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Human capital-centered regionalism in economic development: The case of Philadelphia's biosciences sector

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Introduction

Paralleling a resurgence of regionalist thinking in economic development policy in the 2000s has been an increased focus on human capital as a major source of innovation and competitive advantage (Markusen, 2008; Kresl and Fry, 2005). As a result, human capital has become a major focus of economic development analysis and policy. Markusen (2008) claims that according human capital status equal to that of physical capital in economic development practice promises a new route to competitiveness, and in 2005, the U.S. Department of Labor conferred a federal imprimatur on the importance of the metropolitan regional scale as a venue for human capital development with the launch of its Workforce Innovation in Regional Development (WIRED) Initiative (United States Department of Labor 2010). Scholars, many of them funded by the United States Economic Development Administration, have developed empirical techniques for investigating regions' occupational profiles and have proposed ways in which knowledge about "what regions do rather than make" (Feser, 2003) can be used to devise smarter growth strategies.

While scholars and practitioners have advocated policy approaches that rest on developing human capital in order to attract firms and create innovative milieus, actual instances of such approaches remain under-investigated. In Greater Philadelphia between 2006 and 2010, workforce and economic development actors undertook an explicitly regional human capital-centered development effort pertaining to the area's leading "knowledge economy" industry: biotechnology and biopharmaceuticals. The Delaware Valley Innovation Network, begun under the aegis of a Philadelphia-based economic development non-profit dedicated to attracting young professionals to the region and to sparking the growth of innovative businesses, had a \$5.1 million grant from the U.S. Department of Labor's WIRED program. Over four years, a governing body populated with representatives of industry, state and local economic development officials, and local (but U.S. DOL-funded) workforce boards oversaw a multi-faceted effort to understand the region through the lens of a major industry cluster and to act on the knowledge gained in the interests of talent-driven economic growth.

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While the Delaware Valley Innovation Network produced a wealth of data, disseminated more than \$3 million in training funds, and built relationships and skills among partners, a close examination of this case suggests that the tools developed to facilitate workforce- and occupation-led economic development are running ahead of the institution-building required to put regional strategies into practice. In fact, analytical results may be irrelevant to policy as implemented. We argue that this is the case for two main reasons. The first relates to the vagaries of region-based governance, a theme that has already received significant attention in the literature on economic regionalism. The second concerns persistent ambiguity around the role of the public sector employment and training system in regional development and the fostering of the “knowledge economy.” A by-product of this ambivalence is disagreement among stakeholders about whether “knowledge economy” investments should include the training of production workers, often leading to the neglect of blue-collar occupations. Regional human capital development efforts invariably begin with analysis: extensive documentation of regional occupational specializations, supply/demand and “talent gap” studies, and maps of career pathways. However, best analytical practices are of little use without the institutional capacity to translate analysis into coherent, effective policy, and this in turn raises questions about what the goals of human capital-centered regional policy should be in the first instance. The Delaware Valley region’s experience in the early 2000s offers insight into what occurs when analytics outpace institutions in the context of contested goals.

The analytics of human capital-oriented economic development practice

In the United States, social scientists and practitioners have long stressed the logic of labor market-wide approaches to economic development and growth promotion. The argument that local governments, Chambers of Commerce and professional associations should work cross-jurisdictionally to attract firms and develop innovation systems has been supported by appeals to efficiency (see Bartik, 2007), the imperative to reduce economic inequality (Swanstrom, 2001, 2006) and jurisdictions’ mutual interest in a level of economic prosperity that is realizable only through inter-municipal collaboration. (Berube 2007, Voith, 1998). Literature on the innovation process itself also emphasizes the metropolitan region’s importance. This literature stresses the regional nature of the labor market and asserts a “distinct geography of innovation” that is region-based, even while recognizing the barriers that fragmented systems and weak networks may pose for policy makers (see Simmie, 2005).

There is a strong scholarly consensus that that with the internationalization of production and the growing role of innovation in propelling development (see Feldman and Link eds. 2001), growth and fiscal stability have been most durable in places where of innate advantage and shrewd policy have succeeded in developing, retaining and attracting skilled labor (Glaeser and Saiz, 2003, Gottlieb and Fogarty, 2003). While Audretsch and Feldman (1996) find that the tendency of innovation to cluster spatially tracks the product life cycle, they nevertheless conclude that at every stage of the product cycle, the knowledge embodied in workers makes the spatial clustering of innovation more likely (see also Audretsch, 1998). The ability of older cities such as Boston to overcome the disadvantages of high costs and intemperate climate has been attributed to the capacity

for reinvention and economic opportunism that accompanies an educated, adaptive labor pool (see Glaeser, 2003). According to Simmie, “The most important local factor of production for knowledge-based innovative industries is highly educated and trained labor” (2005, p. 798). Further, while it may rely upon a base of highly credentialed “knowledge workers,” the attraction and retention of innovative industries also poses opportunities to develop human capital for jobs that rely on workers with credentials obtained in technical schools and community colleges (Christopherson and Clark, 2007, Lowe, 2007, Holzer and Lerman, 2010).

Economists and economic geographers have established techniques for incorporating this “talent imperative” into economic development analysis and policymaking. The most basic proposed change is that analysts investigate occupational specialization in addition to industrial specialization: in the words of Edward Feser, that they learn “what regions do rather than make” (2003, p. 1937; see also Markusen, 2004). This is particularly important given the rapid acceleration of the product life cycle. The fact that a given region has a large concentration of establishments in the ceramics industry tells us little about whether the workers at those establishments are engaged in research, design, manufacturing, marketing, or some combination, and in fact Koo (2005a) determined that innovation and design research in ceramics is clustered in the northeastern U.S. while production activities are clustered in the south. Scholars have proposed a number of methodologies for “reading” a region through an occupational lens and have applied them in both analytic and practical contexts. We describe three such approaches below.

Occupational cluster analysis

Many researchers have conceptualized occupational clusters from publicly available data and used them to identify the strengths of particular regions. For example, Barbour and Markusen (2007) examined patterns of occupational concentration in California metropolitan areas, focusing particularly on science and engineering workers. They suggest that regional occupational distinctiveness (the extent to which a region’s occupational structure in an industry differs from the nation’s) is particularly pronounced for science, engineering and information technology occupations. This indicates that regional-level occupational cluster analysis is particularly important for innovation-led economic development policy. Working at a national level, Koo (2005b) distilled 20 “occupation clusters” from 661 distinct occupations identified in the Bureau of Labor Statistics’s ONET system; he then identified 20 groupings based on the skill and knowledge requirements of associated jobs² and examined growth trends in these 20 clusters in the Cleveland metropolitan area, drawing ominous conclusions about the decline of high-knowledge occupations there.

Nolan et al. (2011), in research sponsored by the U.S. Economic Development Administration, resolved difficulties experienced by early researchers in meaningfully linking industries with occupations by proposing a combined “occupation cluster/industry cluster” (OCIC) construct. Their OCIC location quotient (OCIC-LQ) enables scholars to

² Koo relies on a method explicated in Feser (2003) but uses updated federal and state occupational classification data.

identify region-specific occupational concentrations for leading industries -- for example, a preponderance of managerial workers *within a region's chemicals industry* (29) where occupational analysis alone would have yielded separate data about managerial occupations and said little about the industries in which they were concentrated. Currid and Stolarick (2010), however, claim that most analyses rely on categories that are too highly aggregated to produce a detailed portrait of "what a region does." Their corrective is to use Census Microdata: data that simultaneously capture both occupation and industry at a high level of detail for a sample of workers in a sub-metropolitan region. Currid and Stolarick's fine-grained data enables them to describe one industry/occupation cluster in the Los Angeles PMSA – information systems/information technology – in a way that captures the "thickness" of the region's labor market for certain kinds of workers. Where other occupational cluster identification methods would simply flag a high concentration of information technology workers in Los Angeles, Currid and Stolarick reveal that the region has a lower share than the U.S. overall of computer scientists and a higher share of software engineers and network systems analysts. They also show that information technology workers in Los Angeles are infrequently employed by information technology establishments, but tend to be imbedded within other industries like aerospace and motion pictures (350).

