A Study of the Philadelphia Knowledge Economy

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A local civic organization, Greater Philadelphia First, engaged us to study the knowledge economy of the Philadelphia, Pennsylvania region and make recommendations on ways to improve its rate of growth. To structure our thinking and the interviews with local entrepreneurs, civic leaders, and others, using soft operations research techniques, we developed a framework for collecting ideas through interviews, generating our own by reflecting on the interviews, and organizing the resulting ideas. We generated a large number of useful ideas for improving the local knowledge economy. The organization sifted through the collection of ideas and selected the ones it is now advocating.

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A local civic organization, Greater Philadelphia First (now merged with the Chamber of Commerce), engaged us to examine the state of the knowledge economy of the Philadelphia, Pennsylvania region and to make recommendations for accelerating its growth. In this project, we built no models and used no algorithms, the stuff of hard operations research (OR). However, we used our analytic skills and the soft OR approach for understanding systems to guide our thinking. Rosenhead (1989) was helpful in framing our ideas. In many real situations, the hard part of the job is recognizing what the problem is, not the analytics of solving the problem. This study is an example of trying to understand the problem.

The reason for the study was the desire to find ways to improve the growth and vitality of Greater Philadelphia. During the decade prior to the study, the Philadelphia region was the slowest growing metropolitan area among the largest 15 in the United States (http://www.census.gov/population/cen2000/phc-t3/tab03.txt), surpassed even by Detroit, Michigan. Job growth averaged only 1.24 percent per year from 1992 to 2001 (Crone 2001). The size of the region’s economy is now below that of Atlanta, Georgia and only slightly larger than that of San Jose, California. Compounding the problem, Pennsylvania is second only to Florida in the percentage of population over the age of 65.

Philadelphia once was a technology center and in many ways still is. In 1900, the city had manufacturing in more Standard Industrial Classification codes than any other city in the United States. Philadelphia was also one of the major centers for the electronics revolution from the early through the mid 20th century. The region was a leader in the early electronics revolution in radio and television. The first working computer was built at the University of Pennsylvania, and the developers of that computer founded the world’s first computer company, Univac, now Unisys. The region was and still is a major center in the chemical and pharmaceutical industries.

The questions are why has the region grown more slowly than the United States as a whole and what can be done to improve the region’s prospects? To look for answers, Greater Philadelphia First put together two teams. One team interviewed business and civic leaders in selected cities around the country to understand what they did to spark growth in their areas. Greater Philadelphia First asked us to understand the structure of the local knowledge economy...
and make recommendations that could potentially reignite growth in the region. We interviewed local venture capitalists, experts in the local economy, scientists, engineers, entrepreneurs, government officials with development interests, and leaders in the local nonprofit community. The two teams complemented each other: we focused on processes that lead to new technology businesses from the technologists’ perspective, and the other team looked at the leadership qualities needed to turn ideas into realities.

Validity
We were concerned with questions of validity, engaged as we were in interviewing a convenience sample of about 50 people regarding a diffuse, economically important, and emotionally and politically charged topic. Two strategies can foster validity, versus proceeding intuitively and hoping for the best. First, one can do everything possible to obtain a valid sample of respondents, a valid instrument for querying them, and carefully designed and vetted data-collection protocols. Our circumstances did not afford us these luxuries. In this regard, our circumstances were no different from those of all similar studies we are aware of. The second strategy, which we used, is to structure the goals of the project in such a way that the methods available are more or less appropriate.

The question we posed and addressed in the study was not “What should Greater Philadelphia do to foster economic growth?” This question can be answered only after careful scientific, economic, and political vetting. Instead, we asked, “What ideas ought to be investigated for helping the region foster economic growth?” With this question we reduced the influence of sample and personal biases. We reframed the study from asking the interviewees to collectively vote on what should be done (too often implicitly accepted in studies like ours) to asking the interviewees to propose good ideas for subsequent evaluation by the greater community. The risk is that those interviewed missed good ideas for any of a variety of reasons. But if in fact they come up with some good ideas, the study will be valuable for engaging creative thought and deliberation. We produced a long list of plausible ideas for improving the economic prospects of the Philadelphia region, and indeed of any region.

Developing a Framework
We first developed a framework for organizing our thoughts, questions, and the information we gathered. We did a systems study with a strong sociological component, recognizing the value of economics in describing incentives. We used economic data to gauge outcomes and extended some of the notions of business-process analysis to look at the “supply chain” from science and technology to commercialization. Game theory concepts helped us to look at interests and intentions and analyze relationships among people and organizations, as did social-network theory (Monge and Contractor 2003).

