A NATIONAL BENCHMARKING ANALYSIS OF TECHNOLOGY BUSINESS INCUBATOR PERFORMANCE AND PRACTICES

U.S. Department of Commerce
Technology Administration
April 2003

NBIA
National Business Incubation Association

A National Benchmarking Analysis of Technology Business Incubator Performance and Practices

Report to the

Technology Administration, U.S. Department of Commerce

Submitted by

The National Business Incubation Association

September 30, 2002

Principal Authors/Researchers:
Louis Tornatzky, Tomás Rivera Policy Institute
Hugh Sherman, Ohio University Voinovich Center for Leadership and Public Affairs
Dinah Adkins, National Business Incubation Association

with Sara Lichtin Boyd, Ohio University Institute for Local Government and Rural Development; Marsha Lewis, Ohio University Voinovich Center for Leadership and Public Affairs Executive Leadership Institute; JoAnn Rollins, National Business Incubation Association; and Doug Devereaux, U.S. Department of Commerce Office of Technology Policy

Contract manager:
Gina Geremia, National Business Incubation Association

TABLE OF CONTENTS

Appendices

Tables

FOREWoRD

The wealth of nations is changing. While prior centuries were dominated by nations with superior industrial or agricultural capabilities, the Innovation Age rewards new competencies and strengths. Knowledge – ideas and the people who generate them – is the new coin of the realm. Innovative capacity will be the key driver of future economic prosperity, with emerging technologies such as genomics, bioinformatics, and nanotechnology promising even faster change and greater disruption.

To participate more fully in the Innovation Age, many U.S. states and localities are developing strategies that leverage their existing strengths to support technology-led economic development (TLED). Communities around the world are looking to foster business climates that help innovators innovate and encourage entrepreneurs to create jobs, sustainable growth, and community wealth. The Commerce Department's Office of Technology Policy (OTP) and Economic Development Administration work closely with national TLED leaders to advance understanding and implementation of these efforts.

As part of our 2002 TLED activities, OTP contracted with the National Business Incubation Association (NBIA) to identify factors that contribute to business incubator performance. This work was based on our recognition that there is inadequate information to guide those who oversee and operate technology incubators, despite evidence that business incubation programs can have a significant and measurable impact on the communities they serve. The goal of this study was to identify and compare exemplary and under-performing incubator programs in an effort to better understand best practices and strategies.

The data presented here can help improve the operation and economic impact of communities' business incubators. Using this information, policy makers and practitioners can take steps to maximize their investment in local incubators and can implement strategies to develop effective new centers of economic growth.

As always, the OTP welcomes comments, suggestions or feedback on ways to make this report even more useful, or on other topics central to technology-led economic development.

Bruce P. Mehlman
Assistant Secretary for Technology Policy

ACKNOWLEDGEMENTS

A National Benchmarking Analysis of Technology Business Incubator Performance and Practices was made possible by a grant from the U.S. Department of Commerce Office of Technology Policy. It reflects the efforts of a number of individuals and the support of their respective organizations. Special thanks go to principal researchers Louis Tornatzky of the Claremont College's Tomas Rivera Policy Institute and Hugh Sherman of Ohio University's Voinovich Center for Leadership and Public Affairs, whose expertise guided the project from start to finish. Research team members Sara Lichtin Boyd of the Voinovich Center's Institute for Local Government Administration and Rural Development; Marsha Lewis of the Voinovich Center's Executive Leadership Institute; and JoAnn Rollins of the National Business Incubation Association were instrumental in keeping our data collection process on track, among other tasks. Thanks also go to NBIA's Gina Geremia, who served as grant contract manager. We also wish to acknowledge the ongoing support of Doug Devereaux of the Office of Technology Policy. In addition, our advisory board members brought to the project years of experience in fields related to technology business creation. We appreciate the invaluable advice of David N. Allen, Robert J. Calcaterra, David A. Lewis, Sam V. Florance Jr., and Mary Lindenstein Walshok (see Appendix D). Finally, we are indebted to the managers of the 79 technology business incubation programs across the nation who completed our survey and the 15 managers who participated in additional in-depth interviews with research team members. Thank you all for sharing the lessons you've learned.

Dinah Adkins
President and CEO
National Business Incubation Association

EXECUTIVE SUMMARY

Technology-based start-ups represent a cornerstone of the knowledge economy that dominates the attention of governors, regional economic development officials, and average citizens as a result of the jobs and wealth it creates. While business incubators have contributed to U.S. entrepreneurial activity for about two decades, those that focus on technology-based companies are becoming more numerous and sophisticated, and are contributing to marked increases in technology firms' sales, employment and contributions to local economies.

Unlike previous research that primarily sought to understand if business incubation works and whether different types of incubators achieved different results, this study sought to answer questions about:

- The range of client performance outcomes across a national sample of technology business incubation programs
- Which technology incubators could be identified as exemplary and which as low-performing
- What ranges of business assistance services and organizational and management approaches are used by technology incubators
- What relationship exists between "best practices" and performance outcomes
- How these results can help improve incubator operations

To this end, a research team organized by the National Business Incubation Association (NBIA) conducted a benchmarking research study of 79 technology business incubators. The team gathered data from incubator managers on core or *primary* business *outcomes* (employment and sales revenue growth) of client companies, as well several precursor or *secondary outcomes* of clients (obtaining financing and securing intellectual property protection).

In addition to producing this report, which hopefully contributes toward answering the questions listed above, a major purpose of this benchmarking effort was to initiate on-going data collection and peer comparisons *that would promote better incubator performance.* Therefore the team used this information to develop confidential report cards for participating incubator managers that profiled their program's performance in comparison to their peers'. *Already, top-tier incubators identified through this study have used the findings in reports to their communities and less-well-performing programs have identified aspects of their incubator's performance in need of fine-tuning.*

The NBIA team identified 17 "best-in-class" incubators, so designated since they constituted the top 10 programs in either revenue growth or employment growth of client companies. The researchers then conducted qualitative interviews with the managers of these programs to identify their perceptions of "best practices" and

lessons learned. In addition to providing or brokering a full array of incubator services, the majority of best-in-class programs had either a strong working relationship with a research-intensive university, medical research institution, or laboratory, or were located in a metropolitan area that had a high concentration of technology-based companies and associated business support firms (e.g., accountants, intellectual property lawyers, human resource consultants).

The NBIA team analyzed its data in terms of how primary and secondary outcomes varied as a function of the technology focus of the incubators' clients (information technology, biotech/biomedical, and mixed technologies) or their business emphasis (product focus, service focus, mixed product/service). It also gathered data on the incubators' use of various client assistance services and other organizational practices. Descriptive and comparative statistics described the use of assistance services or organizational practices as a function of the technology focus of the incubators' clients (information technology, biotech/biomedical, and mixed technologies) or their business emphasis (product focus, service focus, mixed product/service.)

Findings of this study, in addition to those noted above, include:

- Forty-eight percent of the technology incubators were focused on information technology and electronics, compared to 24 percent focused on biotechnology and biomedical applications and another 28 percent involving a mix of client company technology concentrations
- Forty-four percent of incubators focused on companies that primarily had product-oriented business strategies, compared to 18 percent focusing on service-oriented strategies and 38 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, held more patents and in-licensed more technology than their peers
- Biotech/biomedical-focused incubators' clients had slower revenue growth than IT/electronics and mixed technology incubators' clients and fell behind mixed technology incubators in employment growth. In other words, they grew but growth was based on investment capital.
- Service oriented incubators' companies grew faster both in terms of revenues and employment than product-focused incubator clients

Although the research yielded no strong direct statistical relationships between incubator ***business assistance practices*** and ***primary*** outcomes (e.g., sales and revenue growth), it did reveal a predictive relationship 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. The reason for this, the researchers proposed, is that individual business assistance practices of incubators will have greater predictive relationships with performance outcomes only if *most clients* utilized certain practices. This was assumed to be unlikely, however, as every company has a different needs profile to be addressed. Instead, the re-

searchers propose that the strength and pervasiveness of ties to community technology generators, as well as the individual skills of the incubator manager, are greater predictors of performance than whether the incubator provides mentoring relationships or loaned executives for use by client firms.

The implication for further research in the incubation industry is that more insight might be gained by combining a structured, quantitative approach to *performance* benchmarking with a qualitative, descriptive approach to *practice* benchmarking. That is, we can learn more by identifying exemplary programs on the basis of hard data and developing case studies of those programs than by trying to tease out statistical relationships between specific program practices and client outcomes.

In terms of better understanding the ingredients of "best practice" in technology business incubation, this study reinforces the importance of the organizational and economic context in which incubators operate. This includes their linkages to research universities and laboratories and their location in an area that has a high concentration of technology-based companies and associated business support firms (e.g., accountants, intellectual property lawyers, human resource consultants). In light of this finding, it is imperative that incubator developers and community economic developers pay attention not just to creating a sound incubation program but also in addressing contextual and linkage issues.

INTRODUCTION

The Importance of Technology-based Start-ups in the Knowledge Economy

Many researchers and authors have described the contours and characteristics of the knowledge economy. This new, technology-based economy is arguably the most significant characteristic that defines metropolitan areas (DeVol, 1999), regions, and states (AEA, 2000) that are economically flourishing. In fact, one growth industry in the policy analysis field is preoccupied with developing, publishing, and disseminating comparative statistics on how states or metropolitan areas stack up against one another in terms of having the "right stuff" to compete in the technology economy (Atkinson and Coduri, 2002; Office of Technology Policy, 2000). The knowledge economy dominates the attention of governors, regional economic development officials, and average citizens for a variety of reasons.

For one, jobs in the knowledge sectors pay more and are growing at a faster rate than in other sectors of the economy. Moreover, if a state or region does not have a viable technology sector, there is clear evidence that its best and brightest young people will leave shortly after acquiring diplomas in key disciplines (Tornatzky et al., 1998; Tornatzky et al., 2001). The knowledge economy is global in nature, and significant advances in telecommunications and transportation technologies have enabled its rise. In effect, not only are cities and states competing against one another, they are competing against their counterparts all over the world. The knowledge economy is "weightless" in the sense that it often involves high-value products and services that have limited physical scope but immense underlying ideas and innovation.

Given the high levels of skills and educational credentials that knowledge companies demand, and the fact that knowledge companies typically are built around new technologies and cutting-edge science, states now view colleges and universities as key assets in their economic aspirations rather than as revenue drains with separate agendas. Universities can be a source of new knowledge through research and development, highly skilled graduates, and various other industry-building partnering activities (Tornatzky et al., 2002). Again, governors and university officials are involved in significant discussions about how to do this better, and a craft knowledge of useful policies and practices is slowly developing (Tornatzky, 2000).

It is little surprise that every state, region, and metropolitan area wants to participate in the knowledge economy and its inherent entrepreneurial activity. Unfortunately for many of those aspiring regions, most new economy activity occurs in a few cities and a fewer number of states. Many U.S. regions—such as the upper Midwest—are still making the final structural transitions from a economy dominated by heavy manufacturing, with large assembly and production facilities linked to a highly structured and disciplined supplier chain of many smaller producers of parts

and components. The historical experience with manufacturing has continued to drive economic development strategy in these regions, with traditional approaches predominating (e.g., trying to lure a large factory that will "save the day").

One problem with this approach is that traditional economic development strategies, such as industrial recruiting methods including tax abatements and regulatory relaxation, are often inconsistent with the realities and needs of the knowledge economy environment. First, there are only so many technology companies that might be suitable for a recruitment campaign—and competition between communities for them is fierce. The resulting bidding wars tend to get out of control. Secondly, there is growing evidence that knowledge economy companies are more likely to be interested in access to a highly skilled workforce, university partnering opportunities, and lifestyle amenities, as opposed to traditional inducements. If those recognized attributes are not already in place, it becomes a harder sell indeed.

While some communities will continue to narrowly pursue industrial recruitment strategies that focus on larger technology companies, others are beginning to include parallel strategies that might be best described as "grow your own." In these communities, efforts center on creating an environment that is conducive to the formation of technology-based start-up companies. Some of the components and players in this "grow your own" strategy include:

- Research universities, federal labs, and corporate research and development facilities, with stocks of technology-based intellectual property and an orientation to technology transfer (e.g., patenting and licensing) that emphasizes an entrepreneurial approach
- Entrepreneurial scientists and engineers wanting to commercialize technologies through new company formation
- Business professionals (accountants, lawyers, consultants, human resources specialists) familiar with the problems of launching a technology-based company
- Sources of debt and equity investment—public and private—that can capitalize the early development stages of a new, technology-based enterprise
- A concentration of existing technology companies that could be a source of experienced professionals who could assume leadership positions in technology start-ups, or provide advice to start-ups

Unfortunately, only a few regions in the United States appear to have all these pieces in place (e.g., Silicon Valley and the Northeast). Others, to compensate, have to be more creative in terms of public policies and programs in order to kick-start the technology-based entrepreneurial economy. One increasingly common program element seen in communities employing parallel strategies is the business incubator, which facilitates and brokers the kinds of help that new companies need. However, a business incubator may have a difficult time developing powerfully in a region that is not a mainline stop on the knowledge economy express.

Communities may also look to nearby research universities to take the lead in devel-

oping technology-based companies, but research suggests not all academic institutions are proficient in this arena. For example, more than eight years of research on university-industry technology transfer conducted by the Southern Technology Council (Tornatzky, 2000) shows that only a small number and fraction of universities have achieved a reasonable level of performance in creating start-up companies based on faculty inventions. In more detailed analyses focused on "best practices" (Tornatzky et al., 1995; Tornatzky et al., 2002), it is also very clear that those universities that appear adept in taking an entrepreneurial approach to technology transfer seem to have the following elements in common:

- A set of policies and procedures that enable would-be faculty entrepreneurs to become involved in start-ups
- An organizational culture and internal reward system that reinforces entrepreneurial development
- Novel approaches to injecting debt, equity, and grant financing into the development of start-up companies
- And, significant for the purpose of this report, an almost universal inclination to manage, link to, or utilize the services of technology business incubators

What are some of the implications of these findings? For universities and federal research facilities that wish to become engines of technology transfer, the importance and rationale for links to incubators are evident. By the same token, those regional economic development organizations that aspire to growing a knowledge economy have become increasingly focused on partnerships with universities and business incubation programs. All of these findings argue persuasively for the research that is reported in this document.

