Reshaping Rural Development Through Knowledge Clusters:

The Case of Danville and Southside, Virginia

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Abstract

This thesis examines challenges and implications associated with implementing knowledge-based economic development strategies in rural regions, focusing on the City of Danville in Southside Virginia. In 2000, Danville became the focal point of a major technology-based regional economic development initiative designed to transition southern Virginia away from its traditional base of agriculture and manufacturing towards information and high-tech (IHT). The initiative garnered significant support of the state and outside institutions, and was designed to encourage local firm formation, attract private capital, and improve infrastructure to foster innovation as a driver of rural economic growth.

Patterns in job growth, firm relocation, and plant closure data were analyzed for the City of Danville from 1990-2013 to discern whether investments in knowledge economy infrastructure resulted in diversification into IHT; and if so, to what extent and how. Drawing on elements of the rural knowledge cluster framework, which states that knowledge and innovation provide important sources of rural competitive advantage (Munnich et al. 2002), contributing projects are summarized to lend perspective on overall theory of change guiding the rural economic development strategy in Southside. The thesis concludes with an analysis of social and economic impacts concurrent with knowledge economy investments; challenges and constraints facing the Danville strategy to date; and recommendations to improve economic development practice in Danville based on implications of the data.

Advisor: Prof. Karl Seidman, Senior Lecturer in Economic Development, MIT

Reader: Dr. Amy Glasmeier, Prof. of Economic Geography & Regional Planning, MIT

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Introduction

Background and Context

Rural communities across the U.S. face a challenging set of economic conditions: a narrow and shrinking employment base, outmigration, volatile industry restructuring, sagging educational attainment, barriers to information technology access, capital mobility, and dwindling public resources to stimulate economic diversification. With the emergence of a global economy that is increasingly knowledge-centric, rural communities are falling further behind.

This thesis examines an economic development strategy in one such area, the City of Danville in Virginia's rural Southside region ("the region"). In recent years, high technology firms ("high tech") firms have proliferated in Southside to take advantage of public investments and financial incentive packages focused on supporting a knowledge economy. With its traditional sectors of agriculture and manufacturing facing rapid decline, rural Southside dedicated significant resources to diversify its economic base into information and high tech (IHT) through investments in telecommunications (i.e. broadband), human capital, and research and innovation infrastructure. These were coordinated under a comprehensive regional plan – "The Danville Regional Plan" – that was established in 2000 and designed to foster regional cooperation to spur innovation and IHT growth throughout rural southern Virginia. While the Plan resulted in nascent progress since 2000, Southside continues to struggle with rising poverty and an exodus of manufacturing jobs.

Southern Virginia embodies many of the challenges unfolding in rural communities across the U.S. Many have found it increasingly difficult to compete on traditional measures such as low cost labor and resources alone, as globalization and capital mobility have broadened the range of locations available to firms seeking out the lowest possible costs. Many rural areas have struggled to retain a high-paying job base in the wake of this issue, with closing manufacturing plants, an eroding market share from cheaper foreign imports, and agricultural consolidation and industrialization arising in result. Outmigration further exacerbated rural decline, as large-scale shifts towards "knowledge" as a driver of economic growth concentrated larger shares talent around

denser urban metros. In this new economic paradigm, the ability to attract and retain people – the human capital of cities – has become a fundamental prerequisite to economic success. These factors combined have left many rural areas in the U.S. struggling to compete.

The story of Southside's on-going transition from its historic roots in tobacco and textiles to information and high tech touches upon these challenges, and offers a compelling view of an emerging rural development paradigm oriented towards technology and knowledge-based growth. It also illustrates the inherent challenges and massive resources required to enact significant structural changes in rural economies.

For example, approximately $1 billion has been invested in Danville since 2000, addressing needs related to broadband infrastructure, research, traditional manufacturing, and attracting high tech companies. From 2000-2013, 24% of all new jobs produced in Danville were in IHT, contrasting sharply with 0% IHT job growth during the prior decade. High tech firms in sectors such as software and biotechnology located in Southside in increasing numbers; and new infrastructure and institutions oriented towards research and technology commercialization played an important part in the process. Average years of schooling also increased in Danville by 1.1 years to 13.18 from 1990-2010 (DeVol, et al. 2013); reflecting a steadily improving measure of competency among the regional workforce. When controlled for factors such as the age composition of the workforce, industry mix, R&D intensity, and other structural differences, investments in education contributed to a 12.2 percent growth in real GDP across the metro area during the same period.[1]

These trends were not entirely positive however, as Danville continued to lag behind Virginia whole. Deeper analysis shows that real GDP per capita in Danville grew at a meager rate of 0.61% per year from 1990-2010, falling significantly below the state's broader growth rate of 1.48% annually during the same period.[2] Meanwhile, Danville continued to suffer from population loss and outmigration, amid a steadily shrinking job base throughout the period. It also saw steadily rising poverty and increasing economic disparity across racial segments, indicating that massive economic development investments were perhaps falling short of their intended effect.

Thesis Rationale and Approach

The goal of this thesis is to examine the components and emerging impacts of the Danville strategy to elucidate lessons on the (i) actors, (ii) strategies, and (iii) challenges influencing knowledge-based economic diversification in rural areas.

Chapter 1 asks whether it is possible to integrate rural communities into the knowledge economy and draws on relevant theories and case studies to establish a framework for examining the Danville experience. It highlights the special role conferred to "knowledge" in economic development literature and outlines structural issues facing its application as an economic driver in rural areas. It then outlines why knowledge-based growth may be an important starting point for shaping rural development practice, as well as why it may be relevant for evaluating the Danville experience.

Chapter 2 provides an economic base analysis of the City of Danville and broader Southside Region from 1980-2000 to provide context for its economic and structural challenges. The chapter also summarizes planning responses to these challenges and the subsequent creation of the "Danville Regional Plan," which lent momentum toward a series of regional knowledge economy interventions beginning in the year 2000. The chapter puts special emphasis on the main actors and institutions that allowed for these interventions; though it is not exhaustive in its coverage.

Chapter 3 outlines, then qualitatively describes, the components of the Danville Strategy that have occurred since 2000. It pays special attention to the resources, actors, projects, strategies, enabling factors, inter-relationships, and challenges that embody the case. The chapter attempts to illustrate how projects implemented since 2000 align with the original Danville Regional Plan, as well as how they were designed to operate within a broader systems framework oriented towards technology and knowledge-based growth.

Chapter 4 evaluates the extent of Danville's success in diversifying towards IHT by analyzing data on new job growth, firm relocations, and plant closures in the City from 1990-2013. It does so to examine changes in firm type and sector that have proliferated since, and asks whether specific relationships or structural factors played an important role in any evident diversification. The chapter also gives attention to the relative financial effectiveness of the Danville Strategy, based on public and private

investments per job and approximated wages. It then attempts to draw distinctions between the relative success or failure in spurring job growth between IHT and Traditional Manufacturing in Danville; and outlines structural challenges encountered in the process. Lastly, it concludes by questioning whether the Danville Regional Plan's implementation to date has resulted in its desired impacts and offers recommendations to improve economic development practice in Danville; playing off specific elements of the rural knowledge cluster framework to highlight important concepts .

Methodology

This thesis relied on a variety of primary and secondary data to support qualitative case studies of knowledge economy interventions, as well as a quantitative assessment of the strategy's impact in Danville. Phone interviews, excel files, and internal reports and memos provided primary data. Secondary data was drawn from the census, publicly accessible research reports, and websites. A listing of these data sources is below, followed by a detailed list of phone interviews:

Primary Data

1. **City of Danville Office of Economic Development**
   - *Danville Announcements Since 1990 Excel File*
   - *Danville Closings and Reductions Data (1990-2013) Excel File*
2. **Virginia Tobacco Indemnification and Community Revitalization Commission**
   - *Tobacco Commission Grants Excel file*
3. **Phone Interviews**
   - Economic development organizations, educational institutions, state agencies, private companies; listed on the following page
4. **Internal Reports, Memos, Public Presentations**
   - Provided by Virginia Tech and The Launch Place
   - "Tomorrow in Danville" – Presentation provided by VT KnowledgeWorks

Secondary Data

1. **Demographic and economic data**
   - U.S. Census Bureau, Bureau of Economic Analysis, and U.S. Department of Labor
2. **Web research**
   - Publicly accessible reports, websites, and materials

Phone Interviews: Performed Between March 1st and July 31st, 2013

1. Virginia Tobacco Indemnification & Community Revitalization Commission (TIC)
    a. **Tim Pfohl, Grants Program Director**

2. eCorridors Program, Virginia Polytechnic Institute and State University (Virginia Tech)
    a. **Erv Blythe, former Vice President for Information Technology**
    b. **Nancy E. Franklin, former Senior Director of Technology and Community Development, Virginia Tech**

3. VT KnowledgeWorks
    a. **Jim Flowers, Executive Director**

4. The City of Danville Office of Economic Development
    a. **Corrie Teague, Project Manager**
    b. **Linwood Wright, Consultant**

5. The Institute for Advanced Learning and Research (Danville, VA)
    a. **Dr. Liam Leightley, former Executive Director**
    b. **Dr. Timothy Franklin, former Executive Director**

6. Danville Regional Foundation
    a. **Karl Stauber, President & CEO**

7. The Launch Place
    a. **Eva Doss, President & CEO**

8. Engineered BioPharmeceuticals
    a. **Mark Ketner, Senior Engineer and Principal Investigator**

9. Noblis
    a. **William F. Mitchell, Software Engineer**

CHAPTER 1

RURAL DEVELOPMENT AND THE KNOWLEDGE ECONOMY:

Literature Review of Related Economic Development Theories

Research Methodology for Danville

The Role of Knowledge in Economic Development

Why is knowledge important for economic development? In his "New Growth Theory," Cortwright (2001) proposes that economic growth results from increasing returns associated with new knowledge. Knowledge behaves differently from other economic goods in that it exhibits increasing returns to scale and can be infinitely reused at almost zero marginal cost (Cortwright 2001). Since virtually all forms of knowledge – from research-intensive science to rudimentary tasks – exhibit these properties, firms that use knowledge for production tend to enjoy "quasi-monopoly profits" (Cortwright 2001). To the extent that regional economic development has favored investments in capital, natural resources, and labor, Cortwright (2001) argues that increasing a region's stock of knowledge rather than increasing its labor or capital may offer endless growth.

Distinguishing between types of knowledge and their respective contributions to economic growth has captured the attention of development theorists. Botkin and Seeley (2001) explain that knowledge comes in two forms – "codified knowledge," which is captured and transmitted through formal means, such as text; and "tacit knowledge," or that which is informal and derived through personal experience and embodied within individuals. While technology has enabled information (distinct from knowledge) to travel greater distances more efficiently, knowledge tends to cluster geographically because it is embodied within agents that "do not move frictionlessly" across space (Cortwright 2001). This suggests that "regional proximity" and geography play important roles in determining "knowledge spillovers" among individuals and organizations. Proximity is shown to increase an industry's innovative capacity particularly when firms can share ideas, products, and services (Porter and Stern 2001).

Characterizing the type of knowledge important for industry growth has also captured considerable attention. Botkin and Seeley (2001) estimate that nearly eighty percent of all knowledge is tacit. Cabral and Leiblen (2001) also observe that tacit knowledge tends to dissipate, particularly in small firms, unless it is "exploited" when workers learn through experience. This holds true in industries that do or should adopt to higher forms of technology (Munnich et al 2002). Cabral and Leiblen (2001) conclude

that identifying the type of knowledge used by agglomeration industries should be an important focus of policy makers seeking to grow their economies.

Deriving economic growth in this way requires a ready distinction between the economic value of – as well as the ease of transfer between – tacit and codified knowledge (Cowan and Foray 1997). Cowan and Foray (1997) state that the extent to which knowledge is codified depends on the prevailing benefits and costs of doing so in an area. If it is economically attractive, industries can translate tacit into codified knowledge and leverage it as a tradable commodity (Cowan and Foray 1997).

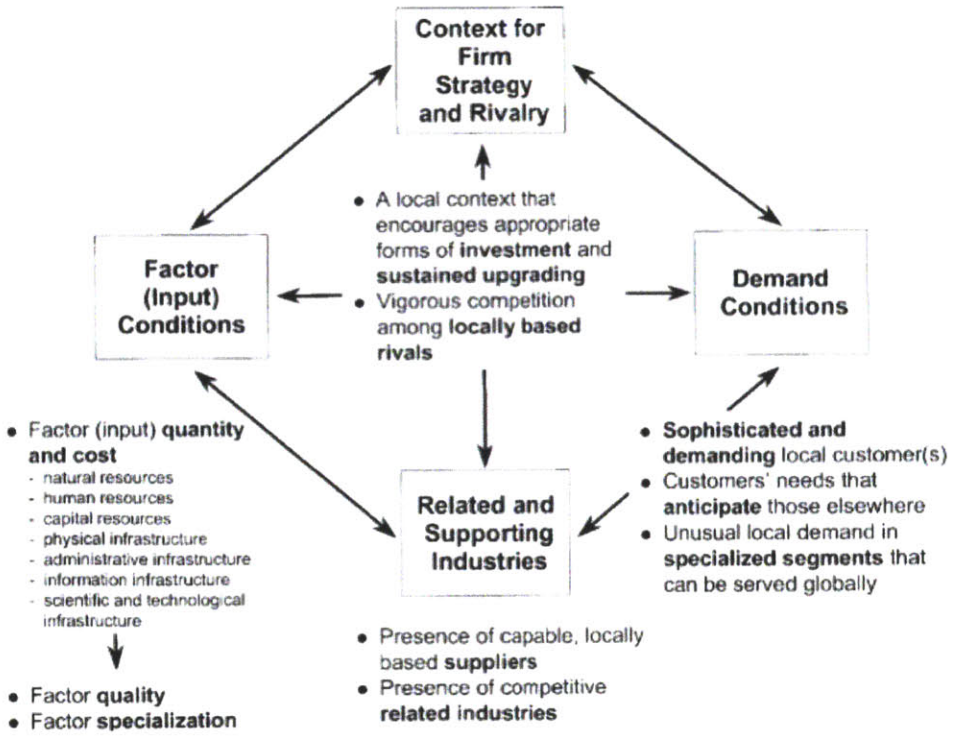
This has important implications for regional development, particularly in areas undergoing structural change. Capitalist development is often characterized as "creative destruction," where firms create new economic structures by destroying a prior economic order (Schumpeter 1942). It is through this process of change that new ideas and technologies take root as the drivers of economic growth. Markets may not converge on the most efficient solution on their own, however, as "technological and regional development will tend to exhibit path dependence" (Cortwright 2001). This underscores the importance of contextualizing regional influences that shape knowledge economy development, such as history, institutions, and geography (Cortwright 2001).

History is important because increasing returns create positive feedback loops that may cause economies to "lock in" to a particular technology or location (Cortwright 2001). The decisions of individuals and organizations have ramifications that impact an region's development trajectory over long periods of time. Institutions are important because they shape the environment for the "production and deployment of new knowledge"(Cortwright 2001). As Cortwright (2001) states, "societies that generate and tolerate new ideas, and that continuously adapt to changing economic and technological circumstances are a precondition to sustained economic growth" (Cortwright 2001). Lastly, geography is important because it influences the factor conditions shaping economic growth – such as access to natural resources and markets – as well as "friction" that impacts the mobility of knowledge agents, such as workers and firms. "Important parts of knowledge are tacit, and embedded in the routines of organizations and individuals in different places" (Cortwright 2001).

Industry Clusters

In 2000, Michael Porter offered a general basis to conceptualize strategies for growing local and regional economies. Rooted in the notion of "industry clusters," Porter's framework derives from an assumption that: (i) the "microeconomics of competition" exert influence on economic development, and that (ii) while "changes in technology and competition have diminished the traditional roles of location," location provides a strong basis for competitive advantage (Porter 2000). Porter defines "clusters" as "Geographic concentrations of interconnected companies, specialized service providers, firms in related industries, and associated institutions (e.g. universities, standards agencies, trade associations) in a particular field that compete but also cooperate" (Porter 2000). In emphasizing their "critical mass of unusual competitive success" in a particular business area, Porter (2001) proposes that "clusters" tend to characterize features of a wide range of local and regional economies.

Porter's "diamond of advantage" (below) characterizes the underlying drivers of competitive advantage, a central tenet of the cluster notion. Under this framework, competitive advantage arises when the confluence of location-specific supply and



Source: Direct Image taken from Porter 2000

Demand conditions enable firms to perform in ways conducive for growth. The theory rests on the notion that clusters excel under a local context that encourages (i) competition and cooperation among proximal rivals, and (ii) sustained investment from industry, government, or other sources to upgrade any number of elements in the diamond. The diamond consists of four main elements:

Elements of Competitive Advantage	
Factor Conditions	The factors of production in a region – including its endowment of human, physical, knowledge, capital, resources, and infrastructure – that make it more inclined for success in a given industry (i.e. computing in Silicon Valley)
Demand Conditions	The nature of local and regional demand for a given product or service, which encourage firms to innovate and compete
Related and Supporting Industries	Networks of buyers and suppliers transacting in close proximity that foster active information exchange, collective learning, and supply chain innovation
Firm strategy, structure, and rivalry	"A climate that combines both intense competition among localized producers, with cooperation and collective action on shared needs, making it fertile for innovation and regional competitive advantage" (Munnich et al 2002)

Additionally, Porter emphasizes that "government" and "chance" play peripheral roles in shaping the competitive advantage and proliferation of the cluster (Porter 2000).

Munnich et al (2002) observe that three important factors tend to arise from the cluster model in an economic development context:

Elements of Competitive Advantage	
Endogeneity	"Successful industry clusters tend to possess dynamics, such as trust, competition, and entrepreneurship that lay the foundation for future success"
Agency	"Human agency, in the form of collective action, industry, and regional leadership, are crucial elements of ongoing success"

Strategy	"The strategic decisions of local firms in competition with one another helps in raising the bar for all parties" (Munnich et al 2002)

Isolating the elements of competitive advantage that are most important for "cluster success or failure" requires a ready distinction between different types of clusters. There are operational challenges to doing so, however, as a regular critique of the cluster model is that it "lacks definitional clarity and consistent application" (Munnich et. al 2002). This often arises when attempting to distinguish between traditional "industry clusters" and "knowledge clusters" – which may exhibit similar characteristics – or when attempting to characterize the underlying drivers of clustering tendencies or what a "cluster" consists of.

For example, Munnich et al. (2002) make the inference that "industry clusters" assume multiple forms, such as (i) geographic concentrations of similar yet competing firms (cite author), or (ii) "hub-and-spoke" models where a major employer is surrounded by a group of supplier firms (cite author). These are often characterized through measures of industrial concentration (i.e. location quotients), industry growth, and competitive shifts in industrial activity (i.e. shift-share analysis) (Munnich et. al 2002). However, these tools tend to overlook key aspects of industry form and function that may be critical for understanding the drivers of clustering tendencies or nature of locational competitive advantages. These aspects may include (i) the nature of firm employment and firm structure, (ii) the geographic distribution of firm R&D and production functions; (iii) the strength of linkages among firms and institutions that encourage "knowledge-creating processes" in the surrounding milieu, such as learning and innovation, and (iv) local capacity to translate exchanges between tacit and codified knowledge into entrepreneurial ventures.

Knowledge and Rural Economic Development

So what do these theories imply for rural areas? The prevailing shift away from natural resources and manufacturing towards an emphasis on "knowledge" as a driver of economic growth underscores a wide range of rural development challenges in the modern era. Historically, many rural areas amassed wealth through agriculture and

manufacturing on account of low cost resources and labor. In recent years, however, the changing nature of these industries and increasing influence of knowledge economy sectors, which have concentrated heavily in urban areas, exacerbated rural decline (Henderson and Abraham 2006).

In agriculture, mechanization and the shifting nature of agriculture from an income-earning family-based enterprise to large-scale corporate farming reduced its viability as a traditional source of rural wealth (Munnich et al 2002). Land consolidation among industrial firms had also crowded out many individual farmers (citation). Consequently, Drabenstott (2001) observes that individual farms tended to remain in business only by growing specific crops as part of a supply chain. In manufacturing, market globalization towards the end of the twentieth century encouraged many firms to move production capabilities elsewhere to take advantage of lower-cost labor markets (Franklin 2012). Remaining domestic operations saw declining demand and increasing competition from cheaper global imports (Torgerson and Hamrick 1999).

Meanwhile, the nature of domestic manufacturing changed dramatically, shifting from low-value, commodities-driven products to those requiring higher levels of knowledge and labor specialization. With many rural communities reliant on the former, educational attainment levels had traditionally sagged in comparison to larger metropolitan areas (Munnich et al 2002). Worker skills associated with manufacturing in rural areas were seen as increasingly incompatible with the high tech demands of newer manufacturing jobs as well as the knowledge economy in general; helping to explain why many communities tended to add lower-paying jobs at the expense of those with higher wages (Munnich et. al 2002). In result, wage gaps between metro and non-metro counties increased significantly; with average earnings in nonmetropolitan counties reaching a historical low of 69.1 percent compared to metro earnings by 1998 (Gale and McGranahan 2001). Together, these trends underscored rural vulnerabilities resulting from high degrees of specialization and an increasing isolation from the knowledge-based economy.

In terms of knowledge economy activity, "rural areas as a whole have generally had lower levels of educational attainment, patenting and venture capital investment than metropolitan areas" (Munnich et al 2002). This aligns with the observation of

Drabenstott (2001) in that rural areas generally lack the infrastructure needed for high technology employment. As such, "rural economies consistently underperform in high technology industries and activities" in which knowledge, translated into innovation, "provides the primary source of competitive advantage" (Munnich et. al 2002). Of high technology employment that does happen to locate in rural areas, these jobs are observed to be generally limited to production level-positions in branch plant facilities illustrating little propensity for innovation or clustering (Glasmeier 1991).

Rural Knowledge Clusters

In light of these challenges, Munnich et al. (2002) drew upon elements of New Growth Theory and Porter's work on competitive clusters to offer a framework for rural development suitable for knowledge-based growth. This framework – Rural Knowledge Clusters (RKCs) – augments the traditional Porter approach by placing added emphasis on the role of "knowledge" as a driver of rural competitive advantage. The authors offer the following definition:

> "Rural knowledge clusters are specialized networks of innovative, interrelated firms centered outside of major metropolitan areas, deriving competitive advantages primarily through accumulated, embedded, and imported knowledge among local actors about highly specific technologies, processes, and markets"
>
> *- Munnich et al. (2002)*

The authors emphasize that to the degree knowledge is "diffused and externalized" to create competitive advantages, "it could be considered a rural knowledge cluster" (Munnich et al. 2002). Given the historically low educational attainment rates of rural areas, as well as their traditional reliance on a narrow range of low-skill industries, the RKC framework posits that rural communities may be better positioned to diversify economically and globally compete by investing in the development of new knowledge and skills.

