The effects of external environment on the North East Tier Ben Franklin Advanced Technology Center at Lehigh University by Yan-Ming Shu.

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The Effects of External Environment on the North East Tier Ben

Franklin Advanced Technology Center at Lehigh University

by

Yan-Ming Shu

A Thesis

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in

Management of Technology

Lehigh University

May 22, 1996
This thesis is accepted and approved in partial fulfillment of the requirements for the Master of Science

May 21, 1996
Date

Thesis Advisor

Department Chairperson
Acknowledgments

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**Abstract**

This study is a single case investigation dedicated to addressing the effects of the external environment on the organization and operations of the North East Tier Ben Franklin Advanced Technology Center at Lehigh University. The mission of the Center is to lead northeastern Pennsylvania to a better economic future by promoting partnerships that develop and apply technology for business advantage. The partnerships usually involve government, institutions of higher education, private sector, and the Center itself.

The study shows that the organizational environment of the Center, which composes of the partners and supraorganizational elements, affects the organization and its operations. The key findings of this research are highlighted below.

- Less bureaucratic control results in greater operational creativity and effectiveness.
- The higher degree of adaptability to environmental change, the better the organization’s performance will be.
- The compatibility of organizational culture between the Center and its clients is a critical factor of success.
- The skeptical attitude toward government involvement in economic development has an impact on the Center’s operation.
Section I. Introduction

The following is a brief introduction to the purpose of the North East Tier Ben Franklin Advanced Technology Center (NET/BFTC) study conducted during the 1995-1996 academic year. A brief historical review of the Ben Franklin Partnership Program is reviewed, as is the role of Advanced Technology Centers in the Partnership Program. Finally, the relationship between the NET/BFTC and its environment is analyzed.

1. The Purpose of the Study

This study is a single case investigation addressing the effects of the external environment on the organization and operations of the BFTC at Lehigh University.

State science and technology (S&T) programs have captured the attention of the federal government, state governments, and academe in recent years. Some programs have been successful in disseminating and utilizing S&T research achievements to accelerate economic development and create jobs [1]. Studies show that a close participation in the program by all relevant constituents was a common theme of those successful programs [1]. The theme implicitly expresses the important concept that environmental constituents may have a significant influence on the performance of an organization. This study’s purpose is to address this concept and provide the results of the investigation.

The research subject, the BFTC, represents a unique kind of institution. It was created to carry out economic development through the collaboration of government agencies, universities, and industry. The interactions between the BFTC and its working
institutional partners make up most parts of the BFTC’s operation. By examining the nature of those interactions, the study seeks to identify the means through which the BFTC’s external environment affects their organization.

2. A Brief Historical Review of the Ben Franklin Partnership Programs

The Ben Franklin Partnership Program is an economic development program which involves partnerships among state agencies, universities, and businesses. The program was established in 1982 by Pennsylvania State Governor Richard Thornburgh who took that office in 1979. The dynamics behind the establishment of the program included: a devastated state economy, a shift of the traditional industrial paradigm, and an increasing awareness of the potential of technological innovation for economic growth.

By the time Governor Thornburgh took office in 1979, the United States was experiencing a serious recession and Pennsylvania was one of the states in the worst shape. The state’s economy began to decline shortly after World War 2. First, the coal industry lost markets to oil; then in the 1970s, the state’s manufacturing industries encountered severe challenges from both foreign competition and internal union problems. These unprecedented challenges made the state’s core industries, such as steel-making and machinery, less competitive in marketplace. The prolonged decline of industrial competitiveness combined with a nationwide recession resulted in a vast amount of unemployment in Pennsylvania. By 1979, the unemployment rate of Pennsylvania was the ninth highest in the nation [2]. Moreover, the fundamental shift of the traditional industrial paradigm from an industrial economy to a postindustrial
economy also weakened the state's ability to recover from recession. The growth prospect of the traditional industries, which the state's economy heavily relied upon, was gloomy in a postindustrial era. It was during this time period that innovation became the engine of economic growth.

Governor Thornburgh responded to this devastating economic situation promptly. Shortly after he took office, he directed the Pennsylvania State Planning Board to conduct a strategic planning effort called "Choices for Pennsylvanians." A board composed of representatives from business, labor, the state legislature and Cabinet, and citizens was formed to conduct an in-depth study of the state's economy. It solicited input from the public through a variety of communication vehicles such as television documentaries, public meetings, and citizen questionnaires. The process took almost three years to complete.