Gap analysis

While insights from occupational cluster and industry/occupation cluster analysis are useful for understanding a region's existing assets and competitive (dis)advantages, development practitioners often are eager for data that help them to opportunistically adapt to changes and shocks. Theodore and Carlson (1998) propose a method for using location-specific occupation and industry data to match a region's labor pool to its employment possibilities. The first step is to inventory the industrial composition of the area's jobs and projected future jobs, gaining an understanding of which industries are growing and declining both in absolute terms and in terms of their need for replacement workers. The second step is to use an industry staffing patterns matrix or Census Microdata to determine the types of workers employed by each industry, and to cross-reference this occupational information with industry information (as well as information on the existing labor force) to estimate the magnitude and location of demand for workers in various job categories. This "gap analysis" technique amounts to a straightforward supply/demand inventory for labor, but as Theodore and Carlson document, the cross-tabulation of industry and occupation data, unusual in practice at the time, enabled a number of labor intermediaries in Chicago to benefit from their methodology.³ Theodore and Carlson's work is targeted to neighborhood-based groups interested in increasing opportunities for the un- and underemployed. However, it is equally applicable to efforts to opportunistically create academic certifications in occupations expected to be in high demand, or to efforts to attract employers based on the ready availability of a labor pool in a certain family of occupations.

³ Since Theodore and Carlson's article was published, job projections by industry and occupation, sometimes in cross-referenced form, have become increasingly available to workforce and economic development practitioners through a variety of on-line data sources.

Peters (2005) also emphasizes both the labor force matching and the business attraction applications of occupation/industry-focused gap analysis for regions. Peters uses mathematical cluster analysis to construct 49 “industry-based labor complexes,” each of which groups firms from a range of industries based on similarities in occupational employment patterns and skill requirements. Working with industry and occupation data for the state of Missouri, he identifies growing and declining industry sectors within labor complexes in particular parts of the state. Workers displaced from declining sectors (shipbuilding, aircraft) can be matched to jobs in growing or stable sectors (motor vehicles, refrigeration machines, engineering and architectural services) in nearby counties. Thus, Peters recommends that practitioners employ labor complex analysis to seize what might be called “windows of occupational compatibility” in their efforts to repurpose the skills and talents of people whose employers have shrunk or moved due to changes in product demand or industry conditions.⁴ He also recommends that Missouri officials use the labor complex concept to identify “existing pools of specialized labor needed by a particular industry, which can be used in marketing efforts to attract firms in this industry to locate in Missouri because existing pools would reduce a new firm’s worker recruitment and training costs” (152).

Sector partnerships and career pathway analysis

As human capital policy integrates more completely with economic development, the analysis of career pathways has also grown more important. Investor and employer decisions since 1980 have changed the contours of the employment relationship; with the decline of the vertically integrated Fordist corporation and the internal labor market, firm-provided training and internal promotion are rarer than they were in the past, and the use of independent contractors and other “non-standard” workers is more common (Capelli et al 1997). What the “new economy” means for many workers is diminished attachment to their workplaces and less obvious lines of progression between steps in their careers. What it means for employers, particularly small ones, is often a need for trained workers in the absence of the internal infrastructure to perform training (see Osterman, 1999, Christopherson and Clark, 2007). There is therefore a market-correcting role for government and the education and training sector in providing small employers with technical assistance and training as well as providing information and skill development opportunities to individuals navigating careers that involve multiple employers (Fitzgerald, 2006, Herzberg et al, 1998). Sector partnerships, under which economic development agencies, employers, industry associations, and providers of education and training collaborate to build and enhance labor “pipelines” in strategically important industries and occupations, often play this role. According to the National Skills Coalition, an advocacy group,

⁴ Peters notes that professional workers displaced from declining industries stand a better chance than assemblers and fabricators, who face employment decline across a number of sectors at once. Other researchers have taken note of the transferability of advanced assembly and fabrication skills to the construction crafts (see Oden, Wolf-Powers and Markusen 1997).

“Successful sector partnerships leverage partner resources to address both short- and long-term human capital needs of a particular sector, including by analyzing current labor markets and identifying barriers to employment within the industry; developing cross-firm skill standards, curricula, and training programs; and developing occupational career ladders to ensure workers of all skill levels can advance within the industry” (2009: 1).

Organizations and initiatives engaged in sectoral partnerships often create “maps” or diagrams of typical lines of progression within occupations or groups of related occupations, from basic to advanced levels of skill and experience (Wolf-Powers 2005, Fitzgerald 2006). Knowledge about career pathways – gained from the examination of occupation/industry matrices and supplemented through interviews with employer and industry association representatives – is an important tool for economic development officials striving to increase a region’s overall competitiveness by building industry-specific human capital stocks. As will be discussed below, however, there is a distinction between sector initiatives aimed primarily at training firms’ incumbent workers in order to reduce business costs and initiatives aimed at creating pathways into the workforce for the disadvantaged.

The literature on regional economic development and competitiveness is rich in techniques for measuring the scope and nature of places’ human capital assets, and these techniques have grown increasingly sophisticated over time. The U.S. Economic Development Administration has invested significant resources in the development of these tools, though less attention has been devoted to their application. Feser (2003) asserts that “The specific occupational mix, breadth and depth of various clusters in given regions can... inform the training offerings of universities and community colleges” (p.1953), while Currid and Stolarick suggest that their findings “may contribute to job training and educational attainment policies aimed at creating a local skill base” (p. 353). However, documentation and evaluation of efforts to translate analysis into policy remain rare. In this article, I examine a regional human capital development effort in Greater Philadelphia’s life sciences cluster to gain insight into how analytics inform practice in one specific case. The next section briefly describes the region and the cluster, setting a context for the case study.

Life Sciences in Greater Philadelphia: Industry and Labor Market Dynamics

The Greater Philadelphia metropolitan region was perhaps the first bio-sciences hub in the United States. Feldman and Schreuder (1996) argue that this is due to a set of historical conditions that conferred initial advantage and repeatedly prompted Philadelphia’s firms to innovate. The first of these was extant medical and technical expertise in Philadelphia in the 18th and 19th centuries; Philadelphia’s “firsts” include the first hospital, the first medical school, and the first college of pharmacy. The second condition was a tradition of reputable pharmaceutical wholesaling activity that involved quality control and certification and that led to a strong specialization in marketing and distribution as well as to the development of collaborative, innovation-driven industry associations. Third, when wholesalers and other entrepreneurs began to move from batch

to mass production,⁵ the process technology expertise resident in the city's labor force and in existing firms offered a significant competitive asset in manufacturing, as did proximity to chemical manufacturing in New Jersey and Delaware. In the latter part of the 19th century, due to the superiority of its port and to the positive influence of German immigrants, New York City overtook Philadelphia as a pharmaceutical manufacturing and distribution center. However, an industrial corridor developed in New Jersey that united the separate industry complexes in Philadelphia and New York, and this Mid-Atlantic corridor has remained resilient as a cluster of research and development, of the manufacture of therapeutics and devices, and of specialized distribution and marketing enterprises. Today, Greater Philadelphia, which includes counties in Pennsylvania, New Jersey and Delaware, retains a strong concentration in the industry, with a location quotient by employment in 2009 of 3.2 in therapeutics and devices, which encompasses research, development and manufacturing in biotechnology, pharmaceuticals and medical devices (DeVol et al 2009).⁶ Montgomery County, Pennsylvania, to Philadelphia's immediate northwest, dominates in traditional pharmaceuticals (NAICS 324512) and (along with Mercer County, NJ) in biotechnology research and development (541711); regional employment in biotechnology manufacturing (NAICS 325411, -13, and -14) clusters in Chester County, PA and New Castle, Delaware. Chester and Bucks Counties in Pennsylvania each have about 2,000 employees in medical device manufacturing. Philadelphia County (coterminous with the City of Philadelphia) has nearly 3,000 employees spanning pharmaceuticals, medical devices and biotechnology R&D. Clearly, however, within the region the cluster has dispersed westward to Chester and Montgomery Counties, south to New Castle, Delaware, and east to Mercer County, New Jersey (Fig. 1). This fact has workforce policy implications, as will be discussed below.