In building this argument, the authors cite the work of several theorists to infer that "innovation-inducing processes" are by no means mutually exclusive or separated from traditionally "low-tech" rural areas. First, they cite the work of Maskell et al. (1998),

who characterize a system of "low-tech learning and innovation" to explain how firms in high-cost European economies competed successfully in traditional "low-tech" industries, such as furniture and fish processing, through a "continuous process of knowledge creation" (Munnich et al. 2002). They then cite the work of Audretsch (1998), in that these industries were viable despite their location in high-cost economies because "knowledge-spillovers from geographic proximity and agglomeration give them an advantage over low-cost economies" (Munnich et al. 2002). They also cite the work of Jarboe (2002), through an inference that "by capturing tacit knowledge, local intellectual capital may help develop products, or create entrepreneurial and business opportunities" (Munnich et al. 2002). They do recognize, however, the limitations of using traditional measures of tacit knowledge capture – such as patents – as a proxy for assessing regional economic performance. "The uneven nature of patenting across industries, and considerable time lag, limits their utility as a broad, cross-sectional measure" (Munnich et al. 2002). Lastly, they cite the work of Jarboe (2001) in that "capturing knowledge is not an easy process, especially 'indigenous knowledge' that is specific to an area and difficult to capture outside of its context" (Munnich et al. 2001).

Cases of Rural Knowledge Clusters

So what methods are appropriate for observation? Based on their analysis of rural clusters in Minnesota – wireless technologies in Mankato, Automation technologies in Alexandria, and recreational transportation equipment in Northwest Minnesota – the authors posit three hypotheses on what may underlie "evident" RKCs:

Hypotheses for "Successful" Rural Knowledge Clusters	
1.	**"Must have an endogenous source of competitive advantage**, such as a skilled workforce, access to market opportunities, or entrepreneurial culture."
2.	**"Must exhibit a path of historical development and evolution in relation to the local knowledge base."**

3.	**"Must relate to formal and informal institutions that have fostered the creation diffusion, and renewal of the local knowledge base,** including universities, community colleges, and other institutions important for facilitating learning and innovation." Munnich et al. (2002)

In Mankato, the authors focused on an evident concentration of diverse activities related to wireless technology, despite the city's size of 30,000 people. The Mankato cluster is comprised of two regional wireless service providers, several mid-sized manufacturers, the Institute for Wireless Education (a research and education center in Mankato that was part of the University of Minnesota's extension campus), and a local technical college, which provided "basic and advanced informational training about wireless technologies to major wireless companies such as Nokia, AT&T, and Lucent" (Munnich et al. 2002). Noting the area's evolution from radio technologies into modern telecommunications fields, the authors cited Mankato's strong base of engineers and technicians as one of its main competitive advantages. Key elements to success were (i) strong relationships between the research institute and technical college, which had aligned their curricula to reduce overlap and foster cooperation; (ii) the relationship between these institutions and local companies to provide a steady base of skilled workers; and (ii) the "ability of local firms to cultivate new and creative niches for wireless technologies across industries" that reduced the "cluster's vulnerability to cyclical trends" (Munnich et al. 2002).

In Alexandria, a town of less than 10,000 people, the authors found that the city's historic knowledge base in package equipment manufacturing provided a foundation from which to extrude niche specializations in technology components with application across a broad range of fields (Munnich et al. 2002). Automation technology is essential to package industry machinery, which allow high volumes of goods to be placed into shipping containers (Munnich et al. 2002). As such, "one may understand the historic locational advantages for Minnesota in this industry in terms of forward linkages to the food processing industry and backward linkages to metalworking firms and small engine manufacturers" (Munnich et al. 2002). The local community college had a strong relationship with local industry; hence it was able to amass steady internal competency in automation control technologies that it diffused among the local workforce as well as

related companies. Through this competency, Alexandria was able to "cross-fertilize" knowledge about automation control technologies into a wide range of local industries, including those to which packaging equipment had backward linkages, such aluminum component manufacturing (Munnich et al. 2002). The local technical college was cited as a critical factor of success, in that it served as a "broker" for automation and control technologies.

In sparsely populated Northwest Minnesota, the birth of the snowmobile gave way to the region's status as "home" to the only two domestic snowmobile manufacturers in the United States (Munnich et al. 2002). Initially, the two companies employed large numbers of people in two small towns in the region (Roseau, pop. 2,750; and Thief River Fall, pop. 8,400) and had regional relationships with suppliers throughout Minnesota (Munnich et al. 2002). To mitigate cyclicality in the snowmobile market, both companies expanded into all-terrain vehicles (ATVs) (Munnich et al. 2002). While the companies eventually moved their corporate headquarters to the Twin City area, Northwest Minnesota remained a hub for snowmobile manufacturing and transportation equipment, as well as a demand for the companies' product.

The two companies at the heart of the cluster – Polaris and Arctic Cat – had historically enjoyed a strong rivalry, as both traced their roots back to the entrepreneurial efforts of a shared employment base. The authors cite the work of Porter (2000) to characterize the positive effects that this combination of rivalry and home demand had on the continued viability of the cluster: "local rivalries encourage innovation and productivity growth for economic development as a whole because the innovation occurs at the microeconomic level but produces macroeconomic benefits" (Munnich et al. 2002). Both companies "lost considerable market share in the 1970s and 1980s to Japanese competitors, including Yamaha, Kawasaki, and Honda" (Munnich et al. 2002). Both responded by turning their attention to the strong demand provided their local base in Northwestern Minnesota – namely, snowmobile racing - to innovate new products (Munnich et al. 2002). In result, the authors found that "the ability to satisfy this market, which they credit to their proximity and agility in developing new ideas, in turn enhanced their ability to compete on high-quality within the broader snowmobile market" (Munnich et al. 2002). The authors also found that this same

source of home demand led to the proliferation of recreational boat manufacturers throughout Minnesota (Munnich et al. 2002).

Applying the RCK Framework to Danville

The underlying driver of cluster development – competitive advantage – often arises because of a variety of conditions intrinsic to place. Danville's experience is unique in that it is largely driven by outside knowledge and expertise, imported into the region to take advantage of a variety of physical assets and institutions. In examining Danville's case, it is important to contextualize which endogenous factors may have led to its knowledge economy outcomes and challenges because of (i) the implications of ensuring continued sustainability of the strategy, (ii) the risks of becoming overly reliant on outside specialized knowledge, expertise, and support for growth in information and high tech and (iii) possible equity implications arising from a high tech strategy arising among a predominantly low-skilled employment base.

The RKC concept offers a useful framework to assess these issues because of its consistency with the notion that "knowledge" provides a fundamental basis for economic diversification and competitive advantage in a globalized economy; and should be given special attention in rural economic development. It also presupposes that knowledge-based growth arises from endogenous factors on a sustained basis. If the intent of Danville's knowledge-based effort is to provide a "gateway" into new sectors that will drive sustainable future growth, such as information and high tech, then it is important to examine: (i) how these efforts draw from regional strengths, such as Southside's history in tobacco farming, polymers, and textiles; (ii) "who" the growth is benefitting and targeted towards; and (iii) how this growth differs from and reflects the historic development trajectories of the region.

Associated questions include: what role do endogenous knowledge and assets play in the Danville strategy and what challenges have inhibited their contributions to economic development? To what extent has the strategy depended on outside knowledge and institutions? How is "knowledge" defined by local institutions and positioned to add value to the region's economic development efforts? How successful has the city been with diversifying into IHT, based on the data? Has the associated

investment strategy been effective? How might the RKC framework help local leaders identify opportunities to address future challenges?

CHAPTER 2

THE DANVILLE STRATEGY: 1980-2000

Economic Base Analysis of the Dan River Region

New Regional Approaches: Formation of the Danville Regional Plan

Economic Base Analysis: The Dan River Region, VA

Background and Context

The Dan River region ("the Region" or "DRR") is located within Southside Virginia, a nineteen (19) county area comprising a large swath of the south central and southeastern Virginia.[3] The Region abuts North Carolina's northern border and consists of Pittsylvania, Patrick, Halifax, and Henry counties, as well as the cities of South Boston, Danville, and Martinsville. The City of Danville – the largest in the DRR and Southside – is within an approximate one-hour drive of North Carolina's Research Triangle Park; a one and a half to two hour drive to Roanoke and nearby Blacksburg; a four drive to Norfolk; and a four-hour drive to the Washington D.C. metro area.

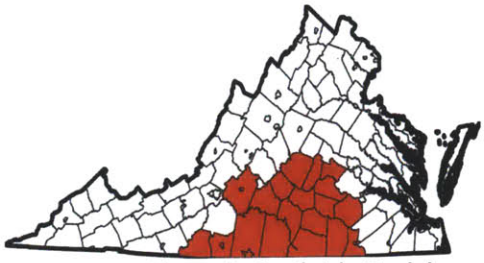


Figure 1: Southside Virginia
Source: Wikipedia

Known for its abundant natural resources, river access, and favorable growing climate, the DRR proliferated as an agricultural center for the high yield commodity crops of tobacco and cotton.[4] Danville, its economic center, grew on account of commerce arising from tobacco production in surrounding communities as well as its location on the Dan River; where low-cost shipping and hydropower resources gave way to higher-order production activities in the tobacco and textile trade (MDC 2003). As a location for low cost labor and natural resources, Danville grew into a production center for tobacco, textiles, and manufacturing, (predominantly in low-value products such as clothing and apparel, forestry products, and food processing, among others).[5] These three industries dominated the economic base of the Region for well over a century and set the stage for much of its physical, cultural, and demographic development.

The Dan River Region (DRR) in Southside
Source: Dan River Region Collaborative

Historic roots in tobacco and textiles set the trajectory for much of the DRR's initial growth. Booming industrial activity during the nineteenth and twentieth centuries encouraged strong linkages to form among its rural and urban communities, given that

the production, processing, and exportation of agricultural inputs comprised a large portion of the regional economy. Three main industry clusters arose and largely concentrated in Danville: (i) tobacco farming and processing; (iI) timber farming and wood product processing; and (iii) cotton farming and textile processing.[6] These sectors required few advanced skills or education and drove much of the Region's growth.

In Danville, a sprawling industrial complex of textile mills and tobacco warehouses drew in workers by the thousands to the downtown core. The city housed significant concentrations of companies in a narrow range of sectors, from textile product and small furniture manufacturing to tobacco warehousing and distribution. Industry infrastructure dominated much of the city's physical development. The Dan River Mills complex in downtown Danville, for example, stood as the largest textile mill in the South and was one most visible symbols of the Region's success. At its peak during the mid-twentieth century, the mills employed as many as 14,000 workers amidst a city population of approximately 40,000 people (MDC 2000).

Industry Structure and Employment

Top Ten U.S. Manufacturing Sectors By Employment (%)			
	Early 20th Century		**Late 20th Century**
1)	Foundry & Machine Shops	1)	Motor Vehicles & Equipment
2)	**Cotton Goods**	2)	**Plastic Products**
3)	**Lumber Products**	3)	Commercial Printing
4)	Iron & Steel	4)	Electronic Components
5)	**Men's Clothing**	5)	Meat Products
6)	Printing and Publishing	6)	Structural Metal Products
7)	Railroad Cars & Related	7)	Newspapers
8)	Footwear	8)	Misc. Industrial Machinery
9)	**Carpentry**	9)	Aircraft & Parts
10)	**Tobacco, Cigars, Cigarettes**	10)	Misc. Fabricated Metal

Table 1 - Sectors highlighted in red have or have had a notable presence in Southside, VA
Sources: (Census, 1968), (Clark, 1984), (Bureau, 2001)

Dominance in agriculture and manufacturing was the hallmark of the Southside's growth as well as its subsequent decline. At the beginning of the twentieth century, many top ten national manufacturing sectors were largely driven by low-value, commodities driven products with high labor content requiring little specialized skill or education. Southern Virginia not only had a direct manufacturing presence in approximately half of these sectors, but also strong agricultural ties through raw materials and crop production. These included cotton goods, lumber products, clothing, carpentry, and tobacco products. By the end of the twentieth century, however, the national industry base shifted towards manufacturing industries that were higher valued, reliant on more sophisticated forms of labor specialization, and characterized by greater knowledge intensity along the value chain. This included sectors such as motor vehicles and equipment, electronic components, aircraft and aircraft parts, and plastic products. As such, while five of the top ten sectors had a notable presence in Southside at the beginning of the 20th century, only one in the top ten had by the end of the 20th century.

Dan River Region, VA Percentage of Total Emp.	1980	1990	2000	Change 1980-2000
Manufacturing	**47.4%**	**43.9%**	**33.7%**	**-28.9%**
Agriculture, Forestry, & Mining	3.5%	2.5%	1.3%	-63.7%
Total	**53.4%**	**48.6%**	**37.4%**	**-29.9%**

Table 2
Source: Social Explorer Tables (SE), Census 1980, 1990, 2000 U.S. Census Bureau and Social Explorer

In 1980, 53.4% of DRR workers were employed in Manufacturing, Agriculture, Forestry, and Mining. Over the next two decades, however, employment sharply declined on account of collapses in the Region's textile, tobacco, and small furniture manufacturing industries. Given that tobacco and textiles were export products, each job lost in these industries reduced the wages and amount of local goods and services purchased by farmers, farmworkers, firms, and industry employees in the DRR; accelerating negative multiplier impacts.

These negative impacts are illustrated by Location Quotient (LQ) trends calculated for the DRR from 1980 to 2000 in Table 3. By 1980, the LQ for Manufacturing in the DRR was 2.49 in comparison to Virginia as a whole, indicating that Manufacturing comprised a substantial portion of the regional also export-driven, responding to exogenous demand and attracting income from outside the Region to stimulate wage and job growth. In contrast, LQs for virtually all other sectors in the DRR were below 1 for the following two

decades; indicating the Region's tendency to import goods and services while relying largely on manufacturing for export-based

Dan River Region, VA Industry Composition	Emp. 1980	LQ 1980	Emp. 1990	LQ 1990	Emp. 2000	LQ 2000	Pct. Change
Employed Persons 16 Years & Over:	**98,693**	-	**101,140**	-	**97,263**	-	-
Agriculture, Forestry, & Mining	3,411	0.96	2,537	0.95	1,219	0.98	-52.0%
Construction	5,324	0.75	5,616	0.71	6,717	0.94	19.6%
Manufacturing:	**46,745**	**2.49**	**44,380**	**2.90**	**32,736**	**2.97**	**-26.2%**
Transportation	2,859	0.72	2,746	0.69	2,999	0.80	9.2%
Communications & Public Utilities	1,605	0.60	1,546	0.55	834	1.07	-46.1%
Wholesale Trade	2,520	0.75	2,234	0.66	2,415	0.91	8.1%
Retail Trade	12,486	0.84	14,406	0.89	11,822	1.07	-17.9%
Finance, Insurance, Real Estate	3,206	0.59	3,574	0.54	3,483	0.54	-2.5%
Business & Repair Services	1,917	0.44	2,903	0.58	-	-	-
Personal, Entert., & Recreation	3,254	0.75	3,140	0.71	5,186	0.74	65.2%
Professional & Related Services:	12,949	0.64	15,573	0.66	25,411	0.74	63.2%
Health Services	4,456	0.68	6,117	0.85	9,409	0.83	53.8%
Educational Services	6,511	0.73	6,114	0.75	7,156	0.40	17.0%
Other Prof. & Related Services	1,982	0.40	3,342	0.41	8,846	1.69	164.7%
Public Administration	2,417	0.24	2,485	0.27	3,211	0.40	29.2%
Information	-	-	-	-	1,230	0.33	
Source: Social Explorer Tables (SE), Census 1980, 1990, 2000 U.S. Census Bureau and Social Explorer							

economic growth. The DRR manufacturing LQ grew to 2.97 by 2000, indicating that the sector comprised larger, more concentrated shares of the local economy over time.

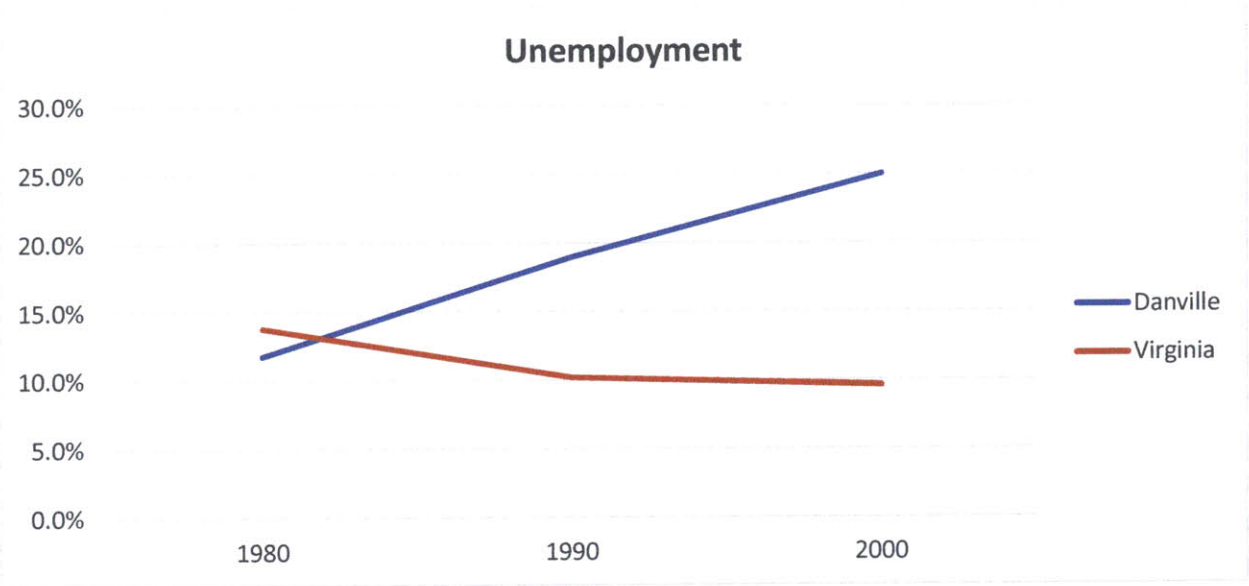
Regional losses were exacerbated by state and national trends. From 1978-1997, employment in Textile Mill Products declined 23.3% in Virginia and 32.1% in the U.S. Employment in Apparel and Other Textile Products also declined 46.3% in Virginia and 36.0% in the U.S. (MDC 2000). Federal tobacco allotments for the DRR also dropped to their lowest levels since 1938, creating further losses in tobacco farm employment (MDC 2000).

The negative impacts of these trends were stark. By 1990, unemployment spiked to a collective 13.5% Region-wide, with rates peaking at 23.6% in Martinsville and 11.8% in Danville where many of the DRR's textile

Dan River Region, VA Unemployment Trends	1980	1990	2000
Halifax County	6.3%	8.1%	9.0%
Henry County	3.7%	16.4%	11.1%
Pittsylvania County	5.3%	12.0%	4.5%
Danville City	6.9%	11.8%	3.9%
Martinsville City	4.4%	23.6%	19.9%
Weighted Avg. Total	**5.2%**	**13.5%**	**7.9%**
Source: Social Explorer Tables (SE), Census 1980, 1990, 2000 U.S. Census Bureau and Social Explorer			

plants were located. While poverty rates climbed only slightly in the DRR during this period, they remained persistently higher than State-level rates, which happened to be decreasing.

Unemployment trends throughout the 1980-2000 period also show that Danville continued to diverge from the state as a whole, suffering from increasing unemployment due to the structural decline of its manufacturing and textile industries.



Source: Social Explorer Tables (SE), Census 1980, 1990, 2000 U.S. Census Bureau and Social Explorer

Educational Attainment

Educational attainment in the DRR historically lagged behind the State. In 1980, approximately 83% of the DRR population had a maximum high school education or less compared to 65%

Southside, VA Educational Attainment	1980		1990		2000	
Population 25 Years and Over:	Pct.	SS / VA	Pct.	SS / VA	Pct.	SS / VA
High School or Less	82.5%	1.25	73.2%	1.42	66.5%	1.49
Some College	9.9%	0.66	17.8%	0.74	22.6%	.87
Bachelor's Degree	7.6%	0.40	6.1%	0.40	7.0%	0.39
Master's Degree	-	-	2.9%	0.32	2.6%	0.33
Professional Degree	-	-	-	-	1.0%	0.44
Doctorate Degree	-	-	-	-	0.3%	0.20

Table 5
Source: Social Explorer Tables (SE), Census 1980, 1990, 2000 U.S. Census Bureau and Social Explorer

statewide; or a proportional difference of approximately 1.25. This reflected the Region's heavier reliance on sectors requiring little skill or training and tendency of workers to seek no more than a high school education before taking jobs in the local factories and agricultural fields. This tendency drove much of the historic difference in educational attainment that accumulated between the Region and the State.

Despite improvements in educational attainment from 1980-2000, the DRR did not keep pace with Virginia as a whole. Table 4 lists ratios comparing the share of educational attainment status as a percentage of total population for the DRR versus Virginia.[7] During this period, the proportion of DRR residents with a High School Education or Less compared to Virginia increased from 1.25 to 1.49; indicating that the State was more rapidly changing in its educational composition than the Region. Nonetheless, Southside did make progress on several fronts, for example in increasing its share of residents with some college (coming into parity with state levels by 2000) and steadily increasing shares of residents with a Bachelor's Degree or higher.

Population Growth and Age Distribution

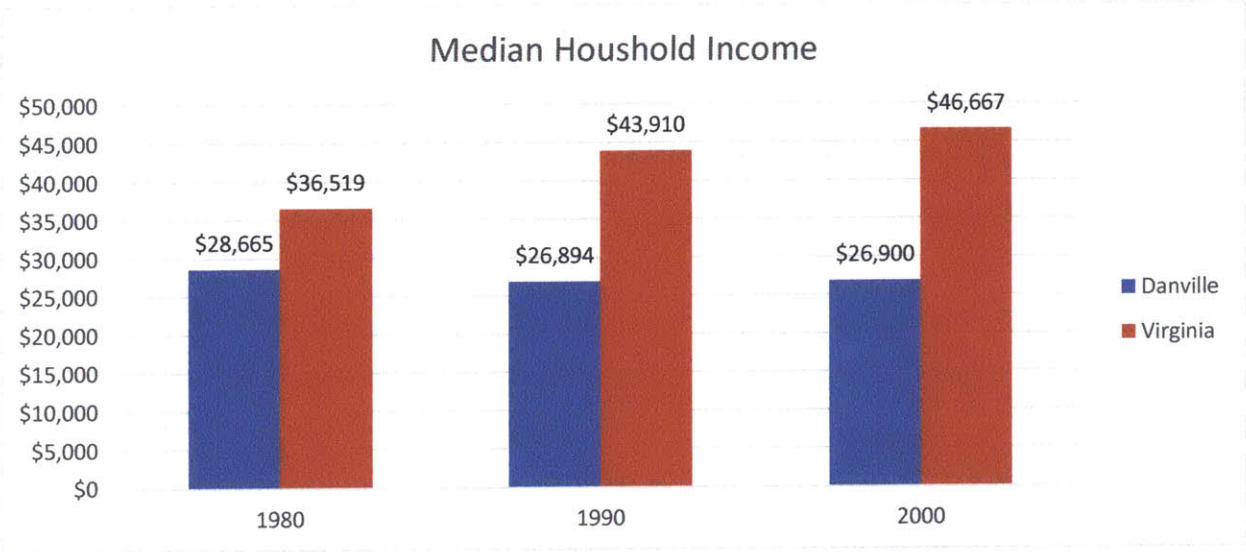
The DRR changed significantly in its Age Distribution during this period. Growing just 1% in total population, the DRR increased primarily in its number and proportion of older population segments. In contrast, younger population segments decreased in size and proportion; indicating a steady outmigration of population and talent. Shifting age distributions underpinned the Region's reliance on undereducated workers as well as aging population. With the continued outmigration of young people, older – and hence, historically less educated – population segments grew in concentration while assuming an increasingly prominent role in the Regional workforce.

