerning incubators, (2) a review targeted at technology incubators, and (3) a review of literature pertaining to networking research. The latter is required because it has become evident that meaningful studies of incubation must be performed in a systemic context.

General Incubator Literature Review

The literature for incubation is new and often ambiguous. To help with this review, the following terms will be used for convenience but no assertion will be made as to their correctness.

Incubator: The term incubator, incubation, and the process of incubation will be used interchangeably. Much of the literature will use the hyphenated term, incubator-incubation but will only be done so here if there is a distinction to be made.

Client: This term will refer to the company being incubated. The term “incubatee” is often used in the literature but client better reflects the relationship. Incubator client will also be used.

Overview of Exploratory Research

This exploratory research of the literature revealed a substantive work in the area of interest but not a lot of depth. Many of the reviews, including this one, sound very similar in many respects, with very little deviation from some of the original work. While progress has been made, especially in the last ten to fifteen years, the problems associated with research in this area remain formidable.

The Council for Urban Economic Development conducted one of the earliest quantitative based evaluations by surveying fifty (50) successful incubators and conducting a stratified analysis of the results (Peterson, 1985) by external affiliation (i.e., public nonprofit, university related, or private) and analyzed the types of firms and their needs relative to the services provided. It concluded that the range of services provided by an incubator program was determined, in part, by the location of the lead organization and targeted clients. This certainly alludes to the difficulty in measuring success or quality given the different activities or service offerings. More recently, analyzing Dun & Bradstreet data on corporate history, Birch (1987) concluded that small entrepreneurial companies created approximately eighty (80) percent of the new jobs in the United States between 1969 and 1976. While many of Birch's conclusions have been challenged, his work has clearly had an effect on public policy (Harrison, 1987; Shahhadi, 1997). This resulted in public policies designed to help small business and help drive the explosion of incubation programs in the U.S. (Osborne, 1990; Harrison, 1997; Eisinger, 1988).

The apparently high new job payoff and its applicability on a regional basis made it important to understand how incubators work and what key factors make it successful. Social scientists and economic development officials have attempted to understand the factors that contribute to successful business incubation, so they can replicate these practices, and have focused their research on successful incubators (Peterson et al., 1985; Campbell et al., 1988; Smilor and Gill, 1986). These published best practices have had demonstrable positive impacts on incubated firms (Kang, 1991; Rice, 1992; Campbell et al., 1988; Lichtenstien, 1992). This section traces the implications of their findings.

Campbell points out that while company survival rates and new job creation rates are important, these measures fail to capture the long-term effect of business incubators (Campbell et al., 1988). Graduation rates and job creation do not take into account what happens to firms once they graduate and leave the incubator. These numbers certainly are important to defining long-term success. Allen and Culp concluded that there are no significant differences in the growth rate of incubator graduate firms and their control groups (Allen et al., 1990; Culp, 1996). The survival rate however, for incubated firms is approximately twice the national average, approaching 90 percent (Molar et. al., 1997). Even given that it has been found that there is no significant difference between incubator graduate firm growth and regional firm growth, the fact remains that twice as many of these firms survive. How much of this is attributable to the incubator program and how much is a function of selection bias is not addressed in this research.

In the 1970's the National Science Foundation's (NSF) Innovation Centers Program began generating interest in the incubator concept through its program designed to stimulate and institutionalize best practices in the processes of evaluating and commercializing selected technological inventions (Bowman-Upton et al., 1989; Scheirer, 1985)[4]. In the 1980's and 1990's the rate of incubator diffusion increased significantly when (a) the passage of the Bayh-Dole Act in the U.S. Congress in 1980 decreased the uncertainty associated with commercializing the fruits of federally funded basic research, (b) the U.S. legal system increasingly recognized the importance of innovation and intellectual property rights protection, and (c) profit opportunities derived from the commercialization of biomedical research expanded. In this environment, several incubator development guides as well as non-academic reports and articles with a geographic and normative focus on current or potential business incubation efforts were generated. This surge in incubator report-generating activity in the early 1980's and the formation of the NBIA in 1985 underscore the growth in popular interest in business incubation in the 1980's. Concurrent to these and other local efforts at studying and unleashing the potential of business incubation to foster economic development, academic incubation studies began in earnest.

Much of this early research addresses the questions ''What is an Incubator?'' and ''What do we need in order to develop an effective incubator?'' Business Incubator Profiles: A National Survey (Temali and Campbell, 1984), a ground-breaking survey of 55 business incubators, is the first academic attempt to address these questions by describing in detail the incubators operating in the United States. It is comprehensive in scope, taking the incubator, the incubator manager, the clients, and the services provided by the incubator as various units of analysis. Although this survey does not test hypotheses or attempt to build theory, its rich descriptive data and insightful perspective established a platform upon which much subsequent incubator development research is based.

According to the study, most incubators at the time were established in existing, and frequently vacant buildings. Many had been purchased and renovated with the assistance of funding from a variety of government loans and grants. Others had been purchased with state or local issued revenue bonds. A few buildings had been donated or sold inexpensively by private corporations. Most of the incubators in the study acted as brokers between new businesses and potential investors by making introductions to key people or by assisting in the development of proposals and loan packages. Publicly sponsored incubators sought primarily to create jobs, and university affiliated incubators sought to transfer research and development activities and to spin off university research efforts.

The Temali-Campbell study identified a number of elements in incubator operations: flexibility in leasing and management of space, centralized services to help reduce overhead costs of tenant companies, and various types of business assistance. It is interesting that the research also discovered a unique social atmosphere that encouraged trading relations.

In the late 1990's, fueled by irrationally exuberant stock valuations of several for-profit incubators and/or their clients, the media popularized a perception of business incubators as innovation hatcheries capable of incubating and taking public ''infinitely scaleable, dot-com e-business start-ups'' less than a year after entering the incubator. This concept of an incubator was pervasive causing leaders such as Florida's Governor in 1999, to veto state funding for incubators in the belief that the for-profit incubator was a better model[5]. This perception and the incubator concept were largely abandoned by the popular press after the collapse of the United States' stock market bubble.

However, rumors of the demise of the incubator were ‘‘greatly exaggerated’’. The media reached its negative conclusions regarding incubators while focused on for profit incubators, a relatively small segment of the total incubator population.[6] The vast majority of incubators are non-profit entities that continue to incubate below the ‘‘radar screens’’ of most journalists. Since the establishment of the first business incubator, most incubators have been established as publicly funded vehicles for job creation, urban economic revitalization, and the commercialization of university innovations, or as privately funded organizations for the incubation of high potential new ventures (Campbell and Allen, 1987).

The fact that most incubators are publicly funded is not trivial. Despite the National Business Incubator Association’s position asserting the importance of operating incubators as enterprises that should become self-sufficient, profit-oriented organizations, it has not been translated into profitability for the majority of publicly funded incubators (Bearse, 1998). **F**inancial dependency forces incubators to operate in a politically charged environment where they must constantly demonstrate the ‘‘success’’ of the incubator and its clients in order to justify continued subsidization of incubator operations with public funds. Such a politically charged environment can tempt incubator industry stakeholders to under report incubator failures and over-report successes.[7]

For the researcher interested in understanding, explaining and building models of incubator phenomena, the politically charged environment and the state of subsidy-dependency in which many non-profit incubators operate cannot be ignored. The review of the literature shows the progression of the research through five primary research topic areas over various, but overlapping, time periods. Hackett and Dilts' (2004) summary of these categories is reproduced in Table 1 below.

Table 1: Overview of Incubator Literature Review ***Source: Hacket & Dilts, 2004***

Research Streams / Characteristics	A Systematic Review of Business Incubation Research Overview of incubator-incubation literature				
	A Incubator development studies	**B** Incubator configuration studies	**C** Incubatee development studies	**D** Incubator-incubation impact studies	**E** Studies theorizing about incubators-incubation
Research period	1984–1987	1987–1990	1987–1988	1990–1999	1996–2000
Main topics Research question(s)	Definitions Taxonomies Policy prescriptions What is an incubator? How do we develop an incubator? What life cycle model can be extracted from analysis of business incubators?	Conceptual frameworks Incubatee selection What are the critical success factors for incubators-incubation? How does the incubator-incubation concept work in practice? How do incubators select incubatees?	New venture development Impact of planning on development What is the process of new venture development in an incubator context? What is the role of planning and the business incubator manager?	Levels and units of analysis Outcomes and measures of success Do incubators achieve what their stakeholders assert they do? How can business incubation program outcomes be evaluated? Have business incubators impacted new venture survival rates, job creation rates, industrial innovation rates? What are the economic and fiscal impacts of an incubator?	Explicit and implicit use of formal th (transaction cost economics, network theory, entrepreneur-ship, economic development through entrepreneurship) What is the significance of relationships and how do they entrepreneurship? What are the critical connection factors to success, e.g., settings, networks, founder characteristics, group membership, co-production value, and creation process?'' What constitutes a model for a virtual incubator? Is the network the location of the incubation process?

A review of each area is provided in following five sections

<u>Incubator Development Studies</u>

The goal of early incubator related researchers was to accurately and / or normatively describe incubators. Themes in incubator development studies include efforts aimed at defining incubators (incubation), incubator taxonomies, and policy prescriptions. Each of these topics is discussed below.

Defining Incubators

It appears that most research assumes that incubators are economic development tools for job creation whose basic value proposition is embodied in the shared belief that operating incubators will result in more startups with fewer business failures (Fry, 1987; Kuratko and LaFollette, 1987; Lumpkin and Ireland, 1988; Markley and McNamara, 1995; Rice, 1992; Udell, 1990). Despite the existence of this shared baseline assumption, definitional ambiguity in the terms ‘‘business incubator’’ and ‘‘business incubation’’ plagues the literature.

Such ambiguity is problematic because, without precise definitions, it is difficult to ascertain the actual size of the incubator population to which a systemic research effort could seek to generalize findings. Who to include and who not to include in a survey becomes a very difficult and subjective decision. The NBIA maintains a listing of member organizations. A quick glance at the list reveals that a significant number of members are not functioning incubators, but are instead virtual incubators and other economic development organizations. The NBIA recently established four separate member categories to help with this issue[8].

Business incubators and incubation in general suffers from several sources of definitional ambiguity. First is the diffusion and repeated adaptation of the original business incubator concept in order to fit varying local needs and conditions (Kuratko and LaFollette, 1987). Second is the interchangeable manner in which the terms “Research Park,” , “Technology Innovation Center,”, and “Business Incubator” are used in the literature (Swierczek, 1992).[9] “Business Accelerator”, “Venture Lab”, and “Innovation and Commercialization Center” are also terms used in practice.[10] Third is the emergence of virtual incubators (also referred to as ‘‘incubators without walls’’) which endeavor to deliver business assistance services to clients who are not collocated within an incubator facility.[11] Fourth is a persistent tendency to not define the incubation process, or—when defined—to disagree on where and with whom the incubation process occurs.[12]

Cumulatively, the above mentioned sources of ambiguity in the terms and concepts of discourse hinder efforts at generalizing incubator or incubation research results to the overall incubator population. Early attempts at defining incubators are careful to draw out a distinction between incubators as real estate development efforts, and incubators as systematic business development and business assistance efforts (Brooks, 1986; Smilor, 1987b; Smilor and Gill, 1986).

Highlighting this distinction in a normative description of incubators, Brooks (1986) describes a two type incubator continuum where start-ups enter an ‘‘economic growth incubator’’ in order to gain access to the incubator’s external support network, shared support services, and the resources of a local university affiliated with the incubator. In this view, once the start-ups have attained a more advanced state of business development they can move into a ‘‘real estate incubator’’ which provides office space and shared services.

Brooks’ continuum is adapted and elaborated by Allen and McCluskey (1990). They discard the notion however, that clients would move into a real estate property development incubator after achieving a critical mass, and instead focus on the primary and secondary objectives of four types of incubators that are distributed along a value adding continuum. From least value-adding to most value-adding, these incubator types include For-Profit Property Development Incubators, Non-Profit Development Corporation Incubators, Academic Incubators, and For-Profit Seed Capital Incubators. The Allen and McCluskey continuum is reproduced in Figure 1.

While the goals and objectives of different incubator types may be indicative of the amount and type of resources that a certain type of incubator maintains, the varying goals and objectives among types of incubators depicted in the figure below may not reflect the objectives of the incubator’s clients. Moreover, regardless of the stated goals and objectives of the incubator, ‘‘the universal purpose of an incubator is to increase the chances of a client firm surviving its formative years’’ (Allen and Rahman, 1985).

	Real Estate	Value-Added Through		Business Development
	For-Profit Property Development Incubators	Non-Profit Development Corporation Incubators	Academic Incubators	For-Profit Seed Capital Incubators
PRIMARY OBJECTIVE	Real estate appreciation Sell proprietary services to tenant	Job creation Positive statement of entrepreneurial potential	Faculty-Industry collaboration Commercialize university research	Capitalize investment opportunity
SECONDARY OBJECTIVE	Create opportunity for technology transfer Create investment opportunity	Generate sustainable income for the organization Diversify economic base Bolster tax base Complement existing programs Utilize vacant facilities	Strengthen service and instructional mission Capitalize investment opportunity Create good will between institution and community	Product development

Figure 1: Allen and McCluskey Continuum (Allen and McCluskey, 1990).

Similarly, regardless of the incubator stakeholders' desire (and political need) to demonstrate the ancillary effects of job creation and economic development, the universal goal of clients is (or should be) to survive and develop as a corporate financial entity that delivers value to the owner(s)/shareholders. This point is often lost in practitioner debates and in politically charged discussions related to the initiation of incubator feasibility studies. With the average incubator start-up costs approaching $1,000,000 (Bearse, 1998), incubator proponents tend to overemphasize the ability of the incubator to ‘‘create jobs’’ as a justification for the large initial capital expense.[13]

As the understanding of the incubator concept advanced, the notion that the incubator itself is an enterprise with its own developmental life cycle was developed. The incubator start-up stage begins at the time a local community begins to consider establishing an incubator and ends once the incubator has reached full occupancy (Allen, 1988). The incubator business development stage is indicated by an increase in the frequency of interaction among incubator managers and clients, stable demand for space within the incubator, and greater support for the incubator in the local community (Allen, 1988). The incubator maturity stage reflects the point when the incubator has more demand for space than it can service and has become a center of entrepreneurial gravity in the community (Allen, 1988).

The recognition of the incubator life-cycle is an important advancement.   Specifically, it highlights the importance of would-be-clients performing due diligence on the incubator in order to determine whether the incubator has the core competencies in business assistance and the resources to provide the kind of value demanded by the venture's management team.

Incubator Taxonomies

One of the great challenges of conducting incubator research is the difficulty of creating a control group of non-incubated companies whose developmental outcomes could then be compared to incubated companies (Sherman and Chappell, 1998). Ways to overcome this problem include adopting the use of matched pairs or comparing the performance of clients to the performance of a virtual incubator's clients (Bearse, 1998). In the literature, taxonomies of convenience are typically employed to create comparison groups. These taxonomies classify incubators on the basis of (a) the incubator's primary financial sponsorship (Kuratko and

LaFollette, 1987; Smilor, 1987b; Temali and Campbell, 1984), (b) whether clients are spin-offs or start-ups (Plosila and Allen, 1985), (c) the business focus of the clients (Plosila and Allen, 1985; Sherman, 1999), and (d) the business focus of the incubator (i.e. property development or business assistance) (Brooks, 1986) (see Table 2).

Table 2: Taxonomies of Incubators

Taxonomy	Representative citation
Incubator level: primary financial sponsorship • Publicly-sponsored • Nonprofit-sponsored • University-sponsored • Privately-sponsored	(Kuratko and LaFollette, 1987; Smilor, 1987b; Temali and Campbell, 1984)
Incubator level: business focus • Property development 1. Single tenant 2. Multi-tenant • Business assistance 1. Shared space 2. Low rent 3. Business support services	(Brooks, 1986)
Incubator level: business focus • Product development • Manufacturing • Mixed-use	(Plosila and Allen, 1985; Sherman, 1999)
Type of incubatee • Spin-off • Start-up	(Plosila and Allen, 1985)

A key finding is that despite the widespread use of these taxonomies, none of the studies reviewed provided a means to predict or explain variation in incubation outcomes—presumably the facet of the incubator concept of greatest interest to researchers—on the basis of these taxonomic classifications.

A.3 Policy Prescriptions

A number of incubator policy prescriptions (best practices) offered in the literature are analyzed below. These prescriptions appear multiple times in the literature but are drawn primarily from the following sources: (Allen and Weinberg, 1988; Brooks, 1986; Bruton, 1998; Campbell and Allen, 1987; Culp, 1996; Plosila and Allen, 1985).

First is the need for an advisory board to serve as an incubator ombudsperson. Because the incubator must make difficult client selection decisions that require a sophisticated understanding of the market and the process of new venture formation, and because the incubator must rely upon political support from its advisory board in order to secure annual operating subsidies, the importance of a strategically constructed advisory board should not be understated.

Second, the rental income risk associated with the temporary tenancy of clients must be managed. Basically, cyclical demands for incubator space are somewhat mediated by the level of development and competencies attained by the incubator and the current state of the entrepreneurial activities in the local community. With this in mind, pre-screened clients should be waiting in the admissions pipeline prior to the departure of current clients in order to optimize incubator rental revenue streams.[14]

Third, a comprehensive menu of support services must be developed in order to be able to properly incubate the clients. Developing and offering a set of services—even if they are underutilized— may be significant, as the availability of the services may induce self-reflexive consideration on the part of clients as to what is required for their new venture to develop.[15]

Fourth, the qualitative difference between applicants for admission to the incubator and incubation candidates must drive the client selection process. Specifically, because the incubator represents an attempt to help entrepreneurial firms overcome some resource gap(s)[16] that prevent them from succeeding in their early stages of development, it is important from an economic rationality perspective to differentiate the types of applicants for admission to a business incubator in the following ways: (a) those that cannot be helped through business incubation, (b) those that should be incubated due to the existence of some resource gap(s) and (c) those that do not need incubation. Ideally, only those firms that are ‘‘weak-but-promising’’ (weak due to a lack of resources, but promising in the sense that they have built a compelling business case) should be considered incubation candidates.[17]

Fifth, the degree to which incubators should / can assist clients with financial matters must be considered**.** Typically, most incubators do not maintain their own investment fund, serving instead as a broker that introduces clients to sources of capital when the need arises.

Sixth, while incubators are not an economic quick fix and while they have numerous limitations, they are an important component of a local economic development strategy and can serve a market failure bridging function by enabling entrepreneurship where previously it was too costly or too risky**.**

Finally, flexible oversight with dynamic readjustment of incubation programs as dictated by local needs is important for maintaining the vitality and effectiveness of the incubator in a cost-effective manner.

In summation, incubator development studies represent the earliest research conducted on the incubator concept. These studies are characterized by efforts to define the incubator, to create taxonomic categories for comparison, and to provide policy guidelines or best practices for operating an incubator. While these efforts have several weaknesses that were previously discussed, it is important to note that incubator development studies are a beginning and not an end. They are novel exploratory, conceptual, empirical and normative attempts to understand a very young research topic. Early research conducted on incubators has provided descriptions that are useful for understanding the scope and nature of incubators. Over the next few years that number of studies rose rapidly. Industry leaders launched the National Business Incubation Association (NBIA), a private membership organization of incubator developers and managers, in 1985. From an initial membership of 40, it has grown to almost 800 members today (Lewis, 2001).

Incubator Configurations

Studies often describe the configurations of business incubators, examining the ‘‘design of the incubator’s support arrangement, and describing facilities, budgets, organizational charts, geographical location, and institutional links'' (Autio and Kloftsen, 1998) with a view to ascertaining the critical success factors of business incubation.[18] The emergence of these studies indicates the evolution of incubator "science" from an initial exploratory, fragmented understanding of the concept to an increasingly holistic perspective.

The following subsets of configuration research are considered: (1) incubator configuration frameworks, and (2) the client selection component of the incubator system.

Incubator Configuration Frameworks

Several attempts have been made to conceptualize incubator configurations and, to a limited extent, the process of incubation. Building on the survey data collected in Temali and Campbell (1984), Campbell et al. (1985) develop a framework offering the first explicit linkage of the incubator concept to the business development process of clients (Campbell et al., 1985). This framework, reproduced in Figure 2, suggests four areas where incubators add value: the diagnosis of business needs, the selection and monitored application of business services, the provision of financing, and the provision of access to the incubator's network.

Implicitly, with this framework, Campbell et al. have normatively defined the incubation process. This is useful because it suggests in detail, and for the first time, how different components of, and activities within, the incubator are applied to facilitate the transformation of a business proposal into a viable business.

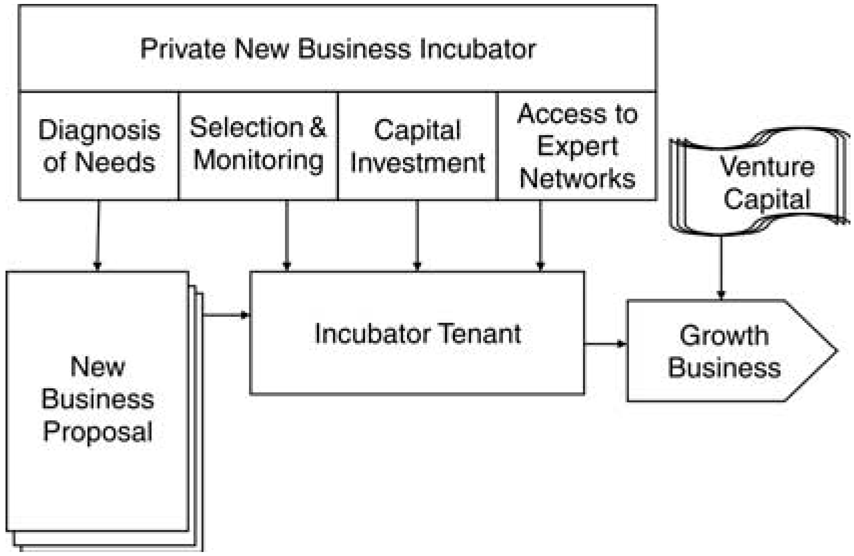

Figure 2: Campbell, Kendrick, and Samuelson Framework

(Campbell et al., 1985).

Weaknesses in the framework center on the failure to account for failed ventures (the framework assumes that all incubator tenants succeed) and the application of the framework to private or for profit incubators only. In Figure 3, Smilor extends the Campbell et al. framework by elaborating various components (incubator affiliation, support systems, impact of tenant companies) of the incubator concept. Unlike Campbell et al., however, the Smilor framework takes an external perspective and fails to account for the incubation processes occurring internally.

Utilizing data gathered from a national survey as well as from interviews, analysis of case studies, and observation, Smilor and Gill (1986**)** casts the incubator as a mechanism for reshaping the way that industry, government and academia interrelate. They categorize the benefits that incubators extend to their clients along four dimensions: (1) development of credibility, (2) shortening of the entrepreneurial learning curve, (3) quicker solution of problems, and (4) access to an entrepreneurial network (Smilor, 1987a). Smilor also conceptualizes the incubator as a system that confers ‘‘structure and credibility’’ on clients while controlling a set of assistive resources: ‘‘secretarial support, administrative support, facilities support, and business assistance’’ (Smilor, 1987b). Smilor’s effort is perhaps the most comprehensive effort at identifying and explaining the various components of the incubation system and most closely approaches our concept of a systemic context for evaluation of incubators.

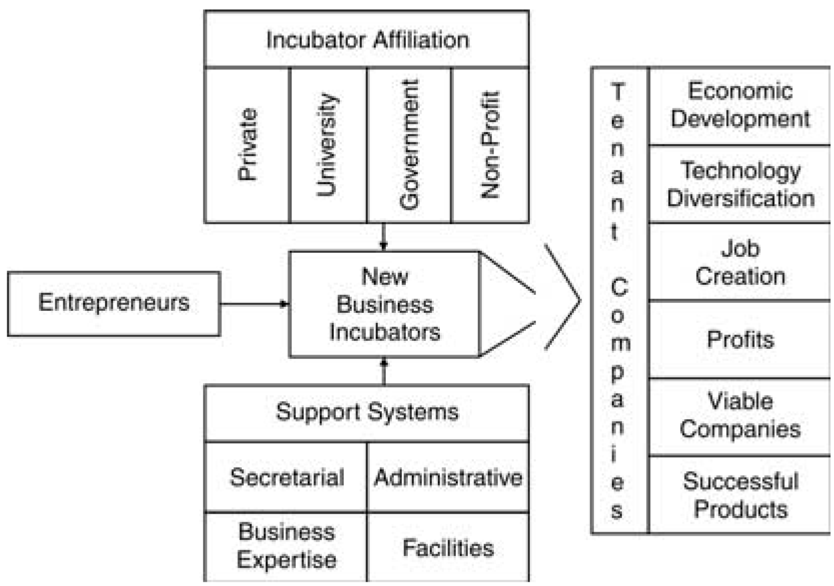

Figure 3: Smilor framework (Smilor, 1987).

Hisrich (1988) advances understanding of the incubator concept by locating the incubator within a complete continuum of innovation: The Enterprise Development Center (EDC) approach to incubation aggregates venture capitalists, student entrepreneurs, corporate intrapreneurs, the community (Tulsa) Innovation Center, the local Small Business Development Center (SBDC) and two local incubators. Hisrich (1988) asserts that localizing the design of an EDC based on cultural demands, having a highly placed champion to promote the EDC, establishing the EDC in a step-wise fashion with validation at each step, and educating private and public sector leaders about the EDC are critical success factors. This assertion is especially interesting as it parallels much of what created the Silicon Valley phenomenon that is presented later. Like Brooks (1986), Hisrich emphasizes the importance of incubating the community as much as servicing the needs of the clients. However, as with the Smilor framework, the Hisrich framework ignores internal incubation processes.

Incubator configuration studies are important efforts at drilling down into the incubator's infrastructure and operations in order to extend broad understanding of the incubator concept. Although most of these studies are atheoretical, they help advance knowledge of a very young concept beyond the definitional level.

Configuring Client Selection

Having specified the basic configuration of the incubator and conceptualized the incubator as a system or process, more intensive studies of the individual components of the incubator system were the next logical step in building the body of incubator research. Surprisingly, beyond Campbell et al.'s (1985) implicit definition of the incubation process and specification of the general configurations of incubators, little effort has been devoted to unpacking the variables associated with the incubation process. What work has been done in this area is generally limited to examining the process of selecting clients. Culp's (1996) position focused on the need to select what are essentially ‘‘weak-but-promising’’ companies. Lumpkin and Ireland (1988) use cluster analysis to categorize incubators on the basis of the selection criteria they employed when choosing incubation applicants for admission to the incubator. This research provides useful insights into the variability of selection criteria configurations across incubators and offers a new taxonomy, but the study does not suggest which configuration(s) are better or worse than others, nor does it attempt to link the analysis of selection criteria used with incubation outcomes or performance.

Merrifield (1987) introduces a constraint analysis approach for selecting candidates for incubation. He grounds the approach in three questions, the first two of which are directed at the incubation applicant:

1. Is this a good business in which anyone should be involved?
2. Is this a business in which the organization has the competence to compete?
3. What is the best method for entry and / or growth?

These questions form the basis for constructs that are operationalized on a number of items relating to business attractiveness and fit.[19] If a business is deemed attractive and a good fit, the incubator addresses the final question: ‘‘What is the best method for entry and / or growth?’’ In general, Merrifield’s approach is sound. However, his emphasis on a firm’s manufacturing capability being an integral factor in determining its fitness precludes the possibility of outsourcing. The approach also assumes client success to a degree that seems somewhat unrealistic.

Kuratko and LaFollette (1987) point out one of the biases intrinsic to incubator research by postulating that variability in the client screening and selection process can lead to incubator and

/ or client failure through the selection of ventures that do not merit incubation for either being too strong or too weak. This concept is elaborated upon by Bearse (1998) who draws a comparison between selecting clients and selecting students for admission to Harvard University. Specifically, Bearse asks whether Harvard students (the clients) succeed because of what Harvard (the incubator) does to them, or because Harvard selects only students who will succeed regardless of what Harvard does to them (Bearse, 1998). In the absence of a ready answer, scholars stress the importance of having a good ‘‘fit’’ between client needs and the business assistance services that the incubator is capable of providing (Autio and Kloftsen, 1998).

The research attempts to identify critical success factors, explain how incubators work, and detail how incubator clients are selected. The work was conducted during an era of much growth and evolution. For profit incubators were making their appearance with very different expectations. Much of this work failed to relate their research to measurable outcomes but a lot of insightful foundations were built.

Client Development Studies

Little progress appears to have been made toward understanding how clients develop within the incubator. This is not surprising, however, because a stream of literature on new venture development that centers on all new ventures (as contrasted with new ventures operating within incubators) exists within the domain of entrepreneurship research. Reviewed below are articles that focus explicitly on incubator client development.

Observing five clients of the St. Louis Technology Center, Scherer and McDonald (1988) generate six flowchart diagrams depicting the evolution of a new venture and conclude that clients benefit most when instructed to balance a ‘‘flexible capability for short-term adjustments to market feedback’’ with a long-term perspective. They caution against the new venture tendency toward unrealistic growth projections and ignorance of the need for operating funds. These findings are not novel, but they are useful in highlighting the fact that incubator clients suffer the same shortcomings as their non-incubator client counterparts.

More importantly they highlight the potential for incubator environments to generate passive interventions that create a layer of heightened strategic-reflexivity (i.e. a greater awareness of cause–effect relationships embedded within their activity sets) amongst clients. Stuart and Abetti (1987) focus on the determinants of ‘‘initial success’’[20] of a convenience sample of new and young ventures located in the Rensselaer Polytechnic Institute’s Incubator Program and Technology Park. Measuring the impact of market, company and entrepreneur characteristics on initial success, the authors find a positive relationship between entrepreneurial characteristics and success, and negative relationships between market dynamism, R&D intensity, organic nature of the firm and success. They interpret their findings as indicative of a need for entrepreneurs to maintain tight, centralized control over their ventures. Given the small sample size and bias however, it is difficult to defend the validity of these findings.

Fry (1987) conducted a census of the members of the NBIA to examine the variance among clients’ intensity of planning activities. A comparison group of companies affiliated with a SBDC is used in an effort to parse out differences between incubator tenants and non-tenants. However, because incubator managers were the respondents to questions on the perceived use of planning amongst clients, a statistical comparison with the self-reported responses of SBDC-affiliated companies is not meaningful.

Fry however, ignoring this point, concludes that clients are ‘‘more active planners’’ than non-clients and argues that results imply that incubator managers should actively encourage planning activities among clients. Although his attempt at overcoming the difficulty in creating a comparison group for experimental research is novel, it seems likely that Fry is comparing the proverbial apples and oranges regarding the types of ventures. The non-profit incubator is established as a ‘‘public-private’’ engine of economic development whose clients are selected in the expectation that fostering their success will help fuel local economic growth. Alternatively, free-standing SBDCs (i.e. SBDCs that do not provide rental office space and that are not integrated into the local innovation development continuum in the manner described in the Hisrich Framework) are purely government-operated programs that provide general advice to any individual(s) seeking to establish a new venture. The typical SBDC customer seeks to establish a lifestyle venture (i.e. a venture that is built slowly over time in order to replace income from a currently held job).

Lyons asserts that there are several levels of client needs that enterprises require depending on the level of development the individual enterprise is in. He asserts that technology incubators provide a higher level of service than do mixed-use incubators. These levels are reproduced in Table 3.

Table 3 Enterprise development levels, *Source Lyons, 2004*

Entrepreneurial Development Level	***Type of Enterprise Development Assistance Providers***
Majors	Venture capitalists, professional consulting practices, investment bankers, etc.
AAA	Angel investors, emerging business consulting practices, university tech transfer offices
AA	Manufacturing extension programs, small business development centers, small specialized venture funds, high technology incubation programs, etc.
A	Micro-enterprise programs, small business development centers, business incubation programs, etc.
Rookie	Micro-enterprise programs, youth entrepreneurship programs, etc.

Hackett and Dilt's perceived relationship among the types of entrepreneurial ventures and support agents is depicted in Figure 4. They complement Lyon's Enterprise model.

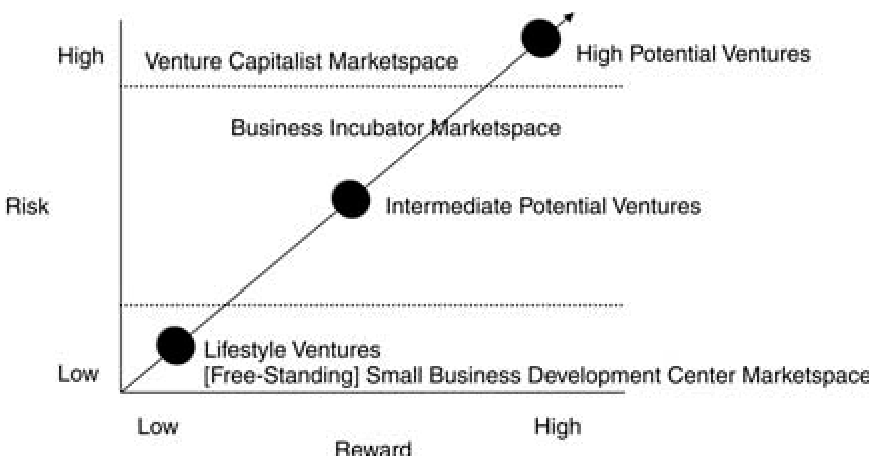

Figure 4: Types of entrepreneurial ventures and corresponding support agent market space, *Source: Hackett & Dilts 2004.*

Client development studies are rather underdeveloped and probably will remain so due to the difficulty of obtaining data from early stage ventures regardless of whether the venture is located within an incubator. Nonetheless, key findings from this area of research include the importance of providing dynamic, proactive feedback to clients, assisting clients with business planning, and encouraging clients to introduce control systems during the early stages of client development.[21]

Incubator Impact Studies

When considering incubator impacts, the fundamental research question is ‘‘Does the incubator make any difference in the survival rates of clients?’’ In the literature review, one study addresses this question squarely: “An exploration of the relationships between incubator structure, services and policies and client survival”, found that more than half the variation in outcomes was explained by the age of the incubator (a proxy for level of development of the incubator) and the number of clients (Allen and McCluskey, 1990). This suggests that reaching a certain critical mass of incubator experience, client interactions, and flow of new venture development by the incubator over time (i.e. organizational learning) may be the most important variable for incubating new ventures.

The use of age as a proxy for development however, is contradicted by Lewis’ (2003) work that showed that age was not a factor in performance of the top technology incubators. In fact two of the top ten were less than 3 years old.

Additional incubator impacts of interest include the number / rate of new start-ups created, the number / rate of corporate start-ups created, and the number / rate of new jobs created (Udell, 1990). Most impact studies that measure these items do so by tabulating simple running counts for each metric.[22]

Measures of Incubator Success

As mentioned in the introduction, Campbell and Allen (1987) offer the following ‘‘milestones’’ as measures of incubator success (Note: ‘‘tenant’’ means client in this context): Creation of a responsive business consulting network, participation of financial intermediaries in tenant capitalization, the point at which a majority of tenants are start-up firms as opposed to previously existing small businesses, and the synergism that occurs when tenants develop trade relations with one another such as subcontracting and joint purchasing. (Ibid, p. 189). Measures of the above aspects are also indicators of the incubator’s level of development, as are the sustainability and growth of the incubator, the scope and effectiveness of incubator management policies, and the ability to provide comprehensive services (Mian, 1997). The degree of fit between the business incubation services offered by the incubator and the needs of the local market is another measure of incubator success (Autio and Kloftsen, 1998). Drawing from the performance benchmarking literature, Bearse (1998) suggests that if data is regularly collected and made available, an incubator could also measure its success in comparison to other incubators on a variety of operational and outcome measures and against a business incubator industry baseline (Bearse, 1998). Despite efforts by the NBIA such data has proven difficult to gather and maintain on an ongoing basis.

Measures of Client Success

The simplest measure of client success is ‘‘graduating’’ from the incubator upon overcoming gaps and developing sustaining business structures.[23] Indeed, in the literature incubator success has been defined as a ratio expressed in the following terms: Number of Firms Exiting the Incubator, Number of Firms Discontinuing Operations While Still a Tenant (Allen and

Weinberg, 1988). Beyond this simple measure, firm growth and development measures have also been applied to the clients. Growth measures include examining increases in number of jobs or sales over time, while development measures are reflected in ‘‘product innovation, quality of the management team, and strategic alliances consummated’’ over time (Bearse, 1998; Udell, 1990).