The Role of Business Incubation in the Knowledge Economy

Among the range of available economic development program tools, the process of business incubation and the development of facility-based business incubators have been a growth industry over the past two decades. In the early 1980s there were at best only a few dozen programs worldwide that would have met the following definitional criteria of a business incubator:

Business incubators accelerate the successful development of entrepreneurial companies through an array of business support resources and services, developed or orchestrated by incubator management, and offered both in the incubator and through its network of contacts. A business incubator's main goal is to produce successful firms that will leave the program financially viable and freestanding. These incubator graduates have the potential to create jobs, revitalize neighborhoods, commercialize critical technologies and strengthen local and national economies. Critical to the definition of an incubator is the provision of management guidance, technical assistance, and consulting tailored to young growing companies. Incubators usually also provide clients access to appropriate rental space and flexible leases, shared business services and equipment, technology support services,

and assistance in obtaining the financing necessary for company growth (Molnar et al., 1997, p. 4). (NBIA, 1996)

Among the first generation of incubators, the majority focused on relatively low technology businesses, typically in the service and manufacturing sectors. Gradually, the incubation industry expanded in size and sophistication of businesses represented among client companies. Currently, the National Business Incubation Association—the international membership organization for those professionally associated with business incubation and enterprise development—has about 1,000 members, representing approximately 600 incubation programs.

Growing in importance and impact is the subgroup of incubators focused on new, technology-based companies.[1] Many of these have affiliations with major research universities (Tornatzky et al., 1997; Tornatzky et al., 2002) or federal labs and research facilities. Typically, these incubators have tenant or affiliate companies with products or services deriving from information technology or advances in the biological sciences, although the technological concentrations have changed along with advances in the underlying science (e.g., ceramics and engineered materials). As such, they represent the incubation industry's increasingly visible role in the continuing development of the nation's knowledge economy.

One of the defining characteristics of the knowledge economy is the importance of entrepreneurial enterprises and people. Small, flexible companies seem to be particularly nimble at exploiting the potential of new knowledge and technology, getting to market faster, and providing a venue that attracts the creative and talented (National Academy of Engineering, 1995). In parallel, new approaches to capital formation and investment have evolved that match the needs and characteristics of knowledge economy entrepreneurs. From an economic development perspective, small companies are a significant, and arguably preeminent, source of new jobs in the economy (Birch, 1997). Whatever the specific value they add to their communities in terms of job creation and other benefits, it is clear that any region aspiring to have a robust, growth economy had better have a strong entrepreneurial, technology-based sector. Moreover, in developing that sector communities and regions can make good use of technology business incubators.

Research Questions

Given the history of research findings[2] and new ways of looking at performance and practice information, this research project addressed the following broad questions:

- What is the range of client performance outcomes across a national sample of technology business incubators, in terms of both **primary business** outcomes (e.g., sales and revenue growth), and the **secondary indicators**

[1] As of 2002, this segment had grown to 37% of nearly 1,000 North American incubators, according to the National Business Incubation Association's State of the Business Incubation Industry 2002 (to be published by NBIA in early 2003), compared to 25% in a similar 1998 survey.

[2] A review of prior research on business incubation may be found in Appendix A.

(e.g., equity investment, patents, research grant support, copyrights, and licensed intellectual property)?
- What is the scope and range of business assistance services that are provided to incubator clients?
- What is the scope and range of organizational and management approaches that are used by technology business incubators?
- What are the technology incubator "best practices" in a wide variety of activity domains, and what are their inter-relationships and their relationship with performance outcomes?
- What do the results tell us about how to improve incubator operations?
- In addition, who are the exemplary and low-performing technology incubators? (NBIA's benchmarking effort also sought to inform participating incubators—on a confidential basis—of their standing relative to peers.)

The Role of Benchmarking

There is one additional shortcoming of the existing research on incubator performance and practices. That is, much of the research has been done in the context of research *about* incubation, rather than research *for* incubator managers. In other words, researchers often designed studies from a program evaluation perspective to address broad questions and inform policy makers, rather than to provide the kinds of practical information that incubator managers would find valuable.

What do incubator managers want from data? Based on NBIA research team members' work in other contexts, it appears that there are two types of information that program managers will find valuable: (1) understanding *how well* they are doing performance-wise compared to peer programs elsewhere in the country; and (2) understanding *what they can do differently* to improve their performance with clients.

Achieving those objectives required NBIA to develop a *benchmarking* research strategy that allowed it to: (1) characterize the performance of a national sample of technology business incubators; (2) use the data to identify both exemplary and low-performing technology incubators, as well as to inform participating incubators (on a confidential basis) of their standing relative to peers; and (3) expand our understanding of technology incubator "best practices" in a wide variety of activity domains, particularly their inter-relationships and relationship with performance outcomes. It should be noted that this approach has been applied with some success in several programs including assistance programs for small manufacturing companies (Luria, 2000) and university-industry technology transfer (Tornatzky, 2001).

In this study,[3] researchers significantly addressed benchmarking objectives 1 and 2. In fact, NBIA provided each of the 79 participating programs a "report card" (see

[3] An explanation of research methods used in this study may be found in Appendix B.

Appendix C) on its performance standing relative to its peers.[4] The private reports presented standings on both primary performance outcomes of clients as well as secondary outcomes, and they were organized in terms of the overall sample as well as logical sub-groups (e.g., incubators focusing on information technology). Because a major purpose of this benchmarking effort was to initiate on-going data collection and peer comparisons *that would promote better incubator performance*, NBIA hopes that the first-ever production of incubator report cards will significantly assist in achieving this goal. *Already, top-tier incubators have used the findings in reports to their communities and less-well-performing programs have identified aspects of their incubator's performance in need of fine-tuning.*

For reasons to be discussed below, the project was somewhat less successful in expanding on the understanding of incubator best practices across a wide area of activity areas and their relationship with specific performance outcomes.

[4] The Technology Administration's interest in this project was confined to learning more about the range of performance outcomes across a national sample of programs and not in the performance standing of any particular program. Consequently, TA did not receive the report cards, or any performance data relative to any specific incubator.

RESULTS

Background of the Summary and Comparative Results

Results in this section are presented largely in the order in which data was gathered from participants in the study, as follows:

Summary and Comparative Results: Incubator Characteristics

The study team characterized the 79 incubators in the study in terms of their technology focus and their product/service mix, based on the types of clients presented by each incubator.

In terms of technology focus, the researchers classified 38 incubators (48 percent) as focusing on *information technology and electronics*; 19 incubators (24 percent) as focusing on *biotechnology and biomedical applications*; and another 22 incubators (28 percent) as involving a *mix of technology* concentrations among clients companies.

In terms of product versus service emphasis of client companies, the researchers classified 35 incubators (44 percent) as focusing on clients that were predominately pursuing a *product-oriented* business strategy; 14 incubators (18 percent) as focusing on clients that were predominately pursuing a *service-oriented* business strategy; and another 30 incubators (38 percent) focusing on clients pursuing both product and service-based strategies. The researchers were unable to assign one incubator to an emphasis, because of fragmentary data.

In order to see how technology focus interacts with product/service emphasis, the research team cross-tabulated these incubator classifications. This is presented in Table 1.

Table 1

Summary and Comparative Services Results: Services Mix

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	100.0%
Biotech/Biomed	11	57.9%	2	10.5%	6	31.6%	19	100.0%
Mixed Technology	12	54.5%	4	18.2%	6	27.3%	22	100.0%
Total	35	44.3%	14	17.7%	30	38.0%	79	100.0%

As can be seen, 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.

The research team also attempted to characterize the 79 incubators by nonprofit and for-profit status; urban, rural, or suburban location, and ties to government, industry, or universities. Table 2 summarizes this information, which reveals that nearly half of the technology incubators examined in this study had university ties, the great preponderance were nonprofit entities, and most were located in urban and suburban locales. The importance of these linkages and the economic context of the incubators' location will become more apparent in the case studies of "best-in-class" programs presented below.

Table 2

Characteristics of Incubators in Survey Sample

Tax Status	No.	Percent	Location	No.	Percent	Affiliation	No.	Percent
Nonprofit	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%

Summary and Comparative Results: Service Mix

For each of the 79 incubators that comprised the study sample, the research team developed "degree-of-utilization" scores for every one of 20 services that incubation programs could offer to clients (e.g., on a scale of 1-3, with "1" = did not receive, "2" = did receive, or "3" = constituted a major service). The study team aggregated these across the sample, as well as within subgroups of incubators. Table 3 summarizes these data. Data are provided for each service for the entire sample (in rank order of use), then within subgroups of incubators organized by their characteristics.

Table 3

Utilization Scores of Client Assistance Services

Service*	Score	Score for Technology Focus			Score for Product/Service Emphasis		
		IT/ Electronics	Biotech/ Biomed	Mixed Technology	Product	Service	Mixed
15. Networking assistance	2.33	2.32	2.26	2.33	2.33	2.19	2.40
16. Access to internet/IT services	2.19	2.30	2.11	2.19	2.21	2.26	2.14
2. Mentoring	2.17	2.27	2.06	2.17	2.33	1.85	2.13
12. Linkage to strategic partners	2.07	2.18	1.96	2.07	2.13	1.64	2.21
1. Business plan assistance	2.06	2.22	2.04	2.06	2.17	1.71	2.09
8. Assistance obtaining angel/VC investments	1.94	1.92	2.00	1.94	2.18	1.41	1.89
3. Marketing assistance	1.92	2.02	1.88	1.92	1.96	1.62	2.01
5. Linkage to university R & D services	1.87	1.61	2.11	1.87	2.11	1.62	1.69
6. Help securing student interns/employees	1.84	1.81	1.83	1.84	2.05	1.55	1.76
7. Management team development	1.82	1.92	1.78	1.82	1.97	1.38	1.82
4. Financial management assistance	1.81	1.84	1.67	1.81	1.79	1.50	1.98
9. Intellectual property assistance	1.78	1.73	1.78	1.78	1.86	1.64	1.77
20. Legal services	1.74	1.88	1.63	1.74	1.71	1.49	1.90
17. Access to specialized laboratory facilities	1.71	1.30	2.21	1.71	1.93	1.44	1.58
19. Human resources management assistance	1.69	1.85	1.48	1.69	1.67	1.44	1.82
10. Product/technology development assistance	1.66	1.65	1.54	1.66	1.84	1.46	1.55
13. Regulatory compliance assistance	1.36	1.25	1.43	1.36	1.43	1.21	1.36
11. Assistance in process related technologies	1.36	1.34	1.22	1.36	1.37	1.21	1.42
18. Machine shop	1.24	1.15	1.33	1.24	1.37	1.06	1.17
14. International trade assistance	1.19	1.23	1.07	1.19	1.24	1.05	1.20

* See Appendix F. Services are numbered as in the survey, Section II: Benchmarking Practices and Services

Summary and Comparative Results: Primary Outcomes

The team computed two ***primary outcome*** scores: employment change, from entry into the program to the current period; and sales revenue change, again from entry into the program until the current period. The reader should also be reminded that the cell entries in Table 5 average changes in the scale scores on the questionnaire and not "real" numbers of jobs and sales increments. The data is broken down and presented by incubator characteristics.

Table 4

Primary Outcome Scores

Outcome	Score	Score for Technology Focus			Score for Product/Service Emphasis		
		IT/ Electronics	Biotech/ Biomed	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

The results in Table 4 can be interpreted fairly easily. Revenue growth is slower in biotech/biomed simply because of the extended product development as compared to IT/electronics. However, there are also few differences in employment growth as a function of technology. Biotech/biomed companies grow, but they grow on investment capital longer and larger 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.

Summary and Comparative Results: Secondary Outcomes

Five items assessed performance on "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, or employees. However, the study team conceptualized that in the world of technology-based start-ups these outcomes are important precursors to those more traditional outcomes. The results are presented in Table 5. 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 5
Secondary Outcome Scores

Outcome	Score	Score for Technology Focus			Score for Product/Service Emphasis		
		IT/ Electronics	Biotech/ Biomed	Mixed Technology	Product	Service	Mixed
Equity Investment	4.60	4.43	5.00	4.60	5.17	3.50	4.60
Patents	2.51	2.04	3.21	2.51	2.97	1.83	2.51
Research Grant Support	2.27	1.59	3.02	2.27	2.60	1.79	2.27
Copyrights	1.85	2.00	1.29	1.85	2.48	1.00	1.85
Licensed Intellectual Property	1.65	1.26	2.12	1.65	1.79	1.54	1.65

Inspection of these data suggests some trends that are quite understandable. For one, there seems to be more money and intellectual property coming to biotech/biomed client companies as opposed to IT/electronics or mixed technology areas. The fact is that biotech/biomed companies have much more of a 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 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 are paralleled by 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 1 noted, biotech/biomed companies are more likely to be product oriented, which could account for the findings here:[5]

- Product-emphasis incubators reported significantly more equity investment than service-emphasis incubators.
- Product-emphasis incubators reported significantly more patents than both service- emphasis and mixed-emphasis incubators.
- Product-emphasis incubators reported significantly more copyrights than both service emphasis and mixed emphasis incubators.
- Both biomed/biotech and mixed technology incubators reported significantly more research grant support than IT/electronics incubators.
- Both biomed/biotech incubators reported significantly more patents held than IT/electronics.
- Both biomed/biotech and mixed technology incubators reported significantly more patents in-licensed than IT/electronics

Summary and Comparative Results: Incubator Environment and Management Practices

The last domain of measurement focused on incubator environment and management practices that were not directly linked to client services. These 15 items (See Appendix F) were contextual in nature and addressed how the incubator operated as an organization, such as doing things that any organization might do (e.g., conducting periodic strategic planning). These descriptive and comparative results are presented in Table 6. As with other groups of items, these measures have different scales and are not directly comparable. They are comparable across subgroups of incubators (in effect, across column but not across rows).

[5] Statistical analysis of these data via analysis of variance (ANOVA) yielded several significant differences ($p < .05$) including the above.