We drew upon the soft-systems methodology to frame the problem, structure our interviews, and connect the different frameworks we used (Checkland 1999). Specifically, the acronym CATWOE from soft systems was very useful in structuring the questions we asked each interviewee. CATWOE stands for

- Customers, the beneficiaries or victims of the system;
- Actors, those who can make decisions;
- Transformation of inputs to outputs, the processes that lead to outcomes;
- Weltanschauung, world view;
- Owners, the people who are responsible for the processes; and
- Environment or constraints outside the scope of the system.

Because we were dealing with a large and heterogeneous political and economic system and not an organization, the decision making is diffuse and the parties involved and affected are diverse with their own perspectives and agendas. Thus, we could not look for an organizational objective. We looked at setting a social agenda. We took the customers to be the members of local business and political communities who want to see growth.

The actors fall into two groups, those engaged in such areas as science, technology, and startups and those who affect the environment in which the science and business communities operate, politicians and heads of nonprofit organizations. We had to understand the former to make recommendations to the latter. The transformations we examined were the creation of scientific knowledge and invention of new
technologies and their conversion into new businesses. These transformations are processes that depend on individual actions of people that cannot be directed by a controlling authority. So, our focus was on improving the environment. Because of the inevitably large random component, we looked at ways to increase the odds of success at each main step in moving from science and technology to new business. Because these steps include processes that depend on the ways people conduct their lives, we also had to look at the life stages of people and the choices they make as part of the system.

Sociopolitical systems such as the one we studied contain many actors operating in different components of the system with knowledge and views based on their experiences and interests. Recognizing this, we structured our interview questions to first elicit their views of their activities, their part of the system, and the system as a whole followed by their views on the people who can influence the functioning of the system. We then asked them their ideas for improving the system, especially their part of it.

One of the most notable features of the project was how many world views were valid for each component of the system. The scale of the system is very large; the region has a population of 5.1 million in the nine-county Primary Metropolitan Statistical Area and, according to the former commerce director for Philadelphia, around 180,000 businesses. Consequently, gathering information requires collecting a greater diversity of views and interests than in the normal corporate situation. The marginal value of each interview did not begin to decline until we had conducted over 40 of the 50 interviews. Each view was relevant and thoughtful but shed light on only a piece of the puzzle.

Because we were dealing with the local socioeconomic rather than with a single organization, as part of the puzzle, we needed an approach to understand the roles of the various players and their potential areas of conflict and cooperation. The approach, based on game theory and outlined by Brandenberger and Nailbuff (1996), is a useful guide for understanding the areas of cooperation and competition among various players. In their approach, one looks at the relationships among such groups as customers, suppliers, complementors, and competitors. In relation to any one organization, other organizations can play multiple roles. For example, in one sense, venture capitalists are competitors because they compete for the lead in good deals. However, to spread the risk, they want other venture capitalists to take pieces of their projects. Furthermore, their deal flow depends on information exchanged with other venture capitalists. Development officials for local governments compete with each other for local companies. However, they need to cooperate because their ability to attract business also depends on the overall health of the region. As another example, one thinks of heads of nonprofits as cooperators focused on the common good. However, they may compete for funds, status, and recognition or, alternatively, form alliances among themselves, depending on circumstances.

The external environment also has multiple dimensions that can function as assets or liabilities. They include location, natural resources, amenities, and social environment. Because amenities are important to knowledge workers, the physical, economic, and sociological environments are all important. The opportunity to foster growth in engineering research has been limited. The end of the Cold War led to cuts in defense funding and to lower growth in funding for engineering research in the United States, although the current expenditures on homeland security are creating new opportunities.

Life-sciences research has been growing dramatically. Yet, information and computing technologies and engineered medical devices are becoming more important research and product areas, and they draw on engineering expertise. Innovation may come via science or engineering, broadly construed, including the medical arts. The path need not be linear from science to engineering to product. Nothing in our framework requires linearity. In fact, our preferred view is of virtuous cycles where improvements in any one step can lead to improvements in other steps.

As regional agencies move beyond the simple but expensive strategies of buying factories with tax incentives and grants, their actions may not directly connect with the positive outcome of growth, yet may be very effective in providing an environment for growth. Founding businesses and making life decisions are individual choices that are random from a policy perspective, and no development agent can
pick winners with any surety. A specific technology horse is out of the barn before any politician, economic-development official, or university president is aware of it.

