# A new direction for technology-based economic development

## The role of innovation intermediaries

**Richard A. Bendis, Richard S. Seline and Ethan J. Byler**

***Abstract:*** *Accelerating innovation to drive economic growth is the foremost goal for technology-based economic development organizations today. Realizing this goal through programmes is challenged by limited and outdated operating models. The authors outline their 21st Century Innovation Intermediary model, which pairs commercialization with regional connectivity to accelerate innovation for regional economic growth.*

***Keywords:*** *innovation intermediaries; regional development; technology-based development; innovation competitiveness; new economy*

*Richard A. Bendis is President and CEO of Bendis Investment Group LLC, 2600 Centre Square West, 1500 Market Street, Philadelphia, PA 19102, USA. Tel:+1 215 496 8102. Fax:+1 215 977 9618. E-mail: rbendis@bendisig.com. Richard S. Seline is the founder and Principal of New Economy Strategies LLC, 1250 24th Street NW, Suite 300, Washington, DC 20037, USA., and Ethan J. Byler is a Project Consultant with New Economy Strategies.*

Technology-based economic development practices have a long history in the USA. Initiatives based on the use of technology as a platform to develop strategies for the economies of regions, focused on specific industry clusters, date back to the 1980s. Twenty-five years later, the effects of these initiatives can be seen in such regions as Silicon Valley in California and Route 128 in Massachusetts, among countless others. Most regions now understand and promote their leading technology-intensive industries and have focused their economic development (ED) efforts so as to exploit their comparative advantages. However, new paradigms are changing the demands of regional competitiveness and will require new practices in ED. The most notable of these is the formation of innovation intermediaries, or regional entities which align a region's technologies, assets and resources so that they come together to produce effective innovation. This article explores the shift from the first technology-based ED programmes to today's imperative for the 21st century innovation intermediary, and elaborates the components needed for a successful operating model. In the article we use the term 'region' loosely, but the model presented is applicable to both states and countries.

### Historical context

Technology-based ED programmes and institutions were pioneered in response to emerging challenges to the USA's industrial competitiveness in the early 1980s.

The nation's prominence in a number of industries was falling with the growth of foreign rivals, shrinking productivity and increasing unemployment. The majority of experts, including the well-known MIT Commission on Industrial Productivity, agreed that the best way to remain competitive was to retain those industries that had high and rapidly rising productivity (Dertouzos *et al*, 1989). The Commission's findings focused the national response on better ways to support US manufacturing firms by developing less inflationary and less destabilizing economic policies. The state and regional responses to concerns about competitiveness gave rise to the first technology-based ED strategies.

States with economies that were heavily reliant on manufacturing industries, like Pennsylvania and Ohio, recognized that foreign competitors' faster industrial design processes and greater flexibility in adapting to new market opportunities would be ongoing causes for concern and needed to be addressed systematically. In response to the rising threats, Pennsylvania Governor Richard Thornburgh created the Ben Franklin Technology Partnership (BFTP) in 1982 (Osborne, 1988). BFTP was structured to provide finance and incentives for applied research and the commercial outcomes of the state's research enterprise. BFTP also provided technical assistance for new and existing businesses through its four regional centres and initiated funding for business incubators.

This groundwork by BFTP initiated the first programmatic approach to technology-based ED, providing a national model for other regions to replicate – which a large number would soon do. Ohio Governor Richard Celeste launched the Thomas Edison Program around the same time as Governor Thornburgh was unveiling the BFTP activities. The Oklahoma Center for the Advancement of Science and Technology (OCAST) and the Kansas Technology Enterprise Corporation (KTEC) were created in 1987, with Richard Bendis (one of the authors of this paper) serving as the first Chairman of KTEC. Under his leadership many of the original KTEC programmes were modelled on BFTP programmes. By 1988, 45 states were reporting more than 250 technology-based ED initiatives (Carnegie Commission, 1992).