Table 6

Utilization Scores of Incubator Environment and Environment and Management Practices

Practices*	Score	Score Within Technology Focus			Score Within Service Emphasis		
		IT/ Electronics	Biotech/ Biomed	Mixed Tech.	Product	Service	Mixed
14. Number of clients served last year	28.17	40.84	18.84	13.26	16.42	38.85	37.17
13. Percent of full-time management positions that came open last year	5.64	10.76	0.00	0.05	5.09	1.25	7.20
15. Rigor of client screening process	3.70	3.63	3.74	3.79	3.62	3.77	3.76
2. Level of cash support incubator received	3.68	3.73	3.89	3.36	3.66	3.21	3.90
3. Management reports progress on achieving strategic goals to board	3.53	3.63	3.32	3.50	3.43	3.43	3.67
1. Uses strategic planning process	3.25	3.41	3.21	3.14	2.94	3.43	3.62
7. Assesses client satisfaction	2.83	2.82	2.63	3.00	2.91	3.21	2.53
2a. Amount of in-kind support received	2.55	2.82	2.13	2.40	2.58	2.38	2.58
5. Information on client outcomes collected	2.30	2.32	2.16	2.41	2.31	2.21	2.33
8. Increasing/decreasing fiscal year budget	2.14	1.97	2.26	2.40	2.09	2.00	2.30
12. Number of management staff providing business assistance services	2.08	2.34	1.58	2.00	1.97	1.85	2.27
6. Graduate outcomes monitored	1.96	2.00	1.88	1.95	2.03	1.77	1.96
4. Staff receive annual performance reviews	1.84	1.82	1.89	1.82	1.86	1.79	1.83
10 CEO's salary on par with local market	1.69	1.69	1.76	1.65	1.63	1.80	1.74
11. Time providing business assistance	1.65	1.74	1.68	1.37	1.65	1.54	1.66
9. Incubator has formal graduation policy	0.75	0.75	0.84	0.70	0.82	0.92	0.62
12c. Ratio: staff to number of offsite clients served (q12/q14b)	0.67	0.69	0.21	1.11	0.76	0.75	0.54
12b. Ratio: staff to number of resident clients served (q12/q14a)	0.30	0.27	0.25	0.39	0.27	0.45	0.26
12a. Ratio: staff to number of client firms served (q12/q14)	0.24	0.23	0.18	0.28	0.22	0.26	0.24
See Appendix F. Practices are numbered as in survey: See Section IV. Benchmarking Incubator Environment and Management Practices.							

Primary Outcomes: Best-in-Class Incubator Programs

Consistent with the benchmarking theme of the overall project, Tables 7 and 8 present a different slice of the ***primary outcome*** data. As noted earlier, the NBIA team created separate, customized "report cards" for each participating incubator that place them in terms of quartile and absolute rankings on both secondary and primary outcomes. However, in each of the two primary outcome domains—employment growth and sales revenue growth—the research team felt that it would also be useful to consider the "best-in-class" programs. Tables 7 and 8 present the top ten incubators, in order of performance on primary outcomes.

Table 7
Best-in-Class Programs – Employment Growth

Program	*Technology Focus*	*Product/Process Focus*
Audubon Business and Technology Center, New York, NY	Biotech/Biomed	Product
MGE Innovation Center, Madison, WI	Biotech/Biomed	Product
Louisiana Business and Technology Center, Baton Rouge, LA	IT/Electronics	Product/Service
Software Business Cluster, San Jose, CA	IT/Electronics	Product
Long Island High Technology Incubator, Stony Brook, NY	Mixed Technology	Product
Purdue Technology Centers, West Lafayette, IN	Mixed Technology	Product
Association for Entrepreneurial Science, Rockville, MD	Biotech/Biomed	Product/Service
University of Central Florida Technology Incubator, Orlando, FL	Mixed Technology	Product
Intelligent Systems Corporation, Norcross, GA	IT/Electronics	Product
Sid Martin Biotechnology Development Center, Alachua, FL	Biotech/Biomed	Product

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 8
Best-in-Class Programs – Sales Revenue Growth

Program	**Technology Focus**	**Product/Process 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 U.S. incubator	Mixed Technology	Product
Anonymous U.S. 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

Considering Table 8, some additional conclusions and impressions emerge from the data. Again it appears that a strong relationship exists between a product focus and being best-in-class. The proximity to a major university is not as strong as in the employment outcomes, and the mix of technologies seems more heterogeneous. Again, both for-profit and nonprofit incubators appeared on this list. This raised the question of what the research team might learn by directly querying the best-in-class incubators.

Lessons Learned: Best-in-Class Incubator Programs

In order to fill out the descriptive picture of technology incubation, the research team conducted some preliminary (*qualitative*) data collection among the 17 incubator programs that were among the top ten in terms of either (or both) primary outcomes. The team conducted interviews with the management of all of these programs that agreed to be interviewed.[6]

The results follow:

Audubon Business and Technology Center, New York, New York

This is a 100,000 square foot, state-of-the-art research incubator managed by Columbia University and developed in partnership with the City of New York, New York State, and Columbia University. The Audubon Center is the only biotechnology business incubator in the city, housing private research and development life sciences companies. Audubon 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, biomedically related businesses.

The Audubon Center is located in Audubon Biomedical Science and Technology Park, a proposed one million square foot development adjacent to Columbia Presbyterian Medical Center. The Audubon Biomedical Science and Technology Park is composed of the Mary Woodard Lasker Biomedical Research Building, which houses the Audubon Business and Technology Center, and the Russ Berrie Medical Science Pavilion. The Berrie Pavilion houses a comprehensive diabetes center, genetics research, and a research program in pediatrics. Work started on the third building in Audubon Park, the Irving Cancer Research Center, in the summer of 2001. The Irving Center will house research on cancer, genetics, and cell biology. Columbia Presbyterian 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.

Mitch Gipson, 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 needs to be noncontroversial and controlled by scientists who have an established reputation. The medical center is a nationally recognized leader, and the

---

[6] Each interview took approximately one hour and was relatively unstructured. Each manager was informed or reminded of the relative standing of his program and was asked to speculate about what has worked or what has been the source of the program's competitive advantage.

incubator management does not want to negatively impact that reputation. The center houses 20 firms, of which 19 have already received private venture money, one is publicly traded, and one has received federal Small Business Innovation Research (SBIR) money.

The MGE Innovation Center at University of Wisconsin-Madison, Madison, Wisconsin

This program is a partnership between the university and Madison 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, nine 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.

The Innovation Center 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 the MGE Innovation Center, 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.

Greg Hyer, 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 reputational benefit, that helps them to find venture money, employees, and customers.

The university resources include a very strong technology transfer office and a Small Business Development Center. In addition, the College of Business has the Weinert Center for Entrepreneurship.

Hyer also mentioned that the Center has a growing reputation for having launched successful high growth firms. New firms know they need to go to the Innovation Center to establish their credibility. Investors and local service firms come there to offer assistance, providing client firms with a network of angel investors and a network of local accountants and lawyers.

Louisiana Business and Technology Center, Baton Rouge, Louisiana

The Baton Rouge business community and leadership of Louisiana State University (LSU) 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 Ourso College of Business at LSU, 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. Executive Director Charles D'Agostino 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 legitimate these new roles for faculty. Of note, two LSU vice chancellors and five deans sit on the incubator's board of directors.

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 ranges up to two dozen, and there are currently 21 in residence. The program emphasizes technology-based new enterprises, and about half of the current clients have some form of 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 LSU policy that encourages faculty involvement in start-ups. The establishment of a new LSU Research Foundation will have a more systemic role 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 being the operator of several programs that complement its incubation activities. For example, it runs the LSU Small Business Development Center (SBDC), which serves upwards of 300 clients per year. This activity functions as a "farm team" for the incubator, with some start-ups eventually becoming resident clients of the incubator. The program also operates—for the Louisiana Economic Development Department—the Louisiana Technology Transfer Office, which functions to transfer LSU technology and as a portal for the transfer of NASA technology from the Stennis Space Center and other federal laboratories to established companies throughout the state. While not nominally focused on start-ups, 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 Louisiana. This includes various training and briefing

activities, as well as a "Phase 0" service that subsidizes proposal writing efforts. The incubator also has a large network of relationships with local business service providers (e.g., attorneys and accountants) who refer potential clients. The upshot of these many complementary activities is that the incubator is seen as the "go-to guy" in the state for activities related to technology entrepreneurship.

In summary, the keys to success for this program reside in its rich network of statewide relationships, complementary program activities conducted for the State of Louisiana, and stable and visible presence on the campus of a major research university. It also has had the benefit of a stable core of program staff and leadership.

Software Business Cluster, San Jose, California

This program usually has 10 to 20 companies as resident clients that range in size from 2 to 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 San Jose Software Business Cluster (SJSBC) is on market development, management development, and financing.

Most of the entrepreneurs come out of larger Silicon Valley companies. To date, none has come directly out of a local university. 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, in the tradition of Silicon Valley.

San Jose 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 of San Jose, 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 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 SJSBC Executive Associate Program, which assigns senior level interns to work on a pro bono basis with the companies on specific issues, such as marketing or fund raising. About 85 percent of companies that enter SJSBC get venture funding or institutional investment. Incubator management requires them to complete and polish their business plans and then works with them on presentations for investors. Once incubator firms are ready

to make their pitches, SJSBC's Venture Capital Referral Program can provide 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**.**

Long Island High Technology Incubator (LIHTI), Stony Brook, New York

The incubator is located at the State University of New York (SUNY) at Stony Brook and 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 New York 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 Rensselaer Polytechnic Institute in Troy.

The purpose of this incubator is to commercialize technology and to support early stage businesses, thereby expanding jobs and the tax base on Long Island and in New York State. The university president is usually the chairman of the incubator board. Most client firms have come from off campus. Only five clients have come from the university.

Since the founding of LIHTI, more than100 companies have been associated with its programs. By the end of 2000 more than 25 companies had successfully graduated from the incubator. They were generating revenues of more than $175 million through New York sales alone and had over 800 employees. One graduate firm, which has since moved to Tucson, Arizona, now has annual sales of more than $350 million.

To enter the incubator a prospective client needs to have its intellectual property in place 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.

Jim Finkle, incubator manager, attributes program success to the incubator's ability to offer clients access to world-class scientists, engineers, and graduate students. SUNY Stony Brook 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 the Strategic Partnership for Industrial Resurgence (SPIR)—a state program that provides companies a 50/50 match when hiring campus researchers to help solve problems—and the Small Business Development Center. In addition the incubator has 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.

Purdue Research Park Incubators, West Lafayette, Indiana

Purdue 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 Purdue Research Park (PRP) has continued to enlarge its program, which now includes two incubation facilities: the Purdue Technology Center and the Business and Technology Center. In addition, Purdue's Hentschel Center 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 PRP's incubation program to become the largest based at any U.S. university.

Similar to other incubators, the PRP 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).

Gregory Deason, director of university real estate, indicates that there are two key reasons that Purdue's incubator has been so successful. The first is that, in 1993, Purdue 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 the Purdue Gateways Program, which is the sophisticated business assistance program that works with all the incubator companies. Started in 1998, Purdue Gateways 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 a Purdue 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 Gateways Program uses Purdue undergraduate students and graduate research assistants, with many coming from the Krannert 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. The program offers initial funding to help firms develop their technologies and to leverage private seed and venture funding; thus it provides 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 Purdue takes an equity position in each firm.

Association for Entrepreneurial Science (AES), Rockville, Maryland

AES 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 the Maryland biotech/biomedical corridor, within the same community that is home to the National Institutes of Health (NIH). Since its start, the program has served 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 AES 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, 12 companies have graduated and five are currently in residence. For the most part, client companies are led by entrepreneurs coming out of area biotech/biomedical companies, with only two firms being NIH spin-offs. These are sophisticated individuals, although a number have not been 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 very 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 AES staff. However, there is no full-time staff, and the real attraction for companies is the access to the physical facilities. In return, AES holds an equity position in each of the member companies, typically about 5 percent. However, AES 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.

The University of Central Florida (UCF) Technology Incubator, Orlando, Florida

The University of Central Florida Technology Incubator (UCFTI) serves central Florida with locations in the Central Florida Research Park, adjacent to the UCF campus in East Orlando, and in downtown Orlando. The incubator facilities consist of more than 70,000 square feet of client office, laboratory and production space, confer-

ence and training rooms, and administrative offices. The program began in October 1999 and now serves more than 30 companies. Its mission is to provide early-stage technology companies with the enabling tools, training, and infrastructure necessary to create financially stable high-growth enterprises.

In addition UCFTI also provides assistance to university faculty in commercializing technology and supports the region's high-tech economic development initiatives activities. The incubator is integrated into many of UCF's entrepreneurship and technology transfer activities.

Companies that enter the incubator must be technology based and have developed at the least a working prototype of their product or service. Approximately 25 percent to 30 percent of the firms have been spin-offs from university developed technology.

Much of the incubator's success can be attributed to its partnerships with the university and community resources. This includes access to strong, experienced technical and business expertise at the University of Central Florida via an on-site Small Business Development Center, a strong advisory board whose members contribute their time and resources, and an Entrepreneur in Residence program. Currently, two experienced serial entrepreneurs serve the incubator as staff Entrepreneurs in Residence. These entrepreneurs, advisors, and incubator business development managers meet regularly with UCFTI clients to provide coaching, mentoring, and other support required to help clients meet their specific goals and objectives.

In addition the UCF School of Business Administration runs several entrepreneurial education and training programs to support the incubator, including a Boot Camp for Entrepreneurs and a seven-week "Excellence in Entrepreneurship" course that is a prerequisite for acceptance into the formal incubation program.

UCF also has a proactive office of sponsored research that strongly supports innovation, technology commercialization, and incubator programs. The office offers grant writing assistance to help university technology spin-offs get started and helps in identifying funding opportunities and potential collaborations.

Partnerships have certainly played a large role in the success of the incubator, which has become a valuable tool in the university's and region's economic development, technology transfer, and technology commercialization efforts. The incubator manages two community entrepreneurial efforts. The first is the Emerging Business Network (EBN), an organization that hosts monthly networking forums and quarterly high technology plant tours. EBN also provides a platform for information about business resources and opportunities to emerging businesses. Members include consultants, investors, entrepreneurs, and business resource providers. The second effort is a seminar series that area professionals host for local entrepreneurs. Topics range from developing a marketing plan to financing and accounting.

Intelligent Systems Incubator, Norcross, Georgia

The incubator is a business unit of Intelligent Systems Corp. (ISC), which has much larger interests in operations management and investment in the information technology sector. The technological focus of the incubator and ISC 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 10 ISC staff members who can 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 Atlanta metropolitan area, an area that technology companies heavily populate. Individuals who have 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 ISC 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 Atlanta area, they are 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.

Sid Martin Biotechnology Development Incubator, Alachua, Florida

Organized in 1987 as an activity of the University of Florida's Biotechnology Program, the Sid Martin Biotechnology Development Incubator (BDI) is located in a 40,000 square foot facility in Alachua and is designed to accelerate development of early-stage biotechnology companies. Currently, 11 companies participate in BDI, and most of these firms are based on University of Florida technology. Patti Breedlove, incubator manager, identified three reasons for BDI's 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 $750,000 in equipment available for tenants' use.

Second is the incubator's affiliation with the university. University of Florida is one of the nation's leading research institutions, boasting $425 million in research expendi-

tures. In 2002, the university experienced a 70 percent increase in licenses issued, and it 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.
Breedlove's third reason is that the incubation program provides professional assistance through in-house and networking activities. Specifically, BDI 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.

BDI 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 of Florida.