Several conclusions resulting from the effort affected the state's economic development strategy and its focus on advanced technology. One conclusion was the recognition that higher education institutions in the Commonwealth were one of Pennsylvania's competitive advantages in its economic development efforts. The Choices report pointed out that Pennsylvania graduated more engineers than all but two other states. It had four universities ranked in the top 50 graduate research institutions in the nation, with technological expertise in a very broad range of fields. A second conclusion was that technology could help to modernize the state's traditional industries such as steel and machinery and help them to regain their competitiveness. A third conclusion was that the state's future job growth would most likely come from small companies, which
coincided with a conclusion of a national study on the role of new and small businesses in job creation [3].

Based on these conclusions, the Commonwealth's economic development strategy recognized that its first priority had to be the existing firms in the state, because the resurrected industries could help the state's economy from losing more jobs. The second priority was the start up of new companies with an entrepreneurial and innovative nature. The final priority revised smokestack-chasing tactics, focusing on investments having long-term commitment and growth prospects in the Commonwealth.

Following from the conclusions of the comprehensive economic development strategy, Governor Thornburgh proposed to the Pennsylvania General Assembly in February 1982 the establishment of four Advanced Technology Centers in the state through the development of a new program called the Ben Franklin Partnership. The Assembly passed the proposal in November 1982. The Advanced Technology Centers then became the first of a number of programs that composed the Pennsylvania's Ben Franklin Partnership Programs and operated the Partnership Programs' largest program, the Challenge Grant Program, which was designed to be a comprehensive approach to technological innovation.

The Challenge Grant Program is not simply a funding mechanism for research projects. It is a comprehensive approach using four Technology Centers to forge a network among colleges and universities, business, the investment community, and entrepreneurs to transform technological innovation into job creation/retention and economic growth through the commercialization of technological innovation.
3. The Roles of Advanced Technology Centers

The four Advanced Technology Centers and the focused fields of technology development associated with each of them are outlined below: (1) University City Science Center in Philadelphia, which includes the University of Pennsylvania, Drexel University; Temple University and others, with its R&D emphases in the areas of sensors, biomedical, space productivity and adaptability, and materials; (2) Lehigh University in Bethlehem whose R&D emphases cover CAD/CAM, biotechnology, polymers and materials, and solid state microelectronics; (3) The Pennsylvania State University in State College with R&D emphases in food and plant, production and processing, mineral production and processing, biotechnology, and manufacturing management and control systems; and (4) a joint Center of the University of Pittsburgh and Carnegie-Mellon University in Pittsburgh with R&D emphases on computer and robotics, biotechnology, and advanced materials, processes and devices.

The Centers are required to carry out three state mandates: joint research and development, education and training, and entrepreneurial development. The first mission aims at improving existing firms’ competitiveness by joint R&D. The second mission has a community service and human resources enhancement purpose. The third mission’s emphasis is creating and nurturing future businesses for the state.

The North East Tier Ben Franklin Advanced Technology Center (NET/BFTC) anchored at Lehigh University is one of the four previously described centers, serving the northeastern area of Pennsylvania. Since the Center opened for business in 1983, it has
helped 184 companies to start up and created 4,519 jobs through the services of the university-government-business partnerships. Since 1983, the Center has obtained a total state investment of 63.7 million dollars which is being matched by a total private investment of 215.3 million dollars (see figure 1-1 for more detail). These figures confirm that the Center has been performing quality work since its inception. The Center currently operates with an annual appropriation of approximately $5 million from state government. For the past 13 years, the state’s appropriation has not been consistent, as shown in figure 1-1, but has leveled off in recent years. The Center’s operations can be categorized as follows: internal operations, business development, and public relations. The business development operations are externally oriented, emphasizing on developing research projects and enhancing the projects’ feasibility and viability. The operations of public relations are promoting the Center’s visibility and credibility to the public.

Figure 1-1. The funding history of NET/BFTC. All numbers excerpted from NET/BFTC’s annual reports
Among the major ties designed to carry out the three state mandates, the project selection for technology development funding is the most significant task. Moreover, the quality of the selection process directly links to the performance of the Center. The Center uses a structured process to select and manage the technology development projects (see Figure 1-2 for detail).