The Carnegie Commission on Science, Technology, and Government began to investigate specifically technology-based ED entities in 1992. The Commission brought together many of the pioneers of the movement, including Bendis and Governors Celeste and Thornburgh, who would go on to serve as Commission Co-Chairmen. The Commission convened to make sense of recent trends and to formulate recommendations for best practice programmes. It confirmed that public–private partnerships were the most effective means of addressing US competitiveness. Leveraging resources, including federal and state funding and private resources, and creating synergies or common purpose among parties, were further recommendations to be addressed through the partnerships. Governors Thornburgh and Celeste and Bendis continued to collaborate on this work as founding board members at the State Science & Technology Institute (SSTI) when it was established in 1996, with the two Governors serving as co-chairs. SSTI is a member-based organization for technology-based ED entities dedicated to improving government–industry programmes that encourage economic growth through the application of science and technology.

The continued development of technology-based ED concepts and best practices led to the reinvention and new formation of entities in the 1990s and 2000s. The Massachusetts Technology Collaborative was formally adopted in 1994. The New York State Office of Science, Technology, and Academic Research was formed in 2000. The Texas Regional Centers for Innovation and Commercialization were created in 2005 to manage funds from the newly established Texas Emerging Technology Fund.

## Globalization of technology

Technology-based strategies must keep pace with nuances in the changing global economy. The most notable paradigm shift for practitioners of ED to understand is the expanded globalization of technology, which in turn has intensified the focus on localized assets and resources. In today's global economy knowledge, technology and innovation are firmly embedded in globally-traded products and services. Corporate production processes are captured within a global value chain, in which specialization can easily be outsourced. Firms and enterprises are more networked, more linked and more distributed than ever. The corporate world is also finding more ways to facilitate innovation internally and expand its reach in areas of research and development.

These trends have drastically changed the role of human capital in the economy. Managerial, professional and technical positions – or 'knowledge workers' – are now the largest occupational category. Competition has intensified for the most talented scientists and engineers at global, state and regional levels. Simultaneously, the global economy is more accessible for these very people to work as entrepreneurs and launch their own technology ventures independent of corporate structures.

Furthermore, US firms are not the only ones innovating. New waves of innovators are emerging in Europe, Japan, Korea, Australia, New Zealand and

Southeast Asia. Foreign research and development investments are rapidly expanding, contributing to increased scientific output. Countries like Israel, Canada, Japan and Sweden have developed strong patent positions in key sectors like information technology and the life sciences.

The rapid development and incorporation into value chains all over the world by a cadre of foreign competitors is now challenging the USA at even greater levels than in the 1980s. Fortunately, US workers remain very productive and wages remain high. A large factor in this positioning is the US dominance in information technology and its successful and productive application throughout US industries. The continued global integration of technology will continue to challenge and potentially diminish this advantage.

## Imperative for regional connectivity

Given the increasing globalization of technology, regions must consider new strategies in addressing regional competitiveness and economic growth, and their primary response since the 1980s has been industry cluster development. The art of cluster development was formally introduced, articulated and made famous by Harvard Business School Professor and renowned business strategist Michael Porter in 1990. Traditional cluster development theory is the notion that all the assets, value chains and required skills must be contained within a proximate geographical location. Economic development is then promoted within the cluster by improving the competitiveness of one or several specific business sectors. Bendis had the opportunity to implement a cluster development strategy with Porter as part of the Council on Competitiveness Clusters of Innovation Project (Porter *et al*, 2001). This strategy helped to build aerospace and defence vehicle and plastics manufacturing clusters in Wichita, Kansas.

However, the evolution of distributed and networked business models compels us to examine the cluster model of ED. For instance, the growth of outsourcing means that larger, fully-integrated corporations are now becoming divested both operationally and geographically. A large pharmaceutical or defence company can be thought of as a network of smaller enterprises, divisions and suppliers. In this context, cluster development acts as a mechanism to provide focus and advise strategy through the alignment of industries and technologies into thematic areas to address growth. However, further tools must be developed to capitalize on strategies that promote innovation not just to support clusters, but to galvanize innovative activity throughout a region.

In today's environment, regions need to alter their approach from technology-based ED to innovation-based ED. The local knowledge base – including local researchers, scientists, entrepreneurs, government officials and representatives of business and industry – constitutes the region's critical assets in fostering innovation. The regional talent base often reflects the location's legacy industries. For example, Detroit's knowledge base has been historically centred on the automotive industry. With the automotive industry faltering, a new ED approach must be implemented beyond the development of industry clusters. Innovation-based economic development requires Detroit to leverage its regional human capital, but for the purpose of achieving innovative outcomes beyond the automotive industry. Detroit has well-educated people with specialized skills, but to the region's detriment they have been focused on a single, failing market.