Technology Innovation Center, Wauwatosa, Wisconsin

The Technology Innovation Center (TIC) occupies a 138,000 square foot building located in the Milwaukee County Research Park, of which almost 85,000 square feet are useable for incubator operations. The incubator currently has 42 client companies, with approximately 350 employees in the building. About two-thirds of the companies are focused on information technology, with a growing fraction (now about 20 percent) focused on biotech. The TIC has been in operation since 1993 with a three-person staff. About 15 percent of clients (mostly biotech) currently come from the Medical College of Wisconsin, which is adjacent to the Research Park. The balance comes from the commercial and industrial base of greater Milwaukee, with many individuals emerging from larger companies in the area. The incubator has four academic affiliates: Marquette University, the Medical College of Wisconsin, Milwaukee School of Engineering and the University of Wisconsin at Milwaukee. These tend not to be research-intensive (the exception being the Medical College), so that there is little direct technology transfer in the usual university-incubator manner. However, many graduates of these schools have ended up in the incubator.

The incubator attributes its success to an "easy rider" or "let's all be adults" approach to assistance services. In fact, staff express some discomfort with the term "incubator," which is seen as connoting too much of a handholding approach to working with companies. As a result, while there is a careful and comprehensive screening process at the onset of a company's involvement (and more than a few are rejected), there is no set program or explicit milestones. Moreover, there is a fairly flexible policy regarding graduation, and the average client tenure in the incubator is about four years. Staff typically broker or provide assistance services in response to a client request, rather than as a result of a formal, periodic review of company progress. In many cases, however, the staff quickly and forcefully intervenes with a company when it appears that things are going downhill.

The incubator places great stock in client-to-client interaction, and the director, Guy Mascari, places some emphasis on maintaining a culture or organizational environment that encourages such interactions. For example, at a monthly breakfast meeting an external speaker—or resident client—will make a presentation on some topic of client interest. Networking and cross-referrals among client companies are common.

Finally, the incubator sees its primary role as the business development of client companies, rather than community or economic development. Management believes that the latter outcomes will happen if they simply succeed in the former. The director and the three-person staff all have business or corporate backgrounds, which they see as a plus.

In summary, there is a very flexible, no-nonsense incubation operation that employs relatively few structured or programmatic approaches to its work but prides itself in maintaining a culture of mutual support among its clients.

Ceramics Corridor Innovation Centers, Alfred and Painted Post, New York

This program consists of two incubator facilities, one of which (40,000 square feet) is located in Painted Post and currently houses seven companies. Some of its current clients are involved in technologies such as photonics, ceramics, filtration, precision machining of high-fired ceramics, and optoelectronics. The second facility (30,000 square feet) is located in Alfred and currently houses eight start-up companies that focus on areas such as glass and ceramics applications, amorphous metals, decorative tile for commercial use, microwave sintering, thin film technology, and ceramic/Zirconia surgical implants. It also includes a new Advanced Research Center in Photonics program operated by Alfred University that has been funded though the New York State Office of Science, Technology & Academic Research (NYSTAR).

Executive Director Jon Wilder indicates that access to resources at the New York State College of Ceramics and Alfred University are major keys to the program's success. Graduates of Alfred University operate some of the client companies in the incubators, and others represent faculty-based start-ups. Corning Inc. and other corporations located in the Southern Tier of New York State are also sources of start-ups, leveraging their research and development facilities in the area.

The program incubates corporate projects as well as other entrepreneurial start-ups. A promising early-stage technology may emerge from a university researcher or corporate laboratory. However, the technology may need maturation via proof-of-concept advanced research or prototype development, activities which are conducted in one of the incubator facilities and paid for from a mix of corporate, government, and in-kind funding. Once this maturation process is completed, decisions are made about subsequent intellectual property protections and whether the technology should be licensed or a business start-up should be formed.

In addition to the project-based linkages between the university and incubator, the provost of Alfred University sits on the incubator's board, as does an executive vice president from Corning Inc. Alfred has coursework in entrepreneurial management and student groups visit the incubator. There are also opportunities for student interns and part-time job placements. About 15 faculty members routinely interface with the program, and the culture of the university has become more receptive and enthusiastic about such relationships. Staff members of the program have an "open door" relationship with faculty on campus, and there is a great deal of informal interaction. It should be noted that the State of New York views the Ceramics Corridor Innovation Centers program as a major asset in its plans to develop the region around technology, and several initiatives are in various stages of planning and development. One initiative will involve five Fortune 500 companies and a consortium of 16 technology research-related universities, which will be focused on the further research, education, and commercialization of photonics technology. This initiative is known as the Infotonics™ Center of Excellence in Photonics and Microsystems.

The State of New York initially provided the incubator program $10 million in combined grant and loan funding in the late 1980s. The buildings were constructed during 1992 and1993, which is when the program really took off. Current operational expenditures are covered primarily through rent revenues and services provided.

In terms of services delivered to client companies, the program has an extensive mentoring program involving a mixture of corporate talent from Corning Inc. and other corporations, university-based faculty consultants, and various business assistance organizations. It also works with the Small Business Development Center (SBDC) program at Corning Community College. As noted above, the R&D assistance linkages are of major importance, with many of these being organized through a partnership with the Center for Advanced Ceramic Technology of Alfred University founded in 1987. This center is one of 10 Centers for Advanced Technology created by the State of New York to speed technology from the state's public and private universities to the marketplace; it operates as a public-private partnership.

Panasonic Digital Concepts Center, Cupertino/San Francisco, California

Founded in 1998, the Panasonic Digital Concepts Center (PDCC) consists of two incubator facilities, located in Cupertino and San Francisco. Together they can house up to 12 early-stage companies developing broadband, networking, wireless, or digital TV/multimedia technologies.

This is a unique incubation program, combining venture investing, incubation, and strategic partnering under one roof. PDCC admits only firms that provide the best opportunities for Panasonic's parent company, Matsushita Electric, by expanding Panasonic's research and development activities and offering the means to see new products that are being developed in the U.S. market.

For firms meeting Panasonic's requirements, PDCC provides the necessary resources to help accelerate business development. These include physical infrastructure such as furnished office space and lab facilities, and a strong set of professional resources, including experienced consultants, bankers, lawyers, accountants, advisors, and prospective investors. Another critical resource that PDCC offers is access to numerous engineering and advanced development teams within Matsushita that provide technology evaluation, market validation, and the potential for technology licensing or collaborative development.

Brad McManus, managing director, indicated that there are three key reasons for PDCC's success: 1) the group's direct investment program that offers funding of PDCC incubator companies; 2) a network of Silicon Valley resources to which PDCC has access, including strategic relationships with other incubators; and 3) the clustering of companies that can gain from relationships with Matsushita.

PDCC will invest in incubator firms (up to ten percent of total capital in financing rounds led by institutional venture capitalists) to advance strategic relationships between the company and Matsushita. Investments in incubator companies usually range from $200,000 to $400,000.

The fund also invests in later-stage companies that offer some strategic opportunity with Panasonic's parent company. These investments generally range from $2 to $5 million. Once an investment is completed, firms have access to Matsushita's vast resources. The result is that fund professionals are active partners who are financially motivated to ensure success of their portfolio companies.

PDCC makes a substantial commitment to developing its network for the benefit of portfolio companies. It is proactive in networking with other VC for co-investment and deal flow. For example, the center hosts a quarterly early-stage venture event to which 15 active venture firms each introduce two companies that they have selected to the other participating venture groups. PDCC's incubator companies have the opportunity to pitch to the venture firms at these events, and PDCC staff gets to see other pre-qualified, early-stage companies they may want to invite to participate in the incubator.

Finally, PDCC managers have many years of experience assisting high-growth technology start-up firms to develop successful business models and to obtain equity financing.

Center for Emerging Technologies, St. Louis, Missouri

Focusing on biotech and biomedical technologies, this incubation program has a particularly strong partnering relationship with Washington University Medical Center. Its first building (42,000 square feet) opened in 1998 and is comprised of both laboratory and office space. It is 92 percent leased. A second facility added 50,000 square feet of expansion space and is housed in a historic building that dates from 1907. It is 75 percent leased. Both buildings have extensive telecommunications

capacities; the second facility is mostly office with some assembly and production space. The Center currently has 14 client companies, with 90 percent having technology roots in Washington University and 85 percent being in the biotech/medical device sector.

Clients have extensive technological platforms for their companies, and the program boasts that clients have been issued 75 patents, with another 81 pending. Client companies have raised more than $200 million in investment over the course of the program, although only three companies have graduated to date given the lengthy development cycle of biotechnology. There are no strict expectations regarding time-to-graduation. Expectations are that 80 percent to 90 percent of the clients will eventually graduate. Currently, tenant companies employ more than 140 individuals with an average salary that exceeds $60,000.

Admission requirements are relatively strenuous, with clients expected to have viable intellectual property and a market focus in place prior to entry. Nonetheless, a considerable amount of applied research does take place while clients are in residence in order to mature their technology platforms, and this past year the firms have secured more than $7.5 million in research grant funding.

The principals in client companies tend to encompass a wide range of experience, with a relatively large fraction being involved in their first start-up. As a result, the incubation experience is fairly structured, with clear milestones and guidelines. Every client has a mandatory quarterly review of progress relative to plan, and there are frequent ad hoc meetings as well. Since about half of the clients already have venture capital backing, their investors also provide considerable oversight. More than 25 scheduled training events relating to intellectual property protection, the Small Business Innovation Research (SBIR) program, technology transfer, etc., take place on the premises each year.

In summary, this is a program that leverages the research excellence of a major university, a growing regional biotech/medical device sector, a structured incubation approach, and excellent facilities.

Business Technology Center (BTC) of Los Angeles County, Altadena, California

In contrast to many nonprofit incubators, this program is run by a government agency, the Community Development Commission (CDC) of the County of Los Angeles. The CDC is an economic development initiative, and all Business Technology Center (BTC) employees work for the CDC. The program has benefited from its public sector lineage in an important way: a first class physical facility. The new building was opened in 1998, and has excellent accoutrements including state-of-the-art telecommunications, high-tech security, and a pleasing appearance. The building and the land are totally owned by the CDC.

As a CDC project, the incubator is located in a lower-income area of Altadena, a

suburb north of Los Angeles that is adjacent to Pasadena. The incubator is about a mile from a major east-west freeway. The expectation is that the presence of the incubator and its success in graduating clients will enhance regional economic development in the county. Thus far, four companies have graduated. Three have located in Los Angeles County, while a fourth has moved to Orange County. The BTC is in a state enterprise zone, which means client firms can make use of special tax credits. Firms also can access a seed capital (loan) fund and other CDC loan programs.

There are 31 companies currently in the incubator, which is a high water mark for the program. Of these, 40 percent came from either the California Institute of Technology (Cal Tech) or the Jet Propulsion Laboratory (JPL), both in Pasadena. Others are drawn from throughout the Los Angeles area, with the Internet being a useful recruitment tool. It is important to note that the companies "coming out" of Cal Tech or JPL are doing so in an informal way. There are no official agreements between the incubator and the technology transfer offices of either institution, although there is a healthy informal referral relationship. Often the client company principals are still working at JPL or Cal Tech, and either moonlighting or transitioning into becoming full-time entrepreneurs. Individuals with some prior start-up experience operate slightly fewer than half of BTC client companies. Most of the companies are built around technology platforms from engineering or the physical sciences, and the balance are in software applications.

The incubator staff is composed of four FTE professionals and support staff, and four part-time interns. The project manager has extensive background in finance and some history working with start-ups; the operations manager has a banking background. There is no governing board, although an advisory committee is in formative stages.

The incubator's technical assistance program is fairly unstructured, with staff responding to client needs and demands as they emerge, as opposed to putting them through mandatory formal reviews or milestones ("If they need help, they will approach staff"). There is an on-site Small Business Development Center, but it tends to service regional businesses rather than BTC tenants. The BTC does provide informal workshops that are led by professionals on a variety of topics including intellectual property protection. There is no mandate regarding graduation, but the norm for residence is three years.

The incubator's leadership points to the fact that JPL and Cal Tech are both less than three miles away as a major cause of its success. This is a huge resource for cutting-edge science, talented professors and smart students. BTC tenants also have been quite successful in obtaining loan or equity financing. Clients may access a loan program (whose funds can be used as seed money), and eight loans totaling over $1.1 million have been awarded. These tend to serve as a financial springboard for subsequent venture capital investments. Illustratively, BTC firms have received more than $35 million in venture capital or angel investment. As one example, the

BTC loaned $250,000 to a start-up biometric firm, which permitted it to hire staff and put management systems in place. The firm recently closed on $4 million in first round venture capital funding. The Los Angeles County Board of Supervisors recently approved permitting the technology loan program (the seed fund) to offer convertible debt; this debt could later be converted to equity, warrants or royalties. The program can also take equity positions in firms as they enter the BTC.

This program leverages a significant investment and mission commitment by a county agency, proximity to world-class research and development assets, knowledgeable staff, and creative access to capital to create a high-performance incubator operation.

Common Results

Taken together, it is obvious that the top-performing incubators identified in the benchmarking effort have two very strong attributes that the program managers have identified as critical to their success. Both factors are related to the incubators' location within or adjacent to a major research university, medical institution, or federal laboratory, or in an otherwise resource-rich environment. These technology incubation programs have accessed 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 credibility and reputational benefits. (The incubators themselves have become known for assisting fast-growth technology firms.) The result is these firms are able to attract highly qualified employees, have credibility with suppliers and customers, and have access to private venture and angel financing.

Predictive Results

The study team 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. As noted above, this analysis should be considered exploratory in nature, in that existing research in the field has not yielded strong statistical relationships between incubator practices and outcomes (Allen, 1990; Lewis, 2003).

It will be recalled that the client performance outcomes were organized into ***primary*** and ***secondary*** categories. *Primary* performance outcomes consisted of changes in either:

- Employment
- Sales revenues

Secondary performance outcomes for clients covered the following areas:

- Amount of equity investment received
- Amount of research grant support received

- Patents held
- Copyrights held
- Extent of in-licensing of patents, copyrights, or trade secrets

The results reported here are organized in terms of the predictive model being tested, or in other words, which of the seven primary or secondary performance outcomes were being predicted by what combinations of services delivered to clients.

Predicting Primary and Secondary Outcomes from Client Assistance Practices and Services

Following the data consolidation approaches discussed above, the 20 practice and service variables were reduced and consolidated[7] into seven factors regarding the type of assistance or predictor variables that were potentially related to performance outcomes. These included:

1. *Core business assistance* encompassing broad issues that would need to be addressed by any business (e.g., help in developing a business plan)
2. *Specialized business assistance*, covering issues that were more complex and might demand specialized expertise (e.g., legal assistance regarding patents)
3. T*echnology-specific business assistance*, encompassing issues that were specific to a technology-based business (e.g., help in linking to university R&D)
4. Assistance in securing *student employees*
5. Help with *regulatory compliance*
6. Access to *Internet and IT services*
7. Assistance with developing *process-related technologies*

Researchers then subjected the resultant database to a regression analysis. In effect, we were trying to explore the relationships between the seven predictor factors (covering the assistance services received by clients) and the seven primary and secondary client performance outcomes listed above. Tables g-1, g-2, g-3, and g-4 (in Appendix G) summarize the results.