Incubator variables that have been put forth to be associated with client success include client selection processes (Kuratko and LaFollette, 1987; Merrifield, 1987), internal incubator network formation (Lichtenstein, 1992), incubator-industry network and incubator support services network density (Hansen et al., 2000; Nowak and Grantham, 2000), incubator manager–client relationships (Autio and Kloftsen, 1998; Fry, 1987; Rice, 2002; Sherman, 1999; Udell, 1990), incubator effectiveness (Sherman and Chappell, 1998), level of incubator development (Allen, 1988; Sherman and Chappell, 1998), and procedural standardization and policy formalization (Bearse, 1998). However, few of these relationships have been empirically tested. While most practitioner studies find a high rate (usually over 80 percent) of client survival (Bearse, 1998), other studies report less optimistic (55 percent) survival rates (Roper, 1999). When examining client survival rates, however, direct comparisons with non-incubated ventures’ survival rates may not be meaningful as the use of selection criteria in admitting clients to the incubator results in a selection bias (Sherman and Chappell, 1998).

Community Economic Impacts

Despite the prevalent practitioner based and politically correct belief of incubator managers and government officials that incubators create jobs, early empirical research suggests that incubators and their clients are not very good job creators (Campbell and Allen, 1987). However, business incubators have been found to be more cost effective economic development tools than programs to attract firms to local regions (Markley and McNamara, 1995; Sherman, 1998, 1999; Sherman and Chappell, 1998).

Summary of the Incubator Impact Studies

There are three key findings in the incubator impact studies. First, the level of incubator development and the number of clients are positively related with client survival. Second, incubators represent a lower cost means to job creation than cost-sharing corporate relocation programs. Third, the area of incubator impact research is surprisingly understudied and represents fertile ground for future research.

Incubator Theory

This section reviews theoretical approaches to explaining the incubator concept that appears in the literature. Given the newness of the field, it is not surprising that much of the literature is exploratory and descriptive with little attention devoted to theory-building. Some, but not many, implicit and explicit efforts at theorizing about incubators can be found in the literature.

Early Theorizing

The incubator development studies that address the question of ‘‘What is an incubator?’’ are implicitly engaged in descriptive and normative theorizing about the incubator concept. The first formal hypothesis ventured regarding incubators is as follows: Once extraneous factors that lead to early stage failure of small businesses (poor management, inability to find early stage financing, high overhead, etc.) are controlled or eliminated, the projected increased survival rate of new ventures should lead to increased employment and an expanded tax base (Brooks, 1986).

This hypothesis is grounded in the ‘‘theory of economic development through entrepreneurship’’ which posits that the entrepreneurial process of conceiving new business concepts and then creating new firms based on these new concepts is the basis of economic growth (Brooks, 1986). This theory is used to address the gap that occurs between conceiving the new business concept and actually instantiating the firm.[24] Brooks contends that the incubator and the incubation process are used to narrow this gap.

Another perspective on bridging the gap can be found in transaction cost economics (TCE). In the TCE view a firm gains competitive advantage by relentlessly reducing the costs of doing business (Williamson, 1978). From this perspective the primary function of the incubator is to bridge the gap by reducing the start-up and other operating costs of incubatees (clients) by providing shared office space and services at low cost. This frees the client management team to focus on building the business. A related hypothesis suggests that incubators are designed to help entrepreneurs develop their business ventures in a supportive business environment. Without the incubator, most of the entrepreneurs would either not be in business or struggle to remain in business. (Plosila and Allen, 1985, p. 732).

This hypothesis is essentially a market failure argument and is complemented by research that views incubators as mechanisms for enabling a firm ‘‘to master the competitive factors linked with effectiveness within particular industry settings’’ (Lumpkin and Ireland, 1988). While such assumptions are both intuitively compelling and difficult to disprove, many incubator clients report that they would have established their firms even if the incubator did not exist (Culp, 1996). This should not necessarily be taken as evidence against the incubator concept, however, as the confidence required to start a new venture may also be associated with unreasonable levels of confidence regarding personal capabilities and success (Nye, 1991).

Structural Contingency Theory

Although the incubator configuration studies were atheoretical, inductive collections of variables of the incubator concept, implicitly this approach rests on structural contingency theory. The primary assumption of structural contingency theory is that the configuration of an organization and the external environment must achieve ‘‘fit’’ in order to obtain ‘‘success’’ (Ketchen et al., 1993). Although most configuration studies do not test for success, structural contingency theory provides a theoretical underpinning for the often asserted need for the incubator to be tailored to meet local needs and norms.

Interdependent Co-production Modeling

Rice (2002) explicitly grounds the collaborative incubator manager–incubator client relationship in the interdependent co-production equation.[25] This equation models the co-creation aspects of the value-adding incubation process. It suggests that the time intensity of business assistance interventions must be strategically allocated by the incubator manager to the clients, and that clients must be properly prepared to utilize the advice and insights resulting from the intervention. This perspective is important because it calls attention away from the incubator facility and toward the incubation process. It does not however address the willingness of a client to utilize the support structure on any given day. It also reminds us of the importance of properly assessing the core competencies of the incubator before entering the incubator and determining whether the incubator and incubator client are a good fit from client-manager relationship perspective. If there is no fit, the interdependent co-production may result in the co-creation of inappropriate, value subtracting incubation processes. Fit in this context refers to a co-production model where the business incubator — in collaboration with the community in which it operates — is a ‘‘producer’’ of business assistance programs. The entrepreneurial ventures located in an incubator, as ‘‘consumers’’ of those outputs, operate in an interdependent co-production relationship with the incubator.

Network Theory

Commercialization usually occurs within an innovation community rather than a single organization (Lynn et al., 1996). Hansen et al. (2000) employ network theory (Nohria and Eccles, 1992) to argue that the primary value-added feature of networked incubators is the set of institutionalized processes that carefully structure and transfer knowledge throughout the incubator network in order to create conditions that facilitate the development of incubator clients and the commercialization of their innovations. They find that the degree of entrepreneurial intensity, economies of scale and scope, and network design are important factors for incubation success. The importance of the network design factor is supported by research that concludes that network relationship building is the most important value-added component of the entrepreneurial support systems (Lichtenstein, 1992). Network theory is also useful because it handily addresses the debate regarding the location of the incubation process: Rather than locate the incubation process either inside the incubator or in the local community, network theory asserts that the incubation process includes and transcends the incubator. A more comprehensive review of networking is included in Section 2.

Virtual Incubation Theories

Lastly, several theories related to the virtual incubator or "incubator without walls" are found in the literature. Middleman theory finds its roots in Weber (1993)[26] and describes a condition in which a resourceful minority group systematically develops a brokering position in a specific industry or industries. Enclave theory locates the spatial positioning of middleman enterprises in a specific cluster. Collective theory describes a form of group-based economic endeavors in contrast to ‘‘lone-wolf ’’ entrepreneurs.

Greene and Butler (1996) explore the phenomenon of virtual incubators by drawing on these three theories. They assert that a virtual incubator drives the entrepreneurial processes among a group of ethnically distinct minority immigrants who consciously position themselves as brokers in a discrete location and work to improve and expand the business achievements of one another.

Also theorizing about virtual incubation, Nowak and Grantham (2000) focus on flows of knowledge in the software industry. They contend that because leading edge software industry knowledge is geographically distributed and embedded within practices, a virtual incubator is needed to foster the development of information intensive new software ventures through information dissemination (Nowak and Grantham, 2000). This argument suggests a growing importance in the roles of knowledge brokering and the market space for ideas (Gans and Stern, 2003).

Summary of Incubator Theorizing

There are several key findings related to studies theorizing about the incubator concept.

1. From a Transaction Cost Economics (TCE) and market failure perspective, incubators are a systematic approach to controlling resources and reducing costs during the early stages of a venture's development.
2. The incubator configuration must meet local needs and norms.
3. The process by which the incubation system is managed and created is a collaborative effort between the incubator manager and the incubator clients.
4. The time duration and intensity of incubator manager intervention, coupled with the breadth, readiness and goodness of fit of the incubator manager–client does impact the success of the incubator client.
5. Network relationships and institutionalized knowledge transfer enhances the likelihood of incubation success.

Challenges within Existing Research

This section reviews the challenges identified within existing research and suggests new areas for future research. Specifically the need for future research to address the lack of convergence in the terms and concepts related to incubators or incubation, the lack of theoretically meaningful incubator classifications, the lack of a business incubation process model, the longstanding challenges in the definition and measurement of incubator-incubation-incubator client ‘‘success,’’ and the need for deeper theorizing about incubators.

Defining Terms and Concepts

Most researchers agree that incubators represent a systematic method of providing business assistance to firms in the early-stages of their development. Assistance is provided with the aim of increasing firm survival rates. Beyond this common baseline assumption, however, definitional and conceptual heterogeneity have made defining the scope and boundaries of the incubator phenomenon as well as the development of a set of obvious statements related to the phenomenon rather difficult. In the absence of strong incubator theory, research has produced catalogs of incubator configurations listing the factors associated with various conceptualizations of incubator ‘‘success.’’ If incubator research is to advance in a scientific manner, a convergence upon a single definition that accounts for the scope and boundaries of the incubator concept is required.

Incubator Classifications: Taxonomies vs. Typologies

The taxonomies of convenience that have been employed in the literature thus far have not been useful with regard to explaining variation in incubation outcomes. Prior research (Allen and McCluskey, 1990; Rice, 2002) suggests that more meaningful classifications may be created by focusing on items such as the competencies of the incubator, the incubator's level of development, and the incubator client's level of potential.

Theoretically grounded and tested typologies that use these metrics have the potential to be much more useful for future research than existing taxonomies. It bears noting that over time a number of the early entrants into the for-profit incubator space, as well as many of the NASDAQ bubble-era for-profit incubators have exited the incubation industry. This not only raises questions about the utility of using "incubator primary financial sponsorship" and "profit-orientations" as meaningful comparison categories, it also raises questions regarding the long-term sustainability of for-profit incubator models. Perhaps the non-profit incubator— with its relatively lower fixed costs and expectations—might represent a better, more politically rational model for allocating community resources and demonstrating the community's long-term commitment to facilitating economic development through entrepreneurship. In this view the politically mediated infusion of public resources into the incubator on an annual budget review basis, and at levels roughly analogous to current economic cyclical demands, seem logical.

Business Incubation Process Model

Despite the fact that the NBIA has noted on many occasions that the incubation process is much more important than the incubator facility, the majority of what is known about the incubation process is focused on the incubator facility (Adkins, 2001). As interest in entrepreneurship continues to grow, interest in methods for increasing the likelihood of entrepreneurial success and preventing entrepreneurial failure will also continue to grow. Accordingly, the development of models of the incubation process represents an opportunity to conduct incubator research that is likely to be of interest to a much broader spectrum of researchers than studies on incubator facilities. To facilitate a focus on incubation process studies, a moratorium on incubator facility configuration studies should probably be considered.

Measures of ''Success''

The attempt to measure the impacts of incubators is as important as it is challenging. Measurement is important because most incubators operate with public funds and are held accountable for the outcomes associated with the use of those funds. Measurement is challenging because the full range of data required to implement experimental research designs that squarely address the question ''If the incubator client had not been incubated, would there be any difference in the survival rate of new ventures?'' is not readily available. Specifically, data on successful incubator clients is relatively easy to obtain because incubators tend to promote their own incubation success stories. Data related to failed clients is somewhat more difficult to access as incubation failures may carry political implications that can result in a decrease or elimination of operating subsidies. Data on the success and failure of comparable non-incubated companies is rarely kept and has proven quite difficult, if not impossible, to obtain (Bearse, 1998). Identified below are the levels and units of analysis available to incubator researchers in order to better understand what kind of variables can be measured in future research efforts.

Levels and Units of Analysis

Specifying the level of analysis employed helps to limit the scope of an investigation by focusing the research efforts. Hackett and Dilts propose the following levels of analysis for incubator research.

1. Entrepreneur (individual) level
2. Incubator manager (individual) level
3. Incubatee (group/firm) level
4. Incubator (firm) level
5. Community (local) level
6. Incubation industry (industry) level

Specifying the unit of analysis is critical for creating any research design. The range of potential units of analysis in incubator research includes (a) the community in which the incubator operates, (b) the incubator as enterprise, (c) the incubator manager, (d) incubator client firms, (e) incubator client management teams, and (f) the innovations being incubated.

The lack of peer-reviewed incubator impact studies that measure success demonstrate the need for more, and the difficulties associated with research in this area. Interestingly, to justify a renewal of funding arrangements for an incubator, most incubator managers and stakeholders prepare annual incubation performance reports. In these reports, the incubator is often the unit of analysis while a running count of incubation outcomes—measured in terms of incubator client job growth, client financial performance, and client developmental advances at the time of incubator exit—provides measures of the incubator's performance.

Cooperation among researchers and practitioners may result in an increase in studies that report incubator impacts accurately and meaningfully for both groups. This is not trivial: the level, scope, and quality of incubation-related data management varies widely among incubators and access to information regarding politically sensitive incubation failures will continue to remain problematic. Accordingly, in addition to measures reviewed in the body of this work, practitioners and researchers should seek to measure the incubator's performance on the basis of incubator client performance to capture incubation outcomes that are relatively politically safe but also meaningful.

Operationally, Hackett and Dilts (2004) propose five different mutually exclusive incubator outcome states at the completion of the incubation process worthy of consideration:

1. The incubator client is surviving and growing profitably.
2. The incubator client is surviving and growing and is on a path toward profitability.
3. The incubator client is surviving but is not growing and is not profitable or is only marginally profitable.
4. The incubator client operations were terminated while still in the incubator, but losses were minimized.
5. The incubator client operations were terminated while still in the incubator, and the losses were large.

Current approaches to conceptualizing incubators and the practice of incubator management suggest that the first three outcome states are indicative of incubation success while the last two outcome states indicate incubation failure or possibly non-success. It must also be noted that the first three outcome states represent only a snapshot of the client's performance on ‘‘graduation day’’ and does not address future success or failure. It also should be noted that these are all measures of the client's success and market forces often play a bigger role in the success of a company than does the incubator.

Theory Development

The current body of research describes the ‘‘what’’ of the incubator concept. Specifically, there exists an accumulated number of empirical and normative descriptions of the factors that should be included in attempts at explaining the concept. However, most of this research is atheoretical (Mian, 1994; Mian, 1996), and theory is the lifeblood of any research area. If the area of incubator research is to advance in a theoretically meaningful manner beyond simple lists of critical success factors, then we must turn our attention from “what” are the important factors to “how” and “why” and “in what context” (“who” “where” and “when”) these factors are interrelated. Finally, the long term viability of incubator research depends not only on grounding future research in theory and developing new theory, but also on demonstrating why incubators are intrinsically, theoretically compelling.

Summary of General Incubator Literature Review

This review attempts to summarize the current state of incubator research through existing academic literature. Concepts, empirical findings, and problems related to existing incubator research using the five primary research orientations along which the literature has evolved is discussed. Although a significant body of research has developed in the years since, Temali and Campbell (1984) set the standard for describing incubators and their configurations. Hacket and Dilts, Lewis, Culp, and Lyons also made significant contributions to the understanding of the research body. It is also clear that research has is just beginning to understand the incubator concept and the many problematic issues associated with research in this area. While considerable attention has been devoted to the description of incubator facilities, less attention has been focused on the incubator clients, the innovations they seek to diffuse, and the incubation outcomes that have been achieved.

As interest in the incubator concept continues to grow, new research efforts should focus not only on these under-researched units of analysis, but also on the incubation process itself. Hackett and Dilts (2004) assert a key point that for the understanding of the incubator concept to advance, we will need to unpack the variables associated with the incubation process and then use these variables to build, validate and test incubation process models that help predict and explain clearly defined business incubation outcomes.

Focusing on the process of incubation rather than on the incubator facility and its configuration will draw attention to the underlying causes of new venture development in an incubator environment. This should lead toward theories of business incubation. The path to such theory development undoubtedly will entail multiple research methods, and will require researchers to draw from theories that are used in other research domains. Understanding the process in terms of how it fits into an overall regional "incubation" process is also needed.

Methods such as case study research, although not always embraced in the scientific community offers much insight into incubation. Incubator case studies suffer however from the practice of only celebrating success and not exploring any causal relationship. In particular, future research may benefit by drawing from the rich set of theories that are used to explain phenomena associated with new venture formation and development, new product conceptualization and development, and business assistance. This research is vitally important to communities interested in developing programs based on best practices for their individual circumstance.

Lastly, it is important to realize that incubator managers and stakeholders rarely take advantage of the existing literature when making decisions as to how to operate an incubator. Efforts should be made to disseminate this information, in an acceptable manner, to the broader community. As with much of the research dedicated to business development, practitioners rarely take advantage of the research, opting mainly for popular press or word of mouth[27].

There are shortcomings in the previous work that need to be addressed before meaningful research can advance. The lack of definitional clarity is certainly an issue. With no agreement as to what you are talking about, how do you start a meaningful analysis? The tremendous variation between program goals is again problematic. This creates problems with the selection of input and outcome variables.

The problem is very similar to measuring the success of a university. While you can measure how well an individual program is performing or point to successful outcomes, how to measure overall success is a difficult task. Rankings are common, however, and as with incubation, change and evolve as efforts are made to understand and accurately assess success.

Technology Incubators

Technology Incubation, Innovation, the Diffusion of Innovation, and High Tech Economic Development are often mingled together in academic literature and practice. The media and common press of the day constantly refer to the new knowledge economy, where intellectual property and know how are now the raw materials of industry. Technology incubators represent an ever growing section of incubators and merit a look at research focused specifically on this class of incubator.

Some of the key ingredients of regional capacity to support innovation are the presence of technology generators, access to a skilled workforce, a culture of interaction, locally-controlled investment capital (inputs), resulting in a high-quality of life for residents, and the optimal mix of industries (outputs). Theoretical arguments and increasing empirical evidence that innovation fosters economic growth have been fundamental to the emergence of technology business incubation as part of an innovation-based economic development strategy at the state and local level (DiGiovanna and Lewis, 1998; Shahidi, 1998; Lewis, 2001; Tornatzky et al., 1996). These arguments indicate the need for a systemic context.[28]

In theory, technology incubators stimulate the innovation process by linking technology development with market demands while providing capital for innovation, particularly in start-up enterprises that are deemed too risky for many investors (Tornatzky et al. 1996; Smilor and Gill 1986). Proponents of technology incubators argue that they increase the pace of new job formation, foster an entrepreneurial spirit that will result in new firm formation, and increase private investment in innovation, as well as create incentives for highly skilled individuals to reside in the host region (Molnar et al., 1997; Allen and McClusky, 1990; Tornatzky et al., 1996; DiGiovana and Lewis, 1998). Furthermore, industrial innovation (product or process) creates first mover benefits for the innovating firm, which in turn leads to new agglomeration (Agarwal and Gort, 2001). New agglomeration increases the prospects for additional wealth generation in the host region (Weber, 1929; Markusen, 1987; Marshall, 1987).[29]

The combination of these factors should enhance regional economic growth (DiGiovanna and Lewis 1998). Technology incubators have a cost, and economic development officials must determine how to best invest scarce public resources to spur economic growth. The average annual operating cost of a technology business incubator is estimated to be $320,701 which is 25 percent higher than the business incubator industry average (Wolfe et al., 1999).

Lewis (2003) asserts that these costs have risen dramatically, from an average of $286,737 in fiscal year 1995 to $520,533 in fiscal year 2000, an 81.5 percent increase over a five-year study period.[30] The inclusion of specialized work spaces (wet laboratories, clean rooms, exhaust hoods, high-speed broadband internet access, etc.), a larger facility size, the relatively longer time for clients to develop and market products/services, and the cost of additional expertise to assist tech entrepreneurs drive up the costs of technology incubation in comparison with other types of business incubators.

Public sector support for incubation, in terms of funding, is still widespread. Over 65 percent of technology incubators receive public funding for operating expenses from the federal, state, and/or local government. If one includes assistance from public universities, the figure rises to

71.2%. Only 20.5% of technology incubator programs are solely supported through client rents and fees for services without external public funding (Lewis 2003). The breakdown of the revenue stream indicates that, on average, governments (federal, state and local) subsidize roughly 29.3% of the operating budget, rents and fees for services support approximately 56.4%, academic partners cover 7.6%, royalties and equity agreements account for 2.1%, with the remaining 4.6% financed by private foundations. The primary expenditures in the operating budgets of technology incubators are staff salaries, facility maintenance and utilities expenses. On average, staff salaries amount to 32.8% of the operating budget, and facility maintenance and utilities account for 31.0% (17.4% and 13.6% respectively). Client services are the next largest expenditure at 18.3%, which includes 4.3% for recruitment of clients. Debt servicing (7.7%) and other non-specified costs (10.3%) account for the remaining operating expenditures.[31]

Table 4: Technology Incubators Compared to All Business Incubators

Variable	**Industry Average**	**Technology Average**	**Average from Survey Results**
Gross square footage	24,375	38,988	39,083
Number of tenants	12.0	13.9	13.7
Number of graduates per year	3.3	1.7	2.4
Percent of firms remaining in the metro area	82.2	86.0	71.7

Above and beyond the annual operating cost, incubator programs typically need to acquire real estate before beginning operations. On average, the cost of purchasing the land and building a facility (or renovating an existing structure) for technology incubator programs has been approximately $3.88 million ($3.04 million to build/renovate and $831,450 to acquire the land and/or building to be renovated).[32] The data also contains eleven incubators that had the land and/or building donated at no cost to the program, which means these averages somewhat underestimate start-up costs. Given the high cost to build and to operate a technology incubator, economic development officials need to understand the components of successful incubation and the local characteristics that can either dampen or enhance the performance of a technology incubator and its client firms.

Innovation in any industrial sector can lead to client firm success, as it has with Jobri Corporation's manufacturing ergonomic back supports and sleep products in a technology incubator in Ada, Oklahoma, or Garrison Guitars, which pioneered new production technology for manufacturing high-end musical instruments in a technology incubator in St. John's, Newfoundland (NBIA 2002). The phrase the "right tech" for your region, not "high-tech," may be more appropriate for the analysis of the performance of technology business incubation designed to catalyze growth through the formation of innovative new enterprises.

Trends in Technology Incubators

At the state and local level, one of the favored policy options to spur innovation-based development has been public investment in business incubators, more recently concentrating on the development of technology business incubators (Preer, 1992; Lewis, 2001; NGA, 2002a; NGA, 2002b). From 1986 to 1996, the incubator population nearly quadrupled, from roughly 140 established sites to 548 in North America (McKinnon and Hayhow, 1998). In a few short years, from 1998 to 2002, the population of business incubators in North America expanded by roughly 40 percent to 900; while in the U.S., the number of technology incubators roughly doubled, from approximately 146 to nearly 300 (Lewis, 2002). Both public and private investment has fueled the growth, but the shakeout in the for-profit segment of the industry has resulted in a disproportionate number of publicly led incubators remaining (Adkins, 2002). Of the 900 incubators, which includes incubators without walls, the NBIA (Molnar et al., 1997) estimates that 90% are not-for-profit and 10% are for-profit ventures. For technology incubators with a multi-tenant facility, the decline of the for-profit model has even been greater; 49.2% are headed by public institutions, 38.5% are private not-for-profit entities, but only 6.9% are led by private for-profit organizations.[33] The latest survey also indicates that incubators exist in all the states, with roughly 45% in urban settings, 19% in suburban areas, and 36% in rural settings.[34]

The aggregate growth in the population of technology incubators masks the reality that their performance varies unevenly across regions and that many technology incubators have ceased operations (Hansen et al., 2000; Lewis, 2001). Recent research (Lewis, 2003) identified twenty six (26) cases of technology incubators that had closed or scaled back their operations to the point that they could no longer be considered incubator programs since they had ceased to provide a full complement of entrepreneurial services.

The evaluative literature on technology business incubators suggests that they have a low public sector cost per job, their client firms have higher than average survival rates and there is a significant return on the public investment in terms of the taxes paid by the client firms and their employees (Molnar et al., 1997). However, this research has been criticized for small sample sizes that tend to favor more successful programs, unreliable graduate firm data, lack of consistent measures of success, and the failure to investigate failed or less than optimal programs (Lewis, 2001; Mian, 1997; Grob, 1998; Bearse, 1998; Markley and McNamara, 1995). In the case of technology incubators, the research has also been impeded by the nascent nature of the industry (Mian, 1997; Lewis, 2001). Furthermore, most of the evaluative research on technology incubators has been conducted with incubators in more developed regions. Perhaps this variability clouds the issue in the mind of the public.

For example, a survey of metropolitan-level economic development officials from 151 U.S. cities found that they perceived business incubation to be one of the less effective strategies for spurring growth (Clarke and Gaile, 1998). Quittner (1999) echoes this perception from the general public’s point of view and questions the wisdom of continued public subsidies for incubators and their client firms as the private market expands its investment in technology entrepreneurs. When we consider the rapidly escalating costs to establish and operate a technology incubator program in conjunction with the mushrooming of public investment, understanding how to maximize these investments is vitally important. While some have theorized about the characteristics of communities that have a greater capacity to host a successful technology incubator (Wolfe et al., 1999), there has been little empirical research that investigates what these factors are, or the degree to which technology incubator programs can compensate for the lack of regional capacity (Lewis, 2001).

Metrics for Technology Incubators

Given the varied motivations and practices of incubators, a one size fits all approach to measuring success and henceforth incubator quality is difficult to derive. Universities struggle with this same problem when trying to assess their performance or quality.[35] A recent attempt (Lewis, 2003) makes great strides in developing quantifiable measures of success for incubators. It does an excellent job of analyzing survey data on incubators but, as with Fry, relies heavily on proxies that may not be good approximations. He does a good job of examining client performance, and regional capacity using accepted statistical methods. The outcome measures of incubator success focus directly on new job creation and increases in incubator client revenue. The research advances a theory that incubator quality and regional capacity are the two drivers of client success and that incubator quality can make up for a lack of regional capacity. Fry does not however, make assertions as to what incubator quality is except in terms of the client success measures mentioned earlier.

Additionally, Fry's research does not take into account the various motivations and expectation that different incubator stakeholders have for their programs. As mentioned previously, incubators are started for many reasons including job creation in the community, promotion of economic self-sufficiency for a selected population group, diversification of the local economy, transfer of technology from universities and corporations, or sharing venture experiences with new companies by successful entrepreneurs and investors.

There are also incubators, such as the one at Rensselaer Polytechnic, that view the incubator primarily as a resource for the university's students, faculty, and technology transfer staff. Their incubator achieves its stated goal by enriching the academic environment and by bringing together already existent but otherwise disjoined resources within the University. For students and faculty, the RPI Incubator acts as a “living laboratory” where ideas generated in the classrooms and research centers can be tested in a real-world environment[36].

A new incubator on the drawing board in Orlando[37] will bring together talent in the entertainment industry to produce motion pictures. In this instance the idea is to form many small companies that will produce major motion pictures. These companies may or may not be disbanded when the projects are completed. They may also be reconfigured and reformed for a future project that requires their particular talent base.

The measurement of quality of the incubation program becomes problematic when measures of success differ so widely. Although new jobs created and increases in revenue drive economic development, sometimes those measures may be a fringe benefit but not required to meet the stated objective. In the case of the incubator at Rensselaer Polytechnic, their client companies could achieve tremendous success, create many new jobs and generate wealth for the region, but completely miss the goals and objectives for the incubator.

Networking Theory

As this dissertation looks at relating the success of an incubator in terms of how well it is integrated into an overall entrepreneurial development system, a review of networks in this context is required. Unlike incubators, there is much in the literature about networking. This section provides a review of business or entrepreneur network theory literature, starting with a review of definitions of networking offered in the literature that most closely relates to issues under consideration in this dissertation. Next, a number of competing theories regarding networking are reviewed followed by a discussion of the management of networks and lastly a discussion of the barriers to networking. The purpose is to understand how networks function and how they affect companies and entrepreneurs that become a part of these networks.

Definitions of Networking

Despite the fact that the literature explains entrepreneurial networks in many different ways, there is general agreement in the literature that networks are relationships formed with organizations or individuals to improve their performance. These relationships may be formal or informal, involve a specific business relationship, or consist of merely the exchange of information. The establishment of these networks may be motivated by a number of factors including cost, resources, trust, and strategic considerations.

Aldich (1979) defined inter-organizational networks as “all organizations linked by a specified relationship… Networks constrain or facilitate the activities of organizations and action sets in a systematic way that can be identified at the aggregate level.” Aldrich distinguished between two perspectives of organization sets and action sets in the following manner: Organization sets focus on a focal organization and its relations with others. An action set on the other hand, refers to an alliance among several organizations for a limited duration and a specific purpose.

Dean, et al. (1997) developed a taxonomy of business networking definitions by examining perceptions of what constructing a network consists of. In a survey of 912 small and medium sized firms in Australia, definitions of networking were solicited from these firms. They included:

- Companies joining together with a common objective
- Exchange and sharing of ideas or resources
- Contacts and inter-business communications
- Positive and beneficial for firms
- Meeting to solve problems
- Cost savings and better performance
- Promotion and writing

Additionally, informal networks were defined as “loose informal arrangements which facilitate the exchange of information”. A formal network was defined as “a formal arrangement between three or more businesses to consolidate resources with a clear common business objective.”

Jarillo (1989) defined networking as “use of personal relationships to obtain advice, financing, sales, etc.” Jarillo tested the hypothesis that growing firms make more use of external resources and found: 1) growing firms used networking 64% more than average 2) low growth firms exhibit the opposite behavior.

Transaction Theory of Networking

Williamson (1979) offered a “transaction costs” approach to firm networking. His model is more in line with the classical economic model where firms explicitly take into account the transaction costs of establishing and maintaining business linkages in the overall objective function of cost minimization. In this model, as the firm engages in the production of a product that includes components and sub-components, necessary business linkages must be made in order to produce the final integrated product. The business linkages incur costs that are ultimately included in the price of the product. This model is heavily influenced by the traditional supplier network framework in which business linkages are conceptualized in the context of various suppliers, each of which is necessary to provide a certain component or service in the final production of a product.

Dyer (1997) used the "transaction cost" theory developed by Williamson (1975) and suggested that transaction costs, contrary to Williamson's theory, do not necessarily increase with the number of relationships in which a firm engages in. Dyer suggested that firms in a production network can maximize transaction value which is asset specialization and lower transaction costs. Dyer examined five variables: (1) firm commitment to supplier to engage in repeated exchange; (2) scale and scope of exchange between firms and suppliers; (3) inter-firm information sharing; (4) safeguards used in interactions; (5) investments in co-specialized assets. The author found that beyond minimizing transaction value, a firm’s trustworthiness can be a source of advantage because it minimizes transaction costs. Trustworthiness also helps in greater information sharing and longer investment payback time. An important finding was that building trust and engaging in repeated business is not without cost. The cost of building trust includes the opportunity cost of not taking advantage of one's suppliers and the loss of the opportunity to use lower-cost suppliers.

Competitive Advantage Theory of Networking

The classical competitive strategy paradigm (Porter, 1985, 1986, 1991) offers another context for understanding entrepreneurial networking. This paradigm views a firm as an independent entity engaged in entrepreneurial activity to enhance its relative competitive advantage. Business networks are considered as part of a firm's "activities" and the firm’s "competitive advantage results from [its] ability to perform the required activities at a collectively lower cost than rivals ... A firm’s strategy is manifested in the way in which it configures and links the many activities in its value chain relative to competitors." (Porter 1991, p. 102). In Porter's model, reproduced in Figure 5, networks do extend outside the firm to include the activities of suppliers, channels, and customers. Porter's model is an integrative approach that includes both the Williamson's "transactions cost" approach and von Hippie's "user innovation" approach. Business network activities are simply part of the firm's "value chain" in producing a product (Porter, 1985) and are part of the components of Porter's value chain: firm infrastructure, human resource management, technology development, procurement, inbound logistics, operations, outbound logistics, marketing, sales and service (Porter 1985, p. 37).

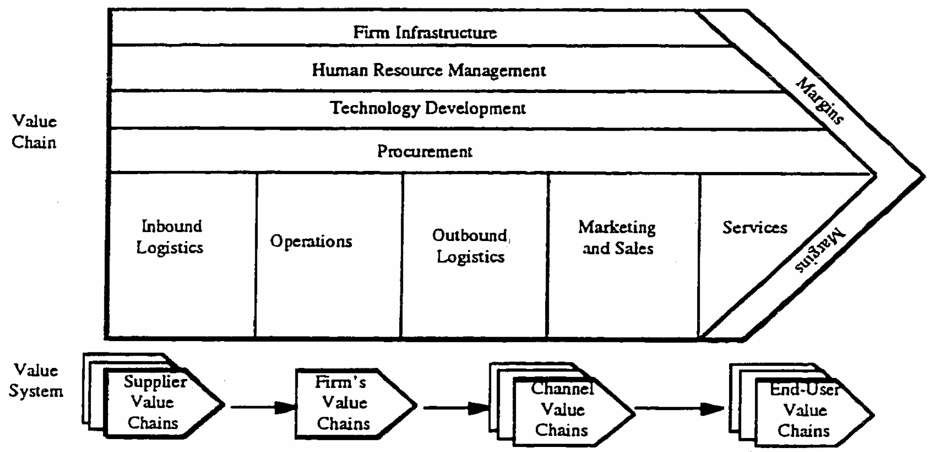

Figure 5: Porter's Value Chain. ***Source: Porter 1991***

Shah (1990) suggested a product life-cycle approach to firm networking. He proposed a model which suggests that the propensity for firms to establish relationships (cooperative, information sharing, joint ventures) is dependent on the time at which technology ceases to yield economic rent. In his model, shown in Figure 6, there is a point at which a firm is indifferent between cooperation and independent operation. Shah suggests that in the early phases of a new technology development, there is a need for large research and development outlays and, as a result, there will be a tendency for firms to cooperate in order to share the large amounts of research and development expenditures. However, if a particular technology is evolving such that most, if not all, of the front-end developmental expenditures are sunk, then the propensity to operate independently increases. Shah conducted an empirical investigation of his model, in which he found that there is a significant relationship between the competitive position and cooperative behavior of firms.

His results show that a firm's expectation of improving its competitive position is one of the primary motivations for “strategic alliances.” However, these cooperative arrangements will not remain a viable organizational approach in the long run.

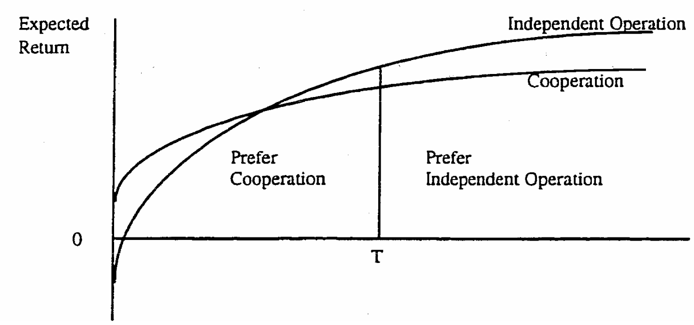

Figure 6: Shah's Life Cycle Approach. ***Source: Shah 1990***

Other efforts examined entrepreneurial networking in the context of a firm's competitive advantage (Brown and Butler, 1995; Jarillo, 1988). They provide frameworks that (a) examine inter-organizational networks as a means for small entrepreneurial firms to gain some strategic advantage over the larger, more established competitors and (b) provide a better understanding of the cooperative behaviors and relationships of a firm.

Social Context Theory of Networking

Aldrich and Zimmer (1986) view entrepreneurship as a process and suggest that as part of that process, certain networks or relations between and among key components is established. This directly supports the National Business Incubator Association’s position that incubation is a process.

Aldrich and Zimmer proposed a paradigm for studying entrepreneurship through “social networks" and define these social networks as relations or transactions among people. These relations contain: (1) communications (i.e., transfer of information); (2) exchange content and (3) normative content or the expectations of people with respect to exchange. A network is defined as "the totality of all persons connected by a certain type of relationship and is constructed by finding the ties between all persons in a population under study..." Dimensions of networks are: density (i.e., extensiveness of ties); reachability (i.e., path or link between two people); and centrality (refers to the focal person's ability to reach the members of the network). The authors discuss the role of a "broker" in the network, without whom numerous one-to-one relationships would need to be created. The authors also discuss the notion of the diversity of network: the stronger the ties with network elements, the better the competitive advantage of the firm. "People with a more diverse role set, connected to distant others via brokers or other intermediaries, will have access to a wider range of information." An incubator could be viewed as the “broker” in this context.

Van de Ven (1993) discusses the role of the individual entrepreneur in the context of a social system and networks. He suggests firms establish cooperative relationships with suppliers, distributors and customers in order to make their own activities more meaningful. Common forms of networks include exchanging multiple resources, communicating and exchanging information with other firms in trade organizations, sharing common pools of knowledge, etc.

Bloodgood et al. (1995) suggest that economic imperatives alone do not determine the entrepreneur’s propensity to network. Rather, there is a broader social context that influences an entrepreneur's decisions on networking activities. While economic factors often lead to inter-organizational relationships, "non-economic ties often bind and maintain relationships key to the survival of the entrepreneurial venture." In this context, there is clearly interplay between the economic and social motives in entrepreneurial activities."