Dan River Region, VA Age Distribution	1980	1990	2000	Change
Under 18	**60,717**	**49,528**	**50,638**	**-17%**
Age 18 to 35	58,447	51,842	43,091	-26%
Age 35 to 65	**73,227**	**77,186**	**90,523**	**24%**
Age 65 and Older	25,800	32,292	36,605	42%
Total	**218,191**	**210,848**	**220,857**	**1%**

Table 6
Source: U.S. Census Bureau

Median Household Income

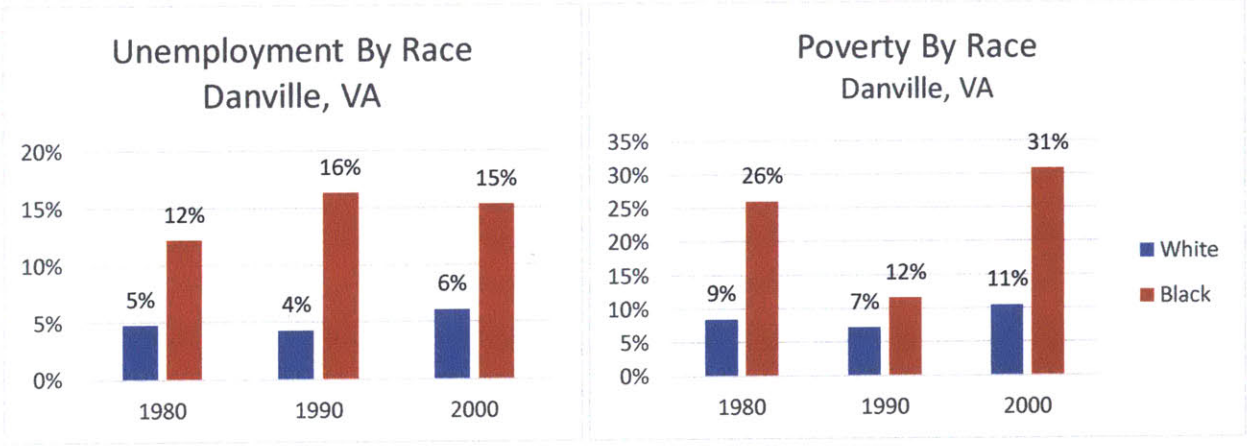
The City of Danville lagged far behind the state for income growth throughout the 1980 – 2000 period. Virginia as a whole continued to outpace Danville, while household income in Danville declined.



Social Explorer Tables (SE), Census 1980, 1990, 2000 U.S. Census Bureau and Social Explorer

Racial Disparity

Throughout the 1980-2000 period, Danville also saw stark disparities between whites and blacks, in terms of both unemployment and poverty.



Social Explorer Tables (SE), Census 1980, 1990, 2000 U.S. Census Bureau and Social Explorer

New Regional Approaches

Forming the Danville Regional Plan (2000)

Throughout the 1990s, many DRR communities resorted to traditional industrial recruitment strategies to replace lost jobs. Despite piecemeal attempts to lure large firms on the basis of low cost labor and inputs, financial incentives, business parks, and other measures, the Region experienced little to moderate success (Interview, Pfohl). Reasons for this dilemma included: insufficient demand from companies; a lack of attractive "site-ready" industrial locations under public control; a lack of skilled and educated workers with proficiency in science, technology, engineering, and math (STEM) driven fields; and a lack of broadband infrastructure capable of meeting basic telecommunications needs of businesses (Interview, Wright). Without intervention, gaps in the Region's human and physical asset base would continue to prevent it from diversifying away from its traditional industries of agriculture and manufacturing.

In 2000, area leaders convened in Danville to discuss new approaches for regional development (MDC 2000). The pressing question underlying the meeting was "how can DRR communities work together to move beyond their traditional yet declining industry base to create a more stable, diversified, and competitive economy with increasing wages for residents?" (MDC 2000). High wage, high-skill jobs were seen as a critical answer to this question. Leaders recognized that in a global economy increasingly driven by talent and ideas, capital and investment tended to follow people – the human capital of cities. As such, investing in the infrastructure and quality of life amenities necessary to attract skilled talent was a prerequisite for high wage job growth. Yet the dilemma facing Danville and other DRR communities was that its isolation and lack of competitive infrastructure, job diversity, and high quality of life and education had stifled talent and companies from accruing in the Region.

With the bottoming out of its textile and tobacco industries and low educational attainment rates, the area faced an impeding economic crisis. As one local leader put it, "the region had to either change or die." In response, DRR leaders developed a bold vision to establish a knowledge economy rooted in new sectors as well as an action

plan ("the Danville Regional Plan") to lay the groundwork for growth and new change in direction. The sentiment at the heart of the Plan was that:

> *"The Dan River Region is at a crossroads [and faces] continued economic decline unless a change of direction takes place. The Region's economy is based on traditional manufacturing and tobacco. These industries are declining. Jobs are disappearing. Wages are not keeping pace with the rest of the Commonwealth. This decline is predicted to continue (MDC 2000)."*

Area leaders surmised that instead of pursuing low-wage, low-skills jobs via traditional industrial recruitment, the DRR should prioritize economic development strategies targeting high-wage, high-skill jobs in sectors with significant growth potential in the Region:

> *"Information technology and high-tech industries that support it are growing at a rapid pace along the East Coast, creating thousands of high-paying jobs. The Dan River Region must shift from a traditional manufacturing/agriculture base to an information/high technology base to create jobs and increase wages. The area is facing an economic crisis and must take bold action (MDC 2000)."*

The Recommendations

Created in 2000, the Danville Regional Plan (MDC 2000) offered recommendations to improve Southside's prospects and develop foundations for a knowledge-driven economy. These included:

1. *Regional High-Speed Internet (i.e. "Broadband") Communication Network* to enhance advanced telecommunications and network capabilities in the Region.

2. *Advanced Research and Higher Education Institute* to provide the Region with long-term capabilities to develop new knowledge and talent in emerging fields.

3. *Education and Workforce Development Programs* to improve academic achievement at all levels and help local workers develop the necessary skills for jobs in information, high tech, and other emerging fields.
4. *Civic Loan Program* to support new ideas and organizations with the potential to create economic development impacts in the Region and improve quality-of-life.

5. *Civic Networks* to improve communication between local organizations and businesses in a way that quickly identifies their needs and convenes the appropriate response

The theory of change driving the Danville Regional Plan was that (MDC, 2000): [1] diversifying the economic base into information, high tech, and other sectors would provide an important counterweight to losses in tobacco, textiles, and traditional manufacturing. The Region was historically dependent on a narrow range of industries and low-skill, low-value jobs. Entry into these sectors would help protect the DRR against future shocks and strengthen regional resilience. [2] Skilled-talent – particularly in science, technology, engineering, and math-driven (STEM) fields – would provide the foundation for growth in information and high-tech. As such, developing a strong talent-base would depend on investments in education, workforce development, and other amenities to attract outside talent to the Region. [3] Attracting higher-wage, high-skill jobs was critical for improving the Region's economic prospects. High-wage jobs would increase wages and resultant spending on local goods and services, creating positive spillover impacts and economic benefits for individuals at all levels. [4] Knowledge economy growth depended on strong physical infrastructure and institutions to facilitate information exchange and production, as well as to meet the evolving communications needs of businesses. [5] Strong civic leadership was needed to coordinate action over the long-term and to project a new regional image oriented towards information and high tech.

The Actors

The Danville Regional Plan became a permanent fixture of southern Virginia's economic development strategy. Since 2000, its recommendations have elicited collaboration and resources from multiple organizations and levels of government. The main organizations include, but are not limited to:

Funders

Virginia Tobacco Indemnification and Reinvestment Commission (TIC) – the TIC is a public body consisting of elected representatives representing the interests of Virginia's tobacco-growing regions. It is the primary steward of Virginia's tobacco settlement, a 1998 settlement between the Attorney Generals of 46 states and four major tobacco companies to pay for smoking related illnesses, from which Virginia will obtain $4.1 billion over 25 years. TIC is one of the primary funders for economic development in Southside, having invested over $450 million in in the region since 2001.[8] It identified outmigration and industrial decline as two of the southern Virginia's biggest problems, and as such, created several program areas to reverse these negative trends. These include: Economic Development, Innovation-Based projects, Research and Development, Education, Agribusiness, Industrial Megasites, and Small Business Financing, among others. TIC sought to invest in aspects of the Danville Regional Plan that could positively shape southern Virginia's trajectory over a 50-100 year time frame (Interview, Pfohl).

Future of the Piedmont Foundation (FPF) – based in Danville, FPF was the initial driving force behind the Danville Regional Plan by funding its initial formation and many subsequent projects. The FPF board consisted of business, government, and community leaders brought together by urgency to confront the unfolding economic crisis in the DRR and garner outside resources to change its course. The group had strong political connections with leaders in the state legislature and lobbied for tobacco settlement funds from the TIC. FPF also established partnerships with institutions outside the Region to add legs to various elements of the Plan.

Danville Regional Foundation (DRF) – also based in Danville, DRF was created in 2005 through funds obtained after the sale of a local hospital. It has played a key role in advancing the plan's recommendations, particularly related to economic development, education and workforce development, and community capacity. In response to the Region's "mill town without a mill" mentality, DRF works to reshape persistent cultural attitudes that inhibit economic growth. These include an undervaluation of education, a belief that single dominant employers will provide the majority of jobs, and an over reliance on outside entities for employment (Interview, Stauber). these represent DRF's ambition to invoke greater entrepreneurship and a sense of personal agency over economic development, as well as to instill flexibility in the local economy in response to industry volatility. Its geographic area encompasses Danville and Pittsylvania and Caswell Counties.

Educational Institutions

Virginia Polytechnic and State University (VT) – after being approached by FPF and other local partners, Virginia Tech offered several proposals to support knowledge economy development in the Region. Among these were a regional broadband backbone, the advanced research and higher education institute, and educational programming to upgrade the local skill-base in information and high tech. Virginia Tech saw the DRR as an opportunity to expand its educational and research mission in multiple research fields while creating economic impact in an isolated part of the state. This objective was well aligned with its public interest charter. VT offered its faculty, educational programming, financial resources, political connections, research expertise, and status as a land-grant institution to establish the Plan and a permanent physical presence in the DRR.

Government

City of Danville and Pittsylvania County – through their resources, public-interest charter, and powers related to taxing, land control, policy-making, and permitting, the City of Danville and Pittsylvania County governments played key roles in shaping the Danville Regional Plan and its subsequent projects. Main functions provided focused

primarily on business attraction, the built environment, and infrastructure development to support high-tech businesses and promote new investment. Both entities were driven by shared concerns to improve the DRR's competitive advantages in information and high tech, attract new businesses and talent, create high wage jobs, increase the local tax base, and modernize local infrastructure. The City also saw the Plan as an opportunity to stimulate downtown revitalization and redevelop large swaths of vacant buildings to attract new talent and businesses.

Business Consulting

The Launch Place (formerly known as the Southside Business Technology Center (SBTC) – Based in Danville since 2005, the Southside Business Technology Center (SBTC) was originally established in partnership with Virginia Tech as a non-profit to provide "management and business consulting services for new business development and existing industry transformation" in Southern Virginia (Interview, Stauber). Over its first 5 years, SBTC provided assistance to over 100 businesses "in the areas of business plan development, feasibility studies, start-up procedures, locating sources of capital, market research and analysis, financial and operational analysis, and legal framework issues."[9] In 2010, SBTC changed its name to "The Launch Place" with an injection of capital from the Danville Regional Foundation to pilot an investment fund and entrepreneur-attraction strategy to lay groundwork for the City's knowledge economy efforts.

Broadband

Mid-Atlantic Broadband Cooperative – In 2004, the Mid-Atlantic Broadband Cooperative (MBC) out of South Boston, VA was formed to assume the role of "steward" of Southern Virginia's existing broadband network and to facilitate future expansions. MBC is a non-profit entity designed to lower the barriers to entry for companies seeking to locate in Southern Virginia with a need for broadband access. It does so by managing tasks related to designing, building, operating, managing, and maintaining broadband system expansion; largely through capital support from the Virginia Tobacco Commission and US Department of Commerce Economic Development Administration.[10]

CHAPTER 3

THE DANVILLE REGIONAL PLAN: 2000-Present

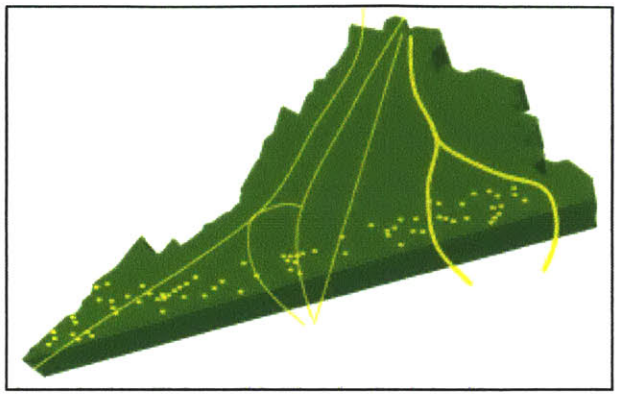
Unfolding of a Knowledge-Driven Economy

Unfolding of the Projects

This chapter describes qualitative aspects of each recommendation proposed by the Danville Regional Plan. It covers each in terms of their intentions, evidence of progress, and – where possible – the challenges facing their implementation. Discussion of the challenges may be inconsistent due to limitations posed by a small number of phone interviews and promotional bias in secondary materials and reports. Nonetheless, this chapter examines how various elements of the Danville Regional Plan are designed to were designed to operate, factors influencing their implementation, and new opportunities that have arisen since 2000. The following projects will be described:

- Regional High-Speed Internet Communication Network (i.e. "broadband")
- Advanced Learning and Higher Education Institute (IALR)
- Education and Workforce Development Programs (IALR)
- Network Development
- Civic Loan Program (i.e. "The Launch Place")
- Industry Cluster Marketing Effort and Downtown Redevelopment

Regional High-Speed Internet Communication Network



Along Highway 58, all existing fiber ran North-South, leaving nearly 100 communities (yellow dots) underserved. (Source: Virginia Tech eCorridors 2002) Image Credit: Virginia Tech eCorrdors

After unsuccessfully competing to attract several technology companies in the late 1990s, economic development leaders from the region convened to discuss strategies to upgrade Southern Virginia's competitive infrastructure. Past public investments created the road and rail access and electricity service needed to support the Region's traditional manufacturing base; yet these assets in were not enough to attract technology companies dependent on high-speed Internet access. Virtually all of the available fiber paths in Virginia ran North-South, with none running East-West. This infrastructure gap prevented communities like Danville and others along Virginia's Highway 58 corridor from moving beyond slower dial-up modem service.

The DRR faced a market failure resulting from unbalanced supply and demand for broadband. The cost of extending service to communities along Virginia's Highway 58 corridor was prohibitively expensive for the private sector, given the Region's insufficient network demand and large infrastructure financing costs. Yet without access to high-speed Internet, the Region would continue to be constrained from developing enough network demand to entice private investments in service extensions. Public intervention was therefore needed to overcome the initial infrastructure financing costs and lower private barriers to entry. Southside leaders approached state legislators and the VTC to garner resources and expertise to address this need.

One of the major institutions to step forward was Virginia Tech (VT). In 2000, the university offered to "serve as a partner and change agent" in the economic transformation of the Region through a series of proposals designed to upgrade the "knowledge-production" infrastructure in Southside (Virginia Tech, 2000). Among these, VT offered to spearhead regional plan for broadband development. This was led by the

university's "eCorridors" program, a research and technical assistance arm dedicated to telecommunications technology and economic development (Interview, Blythe).

The formal goal of eCorridors is to "work with communities, private-sector, and municipal partners to facilitate rapid development of advanced, fiber optic, wireless, and 'next generation' Internet infrastructure across the Southern region of Virginia" (eCorridors Program, 2002). Building off its "eVillages" model – which was originally designed in the 1990s to raise awareness of the Internet and enhance economic opportunities in individual communities– eCorridors grew to adopt a regional focus (Interview, Blythe). eCorridors served as a focal point for the university's collective resources, expertise in telecommunications technology and related disciplines, and aspirations to advance a broadband plan that would help to transform the Southwest and Southside Virginia regions.

Broadband Intentions

Backed by funding from the Virginia Tobacco Indemnification and Investment Commission (TIC) and U.S. Department of Education, VT in 2000 proposed six focused and interdependent projects to grow a more "knowledge-based and networked" economy in southern Virginia (eCorridors 2000). These projects were designed to help local communities better engage the "catalysts" of knowledge economy growth, including "affordable access to technology, an educated, skilled workforce, new business expectations, and new markets to benefit the regions' citizens and its expanding economic base" (eCorridors 2000). Three focused on improving telecommunications capacity (including broadband) and three focused on improving human capacity (eCorridors 2000):

- *Network Economy Analysis and Development Recommendations* – VT study describing the economic conditions and opportunities in the DRR to deploy new broadband technologies; an examination of local telecommunications and state policies; and economic impacts that would accrue from regional broadband development (eCorridors 2000). The study resulted from efforts of VT faculty members and students in engineering, economics, planning, and other

disciplines to devise a strategic broadband plan for Southside and Southwest Virginia.

- *Multimedia Service Access Point Prototype (MSAP)* – pilot project to develop a "local hub model" for the emerging advanced communications and network industry. Anchored in Danville, the project was envisioned as a partnership among VT, private industry, and local communities and designed to showcase the latest in advanced communications and network technology.

- *Advanced Network Technology Apprenticeship Program* – a paid apprenticeship program conducted in conjunction with local educational institutions and private industry partners to install and maintain the "network infrastructure essential for adoption of advanced communications, network, and system technologies" (eCorridors 2000).

- *Virginia Tech, K-12 Partnerships* – proposal to upgrade school network infrastructure throughout the DRR while conducting "technology training for teachers" and providing related math and science programs.

- *Virginia Tech, Local College Partnerships* – proposal to (i) upgrade the electronic capabilities of classrooms throughout the DRR, (ii) implement a faculty development program to "integrate technology into the classroom", and (iii) create computer-based learning programs where appropriate (eCorridors 2000).

- *Youth Development Program* – proposal to develop a three-week summer residential program at Virginia Tech for disadvantaged high school youth that offers individual training in computer hardware and software.

These proposals were driven by several assumptions. First, eCorridors believed that ubiquitous access to broadband would help integrate isolated and lagging Virginia communities into the knowledge economy and improve their basic development metrics

(Interview, Blythe). This would be achieved through expanded economic opportunities and improved access to services, such as education and health care. By connecting anchor institutions such as schools, hospitals, and government buildings to the broadband network first, eCorridors posited that southern Virginia could aggregate a baseline level of demand necessary to stimulate follow on investment and help the region keep pace with more networked portions of the state (Interview, Blythe). By serving the educational community specifically, eCorridors assumed that Southside would be more able to disseminate information technology-driven skills and improve achievement in educational attainment and workforce training.

Second, eCorridors encouraged business models based on providing affordable access to broadband and information technology (eCorridors 2002). Given the high costs of extending broadband service to the region's rural communities, eCorridors recommended that public dollars and other forms of patient capital be dedicated to finance the initial costs of infrastructure development. By lowering barriers to entry through public investment, eCorridors surmised that private companies would be more willing to invest in delivering broadband services as well as in future service extensions.

Third, by expanding rural access to the highest levels of the technology curve, eCorridors sought to create a rural competitive advantage rooted in information production as well as low-cost, state-of-the-art information technology (eCorridors 2002). Traditional network infrastructure (i.e. first generation Internet services) built by telephone and communications companies was largely unidirectional in allocating bandwidth – meaning that 90% of bandwidth was dedicated to receiving information and the other 10% dedicated towards sending information (Interview, Blythe). This arrangement meant that Internet customers had to pay largely for the ability to consume information; giving telecommunication monopolies control over the network while constraining more productive forms of engagement with Internet services. In this case, southern Virginia was no different. eCorridors sought to address this constraint through an "open access" model whereby increasing bandwidth in both directions (i.e. for sending and receiving data) would allow broadband participants to become "information producers" at nearly equal prices as "information consumers" (Interview, Blythe). This cost parity was thought to enable new forms of commerce in industries such as network

and information services as well as new forms of research, communication, and data interpretation (eCorridors 2002).

The improvements in speed for southern Virginia were "designed to meet the high tech requirements of the Department of Defense, research universities, and the private sector" (Materna 2004). eCorridors surmised that these improvements could help "level the playing field" between rural Virginia communities and more networked areas of the country (eCorridors 2002). As eCorridors observes:

> *"The highest levels of access to the first generation of internet technology are concentrated where they were first deployed as part of the massive federally sponsored development efforts, such as ARPAnet, NSFnet, and ESnet – in the greater Boston region, in Northern Virginia and the greater Washington D.C. region, in the Silicon Valley and San Francisco Bay region, and in the greater Chicago area... The Regions that have benefitted most are those that had in place the greatest concentrations of information and network literate knowledge workers, made available to this new economy by the end of the Cold War and the concomitant attenuation of the government investment in the defense industry – again, regions including Boston, Washington, and the Bay area" (eCorridors Program website, 2013).*[11]

By marketing technology capabilities not readily available in heavily networked regions, eCorridors proposed the notion that southern Virginia had an opportunity to "leapfrog" into next generation broadband services and position itself as a competitive location for businesses with sophisticated telecommunications requirements. This would also accelerate the pace for new, endogenous forms of information production to take root in Virginia's rural communities, such as institutionally driven research, e-commerce,[12] and high performance computing. Together, these capabilities would help southern Virginia communities diversify into new sectors such as information, high tech, and others.