The study team found some statistically significant predictive relationships between the secondary performance outcomes (including both financial and intellectual property variables) and the seven predictors. In other words, across our sample of

[7] This involved a principal components factor analysis with varimax rotation. Three interpretable components were retained that accounted for 55 percent of the variance. The variables that loaded into the three components were then recalculated as subscale scores by summing the scores on the individual variables for each component and, based on those results, then consolidating individual items into composites. The three new composite variables and the original variables that were included in subsequent analysis included: *core business assistance*, encompassing questionnaire items (see Appendix D) 1, 2, 4, 7, 8, 12, 15; *specialized business assistance*, including questions 3, 9, 19, 20; and *technology-specific business assistance*, questions 5, 10, 17, 18. Four additional practices and services items (assistance securing student employees, help with regulatory compliance, access to Internet and IT services, and assistance with process-related technologies) that were not included in the three composite variables were also included in the regression.

incubators and their clients, no assistance measure seems to be directly and consistently related to the ***primary business outcomes*** of employment and sales growth.

In addition, the assistance factors that seemed to have the most predictive power in relation to secondary outcomes were ones that were *specific to technology business.*

Thus the technology-business assistance component was related to:

- Research grant support;
- Numbers of patents;
- Extent of in-licensing either of patents, copyrights or trade secrets.

Moreover the strength of these relationships was quite powerful.[8] In effect, technology business incubation assistance works, but particularly or primarily on outcomes that can be conceived as precursors to outcomes such as sales and employment growth, and through the vehicle of assistance services that are very specific to technology companies.

Predicting Primary and Secondary Outcomes from Environment and Management Practices

The predictive model that was tested here was whether the non-assistance elements of incubator activities would predict client performance outcomes. Researchers reduced the 15 Incubator Environment and Management Practices variables to 10 predictive factors using procedures analogous to those discussed above. This helped researchers define one composite variable related to *information-based management*, which seemed to them intuitively sensible, and nine individual Incubator Environment and Management Practices variables.

Table e-5 summarizes the results of the regressions, which yielded one statistically significant relationship between the seven primary and secondary client performance measures and the 10 predictors. Unfortunately that relationship is difficult to interpret and may be spurious. Some of the constituents of the predictive model (e.g., a larger program budget, doing annual employee reviews) seem to be indicators of a resource-rich or "flush" incubator environment. Perhaps this increases the ease with which lawyers can be paid or dragooned to help in securing intellectual property protection via patents—all in all an interpretative stretch.

Predicting Primary and Secondary Outcomes from a Combined, Everything-but-the-Kitchen-Sink Model

The study team also conducted regression analyses to determine the accuracy of the Incubator Practices and Services variables and the Incubator Environment and Management Practices variables *taken together* in predicting primary and secondary

---

[8] The *p* value ranged between $p<.01$ (for two of the relationships) and $p<.001$ for research grant support. In effect the chances are between one in a hundred and one in a thousand that these results could have emerged by chance. These would be considered highly significant relationships for the social sciences.

incubator performance outcomes. The results indicated that this combined model adds no incremental power to the analyses already reported.

Interpreting the Predictive Results

From one perspective, the predictive results are disappointing. That is, none of the *incubator business assistance practices*, nor the *environment and management practices appeared to show* any predictive relationships to client outcomes such as firms' employment or sales growth. One can, of course, search for answers in methodological nuances such as sample size and shortcomings in measurement instrumentation. Regarding the former, a rule of thumb in conducting regression analyses is to have at least 15 times the number of subjects (in our case, incubators) as the number of potential predictors. In several of the regressions described above we did not meet this ratio criterion, which tends to reduce the predictive power of the statistic.

However, perhaps a more parsimonious explanation may lie in a rethinking of how business incubation works generally and in a technological 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. Is that reality? Most likely, every company has a different "needs profile" of what should be improved in order to achieve business success. This might account for the generally low level of predictive relationship between services and outcomes in the research literature on incubators. However, when one considers 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. In fact, the regression findings reported above are consistent with this interpretation.

What is also missing from this analysis is any consideration of the larger context in which these programs operate. As the case studies of the best-in-class programs illustrate, these programs represent a variety of regional economies, linkages with research and development organizations, and local cultures. Some needs of client companies may be being met by "wired in" aspects of the local setting, which will vary widely across locale. So, the challenge that we were trying to address in this predictive analysis was to discover what factors are related to client outcomes *across* clients, contexts, technological emphases, and a variety of other givens. Considered thusly, the findings are understandable and not too discouraging.

DISCUSSION AND RECOMMENDATIONS

The Continuing Search for the Grail of Model Incubator Practices

With very high expectations the research team launched this project with the assumption that it could: (1) measure incubator performance and sort out the elite from the more modest performers; and (2) define a data-based understanding of which incubator practices seem to produce which outcomes.

It appears the researchers succeeded more with the first objective. Building a data-based model of exemplary practices proved elusive. *None* of the predictor variables in the regression analyses appeared to be strongly related to ***primary performance*** outcomes (e.g. increased revenues and employment), although there were a number of statistically significant relationships with ***secondary outcomes,*** such as gaining financing and acquiring intellectual property. Perhaps these results reflect in a crude way what actually happens in technology business incubation. In other words, assistance services directly impact only the precursors to "real" business outcomes, while the latter in turn are most affected by external markets and economic events, far beyond the reach of the incubator.

The andful of interviews of exemplary programs reflects on these issues as well. It was not obvious from those data that there is any consistent pattern of incubators' providing assistance to client companies. Some incubators, particularly those with relatively naïve entrepreneurs leading client companies, had fairly structured programs, with clear milestones and mandatory review of progress to plan. Others, with more experienced entrepreneurs, had a much more relaxed and available-on-demand approach to assistance. 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 Benefits and Attraction of Benchmarking

This project tended to operate within the concept and framework "benchmarking." This included the NBIA team providing (in a parallel series of reports) direct feedback to individual incubators on how their performance compared to peers. It also included naming "best-in-class" programs that the data suggested were performing more effectively than peers. Both of these steps will accelerate learning among and across programs. People not only want to know how they did, but how they can do better next time.

We also believe that the benchmarking approach lends itself nicely to gaining rich qualitative information from incubator programs. Some of this is presented in this report, and more can be mined from the best practitioners.

Data Collection Shortcomings or Incubation Practice Shortcomings?

There were shortcomings in the research data that were unfortunate and, in some sense, a reflection of shortcomings in the incubator industry. As earlier noted, the Advisory Committee and field-testing of the questionnaire 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 they didn't really know what they did or what happened as a result. The results suggest that future benchmarking studies should incorporate more precise measures of outcomes.

This is not just a methodological issue. It raises the question: What is the level of firm diagnosis and proactive provision of assistance, or even organized programming, that is actually operating in incubator programs? In other words, if incubator managers and staff are operating primarily or exclusively as referral or networking operations, then what is business incubation? This research suggests a need for more qualitative or descriptive study of the factors underlying the assistance practices of incubators.

REFERENCES

Adkins, Dinah, Hugh Sherman, and Christine A.Yost. 2002. *Incubating in Rural Areas: Challenges and Keys to Success*. Athens, Ohio: NBIA Publications.

Allen, David N., and Richard McCluskey. 1990. Structure, Policy, Services and Performance in the Business Incubator Industry. *Entrepreneurship Theory and Practice* 15, no. 2 (winter): 61-77.

American Electronics Association. 1997. Cyberstates: *A State-by-State Overview of the High-Technology Industry*. Washington, D.C.: American Electronics Association.

Atkinson, Robert and Rick Coduri. 2002. *The 2002 State New Economy Index: Benchmarking Economic Transformation in the States*. Washington, D.C.: Progressive Policy Institute.

Association of University Technology Managers. 2001. *AUTM Licensing Survey: FY2000*. Northbrook, Ill.: AUTM.

Birch, David, Anne Haggerty, and William Parsons. 1997. *Who's Creating Jobs?* N.p.: Cognetics.

DeVol, Ross. 1999. *America's High-Tech Economy: Growth, Development, and Risks for Metropolitan Areas*. Santa Monica, Calif.: Milken Institute.

Lewis, David A. 2003. *Innovation, Incubation, and Place: An Empirical Analysis of the Technology Incubators in their Host Communities*. Ph.D. diss., Department of Urban Planning and Policy Development, Rutgers University (forthcoming).

Linder, Sally. 2003. *2002 State of the Business Incubation Industry*, 2002. Athens, Ohio: NBIA Publications.

Luria, Dan. 2001. *Annual Report of the Michigan Manufacturing Technology Center, Performance Benchmarking Project*. MMTC. N.p.: Michigan Manufacturing Technology Center.

Molnar, L.A., D.R. Grimes, J. Edelstein, R. DePietro, H. Sherman, D. Adkins, and L. Tornatzky. *Impact of Incubator Investments*, Athens, Ohio: NBIA Publications, and Ann Arbor, Mich.: University of Michigan, 1997

National Academy of Engineering. 1995. *The Role and Importance of Small High-Tech Companies in the U. S. Economy*. Washington, D.C.: National Academy Press.

Office of Technology Policy, U.S. Department of Commerce. 2000. *The Dynamics of Technology-Based Economic Development: State Science and Technology Indicators*. Washington, D.C.: Government Printing Office.

Tornatzky, L. G. 2001. Benchmarking University-Industry Technology Transfer: A Six Year Retrospective. *Journal of Technology Transfer* 26:269-277.

Tornatzky, Louis. 2000. *Building State Economies by Promoting University-Industry Technology Transfer*. Washington, D.C.: National Governors Association.

Tornatzky, L., Y. Batts, N. McCrea, M.Lewis, and L. Quittman. 1996. *The Art and Craft of Technology Business Incubation*. Research Triangle Park, N.C.: Southern Growth Policies Board.

Tornatzky, L., P.G. Waugaman, and L. Casson, S. Crowell, C. Spahr, and F. Wong. 1995. *Benchmarking Best Practices for University-Industry Technology Transfer: Working With Start-up Companies*. Research Triangle Park, N.C.: Southern Growth Policies Board.

Tornatzky, L., P.G. Waugaman, and D. Gray. 2002. *Innovation U: New University Roles in a Knowledge Economy*. 2002. Research Triangle Park, N.C.: Southern Growth Policies Board.

Tornatzky, L., D. Gray, S. Tarant, and J. Howe. 1998. *Where Have all the Students Gone? Interstate Migration of Recent Science and Engineering Graduates*. Research Triangle Park, N.C.: Southern Growth Policies Board.

Tornatzky, L. D. Gray, S. Tarant, and C. Zimmer. 2001. *Who Will Stay and Who Will Leave? Individual, Institutional and State-Level Predictors of State Retention of Recent Science and Engineering Graduates*. Research Triangle Park, N.C.: Southern Growth Policies Board.

Wolfe, Chuck, Dinah Adkins, and Hugh Sherman. 2001. *Best Practices in Action: Guidelines for Implementing First-Class Business Incubation Programs*. Athens, Ohio: NBIA Publications.

APPENDIX A: Prior Research on Business Incubation

Over the past several years, a small body of research on business incubation has emerged. For the most part, that research has focused on some fundamental questions about the practice, including:

- Does incubation work?
- Are different outcomes achieved with different kinds of incubators (e.g., technological versus others)?
- What services define business incubation, particularly technology business incubation?
- What is the relationship between services and client business outcomes?

Thus far, the existing research has been more successful in addressing the first three questions than the fourth one.

Does Business Incubation Work?

To illustrate the first type of study, in 1997 a research consortium including the University of Michigan, NBIA, Ohio University, and the Southern Technology Council completed a comprehensive *Impacts of Incubator Investments Study* (Molnar et al., 1997) with funding from the U.S. Department of Commerce Economic Development Administration (EDA). This effort was the first to profile the varied impacts of incubators on their communities. Results showed that incubators have impressive, measurable impacts and represent a "best value" in economic development based on low costs and high return on investment. The subsidy cost per job created was only $1,109. This calculation included capital costs of the incubator building and any operating subsidy. Cost per job would naturally decrease over time as building costs are amortized over additional jobs produced by incubator companies.

A major strength of the EDA study was that the study team obtained performance measures directly from 126 clients and graduates of the incubators. Outcome measurement included new businesses and jobs created, firm revenues, equity capital invested, technologies commercialized, graduate company survival rates, etc. Some measures were general to all incubators and some applied only to specific types of programs (e.g., technology, empowerment, and mixed-use incubators).

Are Different Outcomes Achieved?

Although the EDA study results were generally positive, they were particularly so regarding technology-based programs and client companies, thus addressing the second research question mentioned above. Reflecting trends elsewhere, the amount of firm growth and value-added was marked among technology-based enterprises. Technology incubator client gross sales increased almost 800 percent and employment increased by 400 percent from the time the company entered the incubator (on average, 1993) until 1996, the period for which data was collected.

The EDA study showed that technology incubators provide clients a multitude of services critical to their success including assistance in building management teams, acquiring intellectual property protections, and developing financing. A majority of firms surveyed reported that incubators expanded their resources and significantly contributed to their success. Fully 90 percent of companies that had ever graduated from technology incubation programs surveyed in the EDA study were still in business.

It should be noted that the EDA study looked at performance outcomes across three major incubator types with a small sample size in each type (50 programs altogether), and the approach to collecting practice data was relatively weak (focusing primarily on a checklist of services that incubators potentially provided to clients). In addition, the sample size precluded a detailed analysis of practice impacts, such as correlating performance with practice activities.

Kind of Services that Define Business Incubation

Addressing the third research question in 1995-1996, NBIA participated in a best practices study conducted by the Southern Technology Council (Tornatzky et al., 1996) that profiled and documented policies, services, and activities of a national sample of 54 technology business incubators. A panel of peers judged these to be exemplary programs, although the absence of quantitative performance data across the sample did not permit verification of this characterization. Nor was the project able to show a quantitative relationship between specific practices (or broader practice domains such as client financing), or to determine whether these practices could serve as predictors of performance outcomes. Nonetheless, the study was qualitatively rich in its description of a wide range of technology business incubation practices underway nationwide.