Consequently, strategies that rely on picking winners have low odds of succeeding. Strategies that focus on improving the processes that generate new businesses are more likely to engender growth. All that regional leaders can do is create the environment and opportunities that encourage technologies to take off locally. What environment is right depends in good part on how individuals make personal and career decisions. It should give people the opportunities to interact and generate ideas that become businesses. This is our root definition in a soft-systems sense.

Along with social networks and soft-system methodology, another relevant subject is the basics of economics. A region or nation can grow using only three means: increasing inputs, achieving greater efficiencies in using existing resources, and increasing innovation. We looked for opportunities to improve growth using all three means for the region.

We developed three components in a framework for the choices people make and the interactions that lead to innovation. The first component is the path that people take in their life choices, decisions on where to live and whether to start new businesses, the personal path. The second is the path that includes the steps from scientific discovery to technology and new businesses, the knowledge-business path. By tracing the personal and business paths, we can articulate decision points where the region can improve the aspects of the environment that influence personal and business choices. The third component includes the ways in which the structure of local institutions and people in them can help people interact productively or, as is often the case, can hinder economic opportunity, the communities model.

**Personal Path**

People who run science and technology businesses base their location decisions on concerns about people and knowledge and not natural resources or logistics. Consequently, to increase the talent in a region, one has to enhance those factors that make a region attractive to scientists, technologists, and potential entrepreneurs. To do this, one must take into account the perspectives of the people that the policy makers want to influence. In Philadelphia, the Pennsylvania Economy League (2000) analyzed ways to build on the region’s educational institutions.

The personal path we describe is a useful device for looking at life choices or circumstances and what the region can do to influence people’s choices at each stage in their lives. It does not describe the general population. Instead it describes the decisions made by the highly educated segment of the population working in professions, science, and technology. A typical path of a professional begins with a career focus and subsequently includes noncareer activities, such as building a family. The steps we use in the path are (1) college, (2) first job or graduate school, (3) try a startup, (4) family years, and (5) mature career.

An important trend in college education in the United States has been the evolution towards a national market for colleges and universities that parallels the increased interregional mobility of the population. In the 1950s, college applicants tended to look locally, no matter what their ability. The evolution to a national hierarchy is exemplified by the increasing interest in ratings by such magazines as *US News and World Report*. The most talented students are the most mobile and look at colleges based on their national rankings. Areas that have many top-ranked colleges, such as Boston, have become attractors of college students, which improves the student quality even at the less prominent schools.

Students and recent graduates want to congregate with others like them in places that allow for many alternative lifestyles (Florida 2001, 2002; Glaeser et al. 2000; Pennsylvania Economy League 2000). Once young adults develop friends and families in a location, they lose mobility. One economic and social trend is the increasing importance of graduate or professional education beyond the baccalaureate. Strong graduate and post-baccalaureate certificate programs have become important attractors for young adults.

Career-focused graduates typically base their decisions on where to live on career opportunities, although amenities also enter into their decisions. This has the flavor of what is termed a convention equilibrium, in which a business sector tends to concentrate where the business sector concentrates. Because young
adults do not have ongoing personal financial commitments, except for student loans, they have lower risks and costs of failure than older people, and the age group is a major source for entrepreneurs, especially those creating informal start-ups. They are likely to create new businesses when major technology shifts occur, as in the early days of the personal computers.

Entrepreneurial activity is actually quite common. Aldrich (1999, p. 75) states that in each year four to six percent of adults engage in activities related to starting a new business and over their lives 40 percent of adults in the United States are self-employed (voluntarily or not) for some period. Only half of the nascent entrepreneurs starting new businesses succeed, and only 10 percent of new ventures grow.

In fields that require long maturity and experience, such as life sciences or health care, midcareer adults are the population most likely to found new businesses. Also, successful entrepreneurs often become serial entrepreneurs. As one interviewee noted, entrepreneurship becomes your expertise. What attracts these midlife entrepreneurs is the opportunity. Successful entrepreneurs late in their lives may become mentors to new entrepreneurs and improve the odds of new start-ups succeeding.

Knowledge-Business Path

By understanding the knowledge-business path, a region can increase its knowledge businesses through improving the processes that lead to knowledge businesses. Regions that are successful in developing knowledge businesses are also centers for research on the processes that lead to knowledge businesses, and they develop prescriptions for ways to improve the processes in this path. Such regions are the Research Triangle area in North Carolina that includes Chapel Hill, Raleigh, and Durham; Boston, Massachusetts; Washington, DC.; and the San Francisco Bay area in California.