Impact of Networking on Firm Performance

Why do firms engage in networking? This question has been explored extensively in the literature. What appears to have emerged as a conclusion from numerous research efforts is that entrepreneurial networking positively influences firm performance (e.g., Covin and Slevin, 1991; Zahra, 1993; Hansen, 1995; Human and Provan, 1997).

Building on the original conceptualization by Covin and Slevin (1991), Zahra (1993) introduces a model for firm-level entrepreneurship in which the relationship between entrepreneurship and firm performance is postulated. First, the model, reproduced in Figure 7, recognizes that there are both financial and non-financial outcomes associated with a firm’s performance. Second, the model acknowledges the possibility that growth and profitability are not always guaranteed through firm-type entrepreneurship. Third, both financial and non-financial aspects of venture performance are useful measures that need to be considered at appropriate stages of a venture process.

The model suggests certain relationships between firm-level entrepreneurship and a number of components as follows: (1) external environment; (2) strategic variables; (3) internal variables; and (4) firm performance. In this model, establishment of business linkages is part of the strategic variable component.

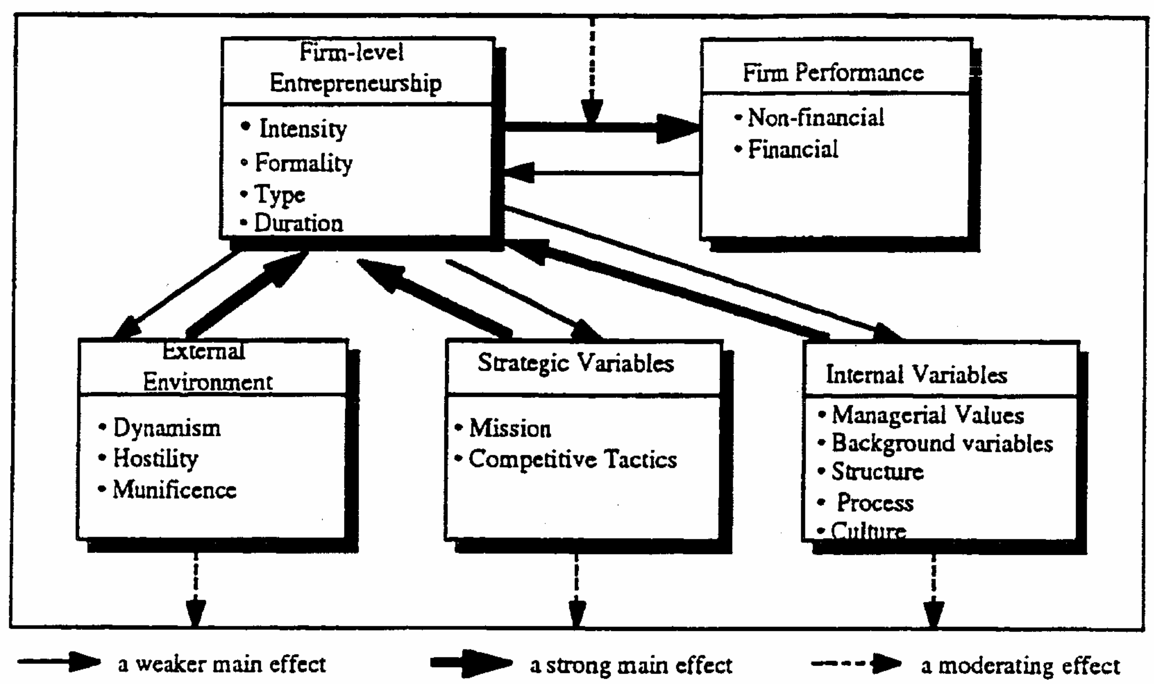

Figure 7: Firm Level Entrepreneurship Model. ***Source: Zahra 1993***

Hansen (1995) suggests that entrepreneurial networks (or "action sets") are linked to first year new organization growth. In a structured interview of 44 entrepreneurs, he examines three pre-founding entrepreneurial network variables: (1) size of network; (2) degree of interconnectivity within the network; and (3) frequency of interaction among the members of the network. The hypotheses that these variables positively influenced first-year growth were strongly supported.

Medcot (1996) examines the management aspect of external networks. He suggests that external networks are increasingly becoming a complex activity and have evolved from the notions of internal technology networks or single-partner collaborations. In examining the management complexity of networks, the role of information technology, organizational culture, disclosure policies, human resources, strategic networking, and harmonization with networks are addressed.

While incubators are recognized for their ability to create networks, no research could be identified that specially addressed the issue of the management of complex networks by incubators.

Shaw (1993) studied 34 medical equipment innovations in the UK with respect to the impact of entrepreneurial networking in creation, development, design, manufacturing, and marketing activities. He found that entrepreneurial networks facilitated the process of learning by doing, learning by using and learning by interaction. During the learning process, capital and human resources were leveraged for technological and economic development. External linkages enabled entrepreneurs to accumulate knowledge and take advantage of existing research. Collaboration with users and other key players in the network facilitated a more effective prototype development, testing, evaluation and marketing process. This also led to the diffusion of research and developmental costs among a subset of the network members.

Zhao and Aram (1995) studied six new technology-oriented entrepreneurial firms in China. Three high-growth firms reported more external relationships and greater interaction frequency with external networks than the remaining low-growth firms. They conclude that networking positively impacts firm growth, especially in the early stage of a firm's development. The high-growth firms found that the time and expense due to interacting with networks were justified given the realized benefits.

Donckels and Lambrecht (1997) studied 900 entrepreneurs in Belgium to examine their network behaviors and explore the impact on firm performance. Two industries were examined: manufacturing and service. The authors found that firms in both the service and manufacturing industries used external consultants and that growth was partially supported by networking activities.

Sarder, Ghosh and Rosa (1997) studied 161 small business firms in Bangladesh to examine the impact of business assistance on the performance of these firms. Support services were defined as "any assistance, financial or non-financial, provided by any organization, public or private." Four performance measures of growth in sales, growth in employment, sales per full-time employee, and value added per full-time employee were used. The authors identified several types of assistance: financial, marketing, management education and training, technical, consultancy, information and common facilities. The results indicated that the effect of support services were significant and varied according to which performance measure was used. While the support service variables were significant, the correlations were low, suggesting that most of the variance in any particular small firm performance was unaccounted for by the influence of support services.

Dean, Homes and Smith (1997) analyzed the impact of networking on firm performance, using a broad definition of performance, and found the following benefits of networking: (1) profits/profitability; (2) sustainable growth; (3) exchange of information; (4) quality of product or service; (5) business recognition; and (6) expansion of sales.

Brown et al. (1990) and Brown and Butler (1995) examined inter-organizational networks as a means for small entrepreneurial firms to gain some strategic advantage over the larger, more established competitors. They proposed a dynamic networking model which distinguishes various networks as a function of the entrepreneurial process (reproduced in Figure 8). Their examination was in the context of entrepreneurial marketing perspective and how networks impact market share growth and capture in the winery industry. Using a small sample of 54 small wineries, the authors tested four key hypotheses: (1) social networks are important during startup phase, but less so after firm establishment; (2) stakeholder networks are important when the firm is established; (3) competitor networks are primarily used to obtain strategic and functional information important to the firm after the startup phase; and (4) stakeholder and competitor networks contribute significantly to improved market growth and product introduction. The survey was based on how much time was "spent building networks" and the results were mixed.

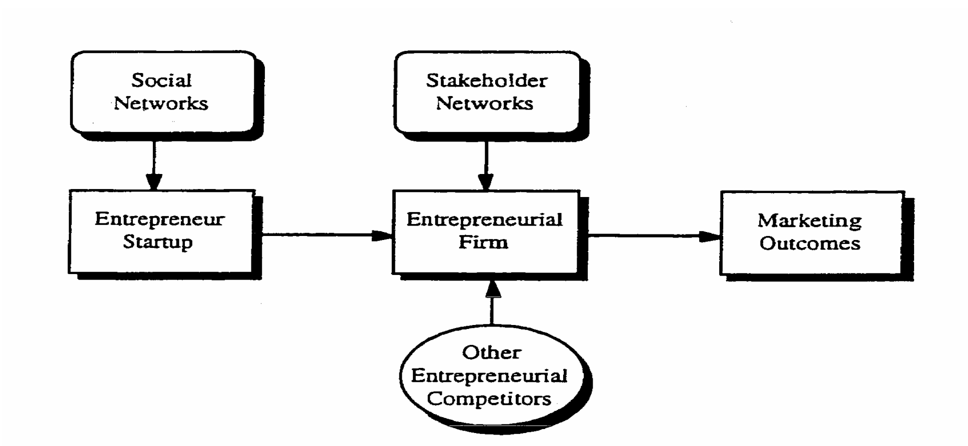

Figure 8: Dynamic Networking Model. ***Source: Brown and Butler 1995***

Conversely, Carsrud, Gaglio and Olm (1987) in their study of 197 female-owned firms did not find that mentoring and network contacts improved firm performance**.** This did not support their theory that social networks improve firm performance (Aldrich and Zimmer, 1986). This may also be attributable to gender specific issues and warrant further review.

Timmons and Bygrave (1986) studied the impact of venture capital on technology oriented firm performance. They found that successful venture-capital investing in technologically innovative firms require more than just risk capital. Successful entrepreneurs seek out venture capitalists that can provide high value-added benefits to them such as helping to find and select key management members, providing credibility with customers and supplies, and helping to shape strategy. Venture capitalists possess specialized know-how, including a web of contacts and networks and great intensity of involvement. The result of the comparative analysis of highly innovative technological ventures and least innovative technological ventures suggests that successful venture capital involvement is positively related to highly innovative technological firms.

Ostgaard and Birley (1996) in a study of 159 entrepreneurs in England explored the effectiveness of personal networks in terms of firm performance and growth. The results indicated a link between the entrepreneur's networking behavior and the growth of the firm.

Management of Networks and Barriers to Networking

Starr and MacMillan (1990) discuss the role of social contracting strategies by independent and corporate entrepreneurs in acquiring resources for new ventures. The authors suggest that entrepreneurs develop social assets primarily as means to secure resources for their ventures. The entrepreneurs then leverage their social assets by building them into a network. In particular the authors provide some discussion as to why entrepreneurs of new ventures are generally less likely to take advantage of external networks or inter-organizational resources. The first reason is that these networking activities often take too much time:

> "...can be hazardous to fragile new ventures, where timing, action, and social interaction are critical. Further, social network resources are 'soft', affective, and emotionally charged, with uncertain tangible value ... [entrepreneurs] are conditioned by their corporate experience to be incapable of amplifying, and trained to look with disfavor on begging, borrowing, or scavenging" (Starr and MacMillan, 1990, p. 89)

Second, organizational procedures may not allow building of social assets and networks. Third, inter-organizational relationship building often cannot be planned. Traditional strategic planning techniques rarely recognize the realities of managing inter-organizational collaborative efforts. Finally, entrepreneurs need time to build social assets and develop networks.

Dean, Holmes and Smith (1997) suggest a number of factors identified as inhibiting networking: (1) concerns with information disclosure; (2) want to remain independent; (3) uncertain assistance to business; (4) distrust of other firms; (5) lack of suitable partners; (6) increased risk to firm; (7) lack of suitable information/guidance; (8) uncertainty with initiating network; (9) financial resources; (10) lack of personal contacts; (11) size of business; and (12) geographical distance.

Network Groups

In this section, literature that relates to specific network groups will be discussed. Network groups are distinct entities with whom an entrepreneur establishes relationships. These groups include customers, suppliers, financial entities, strategic partners, consultants, and trade organizations.

Customers and Suppliers

Customers and suppliers are the life line of the entrepreneur and his or her enterprise. For early-stage high-technology firms the relationship between them and their customers and suppliers are often key determinants of business success or failure. Early rapport with customers, gain of their trust and business, establishment of a long-term relationship, individual attention and delivery of needed products determine the stability of the revenue stream and, thus, the ability to refine and innovate for repeated and continual business. A similar close relationship with suppliers can determine the quality of the product or service being provided and the timeliness of that product and service.

A number of research efforts have been undertaken to better understand the relationship of the entrepreneur with its customers and suppliers. For example, Holm, et al. (1996) suggest that cooperation between supplier and customer firms can raise the value of business relationships and that business network connections have an impact on cooperation. In analyzing a sample of 136 international business relationships, they found that relationship benefit is directly affected by relationship commitment and indirectly through commitment by business network connections.

von Hippie (1988) has shown that interactions between suppliers and customers help to bring about product innovation. In particular his theory suggests that customers or users are a significant partner in the process of innovation and play an active role in product development. In examining the sources of innovation, von Hippie studied innovations that have taken place in the field of scientific instrumentation. He examined some 100 highly technical innovations and their histories. He found that 77 percent were developed by the users as: (1) first to innovation; (2) major improvements; (3) or minor improvements. von Hippie has shown that close relationships between suppliers and customers provides firms with the most important source of innovation. As shown in Figure 9, he conceptualizes networks as a mode of organization than can be used by managers or entrepreneurs to position their firms in a stronger, competitive stance. He focuses on the notion that firms "farm out" activities to the most efficient supplier, and keeps internal to the organization those activities in which it has a comparative advantage, and lower transaction costs.

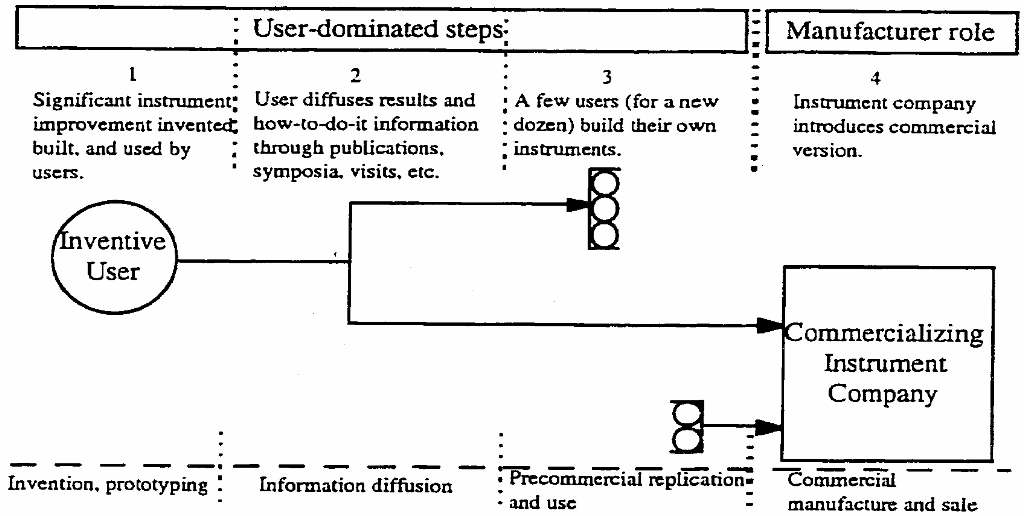

Figure 9: von Hippie Supplier-customer model. ***Source: von Hippie 1988 p19***

Another case depicts a model of supplier networks used by Japanese manufacturing firms (Imai, Nonaka and Takeuchi, 1985). The model, reproduced in Figure 10, describes how large Japanese companies, in general, and the case firms studied, in particular, use supplier networks. In this topology, three business network types are described. Affiliated networks are those companies that supply raw material and parts or serve as sales organization. Supplier networks are comprised of small to medium firms that manufacture and process parts. R&D networks are those research organizations (public or private) that engage in cooperative research and development activities.

This conceptualization is a departure from the competitive strategy or economic transaction cost paradigms in the sense that it suggests a broader and more complex entrepreneurial behavior---one that is not bound by the former economic paradigm. Rather, it is more suggestive of the classical supplier-customer paradigm.

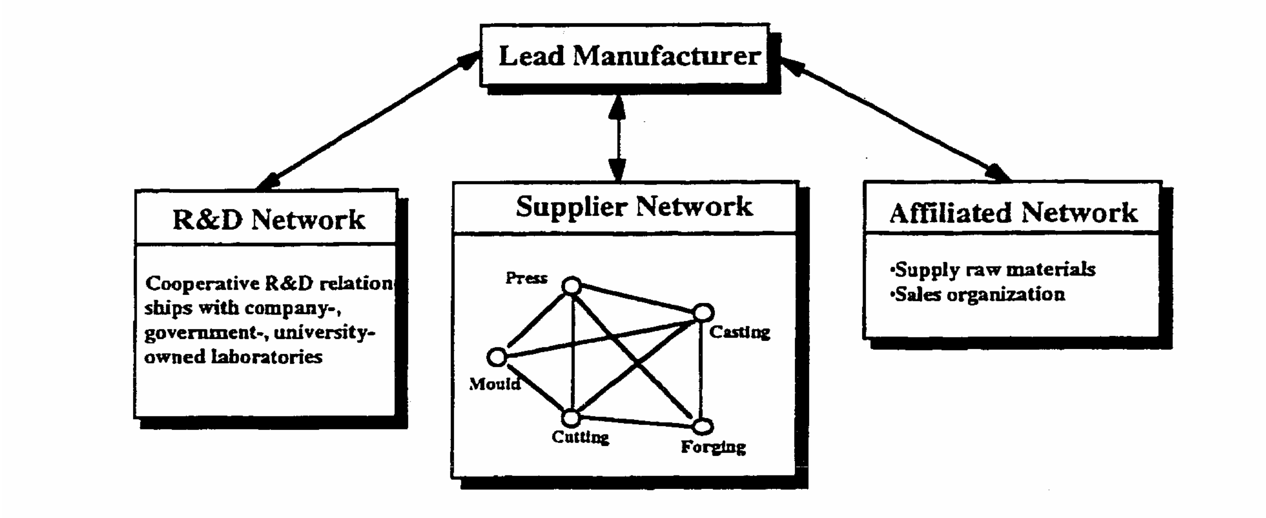

Figure 10: Imai Supplier Network Model. ***Source: Emai 1985, p.552***

Zeffane (1995) examined the role of networking as it relates to supplier relationships. He found that outsourcing is a fundamental strategy in certain small high-technology companies and, as a result, a key aspect of the entrepreneur's overall network position.

Trade Organizations

One approach for the entrepreneur, especially in the high-technology industries, to maintain current knowledge of products, markets, and technologies is through the use of trade organizations. This is especially important to entrepreneurs in the high-technology sectors since the product development cycles are extremely short and time-to-market periods are compressed. As a result the entrepreneur must gather all pertinent information at an acceptable cost and utilize the information to take appropriate actions. Trade organizations and trade activities can be effective and inexpensive in achieving this objective.

Consultants and Advisors

Consultants and advisors play an important role in helping the entrepreneur initiate his or her enterprise and help provide needed expertise throughout the early development phase of the business (Day and Reynolds, 1995; Birley and Niktari, 1995). Entrepreneurs in high-technology industries tend to have higher levels of experience in their technical field, while lacking adequate experiences in other dimension of running an enterprise, such as management, human resources, legal, financial and the like. Research has shown that the use of consultants by entrepreneurs during the early stages of enterprise development is primarily to compensate for a lower level experience or expertise in certain areas (Bayer, 1991). Additionally, these entrepreneurs often do not have the time or resources to engage in long term planning (Robinson 1982). In this context, numerous studies have examined the use and role of consultants and advisors in helping entrepreneurs with their enterprise development (Kentzman and Samaras, 1960; Golde, 1964; Robinson, 1982). Some research has shown that the use of outside consultants and experts positively influences firm performance (Donckels and Lambrecht, 1997).

Certain government initiatives and programs have been designed to provide needed business consulting and expertise in support of small businesses. These programs include Small Business Development Centers (SBDCs), Service Corps of Retired Executives (SCORE), Active Corps of Executives (ACE), the Small Business Institute (SBI) and the newly opened SBA National Entrepreneur Centers. These consulting services are generally thought to contribute positively to a firm performance. For example, some research has found that the consulting services of SBDCs positively impact firms' performance (Sonfield, 1981; Robinson, 1982; Chrisman, 1985; Chrisman and Leslie, 1989; Pelham, 1985; Nahavandi and Chesteen, 1988). In one analysis of the impact of SBDCs, Chrisman and Leslie (1985) found that outside counselors provided in the SBDC programs realized a short-term reduction in costs, as opposed to an increase in revenues with such outside assistance. Those receiving strategic assistance as well, however, achieved the highest performance advantages.

Financial Sources

Financial sources constitute another key part of the entrepreneurs' business network. Entrepreneurs need financial assistance, primarily, for three reasons: (a) to diversity or spread the start-up risk; (b) to accumulate start-up capital; and (c) to finance growth and expansion (Gnyawali and Fogel, 1994). For the most part, commercial financing and most venture capital financing are not available to small early-stage enterprises due their risky and uncertain future. Established firms with proven products and market share are more likely to obtain commercial and venture capital funds.

Additionally, small early-stage enterprises do not prefer financing strategies that result in trading equity for funds and erode their control over the enterprise before they are ready. Several studies have considered the attitudes of the entrepreneurs towards financing. Some empirical studies have found that entrepreneurs in general prefer funds generated internally or their own personal funds since these would ensure control over the operations and assets of the firms (Holmes and Kent, 1991; Landstrom and Winborg, 1995). In the event that debt financing becomes necessary, entrepreneurs prefer short-term debt, often via business credits and other means, since this does not demand any collateral security.

With respect to the sources of financing for small start-up firms, research has shown that entrepreneurs' own funds constitute the major source (Van Auken and Carter, 1989; Holmes and Kent, 1990). This research also concludes that loans from family and friends are commonly used by small firms.

In a study of 160 small firms in Indiana, Birley (1985) examined the role of formal and informal networks in regard to starting a venture. In particular, she found that formal networks came into play when dealing with securing funding from external organizations. Banks were cited as the primary source. External funding of the business was the primary help the business needed and the use of formal networks is considered key in securing this type of financing arrangement.

Freear and Wetzel (1990) studied 284 technology-based firms founded in the New England region to determine the source of equity capital financing of new high-technology firms. They found several sources of financing for these firms: entrepreneurs and their relatives; private individuals; venture capitalists; non-financial corporations; and public stock offering. Private individuals (excluding entrepreneurs and family) were the most common source of equity capital. For all investors, the size of the amount financed increased with the stage of the financing (i.e., seed, start-up, first-stage). The finding of the research is that private individuals tend to invest more heavily in the early stages of development. Venture capital financing tended to occur at later stages of development.

Alliances and Partnerships

It has been well established that technology can and should be used to enhance a firm's competitive advantage in the marketplace and it should be an integral part of the firms overall business strategy (Porter, 1985). Small technology firms in emerging high-technology industries face the challenge of rapid changes in technological development that provide both opportunity and risk. A firm’s ability to pursue the application of new technologies in product innovations and successfully marketing these products is the major determinant of its success or failure. Often, however, a firm does not possess all the necessary skills or technologies to pursue new product innovations in a timely manner. In industries where technology changes are occurring in an ever increasing manner, small firms face the challenge of maintaining its internal core competencies on a par with the rapid pace of technology. As a result, small technology firms are using "strategic alliances" as an explicit part of their overall strategy.

A variety of terms have been used in the literature to describe the relationships between organizations when they collaborate for strategic reasons: strategic alliances, partnerships, co-operative agreements and the like can be found throughout the literature (Porter, 1985; Porter and Fuller, 1986; Mariti and Smiley, 1983; Harrigan, 1985; Adler, 1966; Varadarajan and Rajaratnam, 1986). Forrest (1990) provided a proposed taxonomy of these alliances. This taxonomy is presented in Table 5.

Table 5: Forrest Taxonomy of Alliances ***Source: Forrest 1990, p. 39***

Joint Venture	An independent third enterprise formed by the company with another company. Assets are contributed by both parties, who also share the risk.
Equity investment	An investment by a large company in a smaller technology firm.
Client sponsored research contract	The small company is paid to conduct research on particular products or processes for another organization.
Marketing/distribution agreements	Agreements whereby another company will market and distribute the small technology based firm's product.
Manufacturing agreements	An agreement whereby another company agrees to manufacture products for the small technology based firms.
University agreement	An agreement with a university whereby the small technology based firm pays the university to conduct research on its behalf.
Research institute agreement	Similar to above but with a research institute.
Collaborative R&D	An agreement between the small technology based firm and another company to collaborate on the development of specific products or services.
Research and development limited partnerships	A tax advantaged investment vehicle which provides funding for new product R&D at no cost to the company. The company retains ownership of the technology and receives royalties if commercialized.
Technology licensing (Inward)	A contractual arrangement by which the small technology based firm is granted access to another company's patents or technology for a fee (usually royalties).
Technology licensing (outward)	The reverse of above. In this case the small technology based firm receives royalties from another company for allowing use of its technology.

Malecki and Tootle (1996) examined the behaviors of firms with respect to the role played by networks in information flow as it relates to firm competitiveness. They suggest that for large firms, formal ties, such as strategic alliances and joint ventures are common, but for small firms more flexible, informal connections are the norm.

Osborn and Hagedoorn (1997) conducted a review of the various theories and views concerning alliances and networks. In particular they reviewed three types of alliance and network paradigms: R&D collaborations, international business perspectives, and transaction approach. The authors discussed management issues with respect to alliances and networks, the impact of technology on networks, social and individual characteristics, and institutional issues. The authors concluded that there is a need for an integrative theory to help in further understanding of alliances and networks.

Research has shown that small, start-up firms consider forming alliances key to their initial success, especially in the high-technology industries (Freear et al. 1995; Birley et al. 1991). In one study of the software industry, results indicated that some 67 percent of the entrepreneurs considered forming alliances to be an important factor in their initial success (Freear et al. 1995). In another example, between 1973 and 1989 over 2,200 cooperative agreements were formed between start up and established firms in the biotechnology industry (Barley, Freeman, and Hybels 1991).

Environmental Factors Impacting New Venture Creation

Given a satisfactory market opportunity, there are a number of environmental elements that must be in place to support a successful start-up. William B. Gartner (Gartner, 1990) lists ten ingredients that are most important to successful venture creation:

- Suitable financing
- Availability of a competent workforce
- Accessibility to helpful suppliers
- Government support, or at least the absence of obstacles
- Proximity of universities to assist in research
- Availability of land or facilities
- Access to transportation
- Support of local population
- Available support services - secretarial, telecommunications, etc.
- Low entry barriers

Each of the above factors is important. Some of them may be more critical to one venture and not another, but all of them have a considerable role in ensuring new venture success. Proximity to universities is noteworthy in two respects. In high tech start-ups where new inventions or technologies play a dominant role, these institutions can make significant contributions to a successful start-ups through research, problem solutions and engineering support. Another benefit of the university is often its business school and the availability of consulting services in terms of marketing, production systems, MIS, accounting and finance advice, etc.

Benjamin Mokry suggests that in order to create a more receptive environment for entrepreneurship, a number of fundamental societal changes must occur (Mokry, 1984). He supports the major truism that “local communities are the breeding ground of entrepreneurship” and are capable of creating an environment favorable to it. Mokry has added two factors to Gartner’s 10 factors that affect entrepreneurial success:

- Existence of an entrepreneurial sub-culture. The tremendous success of Silicon Valley, Boston, Austin and San Diego very much support the notion that entrepreneurs feed off each other in a synergistic fashion and create their own dynamic environment.
- Incubator organizations, many of which are initiated by local universities and governments as enterprise centers.

Prior research also concluded that technology business incubators located in urban areas and / or associated with a university provide value added services that are correlated with improved client performance at a higher rate relative to non-urban incubators and incubators that are not associated with institutions of higher education. (Tornatzki, et al., 1996)

Lewis’ recent research supports the fact that younger incubation programs that adopt best practices can achieve great success (Lewis, 2003). Lewis states that while temporal factors play an important role in the maturation of incubator programs, some younger programs also achieved top-performing program status. Of the sixteen top-performing programs in terms of graduate firm revenue, two were in operation for only two years and a third was operating for only three years. Though anecdotal, the success of these programs implies that younger programs can reach optimal performance relatively fast. However, the success of these younger programs may have been the result of one or two star graduates whose revenue and employment skyrocketed. This theory is also supported by the UCF Technology Incubator's ability to become a top ten technology incubator within a few years and then to become the 2004, National Business Incubator Association's Incubator of the Year in only its fourth year.

Conclusions

The literature illustrates the difficulty of incubator research. There is a wide variety of perspectives and a small amount of research. The fact that the incubator phenomenon is relatively new is a factor contributing to the scarcity of research. Another factor is the difficulty involved in the conduct of the research. As discussed in the literature review, these problems include:

- Complex multiplicity of needs and objectives
- Wide range of approaches
- Too many possible combinations
- The need for contextual approaches to understanding
- Many different objectives, different metrics

ENDNOTES

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[1] This story along with several others can be found at: http://www.geocities.com/capitolhill/2817/govern.htm

[2] The Florida High Tech Corridor Council (FHTCC)was formed as part of the effort to keep what is now called Agere Inc. in Orlando, FL. The FHTCC mission now is to grow, attract and retain High Tech Industry in an eleven county region that covers Central Florida from coast to coast.

[3] This comes from personal conversations with Agere management and while accurate at the time of writing, could change as with any business decision.

[4] NSF's Partnerships for Innovation Program is a modern version of this program that continues to provide funding to help communities capitalize on innovations.

[5] This is from first hand knowledge of the author as the UCF Technology Incubator had secured funding for its incubator from the legislature. The state's Innovation and Commercialization Centers funding was also vetoed that same year.

[6] The National Business Incubator Association's most recently available figures indicate that 75% of incubators are non-profit.

[7] Udell (1990) and Bearse are especially critical of self reported measures of success.

[8] The NBIA web site allows for four categories of membership: Incubation Professional defined as an organization that operates; sponsors or is developing an incubator; an Associate as an organization that operates, sponsors or is developing an incubator or represents an economic development agency or other non-profit organization; or a consultant or small service provider and corporate or large service provider.

[9] In principle, a research park (a.k.a. a science park) is a location for the conduct of basic research; a technology innovation center is a location for commercializing the results of basic research; and a business incubator is a location for fostering the development of new or young businesses. In practice, a

great deal of convergence amongst these three organizational forms has emerged; differences are in scale of operations and expectations.

[10] Business Accelerator was often used when the term incubator reflected negatively on a client company's stage of development. The term Venture lab is synonymous with Georgia Tech's well respected program. Innovation and Commercialization Centers are often associated with the public / public partnerships that lead to corporation such as the Central Florida Innovation Center and five (5) other such centers in Florida in the early 1990's.

[11] The emergence of virtual incubators is problematic because it is questionable whether they can be considered ''bona fide'' (Bearse, 1998) incubators. If they can be considered incubators, then implicitly any entity that provides business assistance services can also be considered an incubator. This significantly increases the population and heterogeneity of incubators, further constraining the ability to generalize research findings.

[12] Campbell et al. (1985) are the rare group of scholars who attempt a definition, defining the value-adding process of incubation as follows: "(1) The diagnosis of the total business needs of a new business, from the collective experience of a diverse group of business generalists and specialists. (2) The cost-effective selection, provision and monitoring of the acquisition, implementation and coordination of the various business services needed by the new business. (3) The provision of capital—if needed—to pay for product development and the business services provided by third party professionals. (4) The provision of a growing network of business development expertise." They locate this process inside the incubator. Alternatively, Brooks (1986) identifies the incubation process as a set of activities occurring in the community where the incubator is located. These activities include educating members of the community regarding the theoretical benefits of entrepreneurship and demonstrating the benefits of launching entrepreneurial ventures.

[13] Readers interested in learning how to conduct an incubator feasibility study should see the following: Bazan (1987); Meeder (1993).

[14] This is not a trivial undertaking from my personal experience. Keeping an incubator filled with perfect clients will never happen in real life.

[15] Rice (2002) provides a comprehensive discussion on the passive intervention effects associated with incubators.

[16] Resource gaps can include, for example, a lack of access to information, a lack of access to potential customers, a lack of expertise required to complete new product development, a lack of access to expensive equipment, or a lack of access to funding sources.

[17] Some clients that fall in the category of “don’t need incubation,” especially ones that have a high chance of success, are often the clients incubators seek most to help them show success.

[18] For additional examples: Brooks (1986); Campbell et al. (1985); Lumpkin and Ireland (1988); Smilor (1987b); Temali and Campbell (1984)

[19] Merrifield uses items related to business attractiveness and fit including finance, legal, regulatory, manufacturing, management, marketing, distribution, and technology factors.

[20] Initial Success is a function of Initial Quantified Success, comprised of: (Sales Growth, Employment Growth, Profitability, ROI, Sales/ Employee, Sales/Assets) and Initial Subjective Success (Original Expectation, Attainment, Probability of Survival, Ability to Attract Outside Capital, Employee Satisfaction, Contributions to Society).

[21] By definition, Incubator client studies are only at the level of the venture. Dimensions of community and incubator would not be meaningful.

[22] See, for example, Allen and Rahman (1985); Hansen et al. (2000); Markley and McNamara (1995); Safraz A. Mian (1994); Roper (1999); Sherman (1999); Smilor (1987b); Temali and Campbell (1984)

[23] Richard Fox with the Central Florida Innovation referred to the gaps as the Fatal Flaw in their Business plan.

[24] This gap is often referred to as the “Valley of Death” (Branscomb and Aurswald, 2002).

[25] $Q = cRP^{d}CP^{e}$: Q = value-added output (incubation process); c = a scaling factor; RP = regular producer (incubator manager) inputs; ^{d} = output elasticity; CP = consumer producer (incubatee) inputs; ^{e} = output elasticity.

[26] Originally published in 1958, Max Weber's life spanned from 1864 – 1920.

[27] NBIA evaluations of sessions that feature research findings are not well attended and negative feedback sited the session as being too academic.

[28] Harrison et al. (1996), Malecki (1997) and Markusen (1987) all provide good reviews of the regional development literature regarding innovation and agglomeration.

[29] Lewis used constant 2000 dollars. His survey was based on 65 (83.3%) responses to the operating costs in 1995 questions, and 70 (89.7%) responses to the operating costs in 2000 questions.

[30] Sources: The industry average and results from previous research on technology incubators use sample data (Culp 1996; Wolfe et al. 1999, 2000, Lewis 2001). Lewis' survey consisted of a population of technology incubators only.

[31] These numbers do not equal 100% due to rounding errors.

[32] Lewis again used constant 2000 dollars to calculate these values.

[33] Feller (1992, 1997) and Coburn and Brown (1997) present evidence that States are increasing their role in the national innovation system both as a result of federal devolution and as a catalyst for economic growth.

[34] These figures are from the national survey by the Department of Commerce of all technology incubators in the United States, established prior to 1999 and still operating in June 2001.

[35] Universities are under pressure to develop and implement effective assessment tools as part of their review and accreditation process.

[36] A complete description of the Rensselaer Incubator can be found on their web site at: http://www.rpi.edu/dept/incubator/homepage/mission.html

[37] The proposed incubator will be a partnership between the City of Orlando, the University of Central Florida’s Film Department, the UCF Technology Incubator, and a Hollywood, CA based production company.

CHAPTER THREE: RESEARCH METHODOLOGY

The goal of this dissertation is to better understand which factor(s) are key to incubator client success. After combining a comprehensive literature review with extensive personal experience in operating an incubator, the research question of most interest that needs further understanding is the following:

Definition of Research Question

What practices of University Technology Incubators create the largest increases in employment growth of incubator client firms?

A Priori Constructs:

Previous literature (main references cited below) combined with personal observations have led to the following preliminary assertions / constructs:

- Successful incubators are a part of a larger local economic development system and their success is significantly tied to the larger development system. [Gartner, 1990; Smilor, 1987]
- The best incubators fill in the gaps by connecting local, often disconnected resources, thereby allowing companies to fail or succeed because of market forces, not because of their entrepreneurial or other business skills. [Lewis, 2003]
- Areas that take advantage of “Steeples of Excellence” which they are able to draw upon contribute significantly to startup companies and hence incubator success. [Lewis, 2003; Tornatzki, 2003; Shane, 2004]
- The selection process for incubator clients significantly biases incubator client success measures.

<u>Case Selection</u>:

The population from which cases will be selected is university affiliated technology incubators in the United States. Cases will be selected by examining survey data from the following: a recent US Department of Commerce study (Tornatzki 2003); and David Lewis' research (Lewis 2003). Those university technology incubators identified by the studies whose firms show the largest increases of jobs will be selected. Incubator firms that demonstrate the lowest job creation numbers will also be examined to help contrast practices.

Various tests were conducted using statistical software packages such as Minitab, SPSS, and Matlab to identify any significant factors or groups of factors that correlate to the primary and secondary outcomes. Secondary measures of client performance interest include: total investment received; research grant support; patents held; copyrights held; and licenses.

Once this was done, IRB approval was acquired.

The number of case studies included in the project depended on the data collected. Case studies will be added until the saturation point discussed in Eisenhardt's (1989) paper is reached.

<u>Instruments and Protocols</u>

Instruments will be constructed and modified prior to and during the data collection process. These instruments will help combine the various data collected from multiple sources. Data for this dissertation will come from interviews, observations, and archival sources. These instruments will help to triangulate the evidence collected from these various sources.