![Figure 1-2. Project selection and management process](image-url)
The process begins when the applicant for funding contacts and submits an informal project proposal to one of BFTC’s five field agents. The contacted agent will typically work with the applicant to refine the technological and commercial aspects of the would-be project with necessary resources which usually include voluntary experts outside of BFTC. The refined projects will then be formally submitted to the BFTC for evaluation. The efforts of evaluation are generally shared by BFTC’s two functional committees, technology and business. Each of the committees has a pool of experts who will be solicited to serve on the basis of the need further expertise. With the feedback from the two committees, the BFTC then prioritizes the projects on the basis of technology merit and business feasibility. The ordered projects are forwarded to the NET/BFTC Board of Directors for a final decision. The approved projects will be awarded grants to be performed on a contractual basis. The responsibility of monitoring the progress of the projects belongs to the field agent who makes the initial contact and escorts the projects through this entire process. The clear distribution of accountability helps to establish a mutual trust and working relationship between BFTC agents, university researchers, and the client firms.

In addition to managing the solicitation, selection, appropriation, and supervision of technology development projects, the BFTC also supports community education, assists with training programs, and manages an incubator.

4. The Relationships of NET/BFTC and Its Environment
From the histories of the Ben Franklin Partnership Programs and the creation of the Advanced Technology Centers, evidence shows that each of the four Centers retains a close interaction with its environmental constituents such as state government, universities, client firms, researchers, etc. For instance, the state government played a major role in selecting the mechanisms used by the Centers to determine research priorities; the universities and the state government were involved in the organizational arrangements used to bring together academe, business, and government agencies. A thorough understanding of the interaction of the Center and its external environment is necessary to comprehend the Center’s operation and its performance, and to improve and strengthen the Center’s services.
Section II. Literature Review

Much of existing management literature "...approaches management as an internal problem within a given organization. The impact of external constraints on internal management is treated peripherally..." [4]. In effect, organizations operate in the context of a broad environment. Organizations affect and are affected by a wider population of stakeholders such as suppliers, customers, and competitors as well as by a number of conceptual environment variables such as culture, political climate, infrastructure, etc., whose influence may be implicit but significant. Several organization theories and management theories, however, have explicitly addressed the interaction of the organization and environment and recognized the significance of that interaction on organization performance. These theories are open systems theory, resource dependence theory, contingency theory, organizational ecology theory, stakeholder theory, and comparative management theory. A brief introduction of each theory is outlined below.

1. Open Systems Theory

Open systems theory [5,6] was the pioneer theory to conceptualize the interaction of organization and environment, which borrowed the concept of organization as an open system principally from Bertalanffy's pathsetting article, "Open systems theory in physics and biology" [7]. Bertalanffy argued that a system is open "if there is import and export and, therefore, change of components. Living systems are open systems, maintaining themselves in exchange of materials with environment." Adopting this concept, systems theorists viewed organizations as open systems in which exchanges of resources with the
environment occurred continuously. These exchanges are critical to the viability of organizations. This heavy dependence on the environment leaves organizations vulnerable to environment changes.

Systems theorists, however, have formulated conceptual frameworks for management to ease this vulnerability; Ashby, for instance, has contrived what he calls the "law of requisite variety," which states that the rate of change of organizational systems must correspond to the rate of chance of environmental systems [8]. It implies managers must persistently scan the environment in order to detect and respond to environmental changes to increase the change of organizational survival. Lawrence and Lorsch [9], on the other hand, found from their comparative analysis of a small number of firms in plastics, food, and containers industries, that organizational effectiveness is related to the degree of the "goodness of fit" between organizational structure and the type of environment.

Open systems theory was the first to recognize the influence of the environment on the overall performance of an organization. Unfortunately, most of the conceptual frameworks prescribed were highly abstract and nonoperational. In addition, the environment was operationalized in terms of vague concepts such as stable/uncertain [9], placid/disturbed/turbulent [10], or simple/complex and static/dynamic [11]. Those concepts were not specific enough to help management pinpoint the most influential environmental variables and direct attention and resources to subsequently cope with changes in environment.
2. Resource Dependence Theory

Resource dependence theory is theoretically rooted in the open systems theory. Resource dependence theory assumes that organizations require resources to survive, organizations are dependent upon their environment for resource acquisition, and organizations seek to minimize their resource dependence on other organizations and to maximize the resource dependence of other organizations [8, p.9]. At least two types of strategies are formulated by resource dependence theorists for organizations to cope with the external dependency. One is the adaptation of the organization to the environment [9]. For doing so, organizations have to manipulate their internal structure to accommodate the environment in order to gain control over resources to minimize their external dependency. The other strategy is the absorption of dependence by means of integration, mergers and acquisitions, or joint ventures, in order to absorb or partially gain control over important external organizations upon which the focal organization is dependent [8, p10]. A study found that the proportion of mergers between industries during 1948 - 1969 was positively correlated with the proportion of transactions between industries [12].