Science is about discovery and theory, while technology is about application and innovation, that is, the invention of new products and processes. The two areas have different mind-sets. Scientists know what is known and are curious about what they do not know. They are driven by a need to understand. They know where they are but not where they are going. Technology has a different focus. Engineers start with a goal and know where they want to go. When they begin, they do not know how to get there. Engineers and entrepreneurs define goals by recognizing unsatisfactory situations or things. Petrofski (1992) explains their methods, particularly in his discussion of the evolution of the fork.

For centuries, science has played an important role in the development of new products. For example, organic chemistry developed hand in hand with the petrochemical industry, and discoveries in physics produced electronics and modern communications technologies. Efficient innovation systems that shorten the time from science to product keep science and technology in close proximity so that they can feed off each other (Narin and Hamilton 1997).

One of our interviewees opined that it takes around a billion dollars of research to produce a discovery of major commercial value. Consequently, the more research a region has, the higher the odds that someone will make a major commercial discovery. Almost all of the regions in the United States that are growing faster than the country as a whole have major federally funded research centers, such as large national laboratories. Examples include Austin; Boston; The Research Triangle area in North Carolina; and the San Francisco Bay area. The fastest growing regions have embedded these centers into the local knowledge economy rather than kept them isolated as ivory towers. The greater a region’s research activity, the more it knows about major discoveries and innovations in other regions as they occur, and the more likely it can capitalize on that discovery if it has the infrastructure to do so.

Organization has played a critical role in enhancing the rate of innovation. Edison’s invention of the research laboratory (Israel 1998, p. 119) was an organizational innovation. (Henry the Navigator is usually granted bragging rights for creating the first successful large-scale research and development organization in the 15th century.) Understanding the structure of networks of researchers and businesses that reach beyond individual organizations is now an important area of research into the efficiency of idea generation. (See Mansfield 1998, Owen-Smith et al. 2002 for an illustration of this in biotechnology, and Saxenian 1996.)
Since World War II, the time between discovery and product has been shrinking as the move from science to product has become better organized, although the organization remains a network of relationships, rather than a formal entity. Organizing innovation processes around social structures turns out to be more efficient in generating activity in new areas than relying on formal organizations, which have formal decision hierarchies in which a few senior managers can block important innovations. The regions that innovate in ways that improve the process of linking science, technology, and business problems are the future growth regions.

We have articulated a complex set of interactions that form the knowledge-business path, connecting science, technology, and business. Ideas move along this path in two directions, from science (or engineering) to business and from business to technology or science. Ideas can cycle among the steps until a viable business emerges. As with the personal path, the knowledge-business path can reveal where policies can have an impact.

In the knowledge-business path, discoveries lead to insights that feed new applications. The path often leads to whole new business areas as it did with plastics and electricity. The path can lead to new ways of doing existing activities, for example, fiber optics in telecommunications. The steps in the science-business path are (1) discovery or science, (2) technology, (3) start-up, (4) rapid product evolution, and (5) stable business.

A variant of this path starts with business or government problems rather than scientific discovery. People with problems search out people in technology or science for solutions. Starting with business problems usually implies that the innovations enhance existing industries. However, whole new industries may result. The oil industry began when Colonel Edward L. Drake asked Benjamin Silliman, a professor of chemistry at Yale University, to develop a method for separating crude oil into its constituent parts. The military funded the development of early computers because it needed to calculate bomb trajectories. The Internet developed out of a sequence of needs beginning with the government’s need to reduce the cost of funding computing research (Segaller 1998). Except for the source of the initiating problem, the path is the same from Step 2 on. The technology-business interaction can strengthen existing firms or result in new industries.

Much of what is written about the knowledge economy focuses on the knowledge-business path starting with science. However, much of the growth in the Washington DC and Northern Virginia area comes from the variant of the path that is driven by government needs. Furthermore, the industrial liaison offices at Massachusetts Institute of Technology (MIT) and Stanford University, which identify knowledgeable faculty for businesses that have technical problems, have been important sources of growth because they improve the processes of connecting problems with technology.

A whole range of innovations drawing from many different disciplines may be necessary for a technology to work. In a comparative analysis of the organization of research in the United States and Europe, Owen-Smith et al. (2002) found that the European research institutes’ specialization in subject areas limits cross-fertilization, and thereby the productivity of the European research system. In comparison, the US universities operate as broad research centers that facilitate cross-fertilization. The institutions manage people and innovation processes instead of focusing on specific technologies.