Broadband Economic Development Components

Drawing on the research and technical assistance provided by VT and eCorridors, leaders from Danville and Pittsylvania County put their broadband aspirations into a proposal in 2000 and submitted it to the TIC for funding (eCorridors 2002). These aspirations rested on the notion that the DRR would have to make major investments in broadband capabilities to capture Internet-related economic activity, improve its existing economic base, and prevent itself from falling further behind more networked areas of the country. The first phase of development, initially dubbed "eDan," was anchored in Danville and consisted of five elements (eCorridors 2002):

- *Inter-Community Next Generation Optical Link (Danville to Chatham)*, to provide an Internet superhighway segment linking Danville and Pittsylvania County

- *Gigabit Gateways,* to enhance the speed and effectiveness of Internet delivery to local customers throughout the network

- *Two Multimedia Services Access Points (MSAPs)*, to provide central, broadband switching and access points (i.e. information "on- and off-ramps" to the regional network) for all local Internet, voice, and video traffic; this focused on keeping local traffic local and improving performance to reduce the cost for service providers[13]

- *Pilot Projects focused on local "1st Mile" access*, to bring broadband access "to the curb" of homes and businesses in targeted areas of the City
- *Business Plan for the "Dan River region to Tier 1 Internet Backbone"*, to connect the City of Danville to the broadband superhighway running throughout the state

Upon receiving $2 million from the TIC for two years, FPF and eDan solicited for private sector participation by sending a "Request for Collaboration" to approximately 50 companies (eCorridors 2002). An information session was held in October of 2001, which was ultimately attended by 75 companies, including seven with a national

presence and three with an international presence (eCorridors 2002). According to eCorridors (2002), "several attendees represented business start-ups that were looking for locations to establish their dot-com businesses." Representatives of eDan, Future of the Piedmont Foundation (FPF) the City of Danville, and Pittsylvania County were on hand to answer questions and establish contacts to ensure further collaboration (eCorridors 2002).

Evidence of Progress

After receiving proposals from interested companies, FPF and eCorridors selected several for funding (eCorridors 2002). The resultant projects indicated that public-private collaboration was indeed resulting in economic development progress. For example (eCorridors 2002):

- Communities throughout the Region worked together to provide space and "rights-of-ways" allowing for broadband development

- Local task forces were created with representatives of the communities to "address public relations, applications, inter-community fiber build, rights-of-ways, and MSAP facilities" (eCorridors 2002).

- The City of Danville and RACO, a local contractor, built a "40 mile, 60-fiber route linking Danville to Chatham and Gretna" (eCorridors 2002)

- Local contractors, including Gamewood, a local Internet Service Provider (ISP), took an active role in providing local Internet services and participating in network expansions
- Formation of the Mid-Atlantic Broadband Cooperative in 2004 to assume role of system steward and manager

nDanville Broadband Network

The most evident outcome of these efforts was the "nDanville" broadband network, a high-performance, open-access fiber network in Danville that plays a central role in the City's economic development strategy (Cohill 2012). Since 2000, the strategy has focused on three interrelated areas: advanced telecommunications infrastructure, technology education and workforce training, and targeted downtown revitalization projects (Cohill, 2012). Commissioned in 2007, nDanville consists of 135 miles of fiber and passes more than 1,000 business locations. It currently serves five business parks, the City's downtown, its historic Tobacco Warehouse District, a variety of medical and educational institutions, and city office buildings. It also offers free wireless Internet "hot spots" in several locations in Danville, including the downtown Historic District and various public parks (City of Danville, 2013).

nDanville grew through leadership provided by the municipal utility, Danville Utilities, to deploy a fiber-optic network and smart-grid "incrementally until it could serve every home, business, and community anchor institution in Danville Utility's territory" (Community Broadband Networks, 2011). As such, the utility played an important role in implementing the network. It is the largest municipality in Virginia to own electricity distribution services; serving approximately 44,000 electricity customers in Danville, southern portions of Pittsylvania County, and small portions of neighboring Halifax and Henry counties (Cohill 2012). Approximately half of its customers are located in Danville's 44 square-mile footprint, with the rest located throughout a 456 square-mile rural area outside the city (Cohill 2012). As an arm of the city government, Danville Utilities gave Danville a significant advantage to implement broadband successfully by eliminating permitting costs and fees otherwise associated with negotiating utility infrastructure construction (Cohill 2012).

A central tenet of nDanville is its public-private structure. Being city-owned, nDanville was designed to function as a "public access digital roadway" allowing private businesses use of the system to deliver broadband services, such as Internet, TV, phone service, and others (Cohill, 2012). The city does not sell broadband services, but rather invests in and maintains the system in similar fashion to conventional transportation roadways. By applying the same usage rules and pricing to private

service providers (through a publicly available list of prices), the model encourages local competition while allowing companies to offer their services at lower cost (Cohill 2012).

nDanville aspires to create "universal access" for network users by providing "equal levels of quality and service to homes and businesses" throughout its network footprint (Cohill, 2012). This supports the "open access" model promoted by eCorridors by helping to "aggregate the largest possible numbers of potential customers for service providers" (Cohill 2012). Similarly, nDanville also encourages local competition and economic benefits by: enabling multiple services simultaneously, such as Internet, phone service, TV, and others; providing unlimited bandwidth to customers on the belief that every home and business should have full access to capabilities needed to compete in the global economy; and enabling upstream and downstream data capacity to support business class services and applications, such as video-conferencing (Cohill 2012).

Evidence of impact from broadband availability has accrued on multiple fronts, most notably, in the areas of local government operations, business attraction, and education. A high-performance city intranet provided by nDanville has given the city administration new capabilities to communicate between departments and synthesize information related to critical government services. For example, in the case of permitting and real estate, an online intranet application provided by the City of Danville Department of Economic Development titled "ProjectView" allows for: (i) an "Electronic Approval Process," where all agreement forms are filled out, submitted, approved, stored, and retrievable electronically for real estate projects; (ii) "Project Transparency," in that full access to real estate project details are provided to enhance collaboration and communication with developer clients during a real estate project's life cycle; and (iii) "Enhanced Communication," where real estate project details are exposed, including vulnerabilities such as "risks, issues, changes, notes, and costs" (City of Danville website, 2013).

Noblis Supercomputing Center

Another important result from broadband development was the 2011 inception of the Noblis Supercomputing Center in downtown Danville. Noblis is a company based

out of Washington D.C. that provides sophisticated software, data storage, and data analytics services for a research-driven clients, including the federal government and private industry.[14] Because many federal contracts require research and data management contractors to have backup data storage capabilities – as well as facilities located outside of the "blast radius" of Washington D.C. – Noblis chose Danville as the home of its second computing location (Interview, Mitchell). A variety of factors also contributed to this decision, including (i) bandwidth availability, (ii) low cost of electricity and data transfer, (iii) a City administration and industrial development authority heavily oriented towards the needs of technology companies, particularly in subsidizing redeveloped office space, and (iv) an efficient City permitting and administrative process that lowered the costs of constructing the location (Interview, Mitchell).

Supercomputing is a field that focuses on dividing up complex, data-intensive computing problems into parallel processes that can be run on multiple computing systems (Interview, Mitchell). While Noblis offers services to clients in sophisticated fields – such as genetic sequencing – the company has also expressed interest in supporting local economic development efforts by offering its computing and IT services to small business as well as local government (Interview, Mitchell). Despite these ambitions, such services have not yet garnered significant traction.

Training and human capital development are also important aspects of Noblis's mission. Since the construction of their second center, they have set up an internship program in Danville as well as their Washington D.C. headquarters (Interview, Mitchell). The program focuses on developing software to support their R&D initiatives, and targets students from regional universities (i.e. University of Virginia, NC State, UNC Chapel Hill etc.) interested in becoming software developers (Interview, Mitchell). While the program has had nascent success, the company expressed continuing challenges to attract interns to Danville because of a lack of quality of life amenities to attract them to the area, such as a well developed downtown and nightlife or attractive riverfront access (Interview, Mitchell).

Institute for Advanced Learning and Research
Providing a Platform for Education and Workforce Development

Heavily isolated, rural Southside faced longstanding problems due to its lack of a major research university or institute of higher education. Unlike metropolitan areas – which benefitted from long histories of public investment in research universities, civic amenities, transportation, and other means to promote innovation and attract talent – Southside suffered from a downward spiral of disinvestment and isolation from knowledge economy regions (Franklin 2012). Research universities, quality education, and competitive infrastructure were mostly found in other places. Talent and young people also tended to migrate out of the area to follow jobs and modern lifestyle amenities elsewhere. Since talent and brainpower increasingly drove economic growth, Southside needed an institution to renew the local knowledge base and produce the new ideas and technologies that would drive future growth. While local leaders anticipated it would take decades for substantial changes to materialize, they strongly believed this institution would play a key role in transforming the Southside region.

In 2000, Virginia Tech proposed a new $80 million higher education institute in Danville – the Institute for Advanced Learning and Research (IALR or "the Institute") – to serve as a centerpiece for this regional strategy. Commissioned in 2004, the IALR was built to provide comprehensive research, technology commercialization, and educational programming in a wide variety of fields to support a stronger "innovation ecosystem" and talent hub in Southside (Franklin 2012). The Institute would support the development of new traded sectors with historic roots in regional strengths and train new workers with skills needed for jobs created, in part, by technologies, companies, and investments resulting from its research (Franklin 2012).

The Institute for Advanced Learning and Research
Image Credit: www.danville-va.gov:

IALR Mission

The IALR signaled a major shift in Virginia Tech's interpretation of its public outreach mission. In contrast to "one way, discipline based, and episodic interactions" (Franklin et al 2008) that often characterized traditional university-community relationships, Virginia Tech sought to engage the Region through a place-based model emphasizing "reciprocal, sympathetic relationships, redesigned programs, collaborative priority setting, joint investments, and mutual learning and change" (Franklin et al 2008). Virginia Tech was already heavily involved in Southside's broadband development; as such, the IALR would provide a critical overlap and focal point from which to target university resources to rebuild Southside's stock of knowledge and human capital. In addition, Virginia Tech would leverage IALR to inform its own learning and scholarship with challenges facing Southside, enabling "holistic, interdisciplinary approaches and solutions" to emerge for its students and partner communities (Franklin et al 2008). In short, by extending its physical presence and programming from Blacksburg to the IALR in Danville, Virginia Tech sought to increase its involvement Southside beyond broadband development and assume an ongoing role in enhancing the endogenous stock of knowledge.

The formal IALR mission was "to attract and develop technology and talent critical to Southside's prosperity" (Franklin 2012). This mission reflected local aspirations to more deeply engage in the knowledge economy and underpinned a holistic economic development approach. Tim Franklin, the first director and head of the IALR, summarizes its guiding principle:

> *"Strategies that focus exclusively or separately on talent development, entrepreneurship, community development, or infrastructure enhancements have generally not proven to be sufficient. Because talent and brainpower concentrations are fundamental to economic prosperity, economic-, workforce-, and community-development strategies need to become interdependent and co-related" (Franklin 2012).*

IALR Goals

In line with this principle, IALR was deigned to provide a focal point for multiple regional development initiatives. Four goals underpinned the IALR mission:

(i) "To foster the development of a new economic base"
(ii) "To attract and develop an innovation economy workforce"
(iii) "To create a destination location for visitors, companies, talented residents, and new investors;"
(iv) "To enable access to networks," beginning with those focused on information technology, talent, and innovation (Franklin 2012).

To do so, IALR would be organized as an independent state institution managed by Virginia Tech and charged with brokering and coordinating educational and outreach programs with multiple colleges, universities, and K-12 partners in Southside (Franklin et al 2008). Virginia Tech's main responsibility was to oversee IALR's "distributed research" program, which would enhance Danville's capacity to house research operations in broader fields and collaborate with other areas and companies on research projects (Franklin et al 2008). This framework guided the development of the IALR's programs as well as millions of dollars in investment, amounting to more than $80 million between 2001 and 2007 (Franklin 2012).

Physical Space and Technology Capabilities

Investments were dedicated toward research labs, distance learning classrooms, salaries for faculty and staff, conference centers, and over 160,000 square feet of space housed within a state-of-the-art building and other laboratories in Southside (Franklin 2012). The IALR was outfitted with cutting edge technology capabilities to take advantage of the emerging broadband system and information networks that would help connect Southside to global markets (District 2012). According to the West Piedmont Planning District (2012), "the Institute serves as a focal point for the development of regional technology infrastructure" and provides "a home for cutting edge voice, data, video, and multimedia technologies." Leveraging its connection to the regional

broadband backbone, these capabilities allowed for faster, seamless telecommunication and data exchange between the IALR and Virginia Tech, some 125 miles away, as well as with other remote research institutions and companies (Interview, N. Franklin).

IALR Business Model

Research	Education	Conferencing	Business Development
Function - Align with Virginia Tech research strength - Leverage Southside asset - Align with market opportunity with potential for Southside - Public and private sector relationships - Contract-based research - Import and/or train researchers	Function - K-12 Resources - Broker degree programs and credits among regional colleges and universities - Professional Development - Community-Focused Programs	Function - Provide central meeting space with cutting edge high tech capabilities - Facilitate networking and communication - Increase business and visitor traffic to region - Raise regional profile	Function - Business relationships with high tech firms - Market Danville in support of attracting firms to the region - Business incubation - Create new products, processes, and technologies - Collaborate with industry and academic partners - Derive new revenue and business
Research Focus - Sustainable & Renewable Materials - Analytical Chemistry - Polymers & Composites - Vehicles and Robotics	Education Focus - Integrate all levels of regional education system with: - STEM learning - Curriculum development - Emerging sectors of IALR research	Conferencing Focus - Executive and professional training - Workshops - Tradeshows - Conferences - Business Networking Groups - Community events	Business Dev. Focus - Consulting - Commercial testing and services - Contracts and standard agreements - Measurement, composition, and fabrication with data analysis

ECONOMIC DEVELOPMENT
SUPPORT FOR THE CITY AND REGION

IALR Goal #1: Fostering a New Economic Base

Intentions

The Institute's first goal, "to foster a new economic base," was built upon three layers of integrated programming – applied research labs, commercial testing and engineering services, and entrepreneurial support services (Franklin 2012). These programs targeted focus areas that were tied to Southside's historic strengths in agriculture and manufacturing, as well as other legacy assets in the region. These focus areas included sustainable and renewable materials, analytical chemistry, plant biology, polymers and composites, robotics, and vehicular research, among others (Franklin 2012). Together, these were designed to strengthen the role of innovation and entrepreneurship in the regional economy.[15]

The first layer of programming – applied research – created specialized research labs in Danville for each focus area. Each was based on an existing area of the university's research strength (in polymer science, plant biology, and mechanical engineering, for example), an existing Southside asset (such as polymers companies, fallow greenhouses, an agricultural supply chain, and motorsports tracks) and "an identified market opportunity with significant growth potential for the Region" (Franklin 2012). The labs were created in partnership with Virginia Tech, which provided the initial impetus to recruit faculty, funding, and students to Danville.

The "distributed research" model that emerged was designed to enhance and extend – rather than duplicate – Virginia Tech's research capabilities in Blacksburg. This gave Southside distinct competitive advantages in industry-specific fields, such as polymer processing and bioscience. It also set the stage for mutually dependent relationships between Danville and Virginia Tech's Blacksburg campus, building critical capacity in a region without significant knowledge economy resources.

"Distributed research" consisted of several important elements. First, it allowed doctoral and graduate programs to be offered on-site in Southside, helping to accumulate critical science and engineering human capital (Franklin 2012). Second, it encouraged collaboration among faculty, students, and researchers at both institutions, dedicating broader attention to research questions with specific relevance to the region. Third, it blended elements of basic (theory- and principle-driven) and applied research,

allowing for a smoother translation of theory-based knowledge into real-world applications. Fourth, the combination of basic and applied research provided a stronger base to market IALR's services in tandem with Virginia Tech to federal and industry research partners; increasing the likelihood that research investments would be attracted to Danville and result in economic spillovers within commuting distance. Together, these elements were thought to improve the Region's competitive prospects and strengthen its capacity to create new knowledge with market value.

The second layer of programming – commercial testing and engineering services – built off the "distributed research" model by linking IALR research programs to the "innovation value chain" in the region (Franklin 2012). Its objective was to attract companies interested in obtaining contract-based engineering services at IALR's specialized research labs from faculty "specialists" (Franklin 2012). Companies and entrepreneurs were encouraged to take advantage of "pilot scale-up facilities, commercial testing, prototyping, or engineering services for higher order technical assistance for a fee;" primarily for product development (Franklin 2012). These services play an important part in driving the Institute's research agenda, revenue generating abilities, and capacity to spark regional economic transformation (Interview, Leightley).

The third layer of programming – entrepreneurial support services – built off the Institute's core innovation infrastructure to support start-up businesses and product commercialization efforts. The U.S. Economic Development Administration provided the initial funding, allowing IALR to offer "market research, capital access, and technology commercialization expertise" (Franklin 2012) to companies and entrepreneurs interested in growing in the Region (Franklin 2012). Together, these three layers of programming underpinned IALR's effort to blend innovation and education with entrepreneurship, thereby improving Southside's competitive advantages in a broader range of fields.

Evidence of Progress

Since its inception, IALR has leveraged this program model to make substantial progress towards reinventing Southside's economic base. Through applied research, education, and technology commercialization, IALR is helping the region develop new

knowledge in fields tied to its historic strengths. Brief case studies will be provided of IALR program areas and the ways in which it is seeking to transform the economic base of Southside.

IALR Research Focus	Relation to Economic Base	Southside Assets
Sustainable & Renewable Materials (i.e. Plant Biology)	Agriculture, Tobacco, Textiles	Existing supply chain of farms, fallow fields, agricultural infrastructure
Polymers and Composites	Polymers manufacturing	Existing concentration of companies, workforce
Sustainable Chemistry	Provide services to surrounding industries such as polymers and chemicals	New IALR research center addition
Vehicular Research and Robotics	Traditional and High Tech Manufacturing, Engineering	Virginia International Raceway, IALR VIPER

IALR partnered with The Launch Place to conduct targeted analyses of industry clusters in the region; drawing on elements of Michael Porter's industry cluster assessment framework. Resultantly, IALR has aligned its program model with other economic development initiatives in Southside in an effort to develop and support new clusters. This section will briefly cover the evidence of progress in each area to illustrate how IALR is operating within a "rural knowledge cluster" framework.

Sustainable and Renewable Materials

"Imagine a day in Southern Virginia when you drive down the road and see fields of bioenergy plants growing. When you stop to fill up your tank, one of your options is biofuel that was produced right here in Southern Virginia. That day is not far away. IALR's Institute for Sustainable and Renewable Resources is working on projects that will not only fuel the next generation of vehicles, but expand our existing agricultural history with high-value or novel plants"
- IALR, 2010

Tobacco Fields, Prnce Edward County, Virginia
Image Credit: David Hoffman, Universal Pops, 2009

Southside's concentration of legacy agricultural assets – including fallow greenhouses, remnant tobacco fields, and local growing expertise – offered a platform to create new industries and plant-based products through biological research and biotechnology application. IALR's resulting "Institute for Sustainable and Renewable Resources" (ISRR) was created in 2010 to work with "established multi-national and emerging businesses to develop novel plants and plant processes" in areas such as bioenergy feed stocks and high-value horticulture. [16] By combining faculty and student expertise in analytical chemistry, plant cell and molecular biology, and tissue culture with state-of-the-art lab equipment, ISRR programming was designed to draw on the region's agricultural history and provide the physical and intellectual infrastructure for a new swath of bio-related industries.

The effort received substantial consulting assistance from The Launch Place, which provided market analysis articulating what the ISRR's potential role could be in advancing a "plant biology cluster" in southern Virginia. In drawing on research of clusters elsewhere (i.e. Iowa's ethanol industry, North Carolina's biotech industry, and Tennessee's bioenergy industry), The Launch Place emphasized that no recognized "Plant Biology" clusters yet existed nationwide and that the IALR could tailor its research program and related efforts to help southern Virginia capture this emerging opportunity.

Over time, ISRR provided a focal point for regional initiatives in "bio-fuels, new crops, and other commercially viable plant products" (Franklin 2012). These initiatives were designed to support elements of the local economic base, given that area farmers, nurseries, and other elements of the agricultural supply chain afforded opportunities to conduct research and targeted product development.

Southside leaders were under the impression that the region could take advantage of a variety of new markets based off its existing agricultural base. In 2008, The Launch Place convened a study to assess the potential of supporting a "Plant Biology Cluster" encompassing three knowledge-intensive and research- and technology-focused areas: (i) developing high value horticulture and forestry crops, (ii) developing high value compounds and technology from plants, and (iii) developing bio-energy crops via molecular breeding (Interview, Doss). Based on Location Quotient measures and other means to approximate industry concentration and activity in the region, The Launch Place estimated that Southside had a nascent concentration of related firms to support further cluster development (The Launch Place, 2008).

The cluster was designed to be a strike a balance between research and development in the field of plant biology, nurseries, farmers, industry associations, and suppliers (The Launch Place, 2008). The "Novel Horticulture and Forestry Crops" focus had identified "consumer gardening products" as a niche market the region could more aggressively explore, given that "Nursery and Greenhouse" crops were one of the largest commodity crop industries in the United States (The Launch Place, 2008). The "Nursery and Landscaping Industry" was also identified as one of the largest national employers in the crop sector, with net farm income as the "highest of any production specialty in U.S. Agriculture."[17] Of this market, The Launch Place recommended that the IALR and ISRR take a more aggressive role in carving out R&D niches for genetically engineered crops and plant varieties as one possible avenue for growth and cluster differentiation; given that new plant varieties could be engineered for subsequent development and sale in the consumer gardening and nursery industries (The Launch Place, 2008).

The Launch Place also identified "High Value Compounds and Technology From Plants" as one avenue, which would include genetically modified crops for agricultural production (The Launch Place, 2008). Citing Virginia's low national ranking in terms of agricultural productivity, and Southern Virginia's particular reliance on tobacco, The Launch Place identified genetic engineering of plants as one possible avenue to develop through the IALR, ISRR, and related programs on horticulture and forestry to diversify into a greater range of agricultural sub-sectors for "the next generation of farmers."[18] The field is competitively based on deriving new compounds and properties in agricultural plants and heavily subsidized by federal research grants (The Launch Place, 2008).

Agricultural research scientist
Image Credit: IRRI, 2007

Lastly, the Launch Place identified "Bioenergy Crops via Molecular Breeding" as another avenue for the region to explore with the IALR and ISRR as a research base (The Launch Place, 2008). This cluster area focuses on more aggressively gaining market share in bioenergy production through the genetic modification of new plant varieties for use as an bioenergy feedstock alternative to corn (The Launch Place, 2008). The demand for renewable energy sources such as "ethanol" was expected to increase according to several market studies and pending government regulations. New ethanol refineries and biomass energy facilities were also anticipated to be under development – or possibly so – in the general region that would pair with this anticipated increase in demand. As such, interest in the cluster has coalesced around the possibility of using modified tobacco varieties, high-yield Miscanthus, and other agricultural crops, such as the Jerusalem Artichoke, to serve as possible alternatives (The Launch Place, 2008).