It is speculated that the integration of the incubator into a larger system will be achieved largely through networking type activities. The importance of networks has been discussed in the literature review. Unlike many other types of network settings, incubators have clearly demarcated boundaries -- it is easy to determine who is included and who is not, thus making them well-defined. This is an important attribute for limiting the research task as well as for drawing conclusions from the data.

The permission of the incubator managers and clients will be obtained prior to collecting data for this dissertation. Included in the request will be a commitment to share the results of the findings with the participants in the study.

As an additional reference point, a reflective case study of the UCF Technology Incubator will be provided, detailing many of the operational and historical elements that have influenced the incubator's growth. The incubator has received national recognition as a best practice and model for success that includes receiving the National Business Incubator Association's highest honor, Incubator of the Year, 2004, after being in operation for less than five years. It was ranked in the top 10 in terms of revenue growth of clients and increases in jobs (Tornatzki, 2003) in its third year.

Entering the Field

The subject of networks and their significance for incubator success is a relatively unexamined issue. For this reason and because developed networks within incubator settings are not often documented, the research is exploratory and descriptive in nature, not explanatory.

Data Collection

To help insure data integrity, multiple sources of evidence will be secured, a case study data base will be created, and a chain of evidence will be maintained. Data will be collected through in-depth interviews, client observations, and examinations of existing documentation. In the case of the UCF Technology Incubator, results from an annual survey of tenants will also be used. Incubator managers and clients will be the main source of data.

The initial data will be gathered from documents such as incubator applications, web sites, and other achieved data. Next, interviews of at least one hour in length will be conducted with each incubator manager, clients, and other appropriate people at the various incubators. These interviews will be conducted using the research instruments as a guide but allowing for deviations to explore areas of interest that come out of the interview itself. Field notes will be taken to record whatever impressions occur during these interviews. Whenever possible, these sessions will be recorded to facilitate better recollection of details and allow for more engagement during the interview and less transcribing.

Concepts and variables suggested by the literature will be used to construct the instruments that will draw out other insights as well as to check those arrived at empirically. This analysis will be an iterative process, with the conceptual investigation and the empirical one pushing each other forward. This process may be replicated multiple times until the framework and the patterns of interaction or relationships emerge and the state of saturation discussed by Eisenhardt (1989) is reached.

After each interview or observation, the following questions will be addressed:

- What was learned?
- How does this case differ from the last?
- How is it similar to the last?

Preliminary findings will be presented to participants to get feedback as to interpretations.

Additional adjustments may be made to data collection instruments, such as the addition of questions to an interview protocol or questions to a questionnaire (e.g, Harris & Sutton, 1986). These adjustments allow for probing of emergent themes or to take advantage of special opportunities which may be present in a given situation. In other situations adjustments can include the addition of data sources in selected cases. For example, Sutton and Callahan (1987) added observational evidence for one case when the opportunity to attend creditors' meetings arose, and Burgelman (1983) added interviews with individuals whose importance became clear during data collection. Leonard-Barton (1988) went even further by adding several experiments to probe her emergent theory in a study of the implementation of technical innovations.
The goal is that the methodology and the analysis will lead to confidence in the findings so that others asking similar questions and following a similar process would reach similar conclusions.

Data Analysis

Data will be analyzed using Eisenhardt's methods by beginning with a "within case" data analysis. Within-case analysis typically involves detailed case study write-ups for each site. These write-ups are often simply pure descriptions, but they are central to the generation of insight (Gersick, 1988; Pettigrew, 1988) because they help to cope early in the analysis process with the often enormous volume of data. The overall intent is to become intimately familiar with each case as a stand-alone entity. This process allows the unique patterns of each case to emerge before pushing to generalize patterns across cases. In addition, it gives a rich familiarity with each case which, in turn, accelerates cross-case comparison.

Coupled with within-case analysis is cross-case search for patterns. The tactics here are driven by the reality that people are notoriously poor processors of information, and leap to conclusions based on limited data (Kahneman & Tversky, 1973), are overly influenced by the vividness (Nisbett & Ross, 1980) or by more elite respondents (Miles & Huberman, 1984), ignore basic statistical properties (Kahneman & Tversky, 1973), or sometimes inadvertently drop disconfirming evidence (Nisbett & Ross, 1980). The danger lies in reaching premature and even false conclusions as a result of these information-processing biases. Thus, the key to good cross-case comparison is counteracting these tendencies by examining the data in many divergent ways.

Categories or dimensions will be selected and then within-group similarities coupled with inter-group differences will be identified. Dimensions will be derived from the research question or from existing literature. Overall, the idea behind the cross-case searching tactics is to go beyond initial impressions, especially through the use of structured and diverse lenses on the data. This tactic improves the likelihood of accurate and reliable theory, that is, a theory with a close fit with the data. Also, cross-case searching tactics enhance the probability of capturing a novel finding which may exist in the data.

Every attempt will be made to reduce bias by sharing intermediate conclusions with committee members, incubator managers, or incubator clients as appropriate. Participant observation will allow comparison of interpretations of what entrepreneurs said with their actual behavior in various situations.

Shaping Hypotheses

From the within-site analysis plus various cross-site tactics and overall impressions, tentative themes, concepts, and possibly even relationships between variables will begin to emerge. The next step of this highly iterative process is to compare systematically the emergent frame with the evidence from each case in order to assess how well or poorly it fits with case data. The purpose is to constantly compare theory and data--iterating toward a theory which closely fits the data. A close fit is critical to building sound theory because it incorporates the new insights possible from the data and yields an empirically valid theory.

Step one in shaping hypotheses is the sharpening of constructs. This is a two-part process involving (1) refining the definition of the construct and (2) building evidence which measures the construct in each case. This occurs through constant comparison between data and constructs so that accumulating evidence from diverse sources converges on a single, well-defined construct. This process is similar to developing a single construct measure from multiple indicators in hypothesis-testing research.

Step two for shaping hypotheses is verifying that the emergent relationships between constructs fit with the evidence in each case. Sometimes a relationship is confirmed by the case evidence, while other times it is revised, disconfirmed, or thrown out for insufficient evidence. Thus, the underlying logic is replication; that is, the logic of treating a series of cases as a series of experiments with each case serving to confirm or disconfirm the hypotheses (Yin, 1984). Each case is analogous to an experiment, and multiple cases are analogous to multiple experiments. This contrasts with the sampling logic of traditional, within-experiment, hypothesis-testing research in which the aggregate relationships across the data points are tested using summary statistics such as F values (Yin, 1984).

Enfolding Literature

An essential feature of theory building is comparison of the emergent concepts, theory, or hypotheses with the extant literature. This involves asking what is this similar to, what does it contradict, and why. A key to this process is to consider a broad range of literature.

Overall, tying the emergent theory to existing literature enhances the internal validity, generalizability, and theoretical level of theory building from case study research. While linking results to the literature is important in most research, it is particularly crucial in theory-building research because the findings often rest on a very limited number of cases. In this situation, any further corroboration of internal validity or generalizability is an important improvement.

Reaching Closure

Cases will be added until theoretical saturation is reached. Theoretical, saturation is simply the point at which incremental learning is minimal because the observed phenomena have been seen before (Glaser and Strauss, 1967). Because of the availability of resources and because of time constraints, it is anticipated that the number of cases, will total between four and ten cases.

The process of iterating between theory and data will cease again, when saturation has been reached. That is, the iteration process stops when the incremental improvement to theory is minimal.

Points of convergence and divergence will provide the basis for forming conclusions. A high degree of consistency and consensus among the various sources used to develop patterns of interactions to ascertain the factors that support the hypothesis will be sought. Points of divergence will be noted and discussed.

Yin explains that one issue of potential concern for the conceptual framework is the development of programs over time and the processes by which they form. There are two ways in which this issue could be explored. One method is to survey the same incubator network at several points in time. The other method is to study several incubators at different stages of development. As pointed out earlier however in Lewis's work, the age of the program was not a significant factor and therefore may not present a significant problem.

Interpretation

One method of uncovering biases in the analysis and interpretation of the data is to compare several perspectives and to critically assess their ability to contribute to our understanding of the data. Every effort will be made in the case study presentation to distinguish between the data and interpretation. This will enable others to review the data and determine for themselves whether they would arrive at the same conclusions.

Evaluation

The final issue is that of evaluation. Conclusions on the value of external development systems on incubator success will be drawn from the data by using the empirical data to identify top performers and using the case study method to identify best practices.

Proposed Case Study Outline

The following outline is suggested to begin the case study data collection. As stated earlier, it is anticipated that this will be iterative and adjustments are anticipated.

I. Incubator

- Selection Criteria
- Types of Firms
- Leasing Arrangements and Services
- Programs and Forums
- Incubator Management and Staff
- Location

II. Community

- Interaction Among Entrepreneurs
- Interaction Between Entrepreneurs and Incubator Manager
- Interaction Between Entrepreneurs and Outside Individuals
- Access to Incubator Advisory Board
- Access to External funding sources
- Access to University
- Interactions between Incubator and Community
    - Local Government
    - Local EDC
    - Other University Departments
    - Funding Sources
    - Other Entrepreneur Support Organizations

III. Incubator Clients

- Types of Businesses
- Stage of Development
- Norms and Attitudes
- Space
- Forums

Summary of Research Method:

The process of building theory from case study research is a strikingly iterative one. While an investigator may focus on one part of the process at a time, the process itself involves constant iteration backward and forward between steps. For example, an investigator may move from cross-case comparison, back to redefinition of the research question, and out to the field to gather evidence on an additional case. Also, the process is alive with tension between divergence into new ways of understanding the data and convergence onto a single theoretical framework. Each of these tactics involves viewing evidence from diverse perspectives. However, the process also involves converging on construct definitions, measures, and a framework for structuring the findings. Finally, the process described here is intimately tied with empirical evidence.

The overall methodology used for research is depicted in figure this program is Figure 11.

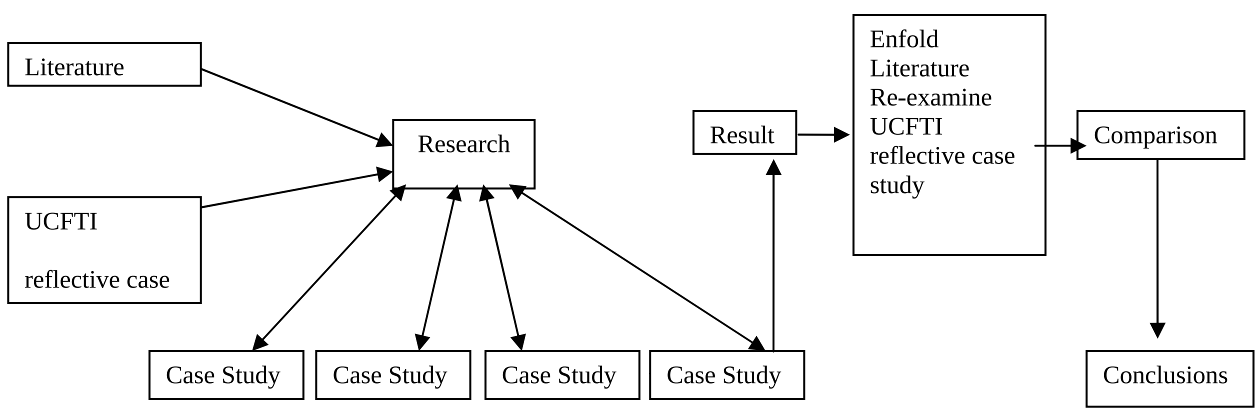


Figure 11: Research Methodology

CHAPTER FOUR: FINDINGS

Research Method

This study used a multiple case design that allowed replication logic; that is, a series of cases is treated as a series of experiments, each case serving to confirm or disconfirm the inferences drawn from others (Yin, 2003). Table 6 describes the nine university affiliated technology incubators studied.

Table 6: : Description of University Affiliated Technology Incubators

Incubator	Region description	Technology Focus	Product/Service Focus
Incubator A	Large metropolitan	Biotech/Biomed	Product
Incubator B	Medium metropolitan	Biotech/Biomed	Product
Incubator C	Medium metropolitan	IT/Electronics	Product/Service
Incubator D	Large, high tech metropolitan	IT/Electronics	Product
Incubator E	Small town close to large metro region	Mixed Technology	Product
Incubator F	Small town	Biotech/Biomed	Product
Incubator G	Small community adjacent to large metropolitan area	Biotech/Biomed	Product/Service
Incubator H	Not used in study (for profit)		
Incubator I	Small town next to large metropolitan area	Biotech/Biomed	Product
Incubator J	Medium metropolitan area	Mixed Technology	Product

This study also employed an embedded design; that is, multiple levels of analysis, focusing on the issues from three levels: (1) A review of previous empirical data; (2) case study information from top performing incubation programs and a program not in the top class of incubators; and (3) and introspective of the UCF Technology Incubator which was ranked the top incubator by the National Business Incubator Association in 2004.

Data Sources

The empirical data was provided by a member of the research team at the University of Ohio that conducted the survey for the Tornatzki et.al., (2003) study. Included with the data was the data dictionary and copies of the survey documents used. The data was in redacted form with the exception of the identification of the top programs in terms of revenue increases and employment increases. Other sources of empirical data came from Lewis (2003) and Steven et al., (2005).

Data for the case studies came from three sources: (1) archival data collected from web sites, the National Business Incubator Association conference proceedings; and articles written about the incubator programs or incubator clients; (2) interviews with incubator managers; (3) incubator client interviews.

The introspective of the UCF Technology Incubator was written by the founder of the incubator and author of this dissertation. References for the introspective included: public and private memos; e-mails; meeting minutes; and personal recollections of the events that occurred during the time frame of 1998 through 2004.

Interviews with incubator managers

A request for interview was sent via e-mail to each incubator manager selected. The names and e-mail addresses were obtained from the web sites of each program. The managers were provided the questions below in an e-mail to help them prepare for the interview. A copy of the actual e-mail is provided in Appendix A.

- What are the top things you feel have contributed most to help your companies become successful?
- Is your incubator part of a larger incubation system or is it mainly a stand alone entity?
- Do you feel your incubator fills in gaps in region resources, i.e., access to funding, professional service providers?
- Do you feel your incubator adds significantly to the credibility of companies in your program?
- How rigorous is your screening process?
- Have you had a few very successful clients that have driven a lot of your success?
- What would you do different if you had it to do over?

Appointment times were selected via e-mail or follow-up e-mail. Follow up phone calls were necessary in two of the cases to arrange for an interview. The interviews were scheduled so the author of this work and the committee chair could both participate as whenever possible. This was possible in seven of the nine cases.

The interview began by thanking them for their participation and informing them that individual answers would be held in strict confidence. Each question on the list was then asked in semi-structured form but allowed for skipping around when the interviewees replies naturally lead to a different question. Responses were separately recorded on legal pads by both observers. During the interview, copies of the questions and the evidence tools developed for this study were used to insure that the questions of concern were asked and responded to. The strategy used was to ask the questions and let the manager answer as they desired, elaborating on any point they felt deserved it. Once the questions were asked, the evidence tool was used to verify that the issues under investigation were addressed in the interview. Several incubator managers were asked to recommend incubator clients or other constituents that they felt were appropriate to contact.

The first question asked was always: What are the top things you feel have contributed most to help your companies become successful? The intent was to address this topic first and reduce the influence that subsequent would have on the answer. At some point during the interview, the answer to this question was paraphrased back to the interviewee to ensure the response was understood.

After the conclusion of the interview, a summary discussion was held between the two observers arrive at concurrence as to the understanding of the answers given, to discuss what important points or information was learned from the interview was, to discuss how this program was similar or differed from previous interviews, and to discuss how this confirmed or disconfirmed the postulates of the study.

Once the interview and discussion were completed, information was immediately transferred into the evidence tool while it was fresh in the mind and to avoid confusion with other interviews. Field notes were referenced during the transcription to the evidence tool to further ensure date integrity.

A separate binder was created to store the field notes, archival data, regional data, client testimonials, and relevant data for each case study. The reference documents in the binder often identified the participants and were therefore kept separate to ensure the confidentiality of the study participants while keeping important data available to assist with the data analysis given the number of cases.

Eco System maps were created to allow for visualization of how the incubator was positioned among the various external resources and constituents of the region. The maps were then included as part of the individual case study write up.

Data Analysis

The data was analyzed as follows. For the empirical data, copies of the survey documents were obtained to search for data that would confirm or not confirm the postulations of interest. The data was examined to search for patterns and the analysis of the previous research was reviewed to understand what assumptions, bias, and level of confidence the authors had in their results.

The raw data was sorted by employment growth so the various characteristics of the top ten incubation programs could be compared and contrasted against the overall average. The differences and similarities were noted. Additional searches of the literature was conducted as part of the process to enfold additional literature into the research as is detailed in Eisenhardt’s (1989) methodology. Sometime the additional information was added to previous sections of the literature review and other times it was discussed in the review section such as the additional quantitative data concerning university spin outs by Shane (2004).

The results of the empirical data analysis helped form the postulations for the study as well as questions for the case studies. The intent of the questions was to allow for an open dialog that would confirm or not confirm the indications from the quantitative analysis. After each case study the postulations were revisited to see if the data confirmed the proposed relationships. One of the original postulates was dropped because the research method did not provide relevant data. After several iterations, existing literature was reviewed again to sharpen insights yielded during the process. What emerged was a better understanding of the issues, the postulations, and the strengths and weaknesses of the research data, method, and postulations.

Detailed data from each case study was captured in a binder. This was then summarized in a set of evidence instruments for each case. Upon completion of the summary, a separate summary instrument was developed that would allow data to be captured for each postulate, and for all of the case studies, on one document. This instrument would summarize the case study finding allowing for a triangulation of the three sources of data (previous empirical, case study, and introspective) for each postulate.

Review of Empirical Data

Survey data utilized from a recent Department of Commerce Survey (Tornatzki, 2003) produced the following analysis. The data was provided in redacted form with names stripped from responses. The names of the top performing incubators in two outcome categories, increase in revenue and increase in employment, was provided.

Descriptive Statistics

The survey data represents responses from 79 incubators in the US. They are characterized by the technology focus and product / service mix of the client companies being served by each incubator.

Forty-eight percent of the technology incubators (38/79) focused on information technology and electronics, compared to twenty-four percent (19/79) that focused on biotechnology and biomedical applications. The remaining twenty-eight percent (22/79) of the incubators involved a mix of client company technology concentrations.

Forty-four percent of incubators focused on companies that primarily had product-oriented business strategies, compared to eighteen percent focusing on service-oriented strategies and thirty-eight percent on clients with a mix of strategies.

The clients of incubators with a greater biotech / biomedical client focus had raised more money, obtained more research support, and possessed more patents and in-licensed more technology than their peers. Biotech or biomedical-focused incubator clients had slower revenue growth than IT/electronics and mixed technology incubator clients and fell behind mixed technology incubators in employment growth. In other words, they grew but growth was based on investment capital.

Service oriented incubator companies grew faster both in terms of revenues and employment than product-focused incubator clients.

The data yielded no strong direct statistical relationships between incubator business assistance practices and primary outcomes defined as sales and revenue growth. A possible reason for this is that individual business assistance practices of incubators will have greater predictive relationships with performance outcomes only if most clients utilize certain practices. This is not likely, however, as every company has a different needs profile to be addressed.

A predictive relationship was revealed between the business assistance practices and the secondary business outcomes (e.g., equity investment, patents, research grant support, copyrights, and licensed intellectual property) that are important precursors to the primary outcomes.

Summary and Comparative Results: Incubator Characteristics

As can be seen in Table 7, incubators that had an IT / electronics technology focus were also somewhat more likely; in turn, to have clients that emphasized a service-oriented business strategy; either a pure service business or a mixed strategy. This perhaps reflects computer systems support companies or their equivalent.

Table 7: Incubator Client Characteristics

Technology Focus	Product / Service Emphasis							
	Product		Service		Mixed		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
IT/Electronics	12	31.6%	8	21.1%	18	47.4%	38	48%
Bio related	11	57.9%	2	10.5%	6	31.6%	19	24%
Mixed	12	54.5%	4	18.2%	6	27.3%	22	28%
Total	35	44.3%	14	17.7%	30	38.0%	79	100%

Data Source: Tornatzki, Sherman, Adkins 2003 NBIA National Benchmarking survey

The 79 incubators surveyed were characterized by nonprofit and for-profit status; urban, rural, or suburban location; and ties to government, industry, or universities. Table 8 summarizes this information, which reveals that nearly half (46.8%) of the technology incubators examined in this study had university ties. The great preponderance of the incubators surveyed were nonprofit entities, and most located in urban and suburban locales.

Table 8: Characteristics status of Incubators in Survey Sample

Tax Status	No.	Percent	Location	No.	Percent	Affiliation	No.	Percent
Non Profit	64	81.0%	Urban	34	43.0%	Government or other Public entity	20	25.3%
Profit	10	12.7%	Suburban	33	41.8%	Corporate or Public/Private Partnership	22	27.8%
Unknown	5	6.3%	Rural	12	15.2%	Has University Ties	37	46.8%

Data Source: Tornatzki, Sherman, Adkins 2003 NBIA National Benchmarking survey

Summary and Comparative Results: Service Mix

For each of the 79 incubators that comprised the study sample, a “degree-of-utilization” score was developed for the twenty (20) services in the survey that incubation programs could offer to clients. The scale used in the survey was: scale of 1-3, with “1” = did not receive, “2” = did receive, or “3” = constituted a major service. The scores are aggregated across the sample, as well as within subgroups of incubators. Table 9 summarizes this data for each service for the entire sample (in rank order of use), then within subgroups of incubators organized by their characteristics.

Table 9: Utilization Scores of Client Assistance Programs

	Score Avg/Top 10	Score for Technology Focus			Score for Product / Service Focus		
Service		IT/ Electronics	Bio Related	Mixed Tech	Product	Service	Mixed
Networking assistance	2.33 / 2.17	2.32	2.26	2.33	2.33	2.19	2.40
Access to internet/IT services	2.19 / 2.53	2.30	2.11	2.19	2.21	2.26	2.14
Mentoring	2.17 / 1.90	2.27	2.06	2.17	2.33	1.85	2.13
Linkages top strategic partners	2.07 / 1.88	2.18	1.96	2.07	2.13	1.64	2.21
Business plan assistance	2.06 / 1.90	2.22	2.04	2.06	2.17	1.71	2.09
Assistance obtaining angel/VC investments	1.94 / 1.79	1.92	2.00	1.94	2.18	1.41	1.89
Marketing assistance	1.92 / 1.77	2.02	1.88	1.92	1.96	1.62	2.01
Linkages to University R&D services	1.87 / 2.40	1.61	2.11	1.87	2.11	1.62	1.69
Help securing student interns/employees	1.84 /2.04	1.81	1.83	1.84	2.05	1.55	1.76
Management team development	1.82 / 1.64	1.92	1.78	1.82	1.97	1.38	1.82
Financial management assistance	1.81 / 1.61	1.84	1.67	1.81	1.79	1.50	1.98
Intellectual Property assistance	1.78 / 1.76	1.73	1.78	1.78	1.86	1.64	1.77
Legal services	1.74 / 1.50	1.88	1.63	1.74	1.71	1.49	1.90
Access to specialized laboratory facilities	1.71 / 2.17	1.30	2.21	1.71	1.93	1.44	1.58
Human resource management assistance	1.69 / 1.56	1.85	1.48	1.69	1.67	1.44	1.82
Product/technology development assistance	1.66 / 1.83	1.65	1.54	1.66	1.84	1.46	1.55
Regulatory compliance assistance	1.36 / 1.52	1.25	1.43	1.36	1.43	1.21	1.36
Assistance in process related technologies	1.36 / 1.33	1.34	1.22	1.36	1.37	1.21	1.42
Machine shop	1.24 / 1.37	1.15	1.33	1.24	1.37	1.06	1.17
International trade assistance	1.19 / 1.13	1.23	1.07	1.19	1.24	1.05	1.20

Data Source: Tornatzki, Sherman, Adkins 2003 NBIA National Benchmarking survey

The usage for the top ten was calculated as well compared in Table 10.

Table 10: Utilization Scores Comparison for Assistance Programs

Service Use Overall	Score	Service Use By Top Ten Programs	Score
Networking assistance	2.33	Access to internet/IT services	2.53
Access to internet/IT services	2.19	Linkages to University R&D services	2.40
Mentoring	2.17	Networking assistance	2.17
Linkages to strategic partners	2.07	Access to specialized laboratory facilities	2.17
Business plan assistance	2.06	Help securing student interns/employees	2.04
Assistance obtaining angel/VC investments	1.94	Mentoring	1.90
Marketing assistance	1.92	Business plan assistance	1.90
Linkages to University R&D services	1.87	Linkages top strategic partners	1.88
Help securing student interns/employees	1.84	Product/technology development assistance	1.83
Management team development	1.82	Assistance obtaining angel/VC investments	1.79
Financial management assistance	1.81	Marketing assistance	1.77
Intellectual Property assistance	1.78	Intellectual Property assistance	1.76
Legal services	1.74	Management team development	1.61
Access to specialized laboratory facilities	1.71	Financial management assistance	1.61
Human resource management assistance	1.69	Human resource management assistance	1.57
Product/technology development assistance	1.66	Regulatory compliance assistance	1.52
Regulatory compliance assistance	1.36	Legal services	1.50
Assistance in process related technologies	1.36	Machine shop	1.37
Machine shop	1.24	Assistance in process related technologies	1.33
International trade assistance	1.19	International trade assistance	1.13
Average	1.7875		1.7900

Data Source: Tornatzki, Sherman, Adkins 2003 NBIA National Benchmarking survey

It is worth noting some of the differences and similarities. In general, the top incubators' clients do not utilize more services (average usage 1.7875 verses 1.7900), but there is a difference in the mix of services. Included in the top five rated services for both categories were networking assistance and access to internet / IT services. The top programs however made use of linkages to university R&D services, access to students, and access to specialized facilities for the remainder of the top five with mentoring coming in sixth. Mentoring, linkages to strategic partners, and business plan assistance completed the overall top five used services.

Summary and Comparative Results: Primary Outcomes

The two primary outcome scores are:

- employment change, from entry into the program to the current period.
- sales revenue change, from entry into the program until the current period.

The cell entries in Table 11 represent average changes in the scale scores on the questionnaire and not real numbers of jobs and sales increments. The scale was (1) $0-$99K, (2) $100 - $499K, (3) $500 – $999K, (4) $1M - $5M, (5) $5M - $10M, (6) > $10M. The data is broken down and presented by incubator characteristics.

Table 11: Primary Outcome Results

Outcome	Score (delta)	Score for Technology Focus			Score for Product/Service Emphasis		
		IT/ Electronics	Bio-Related	Mixed Technology	Product	Service	Mixed
Employment Growth	1.62	1.56	1.61	1.72	1.44	1.89	1.38
Revenue Growth	1.35	1.37	0.97	1.63	1.22	1.57	1.10

Data Source: Tornatzki, Sherman, Adkins 2003 NBIA National Benchmarking survey

As shown in Table 11, revenue growth is slower in bio related companies, most likely due to the extended product development as compared to IT / electronics. However, there are few differences in employment growth as a function of technology. Biotech / biomed companies grow, but they grow on investment capital longer than in other industries. In the product and service comparisons it is clear that both employment and revenue growth favor service-oriented client companies. This is not too surprising in that product-oriented companies typically encounter hurdles in accumulating the necessary capital and production equipment in order to get to scale, whereas service businesses are by definition not capital-intensive.

Lewis (2003) postulated that that firm employment growth is predominantly a function of (1) the strength of the advisory board, (2) location on an academic campus, (3) the years of experience of the manager, and (4) the percentage of the population between the ages of 25 and 54. The fourth, the percentage of population between 25 and 54, is used as a proxy a measure of the quality of life in the region of interest.

Lewis' data indicated that incubator programs that developed a strong strategic alliance with an academic institution enhance tenant growth in terms of both employment and revenue**.**

Lewis cautions however that interpreting the results of his analyses of the growth of tenant firms is hampered by the lack of variation in the dependent variables. For example, the distribution of the change in tenant revenue indicated that sixty-five (65) cases were low growth, twelve (12) were medium growth and three (3) were high growth. He states that the lack of variation also diminished the predictive value of his analyses

Lewis' data indicates that incubators that are located on an academic campus, have an optimal mix of advisory board members, and stable management are better positioned to overcome deficiencies in regional capacity. The quality of life in the region may also be important for attracting potential clients and retaining the high-skilled workers necessary to staff new technology enterprises. As seen in Table 12, the F statistic ranking in Lewis' study of the predictor variables supports his hypothesis that incubator quality can compensate for regional capacity during the client firm's tenancy. The two best predictor variables (management stability and composition of the advisory board) are both measures he attributes to incubator quality. His model correctly predicted 65.2% of the cases ($p < .05$) with a high canonical correlation (.480), suggesting relatively strong predictive power.

This implies that incubators with managers that have developed strong relationships over time to the community through their advisory board or other means deliver more effective programs in terms of the number of employees generated by client firms.

Growth of tenant firm employment = f(BOARD, ACADEMIC, YEARSEMP, %WORKAGE)

Table 12: Analysis of Growth of Tenant Firm Employment (Correctly classified cases 65.2%)

Discriminating Variable (Range of each variable)	Mean for Each Category Low	Med	High	F- value	Correlation With Function
Number of Years manager employed (1-6)	3.250	5.000	4.000	2.917*	0.506
Weighted index of advisory Board members ((0-35.5)	18.356	20.875	25.750	2.457*	0.503
Quality of life, % regional population between 25-54 (43%-63%)	0.510	0.535	0.470	2.255*	0.282
Percent of regional population over 25 with a college degree (11%-44%)**	0.234	0.273	0.250	2.006*	0.356
Industrial mix (25%-55%)**	0.339	0.375	0.330	1.784*	0.322
Located on an academic campus (0=no; 1=yes)	0.321	0.167	1.000	1.387	0.269
Weighted index of higher educational institutions (4-1501)**	215.911	355.500	175.540	0.513	0.218
Percent of regional income from interest, dividends or rent (5%-21%)**	0.0736	0.0733	0.0600	0.201	-0.175
Percent of regional population living in an urbanized area (35%-95%)**	0.715	0.760	0.700	0.101	0.350
Weighted index of services (0-41.5)**	34.446	34.583	37.500	0.099	-0.041
Number of years of operation (2-35)**	8.214	8.167	8.000	0.001	0.099

Data Source: Lewis 2003 survey
Notes: * predictor is significant at $p < .05$
** variable not entered into the discriminant function
All independent variables were used in the analysis, with F in =1.00 and F out =1.01.

Though the location of an incubator program on an academic campus did not rank in the top five of the predictor variables (as measured by the F statistic), Lewis entered it into the discriminant function. Perhaps the most revealing data point in Lewis' survey was that all of the top-performing programs, in terms of the growth of tenant employment, were located on an academic campus. The incubator industry should also note that the age of the program was the least important predictor variable, suggesting that younger technology incubator programs that have stable management, provide the key entrepreneurial services, develop close linkages to an academic institution, and have an optimal mix of advisory board members enhance tenant firm growth.

It is also interesting that the list of the top performing incubators in employment growth and the list of top performing incubators in terms of revenue growth are significantly different. Only three programs showed up on both lists. Of the three, one was in IT and the other two were mixed technology.

This difference between employee growth and revenue growth was also demonstrated by the predictor models that Lewis developed in his study. The revenue model predicted fewer cases accurately (59.2%), and the functions contained only one overlapping variable, the location of the incubator on a university campus. The other two predictor variables for revenue were percent in an urban area and robust level of services.

Lewis' conclusion was that incubator quality can compensate for a lack of regional capacity, indicating that successful incubators are part of a larger system and that their roles should be determined by the needs of the region's overall economic development system.

Lewis' case-by-case analysis also suggests three important findings. First, the location (northeast, south, etc.) or size of a host community did not distinguish the individual cases. He concluded from this that regional capacity is not a function of size, climate, or proximity to natural features such as the ocean, mountains, etc.

Second, the aggregate size of the facility did not distinguish cases, suggesting that incubator performance is more a function of other attributes. There is no evidence to support arguments of an optimal facility size, minimum facility size, or increasing returns of scale for the incubator.

Finally, the evaluation of the ratio of tenants to full-time equivalent incubator personnel supports prior research conclusions that the quality of interaction among tenants and between the tenants and the staff is more a function of the manager than of the size of the staff. The other important factor is that many technology incubators provide the key services through networks with the area business community, therefore staff size is less important if the incubator is embedded in business community networks. In discussions with managers and other industry experts, this point is stressed, asserting that the networks are fundamental to success and retaining the graduates in the host community.

Summary and Comparative Results: Secondary Outcomes

Five items were surveyed in the Tornatzky (2203) survey to assess the performance of secondary outcomes. The secondary outcomes included two measures of financing outcomes, and three measures of intellectual property outcomes. These are not the usual indicators of business vitality such as growth in revenues, profits, employees, or assets. However, these items are important in the world of technology-based start-ups as they are often precursors to those more traditional outcomes. The results are presented in Table 13. It should be noted, however, that since different scales were used for each of the secondary outcomes, the results are not comparable across outcomes. However, the outcomes themselves are comparable across different subgroups of the sample.

Table 13: Secondary Outcome Scores

Outcome	Score (scale)	Score for Technology Focus			Score for Product/Service Emphasis		
		IT/ Electronics	Bio-Related	Mixed Technology	Product	Service	Mixed
Equity Investment	4.6 (7)	4.43	5.00	4.60	5.17	3.5	4.6
Patents	2.51 (5)	2.04	3.21	2.51	2.97	1.83	2.51
Research Grant Support	2.27 (5)	1.59	3.02	2.27	2.60	1.79	2.27
Copyrights	1.85 (5)	2.00	1.29	1.85	2.48	1.00	1.85
Licensed IP	1.65 (5)	1.26	2.12	1.65	1.79	1.54	1.65

Inspection of the data suggests some trends that are quite understandable. For one, there seems to be more money and intellectual property supplied to biotech / biomed client companies as opposed to IT / electronics or mixed technology areas. This is explained by the fact that biotech / biomed companies have a much stronger basis in scientific research and associated patenting and licensing than do IT companies. They also typically take a longer time to get to market, with associated larger capital demands. The only exception is the greater importance of copyrights among IT / electronics client companies. This is explained by the fact that a large fraction of software is protected by copyright rather than patenting.

These results complement the findings favoring pure product strategies over service and mixed approaches in terms of garnering research and investment financing as well as protecting intellectual property. As Table 13 indicates, biotech / biomed companies are more likely to be product oriented, which could account for the findings here:

1. Product-emphasis incubators reported more equity investment than service-emphasis incubators.

2. Product-emphasis incubators reported more patents than both service-emphasis and mixed-emphasis incubators.
3. Product-emphasis incubators reported more copyrights than both service emphasis and mixed emphasis incubators.
4. Both biomed / biotech and mixed technology incubators reported more research grant support than IT / electronics incubators.
5. Both biomed / biotech incubators reported more patents held than IT/electronics.
6. Both biomed / biotech and mixed technology incubators reported more patents in-licensed than IT/electronics.

Summary and Comparative Results: Client Screening

One question of particular interest in the study was the question related to client screening. The scale used was:

4	Mandatory and rigorous
3	Intermittent or used primarily for diagnostic
2	Informal and infrequently utilized
1	No defined process

As Table 14 shows, the answer across all surveyed areas points to a rigorous screening process. This indicates a need to investigate further in the interview portion of this study.

Table 14: Client Screening Characteristics

	Score	Score for Technology Focus			Score for Product/Service Emphasis		
		IT/ Electronics	Bio-Related	Mixed Technology	Product	Service	Mixed
Rigor of screening process	3.7	3.63	3.74	3.79	3.62	3.77	3.76

Primary Outcomes: Best-in-Class Incubator Programs

Of the 79 Technology Incubators that participated in the study, the top ten in terms of revenue growth and job growth are listed in Tables 15 and 16. They are listed in order of performance on primary outcomes. Two things are evident from this list. Virtually all of the best-in-class institutions have physical adjacency to a research university, and none is focused exclusively on a service business strategy. Also, both for-profit and nonprofit incubators appear on this list.