The next component to be understood is how technology is emerging in the region's industry and local research activities. The regional alignment of key enabling technologies and the local knowledge-base forms competencies that can then be directed towards innovation. Innovation-based ED solutions, then, lie in understanding the connections among these key assets in the regional economy: value must be extracted systematically and the available resources aligned as part of a regional strategy.

Co-author Richard Seline has worked in numerous US regions over the past decade through his consultancy New Economy Strategies. This experience has led to the conclusion that determining whether a region is a hub (that is, a significant concentration of most of the necessary assets and attributes for a given industry) or a node (a concentration of one or two highly critical elements of an industry's value chain) in specific unique regional competencies fosters appropriate discussion and debate on its ability to concentrate resources, leadership and ultimately collaborative responses on

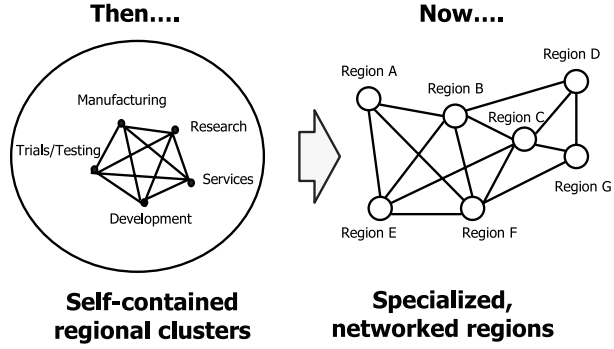


**Figure 1.** The New Economy Strategies perspective on global hubs and nodes.

fostering innovation-based ED. Due to the efforts of Seline and New Economy Strategies, Greater Detroit, for example, now has a roadmap for collaborative initiatives that will promote innovation in the region (see, for example, NES, 2006). Figure 1 illustrates the New Economy Strategies perspective on global hubs and nodes.

Our knowledge of science, technology and the current global paradigm with respect to numerous regions in the USA highlights the need for regional connectivity. To achieve the full potential of a regional economy, all assets and players in knowledge industries, scientific advancement and technological innovation must be connected. These assets and players include researchers, institutes, companies, investors, business leadership and government officials. Innovation-based ED programmes must be developed to provide mechanisms that accelerate this connectivity.

## What is an innovation intermediary?

Appropriate organizational mechanisms can enable greater collaboration between human and institutional players to work on new projects and initiatives, and assist in the leverage and alignment of regional resources to maximize economic growth. An innovation intermediary is such an organization, situated at the centre of a region's efforts to align local technologies, assets and resources to work together on innovation. Technology-based ED organizations must identify ways in which they can be restructured more like innovation-based intermediaries, as described further in this article.

The innovation intermediary has two primary functions. First, the intermediary must provide operating mechanisms for regional connectivity (see Figure 2). It accomplishes this by assuming the role of a neutral convener for regional growth, providing venues for information exchange and connectivity. One of the most notable examples of an innovation intermediary playing this role is CONNECT, created in 1985: a non-profit