[Insert Fig. 1 here]

Feldman and Schreuder emphasize the historical adaptability of the pharmaceutical sector in the mid-Atlantic corridor as one of its strengths, noting the persistence of the cluster in the face of shifts from botanical products to alkaloids and biologicals, and finally, to synthetic drugs. In the late 20th century, however, the focus of the life sciences industry shifted from the fine chemistry practiced by the pharmaceutical industry to a molecular biology approach practiced by university-based research facilities and dedicated biotechnology firms or DBFs (Cooke 2004a, 2004b). The trend away from vertically integrated pharmaceutical firms and toward DBFs as the main source of growth in life sciences poses distinct challenges for the Greater Philadelphia region. The historic strength of the integrated pharmaceutical firms, the amount of venture capital investment, a high patent concentration, and the presence of academic institutions where basic and applied life sciences research is taking place represent regional assets. However, Greater Philadelphia, compared with other life sciences-specialized metropolitan regions, has low

⁵ Feldman and Schreuder note that “wholesalers integrated backward into manufacturing activity and brought a sense of commercial expediency to the ways in which the industry evolved” (858).

⁶ DeVol et al also calculate location quotients slightly above 1 for Greater Philadelphia in health care services and in “life science supporting industries” but local-serving industries (for example, drugstores and pharmacies) dominate in these categories.

rates of concentration and growth among the small enterprises that now drive innovation in the sector. Despite recent consolidation and restructuring, the Pharmaceutical and Medical Manufacturing subsector represents nearly half of all life sciences employment in the region. Moreover, there are relatively few instances in the region of “big pharma” alliances with extramural DBFs. Firms are also found to have low rates of commercialization and technology transfer, (Cortwright and Mayer, 2002, DeVol et al 2009). Jobs have been lost in traditional pharmaceutical firms as that part of the cluster restructures, and other leading metropolitan areas for the life sciences – Raleigh-Durham, San Francisco and Boston – have increased their relative dominance (DeVol et al, 2009).

Greater Philadelphia’s life science labor force is a rich asset. To gauge occupational specialization, DeVol et al measured the Greater Philadelphia region’s intensity in 13 distinct life sciences job categories -- from chemical and material engineers to microbiologists to biological and chemical technicians -- and compared intensities in these occupations to those of ten other life sciences-specialized regions.⁷ Greater Philadelphia exceeded the average for the metropolitan areas studied in almost every life science occupation considered; it is particularly strong in chemical engineers, biochemists and chemical technicians.⁸ DeVol et al did not collect data on skilled production workers, perhaps concluding that this occupation was sufficiently cognate with jobs in technical services. They also noted that the region could improve its competitive position by enhancing its concentration of biological technical services workers (64).

Case: The Delaware Valley Innovation Network

Notwithstanding the region’s relatively ample supply of life science workers (particularly highly educated such workers), a consensus developed among Greater Philadelphia economic and workforce development officials in the mid-2000s that improving the workforce in the biotechnology sector was a regional priority, and that public/private entities with the ability to coordinate actors across institutions and across states (since this was a multi-state region) had a role to play in the creation of this “talent pipeline.” When the U.S. Department of Labor unveiled an initiative to promote regional partnerships for economic development through talent development, Workforce Innovation in Regional Economic Development (WIRED) in late 2005, the group Innovation Philadelphia positioned itself for this role.

Innovation Philadelphia was a group of Philadelphia-based business and government executives dedicated to promoting the region’s knowledge economy by providing networking opportunities for creative individuals and firms and by promoting Greater Philadelphia as a location for companies in “knowledge-intensive” industries. Founded in

⁷ DeVol et al calculated the number of workers in a given BLS-defined occupation per 100,000 workers in the region. Aside from Philadelphia, the regions studied were Greater New York, Boston, Greater San Francisco, Greater Raleigh-Durham, Los Angeles, Chicago, Minneapolis, San Diego, Washington, DC and Seattle.

⁸ This represented a change from a similar assessment in 2005, which had identified a shortage in the engineering disciplines.

2001 by Philadelphia-based business and education leaders with the goal of “helping to grow the technology and knowledge industry sectors of Philadelphia’s economy” (Innovation Philadelphia 2011), it differentiated itself from other business groups with an explicit focus on providing resources and seed funding to start-ups, supporting entrepreneurs and attracting coveted 25-to-34-year old professionals to the city. Initially funded substantially by the City of Philadelphia under Mayor John Street, and with an emphasis on growing firms and attracting population within the city’s boundaries, the organization soon began portraying itself as a regional entity, for example with the publication of *Creative Footprint* (which estimated the economic impact of for-profit arts, media, design and information technology firms) in 2007 and the *Greater Philadelphia Entrepreneurs Resource Guide* in 2009.

Given the existence of Pennsylvania Bio as a distinct advocate and trade association for the bio-pharmaceutical sector, Innovation Philadelphia initially focused on attracting and incubating companies in the digital media, information technology and the design fields. It moved opportunistically into the life sciences, however, when the U.S. Department of Labor’s Employment and Training Administration announced a new federal program to fund partnerships for regional talent development. The organization’s staff and board assembled a team of stakeholders, created an entity called the Delaware Valley Innovation Network (DVIN) and responded to the Department of Labor’s Solicitation for Grant Applications for the program, known as Workforce Innovation in Regional Economic Development (WIRED). While not chosen for a first round of 13 \$15 million WIRED grants (“Generation I”), the Delaware Valley consortium was, with 12 other regions, awarded a \$100,000 planning grant in April 2006 and designated a “virtual region,” with an invitation to participate in program activities and to create an implementation plan. In January 2007 the Department of Labor awarded DVIN and its 12 counterpart organizations in these “virtual regions” three-year grants of \$5 million each to implement the plans they had devised. This came to be known as WIRED Generation II.

Throughout the approximately three-year life of the DVIN (January 2007-March 2010), Innovation Philadelphia served as its fiscal agent. However, the partnership had its own set of by-laws and was governed by an executive committee whose members included staff of the three state governors’ offices, the three state departments of labor, the three state bio-science industry associations, and one Workforce Investment Board from each state whose role was to represent all local workforce investment boards in that state (see Table 1). A project director - a Delaware workforce development official who had originally been a member of the organization’s Executive Committee - was hired to oversee the committee’s work and implement the activities outlined in DVIN’s plan, assisted by program staff that eventually numbered three.

[Insert Table 1 here]

As noted below, the Delaware Valley Innovation Network was not sustained as an organization following the 3-year WIRED grant period. Moreover, in April 2010, shortly after the end of the DVIN grant, the executive director of Innovation Philadelphia stepped

down, and the organization's board did not replace her. At that point, the Chair of Innovation Philadelphia's board announced that organization was reevaluating its role in Greater Philadelphia's innovation eco-system. The organization has not officially disbanded, and according to a more recent posting on its website (which describes the DVIN and hosts related documents), the members of its board continue to deliberate as to its future. In conducting this case study, then, the author has relied on interviews with former DVIN Executive Board members, with other stakeholders in economic and workforce development in the region, and with a U.S. Department of Labor representative involved in staffing the WIRED project. Extensive documentation related to the case, produced both by the Department of Labor and by DVIN itself, was also analyzed.