Recent work supported by the Maryland Technology Development Corporation (Wolfe et al., 2001) has expanded the descriptive understanding of client service best practices. This study built on earlier work by examining a more select group of recognized, top-performing incubators and obtaining more detailed information from them on similar types of practices.

In 2000, NBIA and Ohio University looked at the performance of a small group of rural incubators (Adkins et al., 2001) and the degree to which they incorporated 35 commonly accepted incubator best practices. The comparative case analyses suggested a relationship between compliance with these best practices and incubator and client performance.

Before moving on, it would be useful to comment about the logistics and organizational politics of gathering these types of data. The body of research just reviewed (and other work not cited) tends to gather two *types* of data: information on incubator client *performance* improvements; and information on incubation *services and activities*, most of which are directly delivered to incubator clients. In turn, the

sources of these data tend to be twofold: information gathered from *incubator managers*; and information gathered from *client companies*. These types and sources of data create research design choices, each of which has its positives and negatives.

For example, data about performance outcomes that are gathered directly from client companies provide tend to be precise, valid, and reliable; however, it is difficult for researchers to extract this information from the managers of start-up companies. Unfortunately, EDA study researchers concluded that this was an extraordinarily difficult and expensive task. Chief executive officers (CEOs) of start-ups are very private and loath to provide proprietary information that might be leaked to competitors. Each data point involves extensive back-and-forth discussion and entreaties, which adds to the research team's time. Conversely, we also found that company CEOs were not very good information sources about the profile of services delivered by incubators. Since they get business development help from a variety of sources, some of which involves intervention or brokering by the incubator management, the entrepreneurs find is difficult to sort out where they got what from whom. In part they don't really care, since a careful examination of the impacts of incubator services is not high among their priorities.

The situation is somewhat different with incubator managers. They have extensive relationships with dozens of client companies, concurrently and over time. Many incubators are understaffed, and there are few incentives for careful record keeping. There also seems to be a reluctance among incubator managers to keep close tabs on the precise performance of client companies. In effect, incubator managers do not operate analogously to venture capitalists in terms of tracking return on investment. In several studies, incubator managers have indicated that they have, at best, approximate awareness of the extent of client company performance improvement. In addition, while incubator managers have a good grasp of the type of services that they offer *across all client companies*, they seem to have limited ability to chronicle the specific services that were delivered to any given company.

APPENDIX B: Research Methods

The following subsections present an overview of the research approach. Additional detail is provided in Appendices C, D, E, and F.

Research Advisory Committee

Every step of the methods development involved both field-testing as well as sound advice from a nationally prominent group of individuals who were experts on the incubator industry and/or evaluation methodology. The list of Advisory Committee members is provided in Appendix D.

Research Sample and Data Collection Procedures

The final study sample consisted of 79 technology incubators. This represents approximately 24 percent of all U.S. technology incubators, although as will be seen below, such estimates are problematic.

The process of recruiting the study sample consisted of several steps. First, NBIA searched its membership databases (National Business Incubation Association, 2001) and identified 329 incubators that had described themselves in a national survey as having a technology business focus. This constituted the "candidate" study population.

Researchers contacted each of the self-identified technology incubators via letter, email, and phone, and various combinations of these means. All were asked to participate in the study, and a copy of the data collection was transmitted via hardcopy and/or electronic format. A sample of the contact letter is provided in Appendix E.

Of the 329 incubators that were initially contacted, 59 appeared to be either out of the business or indicated that they were not a technology business incubator (the dot-com incubator "bust" was still underway, although in later stages, when the study was initiated). An additional 18 programs responded that they were too new to have yet had three graduate or client companies, and four other programs responded they were "between managers" and so had no person who could respond to the survey. As a result the adjusted population was 248. Since the study effort eventually generated 79 responses, the response rate was 24 percent of the originally defined study population and 31.9 percent of the adjusted population. The study team utilized upwards of five follow-up contacts—via mail, email, and phone—to elevate the response rate.

Questionnaire

Reflecting the data collection issues discussed above and the resource constraints of the project, the team decided to develop a questionnaire that would use incuba-

tor managers (or their designees) as the exclusive respondents. The research team did not provide a questionnaire or make other data collection contacts with incubator clients.

There was one other reason to use this questionnaire strategy: NBIA hopes to use this project as a springboard to a longitudinal program of performance benchmarking among its members. As such, the data collection approach and instrumentation needed to be accessible, reasonable, and inexpensive for the industry. Gathering information directly from incubator clients is none of those things.

The questionnaire is provided as Appendix F. Several design features are worth comment.

Client Focus of Data Collection

As noted above, the data collection strategy called for asking incubator managers for information about their clients. But which clients? Clients in general? The manager's "stars"? The research team decided to ask each manager to provide data on three clients (A, B, and C) that were either the *last three graduates*, or in the case of a new incubator, the *last three admitted clients*. (The actual study population split about 50/50 between these response options.) As a result, each specific question about client performance or exposure to services was in effect repeated three times. After field testing and input from our Advisory Committee, the approach proved to be workable.

Substantive Domains of Measurement

The research team gathered information in four broad areas, with the first three being client-focused and the last addressing organizational and management practices of the incubator itself. The first part of the questionnaire addressed background information of the A, B, and C and clients, such as their entry into and graduation from the incubator, tenant versus affiliate status, service or product emphasis, and technology focus. The research team was very careful in the wording of the questionnaire to indicate that managers were *not* to provide the names of clients A, B, and C, thus providing them with a significant degree of confidentiality.

The second part of the questionnaire addressed the extent to which clients A, B, and C received each of the 20 services.

The third part of the questionnaire addressed performance changes experienced by clients A, B, and C during their engagement with the program. These performance outcomes included *secondary* outcomes that researchers hypothesized as precursors of familiar business impacts. These covered financing and intellectual property. The *primary* outcomes focused on changes in employment and revenues.

The final section of the questionnaire inquired about the environment in which the incubator operates and the extent of the incubator's utilization of 15 management practices or organizational approaches. These questions were *not* phrased in terms

of clients A, B, and C, although those relationships were assessed empirically in the analysis (see Results section).

Scaling

The research team spent considerable time, discussion, and field-testing to develop the version of the questionnaire provided in Appendix F. Rather than asking for specific, factual answers in any domain, the team employed a Likert scaling approach. For example, managers provided estimates of client gross revenues on a five-point scale, with each scale point encompassing a wide range of values. For example, the 4th scale point on a five-point scale of client sales revenue read as "__ $1M to 5M," which encompasses a spread of $4 million. The benefit of this approach was that incubator managers were willing and able to fill out the questionnaire, and it also reinforced that they were not violating the confidentiality of their clients. The downside of the approach, as will be seen below, lay in the extreme loss of precision and general degradation of the database.

Data Analysis

Pursuant to this report, the study team conducted three major data analyses, as follows:

Data Coding and Data Consolidation

As noted above, several of the questions involved unique responses for clients A, B, and C. Researchers combined responses to such items so as to represent the average response across clients. We also devised a coding scheme for scaled items (see above) such that the data point was a number that corresponded to the highest level of a scale (e.g., most revenue = 6; least revenue = 1). The nature of some items called for the computation of "change scores," particularly in terms of primary outcomes. For example, since data were gathered on employment at entry as well as employment at graduation, simple subtraction yielded a change score. Finally, based on responses to the first section of the questionnaire, we coded the incubators in terms of their dominant technological focus, as well as the product versus service mix of their clients.

One final important bit of data consolidation is worth noting. Since the database was subjected to predictive analysis via regression techniques (see below), it was important for statistical reasons to reduce the variables that were used in the prediction equations. Based on a technique called factor analysis,[9] researchers computed composite scores that in effect combined data from several different measures.

---

[9] Factor analysis involves statistically examining data from a relatively large number of individual measures, and discerning common pattern of relationships within a sub-group of measures. Thus, for example, data from measures A, B, C, D, and E might be "reduced" to a composite of all five which might be called factor X. The net result is to increase the statistical power of other analyses, such as multiple regression.

Descriptive and Comparative Analyses

This component of the analysis involved fairly straightforward presentation of the data so as to highlight overall performance trends, clients' use of various assistance practices, and the incubators' environment and management practices The study team developed comparisons as a function of technology focus and product versus process emphasis of the incubator.

Predictive Analyses

This analysis involved multiple regression,[10] which can best be understood as trying to explain (or "predict") how an outcome in which we are keenly interested (e.g, client revenues) changes as a result of different combinations of inputs (e.g., receiving a mix of client services). The practical value of predictive analysis lies in the assumption that if we know at a high level of statistical confidence[11] that variables A, B, and C "predict" outcome X, then in the real world we might try to enhance A, B, and C and hope to achieve more or better results. Of course, sometimes this assumption is over-optimistic or unwarranted given the complex nature of causation in the real world. In fact, this component of the analysis should be considered exploratory in nature, in that it was hampered by the relatively small sample sizes and unavoidable measurement issues.

Phone Interviews of Best-in-Class Programs

The study team called managers of the top programs and asked them to identify what they believed to be their program's best practices. These interviews resulted in written profiles of each program that were sent to each respondent for comments and corrections.

---

[10] Regression builds from a simpler technique, correlational analysis, which involves two variables, say X and Y. A correlation coefficient can theoretically range from 0 to +1 or 0 to –1, but is always expressed as a decimal that is usually a lot less than 1. For example, if a series of measures of X and Y turn out to be correlated at a level of say 0.78 (which is very high), that means that an increase in the value of X will be accompanied by an increase in the value of Y. A negative correlation, say –0.78, means that an increase in X will be accompanied by a decrease in Y, and vice versa. Multiple regression merely extends the logic of correlation to a situation where we are trying to predict how a combination of variables or predictors (A, B, C, and D) will be associated with changes in an outcome (e.g., the price of a stock).

[11] Generally this is discussed in terms of the "statistical significance" of a finding and expressed in terms of a numerical value of the statistic and its "*p*" value. The latter is easy to understand. For example, a p of $<.01$ means that the odds are less than one in a hundred that the observed result could have occurred by chance. In the social sciences, a $p < .05$ (less than 1 in 20) is the minimal acceptable level of statistical significance.

APPENDIX C: Personalized Report Card

Technology Incubation
Benchmarking Results

Name of Incubator

City, State

A Confidential Report

Developed by

The National Business Incubation Association

Athens, Ohio

September 2002

Introduction

As part of its effort to improve business incubation practice, the National Business Incubation Association (NBIA) recently completed a performance benchmarking survey of technology business incubators in the United States. The Incubator Name and 78 other incubators participated in the survey. The NBIA study team greatly appreciates the cooperation that enabled this data collection effort.

So that your incubator might realize additional value commensurate with its involvement in this project, we are providing you this confidential report. It is a customized, institution-specific analysis of the performance data collected. Each of the 79 organizations involved in this benchmarking effort has been provided with its own unique, confidential "window" on the data. These organization-specific reports are not for general circulation, and the PDF file you receive is the only one in existence outside of our own files.

This report is intended to provide input for internal evaluation, self-analysis, and program planning purposes. The report includes a series of comparisons with other incubators that participated in the project. First, it provides information on how your program ranked on each of the metrics relative to the entire study sample of 79 incubators (or fewer, depending on the number of respondents to a particular question). The report also provides information on how your program ranked within subgroups of programs. Two subgroup rankings provide:

- Comparisons based on the technological focus of each incubator's clients. Thus, the 79 programs were grouped into those with a client mix: (1) focused on information technology and electronics; (2) focused on biotech and biomedical technologies; or (3) that spanned several technological areas. Based on questionnaire responses, your program was categorized as one with [Client Technology Category] focus.

- Comparisons based on the business emphasis (product vs. service) of each incubator's clients. Thus, the 79 programs were grouped into those whose clients: (1) were mostly product oriented; (2) were mostly service oriented; and (3) were heterogeneous in terms of product and service emphasis. Based on questionnaire responses, your program was categorized as one with a [Client Emphasis Category] emphasis.

The Benchmarking and Measurement Framework

Central to all questions about performance measurement is the mission and purpose of the organizations being benchmarked and how they generally go about their business. In order to facilitate the development of a performance benchmarking framework, the NBIA team adopted the following conceptual model of the incubation process:

A. The ultimate goal of incubators is to facilitate the business success of their client companies. As such, the "end stage" or ***primary*** performance metrics

for incubators are synonymous with those of their clients. Thus they include measures of employment growth, revenues, profits, and the like. In this project, these client outcomes were measured indirectly, on the basis of data supplied by incubator managers.

B. There also are "instrumental" or ***secondary*** business outcomes experienced by client companies. Although not synonymous with sales or profits, these outcomes generally are key milestones in the business development process. These outcomes might include obtaining external financing or securing intellectual property protection regarding core technologies. In this project, these performance measures were gathered indirectly, on the basis of information supplied by incubator managers.
C. In terms of incubator activities, the client performance outcomes outlined in A and B are facilitated by the provision of a variety of services on the part of the incubation program. These services include help with business planning, financial management and regulatory compliance. These services were measured as well.
D. Finally, each incubator performs management functions. These include organizing and staffing, planning and strategizing, and working with important constituents. An incubator's management functions are an important contextual element and also were examined in this study.

The performance benchmarking results presented in this report were derived exclusively from measurement domains A and B, above. Other reports resulting from this project will examine the relationships between elements C and D and outcomes A and B but are not presented here.

Reading This Report

This benchmarking report presents data via useful metrics. The data are tailored to each incubator based on survey responses collected during the Winter/Spring of 2002.

Each metric includes the following comparisons (as appropriate):

- A comparison of your incubator's ranking among all other participating incubators
- A comparison of your incubator's ranking among other incubators with a comparable technology focus in terms of clients served
- A comparison of your incubator's ranking among other incubators with a comparable product or service focus in terms of clients served

NBIA will not release this report to those outside the reporting institution without permission.

If you have any questions or comments about this report or any of its contents, please contact NBIA at research@nbia.org.

Results

The performance benchmarking results in this report are categorized in two broad domains – ***primary outcomes*** and ***secondary outcomes.*** Primary outcomes correspond to category A discussed above; they include key business outcomes such as sales growth, employment growth, and related outcomes. In contrast, secondary outcomes are those client company outcomes that are instrumental to the achievement of primary outcomes (e.g., securing financing). Secondary outcomes correspond to category B discussed above. Not all participating incubators provided data for all outcome measures; the number of responding incubators is noted below.

Your incubator's performance is reported as a rank based on all respondents' scores for each metric. Your rank indicates the number of programs that performed better than your program on a particular metric.

Ranks

Scores were organized from highest to lowest to derive ranks; a rank of 1 represents the best-performing program or programs. In the case of tied scores, participants share the same rank, which means that on a particular metric there may be fewer rankings than participants. This also means that, for example, if three programs share a rank of 10, the next best-performing program or group of programs would have a rank of 13 (i.e., there would be no ranks of 11 or 12). Therefore, a rank of 13 means that there are 12 programs with better results than the 13th ranked program.