In each area of the Plant Biology cluster, it was understood that heavy emphasis on R&D would be needed to carve out new technologies and market specializations that

could lay foundations for future growth (The Launch Place, 2008). A period of approximately 8 years was identified between when plant biology technologies could be developed through R&D and when broader benefits could be reaped in the form of productivity increases.[19] This high level of R&D required a continuous supply of a trained and skilled workforce, such as graduates and researchers from Virginia Tech's Departments of Horticulture and Forestry (The Launch Place, 2008). The Virginia Landscape Association was also identified as one possible workforce development avenue for horticulturalists (The Launch Place, 2008).

Plant Biology Cluster Progress

By proving new technologies in ISRR labs, IALR secured federal funding from the EDA and USDA to convene a business plan for a new startup – Dan River Plants – to grow miscanthus and other high-value plants for commercial application in the bioenergy and high-value horticulture industries. In result, more than ten thousand plants now grow in the fields of Pittsylvania County (which were provided to a local grower for field trials and performance assessment) in support of the Dan River Plants venture.[20]

In a related example, ProteiosBio, a bio-energy startup, moved to the IALR in 2012 to explore the potential of developing new plant varieties as a bio-energy feedstock.[21] The IALR reviewed the company's proposal to develop high value chemicals from plants and approved their relocation plans, knowing the company's ambitions were well aligned with its research expertise. According to Dr. Liam Leightly, former President of the IALR: "they specifically wanted to move their base from Charlottesville to Danville because they knew [the IALR] had the facilities and researchers that aligned with their business model" (Interview Leightley) Seeing value in rehabbing vacant greenhouses and fields to grow their plant varieties, as well as in opportunities to work with IALR researchers and local growers to evaluate the conversion potential of local crops, the company partnered with IALR to obtain funding from the Tobacco Commission. The total was a $1.3 million dollar grant from TIC as well as $1.7 million in private matching funds, which was jointly invested by the IALR and ProteiosBio in a new laboratory, equipment, and a greenhouse with six jobs

expected by 2013.[22] The IALR will retain title to all laboratory equipment after the company "graduates" from the incubator and moves to a different space.

The Sustainable Energy and Technology Center (SENTEC) Image Credit: Institute for Advanced Learning and Research (IALR)

In one last example, IALR sought to construct a new 25,000 square foot building providing permanent R&D and office space for biotechnology companies attracted to the Institute. IALR viewed the building as a potential new source of revenue that could help it transition away from volatile public funding (which covered a substantial portion of its operating budget) and reinvest in capital improvements across its program areas. Revenue would come from leasing and research fees paid by participating companies, as well as through licensing technology developed at the center (Interview, Leightley).

This building, the $19 million "Sustainable Energy and Technology Center (SENTEC), opened in 2012 with a blend of public and private investment. It complements the on-going biofuels and bio-based products research occurring at the IALR and ISRR. SENTEC graduate students and faculty researchers work closely with local farmers on strategies to utilize their crops in more economically feasible and environmentally sustainable ways, with special focus on the bioenergy industry. Its anchor tenant, Virdia, is a biotechnology company that develops advanced carbohydrates for a wide variety of bio-based market applications.[23] According to Dr. Leightley, the building was fully leased with company tenants by 2012 (Interview, Leightley). Virdia invested nearly $10 million to construct SENTEC, with remaining funds provided by the Tobacco Commission, City of Danville, and Higher Education Trust Fund.[24]

SECTEC focuses on drawing in outside companies and knowledge with an interest in exploiting Southside's agricultural knowledge base. Headquartered in Redwood City, CA, Virdia chose SENTEC to house its U.S. technology center and pilot demonstration facility; employing 34 people with an expectation of growing to 50 over time.[25] SENTEC will help Virdia showcase its "process of converting biomass to cellulosic sugars and lignin for use in the renewable chemicals, bio-energy, and nutrition

industries," among others.[26] This expertise underpins many of SENTEC's R&D projects, which focus on developing and integrating biomass crops, assessments of conversion technologies, co-products from conversion processes, and feasibility studies into the development of bio-refineries in Southern Virginia.[27] Possible applications for the sugars include "renewable fuels and fuel intermediaries, renewable chemicals and materials, and nutritional additives for the animal feed industry" (IALR 2012). According to the IALR, the product has also "proven to be valuable feedstock for plant-based plastics and other thermo-chemical transformations," including synthetic rubber. This suggests that Southern Virginia sits at the potential intersection of a variety of "downstream" market applications drawing upon elements of agriculture, bioscience, and polymers and advanced materials (IALR 2012).

Polymers, Composites, and Analytical Chemistry

IALR's intersection between agriculture and technology offers positive implications for other industrial clusters in Southside, such as its concentration of polymer manufacturing companies. These include a Goodyear plant, blown-film manufacturers, and other firms representing elements of the plastics- and rubber-oriented supply chain (Franklin 2012). Prior studies illustrated that this job base – which largely consisted of commodity-based branch manufacturing plants – was at risk of decline without R&D facilities and other office amenities to justify branch locations on a basis other than low-costs alone (Franklin 2012). With assistance of The Launch Place, the IALR conducted a survey of polymers companies within a 40 to 50 mile radius to develop a better idea of what it was they did, their needs, their challenges, the source of their raw materials, and what the IALR could offer in terms of R&D assistance that would garner their interest (Interview, Leightley). Armed with data and backing provided by Virginia Tech's polymer science program, IALR created an applied polymers research center – The Advanced and Applied Polymers Processing Institute (AAPPI) – with state-of-the-art equipment to serve area companies and attract faculty, students, and funding to the Region (Franklin 2012).

AAPPI complemented Virginia Tech's basic and applied "polymers science" research program in Blacksburg by focusing on the more "applied aspects" of polymers

processing, such as those found in manufacturing and chemistry-driven aspects of polymer product development (Franklin 2012). It provided state-of-the-art labs and equipment for polymers testing, processing, and injection molding, as well as dedicated funding for faculty and graduate students (Franklin 2012). It also offered doctoral programs on-site, with degrees conferred by its partner institutions, such as Virginia Tech.

An important component of the AAPPI was its focus on analytical chemistry. Polymer and composite manufacturing was, by nature, a field driven by high degrees of expertise rooted in chemical, mechanical, and thermal analysis (IALR 2012). To compete in these industries, robust R&D capabilities were necessary in order to respond to the rapidly evolving nature of polymer niche market applications.

In 2013, IALR's analytical chemistry laboratory achieved international certification by an independent accreditation firm for chemical testing.[28] According to the IALR, the lab's "specialized analytical equipment allows for the separation of complex mixtures of chemicals and the identification of those chemicals to the parts per trillion level" (IALR 2013). This accreditation "reflects a demonstration of technical competence, operation procedures, and quality control that meet or exceed international standards" (IALR 2013). More importantly, the accreditation opens the door for broader revenue generating opportunities in polymers and composites, as stated by Dr. Leightley, "[the accreditation] is not a hard asset, but a certificate that companies can provide to their customers to demonstrate that their products' underlying research was performed by a certified lab" (Interview, Leightley). In result, IALR is now positioned to aggressively market its laboratory services and equipment to companies and position Southside as a serious player in the polymers and composites field.

Over time, AAPPI evolved into the "Dan River Polymers and Composites Center" (DRPCC) due, in part, to cross-pollinating influences from IALR's biotechnology-related research and strides in analytical chemistry. For example, the DRPCC heavily focuses on biodegradable and biorenewable plastics. This reflects not just the influence of Virdia and its biomaterials and biochemistry expertise, but also IALR's aspirations to strengthen "upstream" linkages among elements of the region's agricultural-, manufacturing-, polymer-, and rubber-based supply chain (IALR 2012).

Vehicular Research and Robotics

Recognizing the educational and research value embodied in a shuttered motorsports raceway in close proximity to Danville, IALR convened a "motorsports engineering" program as one of its core focus areas. By combining the strengths of multiple departments, Virginia Tech offered a deep background in "performance engineering" that laid groundwork to explore elements of vehicular research. IALR's program now focuses on tires, suspensions, and composite materials for vehicular body panels.[29]

For tires and suspensions, the National Tire Research Center (NTRC) at the Virginia International Raceway in Halifax County resulted from a partnership between the Virginia Tech Transportation Institute, Virginia Tech Mechanical Engineering, and the IALR; with funding provided by the Tobacco Commission (IALR 2013). With backing from the newly created Virginia Institute for Performance Engineering and Research (VIPER) – an institute which is co-located at the raceway in Halifax County and at the IALR in Danville – NTRC's business model was driven by strengths in vehicle suspensions and virtual testing, accessibility to the raceway, laboratory equipment, and faculty and student researchers.

In the time since its inception, both NTRC and VIPER have attracted a number of graduate and PhD students in performance engineering on account of industry-sponsored research contracts generated by the center (Franklin 2012). By 2009, "13 of the 16 graduate students enrolled in the Virginia Tech mechanical engineering degree curricula in Danville work as research assistants in several different performance-engineering and robotics labs."[30] These different labs – including areas such as Performance Engineering Research, Vehicle Terrain Profiling, and "Intelligent Transportation" – all feed data into VIPER as well as private industry and government agencies.[31] According to Franklin (2012), "Dodge, General Motors, NASCAR racing teams, and tire manufacturers represented the types of firms that used these services."

For composite materials, the DRPCC underpins IALR research surrounding the use of "bio-composites" as one possible option for vehicular body panels. In contrast to glass fiber reinforced composites, bio-composites are emerging as a viable alternative due to their "low-cost, low density, competitive mechanical properties, reduced energy

consumption, and biodegradability" (IALR 2013). This extension into vehicular-based bio-composites reflects IALR's continuing effort to blend elements of the region's strengths in agriculture and manufacturing with its research centers and product development efforts.

IALR Goal #2: Developing an Innovation Economy Workforce

Intentions

The Institute's second goal, "to attract and develop an innovation economy workforce" (Franklin 2012), underpinned the human capital portion of the regional strategy. At the time of IALR's inception, the share of adults over age 25 in Southside with a bachelor's degree was less than 10 percent – the lowest in Virginia (Franklin 2012). "Brain drain" was also persistent. These demographic trends posed direct risks to the Region's innovation-based development approach, given that creating high paying knowledge-economy jobs was dependent on the steady presence of human capital (Franklin 2012).

As such, the IALR envisioned itself as a magnet for talent attraction as well as focal point to cultivate talent development from within the Region. "If the IALR was going to be successful," Franklin (2012) asserts, "strategies to attract and retain brainpower needed to converge with those focused on developing talent." Increasing local talent in STEM-based fields was a critical part of this process, as it was thought to provide a valuable platform for future growth. As Tim Franklin reflects:

> *"Graduates in science, technology, engineering, and math, or STEM, fields represent a small proportion, roughly 5 percent, of college graduates, but they are given credit for generating nearly 50 percent of United States economic growth over the second half of the 20th century"* [32]

Whether attracted from elsewhere or educated from within the region, STEM-based talent would need to choose to live in Southside. Local leaders surmised that for this to happen: an abundance of high-quality jobs needed to be available; and that (ii)

Danville and broader Southside needed to be perceived as a good place to live (Franklin 2012). This required a new level of integration among "economic, workforce, education, and community development strategies" to create a "quality, connected place" capable of getting talent to "stick" to the region (Franklin 2012).

The first step in this process was to create initial momentum for talent attraction and development. As such, IALR set a formal objective to increase "the number of adults with a college education who lived and worked in Southside" (Franklin 2012). This would be achieved by:

- Attracting graduate students
- Creating academic pathways
- Expanding STEM enrichment programs

This approach sought to address the dual dilemmas that (i) STEM-based talent would not choose to move to Danville without the presence of quality jobs; and that (ii) Southside faced historic difficulties attracting high tech companies because of its absence of STEM-based talent.

One solution for attracting talent was to leverage IALRs "distributed research" model to attract a baseline level of faculty, PhDs, and graduate students, to Danville. This new source of human capital would help "jump start" the local talent base by providing permanent workforce staff at the research centers, as well as a draw for prospective companies. Since its 2004 inception, IALR has attracted students and researchers on account of its specialized programming and contracts with private industry. "By late 2007," Tim Franklin asserts, "37 scientists, graduate students, and engineers were based at the Institute, held 68 U.S. and International patents, and were attracted by the Institute's economic transformation and commercialization focus" (Franklin 2012). With many drawn on account of IALR's specialized research centers, Southside has developed considerable momentum towards strengthening its human capital base in a wider range of sectors, as will be discussed in the sections to follow.

To create academic pathways, IALR sought to increase the educational opportunities available to residents within the Region, particularly in STEM-based fields. Both

emulating and building off the initial "human capital" recommendations outlined by the original Virginia Tech eCorridors proposal, IALR created educational programming that targeted area schools ranging from "primary through masters education" (Franklin 2012). Guidance was provided by faculty at Virginia Tech as well as IALR to develop course offerings for regional primary-level through masters-level programs. These courses targeted "cutting-edge curricular information and pedagogy in the sciences, biotechnology, and information technology" (Franklin 2012).

The heart of this approach was to align Southside's in-region talent develop ecosystem with the emerging focus areas at the IALR research centers. With higher-order, specialized knowledge accruing on account of IALR research – in fields such as biotechnology, polymers, advanced materials, analytical chemistry, sustainable energy, vehicular engineering, information technology, and robotics – Southside needed to ensure that its stock of human capital could adequately engage in the opportunities afforded by its transforming economic base. The same philosophy applied to Southside's broadband network, which offered its own new range of educational and professional opportunities.

Evidence of Progress

As such, the presence of both broadband and IALR's research centers influenced "public school systems, community colleges, and four year institutions" throughout the region to align their curriculum with the new technology-based economy envisioned for Southside (Franklin 2012). For example, Pittsylvania County improved upon its pre-engineering math curricula to prepare students for employment in technology-driven fields, including those of focus at the IALR (Franklin 2012). Additionally, "the Danville Public School System, in partnership with Virginia Tech and NASA Langley, won an $8 million magnet school grant that funded curricular tracks in aerospace, information technology, and biotechnology at elementary schools and secondary levels" (Franklin 2012). Through the IALR, Virginia Tech, Averett University, and Danville Community College began to offer courses and programs of study focused on developing a high-tech workforce for the "Innovation Economy" (District 2012). Through systems based on credit transfers, shared curricula, and industry-aligned

certificates, these institutions now work together to provide seamless stepping-stones across a variety of technology-driven academic pathways (Franklin 2012).

In the case of community-based, broadband-supported education, IALR convened a variety of programs to strengthen computer literacy among Southside residents. Given that many in the Region had not earned more than a high school or elementary education (to take jobs in the tobacco and textile mills, for example), economic dislocation had impacted a wide variety of residents when the traditional industry base collapsed. Retooling the basic information technology skills and STEM literacy levels of older workers would therefore be an important piece for reintegrating area residents into the workforce, as well as help them engage the Internet in their daily lives. As such, IALR dedicated a wing of its facility to computer labs open to community-based education program, and outfitted them with software packages to help residents identify their strengths, weaknesses, and goals for educational attainment in STEM-focused areas (Interview, N. Franklin). Known as "Learning Liftoff," this program also assists residents with math competency on an individualized basis (Interview, N. Franklin). Other programs funded through federal sources – such as the National Science Foundation – at the IALR have also adopted a community-focused approach. These include internship programs connecting Southside students in STEM fields to area companies as well as summer camps targeted on STEM and information technology literacy (Interview, N. Franklin).

GOAL #3: Creating a Destination Location

Intentions

Building off the momentum created by its emerging research and market expertise, the Institute's third goal, "to create a destination location for visitors, companies, talented residents, and new investors," sought to reverse the decades of negative perceptions that had accumulated about Southside. Instead of a reputation characterized by economic decline and outmigration, IALR would offer the outside world a symbol of Southside's renewal as a center for innovation and technology.

The lynchpin of this strategy hinged on increasing business traffic to the Region. As Tim Franklin (2012) reflects, this objective "grew from the notion that if businesses visited the region, a few might relocate and many others would spread the word about Southside's new assets and energy." To create this buzz, the Institute constructed cutting edge physical facilities to complement its impressive array of commercial testing and research space, such as a conference center, telecommunications capabilities, and a striking architectural design. It also plays an on-going business attraction role for the City, providing a regular stop on local tours of the area for visiting business delegations (cite interview).

Evidence of Progress

This approach resulted in immediate impacts. From 2004 to 2007, the Institute Conference Center (ICC) brought more than 53,000 conference participants and 116 statewide events to Danville.[33] In its fiscal year of 2006, just two years after its inception, IALR attracted more than 150 out-of-region businesses.[34] In reflecting on its impact on business attraction, Dr. Liam Leightley states "companies have located in Danville because of the infrastructure, the Institute, and its presence in the community" (Interview, Leightley). Specifically, he said that several companies were attracted to the city despite not needing technology development, as was the case of EIT[35] and Swedwood[36]. When these two companies initially visited the area, they expressed interest in seeing the Institute to get a better idea of its conferencing capabilities and overall connection with the business community. EIT is now co-located with the IALR on Danville's CyberPark campus. "Rather than being prescriptive," Leightley reflects, "companies are leveraging the presence" (Interview, Leightley).

Since its inception, the IALR has attracted many conference clientele and visitors, largely on account of the convenient space and network opportunities it affords. On the local level, American National Bank, Franklin Covey, Goodyear, Telvista, the Danville Medical Center, and the Danville Pittsylvania County Chamber of Commerce, among other organizations have utilized the ICC for major events.[37] On a broader regional level, "the Virginia State Bar, LEAD Virginia, The University of Virginia, IKEA, the National Academy of Sciences and SAE International" held functions at the ICC

(IALR 2012). Scientists from Oak Ridge National Laboratory as well as Vice President Joe Biden have also visited the Institute on account of its transformative regional presence.[38]

One noteworthy example of this impact is the IALR's 2013 hosting of the "Southern Virginia STEM-H (Science, Technology, Engineering, Mathematics, and Health) Summit. In partnership with the New College Institute, Southern Virginia Higher Education Center, and Virginia Secretary of Education, the IALR summit convened educators, students, community, and industry leaders to collaborate on the development of "next generation" STEM-H programming. This represents IALR's continued effort to raise the visibility of southern Virginia in STEM-H programming; which is deemed as a "necessity for the economic and social transformation of the nation and region" (IALR 2013).

GOAL #4: Enabling Access to Networks

Intentions

Building on its closely related goal to create a "destination location for visitors," the IALRs fourth goal, "to enable access to networks," focuses on building stronger connections with places outside of Southside as well as strengthening social capital within the region. This objective was convened in response to the decline of headquartered companies in the area, which eliminated many of Southside's connections to innovation and product development. By facilitating greater connectivity among "new innovation networks, financial networks, business networks, and technology networks" in the area, the IALR – in partnership with Virginia Tech and Southside political leadership – sought to build on the Institute's prominent physical presence with programming to actively support business development, as well as to and strengthen the civic infrastructure in Danville to guide regional transformation (Franklin 2012).

Evidence of Progress

One of the most visible results of this effort was "The Network," a program convened at the IALR in 2012* to accelerate networking, communication, and collaboration in specific industry clusters. Its mission is to "enable local companies, entrepreneurs, scientists, farmers, and economic development officials forge and strengthen relationships in [the] region, through a regular series of events geared toward sharing information and strategic collaboration" (IALR 2013). The Network envisions a "thriving business and scientific community" in Southside, along with "more public and private investment attracted to the region, and broad-based recognition that southern Virginia is achieving economic transformation through a coordinated effort" (Interview, Leightley).

Since its inception, The Network has focused on two types of networks in Southside: (i) those focused on the broader community, and (ii) those focused on specific business clusters (Interview, Leightley). The community-oriented events focus around general themes of business, science, education, and technology (such as the impact of biotechnology on agriculture and economic development, career opportunities in robotics and vehicular engineering, or general themes in management and innovation, for example). The business-oriented events have convened around specific industry clusters through monthly networking events, speakers, and email communications.

For example, the Virginia Polymer Coalition – an IALR-sponsored organization – convened to in 2012 to "reinforce the local cluster of industry related to polymers and plastics" and to "make [Southside] sustainable and competitive in a global economy (IALR 2013). Building off the original recommendations of the Southside Business Technology Center, a survey by The Launch Place found that "several area polymer firms expressed interest in collaboration as a means of managing energy and raw materials costs, finding a skilled workforce, and finding better methods for product testing, materials analysis, and waste recycling" (IALR 2013). The Virginia Polymer Coalition was convened to build on momentum created as several companies began networking with one another around these needs in an effort to establish collaborative relationships.[39]

Civic Loan Program and Physical Redevelopment
Danville's Entrepreneur Attraction Strategy

"In order to be effective in any marketplace, an organization's offering must truly matter to its targeted clients and clearly set it apart from its competitors. Danville must find a way to be relevant, and it must become a uniquely attractive place."

- Jim Flowers, presentation to Danville leaders on August 17, 2011

With its newly minted broadband network and innovation infrastructure in place, one of the biggest challenges facing Southside was how to attract knowledge economy talent and retain it long term. Small numbers of large firms would no longer provide the bulk of employment; rather, diverse arrays of entrepreneurs and smaller technology-oriented companies would be needed to translate new ideas into jobs (Interview, Stauber). Yet much of the talent to do so resided outside of the Region. Building a critical mass of engineers, computer programmers, MBAs, and other professionals that resided in Danville was therefore critical to the city's knowledge-economy strategy. While Virginia Tech and the IALR provided initial institutional momentum to attract human and intellectual capital, Danville needed a long-term "air of appeal" and a high enough quality-of-life to get talent to reside locally and stick to the region.

Recognizing the potential of universities in its own backyard, Danville leaders realized that tapping human capital networks in the surrounding the region would play a critical role in the rebuilding process. Danville was situated in close proximity to more than seven major research universities all within a two hour drive, including Duke University, the University of North Carolina, N.C. State, U.N.C. Greensboro, Winston Salem State University, Virginia Tech, and the University of Virginia, among others. The challenge, as Karl Stauber of DRF put it, would be to "convince recent graduates and entrepreneurs that Danville was a 'place for the possible'" (Interview, Stauber).

Convincing of this nature was not without its challenges. Danville suffered from decades of disinvestment and outmigration that left a hollowed out industrial core in its wake. The city was small. And it was isolated. Yet Danville had a deluge of assets that – with visioning, coordination and reinvestment – were thought to provide a launch pad for

future entrepreneurs with an interest in Southern Virginia. These included Danville's proximity to the Research Triangle Park (one hour drive) and Washington D.C. metro area (three hour drive); agricultural roots; emerging expertise in fields such as biotechnology and advanced materials; rising numbers of college-educated residents; an affordable cost-of-living; broadband capabilities; and strong "bones" for urban redevelopment.