Although resource dependence theory has an explicit concern over the influence of the environment on the survival of an organization, the scope of environmental variables examined by the theory is relatively narrow. In other words, the environmental factors that have a direct link to the focal organization are those of most concern in resource dependence theory. In this approach, environmental dependence is often a synonym of interorganizational dependence. Therefore, environmental variables are often
the organizations who have direct relations with the focal organization and are suppliers of essential resources. This rather narrow view ignores the fact that indirectly-linked environmental variables may also have a significant effect on the focal organization. The Federal Reserve, for instance, is not normally characterized as an interdependent organization to an ordinary business institution, but it has dominant influence on the cost and supply of money upon which business organizations’ survival is dependent.

3. Contingency Theory

Contingency theory is also a theoretical ramification of open systems theory. The basic premise of contingency theory is that organizational effectiveness is a function of the degree of compatibility of the internal organizational system and the external environment. The contingency view suggests that there is a middle ground between “universal principles” and “it all depends” in managerial theory settings. It advocates that there are definable patterns of relationships for different types of organizations and suborganizations [13]. The contingency approach to analyzing the interaction of the organization and environment emphasizes the coordination of an organization’s internal and external environment. This presumes that changes in the external environment necessitate subsequent internal adjustment in order to sustain organizational viability and effectiveness. This conceptual interaction of environment and the organization can be illustrated as a chain configuration as shown in figure 2-1.

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<thead>
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<th>Organizational Effectiveness</th>
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Internal Environment

14
The configuration demonstrates that the flow of changes starts from the external environment which in turn, affects an organization's internal environment. The adaptability of an organization to its environment is explicit in contingency theory.

4. Organizational Ecology Theory

Organizational ecology theory represents a basic theoretical shift as compared to the open systems theory and its offspring. Borrowing from biology, demography, and sociology, organization ecology is an adaptation of the population ecology model to populations of organizations, characterizing the relations of organization and environment as environmental selection processes. Organizations that survive under competition are selected by the environment, which means the population of organizations fits into at least one of the various properties of the environment. That implies management and strategic decision-making within an organization have less effect on the chance of survival and the performance of the organization than the environment does. The ecology analysis includes an emphasis on population dynamics as well as environmental dynamics, both of which are macro in scope and highly abstract [8,p21]. An example helps to illustrate this point. In analyzing the invention and spread of modern business organizations, Alfred Chandle [14] examines wholesale distribution in detail. In his analysis, he attributes the emergence of the wholesale warehousing industry to three causes: the invention and widespread use of railroads across the nation, the invention and construction of telegraph lines across the nation, and the exploration of scale and scope.
economies of storing and distributing large volumes of goods. Organizational ecologists [15] viewed Chandle’s analysis as a typical ecological analysis because the macro environmental dynamics play a dominant role in the emergence and survival of a population of organizations.

In addition to the organization theories outlined above, two management theories also have addressed the significance of the external environment on the performance of an organization. These theories are stakeholder theory and comparative management theory. A brief outline for each theory is provided in the following sections.

5. Stakeholder Theory

Stakeholder theory provides an alternative view of the relationships of the modern corporation and the environment, challenging the traditional assumption of managerial capitalism that the principal goal of the corporation is to maximize returns to stockholders. Stakeholder theory revitalizes “the concept of managerial capitalism by replacing the notion that managers have a duty to stockholders with the concept that managers bear a fiduciary relationship to stakeholders” [8, p.336]. Stakeholders by definition, [16, p.53] are “any group or individual who can affect or is affected by the achievement of an organization’s objectives.” By this definition, effective organizations and managers must deal with those group that can affect the organization and also be responsible to those groups that can be affected by the organization. The stakeholder view of organization tends to include only “legitimate” entities in the organization’s
stakeholder map, see figure 2-2 [16, p.55], but exclude the **supraorganizational** elements such as culture, social and economic systems, etc. from consideration.