Defining the region

Regional economists typically define regions by their labor markets (also called "commuter-sheds"), and in the United States, Metropolitan Statistical Area (MSA) categories issued by the federal Office of Management and Budget follow this practice. MSAs, which may cross states, consist of component counties and are centered on one or more urban agglomerations, with the primary urban agglomeration listed first in the MSA name. Economic development regions defined for policy purposes, however, are often distinct from MSAs, though they too are usually comprised of county "building blocks." As scholars have noted, regions function as containers not just of households and business establishments, but of shared identity (see Markusen, 1988, Kanter, 2000). Governing economic development partnerships in regions with multiple political jurisdictions represents a sizable institutional challenge, one that is magnified when a region spans two or more states (Hollenbeck and Hewat, 2010).

The Delaware Valley region as defined by DVIN consisted of 14 counties, ten of which were part of the 11-county Philadelphia-Camden-Wilmington Metropolitan Statistical Area (Figure 2). In addition to leaving out Cecil County, Maryland,⁹ Innovation Philadelphia added four non-MSA counties, two in New Jersey (Cumberland and Mercer) and two in Pennsylvania (Berks and Lancaster). Motivating these modifications was a desire to capture the supply relationships associated with life science supporting industries like packaging and bioscience-specialized market research/advertising/public relations, which were centered in outlying geographies not technically part of Greater Philadelphia's labor-shed.¹⁰ However, the 14-county DVIN region was not a coherent regional labor market, and the component counties did not hold an economic identity in common. The fact that the region's second-most-important county in volume of biotechnology research jobs (Mercer County, NJ second after Montgomery County, PA) and its second-most-important county in volume of biotechnology manufacturing jobs (New Castle County, DE, second after Chester County, PA) did not have a state government in common with the primate city – as well as the fact that the primate city

⁹ While technically part of the Philadelphia-Camden-Wilmington labor-shed, Cecil County hosted little activity in the life sciences sector. Including this county also would have required the partnership to integrate the institutions of a fourth state.

¹⁰ Cumberland County, NJ was added because it shares a Workforce Investment Board with Salem County.

itself was not a clear leader in job density or growth – posed barriers to collaboration. Given that a main goal of the WIRED initiative was to foster “regional purpose and confidence” across jurisdictions and across sectors and professions, however (see U.S. Department of Labor, 2008), this was not an intrinsic limitation. In fact, the DVIN case tests the proposition that in a region whose highly disparate administrative components are nonetheless economically linked, similarly motivated institutions can succeed in building a coordinated talent development enterprise.

[Insert Fig. 2 here]

The analytical project

DVIN’s work began in early 2007 with an analytical exercise whose aim was to “evaluate and prioritize current and anticipated gaps” in order to “better understand, expand and refine the region’s workforce pipeline for the life science industry” (Delaware Valley Innovation Network 2008, p. 1). Unveiled in December, 2008, the DVIN’s “Talent Gap Analysis” consisted of a standard industry profile with projected employment growth in eight industry sectors; a profile of regional concentration in 88 life sciences-related occupations, with a demand forecast component; a career navigation tool depicting potential pathways of advancement within nine bioscience “job families” featuring 55 of the original 88 life science occupations examined; and estimates of the supply of life science graduates to fill impending demand, based on an analysis of program completions at the region’s 241 post-secondary life sciences education programs. DVIN employed all three of the analytical methods discussed in the literature review above, although they did not attempt to cross-reference industries with occupations, nor did they link the career pathways analysis with occupational demand data (Table 2). These methodological enhancements might have yielded additional insights to inform the organization’s strategy.

[Insert Table 2 here]

A pivotal moment came in late 2008 when the DVIN’s Executive Committee and staff – as they prepared the Talent Gap Analysis for publication – synthesized industry and occupational forecasts, information on career pathways and data from interviews with firms and education providers into a regional portrait that would guide the remainder of the organization’s work. Consulting the findings laid out in Table 2, the group concluded that markets for education and training appeared to be working; there was not a need to increase the flow of workers positioned for available life science jobs in the Delaware Valley. Instead, the main priority emanating from the data was a need to build teamwork, non-technical business skills and entrepreneurial skills among life sciences employees in the region. The firms in which these skills were most needed were the small and medium-sized research and product/process development firms that had become, as a result of an industry “paradigm shift,” the likeliest source of future growth. Moreover, the employees in need of this cross-training were high-end employees. According to the Talent Gap Analysis Report:

Examinations of the workforce system revealed that the region is not facing a gap in the number of graduates (with the possible exception of information technology), but rather it faces a gap in skills and competencies. It also revealed workers' ability to deal with a changing work structure will require greater flexibility, adaptability and dynamic cooperation. As the primary driver of growth in the life science industry has shifted from large companies to smaller companies, the business culture has changed with less focus on job titles and classifications and a greater focus on the possession of a breadth of competencies that include science, technology, and business skills. Strains in workforce availability are expected to appear in higher-end positions in management and research, not in production (DVIN, 2008).

The essential conclusion drawn from the data – namely that the “talent gap” in the region’s life science sector consisted primarily of a need to cross-train the high-end incumbent and future employees of the region’s small and medium-sized companies – was intended to give shape to the work of the Delaware Valley Innovation Network during 2009 and 2010. A secondary conclusion – the notion that awareness of life science career opportunities was lacking among elementary and secondary school students in the region and among science majors at the area’s colleges and universities – also drove DVIN’s agenda in the second and third years of the grant period.

However, several factors, ranging from the grant’s limited time horizon, to difficulty in forging a regional identity and strategy, to disagreement about the what the Talent Gap findings portended for policy and program, posed barriers to the “regional transformation” envisioned by the creators of WIRED at the U.S. Department of Labor. The following section explores the institutional background that gave rise to challenges.

Institutional context

Regional dilemmas

The architects of the WIRED program at the U.S. Department of Labor proceeded from the premise that to be competitive and prosperous, economic regions must actively connect separate systems governing workforce development and economic development (U.S. Department of Labor n.d.) Funding for the program derived from fees charged to employers seeking H1B non-immigrant visas for foreign workers in specialty occupations. H1B fees had financed technical training for U.S. workers since 1998, the logic being that what was essentially a high-skilled guest worker program should be leveraged for Americans seeking similar skills. But WIRED pursued a theory that in order for the “growing of workers in place” to succeed at reducing demand for high-skilled immigration, training needed to be integrated with economic policy *at the level of the region*.

However, from the first, it was problematic to define and enact collaboration involving 14 counties in three states. Some representatives of Delaware and New Jersey chafed at the centrality of Pennsylvania, and particularly Philadelphia, to the initial planning and grant-writing stages. The Executive Committee’s composition achieved equivalency by

state in governance, but the notion of a tri-partite effort was then complicated by the fact that Mercer County, the New Jersey County with the most significant presence in biosciences, became part of a New Jersey-specific biotechnology collaboration that received Department of Labor funding in June 2007, under WIRED “Generation III.” An endeavor whose regional components lay within the same state was immeasurably easier than one in which three Governors, three state Departments of Labor and three state economic development and business recruitment operations were involved. By several accounts, New Jersey’s interest in the Delaware Valley effort soon waned.

Another theme from participant interviews relates to weak incentives for collaboration among economic development officials concerned for their own states. One interviewee attributed the eventual cohesion of the DVIN’s governance structure to the ultimate emergence of a leadership core among state and local workforce development representatives:

The economic developers ...were initially in charge. But economic developers don’t play well together...Economic developers seem to me antithetical to the whole WIRED idea...they’ll kill each other. The Workforce Investment Act is a federal program and [workforce development officials] don’t care [about cross-border competition for job growth].