In 2011, DRF hired an independent consultant, Jim Flowers from VTKnowledgeWorks (VTKW), to assess these issues as well as gaps in the city's clustering and entrepreneurship strategy. Given his over 30 years' direct experience starting and managing technology-related companies, Flowers was asked to investigate whether a model similar to VTKW could be replicated in Danville (Interview, Flowers). VTKW was a technology transfer and business technical assistance subsidiary of Virginia Tech. Based out of Blacksburg, VTKW encouraged entrepreneurship through curriculum, resource centers, and networking among other global regions on business issues. It also operated a technology transfer office that provided financing and business support services to staff, students, and alumni proposing to establish new ventures in Blacksburg based on Virginia Tech-licensed technology.[40] The VTKW model was designed to support "Innovation Driven Enterprises" (IDEs), or those that integrate elements of economics, business, technology, sociology, and engineering to achieve innovation-driven growth.[41]

His recommendations built upon existing economic development efforts in the City and introduced new ideas to strengthen collaboration around entrepreneur attraction and cluster development; particularly in bio-related industries. These recommendations were four-pronged: (i) create a vision of what Danville aspires to become, such as an industry hub for "plant biology, biochemistry, biomaterials, and other bio-based fields" (ii) align key elements of the local economic development system, such as the City and regional marketing organizations, to support its vision, (iii) "import" innovation and technology-oriented entrepreneurs to Danville through a mix of subsidies and business support programs, and (iv) invest in a "live, work, play" environment in the Tobacco Warehouse District to provide a higher quality-of-life that

can retain resident entrepreneurs (Interview, Flowers). These recommendations are being implemented in varying degrees, which will be described.

Challenges and Opportunities

In his presentation to area leaders, Flowers offered a fresh vision for a future Danville – one driven by industry collaboration, public education, new product demonstrations, and a sharp "brand" built on cutting edge bio-industry specializations. By depicting the future Danville as a potential center for emerging bio-related industries, Flowers encouraged local leaders to think of their city with new air of global relevance in the 21st century economy. His vision was not to be taken as a "guarantee" nor "silver bullet," however, as Flowers cautioned that significant challenges needed to be addressed.

Challenges

According to Flowers, cities and regions all over the world are competing for national and global economic relevance. "No place can be competitive on all fronts. Hence, subsidized technology clustering [and technology-based entrepreneurship] is rampant" (Flowers 2011). In order to cluster and attract entrepreneurs, Flowers argued, "Regions must be *uniquely* attractive."[42] As such, Flowers emphasized four key themes to guide Danville's economic development strategy: relevance, attractiveness, clustering, and entrepreneurship.[43]

Beyond its prior base in textiles and tobacco, Danville was not readily seen as a regionally, nor nationally, relevant city. Its challenging demographics would likely prevent it from achieving critical masses of talent on account of size alone (Flowers 2011). "To be economically or technologically relevant, a place the size of Danville must have a clear focus, a concentration of forces that puts a point on a spear" (Flowers 2011). Flowers argued that this notion was at the heart of clustering, as well as why the city should continue specializing in markets not yet "claimed" by other regions – including plant propagation and bioscience.

On attractiveness, Flowers cited that the city's negative external image could deter entrepreneurs from locating there. Specifically, he raised the point that some may

tend to characterize Danville as (i) "a former mill town trying anything it can to arrest a downward spiral of decline," (ii) "an unsafe, unattractive destination for work, play, or residency," or (iii) one whose economic development efforts were no different from those of similarly sized cities (Flowers 2011). High concentrations of vacant and abandoned downtown mill buildings were also said to exacerbate the city's image of decline; especially given its lack of residential, retail, and entertainment options. In citing perceptions that the IALR may not have lived up to its initial "job creating" and the City's lack of clear marketing focus, he also suggested that entrepreneurs might not view Danville as a competitive location to start a business.

In terms of entrepreneurship, Flowers' analysis revealed that Danville lacked a local presence of "creative entrepreneurs" as well as pent up demand for VTKW services. While local business consulting organizations (such as the SBTC) made strides in servicing local business needs, there was not an evident pipeline of innovation-driven entrepreneurs or enterprises in the area. Danville's lack of ready access to early-stage capital was cited as a contributor to this problem. As such, "Innovation-driven" entrepreneurs would have to be imported from elsewhere and supported to "jump start" the local entrepreneurial base. Rather than extend the VTKW model to Danville, Flowers emphasized that local organizations should "scale up" their services for IDE needs, with VTKW as a remote partner.

On clustering, Flowers (2011) cited "a lack of effective cooperation and coordination among various jurisdictions and service providers across the region, possibly because of a lack of shared vision or common focus." This was exacerbated by a long history of unfocused "spreading of money and facilities" around the region, largely due to political pressures and the wide availability of Tobacco Commission funds (Flowers 2011). Greater cohesion was needed among local leaders as to which investments and strategies were most important for helping the region specialize in bio-related fields.

Flowers' focus on specialization was not without its critics, however, as some local leaders expressed a hesitancy to put all the City's proverbial "eggs in one basket." As Karl Stauber of the Danville Regional Foundation reflects:

> "I don't think people can easily see around the corner to identify 'the next great opportunity' or even series of opportunities in the economy. Clusters develop organically rather than intentionally. There is a lot of discussion in the Region about becoming 'the place for XX'…yet, when you look to other industrial cities, such as many of those in the Midwest, they based their economies on specific industries – which volatility can disrupt. So where does that leave you? You have to create economic 'platforms' that have some level of flexibility so that as the economy changes and opportunities evolve you are not stuck in a dead end. You have to have the ability to move and evolve to take better advantage of opportunities that are out there" (Interview, Stauber).

By "platforms," Stauber was referring to institutions that underpin "new knowledge creation," such as universities, an educated workforce, and a healthy agglomeration of diversified skills and ideas in a region's external economy. He cited the examples of universities like Stanford and MIT, in that "the universities themselves have a platform within them that can produce new opportunities on a continual basis" (Interview, Stauber). While Danville did not have a strong research university, it was attempting to lay groundwork for its own range of advanced research and educational opportunities with the IALR.

Opportunities

Building on this notion of "platforms," Flowers' identified three groups of physical assets to integrate into the City's bio-industry cluster and entrepreneur attraction strategy: (i) downtown Danville, (ii) research institutions including the IALR and SENTEC, and (iii) the city's surrounding business parks. By merging a regional "bio-industry" cluster branding strategy with cross cutting investments and entrepreneurial agendas, Flowers emphasized that economic development entities in Danville and broader Southside could work together to pursue industry transformation through a holistic and integrated approach.

Areas of integration included: redeveloping old industrial structures into modern office space for biotechnology companies and other types of entrepreneurs, with

primary help and financial support provided by the City, Industrial Development Authority, The Launch Place, and TIC; industry-focused business recruitment and support strategies, coordinated among the City, IALR, The Launch Place, local Chamber of Commerce, and other local and state entities; encouraging marketing to elevate outside visibility of local research institutions – such as IALR and SENTEC – and their related agendas in biotech and other disciplines as a flagship for rural competitive advantage; providing early-stage capital to technology entrepreneurs through a series of community based and industry-focused investment funds, given the stark absence of such funding throughout rural Southside; and industry-focused education and product demonstration centers designed to bring companies in targeted clusters together from throughout the region, primarily to discuss and demonstrate product innovation. While not all of these recommendations were implemented, Flowers used this vision to encourage local leaders to think along new lines for integrating their efforts in a way that elevated "regional entrepreneurship" as an economic development strategy.

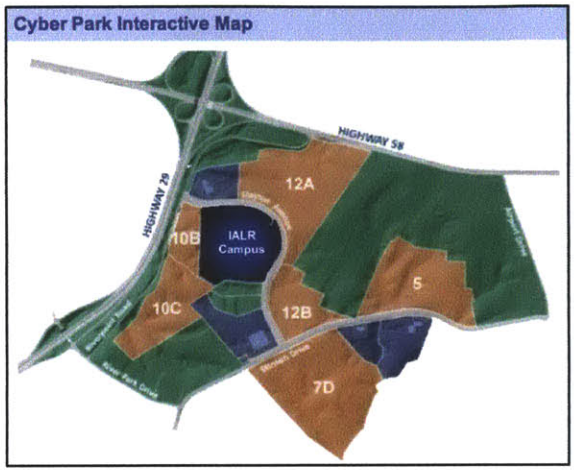
Physical Layout

To drive home these points, Flowers heavily emphasized the importance of Danville's physical assets and layout. Downtown Danville was an important local asset. Situated along the banks of the Dan River, it occupied approximately 40 blocks and contained the city's core industrial infrastructure. Its historic tobacco warehouse district had some three-dozen structures, ranging from former factories and tobacco and textile storage facilities to former worker dwellings. The downtown also afforded a series of amenities within walking distance, including a redeveloped railroad station, an amphitheater, riverside parks, office space, apartments, and a recently constructed YMCA.

Despite decreases in population and households from 2007-2010, many in Danville viewed the downtown as viable for redevelopment (BBP & Associates and Associates 2011). From 2008-2010, the number of businesses within a half-mile of City center increased by 65 percent, with a concurrent 105 percent increase in employees during the same period (BBP & Associates and Associates 2011). Residential building

permits were also higher than the projected number of units to be absorbed in the City (BBP & Associates and Associates 2011). By 2012, downtown Danville landed several noteworthy establishments, including the Noblis high-performance computing center, the Averett University campus extension, new medical offices, and a range of high-tech businesses in rehabbed office space. The City's 2011 "River District Plan" sought to build on this momentum through proposed investments in hotels, office space, apartments, mixed-use development, and a series of public spaces.

Three miles from downtown was the IALR and its adjoining business park (i.e. the "CyberPark"). By 2013, the CyberPark had attracted several technology companies, a private vehicle research institute and business incubator, the Regional Center for Advanced Technology and Training, SENTEC, and an IALR research center dedicated to technology development across plant biology, robotics, unmanned systems, and high performance motorsports.[44] The site still had a number of vacant lots that the City was actively marketing to larger corporations and high-tech businesses.



CyberPark and IALR Campus
Image Credit: City of Danville

In total, these assets were thought to lay groundwork for an aggressive strategy to attract entrepreneurs and technology-based businesses; many of which were the focus of nascent cluster development studies conducted by The Launch Place. While Danville established a strong basis for research and innovation infrastructure, frequently cited issues standing in the way of talent and company attraction related to quality of life. Local leaders knew that to attract entrepreneurs and talent, continued downtown revitalization was vital in order to provide the quality of life amenities (i.e. dining, entertainment, retail, housing, office etc.) for a "live, work, play" environment.

Types of Entrepreneurs

Flowers identified two distinct entrepreneurial types to target in a bio-industry cluster strategy: (i) professional / serial entrepreneurs, or those that are more experienced and gravitate to capital-intensive ventures at the "heart" of a given cluster and (ii) creative / inventive entrepreneurs, or those that are less-experienced and oriented towards direct (Program 2002)collaboration on ideas at the "edge" of a given cluster (Flowers 2011). Profiles of these types are listed in the following table.

Entrepreneur Type	Well-Suited For	Typical Profile	Needs
Professional / Serial Entrepreneurs	- Capital intensive ventures with other large investors - Cooperative out-licensing of research-intensive cluster tech. - Formal office space likely in surrounding corporate and industrial parks	- Over 40 - Married with children - Previously successful	- Strategic control - Access to significant capital - Manageable technologists - Upscale housing - Exceptional secondary schools - Upscale housing - Professional amenities
Creative / Inventive Entrepreneurs	- Inventive ventures on the edge of the cluster - Inventive ventures in direct support of other cluster members - Flexible office space likely downtown	- Highly energetic - Mostly under 40 - Unmarried and/or childless - Financially strapped	- Autonomy - Modest capital - Well-equipped but simple workspaces - Minimal commute - Urban amenities - Access to recreation

Table 4
Source: "Tomorrow in Danville: A Draft Proposal for Focused and Aggressive Transformation Through Technological Entrepreneurship," Jim Flowers, August 17. 2011

Linking Physical Sites with Entrepreneur and Company Attraction

Based on these profiles, Flowers offered four recommendations to link the IALR and downtown redevelopment with a cluster-focused, entrepreneur attraction strategy: (i) concentrate traditional company recruitment efforts – both physically and programmatically – around the IALR to achieve a critical mass of bio-related companies and talent; (ii) "concentrate venture-funded, professionally managed, research-based start-up efforts around the IALR where large scale [capital] investment is most appropriate;" "concentrate small-scale, creative start-up efforts in the [downtown] warehouse district to create a globally newsworthy urban enterprise zone;" and "concentrate key [business and entrepreneur] support services under one umbrella" (Flowers 2011).

The City of Danville Office of Economic Development Office had already taken an aggressive step toward this measure by redeveloping old industrial buildings in the downtown core into flexible, modern office space. Through public subsidies and a unique arrangement with the Danville Industrial Development Authority (IDA), the City of Danville sought to redevelop older buildings in the Tobacco Warehouse District that were historically under private ownership from entities outside the region (Interview, Teague). With funding support provided by the TIC, the City and IDA redeveloped several buildings in the district under a commercial real estate strategy and positioned them as affordable spaces for emerging technology companies and entrepreneurs (Interview, Teague). Unlike the City, the IDA is a bonding authority without taxing powers that raised and invested significant resources to improve buildings in the District (Interview, Wright). The IDA bought the buildings, invested money for redevelopment, and set up a lease-purchase structure for companies relocating to downtown Danville (Interview, Wright). At the end of the leasing and amortization period, which was designed to last anywhere from 5-20 years, companies were given the option to assume ownership; effectively lowering private risk and barriers to entry into Danville (Interview, Wright).

In terms of the River District, the City established an aggressive cash grant and incentive program to assist developers with redeveloping buildings in the area (Interview, Teague). According to officials at the Office of Economic Development, the

City vets small business and development projects to determine the grant size and level of competition with other businesses in the District. Upon conferring the grant, the City enters into an agreement with the small business locating downtown whereby they choose to stay in the downtown for a minimum of seven years, or pay a penalty for leaving early commensurate to the time left on the contract (Interview, Teague).

The City also highlighted the importance of the local utility and broadband network in providing a "one-stop-shop" to market potential sites – particularly at local industrial parks – to businesses weighing a decision to locate in Danville (Interview, Teague). As an arm of city government, the municipal utility provides an expedient and reliable role in ensuring all businesses are met with the appropriate infrastructure and permitting support on issues ranging from broadband and electricity to water, sewer, and gas. This has not only been critical in marketing development for a number of industrial parks within the City, but also for jointly owned industrial parks outside City limits in the jurisdiction of Pittsylvania County (Interview, Teague). Through an agreement with Pittsylvania County government and collaboration with MBC, the City of Danville leveraged its municipal utility to provide power, broadband, and other services for industrial "mega site" development (Interview, Teague). A board comprised of half City members and half County members governs development decisions (Interview, Teague). Costs are split among the City and County, and subsequent tax revenues are split according to the tax structure within each respective political jurisdiction (Interview, Teague).

The Launch Place: Entrepreneur Attraction With Community-Based Venture Capital

In 2011, Danville's philanthropic community convened a new investment fund to address the widespread lack of early stage capital in the region and to support and entrepreneurship-based economy. The Launch Place collaborated with VT KnowledgeWorks to create a comprehensive entrepreneurship plan. As such, the Danville Regional Foundation awarded The Launch Place a $10 million grant for 5 years support an entrepreneurship-based economy building off of its technical assistance and business planning platform. The fund's objective is to retain, recruit, and develop

emerging entrepreneurs in Danville and entice them to locate their business to – and live – in the River District in downtown Danville with support from technical and financial incentives provided by The Launch Place and City of Danville.

Initially capitalized at $10 million, the fund provides housing and office subsidies to technology entrepreneurs in exchange for residing their business in the River District. These ambitions aim to lower the cost of entry for entrepreneurs to set up their businesses in the City, and to provide a steady "critical mass" of talent through an influx of outside entrepreneurs. The investment fund targets companies and entrepreneurs in identified industry clusters, such as biotechnology and advanced materials. As of July 2013, the Fund has yet to complete its first round of investments.

The fund is focused on entrepreneurship recruitment, retention, and development through various areas. Strategies to achieve these goals are outlined below, along with details on the nature of seed fund investments.

Entrepreneur Recruitment, Retention, and Development
• Recruit young innovators from regional universities • Participate in, and host, business plan competitions • Paid internships at The Launch Place • Recruit back local/regional entrepreneurs • Encourage innovation in existing businesses, leveraging local assets such as the research facilities at the IALR and relationship with VT KnowledgeWorks
Fund Details
• Provides seed financing to entrepreneurs moving into the River District • Acts as a Virginia non-stock corporation with its own seed fund manager • Primary responsibility is to create lead flow, evaluate seed fund applications, and make investments • Offers convertible debt (where debt is converted to equity at later date), equity, and gap financing *Source:* (Doss, 2013)

CHAPTER 4

THE DANVILLE REGIONAL PLAN: 2000-Present

Assessing Results and Drawing Lessons

Progress and Challenges

This chapter reviews then discusses the implications of demographic and economic trends that have occurred in Southside since 2000, focusing primarily on Danville. It then outlines the existing challenges and context for advancing knowledge-based economic development in the area, drawing on data and elements of rural knowledge clusters (RKC) as a guide. It concludes by offering recommendations to economic development leaders for improving existing practice.

Findings

Thirteen years after the initial implementation of the Plan, the evidence offers mixed results.

Population (2000-2011)[45]

Danville and the broader region continued to lose population, particularly among younger and middle aged residents.

Population Change	2000-2011	Age 18 to 45	2000-2011
Danville MSA	-11%	Danville MSA	-16%
Dan River Region	-11%	Dan River Region	-23%

Educational Outcomes[46]

The region improved its educational achievement across multiple indicators, particularly among its college-educated residents in relation to the State.

Share with College Degree or Higher		2000	2011
Danville		14%	16%
Dan River Region		11%	14%
Average Years of Schooling	1990	2000	2010
Danville	12.08	12.3	13.18
High School Graduation Rates		2008	2011
Danville		74%	76%
Pittsylvania County		82%	87%

**SS / VA represents the proportion of educated residents in Southside to that of the State as a whole*

Southside Educational Attainment[47]	1980		1990		2000		2010	
Population 25 Years and over:	**Pct.**	**SS / VA**	**Pct.**	**SS / VA**	**Pct.**	**SS / VA**	**Pct.**	**SS / VA**
High School or Less	82.5%	1.25	73.2%	1.42	66.5%	1.49	58.8%	1.47
Some College	9.9%	0.66	17.8%	0.74	22.6%	.87	27.6%	1.05
Bachelor's Degree	7.6%	0.40	6.1%	0.40	7.0%	0.39	8.7%	0.43
Master's Degree	-	-	2.9%	0.32	2.6%	0.33	3.5%	0.35
Professional Degree	-	-	-	-	1.0%	0.44	1.0%	0.40
Doctorate Degree	-	-	-	-	0.3%	0.20	0.5%	0.33

Mixed Economic Picture

Despite rising education and income levels, however, higher shares of people were living in poverty, particularly among blacks.

Per capita income[48]	2005	2009
Danville and Pittsylvania County	$27,081	$30,092

Living in Poverty[49]	2000	2005	2011
Danville (Total)	20.0%	24.0%	28.0%
White	10.5%	9.0%	15.4%
Black	30.8%	41.3%	39.0%
Pittsylvania County (Total)	11.8%	13.8%	15.0%
White	9.3%	10.9%	11.1%
Black	19.6%	20.6%	25.9%

Unemployment and Job Loss

Dislocation and unemployment likely exacerbated poverty in Danville, particularly in the wake of major plant closings in the area's traditional manufacturing sector.

Danville MSA Unemployment Rate (2002-2011) [50]										
Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Rate (%)	7.6	7.7	7.4	7.8	6.7	6.4	7.7	12	11.5	9.7

City of Danville MSA	1990	2011	Change
Total Non-farm employment	42,200	39,600	-6.2%
Manufacturing	16,000	6,800	-57.5%

Continued Decline of Traditional Manufacturing

Plant Closings (2000-2013)[51]	
Textiles & Clothing	7
Tobacco Products	3
Other Manufac.	5
Total	15

Danville experienced continued volatility in Traditional Manufacturing. While the city created some jobs in this sector during the period, it saw net losses overall due to numerous plant closings and layoffs. Textiles and Clothing saw the most significant losses, with 7 plant closings and net reduction of over 3300 jobs. The closing of Dan River Mills in 2004 was perhaps the most notable, given its preeminent status as the symbol of Danville's Traditional Manufacturing prowess.[52] Other sectors such as Polymers and Rubber saw overall job gains during the period, despite volatility early in the decade. For example, while Danville's Goodyear Aircraft and Truck Tire manufacturing facility shed jobs from 2001-2002; it added jobs by 2008, with over $233 million in investment and assistance provided by the TIC.[54] In

Traditional Manufacturing Trends in the City of Danville (2000-2013)[53]						
Sector	**Firms**	**Local**	**Branch**	**New Jobs**	**Layoffs**	**Net**
Tobacco Products	2	-	2	368	-617	-249
Textiles & Apparel	1	1	-	280	-3652	-3372
Forestry & Paper.	7	2	5	1226	-285	941
Polymers & Rubber	4	-	4	544	-490	54
Other	10	4	6	2393	-287	2106
Total	**24**	**7**	**16**	**4541**	**-5331**	**-790**
Sector	**Reasons Cited for Adding or Reducing Jobs in Danville**					
Tobacco Prod.	Tobacco history, supply chain, global market conditions					
Textiles & Apparel	Global market conditions, firm buyouts, investments in local workforce					
Forestry & Paper Prod.	Market conditions for job loss and gain					
Polymers & Rubber	Volatility; public investment, institutional support (i.e. DCC, IALR)					

another example, the Indian-based global packaging firm Essel Propack located in Danville in 2003, citing local workforce programs that provided specialized training in polymer-based production processes.[55] In all, Traditional Manufacturing commanded a significant amount of public and private investment - $864 million – yet still continued to struggle with job loss.

Traditional Manufacturing Investment (2000-2013)[56]

Sector	Firms	Jobs	Total Investment ($MM)*	Invest. / Job
TAFP**	7	1451	77.2	$53,192
Tobacco	2	98	58.0	$591,837
Polymers	2	193	237.5	$1,230,415
Other	13	2799	491.3	$175,509
Total	**24**	**4541**	**863.9**	**$190,245**

**Public and Private Investment*
*** Tobacco, Agriculture, Forestry, and Paper Products*

Shifting Job Patterns

Outside of Traditional Manufacturing, Danville saw modest job growth in other sectors, such as Telecommunications (at 11%) and Information and High Tech (IHT) (at 24%). These two categories accounted for roughly a third of all new jobs in Danville compared to the prior decade. While the City relied on branch facilities for large portions of all new jobs in both periods, it derived a large share of IHT jobs (38%) from locally based firms from 2000-2013. These either began as startups or relocated their corporate offices to Danville. The rapid growth in Telecommunications resulted entirely from call center branch locations. Danville's Traditional Manufacturing sector also became increasingly reliant on firms outside the region, with 93% of new jobs in the sector created from branch locations in contrast to 80% of the prior decade.