Table 15: Top 10 Programs in Employment Growth

Program	Technology Focus	Product / Service Focus
Incubator A	Biotech/Biomed	Product
Incubator B	Biotech/Biomed	Product
Incubator C	IT/Electronics	Product/Service
Incubator D	IT/Electronics	Product
Incubator E	Mixed Technology	Product
Incubator F	Biotech/Biomed	Product
UCF Technology Incubator	Mixed Technology	Product
Incubator G	Biotech/Biomed	Product/Service
Incubator H	Biotech/Biomed	Product
Incubator I (not used in study)	IT/Electronics	Product

Table 16: Top 10 Programs in Sales Revenue Growth

Program	Technology Focus	Product / Service Focus
Long Island High Technology Incubator, Stony Brook, NY	Mixed Technology	Product
Technology Innovation Center, Wauwatosa, WI	IT/Electronics	Product/Service
Ceramics Corridor Innovation Center, Painted Post, NY	Mixed Technology	Product
Anonymous US Incubator	Mixed Technology	Product
Anonymous US Incubator	IT/Electronics	Service
Panasonic Incubator, Cupertino, CA	IT/Electronics	Product
Center for Emerging Technologies, St. Louis, MO	Biotech/Biomed	Product
University of Central Florida Technology Incubator, Orlando, FL	Mixed Technology	Product
Business Technology Center of Los Angeles County, Altadena, CA	Mixed Technology	Product
Software Business Cluster, San Jose, CA	IT/Electronics	Product

Predictive Results

Previous studies (Allen, 1990; Lewis, 2003; Tornatzki, 2003) conducted standard multiple regression analyses to determine the extent to which incubator practices and services delivered to client firms predicted performance outcomes achieved by those firms. It was stated that their analyses were also considered exploratory in nature, in that existing research in the field has not yielded strong statistical relationships between incubator practices and outcomes.

The studies came to the same empirical conclusion that none of the incubator business assistance practices, nor the environment and management practices appeared to show any predictive relationships with the client outcomes of firm employment or sales growth. Statistical difficulties such as sample size and shortcomings in instruments could account for some of this. For example, a rule of thumb in conducting regression analyses is to have at least 15 times the number of subjects as the number of potential predictors. In several of the regressions conducted, this criterion was not met, which tends to reduce the predictive power of the statistic.

However, perhaps a more enlightened explanation may lie in a rethinking of how business incubation works generally in a systemic context. In order for a predictive relationship to exist between a service practice and a performance outcome, that practice would need to be important and strenuously applied to most clients that come through an incubator program. This is not the case however as most companies have different needs or gaps that need to be improved in order to achieve business success. This might contribute to the generally low level of predictive relationship between services and outcomes in the research literature on incubators.

However, when considering technology-based entrepreneurial companies, there may be some assistance needs that are consistent across clients and that in effect define the field. Intellectual property protection is a good candidate, as is accumulating support for research and development and access to capital. In fact, the regression findings reported above are consistent with this interpretation for the first two listed. What is also missing from the few empirical analysis conducted to date is any consideration of the larger context in which these programs operate.

Case Study Review

Case Study Population

This chapter contains write ups of the incubators that participated in this study. Their names are not disclosed to facilitate open, honest communications of often sensitive information. Empirical and qualitative data was collected but not specifically attributed to any individual or specific incubator program. The source of information for the documentation was obtained from their web sites, the interviews, and National Business Incubator Association materials. The Regional information was obtained from the web site: http://www.city-data.com/.

The data was collected over a six (6) week period. Requests for interviews were sent out in advance by an e-mail that included the list of questions to be addressed. The interviews lasted less than one hour each with some follow up calls or e-mails as necessary to address additional questions that arose after the initial interview. The majority of the interviews were conducted by Tom O'Neal (author of this work) and Dennis Kulonda (chair of this dissertation committee). The rest were conducted by Tom O'Neal solely. Interviews were conducted until the additional insights gained from supplementary calls were minimal.

Incubator A

Location: large metropolitan region
Population: greater than 1 million
Median age: 34.2 Years
Median household income: $38,293
Median household value: $211,900

Characteristics of Incubator A:

- Serves four medical schools
- Specialized real estate development
- Robust region with many VCs, investors, service providers, talent
- No structured real business assistance help
- Access to facilities key service

Incubator A Eco System

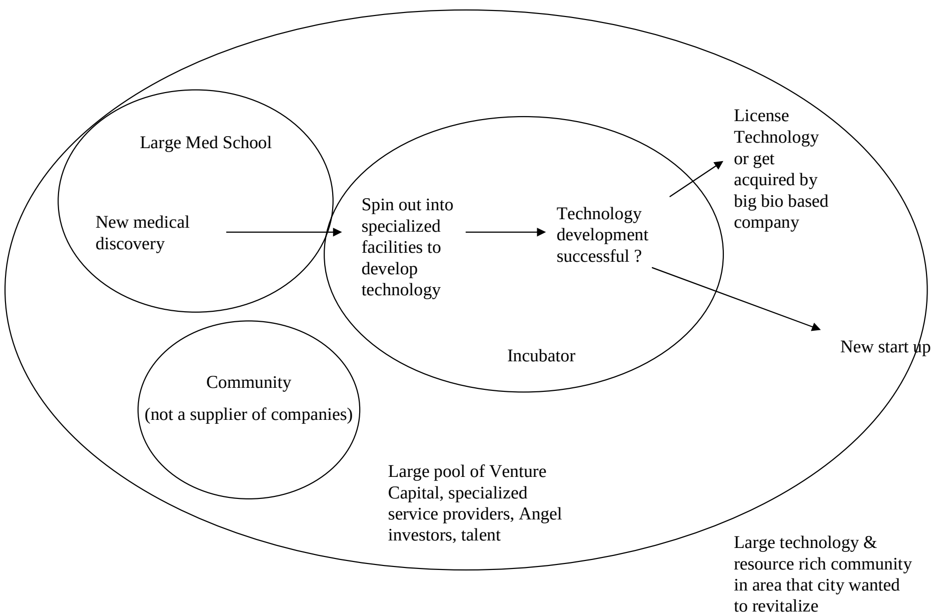


Figure 12: Incubator A Eco System

Mission Statement:

The Incubator located at the University medical center brings medical advances from the laboratory to the bedside through the development of pioneering biotechnology underlying new medical treatments, technologies, and therapies. As the City’s only biotechnology business incubator, the incubator supplies the structure and organization to facilitate developments in biotechnology that will ensure improved health care while contributing to economic growth through the creation of private sector research collaborations and the generation of new biomedical related business.

This is a 100,000 square foot, state-of-the-art research incubator managed by a University and developed in partnership with the City in which it is located. *Incubator A* is the only biotechnology business incubator in the city, housing private research and development life sciences companies. The incubator supplies the infrastructure and equipment to take medical advances from the laboratory to the health care industry while contributing to economic growth through the creation of private sector, biomedical related businesses.

Incubator A is located in a Biomedical Science and Technology Park, a one million square foot development adjacent to a large Medical Center. The Biomedical Science and Technology Park is composed of the Biomedical Research Building, which houses the Business and Technology Center and a Medical Science Pavilion. The Pavilion houses a comprehensive diabetes center, genetics research, and a research program in pediatrics. Work started on the third building in the Park, a Cancer Research Center, in the summer of 2001. The Center will house research on cancer, genetics, and cell biology. The Medical Center comprises more than four million square feet of space and is home to approximately 14,000 employees, including more than 4,000 faculty and research scientists.

The executive director of the incubator indicates that it provides firms with clean, appropriate space at market price, access to state-of-the-art equipment, and access to the medical community. The impressive facilities also attract potential investors and employees. The incubator program has very stringent entrance criteria. Potential entrants must have people, money, and intellectual property in place before they will be accepted. The science must be non-controversial and controlled by scientists who have an established reputation. The medical center is a nationally recognized leader, and the incubator management does not want to negatively impact that reputation. The center houses twenty (20) firms, of which nineteen (19) have already received private venture money; one is publicly traded and one has received federal Small Business Innovation Research (SBIR) money.

The incubator manager considers its program a specialty real estate operation and believes that clients select them. The incubator does not provide extensive entrepreneurial help or assistance to its clients. The assistance they do provide is primarily facility based to ensure clients get their labs and equipment fully functional. One of their success measures is maximize the number of deals (leases).

Table 17: Incubator Specific Data; Incubator A

Incubator A

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Selection Criteria	Easy	Easy	Easy
	Support level:	Support level:	Support level:
Types of Firms	Bio tech	Bio tech	
	Support level:	Support level:	Support level:
Leasing arrangements	Deals	Actively recruits clients	
	Support level:	Support level:	Support level:
Education and other programs	Rare	Rare	
	Support level:	Support level:	Support level:
Incubator management	Facility support	Executes leases and keeps facilities running	
	Support level:	Support level:	Support level:
Location	Robust area	Robust area	
	Support level:	Support level:	Support level:
Credibility	Strong	Strong	
	Support level:	Support level:	Support level:
What is most important function	Specialized facilities		

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 18: Community Specific Data; Incubator A

Community specific issues - Incubator A

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between clients and community	Sporadic	Sporadic	
	Support level:	Support level:	Support level:
Interactions among Entrepreneurs	Moderate	Moderate	
	Support level:	Support level:	Support level:
Interactions between clients and outside individuals	Moderate	Moderate	
	Support level:	Support level:	Support level:
Access to incubator advisory board		Rare	
	Support level:	Support level:	Support level:
Access to external funding sources		Strong (in community)	
	Support level:	Support level:	Support level:
Access to steeples of excellence	Strong	Strong (attached to med center)	

Note: Support levels: Strong = dominant theme in this data that is consistently supported;
Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found;
Sporadic = a theme that appears now and then in this data source.

Table 19: Other Community Specific Data; Incubator A

Community 2 - Incubator A

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between incubator and community		strong	
	Support level:	Support level:	Support level:
Interactions between incubator and Local Government	moderate (once helped revive run down section of town)	moderate	
	Support level:	Support level:	Support level:
Interactions between incubator and local Economic Development agencies		moderate	
	Support level:	Support level:	Support level:
Interactions between incubator and funding sources		sporadic but most companies have funding prior to joining program	
	Support level:	Support level:	Support level:
Interactions between incubator and other entrepreneur support		sporadic but relies on region to provide talented entrepreneurs	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Incubator B

Location: metropolitan region
Population: 215,000
Median resident age: 30.6 years
Median household income: $41,941 (year 2000)
Median house value: $139,300 (year 2000)

Characteristics of Incubator B:

- Partnership between region and regional utility
- Local resources, SBDC & Score support
- Located in successful research park
- Shared, specialized equipment and facilities key to success
- Value added business support service to complement facilities
- Tight integration with local economic development agencies

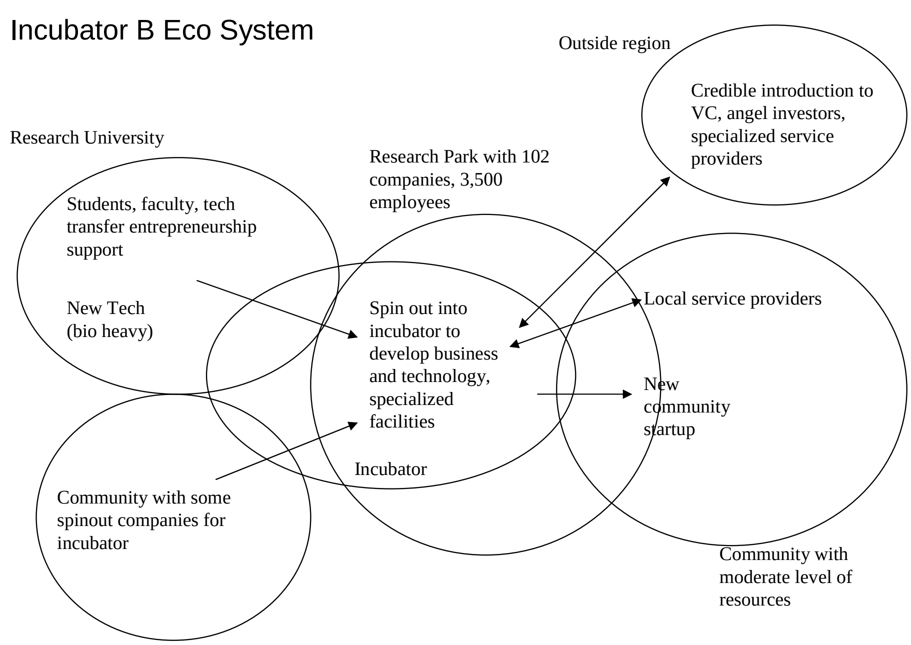


Figure 13: Incubator B Eco System

This program is a partnership between the Region's university and Gas & Electric company. It opened in 1989 and currently is located in a 110,000-plus square foot, state-of-the-art facility. The facility houses 35 office suites, 40 laboratories, 9 conference rooms, and shared shop facilities, laboratories, and commons areas. In addition there is 60,000 square feet of multi-tenant office and lab space for established firms.

The center has provided laboratory, office space, and support equipment and personnel to nearly 50 early stage companies. The purpose of the program is to facilitate technology transfer from the university and to assist the growth of technology businesses. The program reports to the chancellor of the university. Usually, the most successful firms have entered the incubation program with patents, or are based on biotechnology research at the university. These firms must have been identified as having high growth potential before they are admitted.

Incubator B is located in the University Research Park (URP). This is a separate non-profit entity that develops the land and buildings and leases them to companies interested in maintaining close contact with the university community. Companies that have graduated from the incubator or companies from outside the university can choose to lease facilities in this research park. Currently 34 buildings, including *Incubator B,* are located in the park. Unlike most research parks, URP receives no city or state funds to support its infrastructure. The park houses more than 102 firms employing more than 3,500 people.

The Associate Director of the park says there are two important reasons for the program's success. The first is that clients have access to laboratory facilities and university infrastructure and resources. The second is that firms locating in the center achieve “branding” or a reputation benefit that helps them to find venture money, employees, and customers.

The university resources include a strong technology transfer office and a Small Business Development Center. In addition, the College of Business has a strong Center for Entrepreneurship. The Associate Director also mentioned that the Center has a growing reputation for launching successful high growth firms. New firms know they need to go to the Center to establish their credibility. Investors and local service firms visit the Center to offer assistance, providing client firms with a network of angel investors and a network of local accountants and attorneys.

Table 20: Incubator Specific Data; Incubator B

Incubator B

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Selection Criteria	Moderate	moderate (expanded space)	
	Support level:	Support level:	Support level:
Types of Firms	Bio tech	Bio tech, mixed coming on-line	
	Support level:	Support level:	Support level:
Leasing arrangements		Flexible leases	
	Support level:	Support level:	Support level:
Education and other programs	Strong	Strong (uses SCORE, SBDC)	Strong (testimonial at conference)
	Support level:	Support level:	Support level:
Incubator management	Full service	Experienced manager	
	Support level:	Support level:	Support level:
Location			
	Support level:	Support level:	Support level:
Credibility	Strong	Strong	
	Support level:	Support level:	Support level:
What is most important function	Specialized facilities	Shared services backbone of center	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 21: Community Specific Data; Incubator B

Community specific issues - Incubator B

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between clients and community	strong	strong	
	Support level:	Support level:	Support level:
Interactions among Entrepreneurs	Moderate	Moderate	
	Support level:	Support level:	Support level:
Interactions between clients and outside individuals	Moderate	Moderate	
	Support level:	Support level:	Support level:
Access to incubator advisory board		Rare	
	Support level:	Support level:	Support level:
Access to external funding sources		Strong, introductions when appropriate	
	Support level:	Support level:	Support level:
Access to steeples of excellence	Strong	Strong (Location in university research park)	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 22: Other Community Specific Data; Incubator B

Community 2 - Incubator B

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between incubator and community	Strong (good board from community) Gas company wants to sell electricity	Strong ($1M donation from utility company)	
	Support level:	Support level:	Support level:
Interactions between incubator and Local Government	Strong (shared vision)	Strong	
	Support level:	Support level:	Support level:
Interactions between incubator and local Economic Development agencies		Strong	
	Support level:	Support level:	Support level:
Interactions between incubator and funding sources		Strong (Good deal flow)	
	Support level:	Support level:	Support level:
Interactions between incubator and other entrepreneur support		Strong (SCORE, SBDC)	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Incubator C

Location: metropolitan region
Population: 225,000
Median resident age: 30.4 years
Median household income: $30,368 (year 2000)
Median house value: $94,700 (year 2000)

Characteristics of Incubator C:

- Tightly integrated into university
- Many interns, MBA projects, technical support from faculty
- Strong advisory board with high university and community officials
- Access to labs, other university resources
- Incubator also heads up SBDC, STAC, and other statewide development programs
- Provides many programs and networking events
- Strong University Connections key to success

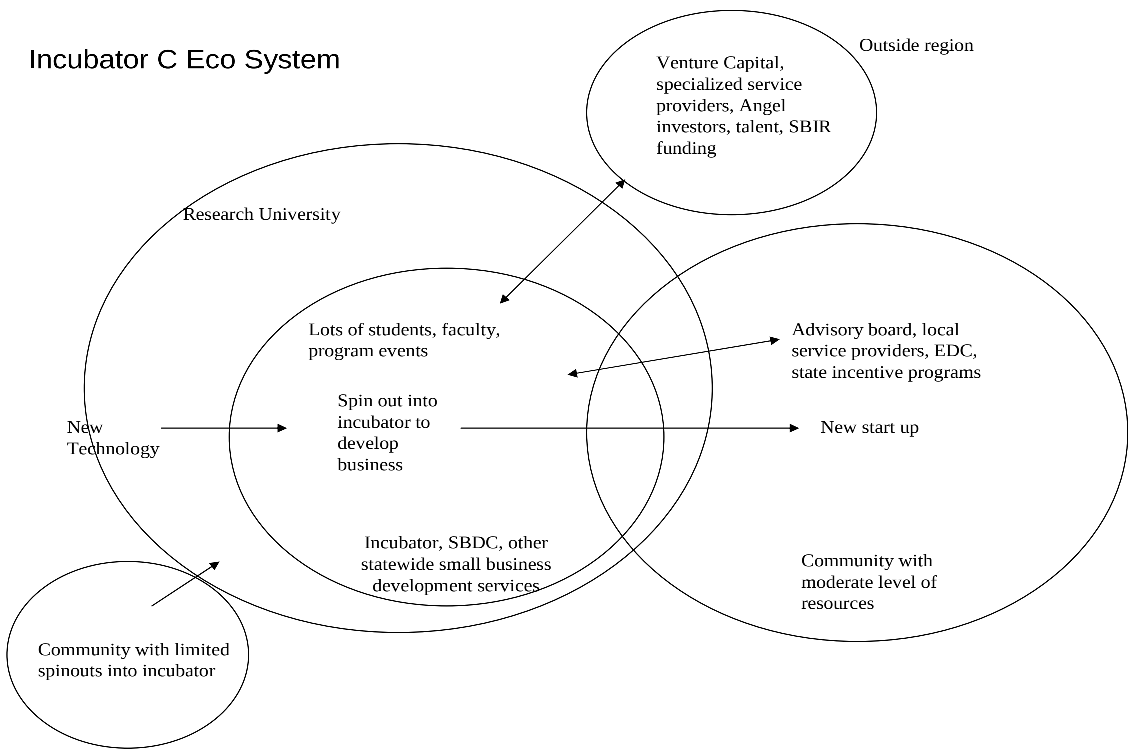


Figure 14: Incubator C Eco System

Mission Statement:

The incubator strives to assist entrepreneurs and small businesses with access to the resources they need to grow and attain long-term success. The incubator plays a crucial role in the economic development future of the state by supporting statewide initiatives and by promoting the formation and growth of businesses, cultivating jobs, and commercializing technology.

The local business community and leadership of the State University embraced this business incubation program, which started in 1988. Both groups are prominently represented in its governance structure, and representatives of the academic and business communities play key roles in brokering various relationships, meetings, and business partnerships. For example, the program is part of the College of Business and all staff members are university employees, with the incubator's executive director reporting to the dean of the college. One benefit of the relationship with the College of Business is the assignment of MBA students to the incubator to work as consultants to client companies. Under the direction of the incubator staff, they assist in developing business plans, marketing plans, and financial statements.

Currently, incubator operations are spread over four buildings encompassing 47,000 square feet in the central part of campus. The Executive Director indicates that this central, highly visible location has been a major asset. Faculty members, students, and university officials can easily drop in for meetings or to satisfy their curiosity about how one becomes an entrepreneur. The physical presence tends to legitimize these new roles for faculty. Of note, two university vice chancellors and five deans sit on the incubator’s board of directors. The president believes strongly in the program and often references the program in his speeches.

The program does not pay rent or utilities on its buildings, and it is permitted to keep its rental income from clients to cover staff and related costs. The number of incubator tenants averages two dozen and there are currently 25 in residence. The program emphasizes technology-based new enterprises, and about a third of the current clients have some form of strong university linkage (e.g., a faculty member is a principal and/or the company is based on university intellectual property). All of this is enabled by a fairly flexible university policy that encourages faculty involvement in start-ups. The establishment of a new Research Foundation should help in this area, extending ties to the medical center and agricultural research operations and enhancing the positive links to university technology transfer.

The incubator benefits significantly from directly operating several programs that complement its incubation activities. For example, it runs the Small Business Development Center (SBDC) which serves upwards of 300 clients per year. This activity functions as a “farm team” for the incubator and some start-ups eventually become resident clients of the incubator. The program also operates, for the University’s Economic Development Department, the State Technology Transfer Office, which functions to transfer University technology and as a portal for the transfer of NASA technology and other federal laboratories to established companies throughout the state.

While not nominally focused on startups, this activity tends to be a source of research and development resources for clients of the incubator and occasionally yields a new client for the program. The program organizes the state's efforts to increase the flow of Small Business Innovation Research (SBIR) grants into the state. This includes various training and briefing activities, as well as a "Phase 0" service that subsidizes proposal writing efforts. One incubator client has thirteen current SBIR grants alone. The incubator also has a large network of relationships with local business service providers (e.g., attorneys and accountants) that refer potential clients. The upshot of these many complementary activities is that the incubator is seen as the "go to place" in the state for activities related to technology entrepreneurship.

In summary, the keys to success for this program is its strong university connections and the leverage that it provides to clients such as interns, technical assistance, access to faculty and laboratories. Additionally it offers a rich network of statewide relationships, complementary program activities conducted for the State, and a stable and visible presence on the campus of a major research university. It has also had the benefit of a stable core of program staff and leadership with seventeen years of experience, an excellent reputation, and credibility that benefits clients immediately.

Table 23: Incubator Specific Data; Incubator C

Incubator C

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Selection Criteria	Strong	Strong	
	Support level:	Support level:	Support level:
Types of Firms		Tech based, mixed	
	Support level:	Support level:	Support level:
Leasing arrangements		Flexible 1 year lease	
	Support level:	Support level:	Support level:
Education and other programs		Very Strong	
	Support level:	Support level:	Support level:
Incubator management		Very strong (stable)	
	Support level:	Support level:	Support level:
Location		strong (on campus)	
	Support level:	Support level:	Support level:
Credibility		Very Strong	
	Support level:	Support level:	Support level:
What is most important function	The University resources associated with program	Strong university connections, other complementary functions	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 24: Community Specific Data; Incubator C

Community specific issues - Incubator C

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between clients and community		Strong	
	Support level:	Support level:	Support level:
Interactions among Entrepreneurs		Moderate	
	Support level:	Support level:	Support level:
Interactions between clients and outside individuals		Moderate	
	Support level:	Support level:	Support level:
Access to incubator advisory board		Moderate to strong (situational)	
	Support level:	Support level:	Support level:
Access to external funding sources		Strong	
	Support level:	Support level:	Support level:
Access to steeples of excellence		Moderate to strong	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 25: Other Community Specific Data; Incubator C

Community 2 - Incubator C

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between incubator and community		Strong	
	Support level:	Support level:	Support level:
Interactions between incubator and Local Government		Moderate	
	Support level:	Support level:	Support level:
Interactions between incubator and local Economic Development agencies		Strong (they are local EDC)	
	Support level:	Support level:	Support level:
Interactions between incubator and funding sources		Moderate to strong	
	Support level:	Support level:	Support level:
Interactions between incubator and other entrepreneur support		Very Strong (part of extended program)	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Incubator D

Location: high tech based metropolitan region
Population: 900,000
Median resident age: 32.6 years
Median household income: $70,243 (year 2000)
Median house value: $394,000 (year 2000)

Characteristics of Incubator D:

- Robust high tech region with many VCs, investors, service providers, talent
- No structured real business assistance help
- Access to connections
- No direct university spinouts
- Software specific, short tenure in program (24 months)
- Great success of clients getting funding of those few that seek
- Goal to keep companies in region

Incubator D Eco System

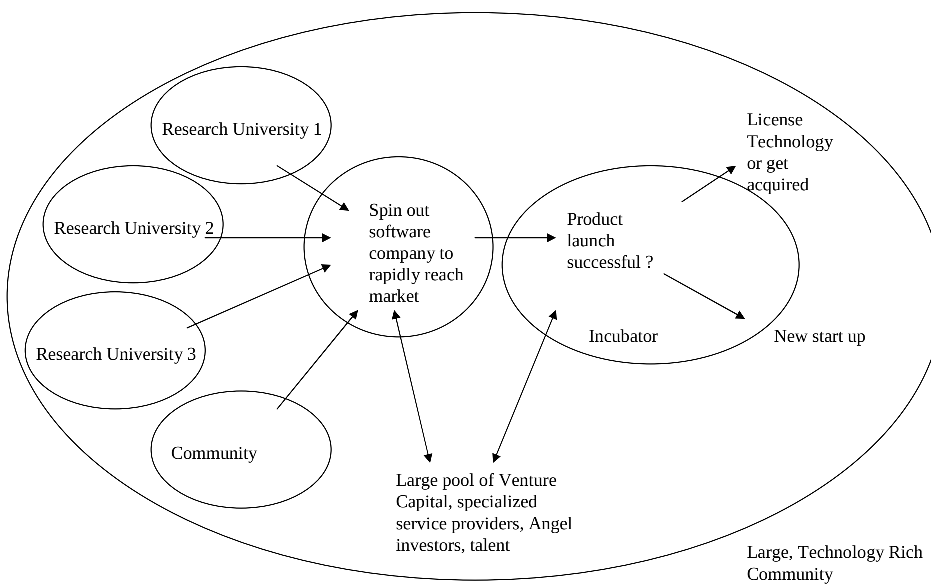


Figure 15: Incubator D Eco System

This program typically has ten (10) to twenty (20) companies as resident clients that range in size from two (2) to twenty four (24) employees. All are software companies and as a requirement for entrance they need to show a demo or pre-Alpha level of product, plus offer a semblance of a business plan. The focus of the Incubator is on market development, management development, and financing.

Most of the entrepreneurs come out of larger regional companies. To date, none has come directly out of a local university. This is more by choice than by happenstance as the manager focuses mainly on experienced entrepreneurs. Recruiting tends to be word of mouth or by referral from a venture capitalist, angel investor, or accounting and legal professionals working with start-ups. There is a great deal of informal networking, as is a tradition of the region. The manager specifically looks for entrepreneurs that exhibit the "Fire in the Belly" that he feels is vital to entrepreneurial success.

The region has an entrepreneurial culture and context, and local government is interested in fostering technology-based start-ups as part of its economic development strategy. The rich local supply of talented people also contributes to the program's success. The program utilizes an extensive informal network of advisors and business assistance companies, as well as locally based equity and debt financing. The presence in the region of a number of large, nationally prominent software and hardware companies creates many partnering opportunities.

Building rent is paid by the City and rental revenues cover the balance of operating expenses. However, program staff is very clear to note that it is "not a real estate operation." Staff consists of 3.5 Full time equivalents (FTE's), including a full-time manager, a business manager, and an office manager. The incubator manager comes from an entrepreneurial background, having successfully launched and sold two software companies.

One of the incubator's most popular programs is the Executive Associate Program, which assigns senior level interns to work on a pro bono basis with the resident companies on specific issues, such as marketing or fund raising. About 85 percent of companies that enter the program obtain venture funding or institutional investment. Incubator management requires the clients to complete and polish their formal business plans and then provides assistance in developing presentations for investors. Once incubator firms are ready to deliver formal pitches, *Incubator D's* Venture Capital Referral Program provides referrals to investors. Given the quality of the incubator's clientele, investors value these referrals.

In summary, this is an incubator that exploits a technological niche, benefits from location advantages, demands a significant level of pre-admission development from clients, has an experienced entrepreneur at the helm, and focuses its efforts on a few key areas of business development. The manager also stated that the program is well established in the region and its clients enjoy instant credibility by participating in the program. A large portion of this incubator's job creation resulted from four highly successful clients that continue to provide positive public relations for the incubator.

Table 26: Incubator Specific Data; Incubator D

Incubator D

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Selection Criteria	Rigorous	Rigorous, only serious entrepreneurs with well articulated plan	
	Support level:	Support level:	Support level:
Types of Firms		Software	
	Support level:	Support level:	Support level:
Leasing arrangements		14 month lease	
	Support level:	Support level:	Support level:
Education and other programs		Individual support with referrals to communnity events	
	Support level:	Support level:	Support level:
Incubator management		Strong serial entrepreneur	
	Support level:	Support level:	Support level:
Location		High tech region	
	Support level:	Support level:	Support level:
Credibility	Strong	Strong credibility of proven success and ROI for previous companies	
	Support level:	Support level:	Support level:
What is most important function	Partnership with region	Credibility, connections, hard nose business advice great relationship with city	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 27: Community Specific Data; Incubator D

Community specific issues – Incubator D

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between clients and community		Moderate	
	Support level:	Support level:	Support level:
Interactions among Entrepreneurs		Moderate	
	Support level:	Support level:	Support level:
Interactions between clients and outside individuals		Strong to moderate	
	Support level:	Support level:	Support level:
Access to incubator advisory board	Strong	Strong	
	Support level:	Support level:	Support level:
Access to external funding sources	Region strong, incubator doesn't fill role	Rare	
	Support level:	Support level:	Support level:
Access to steeples of excellence		Sporadic (Strong indirect tie)	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 28: Other Community Specific Data; Incubator D

Community 2 - D

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between incubator and community		Moderate	
	Support level:	Support level:	Support level:
Interactions between incubator and Local Government		Strong (city provides building)	
Interactions between incubator and local Economic Development agencies		Strong	
	Support level:	Support level:	Support level:
Interactions between incubator and funding sources		Strong (city provides building)	
	Support level:	Support level:	Support level:
Interactions between incubator and other entrepreneur support		Strong (networking key)	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Incubator E

Location: Small town
Population: 13,727
Median age: 38.8
Median household income: $90,009
Median house value: $237,600

Characteristics of Incubator E:

- Significant Research University
- Located in robust business and technology region
- Mixed technology
- Semi structured
- University and community spin outs
- Strong tie to community economic development (incentives)

Incubator E Eco System

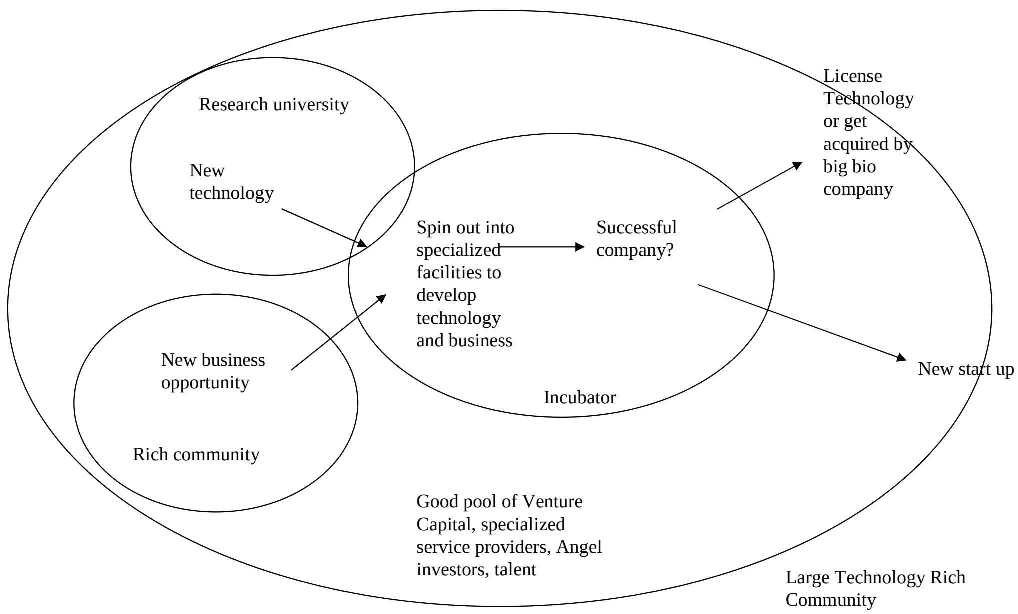


Figure 16: Incubator E Eco System

Incubator E is located at a State University in a small town that is relatively close (50 miles) to a large metropolitan region. This program's vision and dedication is to the concept of transferring technology and ideas from the University to the private sector. *Incubator E* has been in existence for a relatively long time, having been founded in 1984 (although in a much smaller space than it occupies today). The idea for the incubator came from a State Urban Development initiative in the early 1980s, which established small business incubators throughout the state. The first incubator established under this initiative was at another research university.

The purpose of this incubator is to commercialize technology and to support early stage businesses, thereby expanding jobs and the tax base in the state. The university president typically serves as the chairman of the incubator board. Most client firms have originated from off campus. Only five clients have originated from the university.

Since the founding of the incubator more than 100 companies have been associated with its programs. By the end of 2000, more than twenty-five (25) companies had successfully graduated from the incubator. These companies were generating revenues of more than $175 million through state sales alone and had created over 800 employees. One graduate firm, which has since moved to another city, now has annual sales of more than $350 million.

To enter the incubator a prospective client must have its intellectual property secured or have an application for a patent or a license. In addition, the firm needs to have some relationship with the university; that is, the university must be able to supply something the client needs. The incubator manager stated that there is a rigorous screening process in place, but also stated that 95 percent of companies that apply to the program are accepted.

The incubator manager attributes program success to the incubator's ability to offer clients access to world-class scientists, engineers, and graduate students. The university is in the top 50 nationally ranked research institutions, with $130 million in direct sponsored research.

Of secondary importance is that the program provides firms access to laboratories and equipment and other university resources. Among the resources available to clients are a Small Business Development Center and a state program that provides companies a 50/50 match when hiring campus researchers to help solve problems. In addition, the incubator provides access to numerous world class research centers and laboratories including an animal research facility, computer science department, and a materials research facility. The university also has an effective Office of Technology Transfer and Licensing, which generated more than $12 million in revenues to the university last year.

Table 29: Incubator Specific Data; Incubator E

Incubator E

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Selection Criteria	Rigorous	95% acceptance rate but makes everybody submit application	Okay process
	Support level:	Support level:	Support level:
Types of Firms		Mixed technology	
	Support level:	Support level:	Support level:
Leasing arrangements		1 year	
	Support level:	Support level:	Support level:
Education and other programs		Strong	strong (lunch & learn)
	Support level:	Support level:	Support level:
Incubator management		Strong business background	Experienced
	Support level:	Support level:	Support level:
Location		Resource rich	
	Support level:	Support level:	Support level:
Credibility		Very strong	
	Support level:	Support level:	Support level:
What is most important function	Affiliations with university, other established incubators, services, facilities	Strong affiliation with university, access to labs, facilities, animal care	Access to specilaized wet labs (bio company)

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 30: Community Specific Data; Incubator E

Community specific issues Incubator E

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between clients and community	Strong	Strong (university affiliation)	
	Support level:	Support level:	Support level:
Interactions among Entrepreneurs		Strong	
	Support level:	Support level:	Support level:
Interactions between clients and outside individuals	Strong (some out of state)	Strong	
	Support level:	Support level:	Support level:
Access to incubator advisory board		Strong (strong Board too)	
	Support level:	Support level:	Support level:
Access to external funding sources	Strong	Strong	
	Support level:	Support level:	Support level:
Access to steeples of excellence	Strong	Strong	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 31: Other Community Specific Data; Incubator E

Community 2 - Incubator E

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between incubator and community	moderate (not covered a lot)	Strong	
	Support level:	Support level:	Support level:
Interactions between incubator and Local Government	Strong	Strong (joint program)	
	Support level:	Support level:	Support level:
Interactions between incubator and local Economic Development agencies	Strong	Strong working relationship	
	Support level:	Support level:	Support level:
Interactions between incubator and funding sources	Strong	Strong (introductions for VCs)	
	Support level:	Support level:	Support level:
Interactions between incubator and other entrepreneur support	Strong	Strong, (shared person with SBDC)	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Incubator F

Location: small town with large university
Population: 29,000
Median resident age: 22.3 years
Median household income: $24,869 (year 2000)
Median house value: $145,400 (year 2000)

Characteristics of Incubator F:

- Major program of university
- Seed fund available through university foundation
- Located in college town, statewide vision for development
- Located in university owned research park
- Makes extensive use of alumni
- Strong advisory board support

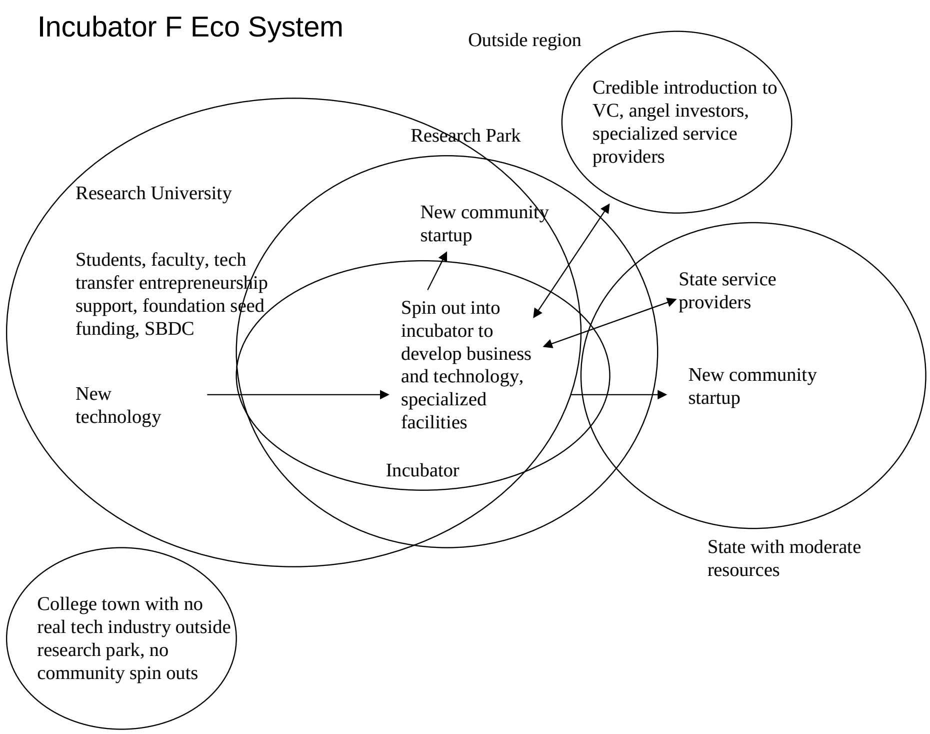


Figure 17: Incubator F Eco System

The mission of *Incubator F* is focused on the retention of technology talent in the State, working to end "brain drain" there and create a situation characterized as "brain gain."