![Stakeholder Map](image)

Figure 2-2. Stakeholder map of an organization [16, p.55].

6. Comparative Management

The rise of comparative management theory has been facilitated by the increasing popularity of the internationalization of the corporation. With the rapid growth in the number, scale, and scope of operations of multinational corporations, managerial academe has turned its attention to this phenomenon. The primary purpose of comparative management focuses on the description of "the similarities and differences among business and management system from different context" [17]. Four categories, at
least, can be classified in the comparative management literature [17]: the economic
development approach, the environmental approach, the behavior approach, and the open
systems approach. Among them, only the environmental approach will be introduced in
this section.

Although the analysis of comparative management is primarily a macroapproach
in nature, the environmental approach in comparative analysis can be appropriately scaled
down for micro applications. The nature of this analysis is to anatomize the entangled
context of the environment surrounding a focal entity. The entity can be a nation, an
international institution, or an individual organization.

The environmental approach of comparative management abandons the notion of
traditional management literature, which emphasizes the "internal environment" of a
firm’s operation and takes the external environment for granted. The environmental
approach focuses on the context of the interdependence and unique relationships between
a firm’s internal operations and processes and its external environment [18]. This
emphasis on the interaction between a business organization and its environment makes it
necessary to detect, identify, and evaluate a variation of environmental components and
their influence on the performance of the organization.
Section III. Research Methodology

This section addresses the methodology that was used in conducting this study. It is organized into four segments: subject identification, research design, data collection, and data analysis.

1. Subject Identification

The research subject in this study is the North East Tier Ben Franklin Advanced Technology Center (NET/BFTC). There are three primary reasons for choosing BFTC to study environmental effects on organization operations. First, external environment factors have played critical roles in the growth and development of the institution since its establishment. Representatives of state government and universities, for example, have been members of the Center’s Board since its inception. Second, most of the constituents that comprise the Center’s external operational environment remain unchanged over time. This is an operational advantage in analyzing what are the most important environmental factors to the Center and the changes of their influence over time. Finally, the Center’s small size and full functioning operations provide a comprehensive yet manageable data base for the study.

2. Research Design

The research is designed to be a case study using the BFTC as the subject organization for examining the influence of the environment on the operations and structure of the focal organization. Two inevitable issues occur in the design phase: environmental measurement and determination of the environmental constituents.
• Environmental Measurement

Several organization and management theories have regarded organizational environment as a fundamental concept in management. However, the conceptualization of the environment is characterized by relatively low consensus among them. At one level, the environment is not a very mysterious concept. It simply means the surroundings of an organization. The concept becomes challenging in analyzing the properties of the environment, instead of simply describing it. This analysis may be necessary and beneficial for understanding the relationship of the environment and organization. The size, the complexity, and the instability of the organizational environment, however, creates methodological obstacles for conducting a thorough analysis. Moreover, different theories approach the concept of organizational environment from various perspectives which renders convergent validity almost impossible. Based on these understandings, the study’s attempt to analyze the environment surrounding the BFTC is not attempting to portray it as a normative. Instead, the study is descriptive, viewing the environment of the BFTC as a collection of systems, organizations, and “climate” external to the BFTC, which directly affects the BFTC.

• Constituents of the Environment

Defining the environmental constituents of the BFTC is based on two common approaches: archival and perceptual measures. The archives used to conceptualize the BFTC’s environment include the Center’s annual reports and published articles and news about the Center. The perceptual measure is generated by the researcher from the
perspective of BFTC members. Unlike the archival approach, the perceptual measure is more subjective and associated with reliability and validity questions to some degree.

Combining the findings of these two approaches, there are six major elements which compose the BFTC's operational environment: state government, clients, researchers, Lehigh University, investment community, and societal-culture, as shown in figure 3-1. Each of them supposedly has effects on the Center's operations through various means with various degrees of magnitude.

![Figure 3-1. The environmental constituents of NET/BFTC.](image)

3. Data Collection Method

The procedure used to gather the data for research is described in four main stages outlined below.

**Stage 1. Select qualitative methods for data gathering** The study is devoted to using qualitative methods to collect data for two reasons. First, the nature of interaction between the focal organization and its environment may be studied more effectively with
qualitative methods. Second, the purpose of the study is to examine the effects of the environment on organizational operations, not to determine the magnitude of the effects. Therefore, a qualitative method is more appropriate for fulfilling the purpose.