Job Growth From New and/or Expanding Businesses, City of Danville (1990-2013)[57]						
	1990-1999			2000-2013		
Sector	**Firms**	**Jobs**	**Share**	**Firms**	**Jobs**	**Share**
Trad. Manufacturing	15	2540	96%	24	4541	64%
IHT	-	-	-	18	1679	24%
Telecommunitications	1	30	1%	1	750	11%
Medical	-	-	-	2	40	1%
Warehousing	1	40	1%	-	-	-
Fin. Services	1	50	2%	-	-	-
Total	**18**	**2660**	**100%**	**45**	**7010**	**100%**

Job Growth From Locally-Based (LB) vs. Branch-Based (BB) Firms, City of Danville (1990-2013)[58]				
	1990-1999		2000-2013	
Sector	**Local**	**Branch**	**Local**	**Branch**
Trad. Manufacturing	20%	80%	7%	93%
IHT	-	-	38%	62%
Telecommunications	0%	100%	0%	100%
Total	**20%**	**80%**	**18%**	**82%**

Nature of Information and High Technology (IHT) Growth

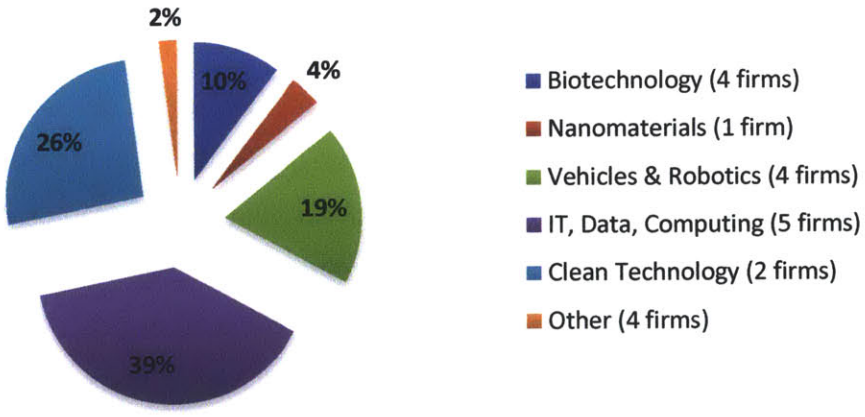
By first evaluating the components of job growth within IHT, the data offers a closer view of whether meaningful concentrations of IHT firms had arisen on account of local knowledge economy investments.

New Job Growth in Information & High Tech (IHT), City of Danville (2000-2013)[59]

IHT Sectors	Firms	Jobs	Total Investment (MM)**	Invested $ / Job
Biotechnology	4	150	13	$ 86,667
Nanomaterials	1	54	6.4	$118,519
Vehicles & Robotics	4	301	13	$43,189
IT, Data, Computing	5	563	17.9	$36,865
Clean Technology	2	377	30	$262,308
Other	4	250	32.3	$144,615
IALR Investment	-	43	80	-
Broadband Invest.	-	-	12	-
Total	**18**	**1738**	**204.6**	**Avg. $117,722**

*** Public and Private Investment*

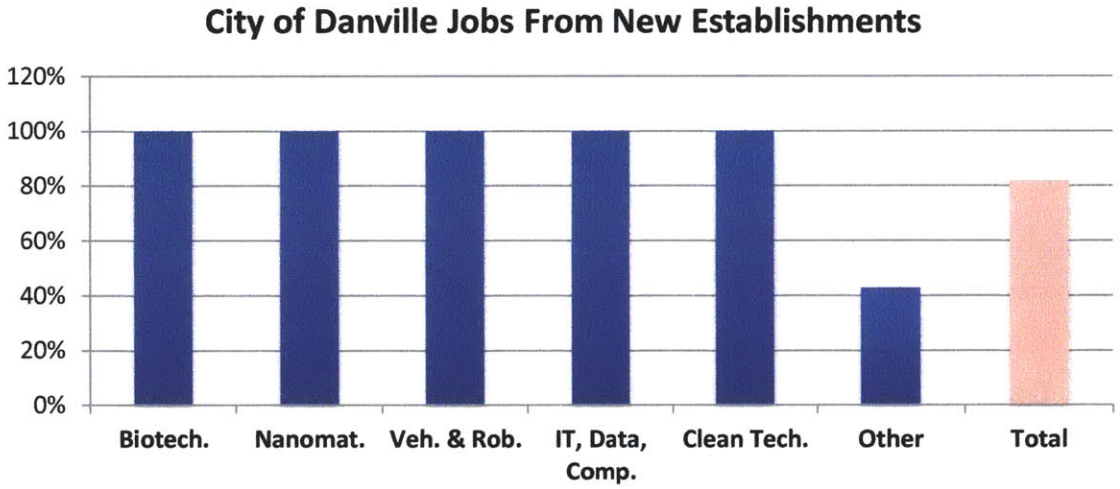
Danville IHT Job Growth By Sector (2000-2013)



Nature of IHT Firm Establishments in Danville Resulting From New Job Growth (2000-2013)[60]									
IHT Sectors	**Firms**	**Jobs**	**Local**	**Branch**	**R&D**	**TD**	**Manuf.**	**IALR***	**DCC***
Biotechnology	4	150	3	1	3	3	3	2	-
Nanomaterials	1	54	-	1	1	1	1	1	1
Vehicles & Robotics	4	301	2	2	2	2	2	2	-
IT, Data, Computing	5	563	-	5	1	-	-	-	4
Clean Technology	2	377	2	-	1	1	2	-	2
Other	4	250	1	3	-	-	1	1	1
Total	**20**	**1695**	**8**	**12**	**8**	**7**	**9**	**6**	**8**

**Indicates affiliation through research partnerships or education and vocational training programs*

*** "TD" – Technology Development; "Manuf." – High Tech Manufacturing*



As a quarter of all new jobs created in the City, IHT grew across a range of technology and knowledge-intensive fields. These fields included biomaterials, biochemistry, pharmaceuticals, advanced vehicle research, electronics design, nanomaterials, high-performance computing, software, data storage, research, clean energy, high tech printing, and, among others. "Clean Tech" and "IT, Data, and Computing" provided the largest share of jobs, while "Clean Tech" and "Other" (i.e. including high tech printing and advanced electronics design and manufacturing) commanded the highest amount of public-private investment per job.

The vast majority of IHT jobs resulted from new establishments in the form of startups or corporate relocations. As indicated in Table 5, Danville also amassed strong concentrations of headquarters for IHT firms, as well as establishments with R&D, technology development (TD), and high tech manufacturing capabilities. Many firms also had evident relationships with local institutions, such as the IALR (in the case of research collaborations) and Danville Community College (in the case of co-developing curriculum for workforce training). Together, these trends suggest that Danville improved its relative attractiveness to technology-focused firms and competitive advantages for supporting innovation-based activity. The types of jobs created included researchers, engineers, and business managers, as well as technicians for high tech manufacturing operations, with an average wage of approximately $65,000 per year.[61]

Summary Results

In assessing the data, it is clear that while Danville has achieved modest job growth and diversification into IHT sectors, its growth has been relatively slow since the 2000 inception of the Danville Regional Plan. At a total of 1738 IHT jobs and 20 firms, and assuming an average wage of $65,000 per year and approximate employment base of 27,095,[62] Danville saw from 2000-2013:

- 130 IHT jobs per year
- 1.53 new IHT firms per year
- $.55 of return in the form of IHT wages for every dollar invested (public and private funds)
- Diversification of 6.41% of the total employment base into IHT sectors

Economic Development Investments in Danville Since the Year 2000[63]	2000-2013 ($MM)	Percent Total
Broadband	12	1.1%
IALR	80	7.3%
IHT (with Broadband & IALR)	204.6	18.8%
Traditional Manufacturing	863.9	79.3%
Other	20.6	1.9%
Total	**1089.1**	**100%**

Implications

Analysis of the Danville case offers fresh perspective at high tech-focused economic development efforts in rural regions. To challenge conventional notions that rural areas lack the capacity to engage in knowledge-based growth, the case offers an example of one such region attempting to "re-engineer" its asset base to do so. The effort has not been without its challenges, however, given largely mixed results presented by the data.

Educational attainment steadily improved across Southside over the last ten years, and Danville saw nascent progress with respect to increasing its engagement in knowledge-intensive industries. However, Danville saw comparatively little job growth in IHT (at 130 jobs per year) and continued to struggle with job loss in Traditional Manufacturing. It also struggled to achieve commensurate returns in the form of wages per dollar invested (i.e. $.55 in wages per dollar in IHT), or a significant diversification of its job base amid steadily rising poverty (diversification of 6.41% of the job base despite a 40% increase in the poverty rate during the period). Of those living in poverty, blacks were roughly three times more likely to be affected than whites; indicating that persistent barriers exist to enabling even access to opportunity.

If knowledge economy efforts in Danville are meant to induce sustainable prosperity, these trends should compel area leaders to evaluate the challenges through continued reflective practice. Long-term opportunity costs and path dependencies may be associated with each major investment decision, arising on account of factors such as history, institutions, or geography. Decisions to refine the existing strategy should therefore stem from close re-examinations of fundamental operational questions; such as whether knowledge economy development is truly deriving from local knowledge; "who" economic development investments are purported to benefit versus who they are actually benefitting; and how such investments might position Southside to avoid repeating past mistakes and otherwise harmful path dependencies.

The economic implications of these questions are important, given the strategy's heavy reliance on outside institutional support and increasing focus on specialized knowledge. The declining availability of TIC resources, for example, highlights a need to reconcile Southside's knowledge economy ambitions with an uncertain public funding

environment in the future; and that future economic growth must derive from increasingly self-sustaining private investment and a diversified pool of options. The area's heavy reliance on outside institutions – such as the TIC and Virginia Tech – for financial and programmatic support on items such as as research, human capital development, company attraction, and entrepreneurship suggest that stronger endogenous capabilities are needed to ensure continued progress when these funding sources expire. And while Southside's dedication to specialized knowledge development and related infrastructure may play an important role in incentivizing continued private investment and company attraction – perhaps in lieu of TIC funding – placing too much emphasis on specialization as the "driver" of economic growth may expose Southside to past mistakes and inflexible development patterns in the face of market shifts; particularly in markets subject to high degrees of technological change and innovation, such as bioenergy.

The equity implications of these issues are important, given evident disconnects between rising poverty and the scale of investment in Southside. At its heart, the issue underscores a need for greater accessibility to economic opportunity and jobs among the low-skilled employment base; and blacks in particular. It also suggests that targeted IHT and Traditional Manufacturing investments may not have produced their desired outcomes and that additional refinements to the strategy may be needed to broaden economic impact.

Even so, the Plan unfolding in Danville illustrates collective aspirations to diversify the range of opportunities available to Southside residents; and to do so through knowledge-based growth. Key anchors of the Danville Regional Plan – such as broadband, human capital development, innovation infrastructure, city reinvestment and redevelopment, and community-based venture capital – have gone to great lengths to build local capacity and increase the region's stock of knowledge, companies, and talent in a broad range of fields. They also evolved according to an increasingly inter-related framework, depicted through a graphic in the Appendix. By conceptualizing these elements as part of a working system, economic development leaders in Danville may be able to compartmentalize and prioritize specific actions according to elements of the

rural knowledge cluster framework. The challenges and context for doing so are provided, along with several recommendations.

Challenges and Context

Significant Public Capital Required	**Unusually heavy involvement from the State and public institutions.** Since the year 2000, the TIC invested approximately $476 MM of its $1.2 billion endowment in broader Southside, with $120 MM of that money going to projects in and around Danville. Danville attracted approximately $1.08 billion of public and private investment alone from 2000-2013, with more than 79% of all monies dedicated to Traditional Manufacturing and 19% towards IHT. TIC spending priorities were not wholly consistent nor adequately focused at the onset, as local communities often competed for pet projects without relation to broader regional development goals. While scale of investment may not apply to all rural areas, its results give the impression that capital and interventions of this magnitude may be required to enact substantive structural changes in rural economies. **Declining public resources for economic development support.** The TIC endowment is shrinking each year, given that its sale of tobacco settlement revenue streams securitized annual payments to the State until 2032 (at which point tobacco settlement funds may be renegotiated for a subsequent bond sale and/or made available for economic development). Annual extractions from the existing corpus were limited to 10% to prolong the life of the endowment, indicating that Southside will be limited to an increasingly smaller pool of funds over time as money is spent. According to TIC commissioners, this endowment may be fully depleted within the next decade; falling well short of the time until tobacco settlement revenue may once again become available in 2032 (Pfohl, interview).
Underdeveloped Knowledge Base in Existing & Emerging Fields	**Lack of knowledge and education among local residents for IHT engagement.** Analysis by The Launch Place revealed that for several sectors, the local (i.e. "endogenous") knowledge base was insufficient to engage in the more knowledge-intensive portions of IHT product development. In the case of bioenergy and biotechnology, local farmers did not possess the educational background to effectively engage in evaluating the conversion potential of hybrid crops. All "Plant Biology" industry clusters were heavily R&D focused and long time lags were anticipated

	between possible patenting activity, technology commercialization, and broader economic benefits. The heavy emphasis on the IALR and ISRR as a center for R&D, however, of codified knowledge to support "downstream" market activity. However, tacit knowledge development through workforce training and knowledge dissemination among area farmers has yet to be fully realized.
Structural disadvantages from low rural densities and lack of agglomeration	**Struggle to amass critical industry density for "recognized clusters."** The Launch Place cited Southside's inability to meet location quotient (LQ) thresholds for federal economic development grants designed to support industry clusters. These grants required that concentrations of companies in the region to exist at a certain percentage above the national average to qualify, particularly, at 1.25 or greater. Since Southside is predominantly rural and its dispersion of companies over a larger area, interviewees cited the Region's structural disadvantages compared to denser urban metros when competing for funding opportunities demanding qualification on this basis (Interview, Doss). **Continued challenges to attract and retain knowledge economy workers and realize anticipated jobs.** Despite announcements of anticipated job creation and job growth among several companies, such as Luna Nanoworks (i.e. 54 announced, 12 realized),[64] the realized versus announced jobs in Danville face some inconsistency. This reflected the broader and continuing challenge the City faces with attracting and retaining knowledge economy workers. From 2000-2011, Danville continued to experience population loss among 18-45 year olds, a key demographic among knowledge-economy companies. While The Launch Place seed investment fund was designed to overcome this challenge and attract younger entrepreneurs, its benefits have yet to be realized given the newness of its 2013 inception. **Lack of communication among producers and suppliers in industry clusters.** According to Eva Doss, local companies in their cluster development efforts – namely, raw materials suppliers and manufacturing product producers – were not aware of one another's products nor expertise, despite the strong overlap and complementarities between their two market niches. This reflected the broader struggle of the region to achieve strong enough social capital and communication

	networks to overcome the isolation of companies/industry sector participants dispersed over a wide geographic area.
Disconnect Between Rising Poverty and Investment	**"Modest" job growth in IHT, as well as evident challenges in translating IHT and Traditional Manufacturing support into broader economic impacts.** Despite Danville's increase in IHT jobs, growth in this respect was relatively minor compared to the overall City job base (IHT grew to comprise 6.4% of the total job base over 13 years). During this period, both the aggregate number as well as general share of people living in poverty in Danville increased; going from 20% in 2000 to 29% by 2011. Blacks were also approximately three times more likely to live in poverty in Danville than whites (going from 30.8% to 39% from 2000-2011, compared to 10.5% to 15.4% for whites), despite comprising less than half of Danville's population. Job losses in Traditional Manufacturing likely exacerbated this trend, as Danville struggled to retain higher-paying jobs that typically conferred lower barriers to entry for a predominantly under-educated employment base.

Recommendations

Should Danville continue with the status quo? Or might there be pretext to reevaluate its evident issues and challenges? How might hypotheses from the RKC framework inform these discussions? Leaders may choose any number of paths, all of which encompass their respective risks and challenges. Recommendations will be offered in the following areas:

1. Traditional Manufacturing
2. Information and High Tech (IHT)
3. Alternative Sectors
4. Community-Based Knowledge Management Tools (KM)

1. Traditional Manufacturing

Align Research and Workforce Development Institutions to Incentivize "Firm Stickiness." Historically, Traditional Manufacturing has provided large shares of relatively higher paying jobs to the region's lower-skilled workforce. For this reason, it should garner the continued attention of economic development leaders, as the sector evolves towards higher degrees of technical sophistication and related workforce needs. While evident challenges facing Traditional Manufacturing may reflect macroeconomic trends, Danville's case shows that its strategy has become increasingly reliant on attracting outside firms. The recent expansions of firms such as Essel Propack, Goodyear, and JTI Leaf Services all demonstrate increasing outside firm commitment to the region on the particular account of Danville's investments in its underlying asset base. These trends are not immune to the same sources of future volatility, however, that have historically troubled the sector.

To the extent local leaders can improve endogenous factors that incentivize firm "stickiness" – such as a technically proficient and educated workforce, greater R&D support between the IALR and firms with related needs, and facilitating communication and linkages among area firms with complementary interests – the area should do so to increase its attractiveness beyond the measure of low costs alone. The examples from Minnesota offer important pretext for the roles that research and workforce development institutions play in in this process, as well as in improving rural competitive advantage. Increasing alignment between the IALR, Averett University, and Danville Community College – on items such as curriculum, codified knowledge development, tacit knowledge capture, and joint-industry engagement for example – may provide a logical starting point as well as nucleus from which to "broker" greater firm support and innovation services in Traditional Manufacturing and IHT.

2. Information and High Tech (IHT)

Overcome the "Silver Bullet" Mentality. Danville's IHT focus illustrates an aggressive effort to carve out specialized niches of expertise across a range of fields to create high paying jobs and attract knowledge economy workers. Despite aggressive investments in broadband and the IALR, however, the region achieved modest success

during its first 13 years. With two successfully graduated firms and 21 associated jobs to account for to date at the IALR, a 6.41% diversification of the job base into IHT overall, and rising poverty, economic development leaders should question the notion that robust R&D and related IHT investments may provide the proverbial "silver bullet" needed to reinvigorate the regional economy; at least within the first few decades of its inception. Thinking along longer time frames, perhaps akin to the 50-60 years espoused by the TIC, may be more appropriate for assessing the relative progress and "success" of structural change in Southside.

Re-examine and Strengthen the Role "Local Knowledge" in IHT Development. In the case of "Plant Biology," the strategy for each sub-sector reflects a presumption that increasing investments in specialized R&D and biotechnology products may invariably result in broader economic impacts in the form of new companies and accessible jobs among the employment base. Its basis in regional assets – such as agriculture and tobacco – also illustrates an attempt to align with endogenous strengths and the historical development path of the knowledge base. Yet fundamental hypotheses of the RKC framework challenge aspects of this notion, as evident disconnects between IALR research and the participation of local farmers suggest that "local knowledge" may not be as effectively integrated into the product development process as possible. Does the IALR's competitive advantage in fields such as biotechnology truly derive from "local" knowledge? Or is it largely reliant on the importation of outside expertise and researchers to maintain its competitive edge? What does this imply for the Region's continued prospects in fields demanding sophisticated R&D, robust infrastructure, and workforce training to be embedded within the region, as well as those that are subject to high degrees of technological change? These questions leave room for debate.

Consider Implications of Poverty, Path Dependence, and Over-Specialization. The IALR should continue focusing on opportunities that offer the greatest number of well-paying, accessible jobs in market-driven fields. This is self-evident, yet it sets important context for discussing the inherent risks associated with placing Southside's

proverbial "eggs" in the "IHT basket." The reality of rising poverty in Danville should caution area leaders to consider the aforementioned questions, particularly as they relate to bioenergy.

Historical precedents for the rise of corn-based ethanol and biofuels suggest that government regulation and subsidy play an instrumental role in achieving industry traction (Peskett, et al. 2007). They also suggest that large-scale bioenergy operations incur the highest part of their costs in the production process (i.e. growing the feedstock), creating downward pressure on price may encourage growers to incentivize land consolidation, inflexible land use patterns, and cost-cutting in the form of lower wage positions along the supply chain (Peskett, et al. 2007). This is heightened in instances where transportation costs for getting the product to market create further downward pressure on price.

Even if Danville were to achieve some level of success in amassing a tobacco-based biofuels industry, these issues may expose the region to a variety of risks. These include (i) encouraging lower-wage positions and surrounding farm consolidation, (ii) investing in specialized infrastructure and research that might exacerbate regional tendencies to "lock in" to specific technologies or inflexible development trajectories, and (iii) increasing the region's reliance on government funding that might expose Southside to the same path dependencies that arose with the advent of government subsidies for tobacco farming. With the advent of new technologies or changes in government regulations or support, any paradigm shift within the biofuels market could impact southern Virginia in a similar fashion to its traditional industries should it become overly specialized or too dependent on government subsidy.

3. Alternative Sectors

Implement a Tourism-Based Strategy. Southside leaders may also consider supporting new economic sectors to generate cash flow and jobs outside of Traditional Manufacturing and IHT. Tourism may be one such avenue, as the IALR already focuses on bringing new visitors to the region with its conference center and marketing activities and is working to connect regional tourism assets (Materna 2004). (BBP & Associates and Associates 2011)In terms of natural resources, Danville is in close proximity to a

number of state parks and has direct access to the Dan River. Numerous interviewees expressed that the Dan River – directly adjacent to downtown – represents the City's most important natural asset due to the potential of enhanced real estate values, recreational opportunities, public space, and overall improvements to quality of life. The City is also gaining momentum with its Historic Tobacco Warehouse District, revitalizing its industrial core, and strengthening connections to the riverfront through public space planning. With sustained effort and a unified artistic vision, the City could strengthen marketing and physical connections to its natural and cultural assets and market itself as a destination location for events and visitors from surrounding communities. The recent inception of the MBA Rugby World Championship in Danville, which draws in visitors from surrounding communities such as the Research Triangle Park on an annual basis, illustrates the momentum that is building in this regard.

Focus on Small Businesses. Small business development is another area of exploration local leaders may consider. In addition to The Launch Place, the Longwood Small Business Development Center, a federally and locally funded technical assistance center for small businesses and entrepreneurs in Danville, provides free education and consulting services that may lend momentum to efforts focused on reconnecting dislocated workers to small business and entrepreneurial opportunities. By mentoring entrepreneurial ventures through Internet marketing support and IT training, the Longwood SBDC places heavy emphasis on matching small businesses with web developers to increase their Internet presence and revenue. While this may help increase the technical proficiency of local workers and provide greater access to broader markets in the long run, they've expressed numerous barriers to entry for small businesses and retraining workers. These include a prohibitively high cost for broadband services, as well as general lack of local web and IT professionals with sufficient skillsets to engage in technical assistance (Interview, Arnold).