This is a university driven incubator located in a college town that is relatively close (60 miles) to a large metropolitan region. The University has long been one of the nation's top 25 public research universities. In 1993, when the university's first incubator opened, the facility filled up quickly with firms started by faculty and graduate students. Currently, 75 percent of incubator firms are still generated from the university.

Over the past decade, the Research Park has continued to enlarge its program, which now includes two incubation facilities: the Technology Center and the Business and Technology Center. In addition, the university has an additional center that comprises two facilities to serve maturing and graduating companies. Collectively, they offer 150,000 square feet of space, housing more than 90 companies, including more than 40 high-tech start-ups. This growth has enabled the incubation program to become the largest based at any US. university.

Similar to other incubators, the program offers various services for start-up firms including business infrastructure (inexpensive office space, two-way video conferencing rooms, specialized labs, and secretarial support) and professional business assistance (access to university faculty as well as accountants, lawyers and bankers).

The director of university real estate indicates that there are two key reasons that *Incubator F* has been so successful. The first is that, in 1993, the university publicly endorsed its role as an agent of economic development. The university subsequently developed a comprehensive, internally coordinated program that fosters faculty entrepreneurship, commercialization of intellectual property and assistance to local start-up firms.

Second is a sophisticated business assistance program that works with all incubator companies. Started in 1998, the program was designed to mirror corporate "intrapreneur" programs at 3M or Hewlett - Packard. It provides or brokers services including business evaluation, planning, product development, access to early-stage capital, and assistance in developing management teams. In addition, a mentor (usually an alumnus) is assigned to each start up firm to help with overall business development. Mentors are assigned based on firms' needs. In addition to fulltime staffing, the program uses undergraduate students and graduate research assistants, with many coming from the School of Management.

Finally, a pre-seed fund was recently created by the University Foundation. This fund provides up to $250,000 for each selected start-up firm (high preference for university IP based companies). The program offers initial funding to help firms develop their technologies and to leverage private seed and venture funding; providing gap financing between start up and the acquisition of outside financing. To qualify the applicant needs a license agreement in place with the university, and the university takes an equity position in each firm.

Table 32: Incubator Specific Data; Incubator F

Incubator - Incubator F

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Selection Criteria		moderate to strong, depends on vacancy rate	Moderate
	Support level:	Support level:	Support level:
Types of Firms		Mixed, biotech	
	Support level:	Support level:	Support level:
Leasing arrangements		6 month lease	
	Support level:	Support level:	Support level:
Education and other programs		Strong	moderate
	Support level:	Support level:	Support level:
Incubator management		Moderate to strong	moderate to strong (had turnover)
	Support level:	Support level:	Support level:
Location		University town	
	Support level:	Support level:	Support level:
Credibility		Very strong	
	Support level:	Support level:	Support level:
What is most important function	University	University at large including university research park	University and critical mass of high tech in university research park

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 33: Community Specific Data; Incubator F

Community specific issues - Incubator F

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between clients and community		Strong	
	Support level:	Support level:	Support level:
Interactions among Entrepreneurs		Moderate to strong	
	Support level:	Support level:	Support level:
Interactions between clients and outside individuals		moderate to strong (in park)	
	Support level:	Support level:	Support level:
Access to incubator advisory board		Strong	
	Support level:	Support level:	Support level:
Access to external funding sources		moderate to strong (SBIR, seed fund for their tech)	
	Support level:	Support level:	Support level:
Access to steeples of excellence	Strong	very strong	

Note: Support levels: Strong = dominant theme in this data that is consistently supported;
Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found;
Sporadic = a theme that appears now and then in this data source.

Table 34: Other Community Specific Data; Incubator F

Community 2 - Incubator F

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between incubator and community		moderate to strong	
	Support level:	Support level:	Support level:
Interactions between incubator and Local Government		moderate	
	Support level:	Support level:	Support level:
Interactions between incubator and local Economic Development agencies		moderate to strong	
	Support level:	Support level:	Support level:
Interactions between incubator and funding sources		moderate to strong (working with university faculty, staff, students)	
	Support level:	Support level:	Support level:
Interactions between incubator and other entrepreneur support		moderate to strong (depends on strength of client)	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Incubator G

Location: metropolitan region located adjacent to larger region
Population : 52,000
Median resident age: 37.8 years
Median household income: $68,074 (year 2000)
Median house value: $198,700 (year 2000)

Characteristics of Incubator G:

- Abundance of talented scientists and researchers
- Access to National labs and state of the art facilities
- National in scope but focus on state economic development
- Incubator tied in to multiple sources of Biotech technology spin outs
- Focus on technology development and facilities
- Uses separate entrepreneur development programs for client development
- Local gap fund and loan program

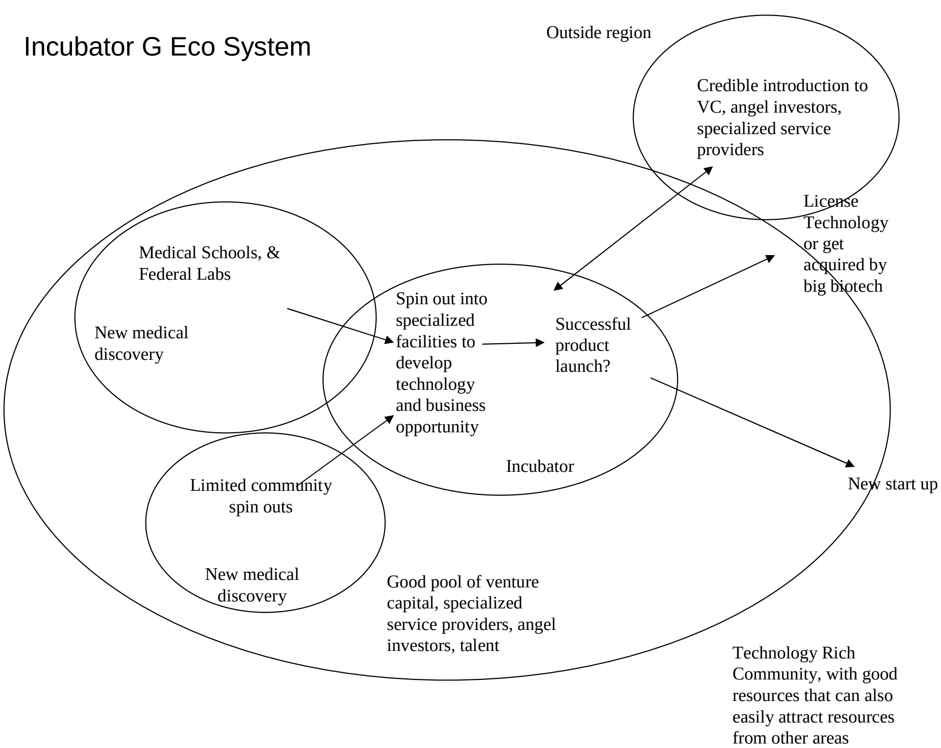


Figure 18: Incubator G Eco System

Incubator G was established in 1984, and operates as a for-profit incubator, or in its own terminology, a "provider of scientific business services." It is located in the heart of a significant biotech / biomedical corridor, within the same community that is home to Federal biotech / biomedical research labs. Since its start, the program has served seventeen (17) biotechnology start-up companies, which collectively have raised more than $500 million in investment capital, created more than 450 jobs, and have an annual payroll of more than $30 million.

Aside from its for-profit status, several other features distinguish the program's approach. For one, there is no set graduation expectation and companies stay in the facility as long as appropriate to execute their business plan. Thus far, twelve (12) companies have graduated and five (5) are currently in residence. For the most part, client companies are led by entrepreneurs coming out of area biotech / biomedical companies, with only two (2) firms originating from Federal lab spin-offs. These are sophisticated individuals, although a number have not previously participated as a principal in a start-up and are somewhat naïve at first.

Second, the 40,000 square foot facilities are state of the art and include an approved animal facility, an animal treatment room, a low temperature repository, a clean room, and warehouse space. The program also incorporates several standing committees that guide the utilization of the laboratory including animal care, radioactive use, and general laboratory safety. The participating companies are research and development intensive, and the quality of their science, along with a viable business plan, is a major criterion for admission.

Participating companies pay rent that is priced at the low end of the local market and receive some administrative services from staff. However, there is no fulltime staff, and the real attraction for companies is access to the physical facilities. In return, *Incubator G* holds an equity position in each of the member companies, typically about 5 percent. *Incubator G* does not invest in any of the companies.

In summary, this is a program that leverages the research and development excellence of its region, offers a first-class physical environment for growth, operates a flexible and low-key approach to incubation services, and attracts a cadre of companies and entrepreneurs with excellent science as a core element of their business strategy.

Table 35: Incubator Specific Data; Incubator G

Incubator G

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Selection Criteria	moderate	moderate	
	Support level:	Support level:	Support level:
Types of Firms	Bio tech	Bio tech	
	Support level:	Support level:	Support level:
Leasing arrangements		Flexible, longer term if necessary	
	Support level:	Support level:	Support level:
Education and other programs	Strong	Strong	
	Support level:	Support level:	Support level:
Incubator management	Well rounded leaders	Understands bio market	
	Support level:	Support level:	Support level:
Location	Robust area	Robust area	
	Support level:	Support level:	Support level:
Credibility	Strong	Strong	
	Support level:	Support level:	Support level:
What is most important function	Specialized facilities	Facilities, services, access to area resources	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 36: Community Specific Data; Incubator G

Community specific issues - Incubator G

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between clients and community	Sporadic	Sporadic	
	Support level:	Support level:	Support level:
Interactions among Entrepreneurs	Moderate	Moderate	
	Support level:	Support level:	Support level:
Interactions between clients and outside individuals	Moderate	Moderate	
	Support level:	Support level:	Support level:
Access to incubator advisory board		Rare	
	Support level:	Support level:	Support level:
Access to external funding sources		Strong (in community)	
	Support level:	Support level:	Support level:
Access to steeples of excellence	Strong	Strong (attached to med center)	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 37: Other Community Specific Data; Incubator G

Community 2 - Incubator G

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between incubator and community		strong	
	Support level:	Support level:	Support level:
Interactions between incubator and Local Government	Strong (complementary services)	strong	
	Support level:	Support level:	Support level:
Interactions between incubator and local Economic Development agencies	Strong	Strong - state wide initiative	
	Support level:	Support level:	Support level:
Interactions between incubator and funding sources	Strong	Very Strong (seed fund, loans, VCs)	
	Support level:	Support level:	Support level:
Interactions between incubator and other entrepreneur support		Strong (part of focused cluster development program)	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Incubator H

Location: small town adjacent to Large Metropolitan Region
Population: 9,000 (adjacent city (500,000)
Median resident age: 29.6 years
Median household income: $44,728 (year 2000)
Median house value: $128,200 (year 2000)

Characteristics of Incubator H:

- Location near major research universities but not a factor in deal flow
- For profit entity
- Invests in high percentage of clients
- Large staff of experienced entrepreneurs

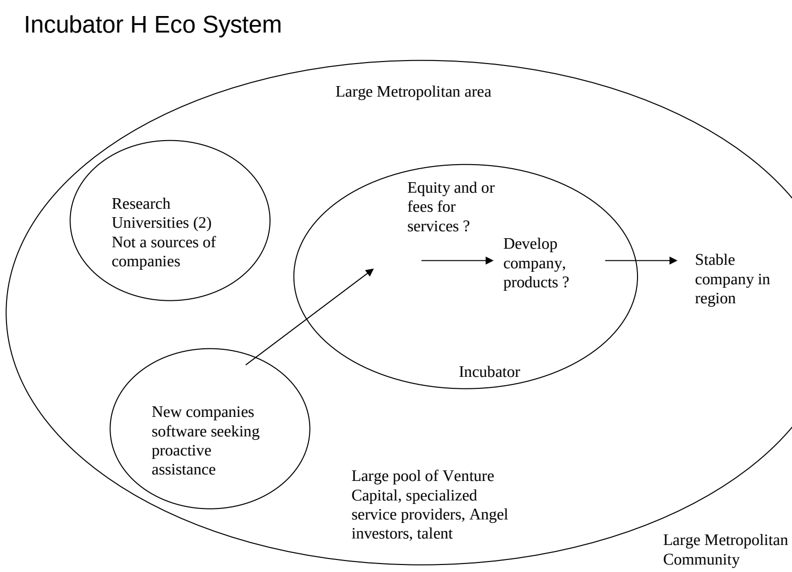


Figure 19: Incubator H Eco System

The incubator is a business unit of a for profit company, which has much larger interests in operations management and investment in the information technology sector. The technological focus of the incubator is in software applications. The incubator program has a core senior staff of three full-time-equivalent employees, all of whom have personal entrepreneurial experience, and has the back-up help of eight to ten company staff members who provide as-needed assistance to client companies. Started in the late 1980s, the for-profit program has attained a notable level of stability and sustained performance, particularly given the recent churning in the information technology sector.

The incubator is housed in a 137,000 square foot facility located in the Northeast section of a large metropolitan area, an area that technology companies heavily populate. Individuals with prior experience as a principal or senior manager in a software company lead many of the client companies in the program. A fairly flexible approach to incubation services parallels this experience base. There is no imposed structure or strict milestones, although incubator staff can, and do, move quickly when a client need arises. Typically, there are about 15 companies in the incubator, and at any given time the incubator is a major investor in about 25 percent of them. The size of the facility is conducive to clients staying longer, and the average company residency is three to four years. Since the program is not conceived as an economic development initiative *per se*, and there are no federal or state agencies demanding turnover, its policies on graduation are quite flexible. Clients pay a monthly fee that covers rent and services. While the program has amicable relations with university-affiliated incubators in the adjacent metropolitan area, this is not a significant source of deal flow or clients.

In summary, this is a program that leverages the assets of an experienced base of entrepreneurs, a location in an area that is heavily populated by information technology companies, a large facility that permits companies to reach greater size and maturity, a flexible approach to services and milestones, and access to the parent company's capital and technical assistance. This Incubator was determined to be a "for-profit" model and no further data was gathered for this research.

Incubator I

Location: small town near a large research university

Population: 10,000

Median resident age: 37.1 years

Median household income: $38,075 (year 2000)

Median house value: $91,700 (year 2000)

Characteristics of Incubator H:

- Located near major research university
- Specialized bio med facilities (animal care facility greenhouse, shared equipment)
- Statewide mission (lose most graduates from region, happy if they can keep company is state)
- Good connections with university tech transfer office, foundation, research centers
- Good supply of technology from university
- Facility key to success

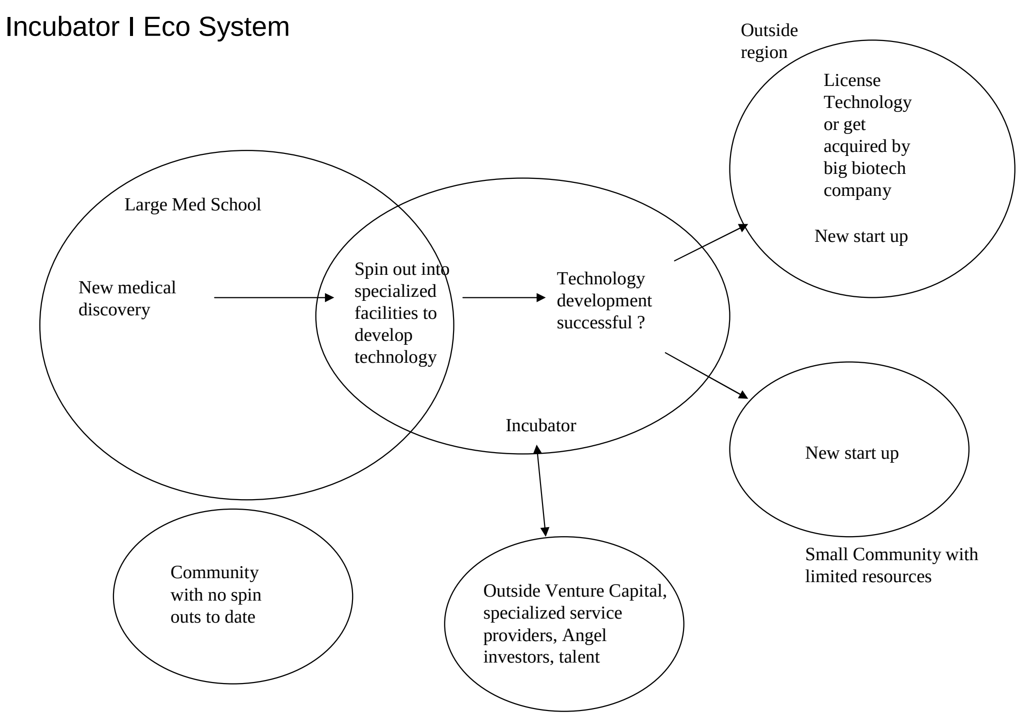


Figure 20: Incubator I Eco System

Organized in 1987 as an activity of a large research university's Biotechnology development Program, the *Incubator I* is located in a 40,000 square foot facility and is designed to accelerate development of early-stage biotechnology companies. Currently, eleven (11) companies participate in the program and most of these firms are based on University technology. The incubator manager identified three reasons for their success. First, the incubator provides considerable technical resources for start-up biotech firms, including state-of-the-art laboratory facilities, central instrument rooms, and shared equipment rooms. It has more than $1,000,000 in equipment available for tenant use, a small animal care facility and a greenhouse.

Second is the incubator's affiliation with the university. The University is one of the nation's leading research institutions, boasting $450 million in research expenditures. In 2002, the university experienced a 70 percent increase in licenses issued and processed 191 invention disclosures. All incubator firms must have some relationship with the university; for example the firm may be licensing university technology or a professor may be involved with a client firm.

The third reason is that the incubation program provides professional assistance through in-house and networking activities. Specifically, the incubator offers business development services and assistance in raising capital. The incubation program also provides companies with access to a number of subscription-only web sites and databases for use in accessing information on markets, competitors, and full-image patents. They also help companies with funding by advising and preparing them to meet with investors and making introductions when the firms are ready.

The incubator thoroughly assesses potential clients by evaluating the candidate's technology and its business plan and milestones. The firm must possess adequate start-up funding and have prospects for obtaining additional funds. A significant percentage of firms have Small Business Innovation Research (SBIR) awards. Applicants must also have the potential to develop collaborative relationships with the University. The average length of stay is three to six years.

The incubator's economic development focus is statewide but the mission of the incubator is not economic development. The main objective is the commercialization of the university's intellectual property.

When asked about job creation, the manager stated it was fairly evenly distributed among their clients with one large exception. She stated that funding and revenue was not as distributed with a few companies accounting for most of the grant funding, revenue generation, and investment.

Networking activity at the incubator was moderate with some companies working for and with each other. She stated that there were not any interactions between the advisory board and the companies as the board was essentially limited to the selection process. There is a commercialization council that provides considerable assistance to companies and is comprised of members from the university's technology transfer office, the incubator, the incubator and the university's foundation. An example of this is that the foundation utilizes its alumni database to locate potential partners, collaborators, and investors for the incubator clients.

Table 38: Incubator Specific Data; Incubator I

Incubator - Incubator I

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Selection Criteria		weak to moderate	Moderate
	Support level:	Support level:	Support level:
Types of Firms		Biotech	
	Support level:	Support level:	Support level:
Leasing arrangements		Yearly lease	
	Support level:	Support level:	Support level:
Education and other programs		Moderate	moderate
	Support level:	Support level:	Support level:
Incubator management		Moderate to strong	moderate to strong (had turnover)
	Support level:	Support level:	Support level:
Location		Strong	
	Support level:	Support level:	Support level:
Credibility		Very strong	
	Support level:	Support level:	Support level:
What is most important function	Facility, access to university	Facility	Facility, access to university

Note: Support levels: Strong = dominant theme in this data that is consistently supported;
Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found;
Sporadic = a theme that appears now and then in this data source.

Table 39: Community Specific Data; Incubator I

Community specific issues - Incubator I

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between clients and community		weak	
	Support level:	Support level:	Support level:
Interactions among Entrepreneurs		weak to moderate	weak to moderate
	Support level:	Support level:	Support level:
Interactions between clients and outside individuals		moderate	moderate
	Support level:	Support level:	Support level:
Access to incubator advisory board		Weak	Weak
	Support level:	Support level:	Support level:
Access to external funding sources		moderate to strong	
	Support level:	Support level:	Support level:
Access to steeples of excellence	Strong	very strong	Strong

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 40: Other Community Specific Data; Incubator I

Community 2 - Incubator I

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between incubator and community		Moderate to strong	
	Support level:	Support level:	Support level:
Interactions between incubator and Local Government		Moderate	
	Support level:	Support level:	Support level:
Interactions between incubator and local Economic Development agencies		Weak to moderate	
	Support level:	Support level:	Support level:
Interactions between incubator and funding sources		Moderate to strong	
	Support level:	Support level:	Support level:
Interactions between incubator and other entrepreneur support		Moderate	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Incubator J

Location: large metropolitan area
Population: 450,000
Median resident age: 34.7 years
Median household income: $34,415 (year 2000)
Median house value: $81,500 (year 2000)

Characteristics of Incubator J

- Part of large university, located 1 mile from campus, weak relations with tech transfer, research office
- Student help from entrepreneurship program
- Only serve faculty spin offs
- City created separate incubator
- No advisory board
- Manager provides most of the assistance

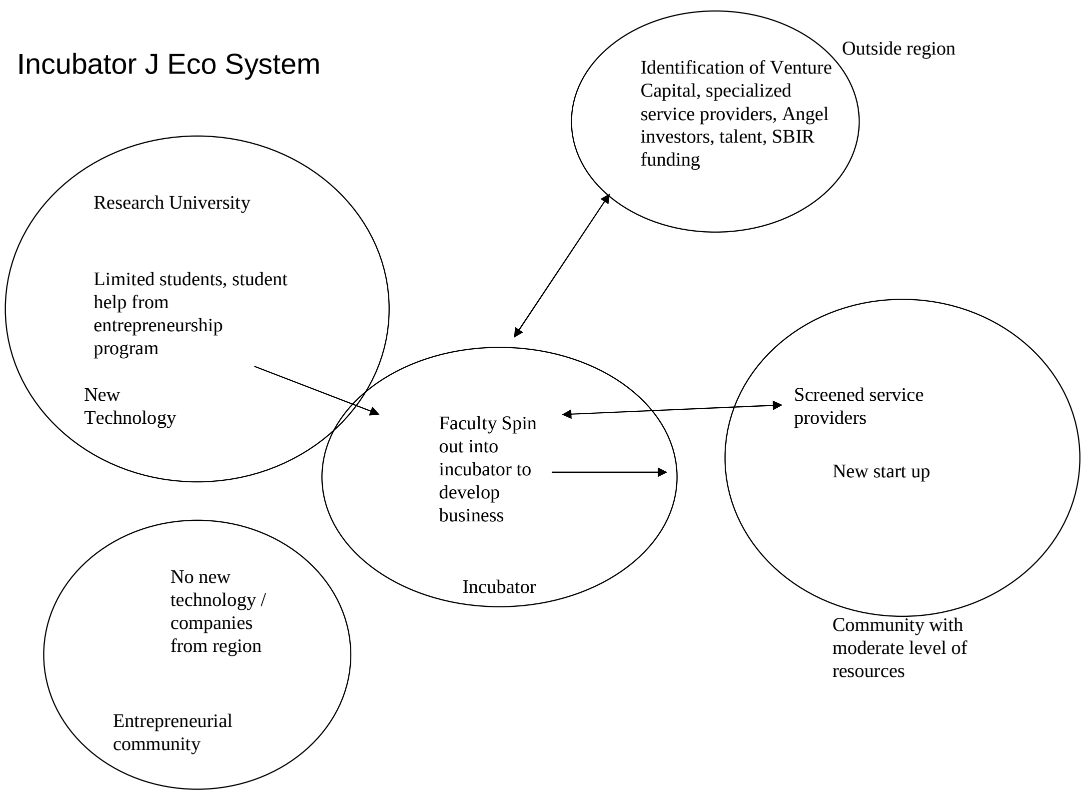


Figure 21: Incubator J Eco System

Incubator J is a part of a large research university. The program is currently in transition having not yet achieved the level of success it originally envisioned when creating the incubator. The current location of the incubator is in a commerce park approximately one mile from the main campus. This location has not helped the incubator in terms of interactions with other units of the university.

The university is modifying its current economic development infrastructure so it can provide a single point of contact for businesses and entrepreneurial communities to access many of the resources necessary for success: intellectual property, management expertise, capital partners and support services.

The university is constructing a 60,000 sq. ft. incubator facility located in the University's Research Park directly adjacent to the university. Facilities will include quality office and laboratory space designed for biotechnology and life sciences research. Shared laboratory facilities provide technology businesses with access to critical research equipment that would otherwise be cost-prohibitive to most start-up companies.

The Incubator provides office and laboratory space and professional advice for companies that meet the requirements. Companies are selected based on criteria that assesses whether the company is a technology based company, has or requires a relationship with the university, and if it needs services supplied by the incubator. Their application consists of five questions that the incubator manager uses to filter the applicants. The manager stated that an anticipated need to improve the stringency of the selection process once the new facility is closer to full occupancy. *Incubator J* works in partnership with the university's Center for Entrepreneurship. The Center for Entrepreneurship provides a wide array of successful entrepreneurial business and technology programs to enhance entrepreneurial education, research and training for both incubator clients and community businesses.

The Incubator is supported by the City and County, but only recently. Previously the Incubator was a stand alone operation focused entirely on university based spin offs. This strategy was abandoned after the first three years and the incubator and the community have both realized benefits in the number of clients now being incubated in the program. Currently half of the clients are from the community.

Incubator J does not have an advisory board but, refers clients to a list of service providers that that offer discounts to client companies. The program also refers clients to entrepreneurship seminars and programs in the community and at the university that provide the educational programming for the incubator.

When asked what Incubator J does that helps its clients the most, the incubator manager cited one on one coaching and mentoring and the ability to identify the specific needs that need to be addressed by the company to reach their goals and objectives. He also stated that the incubator significantly increased the visibility of its clients and that networking and other activities have helped clients to gain improved contacts in the community.

When a client was asked which services were most helpful, hands on help and cheerleading of the incubator manager were reported. The client company stated that participating in the Incubator promoted credibility at first but as the company has grown to over fifteen employees, the reverse is true. As a result, the firm is planning to graduate from the program soon.

Table 41: Incubator Specific Data; Incubator J

Incubator J

Indicator	Survey Data	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
Selection Criteria	Support level:	Support level:	Support level:	Support level:
	Support level:	Support level:	Support level:	Support level:
Types of Firms			High tech in any area	
	Support level:	Support level:	Support level:	Support level:
Leasing arrangements			Flexible leases	
	Support level:	Support level:	Support level:	Support level:
Education and other programs			Outsourced	
	Support level:	Support level:	Support level:	Support level:
Incubator management			Hands on, business experienced manager	
	Support level:	Support level:	Support level:	Support level:
Location			Large metro	
	Support level:	Support level:	Support level:	Support level:
Credibility			Little evidence to support companies get credibility at this point	
	Support level:	Support level:	Support level:	Support level:
What is most important function			one on one coaching and mentoring, helping companies understand what they need to do to be successful	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 42: Community Specific Data; Incubator J

Community specific issues - J

Indicator	Survey Data	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:	Support level:
Interactions between clients and community			Rare	
	Support level:	Support level:	Support level:	Support level:
Interactions among Entrepreneurs			moderate	
	Support level:	Support level:	Support level:	Support level:
Interactions between clients and outside individuals			Sporadic	
	Support level:	Support level:	Support level: None	Support level:
Access to incubator advisory board				
	Support level:	Support level:	Support level:	Support level:
Access to external funding sources			Rare	
	Support level:	Support level:	Support level:	Support level:
Access to steeples of excellence			Rare	

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Table 43: Other Community Specific Data; Incubator J

Community 2 - J

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between incubator and community		Rare	
	Support level:	Support level:	Support level:
Interactions between incubator and Local Government		sporadic (provides funding recently)	
	Support level:	Support level:	Support level:
Interactions between incubator and local Economic Development agencies		Rare	
	Support level:	Support level:	Support level:
Interactions between incubator and funding sources		Moderate (local govt. providing funding recently)	
	Support level:	Support level:	Support level:
Interactions between incubator and other entrepreneur support			Sporadic

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

Fairfield Iowa

Location: Small Town

Median resident age: 41.5 years

Median household income: $31,202 (year 2000)

Median house value: $73,200 (year 2000)

Fairfield Iowa is located two hours southeast of Des Moines--80 miles from the nearest interstate highway or commercial airport, population 9,500. Twenty-five years ago, it was just another small town surrounded by cornfields and hay.

Today, it is a high-tech hotbed known affectionately as “Silicorn Valley.” The credit appears to belong to followers of Maharishi Mahesh Yogi for transforming this remote crossroads into a thriving cosmopolitan pocket of high-tech, New Age entrepreneurs. Since 1974, members of the Transcendental Meditation movement have been moving there from around the globe to study and meditate at the Maharishi University of Management. An economy of small companies using tools like the World Wide Web and e-mail to conduct business was a perfect solution for Fairfield; it created jobs but did not disturb the quiet lifestyle that drew these meditators to Iowa in the first place. Fairfield Mayor Robert Rasmussen commented that "Meditation may be wonderful, but you still need dollars to live." As a result, many residents became very entrepreneurial to survive and in turn created a significant number of at-home occupations.

Transcendental Meditation (TM) practitioners account for 3,000 of the town's 9,500 residents. Only 1,148 of them are working toward undergraduate or graduate degrees at the university; the rest are singles, couples and families who have made Fairfield their home because they do not want to leave the company of other TM devotees, who meditate together for two hours every morning and for another two hours every evening. The remainder of the population lives harmoniously, not as a melting pot, but more as a vegetable soup, according to the head of their Chamber of Commerce.

Since 1988, 400 new companies have sprung up in Fairfield, creating an estimated 2,000 new jobs while attracting over $250 million dollars in investment. That equates to a new company and five new jobs roughly every 10 days over the last 11 years -- enviable growth by any standard.

Even given the large pool of creative people, the growth is unprecedented. When asked what factors account for such growth, leaders quickly point to peer to peer mentoring and community involvement. Virtually every successful entrepreneur volunteers significant amounts of time to assist new start ups. Mentors often invest in ventures, which leads to angel investment and eventually formal investment structures.

Networking is a part of the community, culture, and design at Fairfield. Lunch hour is a daily networking event at the local restaurants and there are more restaurants per capita than San Francisco. The town has three local papers and a monthly magazine.

Residents also have a great tolerance for failure. There have been many failures over the years and it is not uncommon for a single entrepreneur to have more than three failures before finding something that works.

There is no formal incubator in Fairfield. There is a volunteer entrepreneur association that provides a forum for issues and brings in outside speakers on occasion, but the association does not take credit for the culture that is prevalent in the community.

Reflective Case Study

The UCF Technology Incubator

A discussion on why an incubator is started is important, particularly if an understanding of the meaning of success is desired. Incubators are often evaluated using easily measured metrics such as how many square feet the building occupies or how many companies are participating in their program. An incubator started for one reason and measured against outcomes unrelated to that reason can easily fail, while still fulfilling its intended mission.

The idea for the UCF Technology Incubator started in the mid 1990's, in several areas of the university: the office of the Vice President for Research; the College of Engineering; the Small Business Development Center (SBDC) in the College of Business; and the Center for Research and Education in Optics and Lasers (CREOL).

The environment and support for incubators was never stronger than at this time. The "dot-com" era was charged with multi billion dollar successes filling the news media of the day. For-profit incubators emerged across the country as a way for venture capitalists to keep close tabs on their investments.

There were different but complementary motives for starting an incubator at UCF. The Vice President for Research at the time felt pressure to create an incubation program

mainly for political reasons (bandwagon effect). Many metropolitan universities had incubators and the UCF mission mandated partnerships with the community.
The SBDC felt an incubator was an interesting idea that would provide contact with the companies that would count as counseling time to the SBA. In return, it would elevate the visibility of the SBDC, which at the time was located on the third floor of the Business Administration building on campus. The Director of the SBDC was the person promoting the creation of the incubator at the Center.

The College of Engineering wanted to be able to establish closer ties with industry. The College already had two companies sharing space with them in rented space in the research park. These startup companies were working together with College faculty on Small Business Innovative Research contracts and recognized the productive benefits of being in such close proximity to one another. One of these companies, Electrodynamics, became one of the first companies admitted into the program. The College's development officer was also the College’s champion in the establishment of the incubator program.

CREOL’s motivation was founded on a need to spin out technologies developed at the Center into companies. Tom O'Neal (author of this work) was then the Associate Director of the Center and an experience serial entrepreneur. While at the Center, he helped two faculty members start new companies based on research technology developed at the Center. These companies continue to thrive but the process of starting the companies was challenging in the existing university environment.

The University environment was such that faculty starting companies faced severe criticism and scrutiny. In one instance, O'Neal and the faculty members were reported to the State Controller's Office under the whistle blowers act for operating a company while at the university. While both participants were very careful to follow all the policies and were cleared of doing anything inappropriate, the investigative process was quite unsettling and demonstrates the cultural barriers that previously existed at the University.

Starting a new company is daunting enough, but the added complexities and challenges under the existing infrastructure was formidable. The university administration at that time was just beginning to re-think the role that universities play in regional economic development in the new emerging knowledge based economy. Previously it was thought that the best way to deal with issues such as conflicts of interest was to avoid them rather than manage them. There was little history at the relatively young university to guide administrators.

The second motivator for CREOL was a sincere interest in gaining faculty access to competent assistance in their quest to start a new company. Generally speaking, university scientists have little training or understanding of detailed business issues. O'Neal witnessed first hand that faculty will mortgage their house on their technology without a clear understanding of the business potential, the market, or even a basic knowledge of their real customer base.

Getting started

Having learned of these other efforts through a conversation with the Executive Director of the Central Florida Research Park, O'Neal called a meeting between the College Engineering, the SBDC, and himself. The three agreed to join forces to establish an incubator. O'Neal then asked for a meeting with the existing VP for Research. The VP was also investigating the opening of an incubator. O'Neal was informed that the VP was working the issue, that it was difficult, and that she would let him know when there was something to work on. This essentially stopped any further development on the incubator project. A few months later however, the VP for Research was released from administrative duties and a new VP was put in place. The new VP knew of the incubator effort, was not necessarily sold on the idea, but did support the idea of the joint partnership. The only condition was that someone had to be in charge of the project. O'Neal was given that responsibility. O'Neal then began the work of getting everyone together on the project. This also included another organization named the Central Florida Innovation Corporation (CFIC), a not for profit "virtual incubator" with a mission of building investment grade high tech companies in Central Florida. The vision was to have the SBDC and CFIC located in the incubator to provide on-site service to the incubator clients.