In the view of this respondent and others, the initial dominance of state economic development officials hampered the common talent development project. According to them, only after Workforce Investment Boards began participating fully in the effort did functional collaboration develop.

Another regional issue concerned the relationship of the primate city/county, Philadelphia, to the less urban counties in the partnership. In all of its work, Innovation Philadelphia promoted a creative Philadelphia at the heart of a competitive region. But this entailed some legerdemain (a majority of “creative professionals” highlighted in its 2007 Creative Footprint report worked in outlying counties, for example), and underscored persistent tensions in Greater Philadelphia over the city’s declining share of regional employment and its large population of poorly educated residents (see Philadelphia Workforce Investment Board 2007, 2009).¹¹ Philadelphia hosts the bulk of the region’s university-based research, but it is not a hub for private sector biotechnology research and production, which in any case is a field in which even low-level technical and production positions typically require post-secondary credentials (certifications or associates degrees). As the Talent Gap Analysis revealed, Philadelphia has a total of 111 post-secondary life science programs, but only one of these offers training below the Baccalaureate level, even as only slightly more than a fifth of the city’s residents aged 25 and over hold bachelors degrees and “adult learners typically enter post-secondary

¹¹ Philadelphia has both one of the lowest labor force participation rates (45 percent) of any U.S. city and one of the highest poverty rates, 24 percent. 40 percent of working adults in the city earn poverty-level wages as measured against the Pennsylvania Self-Sufficiency Standard for a family of four (Philadelphia Workforce Investment Board 2007, 2009). Of the working age population, 21% have not obtained a high school degree, and the college attainment rate is 22%, one of the lowest in the country.

education through two-year or community college programs” (13). This tension underlay the regional dynamics of the DVIN and provoked skepticism about the extent to which the development of human capital for the biotechnology sector would or could increase revenues for the fiscally distressed central city, as well as raising questions about what training and employment opportunities the effort had to offer job-seekers in Philadelphia and across the region who did not hold bachelors degrees.

Ambivalence about the role and capacity of the public workforce system

Ambivalence among economic development officials (and some top labor officials) about what role to accord local workforce agencies in a talent pipeline development endeavor is a second relevant institutional factor. Historically, public workforce programs have been means-tested and targeted at the poor, conceived by many as a service to the disadvantaged rather than a response to economic growth imperatives. However, the states involved in the DVIN, particularly Pennsylvania, have been leaders in industry partnership programs, which represent an exception to this model. Guided by state policy, Workforce Investment Boards assemble employers in related sectors, consult with them about industry needs, and use public funds to equip workers (often incumbent workers) with skills needed for industry competitiveness and expansion. This may be particularly important in sectors where firms are not large and vertically integrated and thus lack internal mechanisms for the imparting of skills. Several interviewees suggested that the most logical strategy would have been to tap workforce boards to apply the industry partnership model in the DVIN case. However, top officials at the U.S. Department of Labor deliberately vested fiscal agency and implementing authority under WIRED in organizations whose primary affiliation was not with the public workforce system. The Assistant Secretary of Labor for Employment and Training at the time, said one respondent,

was not a proponent of her own system [of Workforce Investment Boards].... She wanted to use the dollars outside the system rather than reforming it. She didn't think the Workforce Investment Boards could step up. She wanted to relate more strongly to economic development and [through economic development agencies to] employers.

As the WIRED program proceeded from the original awarding of grants in 2006 (Generation I) to its second and third iteration (Generations II and III), the Department of Labor had begun requiring greater involvement from the public system. In the Delaware Valley's case, by the time a Revised Implementation Plan was issued in December 2007, the participation of state departments of labor and county workforce investment boards was institutionalized, and these entities participated in the Talent Gap Analysis. This distinguished the DVIN from “Generation I” WIRED projects in which the workforce system became involved at later stages. Even so, interviewees reported that Workforce Investment Boards were not fully integrated into DVIN's executive committee structure until mid-2008.

Conflict over the aim and focus of “talent development”

One interviewee suggested that the best way to proceed would have been to have state officials work together at a high level to perform a gap analysis and only then choose representatives for an Executive Committee from relevant counties' workforce systems and economic development divisions. This likely would not, however, have resolved a third relevant institutional issue: disagreement about the policy implications of the Gap Analysis findings. Some members of the Executive Committee – those representing several of the Workforce Investment Boards and community colleges – pointed to indications that projected labor demand in production and technical occupations requiring certificates and associates degrees was comparable to projected demand for scientists and engineers. This evidence, they maintained, suggested that DVIN's brief should go beyond the cross-training of high-end employees and awareness-building among the college-educated or college bound and seize an opportunity to prepare non-college-bound candidates for advanced manufacturing and technical positions. Economic development officials and representatives of the biotechnology industry associations¹² disagreed, citing slow expected growth in net new production jobs and asserting that the well-documented growth projections for production-related occupations were due to high replacement rates in these occupations (openings stemming from retirements).

As the DVIN released over three million dollars for life sciences-related training and outreach during 2009 and early 2010, those who favored a focus on high-skilled jobs prevailed, citing the trend analysis findings in the Talent Gap study (see Table 3). However, the workforce developers' stance rested less on trend analysis than on a set of ideas about a potential growth path for the region's bioscience sector which they imagined that the DVIN might actively help companies pursue. While the mass production operations of the pharmaceutical companies had shrunk, proponents of this alternative path argued that Greater Philadelphia could build on its manufacturing legacy to improve its capacity in early-stage drug and prototype device manufacturing, as well as the manufacture of pharmaceutical and medical device packaging.¹³ Because proximity between research and manufacturing is important early in the product cycle, a supply of trained employees (technicians, operators and repairers of software-controlled machinery, quality control specialists) could draw to or retain research and development firms whose executives wanted to manufacture in-house or nearby. While it has been argued that specialized research firms tend to outsource early stage production to low-cost regions (Bagchi Sen et al, 2004, Gray and Parker, 1998), the counterclaim is that in biotechnology, close control over the manufacturing process is preferred as it allows accelerated time to market and extends the companies' proprietary position (Feldman and Ronzio, 2001). With an unproven new product, the process innovation that is possible when manufacturing and research are side by side may be critical to developing competence and long-term advantage. Under this paradigm, a stronger commitment to human capital infrastructure for biotechnology manufacturing might have influenced growth in this part of the cluster.

¹² While the position of industry association representatives might be interpreted as dispositive, several interviewees argued that the trade groups had limited awareness of non-research occupations in the life sciences.

¹³ Berks and Lancaster Counties are specialized in packaging manufacture of all types.