To convert science to economic gain, a region needs a research community that is pragmatic or connected to pragmatic people. In Philadelphia, the biosciences community is very strong. For example, the region has three National Cancer Institute centers of excellence. However, it has no nationally recognized engineering program to foster a pragmatic engineering culture.

Aldrich (1999) notes that most new businesses are incremental rather than novel additions to the economy. New technology businesses require both entrepreneurship and a knowledge of the technology. This requires a mix of entrepreneurs, technologists, and scientists, or people who have both technical knowledge and an entrepreneurial spirit. Start-ups tend to occur where the science or technology is developed. Segaller (1998) describes the interactions that led to the development of the Internet.

Start-ups come in two forms, garage start-ups and formal organizations. The difference between the two
is the amount of money needed to start a company. Apple, Google, and Yahoo are famous garage start-ups. Examples of formal start-ups are Genentech, Amgen, and Centocor. It is no accident that our examples of garage start-ups are in information technology and formal start-ups are in biotechnology. When developers can do the work nights and weekends or during school, garage start-ups predominate.

When start-ups require large amounts of capital for equipment with revenues that lag expenditures by years, they need venture money, and venture capitalists invest in formal organizations with business plans. Products in life sciences require testing and formal approval, which are expensive and require long lead times. Often the entrepreneur’s goal is not to build a permanent business, but to develop a therapeutic drug or device and then sell out to a major pharmaceutical or medical-technology firm. The costs of setting up a marketing organization to reach physicians is expensive, and the odds of a second product success typically are low, probably no better than the odds of the first success. Occasionally, such start-ups grow internally or acquire other firms and become major companies. Examples are Amgen in California and Cephalon in Philadelphia. Because different types of businesses require different starting conditions, one cannot set broad prescriptions for encouraging start-ups.

Because founding a business entails taking risks, entrepreneurs need risk-management strategies to start companies and minimize the consequences of failure. Having a fallback position makes it easier to start a company. Most important is being able to find work if the venture fails. Founding a business where many similar businesses exist improves the job prospects for the entrepreneur and the employees if the start-up fails. Venture-capital markets spread the financial risks of start-ups.

New companies need a range of support services, including lawyers, accountants, and advisors. Companies that make it through the rapid growth phase tend to become more self-sufficient and less dependent on outside support services. Several interviewees noted that such mature firms form much of the technology sector in the Philadelphia region. For pragmatic reasons, senior managers tend to locate these companies in office parks in the suburbs, and they do not contribute to vibrant technology communities. They also tend to focus on ongoing operations rather than development of new technologies, and they often become isolated from the sources of the new technologies.

Networks of local businesses become less important for businesses as they mature than national and international networks in their industries, and local networks atrophy long before the company or region declines. Because mature companies in mature industries dominate the Philadelphia region, the region has weaker business networks than the newer technology centers. Thus, a region can have a virtuous cycle of start-ups, making it easier for other start-ups to succeed through a more connected community or a negative dynamic of a lack of start-ups leading to a disconnected community that makes it more difficult for new ideas to become businesses.

The steps in the knowledge-business path differ in importance for different industries. Biotechnology is largely science driven, with nonprofit research laboratories developing most of the basic science. The technology component of biotechnology consists of developing methods for producing and delivering the newly discovered molecules. For most computing-related activities, technology is more important than science, and companies typically perform the relevant research as part of product development. One has to be careful about making generalizations because, for example, medical technology can be too narrowly defined as therapeutic drugs, but artificial body parts and measurement devices are part of the medical-technology world, and bioinformatics is one of the fastest areas of growth in medical research.

**Communities Model**

Two kinds of communities are essential for a healthy local economy, the formal communities of businesses, universities, nonprofits, and government agencies
with established patterns of interactions and the informal communities of collections of individuals with a mixture of chance interactions and established personal relationships. Formal communities evolve out of informal communities and develop institutions that facilitate their activities, such as chambers of commerce, when the informal communities have lasting reasons to continue. For example, the New York Stock Exchange, which is owned by its members, started out informally “under the buttonwood tree.” One can facilitate the growth of informal communities by improving the odds of people making connections. MIT holds events to mix students and entrepreneurs. At these events, people wear name tags whose different colors represent what they bring: ideas, skills, management, or money. The kinds and levels of interactions a region fosters through its geography and institutions have a major impact on the extent to which people create new science and invent new technologies and then apply this science and technology by forming businesses.