Making it happen

As with many similar projects, several key things must happen before the doors can actually open. Funding, staff, and other support had to be garnered for the program. There was no existing funding available for programs such as the incubator at UCF. This meant that more creative means needed to be employed. The next task focused on finding seed money to launch the incubator program. Three $8,000 investments were secured from The College of Business Administration, the College of Engineering and CREOL. This $24,000 seed fund was then matched with $26,000 from the Office of Research, establishing a $50,000 baseline to operate from. A proposal was written to the Florida High Tech Corridor Council for matching funds and another $40,000 was acquired for the project. At this same time, the Scottish Government which had an economic development office located downtown at City Hall, was looking to open a series of technology centers in the US. The idea was to provide Scottish companies with a "stepping stone" to help them penetrate the US market. After several meetings with O'Neal, including a trip to Scotland with then Governor Chiles, the Scottish government agreed that the best place to locate a new facility would be in Orlando at the university's incubator once realized. This was a key event that validated the idea to various university administrators. There would now be an anchor tenant in the incubator, providing a steady stream of revenue to offset the costs.

Arrangements were made to place the Small Business Development Center in the Incubator to have them close to these new companies. The College of Business made arrangements to pay for the cost of locating them in the incubator. In addition, it was decided that the Central Florida Innovation Corporation would also be located in the incubator. The UCF Office of Research was already providing space to CFIC and agreed to continue to provide space and house CFIC in the incubator. With this, and a multiyear commitment from the Scottish government, UCF entered into an agreement to lease 12,000 square feet of space in the University Tech Center. The building required moderate renovations over approximately in order nine (9) months in order to open it to tenants. In the mean time, a proposal was written to the Technology Research and Development Authority (TRDA) for funding of the incubator, using the funding already committed as match (including rent from the Scottish Government), an additional $300,000 was acquitted for the incubator. Some of the funding ($70,000) was provided to CFIC to provide Business Development Support to the new companies that would be populating the incubator.

Moving in

With enough funding now in hand to start the incubator, a grand opening event was held that included 40 visiting companies from Scotland, then City of Orlando Mayor Glenda Hood, Orange County Chairman Martinez, UCF President Hitt, TRDA Head Frank Kinney, Greater Orlando EDC Chairman Darryl Kelly, and the Head of the Scottish

Technology Initiative. More than 150 community leaders attended the event generating a great buzz in the community regarding the potential for high tech economic development in the region. The opening also featured the incubator's first clients. There were four companies on day one that moved into the incubator, in addition to the Scottish Technology and Research Center. These companies were based on technologies in the areas of Engineering, Optics, and Computer Science, or Information Technology.

A public relations firm was hired to manage the opening event by the Scottish group to ensure maximum return on the event. The event did meet or exceed expectations, including significant coverage in the local and Scottish press. This early exposure resulted in many inquiries into the incubator from new companies as well interested community organizations. O'Neal quickly realized the impact that the media could have on the incubator and hired the public relations (PR) firm that managed the opening event to conduct PR for the incubator during it's first year of operation. The scope of work focused on introducing the incubator and the concept of incubating companies to the Central Florida Community. The decision provided excellent returns. Within the first year, the incubator was featured in the Orlando Sentinel, the Orlando Business Journal, the Tampa Tribune, the St Pete Times, Florida Trend Magazine, and the Wall Street Journal. It was called out as a "bright light" for Central Florida by the Orlando Sentinel. Indeed, the region embraced the incubator.

The problem remained that the incubator still only had funding secured for the first year. Long term funding had to be secured to keep the incubator open. O'Neal began soliciting support from the City of Orlando, Orange County, and the State of Florida.

Learning the Incubator Business.

One of the benefits associated with the length of time it took to get the doors open for the incubator is that it allowed key constituents an evolutionary period for on how to run an incubator. O'Neal learned that a strong National Association existed to support the industry, the National Business Incubator Association (NBIA). The NBIA holds two major events per year, their annual conference and the Fall Training Institute. The timing worked out such that O'Neal was able to attend three key events prior to opening the incubator. These proved to be invaluable in understanding what incubators do on a day to day basis. Each event featured a host incubator and included tours of their facilities. In addition to the formal sessions during these three day-long conferences, there were many networking activities that provided additional information and sharing between the participants. Each event drew approximately 800 participants, most of which eagerly shared ideas, practices, and policies and procedures. O'Neal used many of these materials to establish the initial policies for the incubator. It also became clear that someone would need to be hired soon to take care of the day to day management activities of the incubator. He began searching for someone to put into the position at least temporarily until a permanent person could be hired.

O'Neal hired a development person with excellent networking and people skills, that was working for the Scottish Center, into the position of Chief Operating Officer for the Incubator.

Providing Business Assistance

The original idea to provide service for incubator clients was to co-locate the Small Business Development Center, the Central Florida Innovation Corporation, and the Incubator in one facility. It was assumed that the placement of these service providers in such close proximity would create an environment where each company would seek assistance when needed. Within a relatively short time frame however, it was clear that close proximity alone was not enough to insure that the incubator companies were receiving the services they required. In fact, O'Neal observed that the companies and service providers were not really interacting at all. The halls were empty with companies and service providers simply working in their designated space, with little or no interaction.

An investigation into the lack of interaction presented interesting results. The on-site service providers, The Central Florida Innovation Corporation and the Small Business Development Center stated that companies had not been in to see them. The same response was obtained from the companies. Both were literally waiting on the other to initiate contact. Neither had a clear understanding of what each needed to start the process. The SBDC required companies to fill out a client request form prior to services being rendered and therefore was not initiating the process of providing services to the incubator clients. CFIC simply felt the clients would come to them if and when they needed help. The clients were reluctant for a number of reasons including not knowing who to go to for different advice and being afraid of not knowing enough to ask the right questions.

At that point, O'Neal simply began scheduling monthly meetings with each client between CFIC, the SBDC, or other external service provider. The SBDC forms were handed out and each client returned the filled out requests. Brown bag luncheons were held once a month to encourage interactions, and bi-monthly seminars were scheduled that covered a wide variety of topics.

Selection of Clients

For the first year, applicants to the incubator filled out some application forms and then did a one hour presentation to a selection committee. The process was moderately effective, but was not a consistent predictor of how well a client would fit into the program in terms of their receptiveness to the services of the program. O'Neal and others simply believed that the process did not reveal the true potential of a client company.

It was decided that a pre-incubation program should be developed as a way to help the community and become the selection process for the incubator. A program was developed that eventually serve as the filter for new companies applying to the incubator. The seven session course, called “Excellence in Entrepreneurship,” was developed with the assistance of a professional curriculum developer and is delivered in cooperation with UCF's College of Business Administration. Faculty from UCF’s Management Department facilitate and oversee the sessions that incorporate many industry practitioners in the delivery of the material.

The final session of the Excellence in Entrepreneurship program is a presentation of the business opportunity to the incubator's CEO, advisory board members, and invited guests. Evaluations of the business opportunity, the presentation itself, and fit into the incubator are reviewed by the CEO and COO of the incubator to determine acceptance. Acceptance is based on the final evaluations and the applicant’s commitment exhibited throughout the course.

Types of Firms

UCF accepts all types of technology companies but prefers companies that have technologies that complement the university’s expertise. The definition of technology is somewhat ambiguous but is generally defined as new, innovative products or services, that are scaleable, and that hopefully provide a sustainable competitive advantage for the firm.

The incubator companies can be categorized in the following manner:

Technology Area	Number of Clients
Software	16
Modeling and Simulation	8
Photonics	10
Engineering	16
Bio-Technology	4
Total	54

Leasing Arrangements and Services

The UCF Technology Incubator requires every client to execute a sub lease for the space physically occupied by them. These leases are flexible and allow companies to expand and contract without penalty. Companies are given a one year lease, with an option for a second year. Companies wishing to remain longer than two years must meet with the CEO of the incubator to show progress towards the initial milestones outlined in their application process.

Facilities

The initial facility of the UCFTI consisted of 12,000 square feet but demand quickly forced the incubator to expand. Space was acquired gradually over the first three (3) years to its present inventory. At this writing, the UCF Technology incubator consists of 66,000 sq ft of space, in four separate buildings. Three of these buildings are located in the Central Florida Research Park (CFRP). The CFRP is one of the top ten Research Parks in the US and boosts over 100 companies with approximately 10,000 high tech workers. The fourth location of the UCF Technology Incubator is in downtown Orlando.

Client offices range in size from 150 square feet to 7,000 square feet. Some specialized capabilities have been added to the facilities, including wet labs and clean rooms. These resources and capabilities are developed on a case by case basis, with the clients off setting a large portion of the costs. Rent waivers and other accommodations have also been made.

Clients are not charged for shared resources, which includes three conference rooms, work rooms (copy machine, etc), halls, break-rooms, rest rooms, and a small business library.

Programs and Forums

The UCFTI offers a full menu of entrepreneurial support services. These services include but is not limited to:

- Boot camps for entrepreneurs
  - 2 per year minimum
- Business plan competitions
  - Winners receive incubator support
- Excellence in Entrepreneurship certificate course
  - Selection filter providing community entrepreneurship support
- Assist other incubator programs
  - Sanford, Tampa, Melbourne, St Pete, Puerto Rico, etc
- Support for industry associations
  - AEA, Photonics Cluster, Florida Business Incubator Association
- Technology entrepreneurship workshops · Seminars on various topics
  - Average of 1 per week
- Emerging business network
- Entrepreneur in residence
- In house networking events
  - Brown bag luncheons, barbeque, etc.

The number of events offered clients is more than most would be able to attend. Clients attend sessions they are most interested in and can fit into their schedule. In some cases, certain clients are strongly urged to attend workshops that incubator personnel believe they would benefit the most from.

Early in the history of the UCF Technology Incubator program, it became clear all the talents of the SBDC, CFIC, and the incubator staff combined were not going to be able to provide the broad range of services necessary to properly assist the clients of the incubator. A strategy to enlist addition resources was necessary.

After conferring with other incubator managers at an NBIA conference, O'Neal began recruiting professional service providers from the community to help. This included brand name accounting legal, financial, marketing, HR, and other firms. The response was remarkable with nearly 100 percent of the firms approached more than willing to dedicate time to assisting these young firms. While none of the organizations offered financial support to the incubator, the time they dedicated assisting clients quickly represented a major asset to the Incubator that would not otherwise have been affordable to the clients or the incubator.

With that, the quality of the program grew rapidly, as did the reputation of the incubation program. The perceived value attracted an increasingly more sophisticated client, allowing the incubator to achieve better results with less effort. The program began attracting more attention, ultimately reaching a critical mass resulting in a snowball effect in the region in support of technology startups and incubation.

Integration into larger technology development system

Since its inception, the UCF Technology Incubator has always been a partnership. The City of Orlando, Orange County Government, the Florida High Tech Corridor, the Technology Development and Research Authority, and others have been critical to the establishment and success of the incubator.

The City of Orlando and Orange County jointly funded a study examining how to diversify the region's economy. A prominent consulting firm from Austin made many recommendations including the recommendation to significantly increase the capabilities of the UCF Technology Incubator.

Orlando's Mayor then formed a task force to review the recommendation. The committee consisted of several community leaders including high level UCF administrators. One of the ultimate recommendations of the study was to significantly strengthen the UCF Technology Incubator as part of the economic development agendas of the City and County. Both agreed to financially and otherwise support the program and are providing supporting funds in excess of $100,000 per year each to the program.

The Mayor's task force was another key event that cemented the incubator into an overall high tech development agenda for the region. The funding was also a key resource necessary for the expansion of the program.

Incubator Management and Staff

The incubator team at UCF consists of the following positions:

- CEO
- COO
- Business Development Manager
- Event planner, marketing
- Receptionist
- Facilities manager
- Site coordinators for the downtown and second research park locations

The Chief Executive Officer: This position has been held by Tom O'Neal since the beginning of the program. O'Neal was part of the team that originally founded the incubator and remains its champion at the highest level. He is also the Associate Vice President for Research at UCF, a position that has been very beneficial to the development of the Incubator. O'Neal makes all of the typical decisions a CEO would make concerning strategic issues, budgets, and personnel. He also represents the incubator to university and community leaders (along with the COO), helps connect the incubator to other university and community needs and resources, interfaces with sponsors, makes the final decision as to which applicants are accepted into the incubator, if the firms can stay longer, if the firms can increase their space, and if a firms needs to be asked to exit the program.

O’Neal also provides valuable linkages between other UCF Colleges, Research Centers and programs including the Colleges of Business Administration, Engineering and Computer Science, and Optics and Research Centers such as the Center for Research and

Education in Optics, the Institute for Simulation and Training (IST), the BioMolecular Science, and others. This also includes connecting clients to the programs of the Florida High Tech Corridor which can represent a significant financial opportunity for the clients involved in research.

Chief Operations Officer: The responsibilities of this position are to facilitate the day to day operations of the incubator. This includes supervising the remaining staff of the incubator, daily interactions with clients to resolve issues, scheduling appointments for regular meetings, connecting incubator clients with external resources, and many other duties that vary daily. Because O'Neal's time is not dedicated full time to the incubator, the COO position was filled with a person that could provide more than COO level assistance to the team when necessary.

This person is exceptional at networking and maintaining an extensive network from which to draw upon. This has helped to increase the size of the external resources available to incubator clients.

Business Development Manager (BDM): This position is responsible for providing strategic and tactical support to companies, identifying gaps in the development of the company or entrepreneur, and working with the CEO and COO to identify the best resources to address those gaps. Each client is required to meet with this person at least once a quarter. The BDM meets with the CEO at least once a month to review client progress, concerns, and other issues.

The BDM also provides the CEO with support related to university spin offs, conducting due diligence for opportunities under consideration, and serving as interim CEO for new spinouts until a permanent CEO can be recruited. The BDM also provides support to the local angel investor group and assists in the production an annual venture capital conference targeting young companies.

Event planner and marketing: This position is responsible for logistical and other infrastructure support for the programs, seminars and marketing efforts of the incubator. This includes scheduling, announcements, booking venues, tracking RSVP, producing newsletters, and other materials. Support is also provided to clients as they prepare collateral materials for their companies.

Receptionist: Provides traditional support as a receptionist for the incubator, schedules conference rooms and provides limited administrative support to clients. Also helps with other duties on a non-interference basis, such as helping with the newsletter or other client needs.

Site Coordinators: Act as receptionist and facilitator at the additional facilities. Site coordinators also act as a conduit to the resources at the main incubator facility as well as other complementary organizations. These individuals also assist with other tasks such as helping with events at their locations, lease tracking, and other administrative duties.

Facilities Manager: This person is responsible for maintaining the physical infrastructure of the incubator; including preparation of client space, network (internet) connections, reconfiguration of space for existing clients, plus oversight of all the maintenance issues of the four buildings the incubator occupies.

Location within the Central Florida Research Park

The UCF Technology Incubator is located in the Central Florida Research Park (CFRP). The Central Florida Research Park, abutting the main UCF campus, is a university related research park established as a result of legislation passed by the Florida Legislature in 1978.

The objectives of the Central Florida Research Park are in keeping with the legislative action which enabled its creation "to encourage and promote the establishment of research and development activity combining the resources of institutions of higher learning, private sector enterprise involved in pure or applied research, and state or federal governmental agency research."

Totally planned to provide a campus-like environment for businesses adjacent to UCF, the Central Florida Research Park consists of over 1,000 acres of land. Businesses which desire a "university relationship" can purchase or lease land in the Research Park on which to construct a facility or can lease space for office, office / lab, or light manufacturing activities.

University organizations, including the Institute for Simulation and Training and the Office of Research and Commercialization, are located in the Research Park. The Naval Air Warfare Center Training Systems Division, and the Army Simulation, Training, and Instrumentation Command (STRICOM), the focal point of the nation's simulation and training industry, are headquartered in the Research Park. Over $700 million in federal contracts are granted by the Army and Navy each year.

Currently over 100 companies are located in the Research Park pursuing activities in simulation and training, lasers, optical filters, behavioral sciences, diagnostic test equipment, and oceanographic equipment. Approximately 10,000 employees currently work in the Research Park, including many University students and faculty.

Research Park tenants are involved with the University of Central Florida through sponsored research, employing faculty as consultants, and utilizing graduate and undergraduate students for intern programs and part-time employment. Research Park tenants can also contract with the University for use of the library, computer resources, and laboratory facilities. Cooperative projects range from technical research to developing business plans and employee training programs.

Current status of the incubator

As of this writing, the UCF Technology Incubator has assisted more than 70 firms. It has 55 current clients and has graduated 10 companies. It was named the Incubator of the Year at the National Business Incubator Association's annual conference in 2004. It has ranked in the top ten listing of incubator programs nationally in terms of revenue growth and jobs created for the past three (3) years. In summary, over the first four (4) years, clients in the program have:

- Created more than 600 jobs, with an average salary of $58,000
- Raised more than $150M in investment funding
- Generated more than $140M in revenue
- The total number of patents held by clients in the incubator = 286
- The total number of copyrights held by clients in the incubator = 74
- The total number of trademarks held by clients in the incubator = 47
- The total number of trade secrets held by clients in the incubator = 64

Several UCF Technology Incubator clients that have experienced significantly growth since entering the program. In fact, the top five companies account for more than 40 percent of the jobs created with one company creating one-sixth (110) of all the jobs created.

Incubator Interactions:

Interaction between clients

Client interactions range from heavy to non-existent with the average being more toward having regular interactions. Organized events facilitate introductions with other members, but the incubator does not require, or force, these relationships. Relationships formed to date include:

- Buying and selling of services between clients
- Informal discussion and shared experiences
- Conducting joint research programs (sub-contracting)
- Sharing resources
- Sharing space
- Bartering for services
- Sharing of CEO (only in two instances)

Interactions between clients and incubator management

The UCF Technology Incubator has three management level resources for clients to draw upon: the CEO; COO; and Business Development Manager. The bulk of management time is spent helping entrepreneurs solve their problems by identifying and referring them to the right person, or by working as an agent on their behalf. Between the three management personnel, the incubator has an extensive pool of contacts and resources available to clients in a wide range of areas, including accounting, legal, human resources, grant writing, and funding.

The interactions and relationships between the entrepreneurs and the staff flow in two directions. Client problems, issues, opportunities are discussed regularly. Entrepreneurs engaged in the program have become the significant source of new clients for the incubator. Their knowledge of the program and its benefits, from the perspective of an emerging company, is a valuable recruiting tool.

An example of one of the more interesting interactions was between an existing client that needed to expand into specialized facilities. The client fronted the money to the incubator to build out a 6,500 sq ft wet lab. The incubator is providing a large discount on their rent until the $300,000 build-out is paid back with the understanding that when the firms graduates, the dept is paid in full. Another client constructed a clean room from a DARPA funded research program that will again, revert to the incubator upon graduation.

There is large component of public relations support in the client – incubator interactions. The UCFTI often showcases client accomplishments and sends out regular press releases on their behalf. The incubator also provides regular tours of the incubator to dignitaries, politicians, and other officials. This publicity increases the incubator's credibility, making it easier to attract external support as well as potential clients. A large number of existing companies first heard about the incubator through the media coverage.

The Incubator CEO has an office located near the incubator and available to clients as his schedule permits. Periodic meetings scheduled between incubator clients and the CEO, and planned networking events also help to increase and facilitate consistent interactions. E-mails are sent regularly notifying clients about opportunities or upcoming events. The CEO connects people together, with or without himself being present, if he thinks there is a possible mutual benefit, such as a qualified applicant looking for a job, a VC looking to fund certain types of business, a potential customer or supplier, etc.

The COO is the hub for day to day communications and is accessible at the Incubator or through cell phone or e-mail. She occupies the office at the beginning of the hall across from the conference room and posts messages outside her door as to where to reach her when she is out. She is adept at networking and making connections for clients.

The Business Development Manger meets regularly with clients but also participates in several informal, hallway discussions. His main responsibility is to provide strategic and tactical support to the clients and plot their progress against milestones developed with them. Clients view him as an excellent person to bounce ideas off and he often provides them with advice on how to execute portions of their business plan.

Interactions with other staff:

Clients interact daily with the other staff. They often find out what is going on with others through their encounters when they use their services, or pay rent, or just stop by and chat. The communications person constantly provides clients with updates of seminars and events; produces a monthly incubator newsletter, and organizes and promotes the networking functions. The facilities manager works with companies to resolve their infrastructure needs and helps with their individual production and equipment problems. The site managers act as a bridge to the other incubator resources and communicate across the various facility boundaries.

Interaction between clients and outside individuals

Clients spend a large percentage of their time interacting with customers and suppliers and other professional service providers. The majority of these interactions would be similar to non-incubator companies. Additional interactions however, resulted from formal meetings such as the UCFTI's Emerging Business Network and introductions from incubator management and staff.

The College of Business Administration facilitates three to seven internships to incubator clients as well. Internships last approximately 9 months (2 semesters) and provide benefits to both clients and students. Students learn first hand about the issues facing start up companies and clients gain access to young talented help that they might otherwise not be able to afford. Students share their experience with others which helps attract more students and showcases the College of Business' entrepreneurship programs, as well as the incubator program.

The UCFTI also has an Entrepreneur in Residence program that brings experienced entrepreneurs into the incubator. These mentors maintain office hours several days a month, are given business cards, and interact at a very detailed level with a subset of incubator clients that aligns with their expertise. Incubator personnel facilitate introductions but after that, the serial entrepreneur and incubator clients are on their own in establishing a relationship. Clients acquire access to talent that they would otherwise have a difficult time identifying and affording; and the entrepreneurs in residence are able to investigate companies that could represent a new investment or partnership opportunity.

Interactions between Incubator clients and the Incubator Advisory Board

The incubator management facilitates most of the interaction between the advisory board and its clients. The board supplies most of the professional service provider support for the incubator and, as shown below, is broad enough in skills and abilities to address many client issues. Current University of Central Florida Technology Incubator Advisory Board members represent the following organizations:

Akerman Senterfitt
Baker & Hostetler
Central Florida Innovation Corporation
City of Orlando
Deloitte & Touche
Ernst & Young
Foler & Lardner
Gallogly Fernandez & Riley
Greenberg Traurig, P.A.
Grubb & Ellis
Florida High Tech Corridor Council
Inflexion Partners
NAI Realvest Partners
Orange County Government
Orlando Business Journal
Benefits Division Inc.
Seminole Technology Business
Incubation Center
SolomanSmithBarney
Technological Research and
Development Authority
University of Central Florida
Wordwise
Metro Orlando Economic Development
Commission

<u>Access to external funding sources</u>

Incubator management helps companies identify potential funding sources and facilitates introductions at appropriate times. This ranges from joint university / business research grants to loans to angel investors and VC firms.

The University's Office of Research and Commercialization provides access to staff that specialize in locating funding sources, and help identify faculty with matching technical expertise. This service is provided at no charge to the clients. Joint research can also qualify for matching research funds under the Florida High Tech Corridor program which is administered by the Office of Research and Commercialization. The Small Business Development Center maintains an office in the incubator and provides assistance to companies looking to secure an SBA or other type of loan for their business.

The UCFTI's Business Development Manager works closely with Angel Investment groups to marshal or guide introductions of attractive opportunities, when the company is at the right stage. While no guarantees can be made, the BDM does conduct a first level screening of the companies to provide the angel investors with a list of high quality companies for consideration.

The incubator has a Venture Capital firm on site to provide assistance to companies and to encourage investment in promising ventures. Inflexion Capital group pays for one office and the incubator pays for one in exchange for them acting as a resource in the development of incubator firms that ultimately desire institutional funding for their companies capital needs. The University's Research Foundation also invested capital in Inflexion to help the firm raise its initial fund. The investment did not carry any stipulations requiring investment in university spin outs or incubator clients. The aim is that the relationship will eventually provide much needed community infrastructure and benefit the region in general.

Access to the university

The incubator is part of the university and acts as a conduit to many resources. The recent annual survey of clients reveals the following:

Number of faculty working with companies:	54
Number of students working part time or interning:	46
Number of UCF students hired:	56
Level of research funding to UCF from joint research:	$5M

Additionally, clients can access the UCF library, recreation facilities, internet backbone, technical, business, and even cultural assets. UCF has a student body of approximately 45,000 students and 1,200 faculty members. The university also offers shared user facilities, with access available to the clients. A most notable resource from the incubator's perspective is the Material Characterization Facility (MCF). Access to this facility and its state of the art equipment formed the basis for starting one incubator company, NanoSpective. NanoSpective rents time on the facility's equipment, off hours, to perform the majority of the diagnostic services it provides to customers. NanoSpective staff, which are well trained in the operation and use of the equipment, often help train university graduate students on how to use the equipment.

Access to Community and local Government Economic Development Agencies

The incubator works closely with several local and state economic development organizations including the Greater Orlando Economic Development agency, Enterprise Florida, City and County municipalities, The Florida High Tech Corridor Council, and UCF's Office of Economic Development. These resources have helped put together incentive packages for several incubator clients, secure workforce development dollars, provide contacts across the region, and co-sponsor several of the events targeted at helping incubator clients.

A notable example is Orange County and UCF sharing the cost to build a biotech greenhouse on the campus of UCF. The green house will support research being commercialized by a UCF faculty spin out company. UCF transferred the technology in exchange for an equity position in the company, and royalties based on sales. This enabled UCF to retain the researcher at the university and hopefully, preserve a large part of the company's operations in Central Florida.

The City of Orlando and Orange County both are major sponsors of the incubator program, providing $100,000 per year each. Both support the Incubator and its programs in non-financial ways as well and the incubator is an integral part of both organization's economic development initiatives.

Access to other entrepreneurial support organizations

Incubator clients are introduced to and encouraged to interact with external entrepreneurial organizations including:

- The National Entrepreneur Center
- The Small Business Development Center
- The Kauffman Foundation
- The National Inventors and Innovators Alliance
- The UCF Student Entrepreneur Society
- The NSF funded Center for Entrepreneurship and Technology Commercialization
- The Florida Business Incubator Association
- The UCF College of Business and its Technology Entrepreneurship Institute

As would be expected, the interactions vary considerably from client to client but most have contact at some point during their residency in the program..

A notable relationship is the National Colligate Inventor's and Innovators Alliance (NCIIA). Funding provide by this organization helped to create "E-Teams" focused on developing companies based on university technology. These student teams worked with faculty to test the market and technical feasibility of a technology at UCF's Institute for Simulation and Training (IST), eventually winning the annual UCF business plan competition and opening a company in the incubator. Additionally, the NCIIA sponsors a one day "Invention to Venture" entrepreneurship boot-camp that provided more than 230 attendees last year with a crash course in business. The event featured the former CEO of America On-line as a key note speaker. In addition, the founder of Atari and Chucky Cheese gave a session on "Is Entrepreneurship for you?"

Summary

The success of the UCF Technology Incubator has been well publicized in various media and with the National Business Incubator Association. This revolutionary growth occurred so quickly that it is difficult to confidently point to any particular set of factors that stand out as differentiators. The incubator provides many tours and overviews of the program, however, to groups from around the world seeking to understand and replicate the formula for their regions. The goal of these visits is to identify specific practices and hallmarks of it's success.

The keys to success appear to be the network of partners, service providers, and entrepreneurs that contribute to the program, access to the resources of a large research university, and a healthy or beneficial reputation as the place to go to start a high tech company. The reputation benefits have been key for attracting increasingly sophisticated and successful clients. A positive feedback loop has been established in the sense that better companies add to the credibility of the incubator, attracting better clients that add credibility, and so on. The current twenty-one hour selection process has proven to be an effective self filtering process and helps ensure high quality clients.

The incubator is a fully functioning part of a larger incubation system. It is however, one of the more visible parts of the system that facilitates and catalyzes much of the high tech economic development activities of the region, particularly when the university is involved. It is a tool for the university's technology transfer activities and the region's local economic development partners. Local Angel and Venture capital firms view the incubator as a place to find the best investment opportunities and appreciate the monitoring services provided by the incubator program. The eco system for the UCFTI is shown in Figure 23 below.

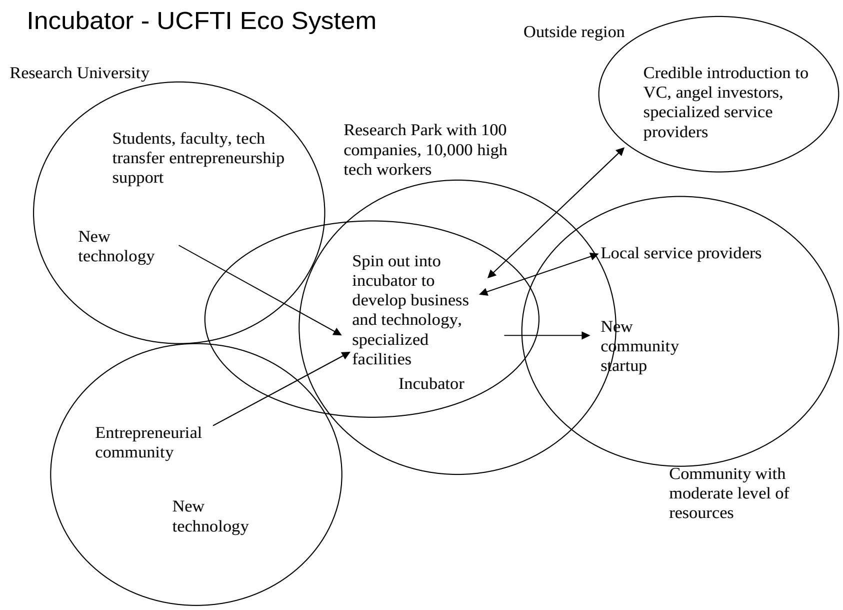


Figure 22: UCF Technology Incubator Eco System

Table 44: Incubator Specific Data; UCFTI

Incubator Specific Info - UCFTI

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Selection Criteria	rigorous	Rigorous (30 % acceptance, 21 hour course)	rigorous
	Support level:	Support level:	Support level:
Types of Firms		Mixed technology	
	Support level:	Support level:	Support level:
Leasing arrangements		flexible leases	
	Support level:	Support level:	Support level:
Education and other programs	strong	Strong (uses SCORE, SBDC, internal, consultants, etc)	Strong (more available than possible to attend)
	Support level:	Support level:	Support level:
Incubator management	Strong	Experienced managers (CEO & COO)	strong
	Support level:	Support level:	Support level:
Location		Medium to large metro	
	Support level:	Support level:	Support level:
Credibility	Strong	Strong	Strong (place to be)
	Support level:	Support level:	Support level:
What is most important function	Integration into university and community	Integration into university and community	Staff, university, programs, flexible facilities

Note: Support levels: Strong = dominant theme in this data that is consistently supported;
Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found;
Sporadic = a theme that appears now and then in this data source.

Table 45: Community Specific Data; UCFTI

Community specific issues - UCFTI

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between clients and community	strong	strong	strong
	Support level:	Support level:	Support level:
Interactions among Entrepreneurs	moderate	strong	varies by company
	Support level:	Support level:	Support level:
Interactions between clients and outside individuals	strong	strong (frequent leads provided)	Strong (great rolodex)
	Support level:	Support level:	Support level:
Access to incubator advisory board	Strong	Strong (provides many hours of help)	Strong
	Support level:	Support level:	Support level:
Access to external funding sources	Moderate (good visibility)	Moderate, many introduction, some success, could be better	Good introductions provided, deals slow to materialize
	Support level:	Support level:	Support level:
Access to steeples of excellence	Strong	strong (Location in university research park)	Strong

Note: Support levels: Strong = dominant theme in this data that is consistently supported;
Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found;
Sporadic = a theme that appears now and then in this data source.

Table 46: Other Community Specific Data; UCFTI

Community 2 - UCFTI

Indicator	Incubator Documents	Interviews with Incubator Managers	Interviews with Incubator Clients
	Support level:	Support level:	Support level:
Interactions between incubator and community	Strong, many partners listed	Strong, often team up to meet regional goals and objectives	
	Support level:	Support level:	Support level:
Interactions between incubator and Local Government	Strong (shared vision)	Strong (shared vision)	Strong, local mayor county chair visits
	Support level:	Support level:	Support level:
Interactions between incubator and local Economic Development agencies	Strong	Strong, EDC co-sponsor & partner	Strong (EDC staff frequents monthly brown bag luncheon)
	Support level:	Support level:	Support level:
Interactions between incubator and funding sources	Strong (VC located in facility)	Strong, could always be better, need gap fund	Good, VC and angel investor frequently available
	Support level:	Support level:	Support level:
Interactions between incubator and other entrepreneur support	Strong	Strong (SCORE, SBDC, NEC, others)	Strong (buffet)

Note: Support levels: Strong = dominant theme in this data that is consistently supported; Moderate = a frequent, but not constant theme; Rare (Weak) = this theme rarely is found; Sporadic = a theme that appears now and then in this data source.

CHAPTER FIVE: CONCLUSIONS

Discussion of Common Findings

The top-performing incubators in terms of new job creation, as identified by the previous empirical studies from which these cases were selected, are all located within or adjacent to a major research university, medical institution, or federal laboratory, or in an otherwise resource-rich environment. The incubators themselves have become known for assisting fast-growth technology firms and as a place to be and be seen for up and coming companies. These technology incubation programs have successfully exploited the nearby research institutions and environments to provide their start-up firms with networks of highly specialized technical assistance providers, qualified workforces (including relatively low-cost graduate students), specialized laboratories, and equipment. In addition, these affiliations provide the entrepreneurial firms with credibility and reputation benefits. The result is these firms are able to attract highly qualified employees, have credibility with suppliers and customers, and have priority access to private venture and angel financing.

In terms of better understanding what the best practices are in technology business incubation, these cases reinforce the importance of the organizational and economic context in which technology incubators operate. This includes their linkages to research universities and laboratories, and their relative location to a high concentration of technology-based companies and associated business support firms (e.g., accountants, intellectual property lawyers, human resource consultants). Incubators can help fill resource gaps in regions where the concentrations of business support firms or specialized resources are low. To achieve the desired level of success, it is therefore imperative that incubator and community economic developers pay attention not just to creating a sound incubation program but also to the contextual and linkage issues. While colleges and universities are not the primary owners and operators of business incubators, they are affiliated with a disproportionately large share of technology incubators and account for most of the top performing programs.

Scott Shane's (2004) research into academic entrepreneurship reveals some very interesting information concerning university based startups in general. He asserts that:

- University-Based Ventures (UBVs) increase local economic strength and diversification
  - Average UBV creates $10M in economic value
  - 80% of UBVs operate in the same state as the university that they came from
  - UBVs serve as magnets attracting the infrastructure to support new venture creation (VC firms, etc.)
- UBVs generate 83 high-paying jobs per US UBV
- UBVs are a unique outlet for uncertain early-stage technologies that would otherwise remain unlicensed

- UBVs are disproportionately successful
  - 18% of MIT UBVs between 1980-1996 went public - 257 times the rate of non-university startups
  - Only 20% of 134 UBVs formed in MIT between 1980-1996 failed by 1997
  - 68% of 3,376 UBVs founded between 1998-2000 remained open in 2001, much higher than the average survival rate of new firms in the US
  - UBVs produce significantly more income for universities than licenses
- UBVs are emerging as an important source of new ventures
  - US Universities generated an average of 83.5 UBVs from 1983-1990
  - 454 UBVs were created in 2000 – a 444% increase (Pressman, 2002)

These results provide insight into why university technology incubators would have an advantage over non-university based programs and therefore have disproportional representation in the top programs rankings. Shane also reports that over 40% of university ventures receive VC or angel funding compared to 1% of traditional startups.

The previous empirical studies that have investigated incubator practices were unable to link any of the predictor variables to firm performance. The search for a quantifiable set of best practices seems elusive. Some secondary outcomes however have been shown to have statistically significant relationships with such variables as gaining financing and acquiring intellectual property. Perhaps these results reflect what actually is important in technology business incubation.

In other words, assistance services that directly impact significant business issues are what matter most. Other issues are most affected by external markets and economic events, far beyond the reach of the incubator.   It is intuitive that funding, and the ability to maintain a sustainable competitive advantage over the competition (patents), would be more important than items such as shared conference rooms, formal coaching programs, an internet connection or the background of the incubator manager.

The case studies of top ranked programs reflect on these issues as well. It was not obvious from the cases studied that there is any consistent pattern of incubator assistance programs that are consistently present in the top programs and conversely absent in programs that have not performed as well using job creation as our base line indicator. Some incubators, particularly those with relatively naïve entrepreneurs leading client companies, had fairly structured programs, with clear milestones and mandatory reviews of progress towards expectations. Others, with more experienced entrepreneurs, had a much more relaxed and available-on-demand approach to assistance. The biotech incubators that dominated the top ten program list, all cited the facility as the most important service provided and did not offer the type of entrepreneurial development content present in other programs. It was also clear across all of the exemplary programs that incubator managers judged no single assistance practice to be of such importance that they universally applied it across clients. This, in itself, would account for the low quantitative relationships between practices and outcomes reported elsewhere in this report.

The obvious conclusion would be that the value of services is more a function of client entrepreneurial skill level, business needs, or regional deficiencies than by specific program offerings. The case studies also revealed a vast difference in the skill levels of entrepreneurs both between programs and within individual incubators. While difficult to quantify, all entrepreneurs are not created equal and that the ability to enhance the skill level of any individual entrepreneur varies considerably. Further review of the literature revealed that Thomas Lyons (2004) recently explained this phenomenon from the perspectives of entrepreneurial skills verses the stage of a firm’s development.