Program implementation and the aims of talent development

In 2009, DVIN's Executive Committee awarded grants to a total of 26 individual projects (Table 3), which were classified under Education and Outreach and Human Capital Development. The grant awards largely adhered to the Executive Committee's premise that the priorities for regional talent development should be, on the one hand, cross-training in business and teamwork for the high-skilled employees of the region's fledgling small biotechnology companies and, on the other, enhanced awareness of life science career opportunities among elementary and secondary school students in the region and among science majors at the area's colleges and universities – though there were notable deviations from this framework. Funds were allotted to high school science teachers to purchase laboratory equipment, to a technical college to run seminars in negotiation and project management for managers at small biotechnology firms, to an organization called Campus Philly to arrange internships in the life science field for college students, and to a long-running program at the University of Pennsylvania's Wistar Institute that prepares students at the Community College of Philadelphia for careers as research laboratory technicians. The one program that the DVIN implemented directly was a Life Science Training fellowship, which sponsored 31 recent graduates with bachelors and associates degrees in science for training experiences in regional life sciences companies between September and December 2009. In all, 40% of the grant funding was allocated to projects focused on high-skilled workers and 26% to awareness and skill-building for K-12 students. 18% of the funds went toward training for moderately skilled incumbent and dislocated workers at area firms, while 11% went to programs focused on credentialization of “middle-skilled” workers through community colleges (one percent was focused on career navigation for high skilled professionals displaced from the conventional pharmaceutical sector).¹⁴

[Table 3 about here]

Among stakeholders consulted for this article, two views of the DVIN's grant-making strategy (and of the accomplishments of the partnership) emerged. The first was that the strategy, as informed by the Talent Gap Analysis, was sound but that it fell short of the “regional transformation” envisioned in the WIRED program design. Reasons cited for this include the awkward and often counterintuitive definition of the region and because of strict limitations on the project timeline (according to Department of Labor regulations, all funds had to be expended by January 31, 2010). In this view, DVIN provided resources to many worthy projects, each of which advanced a cogent strategy

¹⁴ Not included in Table 3 is a \$1.3 million grant to the Workforce Investment Boards representing the 14 counties making up the DVIN region, for the training of unemployed workers. According to interviewees, this grant was awarded just months before the end of grant cycle, with funds (approximately \$93,000 for each workforce board) divided evenly among the county entities. While workforce boards spent these funds on mission-related activities, there was no follow-up to determine whether they had been spent to train workers in life science occupations or for life science jobs, and anecdotal evidence indicates that in most cases they were not. This grant is excluded from Table 3 because in the author's view it was neither awarded nor deployed as part of the organization's life science talent development strategy.

for life sciences talent development. However, due to fragmentation among the jurisdictions participating in the DVIN and to the urgency with which the organization had to expend its funds, grant-making activity constituted a piecemeal approach. DVIN, in this view, accomplished much and yet underperformed its potential as both a region-building and a talent-building enterprise for reasons of regional and institutional cohesion.¹⁵ This was underscored by the dissolution of the Delaware Valley Innovation Network as an organization at the close of the grant period, and soon after by the dismantling of Innovation Philadelphia as a staffed entity.

A second interpretation is that DVIN's strategy, while it responded to some needs identified in the Talent Gap Analysis, failed to take up a growth opportunity that was suggested by the Talent Gap data but which did not correspond to some stakeholders' understanding of what human capital development in a "knowledge economy" cluster should involve. The proposal to focus on preparing a cohort of workers with advanced production skills – skills that might be drawn upon by dedicated biotechnology firms looking to scale up production quickly in proximity to their research staff, or by firms engaged in designing and manufacturing innovative new packaging for biopharmaceutical products – aligned with the Workforce Investment Boards' dual mission of reacting to industry changes with new training options for employers while facilitating opportunities for the non-college-educated and non-college-bound in the workforce. It also would have meant a role for DVIN in shaping the industry it aimed to strengthen; it would advance, among employers, education providers and other institutions that made up the "infrastructure" of the region's life science cluster, a human capital strategy based on promoting growth in the manufacturing sector.¹⁶ This could have positioned the organization as an active intermediary attempting to influence a region's labor market dynamics (see Fitzgerald, 2004, Giloth, 2004, Lowe et al 2010). Again, the fact that the DVIN was not sustained after the duration of the grant period suggests that it was not well positioned to become this type of labor market intermediary.

The difference between the conviction that a focus primarily on college-educated and college-bound workers was a missed opportunity and the conviction that it represented the only viable strategy for DVIN illustrates a distinction that Clark and Christopherson (2009) characterize in terms of "investment" and "progressive" (or "equity") regionalism. Concerned primarily with the attraction and development of top talent, investment regionalists champion "public investment in the physical infrastructure, research, and labor market skills that foster innovation and increase firm productivity in the export sectors" (342). This paradigm also includes amenities strategies to make regions attractive to "knowledge workers" and to firms hoping to employ them. The expectation that regional growth will redound to general benefit is implied in this agenda, as it was in descriptions of the WIRED program. Equity regionalism, by contrast, fuses the

¹⁵ Several respondents noted that the workforce agencies involved in the partnership had both become more collaborative with one another and recognized constructive ways in which their work could contribute to economic growth through talent development. And others emphasized that the Talent Gap Analysis itself was valuable in that it uncovered data that could be used to market the region to potential employers.

¹⁶ Fitzgerald (2006), Lowe (2007) and Lowe et al (2011) describe a community college-based strategy in North Carolina that has pursued this strategy with that state's growing bio-sciences industry.

investment approach with an orientation toward narrowing intra-regional imbalances in resources and opportunity. A key premise underlying this position is that policy makers should look beyond elite-level workers on the cutting edge of innovation and develop less prestigious but nevertheless important “middle-skilled” and moderate-earning workers whose competencies support and sustain the innovative milieu (see also Holzer and Lerman 2007, Council of Economic Advisors 2009). This approach, if successful, has the virtue of bringing income to employees “grown in place” who might previously have numbered among the working poor or unemployed. It also has the potential virtue of bringing, by means of that income, revenue to those places in which the middle-skilled employees reside. Research on the impact of economic development incentives suggests that this path is also desirable from an efficiency perspective; mid-level job positions that are likely to be filled by unemployed and underemployed people from the surrounding region exert a larger welfare effect than higher-paying jobs more likely to be filled by in-migrants (see Persky et al 2004).

Conclusion

In conducting research on the Delaware Valley region’s life science cluster, the Delaware Valley Innovation Network organization adhered to best analytic practices developed by economic development scholars. They painted an occupational portrait of the region, assessed demand/supply gaps, and elaborated career pathways in bio-sciences. They publicized the results of their research to firms, to education and training institutions formulating programs, and (through dedicated outreach programs) to students and labor market entrants contemplating careers in the cluster. Beneath the effort to analyze the tri-state region’s human capital assets and gaps, however, fundamental institutional questions and challenges made these analytics insufficient as the engine for a “talent development” strategy.

The consensus among those interviewed for this case study was that while the DVIN’s strategy, while informed by the Talent Gap Analysis, fell short of the “regional transformation” through talent development envisioned in the WIRED program design. First, mounting a coordinated economic development initiative among 14 counties that held no pre-existing common economic identity as a region was a problem that could not be resolved through better analysis.¹⁷ Past research has demonstrated the practical challenges associated with implementing regional cooperation in the context of fragmented governance structures (Niedt and Weir 2010, Adams et al 2009 Chapter 1), and the experience of the DVIN confirms the findings of this research.

A second barrier to the deployment of analytics in the service of a growth agenda was uncertainty within the partnership about whether investment in the knowledge economy should include the training of production workers and the promotion of the region as a location for advanced manufacturing. Workers who stood to benefit from growth in life sciences production employment (and from the pursuit of intermediation strategies that

¹⁷ It should be noted here that the Delaware Valley is in common usage as a term for a 9-county region that includes Bucks, Chester, Delaware, Montgomery and Philadelphia Counties in Pennsylvania; and Burlington, Camden, Gloucester and Mercer Counties in New Jersey.

increased the likelihood of production job growth) were not well-represented in the governance of the DVIN until Workforce Investment Boards assumed a larger role in 2008. Even then, conflict emerged around the nature of “knowledge work” and the viability of pursuing middle-skill jobs in the context of an industry cluster where scientific innovation was seen by many as the sole key to growth. Further, interviews with educational institutions had revealed that many labor market entrants in the region, including those with high school degrees, were insufficiently prepared academically to qualify for the post-secondary training deemed necessary for even entry-level employment in biotechnology. This finding prompted awareness and alarm about pervasive deficits in workplace literacy in the Delaware Valley and particularly in its high-poverty cities. The brief of the WIRED program, however, was not wide enough to encompass counties’ need to overhaul flawed school systems or improve functional literacy rates among working adults. This finding points to the severe fragmentation of primary, secondary and post-secondary labor force preparation systems not only in the economic region encompassed by the DVIN but within the individual jurisdictions that comprised it.