Primary Outcomes

Employment Growth

Compared to the Entire Sample. Of the 79 programs that responded to this question, Incubator Name is ranked XX in terms of the **average employment growth** of its client companies.

Compared to Incubators With [Client Technology Category] Focus. Among the XX incubators with this focus, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of the **average employment growth** of its client companies.

Compared to Incubators Whose Clients Had a [Client Emphasis Category] Emphasis. Among the XX incubators with this primary emphasis, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of the **average employment growth** of its client companies.

Revenue Growth

Compared to the Entire Sample. Of the 64 programs that responded to this question, Incubator Name is ranked XX in terms of the **average revenue growth** of its client companies.

Compared to Incubators With [Client Technology Category] Focus. Among the XX incubators with this focus, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of the **average revenue growth** in its client companies.

Compared to Incubators Whose Clients Had a «M_3» Emphasis. Among the XX incubators with this primary emphasis, XX provided complete responses to this question. Of those respondents, your incubator is ranked XX in terms of the **average revenue growth** in its client companies.

Secondary Outcomes

Equity Investment

Compared to the Entire Sample. Of the 67 programs that responded to this question, Incubator Name is ranked XX in terms of **average equity investment** in its client companies.

Compared to Incubators With [Client Technology Category] Focus. Among the XX incubators with this focus, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of **average equity investment** in its client companies.

Compared to Incubators Whose Clients Had a [Client Emphasis Category] Emphasis. Among the XX incubators with this primary emphasis, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of **average equity investment** in its client companies.

Research Grant Support (e.g., SBIR, ATP, state grants, etc.)

Compared to the Entire Sample. Of the 65 programs that responded to this question, Incubator Name is ranked XX in terms of **research grant support** realized by its client companies.

Compared to Incubators With [Client Technology Category] Focus. Among the XX incubators with this focus, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of **research grant support** realized by its client companies.

Compared to Incubators Whose Clients Had a [Client Emphasis Category] Emphasis. Among the XX incubators with this primary emphasis, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of **research grant support** realized by its client companies.

Patents

Compared to the Entire Sample. Of the 64 programs that responded to this question, Incubator Name is ranked XX in terms of the number of **patents held** by its client companies**.**

Compared to Incubators With [Client Technology Category] Focus. Among the XX incubators with this focus, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of the number of **patents held** by its client companies**.**

Compared to Incubators Whose Clients Had a [Client Emphasis Category] Emphasis. Among the XX incubators with this primary emphasis, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of the number of **patents held** by its client companies**.**

Copyrights

Compared to the Entire Sample. Of the 42 programs that responded to this question, Incubator Name is ranked XX in terms of the number of **copyrights held** by its client companies**.**

Compared to Incubators With [Client Technology Category] Focus. Among the XX incubators with this focus, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of the number of **copyrights held** by its client companies**.**

Compared to Incubators Whose Clients Had a [Client Emphasis Category] Emphasis. Among the XX incubators with this primary emphasis, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of the number of **copyrights held** by its client companies**.**

Licensed Intellectual Property (patents, copyrights, or trade secrets licensed from another company, university, federal lab or research institution)

Compared to the Entire Sample. Of the 56 programs that responded to this question, Incubator Name is ranked XX in terms of the amount of **intellectual property** that its client companies have licensed into their operations.

Compared to Incubators With [Client Technology Category] Focus. Among the XX incubators with this focus, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of the amount of **intellectual property** that its client companies have licensed into their operations.

Compared to Incubators Whose Clients Had a [Client Emphasis Category] Emphasis. Among the XX incubators with this primary emphasis, XX responded to this question. Of those respondents, your incubator is ranked XX in terms of the amount of **intellectual property** that its client companies have licensed into their operations.

Conclusion

The NBIA team hopes all incubator managers who participated in this benchmarking process found it of interest and that you will want to participate in future benchmarking efforts as a means of highlighting strengths and weaknesses. The cumulative effect of such a process will mean better service to clients and a stronger business incubation industry.

Survey Questions Used for Report Card Rankings

Primary Outcome Indicators

Employment

What was the approximate number of each client's full time equivalent (FTE) **employees the year that they entered** the incubation program?

O 1-2 O 3-5 O 6-15 O 16-25 O >25 O Don't know

What is the approximate **current number** of each client's full time equivalent (FTE) employees?

O 1-2 O 3-5 O 6-15 O 16-25 O 26-50 O >50 O Don't know

Revenues

What were each client's fiscal year gross sales **revenues the year that they entered** the incubation program?

O $0-$99K
O $100-$499K
O $500-$999K
O $1M-$5M
O $5M-$10M
O >$10M
O Don't know

What were each client's gross sales revenues during the **immediate past fiscal year**?

O $0-$99K
O $100-$499K
O $500-$999K
O $1M-$5M
O $5M-$10M
O >$10M
O Don't know

Secondary Outcome Indicators

Equity Investment

What is the TOTAL amount of **equity investment**, from all sources, that each client company has received since its founding?

O $0-$99K
O $100-$499K
O $500-$999K
O $1M-$5M
O $5M-$10M
O >$10M
O Don't know

Research Grant Support

What is the TOTAL amount of **research grant support** (e.g., SBIR, ATP, state grants, etc.) from all sources that each client company has received since its founding?

O Zero O $1-$49K O $50-$99K O $100-$500K O >$500K O Don't know

Patents

How many **patents** does each client company hold?

O Zero O 1 O 2-3 O 4-6 O >6 O Don't know

Copyrights

How many **copyrights** does each client company hold?

O Zero O 1 O 2-3 O 4-6 O >6 O Don't know

Licensed Intellectual Property

How many **patents, copyrights, or trade secrets have each client licensed** from another company, university, federal lab, or research institution?

O Zero O 1 O 2-3 O 4-6 O >6 O Don't know

APPENDIX D:
OTP Benchmarking Research Advisory Board

David N. Allen, Ph.D.
Vice President, Technology Transfer
University Technology Corp.
4001 Discovery Dr.
Suite 290 Campus Box 588
Boulder, CO 80309
(303) 735-1688; fax: (303) 735-3831
david.allen@cu.edu

Robert J. Calcaterra, Ph.D.
President & CEO
Nidus Center for Scientific Enterprise
Monsanto Corp.
893 No. Warson Rd.
St. Louis, MO 63141
(314) 812-8001; fax: (314) 812-8080
robert.j.calcaterra@monsanto.com
robert.j.calcaterra@niduscenter.com

David A. Lewis
Rutgers University
33 Livingston Ave., Suite 100
New Brunswick, NJ 08901
(607) 275-9342 (home)
dalewis@eden.rutgers.edu

Sam V. Florance, Jr., Ph.D.
Assistant Vice Provost for Engagement
Purdue Research Foundation
3000 Kent Ave.
West Lafayette, IN 47906
(765) 496-6246; fax: (765) 496-6489
florance@purdue.edu

Mary Lindenstein Walshok, Ph.D.
Associate Vice Chancellor for Public Programs
and
Dean of University Extension
University of California-San Diego
9600 North Torrey Pines Rd.
Mail Code 0176
La Jolla, CA 92093-0176
(858) 534-3411
mwalshok@ucsd.edu

APPENDIX E:
Cover Letter Sent with Mailed Version of Survey

April 2002

Dear Technology Business Incubation Program Manager/CEO,

This letter follows up the recent telephone call you received from the National Business Incubation Association (NBIA). As promised, here is the incubator benchmarking survey for you to complete. Your participation will help make this important project successful.

The overall goal of the project is to develop a data collection and reporting system that U.S. technology incubators can use to obtain timely and useful information about:

- the performance of technology incubators from across the country
- how your program compares to similar incubators through a confidential "report card"
- identification of types of client services and other incubator practices that seem to be related to superior outcomes for client companies

This effort is funded by the Office of Technology Policy of the U.S. Department of Commerce.

To accomplish this project's goal, our research team has developed the enclosed questionnaire in consultation with numerous experts in the field. We trust you will find this survey captures key information in a user-friendly format that is not burdensome to you. Please note that the final survey report will aggregate all incubator managers' responses. Neither your answers nor those of other managers will be reported in isolation without your express approval.

In order to maintain our project schedule, we request that you complete the questionnaire and return it within two weeks in the enclosed self-addressed stamped envelope. If you prefer, fax it to NBIA at (740) 593-1996.

If you have any questions regarding this project please contact JoAnn Rollins [(740) 593-4331; research@nbia.org] at NBIA. Once we have concluded our data collection effort, we intend to send each participating manager a confidential, computer-generated report comparing your answers to similar programs. This report will be sent to your attention, *For Your Eyes Only*.

The quality and validity of the reports that we generate depends on receiving responses from as many technology business incubation managers as possible. Thank you for your help.

Sincerely,

Dinah Adkins
President and CEO

APPENDIX F: Benchmarking Survey

Technology Incubation Progam Benchmarking Project

Introduction and Methods

The purpose of this pilot project is to create a system, and set of metrics, for better understanding the performance and associated practices and policies of those incubators focusing primarily on technology-based businesses.

Several benefits will derive from your immediate and long-term participation:

1. Receive a confidential, customized "report card" on how your program's performance metrics compare to other similar incubators' metrics
2. Gain a better understanding of what types of client services and other incubator practices seem to be related to superior outcomes for client companies

This pilot benchmarking effort is new, and the methodology will be refined when this questionnaire is revised in future benchmarking studies.

I. Client Focused Questions

The first section of the benchmarking effort asks you to identify or have in mind particular incubator clients who will become the subject of subsequent questions. We are asking you to identify or have in mind particular clients in order to tie this assessment to specifics.

If your incubator has existed long enough to have at least three program graduates, please have in mind the **last three clients that graduated** from your program. By "graduated," we mean that the client company was at a stage of development appropriate to moving to a more independent setting. In effect, the period of intensive support from your program was over and the firm met your incubator's agreed-upon graduation criteria. Do not include companies that failed or left your incubator without meeting your incubator's graduation criteria.

If you represent a new program that has not yet graduated three clients, please report on the **last three clients that were admitted** to your program by meeting formal entrance criteria and who have participated in the program for at least six (6) months. Eligible clients fully participate in your **comprehensive** business assistance program and may be either tenants of your facility **or affiliates** that are not sited in your facility.

In subsequent questions we will refer to these most recent graduates or first incubator clients as Clients A, B and C. **In order to protect the confidentiality of these clients, we would rather not know the names of Clients A, B, and C.**

Please indicate which situation applies to you by filling in the corresponding circle in blue or black pen:

- ○ The specific companies about which I am reporting represent my incubator's most recent graduates.
- ○ The specific companes about which I am reporting represent my incubator's last three clients that have participated in the program at least six months.
- ○ My incubator is so new that it does not yet have three graduates or three client companies. If this is true please do not continue with this survey and fax only this page to NBIA at 740-593-1996. Thank you for your interest in our study.

Incubator name _____ City _____ State _____

Name of person completing this survey _____ Your phone number _____ Your e-mail address _____

☐☐☐

All information collected will be held strictly confidential by NBIA and reported only in aggregate.

Client A

1. Regardless of whether this company is a current client or a graduate, when did it formally enter your incubator program? ☐☐\☐☐☐☐ MONTH YEAR

2. Is this company **primarily**:

○ A service company ○ A product company ○ A company that offers products and services

3. Was this client an affiliate client (nonresident) or a client who was a tenant of your building? ○ Offsite ○ Tenant

4. What is the primary technological focus of this company:

○ IT (Software, communications, and Internet-delivered services) ○ Advanced manufacturing devices and materials

○ Electronics (Hardware and electronic devices and instruments ○ Consumer goods and services

○ Biotechnology (Biologics, therapeutics and diagnostics) ○ Environmental goods and services

○ Biomedical devices and instruments ○ Other (please specify):

5. If applicable, when did this company graduate? ☐☐\☐☐☐☐ MONTH YEAR _____

Client B

1. Regardless of whether this company is a current client or a graduate, when did it formally enter your incubator program? ☐☐\☐☐☐☐ MONTH YEAR

2. Is this company **primarily**:

○ A service company ○ A product company ○ A company that offers products and services

3. Was this client an affiliate client (nonresident) or a client who was a tenant of your building? ○ Offsite ○ Tenant

4. What is the primary technological focus of this company:

○ IT (Software, communications, and Internet-delivered services) ○ Advanced manufacturing devices and materials

○ Electronics (Hardware and electronic devices and instruments ○ Consumer goods and services

○ Biotechnology (Biologics, therapeutics and diagnostics) ○ Environmental goods and services

○ Biomedical devices and instruments ○ Other (please specify):

5. If applicable, when did this company graduate? ☐☐\☐☐☐☐ MONTH YEAR _____

Client C

1. Regardless of whether this company is a current client or a graduate, when did it formally enter your incubator program? ☐☐\☐☐☐☐ MONTH YEAR

2. Is this company **primarily**:

○ A service company ○ A product company ○ A company that offers products and services

3. Was this client an affiliate client (nonresident) or a client who was a tenant of your building? ○ Offsite ○ Tenant

4. What is the primary technological focus of this company:

○ IT (Software, communications, and Internet-delivered services) ○ Advanced manufacturing devices and materials

○ Electronics (Hardware and electronic devices and instruments ○ Consumer goods and services

○ Biotechnology (Biologics, therapeutics and diagnostics) ○ Environmental goods and services

○ Biomedical devices and instruments ○ Other (please specify):

5. If applicable, when did this company graduate ☐☐\☐☐☐☐ MONTH YEAR _____

All information collected will be held strictly confidential by NBIA and reported only in aggregate.

		Not Receive	Did Receive	Major Service	Don't Know
9. Client received intellectual property assistance.	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
10. Client received assistance in product/technology development (e.g., developing prototypes, beta testing, etc.).	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
11. Client received assistance in process related technologies (e.g., manufacturing systems, production assistance, process design, etc.).	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
12. Client received assistance in linking to strategic partners (e.g., marketing collaborations, distribution arrangements, R&D collaborations, subcontracting or cobidding).	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
13. Client received help with regulatory compliance.	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
14. Client received international trade assistance.	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
15. Client received assistance in networking with other firms.	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
16. Client obtained access to the Internet and other IT related services.	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
17. Client obtained access to specialized laboratory facilities.	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
18. Client obtained access to a machine shop.	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
19. Client received assistance in human resources management.	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
20. Client received general legal services.	Client A	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○

All information collected will be held strictly confidential by NBIA and reported only in aggregate.