Stage 2. Determine type of interview Because of the exploratory nature of the study, the research adopts a semi-structured interview as the vehicle to gather data. The semi-structured interview gives the interviewer an advantage to conduct a rather systematic interview with the opportunity to probe beyond the prepared questions.

Stage 3. Prepare interview questionnaire The question list is formed on the basis of the six environmental constituents mentioned above. Each section of questions starts with an exploratory question and then is followed by a series of specific questions aimed at exploring the interaction of the constituent’s properties and the BFTC’s internal operations. A detailed questionnaire is attached in the appendix.

Stage 4. Conduct interviews Four interviews were conducted for the study, which were completed in the BFTC’s main office building located at the Goodman campus at Lehigh University. The interviews were tape recorded with the permission of the interviewees and the agreement of confidentiality. The names and positions of the interviewees are listed below.

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Job Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark Lang</td>
<td>Executive Director</td>
<td>Oversees the Center’s operations</td>
</tr>
<tr>
<td>Janet Stainbrook</td>
<td>Assistant Director</td>
<td>Manages legislative relations and community activities</td>
</tr>
<tr>
<td>Joe Lane</td>
<td>Director of Business Development</td>
<td>Manages center project and client service activities, Develops programs to meet clients’ needs</td>
</tr>
</tbody>
</table>
4. Data Analysis Method

The process to analyze the collected data follows the guidelines of content analysis [19]. In general, content analysis is not a specific data analysis method but a technique which addresses a systematic and objective identification process for deciphering written or oral messages. In this research, an objective analysis is accomplished by three rules which are outlined below.

**Transcribe interviews completely**  This study believes that even quick and timely note-taking at the time of the interviews is not sufficient to capture all important messages. Therefore, a complete transcription of the interviews is necessary for data analysis.

**Count manifest content**  The analysis takes the messages explicitly expressed in the interviews into account. The elements of the messages can be words, themes, or characters which are emphasized by the interviewees during the interviews.

**Count latent content**  The analysis does not confine itself only to manifest content but extends to an interpretive reading of the symbolism underlying the physically presented data. Although this approach will inevitably incur some subjectivity, the benefits of exploring the deep structural meanings conveyed by the messages is more worthwhile than those of narrow objectivity. Besides, in the study, each interpretation is induced from at least three independent interviews in order to eliminate as much subjectivity as possible.
Section IV. Results

The following is an outline of the results of the interviews.

- The state government’s consistently supportive attitude toward the Center has helped the Center and its staff to sustain a high level of morale and enthusiasm in its missions.
- The state government’s annual appropriation process discourages the Center from long-term planning.
- The changes in the state government’s supervision mechanisms along with the changes of supervisory personnel have adjustment ramifications for the Center.
- An anti-government-involvement in business attitude prevailing in the Reading area downplays the results of the Center’s efforts to promote and generate government-business-academe partnership in that region.
- The growth of entrepreneurship in the northeastern Pennsylvania region is still in its infancy stage. Traditionally, the economic health of this region is linked to the health of a few big companies, such as Bethlehem Steel Co. The mentality about career in this region is to work in a large organization and climb the hierarchical ladder to the top, rather than start up one’s own business. This prevailing attitude discourages the growth of entrepreneurship and increases the difficulty for the Center to promote entrepreneurship.
• The diversified client base, with service demands ranging from technology development to marketing to finance, challenge the Center's operation to supply services in almost every functional business area.

• The different emphases in service demands between the entrepreneurial clients and existing firms challenge the Center's competence to satisfy each of them.

• The distance between researcher, the client, and the Center is an influential factor in a project's success. A closer relationship between any two parties increases the likelihood of frequent communications between them. These frequent communications not only benefit problem solving but also help to establish mutual trust between participants.

• University researchers' enthusiasm of becoming involved in the Center's projects can be encouraged through the university's tenure program and incentive system.

• The comprehensiveness of the university's research infrastructure which includes manpower and facilities, is critical to the Center's extensive technical services. The scale and scope of the Center's technical services depend upon the university's research infrastructure.