Formal evaluations of the 39 WIRED regions, forthcoming from the Department of Labor, may shed further light on the institutional barriers to regional talent development (see Hollenbeck and Hewat 2010). The implication for regional development scholars of this case, however, concerns the circumscribed value of occupational analysis and sophisticated industry/occupation linkage data in absence of cohesive multi-jurisdiction organizational structures and of common strategies for how to engage public sector workforce development institutions, including secondary schools and community colleges, in the project of “talent development” in key industry clusters. The Delaware Valley’s experience suggests that economic development scholars should complement the precision of tools for finding occupation/industry specializations with greater attention to discerning and elaborating the conditions under which regional consortia succeed in confronting implementation challenges.

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Table 1: Organizations Represented on Delaware Valley Innovation Network Executive Committee

Sector	Organizations
Life science industry	(3): Delaware Bioscience Association; Pennsylvania Bio Association; NJBio
Academia	(2): Regional College and University Presidents' Council; Collegiate Consortium for Workforce and Economic Development (Drexel University + five area community colleges)
Economic development (government-led)	(4): Delaware Economic Development Office; New Jersey Governor's Office of Economic Growth; Pennsylvania Governor's Policy Office; Delaware Valley Industrial Resource Center
Economic development (business-led)	(3): Greater Philadelphia Chamber of Commerce; Select Greater Philadelphia; Innovation Philadelphia
Workforce development	(7) Life Science Career Alliance; Delaware Department of Labor Division of Employment and Training; New Jersey Department of Labor and Workforce Development; Pennsylvania Department of Labor and Industry; Workforce Investment Board – Delaware; Workforce Investment Board, Cumberland and Salem Counties, New Jersey; Workforce Investment Board, Lancaster County, Pennsylvania

Source: Delaware Valley Innovation Network Implementation Plan (December 2007)

Table 2: Delaware Valley Innovation Network Analytics

Task	Data	Findings/Conclusions
<i>Employment growth estimates by industry sector</i>	Researchers reported 2003 employment, 2008 employment and trend-based estimates of 2013 employment in NAICS industries 3254 (pharmaceutical and medicine manufacturing); 334510 (electromedical and electrotherapeutic apparatus manufacturing); 334516 (analytical laboratory instrument manufacturing); 334517 (irradiation apparatus manufacturing); 3391 (medical equipment and supplies manufacturing); 54138 (testing laboratories); 541711 (research and development in biotechnology) and 541712 (physical, engineering and biological research, except biotechnology)	<ul style="list-style-type: none"> • Employment in life sciences will rise from 2003-2008. Most new jobs will be in pharmaceuticals (1,100). • Two of three medical device subsectors will grow from 2008 to 2013 but these sectors represent a net loss of employment and thus not much about. • Pharmaceuticals employment has slowed down with employment in research and development. The amount of 2003-2008 job loss in the pharmaceuticals there will be 37,700 employees in 2013 (2003) whereas in pharmaceuticals there will be 1,100 (2003).
	Employer interviews and focus groups	In an industry ‘paradigm shift,’ growth is expected in small companies. Discovery research takes place in small companies acquired by larger ones. Medium-sized firms are growing and bring drugs and devices to market.
<i>Occupational demand forecast</i>	Researchers calculated concentration quotients for the region in 88 life science occupations for 2008 and 2013. They also estimated net new positions and replacement positions by occupation in the region between 2008 and 2013, using Bureau of Labor Statistics data. Skill, knowledge and education requirements for all 88 occupations, based on data from O*Net, were inventoried in a database (see “career lattice” below).	<ul style="list-style-type: none"> • The region is highly specialized in life sciences, biological and chemical technicians. • Taking both net new positions and replacement positions to be strongest for scientists* (2,086 openings) biological and chemical technicians*** (2,086 openings)***
	Employer interviews and focus groups	<ul style="list-style-type: none"> • “Hard to fill” positions include job operations, scientific research, quality control. • Skills in short supply include communication, business skills as well as experienced.

Table 2 continued

Task	Data	Findings/Conclusions
<i>Life science career lattice</i>	Researchers obtained information about job titles, job requirements and progression among jobs from the U.S. Department of Labor, BIOCOM, the Biotechnology Benchmark Compensation Report, and Bio-Link. This information was validated through interviews.	Life science occupations in the Delaware Valley include bioinformatics/data management, clinical development, manufacturing, discovery research, and entry in the succession of job titles within a career path. Credentialization, skill and experience.
<i>Life science program inventory and completion statistics (supply analysis)</i>	Researchers listed and mapped post-secondary life science education programs in the region. Program completion data (2004-2006) was compiled from the Integrated Postsecondary Education Data System (IPEDS) and compared to occupational forecasts.	<ul style="list-style-type: none"> • The region hosts 241 programs in the life sciences including pharmaceutical sciences and administration, management; engineering/technology. • Program completions increased by 15% over the last five years. • “The DVIN region should produce enough graduates to fill the yearly average openings for life science occupations.” (15). • Main challenges for region are to train graduates that require computer and information skills. Many incumbent employees of small- and medium-sized businesses lack business skills.
	Interviews with representatives of educational institutions	<ul style="list-style-type: none"> • Challenge to build and maintain research and development start-ups. • Among community colleges, a barrier to success is students’ lack of understanding about the life science courses. • Funding needed for the development of research and development start-ups.
	Interviews with workforce investment board representatives	“Many of the WIBs focus on training unemployed workers. WIBs face the challenge of transitioning the workforce into the life science industry.” (16)

*chiefly medical scientists and chemists; ** chiefly team assemblers, inspectors/testers/sorters/samplers/weighers, and mixing and blending machine operators, tenders and setters; ** chiefly industrial engineers

Compiled by author from Delaware Valley Innovation Network Talent Gap Analysis Report (2008); Delaware Valley Innovation Network Life Science Occupational Forecast Table (2008); Life Science Career Lattice (2008)

Table 3: Delaware Valley Innovation Network Grants (sorted by target population)

	K-12 students	Community college students	4-year college students or recent graduates	High-skilled incumbent workers	Skilled dislocated workers	Moderately skilled incumbent and dislocated workers
Life Science Career Week opportunities for students from school districts in the region to connect with life science professionals and mentors. Life Science Career Lattice made available	\$60,000					
Life Science Product Certificates awarded to science educators at regional schools for the purchase of science supplies and lab equipment.	\$160,000					
Bio-ID program (BioNJ), to increase interdisciplinary skill sets in science and business in small biotechnology firms.				\$55,187		
The Life Science Leadership Forum Program (BioStrategy Partners) Assisted life science entrepreneurs attempting commercialize products				\$124,400		
Intersection Program, Camden		\$76,005				

County College (interdisciplinary biotechnology associates degree program)						
Internship Initiative Program, (Campus Philly)			\$49,874			
Southeastern Pennsylvania Bioscience Partnership - training opportunities for device, diagnostic and therapeutic companies in the life science/biomedical sector for incumbent and dislocated workers. (Chester County Economic Development Council)					\$380,000	
Mentors 4 STEM program (Council on Adult and Experiential Learning) recruited and trained retirees from science and technology fields to mentor classroom science and math teachers	\$133,250					
2009 Biotechnology Fair and professional development for educators (Conrad Schools of Science)	\$20,952					
Project Management and Negotiation Skills Seminar Series (Delaware Technical and Community College)				\$125,693		
2009 Career Fair, Greater			\$15,025			