Social Networks

Social networks connect people and groups, and the theory of social networks describes these connections (Monge and Contractor 2003). Owen-Smith et al. (2002) describe a social network linking biomedical research centers. It includes dense connections between Boston and the San Francisco Bay area, while Philadelphia is relatively isolated. Aldrich (1999) notes that an indicator of the likelihood of a start-up’s success is the extent of the founders’ social networks. One of our interviewees traced scientific networks and the ways ideas evolve. He found that the most successful biotech start-ups develop in the vicinity of the scientists at the center of the social networks that develop around the relevant scientific subjects.

The primary aspect of companies and markets that economists study is competition, that is, companies in conflict. Yet, in reality companies have many different relationships (Brandenberger and Nailbuff 1996). Overly competitive companies can hurt themselves. Saxenian (1996) did a study of the computer companies in Silicon Valley versus those around Boston. The Silicon Valley firms now dominate because programmers across companies were willing to help each other with programming problems while the Boston firms operated as silos, and their senior managers explicitly discouraged interactions and sharing ideas across firms. Scientists are embedded in a community that seeks to share knowledge. Yet scientists compete to be first in making new discoveries.

The associations that businesses form represent common business interests in public forums or facilitate business activities. In the Philadelphia region, PABIOTECH lobbies for the biotech industry in the state and operates a joint purchasing group for research supplies, lowering the costs of running businesses. Associations can also make markets. The standard economic model says that venture capitalists are in competition for the best deals. However, their interests are better served through cooperation than through competition because of the value of shared information. They need each other to find and evaluate deals, and they share the risks by taking pieces of new ventures. Because some venture capitalists are more expert in certain areas than others, they take the lead in evaluating opportunities in their areas of expertise and bring in others to share the risk, creating joint gain. Regional venture associations organize new-venture fairs so that entrepreneurs can present their business plans to venture capitalists and strike deals. Associations also provide meeting places for people in an industry to develop relationships and exchange information, facilitating the smooth functioning of labor markets.

Universities have a long-documented role to play in regional growth beyond the obvious roles of producing graduates and conducting research. Despite the demise of many of the high-technology firms in the Boston area, such as Digital, Wang, and Prime, that region has remade itself with a new collection of firms because of research conducted at its universities. In a healthy environment, a university’s relationship with the business community is symbiotic. Companies can grow by drawing on the reservoir of talent in the universities. With their profits, they can support the growth of the local schools, deepening the reservoir of local talent. How well the universities aid in regional growth depends on their openness to entrepreneurs and their willingness to support research in areas important to regional industries as opposed to operating in isolation in ivory towers.
Furthermore, local businesses should feel connected to the local universities either through informal relationships or through something like an industrial liaison office.

The symbiotic relationship between universities and businesses in science and technology is exemplified in the connection between Yale University and the oil industry. Because of the connection between Yale and Colonel Drake, New Haven, Connecticut became the center for financing the early oil industry. Some of the largest financial contributions to Yale in the first half of the 20th century came from alumni who went into the oil business in its early years. Similarly, Stanford University is now benefiting from large gifts connected to its role in the development of computer technology in Silicon Valley.

Scientists think of themselves as members of the scientific community. One of our interviewees charted the formation and dissolution of science communities around research areas by examining publication patterns. The efficiency of the scientific community in transmitting discoveries and the methods for producing discoveries determines the rate at which science progresses. An interesting question is whether colleges and universities in a region can break out of their silos and improve the effectiveness of the local scientific community.

Foundations can support amenities that bring people into a region, fund the studies that lead to regional growth plans, build the stature of educational institutions, create knowledge communities, and experiment with new ideas. If they function effectively, they can become catalysts for new ideas and activities in a region.

Government has an important role in fostering a healthy business community while meeting the needs of its citizens. It does this by developing transparent rules under which businesses operate, simple licensing procedures, and tax structures that allow local companies to compete with companies in other locales. World Bank studies show that the developing nations that grow the fastest are those with clear rules, fair taxes, and honest governments (Ouattara 1999, Islam 2002). The same criteria apply to political units of developed countries. Most of the comments our interviewees made about city government were negative statements about the costs and difficulties of operating in the city. They were slightly more positive about suburban governments.