• The investment community's involvement in the Center's project selection process is essential to the commercialization of research results. The input from the investment community helps the Center to measure the commercial feasibility of submitted projects.
Section V. Conclusions

The findings of this study are as follows:

1. Less bureaucratic control results in greater operational creativity and effectiveness.

The study shows that less involvement of state government bureaucracy in the BFTC’s operation results in greater creativity and effectiveness at the Center. The Center was established in an innovative environment because the program’s chief designers in state government insisted that the program must be immunized from the influence of state bureaucracy and career politicians. This policy allowed the Center to create and test innovative means for carrying out its missions. As the Center’s executive director, Mark Lang, puts it, the policy “turned out to be a useful fact.” Over time, the policy has experienced several minor shifts as results of the changes of the state’s supervisory personnel. These policy shifts often created unfavorable constraints for the Center because new supervisors had the intention to raise the level of control over the BFTC’s operations. This generated inevitable conflicts between the BFTC and the new supervisors. Although the magnitude of the friction will ease over time along with the mutual adjustment of both parties, the unnecessary bumps along the road still “make us spend time to deal with that issue rather than spend all our time dealing with clients.” As the Center’s experience has showed, the less government control, the better the Center can perform.
2. The higher degree of adaptability to environmental change, the better the performance will be.

As an intermediate service agent, the BFTC is less likely to change the external environment and more likely to adjust itself to the external changes. Therefore, a critical strength an organization like BFTC has to have is an adaptability to environmental changes. The Center has recognized this, “One of our strengths is we actually have changed. We do things a lot different than we used to because the needs of the companies change.” The adaptation can be reflected in the expansion of scale and scope of services the BFTC provides. For example, the Center’s objective is the commercial success of a project. Academic or political success cannot guarantee that the project will bring profit to the state economy. Therefore, the BFTC’s purpose is to carry each individual project through the project’s life-cycle with assistance ranging from technology to marketing to finance and so forth. A new effort to solicit the investment community to invest in the Center’s projects, which started a few years ago, demonstrated the Center’s attempt to fulfill clients’ needs and provide its clients with a full range of services.

3. Entrepreneurship vs. Intrapreneurship

The study shows that the compatibility of culture between the BFTC and the clients is critical to the project’s success. One main characteristic of entrepreneurship is creativity, which could be demonstrated in functions ranging from product development to process improvement. The wide variety of creativity and the needs incurred by that creativity generate a demand for a broad variety of assistance needs which has to be matched by the BFTC’s services. It is difficult for an organization with a hierarchical,
bureaucratic culture to provide this type of assistance, but it can be provided by an institution with a creative, proactive, and intrapreneurial culture. The flexible organization structure design, intrapreneurial leadership, and empowerment management reflect the Center’s intention to match the cultural characteristics of its entrepreneurial clients.

4. The skeptical attitude toward government involvement in economic development has an impact on the Center’s operation.

The study shows that the suspicion created by government involvement in economic development has a great impact on the BFTC’s efforts to promote and enhance government-business-academe partnerships. The suspicion prevailing in the Reading area demonstrated that the BFTC faced an extra difficulty in promoting, connecting, and forging the three-way partnership in that region. Companies in the Reading area “think government should stay out of business.” This perception created a headache for the BFTC. “Most companies view government as not a friend. So if you are associated with government, it’s very negative; you have to overcome that. ...... So you’re coming from government, I don’t want to talk to you” [cited from the interview with Mark Lang]. This kind of obstacle stimulates the Center to deploy more attention to educate the public about the purpose, the contribution, and the distinction of the program. In other words, the Center has to solicit the public’s attention and support while performing its missions.

5. The technological infrastructure provider has a great impact on the BFTC’s operation.
The study demonstrates that the main technological infrastructure provider of the BFTC, Lehigh University, has a significant influence on the Center’s operations. The factors, which influence the operations, are the comprehensiveness of the technological infrastructure, the school’s attitude toward the involvement of its faculty in the Center’s technological development projects, and the school’s endeavor to encourage faculty to participate in those projects.