4. Community-Based Knowledge Management (KM) Tools

Dedicate Attention To Knowledge Management Principles. With the advent of the Noblis Supercomputing Center in downtown Danville – as well as more

sophisticated connections among the IALR, DCC, Averett College and local companies in joint tacit and codified knowledge development – new opportunities have arisen to strengthen the active role that "knowledge management tools" play in Danville's overall economic development strategy. These opportunities derive from techniques that "improve the communication, sharing, and/or formal capture of information or knowledge" (Jarboe 2001) with economic development implications.

Sveiby (2001) divides knowledge management into two areas – (i) "managing information" and (ii) "managing people." "Managing information" refers to researchers and practitioners with a general background in computer or information science and dedicated to engineering information management systems (or in other words, codifying knowledge). The primary mode of engagement is through software, information storage systems, and the Internet; or in effect, treating knowledge and information as an "object" (Sveiby 2001). "Managing people" refers to researchers and practitioners with a general background in "philosophy, psychology, sociology, or business management" that are primarily involved with "assessing, changing, and improving human individual skills and behavior" (Jarboe 2001). The primary mode of engagement is through human capital development and competency building; or in effect, treating knowledge and information as a "process" that encompasses a complex set of dynamic skills, know-how, and other means that are constantly changing (Jarboe 2001). These means may be on the individual, organizational, or inter-organizational level. Together, these two concepts offer pretext for understanding the potential role and value of community-based KM tools in Danville.

Improve Effectiveness Through Knowledge Management Tools. Area leaders may consider any number of opportunities to facilitate collaboration on community-based KM tools. Drawing on recommendations from the U.S. Economic Development Administration, these may include (Jarboe 2001):

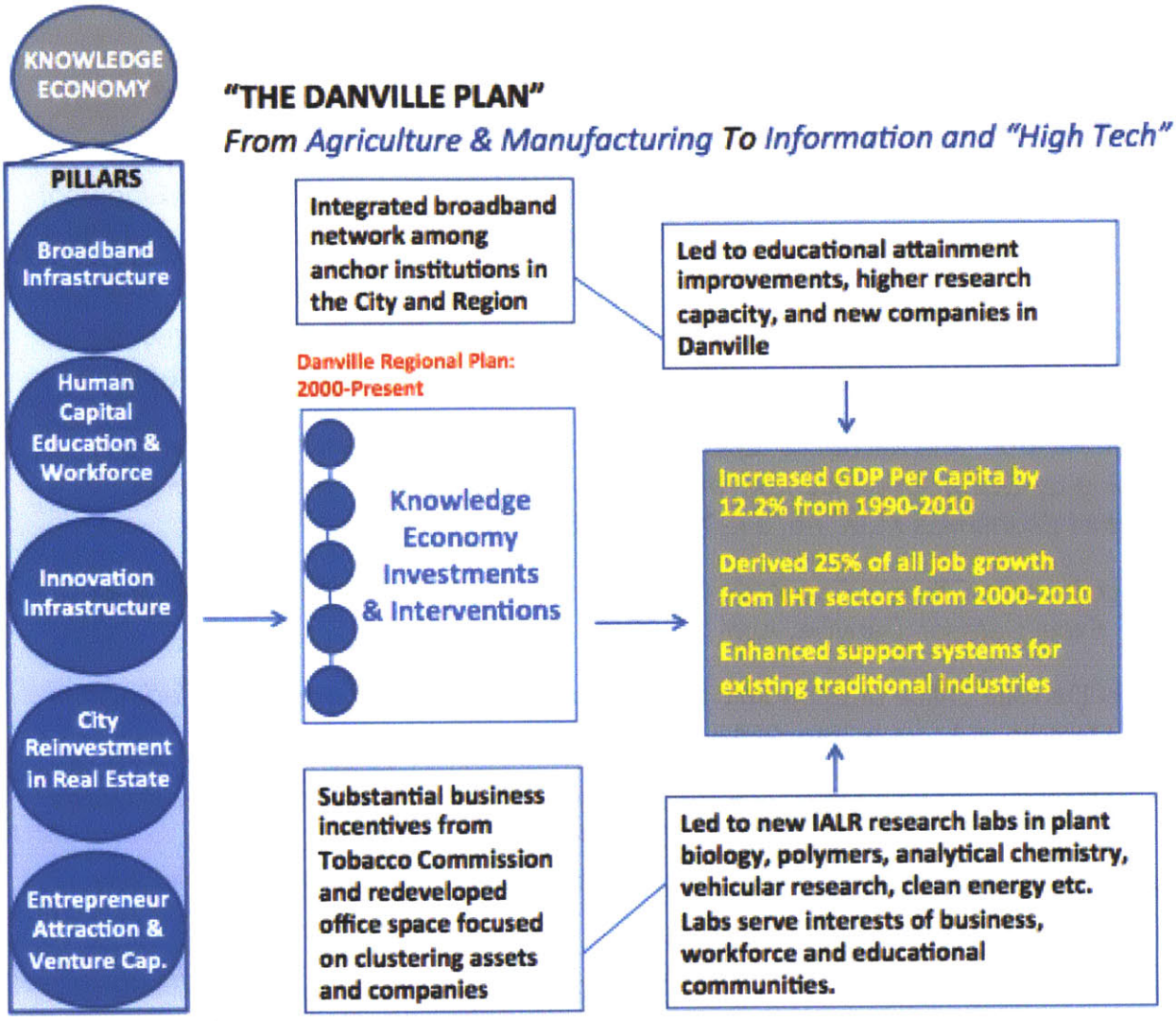
- Enhancing external communications of companies through marketing
- Promoting internal communications within local businesses and help companies capture tacit knowledge

- Uncovering and developing intellectual assets, including the development of information products and identifying entrepreneurial opportunities
- Strengthening economic clusters through information sharing and networking
- Enhancing external knowledge sharing among the economic development community
- Capturing and sharing tacit knowledge within an economic development organization

Tap Local Organizations for Community-Based Knowledge Management. With respect to managing information, the presence of the Noblis Supercomputing center offers perhaps the most striking opportunity to anchor a community-wide KM effort. Its base of technology specialists and mathematicians – who have an interest in developing software and machine-based learning to express their ideas – may be useful for bridging problem domains and technology domains on a wide variety of economic development issues. For example, Noblis employees have expressed nascent interest in codifying and streamlining various aspects of complex, economic development processes with high degrees of public-private interactions – such as permitting and business attraction – to better serve the local community and enhance local competitiveness.

With respect to managing people, the activities of Longwood SBDC and The Launch Place provide nascent evidence that Danville business leaders are working to disseminate process-oriented KM tools among emerging entrepreneurs, businesses, and dislocated workers. Self-directed STEM learning programs at the IALR also represent local efforts to improve the technology literacy and IT proficiency of general community members. If aligned and collectively marketed, collaboration among these entities may offer a new platform to merge "information management" and "people management" elements into a community-based KM framework in Danville. Further exploration will be needed however as these conversations and ideas are in their early stages.

Appendix: Concept Diagram of "The Danville Model"



This graphic depicts evident knowledge economy "pillars" as they have unfolded since the implementation of the 2000 Danville Regional Plan. It is intended to provide a comprehensive view of how separate yet inter-related projects are interacting to stimulate economic diversification in Danville and surrounding rural Southside.

Bibliography

Andrew Michael Cohill, Ph.D. *Danville Transforms Its Economy With Fiber.* LLC Broadband Properties. 2012. http://www.bbpmag.com/MuniPortal/EditorsChoice/1111editorschoice.php.

Arnold, Diane, interview by Drew Pierson. *Director, Longwoord Small Business Development Center, Danville Office* Cambridge, MA, (June 26, 2-13).

BBP & Associates, LLC, and Alllison Platt & Associates. *River District Redevelopment Plan, Final Report for the City of Danville.* Funded Report, BBP & Associates, LLC; Alllison Platt & Associates, 2011.

Botkin, Jim, and Chuck Seeley. "The Knowledge Management Manifesto: Why KM Requires Community-Building." *Knowledge Management Review* 3, no. 6 (2001).

Cabral, Ricardo, and Michael J. Leiblen. "Adoption of a Process Innovation with Learning-by-Doing: Evidence from the Semiconductor Industry." *The Journal of Industrial Economics* XLIX, no. 3 (2001): 269-80.

"City of Danville Office of Economic Development." *Danville Announcements Since 1990, Excel Dataset.* Danville, April 16, 2013.

"City of Danville Office of Economic Development." *Danville Closings and Reductions Data.* Danville, VA, June 28th, 2013.

City of Danville, Virginia Office of Economic Development. *Essel Propack Announces 35 New Jobs in Danville: Third Expansion in Five Years.* April 26, 2007. http://www.discoverdanville.com/DocumentCenter/Home/View/218 (accessed July 10, 2013).

Commission, Virginia Tobacco. "Broadband Initiative to Serve as National Technology Infrastructure Model." *PR Newswire.* June 18, 2003. http://www.prnewswire.com/news-releases/broadband-initiative-to-serve-as-national-technology-infrastructure-model-75056262.html (accessed July 18, 2013).

Cortwright, Joseph. *New Growth Theory, Technology and Learning: A Practitioners Guide.* Funded Report, Portland, OR: Impresa, Inc., with funding from the U.S. Department of Commerce Economic Development Administration, 2001.

Cowan, Robin, and Dominique Foray. "The Economics of Codification and Diffusion of Knowledge." *Industrial and Corporate Change* 6, no. 3 (1997).

DeVol, Ross, I-Ling Shen, Armen Bedroussian, and Nan Zhang. *A Matter of Degrees: The Effect of Educational Attainment on Regional Economic Prosperity.* Research Report, Milken Institute, Washington D.C.: Milken Institute, 2013.

Diamond, Charles A., and Curtis J Simon. "Industrial Specialization and the Returns to Labor." *Journal of Labor Economics* (The University of Chicago Press) 8, no. 2 (Apr. 1990): 175-201.

District, West Piedmont Economic Development. *Comprehensive Economic Development Strategy: 2012 Annual Report.* Funded Report, West Piedmont Economic Development District, with funding from the U.S. Department of Commerce Economic Development Administration, 2012.

Doss, Eva, interview by Drew Pierson. *President and CEO, The Launch Place* Cambridge, MA, (June 26, 2013).

Drabenstott, Mark. "New Policies for a New Rural America." *International Regional Science Review* 24, no. 1: 3-15.

Flowers, Jim, interview by Drew Pierson. *Executive Director, VT KnowledgeWorks* Cambridge, MA, (April 1, 2013).

—. "Tomorrow in Danville: A Draft Proposal for Focused and Aggressive Transformation Through Technological Entrepreneurship." Danville, VA: Jim Flowers, August 17, 2011.

Francesca Affortunato, Edgardo Bucciarelli, Mariateresa Ciommi, and Gianfranco Giulioni. *Assessing local knowledge dynamics: Regional Knowledge Economy Indicators.* International Journal of Human and Social Sciences, 2010.

Franklin, Nancy E., interview by Drew Pierson. *Former Senior Director of Technology and Community Development, Virginia Tech* Cambridge, MA, (June 3, 2013).

Franklin, Timothy V., interview by Drew Pierson. *Director, Office of Public Partnerships & Engagement at the Pennsylvania State University* Cambridge, MA, (April 1, 2013).

Franklin, Timothy V., Sam Leiken, and Nancy E. Franklin. *Planting Innovation in Rural America: Putting Together a Regional Innovation Cluster in Southside Virginia, with All the Right Pieces.* Report, Washington D.C.: Science Progress, 2012.

Gale, Fred, and David McGranahan. "Nonmetro Areas Fall Behind in the 'New Economy'." *Rural America* (USDA) 12, no. 3 (2001): 18-25.

Jarboe, Kenan Patrick. *Knowledge Management as an Economic Development Strategy.* Funded Report, U.S. Department of Commerce Economic Development Administration (EDA), Washington D.C.: Athena Alliance, 2001.

Jeff Caldwell, Press Secretary for Virginia Governor Bob McDonnell. *JTI Leaf Services to Invest $7.5 Million to Upgrade Technology at Danville Processing Facility: Governor to Meet With Firm in Japan.* April 23, 2013. http://www.governor.virginia.gov/news/viewRelease.cfm?id=1787 (accessed July 12, 2013).

Ketner, Mark, interview by Drew Pierson. *Senior Engineer and Principal Investigator, Engineered BioPharmaceuticals* Cambridge, MA, (July 12, 2013).

Killeen, John Patrick. *Restructuring Southside for Innovation: Technology, Education, and Holistic Job Growth in Danville, Virginia.* Thesis, Department of City and Regional Planning, University of North Carolina, Chapel Hill, 2010: UNC Chapel Hill, 2010.

Leightley, Dr. Liam, phone interview by Drew Pierson. *Former Executive Director of the Institute for Advanced Learning and Research* (March 20, 2013).

Materna, Jane M. *The Institute for Advanced Learning and Research Program in the Dan River Region of Virginia and the New Growth Economic Development Theory.* Graduate Thesis, Public and International Affairs, Virginia Polytechnic Institute and State University, Blacksburg, Virginia: Virginia Polytechnic Institute and State University, 2004.

MDC, Inc. *Learning, Working, Winning. Bringing the New Economy to the Dan River Region: A Report of the Future of the Piedmont Foundation.* Future of the Piedmont Foundation, Chapel Hill, NC: MDC Inc., 2000.

Minchin, Timoth. "Dan River Mills." *Encyclopedia Virginia.* September 25, 2010. http://www.encyclopediavirginia.org/Dan_River_Mills.

Mitchell, William F., phone interview by Drew Pierson. *Software Architect, Noblis* (March 26, 2013).

Munnich, Lee W., Greg Schrock, and Karen Cook. *Rural Knowledge Clusters: The Challenge of Rural Economic Prosperity.* Policy Brief, State and Local Policy Program, Hubert H. Humphrey Institute for Public Affairs, University of Minnesota, Minneapolis: U.S. Economic Development Adminstration, 2002.

Peskett, Leo, Rachel Slater, Chris Stevens (ODI), and Annie Dufey (IIED). *Biofuels, Agriculture and Poverty Reduction.* Funded Report, Programme of Advisory Support Services for Rural Livelihoods Department for International Development, UK Department for International Development, Overseas Development Institute, Overseas Development Institute, 2007.

Pfohl, Tim, phone interview by Drew Pierson. *Grants Program Director, Virginia Tobacco Indemnification & Community Revitalization Commission* (April 4, 2013).

Porter, Michael E. "Location, Competition and Economic Development: Local Clusters in a Global Economy." *Economic Development Quarterly* 14, no. 1 (February 2000): 15-34.

Research, The Institute for Advanced Learning and. *The Network, IALR.* June 2013. http://www.ialr.org/index.php/ialr/business-development/the-network (accessed June 18, 2013).

Sam Leiken, Timothy V. Franklin, Nancy E. Franklin. *Leveraging Universities, Technology, and Education to Drive Rural Economic Growth.* June 4, 2012. http://scienceprogress.org/2012/06/leveraging-universities-technology-and-education-to-drive-rural-economic-growth/ (accessed May 1, 2013).

Stauber, Karl, phone interview by Drew Pierson. *President & CEO, Danville Regional Foundation* (March 26, 2013).

Sveiby, Karl-Erik. *What is Knowledge Management?* Report, Sveiby Knowledge Associates, Sveiby Knowledge Management, 2001.

Teague, Corrie M., phone interview by Drew Pierson. *Project Manager, City of Danville Office of Economic Development* March 6, 2013).

Timothy V. Franklin, Lorilee R. Sandmann, Nancy E. Franklin, Theodore J. Settle. "Answering the Question of How: Out-of-Region University Engagement with an Economically Distressed, Rural Region." *Journal of Higher Education Outreach and Engagement* 12, no. 3 (2008): 205.

Torgerson, David, and Karen Hamrick. "Global Conditions Hurting Rural Economy." *Rural Conditions and Trends* (USDA) 9, no. 3 (1999): 7-10.

Wright, Linwood, phone interview by Drew Pierson. *Consultant, City of Danville Office of Economic Development* (March 6, 2013).

[1] DeVol, Ross, I-Ling Shen, Armen Bedroussian, and Nan Zhang. *A Matter of Degrees: The Effect of Educational Attainment on Regional Economic Prosperity.* Research Report, Milken Institute, Washington D.C.: Milken Institute, 2013.

[2] Source: Bureau of Economic Analysis "Regional Data, GDP and Personal Income, Per Capita real GDP by State;" calculated through a weighted average of Virginia's compound annual growth rate from 1990-2012

[3] Southside stretches southward from Lynchburg to North Carolina and westward from the Atlantic coast to Highway 81 (Materna 2004)

[4] http://walkthetown.com/page305/page330/page330.html

[5] Source: Industry data provided by the City of Danville Office of Economic Development

[6] Source: "Tomorrow in Danville: A Draft Proposal for Focused and Aggressive Transformation Through Technological Entrepreneurship." Danville, VA: Jim Flowers, August 17, 2011.

[7] Percentage Share DRR Population With XX Status / Percentage Share Virginia Population With XX Status

[8] Investment Data provided by the TIC

[9] "Southside Business Technology Center Receives Tobacco Commission Grant," May 2006

[10] http://www.mbc-va.com/history-of-mbc

[11] Source: *Rationale for the eCorridors Inter-Regional Advanced Network Infrastructure Program*, eCorridors website, http://www.ecorridors.vt.edu/about/mission/rationale.php

[12] VT's other major project in the DRR – the Institute for Advanced Learning and Research – would later serve as a focal point for raising the role of institutionally-driven research and education as an economic development tool

[13] MSAP Definition: http://www.bev.net/about/research/digital_library/docs/broadbandv3.pdf

[14] http://www.noblis.org

[15] http://www.ialr.org/index.php/research/focus-areas

[16] www.ialr.org

[17] Southside Business Technology Center, "Market Research and Analysis" 2008

[18] [18] Southside Business Technology Center, "Market Research and Analysis" 2008

[19] USDA: Economic Return to Public Agricultural Research

[20] IALR 2010 Annual Report: http://www.ialr.org/files/Annual%20Report/Annual_Report_2010.pdf

[21] www.ialr.org

[22] IALR 2012 Annual Report: http://www.ialr.org/files/Annual%20Report/Annual_Report_2012.pdf

[23] www.virdia.com

[24] "History – SENTEC Opening Signals Progress for Southern Virginia," IALR website, 2012

[25] "History – SENTEC Opening Signals Progress for Southern Virginia," IALR website, 2012

[26] "History – SENTEC Opening Signals Progress for Southern Virginia," IALR website, 2012

[27] http://www.ialr.org/index.php/ialr/business-development/sentec

[28] "Analytical Laboratory Achieves ISO Certification"; IALR website 2013

[29] http://www.ialr.org/index.php/research/focus-areas/vehicles

[30] Deborah P. Morehead "Graduate Students Help Drive Innovation Economy in Southside Virginia," 2009

[31] Deborah P. Morehead "Graduate Students Help Drive Innovation Economy in Southside Virginia," 2009

[32] "According to the Building Science ad Engineering Talent Report (2004), 50 percent of U.S. economic growth in the second half of the 20th century was attributable to the contributions of the 5 percent of college graduates in science and engineering fields" (Franklin 2012). Citing "Building Engineering & Science Talent, *The Talent Imperative: Meeting America's challenge in science and engineering ASAP* (San Diego: Building Engineering and Science Talent, 2004) (The Talent Imperative: Meeting America's Challenge in Science and Engineering, ASAP 2004)

[33] "Attracting Opportunity and Creating Potential," IALR, Summary Annual Report, 2007

[34] "Attracting Opportunity and Creating Potential," IALR, Summary Annual Report, 2007

[35] EIT is a provider of electronic design and manufacturing services. It located its offices in the Danville "CyberPark," right next to the IALR

[36] Swedwood is a furniture manufacturer for IKEA

[37] IALR 2012 Annual Report: http://www.ialr.org/files/Annual%20Report/Annual_Report_2012.pdf

[38] IALR 2012 Annual Report: http://www.ialr.org/files/Annual%20Report/Annual_Report_2012.pdf

[39] "Virginia Polymer Coalition" website: http://www.ialr.org/index.php/research/irc-services-offered/virginia-polymer-coalition
[40] http://vtknowledgeworks.com/
[41] Stanford Center for Sustainable Development and Global Competitiveness
[42] Source: "Tomorrow in Danville: A Draft Proposal for Focused and Aggressive Transformation Through Technological Entrepreneurship." Danville, VA: Jim Flowers, August 17, 2011.
[43] Source: "Tomorrow in Danville: A Draft Proposal for Focused and Aggressive Transformation Through Technological Entrepreneurship." Danville, VA: Jim Flowers, August 17, 2011.
[44] City of Danville Office of Economic Development website (2013): http://www.discoverdanville.com/index.aspx?NID=279
[45] Sources: Social Explorer Tables (SE), Census 2010 U.S. Census Bureau and Social Explorer
[46] Sources: Social Explorer Tables (SE), Census 2010 U.S. Census Bureau and Social Explorer, (DeVol, Shen, Bedroussian, & Zhang, 2013), (Jones, 2010)
[47] Source: U.S. Census Bureau
[48] Source: U.S. Census Bureau
[49] Totals Based on the "Ratio of Poverty to Income Level", Poverty by Race based on official Poverty Status
Sources: United States Census 2000, 2010; U.S. Census American Community Surveys 2005-2007 (3-Year Estimate) and 2011 (3 Year Estimate)
[50] Sources: Jones, Alison, *The Only Way Out Is Up: How MDC helped Danville, VA., chart a new vision for its future*
[51] Source: City of Danville Office of Economic Development "Plant Closings" data
[52] (Minchin 2010)
[53] Source: City of Danville Office of Economic Development "Plant Closings" data
[54] Source: City of Danville Office of Economic Development, *Danville Announcements Since 1990, Excel Dataset.* Danville, April 16, 2013
[55] City of Danville Office of Economic Development, *Essel Propack to Create 81 New Jobs in Danville,* 2008
[56] Source: Data from the City of Danville Office of Economic Development
[57] Source: Data from the City of Danville Office of Economic Development
[58] Source: Data from the City of Danville Office of Economic Development
[59] Source: City of Danville Office of Economic Development, *Danville Announcements Since 1990, Excel Dataset.* Danville, April 16, 2013
[60] Source: City of Danville Office of Economic Development, *Danville Announcements Since 1990, Excel Dataset.* Danville, April 16, 2013
[61] Provided by Michael Duncan, Interim Director of the IALR, through email on July 13, 2013 to serve as a general approximation
[62] Based on the 2007 U.S. Economic Census and approximation of several job categories
[63] Sources for Cost Approximation: City of Danville Office of Economic Development, *Danville Announcements Since 1990, Excel Dataset.* Danville, April 16, 2013; "Broadband Initiative to Serve as National Technology Infrastructure Model," Virginia Tobacco Commission (2003); Franklin (2012)
[64] Phone Interview with secretary of LunaNanoworks, July 7, 2013