The Role of Technology Incubators in Engineering Education

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Abstract The paper sketches the growth of business incubators as a business development tool for community growth and reviews literature regarding measurement of incubator performance. The paper suggests that quality is tied to a synergy and a degree of fit with the target community rather than any specific performance measures. Engineering Schools are shown to have specific advantages as sites for technology incubators.

Keywords: Economic Development, Incubators

Economic development targeted to the high tech sector is becoming more and 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 a 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 all, 1997) reported by the NBIA is that nearly 90 percent of firms that were started through an incubator are still in operation. This compares to an overall national average survival rate of less than 50% for the first 4 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.

In particular, university based incubators may offer a far more profound and deeper advantage to their local industry and the community. The purpose of this paper is to present research into incubator quality issues that has revealed an important role for

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universities, especially those with technology and engineering programs. The implications for engineering education in the future are discussed.

This research emanated from the preliminary investigation to distinguish and understand incubator quality and the performance of technology incubator programs. The answers to such a 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, 2003).

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

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.

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 them 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.ii

The offer was good enough to keep them 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.iii

On the other hand, the cost of creating jobs via a creation strategy incorporating an incubation program averages $1,100 per job created (Molnar et all, 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 all, 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 Incubator has gained popularity in recent times as a major tool for increasing the number of successful “homegrown” companies (DiGiovanna 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). There has been limited work done however on how to assess the quality of incubation programs relative to regional development goals. The goal of this research 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 paper first reviews the developmental history of incubators.
Rationale for Incubation

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 above focuses on the “process” rather than on a “facility”. It captures the notion of providing a supportive environment for new companies, much in the same context as the original 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 the usual performance metrics like floor space and space utilization miss the point. What is needed are measures that assess the effectiveness of an incubator effort based upon its degree of fit and gap closing in the community which is the target benefactor of its services. While the main thrust of this research project is to identify measurement processes that will focus on the multi-dimensional fit assessment, this paper will explore the role of universities in such a context

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)
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% higher), more recent bank loans (32% more), and more major capital investments (23% more). Of the companies interviewed, 59% indicated no relationship with the university.

Growth companies used students as resources. Some 70% hired student interns, while 40% recruited their employees directly from the student population. Additionally, 44% of the firms indicated that they employed faculty as technical resources. In addition to these resources, the growth companies used 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 and 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 have 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 success and what is trying to be achieved?”

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 of strategic fit 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. That is simplistic and ignores the fact that employment gains will 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.

Because of the mounting evidence as the need for strategic ties to the target community and because of the evidence reported by Coopers and Lybrand (1995), Gibson (1998) and Mian (1994), we believe that a university setting offers a particularly fruitful setting for incubation projects. Most obviously, it directly links the incubator to a source of technical expertise in faculty and students. Students are also a form of entrepreneurial energy that can expedite the commercialization of a new technology. Not as obvious but even more important, if our hypothesis is correct, the university setting provides a politically neutral base for an incubator project that aims to unite disparate forces: innovators, local governments, venture capitalists, a workforce, interest groups etc. into a composite effort aimed at restructuring a community to provide economic opportunity for its citizens in a constantly changing world. As we study more case examples of incubators that were launched by fiat or by the singular action of a local hero, we are increasingly struck by the connections that are never made and the lack of mission unity.
that to us seems to be the single most important determinant of success. Simply put: An incubator is not a facility. It is a locus for an incubation process that pulls together those elements of the community needed to build a future economy. Further it identifies and fills those gaps of weak linkages essential to graduate self-sustaining enterprises that provide economic benefit to the community. A university campus is an ideal setting to realize such an objective.

Further, the impact of an incubator on student learning opportunities is both profound and diverse. It provides a real-life laboratory for interested students and potential interns in every phase of the product development cycle. It provides opportunity and motivation to learn, a catalyst to learn how to learn, and the opportunity to integrate business skills and interpersonal development with engineering education.

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

ii The Florida High Tech Corridor Council was formed as part of the effort to keep what is now called Agere Inc. in Orlando. 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.

iii This comes from personal conversation with Agere management and while accurate at the time of writing, could change as with any business decision.

References


Fredriksson, G., John A. List, and Daniel L. Millimet. ‘The International Dimension of Environmental Policy in Maratea Italy,’ 6-11 October 2001


O’Neal, Thomas, D’Cruz, Carmo, 2003. ‘Integration of Technology Incubation Program into Academic Curriculum,’ Portland International Conference on Management of Engineering and Technology

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