Governments also set incentives through their policies. For example, the Bayh-Dole Act of 1984 gives the intellectual property rights of discoveries funded by the federal government to the research institutions that make the discoveries. Prior to this, the discoveries were in the public domain. Innovations in the public domain are often orphaned because no property rights are associated with them. The change gives researchers and research institutions incentives to market their discoveries and technologies.

How these institutions and their members interact is one of the determinants of the health of the business climate. Universities can wall off their activities or they can connect with local businesses and governments. Members of the business community can be insular with little interaction or they can mix and mingle as they do in Silicon Valley. Governments can open up to new ideas or operate as closed, bureaucratic institutions. The formal communities set the environment for the informal communities that lead to the random events that result in new start-ups.

**Policies and Prescriptions**

The full list of suggestions for possible actions that we collected is on the Greater Philadelphia First Web site, www.gpf.biz, and at http://opim-sun.wharton.upenn.edu/~sok/sokpapers/2001-2/gpf/shortreport20011004.pdf. The actions fall into two main categories, those that focus on institutions and those aimed at improving local social networks. We categorized policies by the source of improvement: greater efficiencies, more resources, and more knowledge, and location on the personal or business paths. Our main prescriptions for Greater Philadelphia First are to focus on the processes embedded in the paths and communities model and the environmental elements that affect decisions on the paths and interactions in the communities and to look for ways to improve processes and the environment rather than try to pick technology winners.

For efficiencies, our first recommendations have little to do with technology or science. A region should put its house in order and focus on the basics of good government instead of trying to pick winners.
Locally focused colleges should offer programs that reinforce local strengths. The colleges and universities in the region should engage in group marketing. By making the region more attractive to college students, they can increase their number and quality. To create technical breadth in the region, the universities should coordinate their hiring to encourage cross-university research teams. Doing so would be especially helpful in medical research. One of the existing universities’ main problems is their shortage of resources to support strong graduate programs in a broad range of technical areas, which they need to create effective research communities. If the region were to pool intellectual resources across institutions, it could strengthen research programs and make the schools more attractive to new faculty. This last suggestion is a very radical idea. However, it is not an impossible goal. At the very least, the region needs to organize consortia for managed research as vehicles for garnering research funding.

Organizations can create efficiencies by examining and improving processes. How others perform similar processes is essential information for these investigations. The region needs to benchmark the performance of its institutions with that of their equivalents in other regions both in effectiveness and in processes. Furthermore, the region should continually study the processes for forming technology industries and continually improve them.

The region needs to increase financial inputs. It does well in obtaining funding from the National Institutes of Health (NIH). However, it is the largest metropolitan area in the country without a federal research institute. Also, the growth in funding for medical research has slowed at several institutions. The reason is simple. NIH does not cover the cost of buildings in its research grants. That money has to come from other sources. With the squeeze on hospital profits, traditionally a major source of construction money, new construction has dried up at several institutions, slowing the growth in research. Because of the local direct benefit from the expenditure of research dollars, the local and state governments should subsidize laboratory construction. Foundations could also play a greater role. The region would benefit from a greater number of active venture funds, because they tend to invest locally, especially in early-stage funding. Venture funds from other regions have begun to set up branches in the Philadelphia area.

The largest local foundation, the Pew Charitable Trusts, spends most of its money outside the region. What it does spend locally goes mainly to the arts. None of the local foundations support serious economic development activities. This lack of support is one of the main factors holding back the region, because regional foundations are the only real source of money to address regional issues. For example, when we looked at the research on knowledge-economy development and metropolitan benchmarks, none of the researchers in the field lived in the Philadelphia region. The region needs to support research on the processes that foster new knowledge businesses because understanding research processes leads to novel development strategies.

Not all knowledge and research promote economic growth. Essentially, the main Philadelphia-area foundations spend on consumption knowledge (arts and social issues). They spend nothing on investment knowledge for enhancing growth (science and engineering). The local universities are better known for their business and law schools than for their nonmedical science and engineering schools. Regional leaders must understand that not all university research has the same impact on the regional economy. The region needs to boost its expenditure on investment knowledge in science and engineering.