II. Benchmarking Practices and Services

A second component of the NBIA benchmarking project is to look at the range of practices and services that are typically provided to clients directly by incubator staff or from external service providers whose assistance has been arranged, facilitated, or otherwise "brokered" by incubator staff. The next set of questions is designed to get a sense of the extent and depth of various forms of assistance that the incubator provides or brokers. For this study, we would like you to consider the extent to which **clients A, B, and C actually received or took advantage of these services**. For example, for each specific service or practice, we would like you to characterize the extent to which a given client (A, B, or C) received that service, using the following rating scale:

Not Receive - Client did **NOT receive** this service, either directly from incubator staff or from an external provider that was brokered by incubator staff.

Did Receive - Client **RECEIVED** this service, either directly or from an external provider that was brokered by incubator staff, but it was **not a major component** of the total services received, in terms of either time spent, resources expended, or importance to business development.

Major Service - Client received this service, either directly or from an external provider that was brokered by incubator staff, and it was a **MAJOR and critical component** of the services that the client received.

Don't Know - No easily available records.

Business Incubator Assistance Services		Not Receive	Did Receive	Major Service	Don't Know
1. Client received assistance in developing/refining a business plan.	**Client A**	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
2. Client received regularly delivered advice/mentoring from one or more community businesspersons or from a "shadow board" composed of such persons.	**Client A**	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
3. Client received marketing assistance (e.g., advertising, promotion, market research).	**Client A**	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
4. Client received help in financial management.	**Client A**	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
5. Client obtained assistance in linking to university-based research and development (R&D) services.	**Client A**	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
6. Client received assistance in securing student employees, interns or co-op placements.	**Client A**	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
7. Client received assistance in developing a management team.	**Client A**	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○
8. Client received assistance in obtaining capital investments from angel investors or venture capital firms.	**Client A**	○	○	○	○
	Client B	○	○	○	○
	Client C	○	○	○	○

All information collected will be held strictly confidential by NBIA and reported only in aggregate.

III. Benchmarking Performance

A third component of the NBIA benchmarking project is to look at the range of business and organizational outcomes that have been experienced by clients. **This section is extremely important for the project. If you do not have the requested information in detail, please make an informed estimate based on your recollection or knowledge. You might be able to obtain the information easily from clients A, B and C, particularly if you mention that NBIA will maintain the confidentiality of the database and that their company name will not be provided.**

Capital Acquisition

1. What is the TOTAL amount of **equity investment**, from all sources, that each client company has received since its founding?

Client A	○ Zero	○ $1-49K	○ $50-99K	○ $100-499K	○ $500-999K	○ $1M-5M	○ >$5M	○ Don't know
Client B	○ Zero	○ $1-49K	○ $50-99K	○ $100-499K	○ $500-999K	○ $1M-5M	○ >$5M	○ Don't know
Client C	○ Zero	○ $1-49K	○ $50-99K	○ $100-499K	○ $500-999K	○ $1M-5M	○ >$5M	○ Don't know

2. What is the TOTAL amount of **research grant support** (e.g., SBIR, ATP, state grants, etc.) from all resources that each client company has received since its founding?

Client A	○ Zero	○ $1-49K	○ $50-99K	○ $100-500K	○ >$500K	○ Don't know
Client B	○ Zero	○ $1-49K	○ $50-99K	○ $100-500K	○ >$500K	○ Don't know
Client C	○ Zero	○ $1-49K	○ $50-99K	○ $100-500K	○ >$500K	○ Don't know

Intellectual Property

3. How many **patents** does each client company hold?

Client A	○ Zero	○ 1	○ 2-3	○ 4-6	○ >6	○ Don't know
Client B	○ Zero	○ 1	○ 2-3	○ 4-6	○ >6	○ Don't know
Client C	○ Zero	○ 1	○ 2-3	○ 4-6	○ >6	○ Don't know

4. How many **copyrights** does each client company hold?

Client A	○ Zero	○ 1	○ 2-3	○ 4-6	○ >6	○ Don't know
Client B	○ Zero	○ 1	○ 2-3	○ 4-6	○ >6	○ Don't know
Client C	○ Zero	○ 1	○ 2-3	○ 4-6	○ >6	○ Don't know

5. How many **patents, copyrights, or trade secrets has each client licensed from another company, university, federal lab, or research institution?**

Client A	○ Zero	○ 1-6	○ 2-3	○ 4-6	○ >6	○ Don't know
Client B	○ Zero	○ 1	○ 2-3	○ 4-6	○ >6	○ Don't know
Client C	○ Zero	○ 1	○ 2-3	○ 4-5	○ >6	○ Don't Know

All information collected will be held strictly confidential by NBIA and reported only in aggregate.

Employment

6. What was the approximate number of each client's full time equivalent (FTE) employees **when they entered** the incubation program?

Client A	O 1-2	O 3-5	O 6-15	O 16-25	O >25	O Don't know
Client B	O 1-2	O 3-5	O 6-15	O 16-25	O >25	O Don't know
Client C	O 1-2	O 3-5	O 6-15	O 16-25	O >25	O Don't know

7. What is the approximate **current** number of each client's full time equivalent (FTE) employees?

Client A	O 1-2	O 3-5	O 6-15	O 16-25	O 26-50	O >50	O Don't know
Client B	O 1-2	O 3-5	O 6-15	O 16-25	O 26-50	O >50	O Don't know
Client C	O 1-2	O 3-5	O 6-15	O 16-25	O 26-50	O >50	O Don't know

Revenues

8. What were each client's fiscal year gross sales revenues **the year that they entered** the incubation program?

Client A	**Client B**	**Client C**
O $0 to 99K	O $0 to 99K	O $0 to 99K
O $100-499K	O $100-499K	O $100-499K
O $500-999K	O $500-999K	O $500-999K
O $1M to 5M	O $1M to 5M	O $1M to 5M
O $5M to $10M	O $5M to $10M	O $5M to $10M
O >$10M	O >$10M	O >$10M
O Don't know	O Don't know	O Don't know

9. What were each client's gross sales revenues during the **immediate past fisal year**?

Client A	**Client B**	**Client C**
O $0 to 99K	O $0 to 99K	O $0 to 99K
O $100 to 499K	O $100 to 499K	O $100 to 499K
O $500 to 999K	O $500 to 999K	O $500 to 999K
O $1M to 5M	O $1M to 5M	O $1M to 5M
O $5M to 10M	O $5M to 10M	O $5M to 10M
O >$10M	O >$10M	O >$10
O Don't know	O Don't know	O Don't know

Graduation Rates

Please IGNORE the next two questions if you have NOT GRADUATED any clients from your incubator.

10. Have you served more than 10 incubator clients? O Yes O No

11. If yes, of the last 10 clients that entered the program, how many left before graduation due to failure to meet benchmarks required for graduation, change in business plans, lack of rent payment, etc.? _____

All information collected will be held strictly confidential by NBIA and reported only in aggregate.

IV. Benchmarking Incubator Environment and Management Practices

The fourth and final part of this benchmarking effort asks you to provide information about the environment in which your incubation program operates and the management practices you utilize. Please mark the answers that best reflect your incubator's situation.

1. The staff and management of this incubator worked together to develop, confirm, or revise its strategic/long range plan within the:

- O Past year
- O Past two years
- O Past three years
- O NA, this incubator does not have a current strategic/long range plan

2. What was the TOTAL amount of **cash operating support** that this incubator has received from stakeholders external to itself in the past three years? (Include only grants, subsidies, fundraising proceeds, gifts, loaned staff, facilities or other expense offsets. DO NOT include funds generated from rents and service fees, contracts for which you will provide a deliverable or money to finance facility acquisition, construction, or renovation.)

O Zero O $1-49K O $50-99K O $100-499K O $500K-$999K O $>1M O Don't know

2a. In addition to the above, what is the total amount of **in-kind** support that this incubator has received from stakeholders external to itself in the past three years?

O Zero O $1-49K O $50-99K O $100-499K O $500K-$999K O $>1M O Don't know

3. The incubator staff and management reports to a board of directors or other supervisory individual or group on their progress toward achieving strategic/long-range plan goals:

O More than once a year O Annually O Every 2-3 years or less frequently O Never

4. Each member of this incubator's staff received an annual review of performance:

O Yes O No O Don't know or unsure

5. This incubator's staff collects information on key business outcomes (e.g., employment, gross revenues, etc.) on most or all **incubator clients**:

O More than once a year O Annually O Never

6. This incubator's staff collects information on key business outcomes (e.g., gross revenues, employment, etc.) on most or all **incubator graduates**:

O More than once a year O Annually O Never

7. During the past year, this incubator assessed client satisfaction with services received:

- O On an ongoing basis as services were provided
- O Not on an ongoing basis, but more frequently than annually
- O Annually
- O NA, this incubator currently does not assess client satisfaction with services

All information collected will be held strictly confidential by NBIA and reported only in aggregate.

8. Compared to two years ago, this incubator's current FY (fiscal year) budget has:

- O Increased
- O Decreased
- O Remained about the same
- O NA, this incubator has been in operation less than two years

9. During this last year, this incubator used a formal, written graduation policy requiring all clients who meet certain benchmarks to graduate from the incubation program and requiring those that fail to meet these benchmarks to leave the incubation program?

O Yes O No O NA, this incubator does not have a formal written policy

10. Is the CEO's salary and compensation package on a par with the pay in your area for jobs of a similar nature and level of responsibility?

O Yes O No

10a. If not, is it: O below market rate O above market rate 10b. By what percent? _____%

11. During this last year, on average, how much time did a typical management staff member in this incubator spend per week providing one-on-one and group business assistance services?

O <20 hours per week O 20-30 hours per week O 31-40 hours per week O >40 hours per week

12. How many full-time management staff who provide clients with direct business assistance does this incubator employ?

O <1 O 1-2 O 3-5 O 6-10 O >10 O Don't know

13. Approximately what percentage of these positions came open due to staff departures within the past year? _____%

14. During the past year, on average, how many client firms were served (received a full range of business assistance services) by your incubator? _____

14a. Of these, how many were in-house, resident clients? _____ 14b. How many were offsite, affiliate clients? _____

15. This incubator screens clients for admission to the program via a process that is :

- O Mandatory and rigorous
- O Intermittent or used primarily for diagnostic purposes
- O Informal and infrequently utilized
- O No defined process

Please return to NBIA Research via fax (740-593-1996), or mail in provided return address envelope to: NBIA Research C/O ILGARD; Ohio University; Building 22, Room 104, The Ridges; Athens, OH 45701

Thank You!

All information collected will be held strictly confidential by NBIA and reported only in aggregate.

APPENDIX G: Results of Regression Analyses

Table g-1
Relationship Between Practices/Services and Primary and Secondary Performance Outcomes

Outcomes	R^2	R^2 Adj.	F	Sig.	df
Primary					
Mean Change in Employment	.104	.001	.99		7,60
Mean Change in Gross Revenues	.072	-.036	.66		7,60
Secondary					
Avg. Equity Investment	.178	.067	1.6		7,52
Avg. Research Grant Support	.526	.460	7.9	***	7,50
Avg. Number of Patents	.243	.133	2.2	*	7,48
Avg. Number of Copyrights	.250	.086	1.5		7,32
Avg. Number Licensed Externally	.331	.222	3.0	*	7,43

*p<.05, **p<.01, ***p<.001.
Predictors: Received assistance securing student employees, Received help with regulatory compliance, Obtained access to Internet and IT services, Received assistance in process related technologies, Specialized business assistance score, Tech-specific business assistance score, Core business assistance score.

Table g- 2
Coefficients for Relationship Between Practices/Services and Research Grant Support***

Predictor Variables	β	*t*	Sig. *t*	Bivariate r	Partial r
Core Business Assistance Component	.015	.11		.002	.015
Specialized Business Assistance Component	-.344	-2.63	*	-.196	-.349
Technology-Specific Business Assistance Component	.676	5.56	***	.640	.618
Assistance in Securing Student Employees	.004	.030		.202	.004
Assistance in Process Related Technologies	-.053	-.458		.231	-.065
Help with Regulatory Compliance	.145	1.32		.190	.183
Access to Internet and IT Services	-.078	-.750		-.137	-.106

*p<.05, **p<.01, ***p<.001.

Table g-3
Coefficients for Relationship Between Practices/Services and Number of Patents*

Predictor Variables	β	*t*	Sig. *t*	Bivariate r	Partial r
Core Business Assistance Component	.253	1.40		.198	.198
Specialized Business Assistance Component	-.141	-.84		.018	-.120
Technology-Specific Business Assistance Component	.476	3.04	**	.411	.402
Assistance in Securing Student Employees	.034	.22		.241	.032
Assistance in Process Related Technologies	-.160	-1.07		.094	-.152
Help with Regulatory Compliance	-.145	-1.02		-.005	-.146
Access to Internet and IT Services	.084	.63		.075	.090

*p<.05, **p<.01, ***p<.001.

Table g- 4
Coefficients for Relationship Between Practices/Services and Patents, Copyrights or Trade Secrets Licensed from Another Company, University, Federal Lab or Research Institution*

Predictor Variables	β	t	Sig. *t*	Bivariate r	Partial r
Core Business Assistance Component	-.376	-2.09	*	-.229	-.303
Specialized Business Assistance Component	.046	.27		-.129	.042
Technology-Specific Business Assistance Component	.585	3.76	**	.448	.497
Assistance in Securing Student Employees	-.041	-.27		.042	-.041
Assistance in Process Related Technologies	-.064	-.43		.134	-.065
Help with Regulatory Compliance	.002	.02		-.015	.002
Access to Internet and IT Services	.031	.23		-.033	.035

*$p<.05$, **$p<.01$, ***$p<.001$.

Table g- 5
Relationship Between Incubator Management Practices and Primary and Secondary Performance Outcomes

Outcome	R^2	R^2 Adj.	F	Sig.	df
Primary					
Mean Change in Employment	.077	-.115	.40		11,53
Mean Change in Gross Revenues	.091	-.097	.91		11,53
Secondary					
Avg. Equity Investment	.210	.029	1.16		11,48
Avg. Research Grant Support	.230	.046	1.25		11,46
Avg. Number of Patents	.347	.187	2.17	*	11,45
Avg. Number of Copyrights	.271	-.038	.88		11,26
Avg. Number Licensed Externally	.312	.113	1.57		11,38

*$p<.05$, **$p<.01$, ***$p<.001$.
Predictors: Percentage of firms that were in-house; CEO's salary package compared to similar jobs in same area; Number of full-time management staff employed to provide business assistance services: Graduation policy requirement; State of incubator's current fiscal year budget; Number of client firms served last year; Amount of cash operating support received by incubator; Employee annual performance review; Information-based management score; Amount of in-kind support received by incubator; and Amount of time spent providing business assistance services.