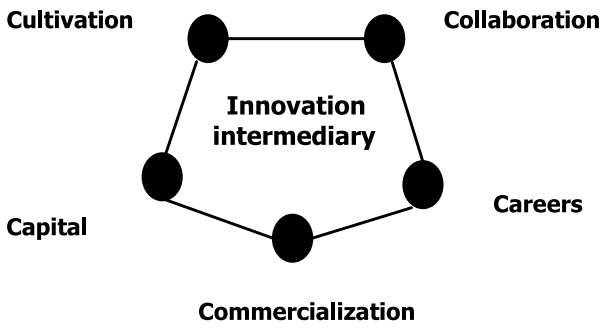


**Figure 2.** Outputs of innovation connectivity.

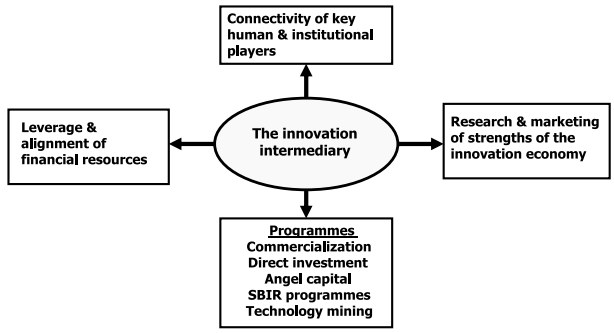


**Figure 3.** The 21st century innovation intermediary: an operating model for regional economies.

organization formed in conjunction with the University of California at San Diego in response to a large downsizing of the defence industry (see www.connect.org). The CONNECT model features the inter-institutional exchange of knowledge and technologies throughout San Diego's research community. It creates opportunities for entrepreneurs, researchers, scientists, business service providers and industry through structural, informational and educational activities that can lead to strong regional collaboration.

The second function of the intermediary is to serve as an accelerator which advances technologies into the marketplace for regional economic benefit. Once a regional connectivity mechanism has been established, it will produce outputs that stimulate innovation in the local economy. The most significant output is the conception and formation of new technology-based products, services and market opportunities. To accelerate innovation, the intermediary must combine scientific knowledge, market awareness, business know-how and complementary investment programmes under a single roof. Too many technology-based ED programmes focus on too few steps, resulting in wasted efforts. Finally, the innovation intermediary must continue to research, identify and market regional strengths so that it can continuously refine and position comparative advantages.

Figure 3 illustrates this central regional role of the innovation intermediary.

## Best practice example: Innovation Philadelphia

Leaders in Greater Philadelphia saw the need for an innovation intermediary when they created Innovation Philadelphia in 2001. Philadelphia had several organizations involved in technology-based ED, including the Science Center, Ben Franklin Technology Partners of Southeast Pennsylvania and BioAdvance. The primary advocates of the intermediary concept were

**Table 1. Example of an effective commercialization structure for an innovation intermediary – the San Antonio Technology Accelerator Initiative.**

| | Technical | Market | Business |
|---|---|---|---|
| Investigation | Technology concept analysis | Market needs assessment | Venture assessment |
| *Development phase* | | | |
| Feasibility | Technology feasibility | Market study | Economic feasibility |
| Planning | Engineering prototype | Strategic marketing | Strategic business plan |
| Introduction | Pre-production prototype | Market validation | Business start-up |
| *Commercial phase* | | | |
| Full-scale production | Production | Sales and distribution | Business growth |
| Maturity | Production support | Market diversification | Business maturity |

*Note:* For details of this initiative, see www.satai-network.com.

Dr Judith Rodin, President of the University of Pennsylvania, and Philadelphia's Mayor, John Street, who understood that efforts needed to be aligned around common goals for the effective implementation of the regional strategy.

As the founder and CEO of Innovation Philadelphia, Richard Bendis focused efforts on connectivity and programmes or tools that would catalyse innovation. As a result of having four technology-based intermediaries, each with pre-seed investment capital and entrepreneurial support services, the Greater Philadelphia Region was promoted as the 'World's Best Technology Network' in supporting entrepreneurial innovation and commercialization. We have not identified any other region in the country or the world that has four technology-based ED intermediaries which all have high-risk, pre-seed capital to invest in companies.

An early task of Innovation Philadelphia was to retain Richard Seline to develop a roadmap for Greater Philadelphia's innovation economy, which resulted in new perspectives on Philadelphia's future economic opportunities and on how talent could be connected for economic growth (NES, 2003). The Knowledge Industry Partnership and Greater Philadelphia Creative Economy were also formed through Innovation Philadelphia's leadership, and the Seline cluster report helped to create cluster strategies in the medical/life sciences, chemicals, nanotechnology and the business process/software industries. The Knowledge Industry Partnership is a coalition of Greater Philadelphia's civic, business, government and higher education leaders, who work together to maximize the impact of the region's colleges and universities on Philadelphia's overall competitive position. The Greater Philadelphia Creative Economy articulates the convergence of technology industries and professionals with the arts and media industries, and promotes Philadelphia as a hub for this activity.