Philadelphia Chamber of Commerce						
DVIN Life Science Fellowship Training Program			\$310,000			
Pennsylvania Biotechnology Center Program (Institute for Hepatitis and Virus Research)				\$150,000		

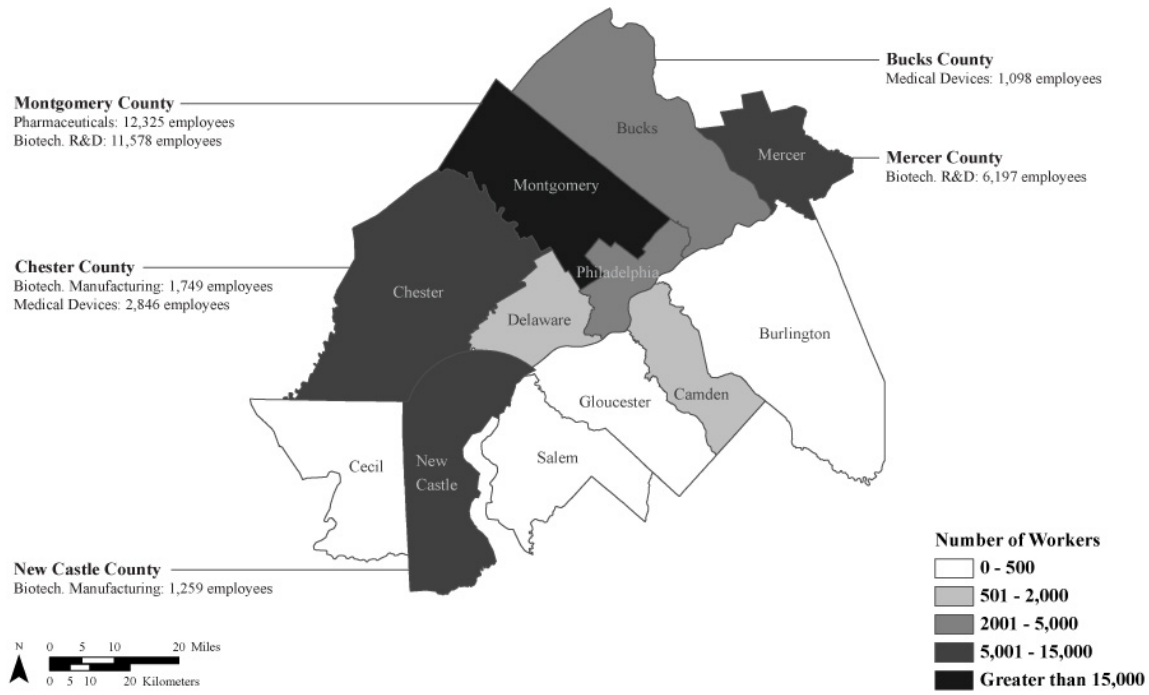
Table 3 continued

bench2BUSINESS conference (iPRAXIS)				\$2,100		
Innovation Hub Program (Junior Achievement of Delaware)	\$36,000					
Translational Medicine Alliance forum (Kaufman Innovation Network)				\$21,500		
Our World Interactive (Life Science Career Alliance)	\$85,500					
Minority Achievement: Robotics, BioMedical Leadership and Engineering (Leon Sullivan Trust)	\$107,500					
Promoting Awareness of Life Science Career Opportunities Program (New Jersey Association for Biomedical Research; Pennsylvania Association for Biomedical Research)	\$11,682					

2 nd Annual Regional Commercialization Conference (New Jersey Technology Council)				\$10,000		
Biotech 2009 Grant Program (Pennsylvania BIO and BioNJ)				\$53,425		
SMART Learning Academy 3 day laboratory management training course (SMART Consulting Group)				\$51,526		
Professional Masters Program in Biotechnology (University of Delaware)				\$26,612		
Career GPS (University City Science Center)				\$16,500		
Biomedical Technician Training Program (Wistar Institute)		\$179,183				
Cyber Teaming for life Science workers, trainers and educators program (West Chester University 3E Institute)				\$20,575*	\$20,575*	
	Total for K-12	Total for community college	Total for 4-year college & recent graduates	Total for skilled incumbent workers	Total for moderately skilled and dislocated incumbent workers	Total for skilled Employment in Life Science Industry Subsectors in Greater Philadelphia dislocated workers
Funds expended	\$ 593,432	\$ 255,188	\$ 91,511	\$ 914,406	\$ 400,575	\$26,500

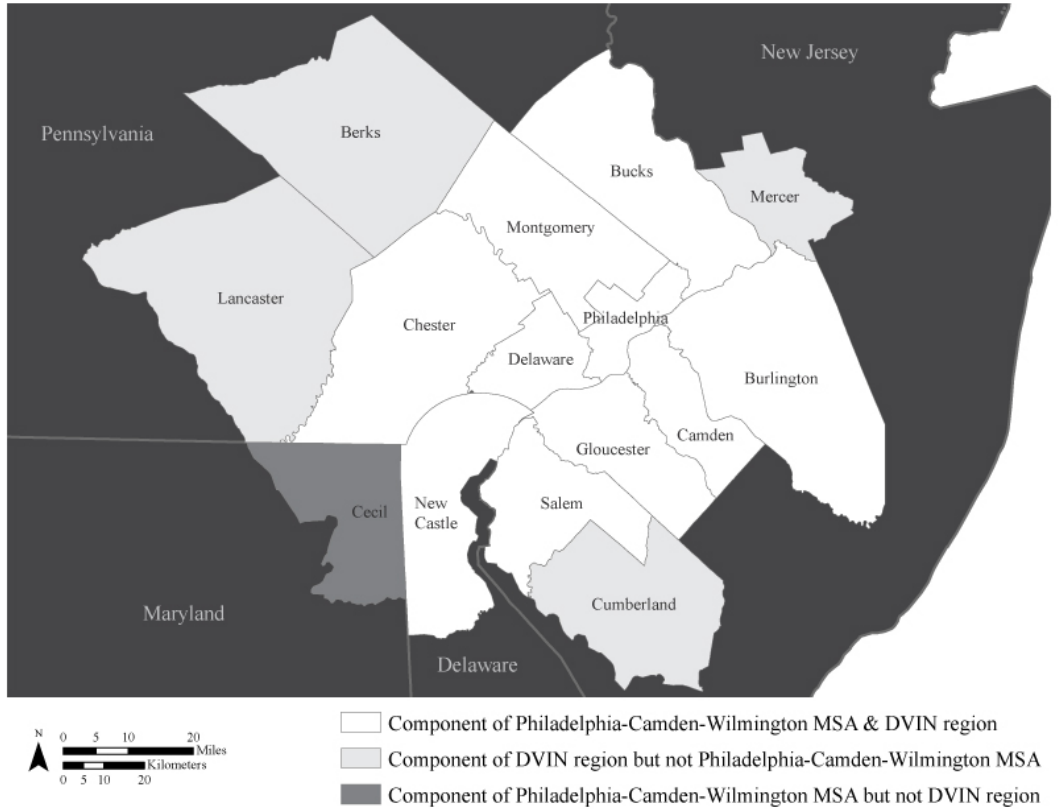
Source: Compiled by author from Delaware Valley Innovation Network 2010

Figure 1: Employment in Life Science Industry Subsectors in Greater Philadelphia



Source: DeVol et al. 2009. Map notes the largest county-based concentrations in pharmaceuticals and medicine manufacture, biotechnology research and development, biotechnology manufacturing, and medical device manufacturing.

Figure 2: The Delaware Valley Innovation Network's Region and the Philadelphia-Camden-Wilmington Metropolitan Statistical Area



Source: United States Office of Management and Budget; Delaware Valley Innovation Network 2007.