In this case, Lehigh’s contributions to facilitate the BFTC’s operations are not always positive. The school does have a comprehensive technological infrastructure which includes a wide variation of research manpower and facilities. The extensive infrastructure can fulfill almost all of the Center’s technical inquiries. Moreover, the school has a formal statement encouraging its faculty to participate in, contribute to, and serve industrial demands, which include the BFTC’s projects. However, Lehigh does not consider participation in BFTC’s projects in granting tenure to its faculty. To some extent, this policy may discourage the rate of participation among the faculty. Therefore, the Center is unable to attract the most qualified faculty to accept specific projects. This effect can be mitigated by the Center’s encouragement and the faculty’s enthusiasm to assist and to contribute to technology commercialization and economic development. Further, the school’s adoption of a proactive policy and a pro-business practice would be beneficial for both the Center and its clients.
References


Appendix

Questionnaire for Interview

List of Elements of Environmental Variables

Government

1. How did the PA state government affect structure and management practices of BFTC, in terms of critical managerial functions such as planning, control, structure design, staffing, direction, and public relations? How have these affects changed over time, and how have BFTC's structure and practices responded?

1a. What was state government's (Governor, the General Assembly, or other influential executive officials) attitude, in terms of support for, toward economic development through the efforts of BFTC? How did that affect BFTC?

1b. What were state government's supervision mechanisms? How did that affect BFTC?

1c. What were state government's evaluation criteria? How did that affect BFTC?

1d. How did state government's annual appropriation process affect BFTC?

1e. Are there any other ways haven't mentioned that state government has affected BFTC?

Societal-Culture

2. How did various aspects of societal culture affect the organizational structure and management practices of BFTC?
2a. What was the prevailing attitude in the general population toward relationships between government, industry, and university institutions? How did that affect BFTC?

2b. What was the prevailing attitude in the general population toward appropriateness of investing public money for the triad partnerships? How did that affect BFTC?

2c. What was the prevailing attitude in the general population toward entrepreneurship especially in the northeastern PA region? How did that affect BFTC?

2d. What was the prevailing attitude in the general population toward professional compensation rates paid through public funds? How did that affect BFTC?

2e. Are there any other ways haven't mentioned that societal-culture climate has affected BFTC?

Clients

3. How did various characteristics of clients in the northeastern PA region affect BFTC?

3a. Were prospective clients initially suspicious of BFTC? How did that affect BFTC?

3b. What was the level of technology sophistication of clients? How did that affect BFTC?

3c. What was the degree of cooperativeness of clients? How did that affect BFTC?

3d. What was the level of investment resources of clients? How did that affect BFTC?

3e. What were the type and level of assistance required by clients? How did that affect BFTC?

3f. What were the differences of characteristics between start-ups and existing companies? How did that affect BFTC?
3g. How many clients wanted to use your services? How did that affect BFTC?

3h. Are there any other ways haven't mentioned that clients have affected BFTC?

Technological Assistance Experts

4. How did various characteristics of the technological assistant experts affect BFTC?

4a. What was their attitude toward collaborative applied R&D? Did they weigh this activity considerably important to themselves? How did that affect BFTC?

4b. How versatile-range of tech-business disciplines covered-were they? How did that affect BFTC?

4c. What was their attitude toward the ownership of proprietary technologies generated from the services they provided? How did that affect BFTC?

4d. Were the experts committed to this kind of service or not, or was it just another job? How did that affect BFTC?

4e. Were such experts readily available, or were they in short supply?

4f Are there any other ways haven't mentioned that technological assistant experts have affected BFTC?

Lehigh University

5. How do various aspects of Lehigh University affect structure and practices/policies of BFTC?

5a. Do university governance or administrative processes or procedures affect structure and practices of BFTC? how?
5b. Do university academic norms and values affect structure and practices of BFTC? how?

5c. Was the university’s technological or R&D infrastructure sophisticated enough to carry the requested assistance? How did that affect BFTC?

5d. Does the nature and extend of technological specializations at Lehigh affect BFTC? how?

5e. Are there any other ways haven't mentioned that Lehigh has affected BFTC?

Investment Community

6. How did various aspects of the local investment community (venture capitalist, local banks, government pension fund, etc.) affect BFTC?

6a. What was the investment community's attitude toward small, technology based venture opportunities? How did that affect BFTC?

6b. What was the investment criteria the investment community used to assess BFTC's projects? Are there any variations among them? How did that affect BFTC?

6c. How much investment capital was available? How did that affect BFTC?

6d. Are there any other ways haven't mentioned that investment community has affected BFTC?
Biography

of

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Publications:


Yan-Ming Shu. Fracture Behavior of Tetragonal ZrO2 Polycrystals, 06/89, Master thesis.


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