Bendis and Innovation Philadelphia created further programmes to fill the gaps in the regional innovation economy. The Economic Stimulus Fund was created to make equity investments in companies. The Mid-Atlantic Angel Fund brought together 89 investors in the Greater Philadelphia Region. These programmes are explained further in the next section. Although Innovation Philadelphia today has shifted its focus to address other regional concerns, all the programmes that were created to sustain the innovation-based economy continue to operate in the Greater Philadelphia region: their management has simply been assumed by other entities. This is the true legacy of an innovation intermediary. Institutions and programmes are assembled to address market demands, and when the institution has achieved its mission other regional entities will act to sustain the programmes.

## Commercialization

Any novel idea has a limited window of opportunity to realize a commercial outcome. As illustrated in Table 1, the progression of an innovation technology must be moved promptly and strategically through a series of technical, market opportunity and business opportunity tools and analyses as the technology evolves.

A good example of a commercialization structure is the San Antonio Technology Accelerator Initiative (SATAI), which uses a Technology Commercialization Model developed by H. Randall Goldsmith (see www.satai-network.com). SATAI moves technologies strategically along a path to commercialization while receiving mentoring, assistance and oversight from the intermediary, staff, leadership and any other collaborating partners.

The regional accelerator must be established with strategic business networks and service providers that can be used at different times to assist in the

commercialization. Goldsmith has been successful in implementing the principles of the model in a variety of locations. In Oklahoma he used it in conjunction with OCAST and in San Antonio with SATAI, and is using it now in his most recent work in Mississippi with the Mississippi Technology Alliance.

## Direct Investment

Investment programmes are another important in-house capability which the innovation intermediary should maintain to bridge critical steps in the commercialization process and incentivize the development of technology-based opportunities. Commercialization requires effective chains of capital that address all funding gaps in the conception and growth of technology-based companies. Direct investment programmes are a basic mechanism for stimulating activity in companies which fall into one of the gaps or which are unlikely to receive traditional venture funding. The most traditional forms of funding are research matching grants and pre-seed and seed stage investments. Depending on the funding source and the organizational funding scheme, it can be mutually beneficial for the firm and the intermediary if the financing takes the form of a loan, convertible debentures, straight equity or other combination of debt and equity.

Referring back to the case of Greater Philadelphia, BFTP of Southeast Pennsylvania has made direct investments since its inception. Innovation Philadelphia created the Economic Stimulus Fund, but could co-invest with BFTP when feasible. BioAdvance and the Science Center also have dedicated investment funds as a part of this network.

## Angel capital

In addition to direct investment funds, there are other forms of capital that are complementary to direct investment – most notably angel capital. It is increasingly important for the innovation intermediary to have access to angel capital. Angels are prepared to invest early-stage capital earlier than traditional venture capital firms in start-up ventures: they provide about 90% of seed and early-stage outside equity capital for start-up entrepreneurs. These investors are traditionally experienced high net worth individuals, institutions and other accredited investors. In 2006, total angel investments reached $25.6 billion, as reported by the Center for Venture Research at the University of New Hampshire, thus surpassing the total venture capital investments of $25.5 billion as reported by PricewaterhouseCoopers.

Angels are often interested in leveraging other public and private investment funding, and have been known to form angel networks to distribute risk. They normally invest in local or regional deals, primarily because of the very personal relationship that these deals require. The critical role the innovation intermediary fills is to subsidize the staff to run the angel group: investors prefer their capital to be invested as equity without a significant portion going into management fees.

The Mid-Atlantic Angel Group (MAG) is a member-managed private equity investment fund that bridges the gap between seed investments and institutional venture capital. It was created and managed by Richard Bendis and Chris Starr at Innovation Philadelphia. MAG leverages public and private funding resources and networks by providing equity capital to seed and early-stage, technology-based high-growth companies. It has 89 unique investors, including public dollars from the states of Pennsylvania, New Jersey and Delaware. MAG was the first angel fund to be established in the region, even though angels had been active in Philadelphia for over twenty years. The management of MAG has now been transferred to the Science Center in Philadelphia.