Lyons refers to the movement from left to right as a pipeline of entrepreneurs and enterprises. He further asserts that entrepreneurs are successful to the extent that they have the necessary skills; entrepreneurs come to entrepreneurship at different levels of skill and, entrepreneurial skills can be developed. This is illustrated in Table 47 based on a recent presentation by Lyons.

Table 47: Movement of Entrepreneurs

Lifecycle **Entrepreneur Skill Level**	**Stage 0** **Pre-venture**	**Stage 1** **Existence**	**Stage 2** **Early Growth**	**Stage 3** **Expansion**	**Stage 4** **Maturity**	**Stage 5** **Decline**
AAA						
AA						
A						
Rookie						

The notion is that entrepreneurs need to reach certain skill levels to move firms down the pipeline. He asserts the following:

- Movement to any other segment of the pipeline (i.e., cell in the map) requires a transformation.
- The ability of an enterprise company to move to the next stage in its lifecycle depends on the skill of the entrepreneur and/or his or her "team."
- There are a variety of possible outcomes in the pipeline: movement to another section of the pipeline, stagnation / arrested development, exit or death.
- Entrepreneurs and enterprises in each segment of the pipeline have different requirements in terms of their needs and the service infrastructure that is necessary to support them.

- Movement within the pipeline is dynamic; companies do not necessarily stay in a particular segment for long.
- “Peers” are entrepreneurs at the same skill level, no matter what stage in the lifecycle their business is operating.
- “Role models” are entrepreneurs who are at a higher skill level and/or whose business is at a later stage in its development.

Given the realities of what incubators do during a company’s tenure in the incubator, it follows that the higher the skill level of the entrepreneurs attracted to a particular program, the more quickly the firm will progress in the pipeline. This would manifest itself as more jobs created, more revenue, and a higher success rating for the incubator.

The shortcomings observed in the empirical research data is a reflection of shortcomings in the incubator industry. The Advisory Committee for the Tornatzki (2003) survey and the field-testing of the questionnaire used in the study showed that incubator managers did not feel that they were able (or inclined) to provide detailed numbers on either the past and current performance levels of client companies or the scope and extent of services that they delivered to client companies. In effect, it appears that most managers do not consistently monitor theses actions or the resulting impact. The results suggest that future benchmarking studies should incorporate more precise definitions and measures of outcomes.

This is not just a research methodological issue. It raises the question: What is the level of firm diagnosis and proactive provision of assistance, or organized programming that is actually operating in incubator programs? Put another way, if incubator managers and staff are operating primarily or exclusively as referral or networking operations or specialized real estate operations, then we are back to the question of what is business incubation?

Additional insight on this may be derived by looking at the town of Fairfield Iowa. A recent trip there by this author uncovered some exceptional findings in terms of what defines incubation. A case study on Fairfield was added to the case studies. Certainly one could argue that this town is a very effective incubator that is conceptually outside the traditional incubator model.

Wu (2005) asserts that creativity and curiosity are key ingredients for innovation, so it is not too surprising that many communities are looking for ways to increase the creative spirit among their residents and businesses. Wu examined seven American cities as well as Dublin, Bangalore and Hong Kong to identify common factors and public policies that have built these cities into urban hubs of creative industries. Wu defines these cities as having a concentration of creative industries that generate products protected by intellectual property (IP) laws and that house the creative workers for those industries. Wu notes the "creative class" includes occupations in architecture, design, engineering, entertainment and science.

According to Wu, several factors appear to form an important role in boosting the creativity quotient of an urban area, including:

- Clustering of activity – geographic concentrations of interconnected businesses and organizations in a particular industry or sector;
- Ease of entry for small firms and a supportive environment within the cluster;
- Higher levels of new business formation via start-ups and spin-offs;
- An existing and growing pool of labor talent; and,
- A creative milieu that nurtures creativity and innovation.

Many creative clusters emerge because they have successfully leveraged a "locational advantage." Wu cites a number of locational factors, including successful anchor firms, mediating organizations, an appropriate base of knowledge and skill, and diversity and quality of place. He also cites recent research that indicates high levels of R&D spending, effective IP protection, openness to competition, and a focus on higher education spending positively influence innovative input. This again points to the importance of understanding the larger context in which incubators operate.

The case studies also pointed out some additional deficiencies in the empirical data. The first issues relate to how the top ten incubators were identified in general. As shown earlier in Table 15, five of the top ten incubators in terms of the increases in jobs were in the biotech / biomed sector, but only one biotech incubator appeared in Table 16 which displays the top ten incubators in terms of revenue generated. The conclusion from the previous empirical study assert that these companies added jobs at a faster rate based on venture funding instead of revenue. When incubator managers were asked to explain this phenomenon the conclusion was more attributable to the fact that these companies are in incubators for much longer periods of time. These companies added jobs at a rate that some thought were slower than most other companies. Incubator managers stated that the average stay for a software company was 24 months while a biotech company was typically four to seven years. The study did not take this into account only asking for increases in jobs from entry into the program until the time the company completed the survey.

Discussion of Specific Findings

Postulation 1: Successful incubators are a part of a larger local economic development system and their success is significantly tied to the larger development system.

Prior research has suggested that incubation should be viewed in the larger context. This research explored the notion that successful incubators are integrated into a larger enterprise development system (Smilor 1987). Theoretical arguments and increasing empirical evidence that innovation fosters economic growth have been fundamental to the emergence of technology business incubation as part of an innovation-based economic development strategy at the state and local level (DiGiovanna and Lewis, 1998; Shahidi, 1998; Lewis, 2001; Tornatzky et al., 1996).

Table 48 summarizes this study's evidence on the issue of successful incubators as part of a larger local economic development system. As the evidence shows, all the successful incubators exhibited strong ties to a larger system. The roles varied significantly as was illustrated in the maps of the Eco Systems developed in the case study section. Incubators A, B, G and I were biotech incubators with roles contributing to their Eco Systems focused on providing specialized facilities, shared resources, and access to protected intellectual property. Incubators C, D, E, and F were mixed technology or software / IT focused and concentrated much less on the facility and more on networking and company development. Incubators A, D, and E provided significantly less entrepreneurial development assistance due to their region's ability to provide those services.

Table 48: Summary of case study finding: Degree of Integration into larger ecosystem

	From Public Sources	From Interviews with Incubator Managers	From Interviews with Incubator Clients	Comments
Incubator A	Strong	Strong		Small part in one sense of larger, well developed system (role player)
Incubator B	Strong (web)	Strong	Strong	Part of regions plans to develop high tech region, lots of university tech transfer & commercialization
Incubator C	Strong (web, articles, presentations)	Strong		Integrated into or leads many to many state programs. Entry point for many new companies into system
Incubator D	Strong (feature articles)	Very strong		Relies heavily on existing system to provide talent, entrepreneurial support, funding, services. Part of city's efforts
Incubator E	Strong	Strong, University resources, community business talent		In very rich community
Incubator F	Moderate - strong	Strong		The university is basically the majority of the eco system
Incubator G	Strong	Strong		Part of state private / public partnership to build strong biotech pipeline
Incubator H				
Incubator I	Strong	Strong		Part of university and state mission, part of many economic development activities
Incubator J	Strong	Moderate	Moderate	hard to determine how well actual integration realized, contradictory evidence
UCFTI	Strong	Very strong	Strong	Built into program from start

Conversely, Incubator J, which was not one of the premiere programs, was not as well integrated into the region or within the university of which it was a constituent. The incubator's stated mission centered only on incubating university faculty startups; interactions between the community and the program were essentially no existent.

Incubators B, C, E, H and to a lesser degree, incubator G are from regions not associated with large numbers of venture capital firms or angle investors. The incubators in these areas all had well established relationships with investment firms from other regions and had the ability to provide credible introductions between viable investment opportunities and investors. They often provided regional angel investors with seminars or other training opportunities, and regularly entertained venture capitalists with tours of their facilities. These incubators often had to reach out to their community as well to help provide professional services to clients.

Incubator G exemplifies an attempt to create an Eco System for a specific cluster, i.e., biotech. In addition to seven specialized incubators, the state has created a venture fund, seed and gap funds, project funds, and also supports numerous industry associations. This is all done to create economic wealth in the state by taking advantage of several national laboratories and rich universities in the area.

It was clear that successful programs do not operate in a vacuum. The larger development system varied significantly depending on the region and the type of clients served. The Eco System maps developed in the case studies illustrate the various systems operating in the case study incubators.

The overall conclusion from the case study data is that the evidence confirms the postulate.

Postulation 2: The best incubators fill in the gaps by focusing local, often disconnected resources, thereby allowing companies to fail or succeed because of market forces, not because of a lack in regional assets.

Previous research by Lewis (2003) concludes that incubators can make up for a lack of regional capacity for the times that an incubator company is a client of the incubator. Prior quasi-experimental research has empirically documented that incubator tenants out-perform a control group of similar firms and that incubator programs have positive demonstrable effects on client firms (Shahidi, 1998; Culp, 1996; Allen and Bazan, 1990). Culp's (1996) research showed that incubator clients grow at an accelerated rate during their tenure in an incubator, but then fall off to the region's rate upon graduation.

In this study, the question, “Do you believe your incubator fills in gaps in region resources, i.e., access to funding, professional service providers?” was asked in each interview. The responses were moderate to strong, depending on how each interviewee initially interpreted the question.

Incubators B, C, F, and to slightly less degree incubator I, which are located in small to medium sized markets felt strongly that the Incubator did fill in for many of the gaps in the local region in terms of access to funding sources, professional services providers, and entrepreneurship training, support, and mentoring. Conversely however, Incubators A, D, and G believed the Incubator helped to exploit regional strengths in specific industry clusters, (biotech and software).

Incubator I stated that it helps facilitate introductions to outside service providers and investors as appropriate but the core mission is not to create jobs for the surrounding region. The program’s main focus is to exploit the strong research programs of the university through technology commercialization and resulting spin-out companies. Incubator I understands that its small community is not always able to capture the full benefits from a successful spin out in terms of jobs, as many of these companies will relocate or be acquired should the technology development prove successful.

Incubator J acts mainly as a promoter or cheerleader, for companies, but will often recommend certain known vendors to clients in need of specialized support. The Incubator does not offer an active training or mentorship program as of this writing but does anticipate developing one in the near future. Table 45 summarizes the results from the interviews.

The overall conclusion is that the case study evidence does not confirm the postulate as writen.

Table 49, Summary of findings: Fill gaps

	From Public Sources	From Interviews with Incubator Managers	From Interviews with Incubator Clients	Comments
Incubator A	Strong	Moderate	Strong	The gap they fill is facility based
Incubator B	Strong	Strong		Works well to identify external talent and uses shared service approach. VC provides financial advice
Incubator C	Strong	Strong evidence		They lead much of the statewide small business assistance programs
Incubator D	Moderate	Moderate		Very well connected community that is a world leader of resources
Incubator E	Moderate	Moderate		Very well connected community that is a world leader of resources & commerce
Incubator F	Strong	Strong	Strong	The university and the incubator are providing significant resources
Incubator G	Strong	Strong from technology perspective		Fill need for very specialized infrastructure to advance the development of the states biotech sector. Also have access to gap funds and loans
Incubator I	Strong	Moderate to strong	Very Strong	Provide directly or indirectly from outside resources
Incubator J		Sporadic	moderate (good source for referrals)	Stated that they introduce clients to a selected list of potential providers of services
UCFTI	Strong (PR, web)	Moderate to Strong	Strong	Provides a large amount of resources, some in the community and some via outside connections

Postulation 3: Areas that take advantage of "Steeples of Excellence" which they are able to draw upon contribute significantly to startup companies and hence incubator success.

As Shane (2004) pointed out in his research, university based ventures are disproportionately successful. These ventures go public 257 times more often than non university spin outs, have a higher success rate (68%), and obtain institutional investment at a rate that is 44 times the national average.

Previous studies by Lewis (2003) and Tornatzki (2003) confirm that university affiliated incubators dominate the list of the most successful programs. In fact, several of the top ten programs existed solely to exploit the intellectual capital generated by the research efforts of the universities or national laboratories in the region.

Incubators A, D, F, G, and I are exceptional at successfully taking advantage of the steeples of excellence in proximity to their location. Incubators B, C, E, also owe much of their success to these steeples, some directly and some indirectly in terms of the support provided to clients generated from the community, and were not as often directly the result of research at these centers.

Incubator J, the non top performing case, is located at a university that is in an area that has a strong biotech cluster. The incubator however does not offer any specialized facilities to take advantage of this regional asset. The incubator's client base is mixed, with two client companies operating in the IT space and another client operating in the electronics (RF) industry sector. While there is some regional talent in these sectors, the area is not known as an industry leader and the university conducts limited research in these two topics. Table 50 contains a summary of the findings from the case studies.

The overall conclusion that the case study evidence confirms postulate 3.

Table 50, Summary of findings: Steeples of excellence

	From Public Sources	From Interviews with Incubator Managers	From Interviews with Incubator Clients	Comments
Incubator A	Strong (web, press releases, client speeches)	Strong (part of medical school)	Strong	
Incubator B	Strong	Moderate to strong		Good ties to research faculty
Incubator C	Web and PR supports moderate to strong	Strong, 30% of companies are based on university developed IP, intensive connection to university		Good biotech at university
Incubator D	Very strong	Very strong. Region known as leader in this field		Software specialized in area known for this
Incubator E	Strong	Strong, largest sources of companies		Strong Biotech, agriculture, and environmental efforts
Incubator F	Very Strong	Strong		Premiere research university
Incubator G	Very Strong	Very strong. Region known as leader in this field		Numerous national labs a top ranked universities
Incubator H				
Incubator I	Strong (web, press releases, client speeches)	Strong, statewide mission to commercialize university IP, create jobs, show results		$450 Million in Research, NSF ERC, Center of Excellence
Incubator J	Weak	Weak connection	Weak, client stated that there were few interactions between him and others beside manager of incubator	Program hasn't tapped into large university research base as of yet.
UCFTI	Very strong	Very strong	Very strong	Strong, 80% of companies in areas that university has strength in

Postulate 4: The selection process for incubator clients significantly bias incubator client success measures.

When reviewing the empirical data concerning the rigorousness of the selection process for incubator clients, the average score was 3.7 on a 4 point scale. This would imply that a very strict process and criteria is utilized in the application process. The case study information reveals that this is not always the case, even with the top incubators.

Regardless of the survey results, there is pressure in most, if not all, incubation programs, to keep buildings occupied. Sometimes it is a financial issue, sometimes political, and sometimes just a desire to reach capacity. Incubator A, C, D, G, and I all admitted that clients undergo a formal application process but that as many as 95% are accepted. In the case of Incubator A, the program competes for tenants with other facilities, and measure success by how many deals (leases) are completed. Incubator B has recently expanded their facilities and admitted that the selection criterion will lax until the new facility is closer to full.

Incubator J is under serious pressure to reach the level of activity of other peer institutions. Incubator J is less that 20 percent occupied and believes it needs to recruit new clients. While the acceptance criterion was less restrictive for Incubator J, the rate of clients opting to join the program was low due to some laborious terms and conditions placed on the companies to join the program. These terms were recently abolished and inquires to join the program are encouraging.

Incubator C's selection process is the most rigorous of the cases. It is one of the more established programs and admits that its requirements were not always as strict. The Incubator is planning on reducing the size of the facilities to help maintain a high standard of clients in the program by reducing their capacity for clients.

New programs appear especially susceptible to establishing low entry standards and will admit just about anyone to the program in the beginning. Incubator I stated that it would not be especially selective until it added a few more companies to fill in the empty space. The building was paid for in this instance so it was not driven by financial concerns. The manager stated the desire to be able to show political leaders that the effort was actively delivering on the promise of economic development and commercialization of university research.

The selection criterion was least rigorous in the non top performing incubator and highest in the more established programs. The trend being that once the buildings are mostly full, it was easier to become more selective. Three incubator managers stated that once they reached capacity and started becoming more selective, the improved clientele helped bolster the incubator's credibility, which helped recruit even better clients, and so on. This indicates that the credibility of the clients and the incubator are dependent on each other. It is therefore incumbent on the incubator to attract and market success early to insure a strong base of client companies from which to build.

This would suggest that if the goal is to select the best possible candidates for a program the best option would be to start small and then expand to some point where the supply of high quality client companies equals the capacity of the incubator to serve them. Building an expansive and costly facility would tend to create pressure on managers to fill the space even at the cost of letting in clients that are not ideal candidates. Table 51 below summarizes the evidence collected in the studies.

The overall conclusion is that the case study evidence does not confirm postulate 4.

Table 51, Summary of findings: Selection process

	From Public Sources	From Interviews with Incubator Managers	From Interviews with Incubator Clients	From empirical data	Comments
Incubator A	Weak	Weak from incubator selection perspective, Clients select Incubator			Try to do as many lease deals as possible
Incubator B	Moderate	Moderate until facility filled, then will be more selective			Recent expansion has eased backlog
Incubator C	Rigorous	Rigorous		Rigorous	
Incubator D	Rigorous	Rigorous			
Incubator E	Rigorous	Rigorous process	Rigorous from process perspective	Rigorous	Process is difficult but 95% are admitted
Incubator F	Moderate	Moderate			University spinouts account for majority of companies
Incubator G	Moderate	Moderate			Based more technology development
Incubator H					
Incubator I	Rigorous	Moderate until facility filled, then will be more selective	Weak, just need to need facilities	Rigorous	Pressure to show results, i.e., full capacity
Incubator J	Rigorous	Weak, need to fill building	Weak, asked to join	Rigorous	Severe pressure to get make the program more successful and success measured by number of clients
UCFTI	Rigorous	Rigorous	Rigorous	Rigorous	Accepts less than 40%, 21 hour selection process

Credibility

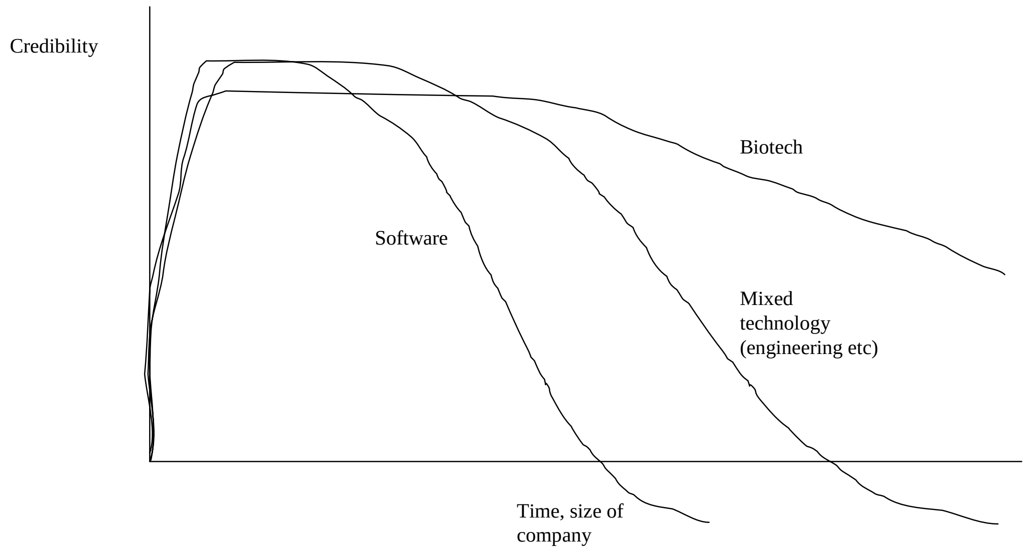
There was no doubt that the top incubator programs added considerable credibility to the clients in the program. This was confirmed by managers and clients alike in the interviews. This credibility helped the client companies secure customers, management and staff, and funding. It also provided them access to top lawyers, accountants, and other professional service providers.

The results were mixed with the lower performing programs. The managers believed strongly that the incubator added credibility but the client interviewed stated that participating in the program only helped in the very beginning, and the client is now actually losing credibility by being associated with the program.

When examining biotech companies the credibility issue is different. It is the facility and physical attributes of the incubator that dominant the incubator client's credibility with customers, investors and employees. Access to state of the art wet labs, specialized and expensive equipment are key factors in the success of these companies. One investor commented that the leverage offered by biotech incubators to companies really influences his investment decision. This investor believed that more of his investment would be used to deliver products to market and not be tied up in expensive equipment with little perceived salvage value.

There appears to be two distinct types of credibility that emerged in the interviews. The first type centers on the instant credibility a company would receive by being in the facility, as opposed to working out of their garage. The second is related to the reputation that the incubator conveys in terms of being a sought after location for successful high tech companies.

Credibility issues vary according to the type of industry sector as well. What provides credibility in the biotech industry is different than that of a software firm. In biotech credibility stems from the access to high tech infrastructure and promising technical results, whereas with a software firm the credibility would be based more on filling a market need and the ability of the team to get the product to market. These and other factors that effect credibility are illustrated in Figure 23.



Factor	*Effect*
Type of industry	Effects slope of curve
Reputation of incubator	Effects magnitude of curve
Location	Effects magnitude and slope
Age of incubator	Incubator dependent

Figure 23 Credibility benefits of Incubator clients over time, size of company

Conclusions

This study confirms the difficulty of discovering and defining the secrets of incubation success. The data collected from the case studies sometimes confirmed and sometimes contradicted the empirical results. In other instances, the cases added substantial insight to the underlying issues.

To assist with the derivation of conclusion, the information collected from each source was cataloged using the research instruments developed for the study. Individual answers were summarized in table form and then placed in a summary sheet for the different issues of concern. Patterns supporting or contradicting were then easy to identify.

Postulation 1: Successful incubators are a part of a larger local economic development system and their success is significantly tied to the larger development system.

Conclusion 1: It was confirmed that successful incubator programs are well integrated into the enterprise development systems operating in their specific areas. The role that any individual incubator plays varies significantly among the programs studied. The key finding is that the role and services provided by the incubator is a function of the larger system and the better fit, the better the incubator will be at creating successful companies and new jobs for the region.

Table 52: Summary of Evidence for Postulate 1

Postulate	Case study	Introspective	Empirical
Incubator part of larger eco system	Strong	Strong	Strong

Postulation 2: The best incubators fill in the gaps by focusing local, often disconnected resources, thereby allowing companies to fail or succeed because of market forces, not because of a lack in regional assets.

Conclusion: The evidence here is unfortunately mixed. It must be taken in the context of Conclusion 1 in that if the specific role of the incubator in a larger system is to fill in gaps, then the successful ones do that very well. The incubator however, does not always function in that role. Three of the top performing incubators, however, were in areas where there were arguably no regional gaps to fill and they simply provided specialized real estate infrastructure or network connections. These incubators serve an important role in the facilitation of technology development, but did nothing to fill gaps in areas that define an incubation or small business development initiative. These incubators, in essence, functioned to exploit strengths, not fill in gaps.

Table 53: Summary of Evidence for Postulate 2

Postulate	Case study	Introspective	Empirical
Incubator fill gaps in regional capacity	Mixed	Strong	Strong

Postulation 3: Areas that take advantage of "Steeples of Excellence" which they are able to draw upon contribute significantly to startup companies and hence incubator success.

Conclusion 3: This was confirmed by the study. All of the top performing incubators took advantage of strong connections with research universities or national labs or were in a technology rich area. Half of the top programs studied focused specifically on biotechnology developed within research centers and another specifically focused on software in a region that specializes in that field.

Table 54: Summary of Evidence for Postulate 3

Postulate	Case study	Introspective	Empirical
Steeples of Excellence	Strong	Strong	Strong

Postulate 4: The selection process for incubator clients significantly bias incubator client success measures.

Conclusion 4: The evidence did not support this postulation. While many of the top programs were able to attract great companies, the process itself of selecting companies did not appear to be the main determinant across the study population. Some of the top programs viewed themselves as competing for clients with other real estate concerns. Even the ones that tout rigorous screening admit that as many as 95 percent of applicants are accepted and that vacant space often is the main driver of program acceptance criteria.

Table 55: Summary of Evidence for Postulate 4

Postulate	Case study	Introspective	Empirical
Rigorous selection process	Weak	Moderate	Strong

Summary

This research confirms that the search for a check list of best practices for incubation is elusive. It is a complicated and daunting task to create successful companies under any circumstance. Each company is different, each region is different, and each entrepreneur is not equal in skills or abilities. Economic development leaders need to do their homework, understand the bigger picture and how their incubator should fit into that system, and be able to make adjustments as their program and their regions evolve and mature.

The postulates did not contradict the previous research therefore it built on the body of knowledge. It raised additional questions however for future research and can provide practical knowledge to practitioners.

Comments and Recommendations

Future planners and developers of incubation programs must spend the time necessary to understand the larger context of the enterprise development system operating in their region prior to developing or implementing a program. The goals and objectives of the program should meet the expectation of the community and fit well into the existing system to either fill gaps in regional capacity or exploit existing strengths. Conversely the community must have a well grounded understanding of the incubator's contribution to the local system.

Regional government, economic development leaders, and financial supporters should also understand that the benefits of incubators rarely come directly back to the incubator. The true benefits come from successful graduates of programs remaining in the region, creating high value jobs, and economic wealth.

Unoccupied space in an incubator facility creates tremendous pressure to fill it with companies. This may dilute the resources of incubation programs on companies unable to help the region meet the intended expectation of the program. It may be better to start small and expand or contract the program to align with the market demand of preferred companies. This strategy, if feasible, will help keep incubator managers from becoming real estate agents.

The top performing programs have strong connections to universities. Universities add instant credibility to the incubation program and the companies that reside there. The most successful programs fully leverage the intellectual capital assets (patents, talented faculty and students, and facilities) that universities represent. If a program is not officially part of a university, efforts should be made to develop strong connections between the incubator and the research and tech transfer operations of the university.

Create a shared understanding of what success will mean for the program as soon as possible. Measures such as job creation, revenue generation, graduate companies, the successful commercialization of technology, or filling a building are different goals and will steer incubator managers in different, possibly unanticipated directions.

It is also important to point out that the top performing incubators in this study have all had at least one very successful client. These clients account for a large majority of the employment growth numbers that put these programs at the top of the category. These successes have increased the stature and credibility of the program. The program is able to attract better quality clients, that create better companies and so on and very soon a positive feedback loop is created. The importance of this for economic development leaders considering the establishment of new incubation programs is that the age of the program was not a factor and young programs can realize tremendous benefits in a relatively short time frame.

Future Research

This search for best practices in incubation revealed the strong need for additional research. Better definitions need to be developed to understand the "what" better so we can assist future researchers trying to understand the "how" and the "why."

In general, the incubation industry needs to come together to collect and report meaningful data. This will be difficult given the political, funding, and public relations issues that exist. The reluctance of managers to provide detailed client information is a significant hurdle, but one that should be addressed at the national level, possibly by the National Business Incubator Association.

The current categorization of incubators does not account for the very different characteristics among the groups. For example, various industry segments require different incubation programs to address their needs. The following subcategories are offered for consideration in the technology incubation sector: (1) Development focus (entrepreneur / technology) and (2) Technology focus (mixed, biotech, IT/Software).

The selection bias issue further exploration. Given the top incubators vary so much on the issue, additional research would be insightful for managers. One item of particular interest relates to understanding the root cause of why the data from the empirical study and case study interviews differed so significantly. It could be simply that the survey did not define the notion of a rigorous screening process adequately or it could be from reasons more political in nature.

The issue of credibility surfaced often during the interviews as one of the most important contributions an incubator provides to its clients. While much has been written by practitioners and in the popular press, there seems to be little research into the subject of incubator client growth increases as a function of the legitimacy provided by being in an incubator. Additional research should also focus on the differences in the legitimacy provided to university affiliated incubators verse non affiliated programs. A search of the archives of the NBIA resulted in no research but the term is mentioned in almost every issue of their publication, *The NBIA Review*, in testimonials from clients and managers.

There is a large body of work in the area of legitimacy and the recent study by Stevens et al., (2005) confirms that it has a positive effect of client growth. More research into the best practices that positively affect the legitimacy of client firms would prove be very useful for economic development leaders planning the next generation of enterprise development initiatives.

As pointed out in the literature review, the incubator industry is growing at a fast pace, about one incubator per week. To this point, the industry is still expanding in mostly untapped areas with little or no overlap or competition among programs. As the industry grows, future research into the growing competition among programs would provide valuable insights for those contemplating programs that would be in direct competition with each other.

Lastly, the research presented here concerning Eco Systems should be extended to a national level. As policy makers determine how federal funding for research dollars is spent and in what areas, a better understanding of the systems required to commercialize new developments out of the laboratory and into the market place should be developed. Technology transfer and incubation should be integral components of new technology initiatives and research into how best to exploit technological improvements is needed.

APPENDIX A: E-MAIL SENT TO INCUBATOR MANAGERS

My name is Tom O'Neal and I am the Director of the UCF Technology Incubator in Orlando, Florida. We were named Incubator of the Year last year by the NBIA and as you can guess, have received a lot of inquiries as to what we did to earn this recognition.

I was hoping I could discuss this very subject with you to better understand what practices are most important, from your perspective, to the success of an incubator program. Would it be possible for me to call you for an informal interview to discuss the following topics? Below are times I have set aside on my Calendar next week. Please let me know if you have a preferred time.

Thank you in advance.

Tom O'Neal

What are the top things you feel have contributed most to help your companies become successful?

Is your incubator part of a larger incubation system or is it mainly a stand alone entity?

Do you feel your incubator fills in gaps in region resources, i.e., access to funding, professional service providers?

Do you feel your incubator adds significantly to the credibility of companies in your program?

How rigorous is your screening process?

Have you had a few very successful clients that have driven a lot of your success?

What would you do different if you had it to do over?

APPENDIX B: GLOSSARY OF INCUBATOR TERMINOLOGY

Advisory/Management Board: Individuals who sit on the board of the incubator. Some incubator programs have both a management board that directs the "business activities" of the program—such as budgeting, personnel matters, etc.—and an advisory board that is responsible for providing value-added business services to client firms and assisting the manager in her/his duties. In most cases these functions are combined in one board, which may have either title. An advisory board usually has representatives from the finance community, legal profession, and host institution as well as economic development professionals, the manager, members of the entrepreneurial community, and, in the case of technology incubators, technology commercialization specialists, among others. When constructing the board, it is desirable to ensure that it can assist in providing value-added services to client firms and help to embed the incubator program in the local community. The networks established by the board should benefit client firms and increase the potential of capturing the firms in the local economy after they graduate.

Affiliate Firm: A client firm that does not lease space at an incubator facility but does participate broadly in the incubator program's entrepreneurial training programs and receives business services from the incubator.

Anchor Tenant: A stable enterprise that does not participate in the entrepreneurial training programs. Usually anchor tenants are long-term and lease space at market rates. The cash flow provided by an anchor tenant's rent helps the incubator meet its financial obligation. Anchor tenants may or may not play another role in the incubation process. For example, an anchor tenant may be a professional service provider and be available for client firms.

Angel Capital Investor: A private investor who invests in earlier stage companies sums typically ranging from $250,000 to $1.5 million. Angel investors tend to be individuals or small groups of investors that help entrepreneurs bridge the capital gap between the entrepreneurs' resources and traditional financial markets, including venture capital markets.

Business Incubation: A dynamic process of business enterprise development that seeks to fill the gaps in entrepreneurial development by providing a supportive environment where new entrepreneurs receive training in business management skills and marketing, buffered from stiff market forces with below-market rent, reduced fees for services, and improved access to necessary seed capital (NBIA 2001).

Business Incubators: Facilities designed to nurture young firms, helping them survive and grow during the start-up period, when they are most vulnerable. Incubators provide hands-on management assistance, access to financing, and orchestrated exposure to critical business or technical support services. They also offer entrepreneurial firms shared office services, access to equipment, flexible leases, and expandable space—all under one roof.

An incubation program's main goal is to produce successful graduates—businesses that are financially viable and freestanding when they leave the incubator, usually after two to three years (NBIA 2001).

Client Firm: Any firm that utilizes the incubator program as either tenant, affiliate, or graduate.

Development Team/Community Advisory Team: A group of community members that are interested in establishing an incubator program. There should be broad representation that increases as the development progresses. Often there is an informal leader(s) who champions the cause. The goal of the board is to gauge the level of community interest and support, identify potential partners, and determine if a feasibility study should be conducted. It is also common that members of this team become advisory board members.

Empowerment Incubator: An incubator focused on fostering the growth of business located in areas that face economic challenges, such as high unemployment or distressed neighborhoods. They may focus on welfare-to-work clients, women owned businesses, or minority-owned enterprises.

Entrance Criteria: Depending in part on the sponsor of the incubator, entrance criteria for a client's admission into an incubator range from the ability to pay the rent to other benchmarks such as local ownership, potential for job creation, type of industry, and having a written business plan. Other criteria may include an evaluation of entrepreneurs' commitment to the new enterprise as well as an evaluation of their entrepreneurial skills.

Exit Policies *see* Graduation Policies.

Feasibility Study: An objective, systematic analysis to determine whether an incubator program should be established in the host community.

Graduate Firm: A client (tenant or affiliate) firm that has exited an incubator program having completed a set of benchmarked goals. Though exit criteria may also apply to affiliate firms, most often these goals are part of the lease agreement for tenant firms in an incubator.

Graduation/Exit Policies: Graduation policies have a rational hierarchy of both real estate and business-development criteria. Firms may exit the incubator as a result of not meeting the real estate criteria (such as noncompliance with the lease agreement or having reached the pre-designed maximum length of tenancy), although in these cases the former client probably did not meet the other benchmarked business development criteria and would not be considered a graduate. One business development criterion is escalating rent over time to cushion the firm's early-stage cash flow while preparing it to pay market-rate rent and inducing relocation as rent approaches or surpasses the market rate. Having a flexible and explicit time limit on the length of tenancy is another best practice. One of the most important goals is firm growth. In the case of technology incubation benchmarked criteria may include prototyping, scale production, and full-scale production. The explicit length of tenancy is usually longer for technology incubators as a result of the length of time it takes to develop and commercialize new technology products and services.

Incubator without Walls: An incubator program that provides some or all of the complementary business services and entrepreneurial training programs but has no physical facility to house tenant firms. Often these services are delivered via the Internet.

Internet/E-Commerce Incubator: An incubator that fosters the development of new enterprises engaged in establishing e-commerce businesses.

Management Board *see* Advisory Board.

Manager: The executive who directs the operation of an incubator program. A manager develops and coordinates business assistance programs and usually provides one-on-one counseling and referral services to incubator clients. Other tasks include marketing the incubator program, fund raising, client screening, collection of rents and fees for service, and managing other incubator personnel.

Manufacturing Incubator: An incubator designed to assist new enterprises engaged in the manufacturing sector. Because of the needs of their clients for manufacturing space in addition to office space, they tend to require more square footage than other segments of the incubator industry.

Mixed-Use Incubator: An incubator that does not focus on a particular type of firm and services clients from a variety of different industries.

Service Incubator: An incubator that fosters the development of entrepreneurial firms in the service industry. Firms range from professional services to household services and may be targeted at selected segments of the service industry.

Targeted Incubator: Incubators that focus on assisting start-up companies from a specific industry.

Technology Generator: An institution—such as a university, national laboratory, or private research and development laboratory—that ensures a sufficient concentration of human capital and engages in an adequate amount of R&D to produce numerous opportunities for new commercialization ventures.

Technology Incubator: An incubator that fosters the growth of new technology ventures by helping to close the gaps in the innovation process and correct for market failures. Generally, if 50% of the client base are "technology firms," then an incubator is considered a technology incubator. There is no standard definition of a technology firm. See Appendix C for a review of the literature on defining a technology industry/firm.

Tenant Firm: A client firm that is housed at an incubator facility, receives the menu of business services, and participates in the entrepreneurial training provided by the incubator program.

Value-Added: In the incubator industry, the concept of value-added refers to the manner in which incubator programs enhance the ability of their tenants to survive and grow in the market place. The value-added components of an incubation program generally include business management and marketing training, affordable rent, shared office services, networking opportunities, financial assistance, and, in the case of technology incubators, access to host institutions' facilities and experts. For example, a university-hosted technology incubator will generally provide access to its library, laboratories, and faculty at no or reduced cost.

Venture Capital: Source of funds for earlier stage enterprises that are on the verge of product/service introduction and need an infusion of capital to ramp up to full production.

These funds may also be used for research and development, testing, or prototyping. In technology ventures, generally the firm has a developed prototype. Typical funding ranges from $5 million to $15 million, the average investment growing steadily from $2.3 million in 1987 to $5.6 million in 1995 (ACE-Net). These institutional funds often include union pensions as well as individual investors' capital.

Note: Sources of the above definitions include Molnar et al. (1997), Meeder (1993), DiGiovanna and Lewis (1998), Allen and McClusky (1990), Wolfe et al. (2000), the NBIA web site at <http://www.nbia.org>, Lewis 2003.

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