Probably the most important goal should be to build the right kinds of social networks. This means creating the environment, institutions, and events that bring people together and draw and hold talent. An important source of stimulation for good research and product ideas is companies asking researchers hard questions. The region has no mechanism to link companies with researchers. MIT and Stanford have very strong industrial-liaison programs. Philadelphia needs equivalent programs. MIT also sponsors networking events where people with innovative ideas can meet people interested in investing their assets in start-ups. Organizations in Philadelphia could fund regional research meetings where researchers could find each other. Local foundations could fund a visiting innovators program and a competitive chairs program, modeled after the Howard Hughes medical researchers.
One novel idea that came out of the interviews is to conduct bright-idea contests that bring people together. For example, the city could hold a competition for the best solution to repair potholes. Finally, one could compare Philadelphia associations with their equivalents in other regions in terms of building social networks and determine the best practices in network building that go on in other regions. The economic health of a region or a neighborhood is best measured by the strength of its social networks because the level of connectedness is a good indicator of where the region or neighborhood is going.

Conclusions

We brought to bear on our study two innovative, intertwined approaches. First, based on the literature, we developed a comprehensive framework for thinking about regional economic development and activity and conducting our interviews. Second, instead of asking our interviewees to vote on what to do, we asked them (in the context of our framework) to propose and comment on specific ideas, or policy initiatives, that plausibly might improve the region’s economy. The results were gratifying. The framework we developed focuses people’s thinking on problems, bottlenecks, and leverage points in the knowledge economy. Asking for specific ideas produced a rich and constructive list of more than 50 promising, realistic, and detailed policy initiatives.

We did a systems study, using the soft-systems methodology, building a framework for organizing thoughts about knowledge-industry development that also helped us to communicate what we learned. We used notions from several disciplines because no one discipline provides a complete view. Looking at the processes from both sociological and analytical perspectives helped us gain insights into the region that our sponsors found quite revealing. We had no expectations of building a mathematical model. We understood our job to consist of defining and structuring the problem and collecting alternatives for action rather than offering any closed-form solution. Most of the ideas in the report are not novel. However, we incorporated them in a framework that puts them in context and establishes their relative values.

Our main recommendation for Philadelphia and other regions is to avoid cookie-cutter solutions and unidimensional solutions. A region should benchmark itself, using the framework we presented and the personal and knowledge-business paths and communities model to find and address its strengths and weaknesses relative to other regions.

Greater Philadelphia First, now part of the Greater Philadelphia Chamber of Commerce, selected ideas from the list of ideas we compiled and is working in the region to implement them. Along with the results of our study, it has used results from the studies of eight other regions and task forces on life sciences and research and development. It also ran a focus group on quality-of-life issues. An immediate benefit of our report is some consciousness raising in the region. The Chamber of Commerce is using its position to work with other organizations on a range of issues. For example, it is working to expand the flow of federal research and development dollars, which increases the inputs. Included in this effort is an attempt to get a federal research facility located in the region. It is shaping the activities of the state-funded regional greenhouse that helps create start-ups in biotechnology (increasing efficiency). It is also trying to increase university-business connections in science and technology. It is engaged in a program to promote the entrepreneurial climate (improving the social networks), which includes recognizing entrepreneurs and improving entrepreneurship programs in local universities. It is using our study and the focus-group results to improve some of the quality-of-life issues for infrastructure and amenities (career life cycle). One of its actions is to streamline and rationalize business-oriented nonprofits to reduce wasteful competition, for example, by merging Greater Philadelphia First with the Greater Philadelphia Chamber of Commerce.

References

Karen J. Hanson, PhD, Managing Director, Greater Philadelphia First, 30 South 17th Street, Suite 1520, Philadelphia, Pennsylvania 19103-4097, writes: “This letter is to confirm that Greater Philadelphia First engaged Steven Kimbrough and Frederic Murphy to undertake a regional assets and liabilities inventory and that this inventory proved very helpful in formulating our strategy for regional growth and development. An especially valuable feature of the study was its organizing framework, which helped us to evaluate the potential benefits of ideas that they and others generated.

“Based on the studies we commissioned, in January 2002 our Board of Directors adopted Six for Success, a strategy that commits Greater Philadelphia First to provide leadership to:

1. Attract more research dollars and expertise
2. Implement strategies to accelerate science and technology commercialization
3. Promote an entrepreneurial climate
4. Launch a business marketing campaign
5. Leverage quality-of-life infrastructure and amenities
6. Streamline and rationalize business-oriented nonprofits

“While many of the ideas included in Six for Success are not new, joining them in this manner has produced a strategy that “makes sense,” a direct influence from findings in Fred and Steve’s research. Their interviews generated a wealth of ideas and viewpoints that we have found valuable. And again, their organizing framework has been very helpful in sorting out specific choices and providing coherence to our program.”