## SBIR grant support programmes

Over $1 billion in Small Business Innovation Research (SBIR) funds and over $100 million in Small Business Technology Transfer (STTR) funds are available each year to qualifying companies, making these the largest pool of seed-stage R&D money available in the USA and the most cost-effective from a company's standpoint. The programme is designed to stimulate innovative research by small businesses while providing government agencies with new solutions to technical and scientific problems. Federal grants for innovation are critical to the prompt commercial development of technologies in any region trying to jump-start an innovation-based economy. For the intermediary, the interface between firms winning grants at this phase provides another avenue for deal flow for the angel and investment community.

Bendis created programmes called Research Dollars, a regional programme for Greater Philadelphia, and the Innovation Partnership, a state-wide programme for Pennsylvania, which were modelled on the successful SBIR assistance programmes of the Kansas Technology Enterprise Corporation. These programmes offer small grants to reimburse the costs incurred by firms in preparing grant applications, which are sizeable costs for small firms. Often, travel is required to meet with federal programme administrators and then there are the opportunity costs involved in preparing the extensive

grant materials. The management of the Innovation Partnership has now been transferred to BFTP.

## Technology mining and scouting functions

Technology mining and/or scouting functions can assist regions in transferring and developing technologies. There are two distinct ways to exploit these functions for regional ED. The first is to target technologies that could be of use to the local research base or early-stage companies. Partnering with the appropriate organization can help draw technologies from labs for local development and can also facilitate transfer from distant locations. Technology Tree, Yet2.com and UVentures are examples of firms that specialize in mining, transferring and developing technologies.

Another way lies in more traditional corporate defensive positioning. Many major companies are soliciting the services of technology scouts to identify novel technologies that could be useful to the company or that have disruptive capabilities. The intermediary can establish services to assist technology companies in monitoring disruptive capabilities, especially when there is a perception that regional innovation hinges on the activities of just a few companies. Strategies can also be developed to assist local companies to capture unrealized intellectual property opportunities.

Bendis created a programme that merged the concepts of technology mining while assisting both small and large companies. The programme is now a joint venture between BFTP of Southeast Pennsylvania and Phoenix IP Ventures and is supported by the Pennsylvania Department of Community and Economic Development. It encourages large companies to donate intellectual property and receive tax benefits for their philanthropic efforts. The partnership then takes the donated intellectual property and works on its commercialization.

## Leadership requirements

Innovation-based ED also requires best practices in leadership. It is short-sighted to believe that a structure and programmes alone can inspire regional innovation. Visionary leadership is necessary to make innovation-based ED work in and across regions. This article has provided examples of such visionary leadership through the pioneering work of Governors Thornburgh and Celeste to guide the future of their states. Dr Judith Rodin and Mayor John Street were visionaries in their identification of the opportunity for an innovation intermediary in Philadelphia.

Secondly, a particular type of leadership is required to operate the intermediary. As noted above in the description of programmes, the operation of innovation intermediaries requires knowledge of technology management, regional connectivity, business operations, investment and commercialization. Leaders of intermediaries can be best thought of as full-time entrepreneurs in residence with the know-how and know-whom and the trust and reputation for success. They must also have convergent knowledge of science, technology, business, markets and ED. Preferably, these people will have resounding connectivity qualities that will assist in the linking and leverage of the innovation-based economy. Finding the appropriate individuals to lead innovation intermediaries is an important step in developing turnkey solutions for regional innovation-based ED.

## Conclusion

Looking to the future, the rapid pace of innovation will continue. The strategy of employing an innovation intermediary can accelerate the rate of regional innovation and serve as a catalyst for the regional economy. Each region's particular response to the challenges of the new economy will be different and will need to be customized to regional institutional and political structures, but tailoring and coordinating the regional approaches adopted will prove to be the key factor in fostering innovation for economic growth. In closing, we believe the following to be the guiding principles for the foundation and successful operation of an intermediary to develop a competitive innovation model for the 21st century (Bendis, 2006):

- shared ownership;
- broad participation and diversity of interests;
- champions and advocates;
- operational principles;
- partnership formalization;
- merit-based decisions;
- flexibility;
- cost-sharing;
- access to investment capital;
- evaluation; and
- long-term commitment and sustainability.

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